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The conserver society : the technological challenge : background papers

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THE CONSERVER SOCIETY:
The Technological Challenge

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Ministry of State Science and Technology Canada	Ministère d'Etat Sciences et Technologie Canada

PREFACE

The work of the Science Council and others on the "Conserver Society" and "Voluntary Simplicity" has started a far reaching debate. In response to these initiatives, the Ministry of State for Science and Technology has been studying some of the technological issues raised in the debate.

As part of its inquiry the Ministry held a series of five seminars entitled "The Conserver Society: The Technological Challenge". Each seminar was held in one of five Canadian cities: Vancouver, Regina, Toronto, Montreal, and Halifax. Each seminar discussed a specific aspect of the Conserver Society.

Participants were invited to the seminars with a view to having representation from a broad range of the interested public. Discussions were initiated by the authors of papers which were prepared especially for the seminar. These are the papers presented in this volume. They are collected together in their original form, without any attempt to change or edit them. Some of the papers are excellent, others are just average. Some are incomprehensible! It is left to the reader to judge the quality of each report.

The views presented are those of the authors. They do not necessarily represent the view of the Ministry of Science and Technology or of the federal government. The issues of the "Conserver Society" and of "appropriate technology" are complex and do not lend themselves to having a single position. These issues suggest a need for many approaches, for a variety of strategies, each applied to different areas of social endeavour. The strategies recommended by seminar participants and others form the basis for a body of knowledge which will hopefully create greater harmony between man, technology and the environment.

CONSERVER SOCIETY

WORKSHOP SERIES

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THE CONSERVER SOCIETY: THE TECHNOLOGICAL CHALLENGE

INTRODUCTION

The Conserver Society is both a concept and a popular movement. Its appeal lies in that it easily lends itself to meaning many things to many people. The broad values which define a Conserver Society — using resources more efficiently, doing more with less — readily encompass a wide range of opinion and ideology. Some promote the Conserver Society and are clearly anti-technology, while other supporters include the world's most innovative inventors.

Unlike other popular movements, this one has a lot to say about science and technology. Conservers are constantly promoting some device or criticizing a technical process. In some cases the criticism is pointed toward technologies which are vital parts of the economy and which have no feasible replacement. In other cases devices and inventions are being touted as "the very things to solve our problems" while in fact they have been developed only as prototypes which have never been fully tested in economic terms.

In either case new directions for science and technology are indicated. The abundant criticism of technology and suggestions for reform are not always consistent with conventional views of social goals, however. Some visions of a Conserver Society would indeed be hard to accept for the majority of Canadians. Other conserver imperatives are so compelling that it is difficult not to see the wisdom of accepting them immediately.

The Conserver Society has always been with us in one form or another. It has always been good business practice to cut costs. Engineers are constantly looking for ways of increasing the efficiency of their machines. The development of techniques and processes for "doing more with less" is an important part of our economic history.

What is unique about the Conserver Society movement as it now stands is that certain types of technological progress are being advocated, not by scientists or industrialists, but by the general population. People are asking specifically for ways of insulating their homes, improving their gas mileage, and preventing their automobiles from rusting away. Now, as never before, the population as a whole is inclined to advance and direct technology. They now understand that they don't have to wait for technology to happen but can rather say "This is what we want of science, let us now reach out to get it."

The Conserver Society idea is not the apocalyptic vision of the "Limits to Growth"; it is more an expression of optimism and opportunity. We are not talking about a society living on marginal agriculture and industry but rather about one which prudently uses resources to create a rich and meaningful life for all its citizens. Nor are we talking about "technological fixes" — devices and processes which bail us out of our troubles. The Conserver Society is a way of taking advantage of the many opportunities presented to us to manage our research and design capabilities so that we can live better without losing those things which we value most.

This is not a simple task but the act of creating something new never is. It is a great challenge with many environmental, social and technological dimensions. It is the technological challenge which is the subject of MOSST's workshops on a Conserver Society.

WORKSHOPS ON A CONSERVER SOCIETY

MOSST's interests in the Conserver Society lie in the discovery of technological opportunities for doing more with less. Some of these include: the development of new energy sources to substitute for dwindling petroleum stocks; the discovery of means to effectively recycle and reuse certain materials; and the design of technologies which create employment and work satisfaction.

In order to study the different technologies of conservation, MOSST is using the following process of inquiry. This process is decentralized to get a wide range of views.

Information and advice is being collected via a series of regional workshops and a national conference. These are organized in the following way. A few individuals in each region have been identified as having an interest in the conserver movement. These form a local advisory committee which prepares the workshop program and identifies potential authors, chairmen, moderators and participants.

The task of the authors is to prepare papers which contain the following elements:

1. An information base which includes a comprehensive survey of the issues, proposals, recommendations and problems which have generally been associated with the theme of the regional workshop.

2. An identification of technologies appropriate to a Conserver Society which distinguishes between: those which are immediately useful, those which could be developed within Canada's existing industrial system in the next five years, and those which require more extensive research and development.

3. An emphasis on the positive aspects of a Conserver Society such as its opportunities to produce exportable goods and its prudent attitude to resources. Such a positive emphasis is important since a principal objective of these workshops is to look for opportunities in the future, rather than to rehearse the weaknesses of the past.

4. A recognition of financial, social, economic, and technological constraints to the development and application of conserver technologies placing special but not exclusive emphasis on factors which could obstruct the development of Canadian-controlled technologies.

5. An identification of ways of overcoming these obstacles.

The papers will be used to focus the discussions in each region. Topics for discussion include: Renewable Energy in the Atlantic Region; Industrial Opportunities in a Conserver Society in the Quebec Region; Industry and Business Economics in the Ontario Region; The Technological Challenge for Small Communities in the Prairie Region; and, Recycling and Waste Management in the Pacific Region. The five regional workshops will be followed by a national conference in Edmonton. This will consolidate the findings of the regional workshops and will provide a national forum for discussing the regional findings.

PERCEPTIONS OF A CONSERVER SOCIETY

The following pages present some ideas of what a Conserver Society is, and is not. The points made are not presented to define once and for all what is to be understood as a Conserver Society. It will present some of the basic themes important in such societies. These notes would then allow us to specify which characteristic part of a Conserver Society requires technological development.

BASIC ISSUES

In spite of the confusing number of possible Conserver Societies, the basic issue is always "doing more with less." In economic or engineering terms this is known as efficiency. Usually this is measured in dollar terms but efficient design can also mean sparing use of energy and materials. Indeed, a well-managed firm practices, as a rule, many "conserver" techniques. This is not surprising since Western business practice as we know it had its origins in the middle-class business habits of the Industrial Revolution. This class was about as cost conscious and efficiency oriented as any class can be.

While all modern firms espouse conserverism and many practice it, modern society is far from being a Conserver Society. There are a number of reasons why this is so. The first lies in the dilemma resulting from unrestricted access to common property. Because no agent is responsible for the efficient management of "free goods" such as fresh air or clean water, these resources tend to get wasted and abused by those who use them. Conservation has for some time now been associated with environmental management especially the aesthetic use of parkland and the preservation of wildlife. Increasingly, conservation has also become an economic problem as the cost of cleaning water and disposing of garbage becomes significant.

There are many suggestions put forward for the management of "free goods" and the prevention of their abuse. These methods range from fines and special taxes to "full cost pricing" which seeks to include in the cost of a product the money needed to clean up the pollution caused during its production. Many of these suggestions have merit, but they are, after all, only ad hoc responses. With more thought and careful planning it can be expected that there are many ways of balancing man's activities with the environment that have not yet been discovered. Bio-degradable plastics and pollution-free fuels derived from natural sources are examples.

In spite of some deficiencies the business sector, operating in a market economy, endorses the principles of a Conserver Society. It seeks to do more with less and often has the technology to do it. The household sector is not in the same position. This sector consumes many goods and services for its own use. It also uses technologies to produce services (meals, balanced books, landscaping).

There are great gains to be made in a Conserver Society by increasing the efficiency of the household economy. Because the household labour force is technologically unsophisticated, it cannot always make the right decisions when it makes its purchases. Much has already been done. Truth in advertising legislation; government programs to increase home energy efficiency; protection against harmful goods and drugs are a few examples. There is still work to be done in the future. As more technology becomes available to the non-specialist, effort will have to be spent to make it more understandable and useable.

PHYSICAL ELEMENTS OF A CONSERVER SOCIETY

1. Energy

Energy conservation is currently the main objective of a Conserver Society. The importance of energy to the economies of the developed world cannot be overestimated. The very success of modern technology is due to its ability to harness energy, mainly from fossil fuels, to produce useful work.

Prior to the Arab oil embargo the systemic role of energy was not widely appreciated. Until then it was generally assumed that as long as substantial reserves of energy were available there would be no problem. We now have to concern ourselves with where and how energy is obtained, how it is used and how excess energy is to be disposed of. Coal cannot usefully be used to run pocket calculators. Differnet energy forms can also be used with different efficiencies.

Science and technology has three basic energy tasks to deal with in a Conserver Society. The first basic task is the extension of the lifespan of energy stocks. This can be done in a number of ways. Stocks can be extended by substituting reserves that are in large supply for those that are in short supply. This could include using solar, wind or biomass energy where possible. It could also include increasing the sophistication of coal-processing technology. Stocks can be extended by increasing the efficiency of their use. There are simple ways of doing this such as turning off lights and motors when not needed. More sophisticated solutions would include the design and use of more efficient motors and the use of micro-processors to ensure that energy use is optimized.

To be an expert in estimating energy stocks requires great skill in handwaving. The prophets of doom give us reserves that will run out by the mid-1990's. The optimists say we have energy to last thousands of years. They are both, in their way, correct. Using existing technology, which requires a specific mix of energy types, we can safely say that the needed supplies will run out in a few decades. Using technological developments which are foreseeable but which are undeveloped and unproven, we can assume much greater reserves.

The second energy-related task is the solutiuon of "throughput" problems. These are problems associated with the use of energy. We may create severe environmental problems in collecting and burning coal. Some uses of energy result in waste heat which may cause local climatic anomalies. Throughput problems will become more significant as both industry and population grow.

Source-related and use-related problems can both be mitigated by energy conservation. Since the costs incurred by these problems are increasing and unavoidable, it is not a question of *if* we need to conserver energy, but of *when*.

The third possibility for doing more with less lies in the development of increased flexibility in the industrial structure. We could design, for example, combustion engines that are easily adaptable to efficiently use a wider range of fuels. Many industrial processes are currently locked into the use of specific energy mixes. As the worldwide energy supply situation changes, national economies that can most easily shift to the use of cheaper fuels will be at an advantage.

2. Materials

As with energy there are three research areas which need to be considered. They are material stocks, throughput, and substitutability.

Modern industry does not consume materials in the way it does energy. With the exception of a few minerals, there does not appear to be a threat of depletion in the foreseeable future. What is important, however, is extraction cost. Most processes are highly energy intensive and as energy costs increase so will the costs of materials. Those materials which have large energy inputs will tend to be replaced with low-energy materials.

Material throughput is, however, a much more serious problem. Ore processing leaves pits and slag heaps. Chemical production distributes toxic materials in the air and in water. After materials are used there is the inevitable problem of garbage. The throughput problems are the ones which will demand more research in the future.

Unlike energy, different materials cannot always be substituted for each other. Wood is obviously superior to stone for building boats. Iron will never replace gold. Increasing the substitutability of materials will demand more research. This will especially be the case when materials which we must get rid of, can potentially replace materials which will become more costly, such as steel. Solutions to such problems require not only technological innovation but also economic measures.

Conservation will be especially important for materials. The operative slogan is "Reject, Reuse, and Recycle". The first two options are largely a matter of personal choice while the last one is more for business and government.

SOCIAL DIMENSIONS OF A CONSERVER SOCIETY

The main technological goals of a Conserver Society relate to the conservation of energy and materials. There are a number of aspects associated with conserverism which are essentially social or sometimes ideological but which nevertheless have technological implications.

1. Decentralization

The first aspect is one of concentration of organization. Proponents of a Conserver Society seem to favour a greater decentralization of all organizations. The reasoning behind this is that decentralized organizations put greater decision-making powers in the hands of those who are closer to the production process. When it comes to increasing efficiency by cutting back on waste, these, it is claimed, are the people who count.

Centralized organizations, on the other hand, may be better at handling larger and more complex systems. There are some possibilities for technology in developing the capability to decentralize operations while maintaining control over the entire system. New computing and telecommunications systems may be required, for example.

2. Labour

A Conserver Society is seen as being more labour intensive than modern industrial society. More time would be spent maintaining and repairing machines. The labour involved in the recycling industry would be high. More time would be spent specifically designing technologies which are appropriate to small enterprise. Mass production of certain articles would be seen as declining.

While this vision of the Conserver Society has its industrial arts dominated by craftsmen producing one-of-a-kind articles, it is more likely that mass production will continue. Products developed will, however, be durable, easily repairable, of flexible use, and easily modifiable. Research into this type of technology may be dominated by the wish of developing countries to increase output through mechanization without at the same time reducing employment. The goal of such development will be not to displace labour with capital but rather to use capital to increase the productivity of labour. Such a technology starts to make sense even in developed countries where unemployment is high.

3. Scale

The Conserver Society point of view on appropriate scale for factories and organizations is "Small is Beautiful". The thinking behind this is that as organizations get large the overhead costs, both in terms of money and speed of decision making, tend to become large.

There are many positive aspects of small businesses that warrant attention. Workers in them tend to suffer less from alienation, and managers feel that their span of knowledge and control covers all areas of their responsibility. These are substantial qualities which can perhaps be increasingly brought about by the design of technologies and industrial processes which give small businesses a competitive edge.

There is no unequivocal evidence that small organizations would, on the whole, manage things any better. Like many other concepts associated with the Conserver Society, the small-scale option is currently a matter of personal choice. It is, however, significant that small organizations are no longer seen as being always inferior to large ones. The renewed interest in the question of optimal scale may well lead to a better understanding of the way in which organizations produce.

4. Self-Determination and Personal Growth

The desire to control one's own destiny and not be tied to the web of installment payments and maintenance appears to be strong among some conservers. This often results in simplifying life, especially when it comes to material possessions. The desire for material simplicity and human scale environments arises from a need to be able to control one's environment. This, it is hoped, will lead to greater options for personal growth.

There are some implications here for technology, especially design science. Devices destined for use by relatively unskilled people can be manufactured with a simpler, more easily repaired design. It is expected that in a Conserver Society objects which are easily maintained will be in greater demand.

5. Ecological Sensitivity

The feeling that everything is connected to everything else, that people and resources are interrelated, will likely be present in any form of a Conserver Society. The waste of energy and materials and the damage to the environment that is caused by a poor understanding of the functioning of whole systems, sooner or later, will have to stop. This will likely lead to a much greater demand for biologists, ecologists and systems analysts.

SUMMARY

A Conserver Society is one in which most of its members make a conscious effort to manage prudently all energy and materials. Its members strive to manage its resource base and its production methods, both in the market economy and in the household economy, such that value received is greater than or equal to value expended.

Militant supporters claim that we do not now live in a Conserver Society because the value of time, labour, energy, and materials is distorted and unstable. Resource extraction permits are not controlled so that maximum benefit is obtained from them. The prices of both energy and many materials, they argue, are subject to arbitrary control by cartels. No one is concerned with throughput problems. Consumers don't, contrary to many claims, get exactly what they want. Modern industry can certainly produce a car that would last twice as long as modern automobiles but be sold at the same price. The indictment runs on.

The Conserver Society debate is becoming a focus for much of the hopes we have for modern urban/industrial society. As such it has become loaded down with ideologies which have little to do with conservation but, perhaps a lot to do with experiencing life much more directly and meaningfully. Some of these ideologies, if they become generally accepted, will have implications for the development of science and technology.

There are technological opportunities available now for mitigating the problems of energy shortages and environmental degradation. Using these opportunities to their fullest is a challenge we now face. There are other problems for which we have yet no solution. Finding these solutions is yet another challenge. Seeking out new solutions and opportunities is an ongoing task for a growing society in a changing age. Where do we go from here? How do we get there? These are some of the questions now being asked in MOSST's workshops on "The Conserver Society: The Technological Challenge".

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ATLANTIC REGIONAL WORKSHOP

RENEWABLE ENERGY

Organized by
The Institute of Public Affairs, Dalhousie University
and
Development Planning Associates

Halifax
February 20, 1978

Dr. Michael Kirby, Moderator
Institute for Research on Public Policy

ATLANTIC REGION

Halifax, February 20th

CANADIAN RENEWABLE ENERGY PROSPECTS

Dr. Harry Swain
Department of Energy, Mines & Resources
in association with:
T.A. Ledwell and R. Overend*

Abstract

This paper presents the prospects for renewable energy use. The present market is examined followed by a discussion of 9 renewable options: solar space and water heating, hard solar, forest biomass, agricultural biomass, wind, tidal power, ocean thermal, gradients geothermal energy, and the traditional hydroelectricity. In conclusion, there is a short discussion of the roles for government in encouraging renewable development.

Introduction: the energy context

An assessment of the prospects for renewable energy resources must begin with some appreciation of the energy supply and demand context in which they will have to fit. Looking first at the international oil market, most analysts foresee a substantial gap appearing between OPEC production levels and what the Western world would like to buy at present prices. Such a gap could appear anywhere between 1983 and 1990, depending on a host of assumptions about the rate of economic growth, the willingness of key Middle Eastern producers to expand vastly their output and thus shorten the economic lifetime of their resource, and so forth. Such scenarios do not account for the always-present possibility of political disturbances in the Middle East leading, as in 1973-74, to supply interruptions. In either case, the world's response to shortage is perfectly predictable: price increase. The question is whether the weakened Western economies will get into serious trouble before the price rises to levels where alternative supplies in the required amounts enter the market. The outlook is disturbing. For Canada, a country richly endowed with all manner of energy resources, permanent problems on the supply side will not be the cause of economic distress, though there will surely be temporary dislocations; rather, our danger is that the impact on those of our trading partners more seriously exposed to the international oil market will spill rapidly into the relatively open Canadian economy.

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* We thank E.P. Cockshutt, S. Holtz, F.H. Krenz, S. Millan and A.R. Scott for their comments on an earlier draft and wish we could blame them for the errors that remain.

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An important part of the energy future is thus another substantial rise in price of the energy market leader, internationally traded crude oil. The limits to oil price increases, and to the market leadership position of oil, are fundamentally determined by the lowering of demand that accompanies price increase, and by the cost of bringing alternate fuels to market or shifting to new processes which do not require petroleum-based fuels. Precisely where such limits lie is impossible to predict, but it is worth noting that at prices roughly double the present $15.50 per barrel, gas-, coal-, or biomass-derived methanol begins to make sense for certain transportation markets, as do certain synthetic oils which can be produced from the same mix of carbonaceous sources.

Energy markets are not uniform, however, and one fuel is imperfectly substituted for another. For Canada, no energy source besides oil is in immediate danger of running low. Coal, natural gas, uranium, tar sands, biomass, wind and sunshine are present in vast, if unevenly distributed, quantity. Part of the challenge will be to shift away from oil, where technically possible, and to reduce oil demand in those markets, like transportation, where there are no ready substitutes. Taxes, incentives, and the regulation of matters such as automobile gasoline consumption can be expected to keep oil demands increasingly below the projection of historical trends, though not enough to achieve the self-reliance which is the cornerstone of Canadian energy policy. Figure 1 shows the worrisome and expensive gap between supply and demand, even assuming that all the ambitious goals for conservation and new domestic supply are met.

In other energy markets, Canada is in a much better position. Gas prices can be expected to follow oil upward, but not as fast. Very large amounts of coal are available at or near present prices, although high transportation costs may make it relatively unattractive in parts of the country remote from the coal fields. The upper limit to what most Canadians need to pay for baseload electricity is given by the delivered price, about 30 mills per kWh*, of new hydro or Candu-derived energy. In other words, the competition faced by renewable energy is stiffer in Canada than in countries less well endowed. Unless, of course, the rules are changed, and matters of economics are not accorded their present high weight -- a point to which we will return.

A digression on costs

Before enumerating and commenting on each of the renewables, it would be well to make a few distinctions which will aid in interpreting the numbers. First, energy production and energy consumption differ by roughly 2:1, on a nationwide average, due to transmission and conversion losses. Mismatching supply type and end use causes thermodynamic losses which make what is statistically labelled consumption much larger than useful energy. Useful energy is what produces energy services: warm feet, a telephone call, automobile transportation, and so forth. But while the thermodynamic efficiency of energy systems can often in principle be multiplied several times, it is cost and convenience, not Carnot, which is relevant to human choice.

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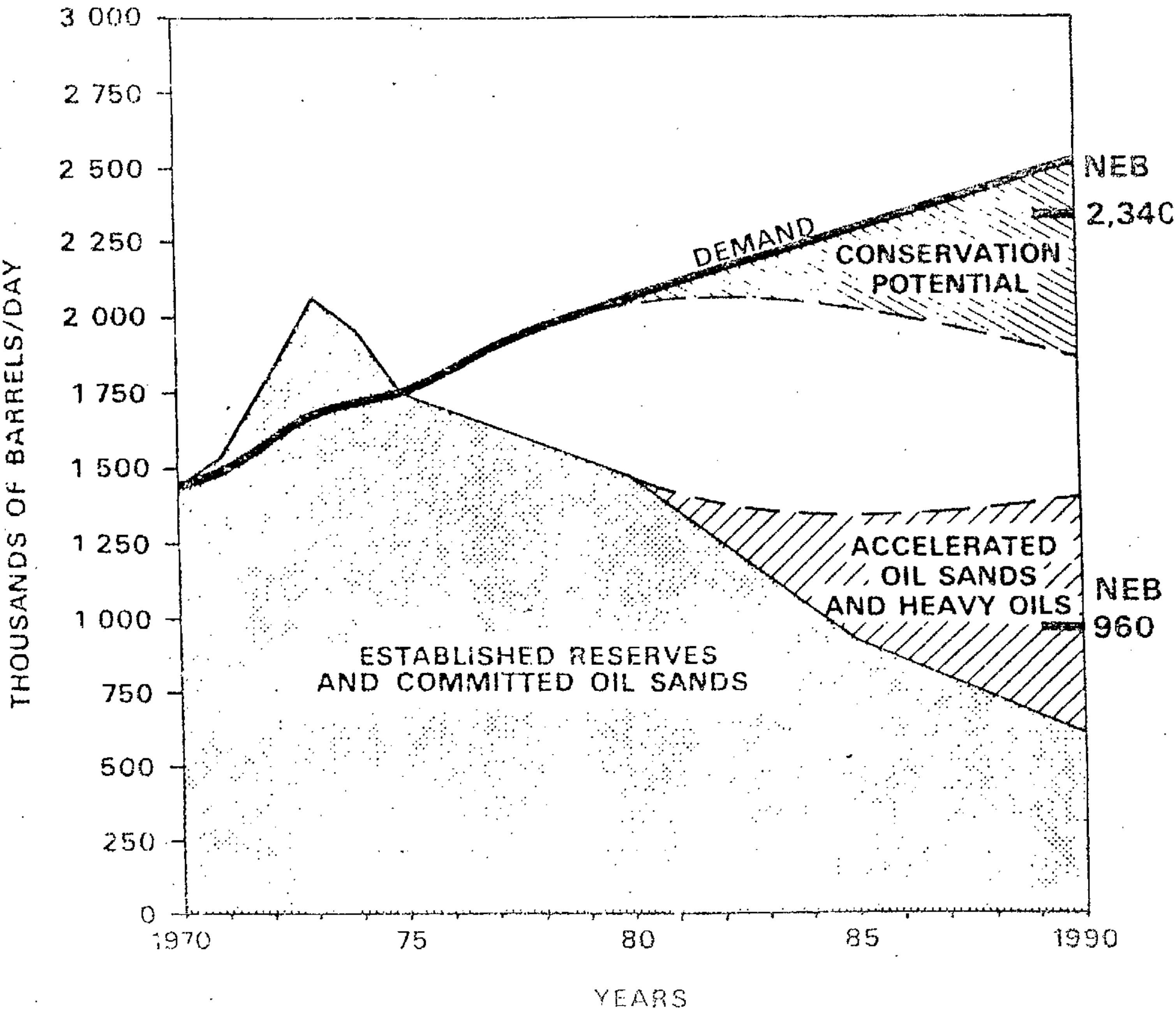
* Each energy commodity has its own peculiar measurement system. This paper normalizes all costs to the international units, watts (W) and joules (J). See Appendix 1 for conversion factor.

FIGURE 1
REVISED
OIL DEMAND AND AVAILABILITY
HIGH PRICE SCENARIO
1970 - 1990



Second, in an inflationary world, dollars must be dated. The 1978 model, as the automakers say, has been resized.

Cost must likewise be examined in the context of energy systems. It is improper to compare the cost of solar home heating at, say, \$8 to \$15 per GJ, with the 17 mills per kWh or \$4.70 per GJ cost of electricity from a Candu reactor, since the latter is production cost at the busbar while the former includes all transmission, delivery, and utility overhead cost. The comparable 1978 electrical cost is about \$8.50 per GJ. Further, Candu-derived electricity is economically attractive only in 600 to 800 MW packages, while other sources are more finely divisible: a two-edged sword, since size, in energy supply, is very effective at reducing unit cost. It is proper, however, to compare the cost of finding and producing new oil with the factory cost of a substitute. For oil and methanol, those numbers at present are on the order of \$2.40 and \$7-10 per GJ, for example. In this case what are being compared are resource costs, and not market prices. The first modification to the simple economic rule is that prices are generally distorted, perhaps particularly so in energy markets, and are an imperfect guide to rational behaviour for all but those atomistic players in the economic game who cannot affect price levels. Calculations of social cost must deal with the deviations of price from resource cost, where substantial, before summing costs borne by all actors and the common weal.

A last point on the systems aspects of energy costs. The capital cost of electricity generation is frequently given in dollars per kW of capacity -- not a bad approximation, since at least with non-fossil fuelled generation, the amortization of capital accounts for almost all of the final price. But such costs are not directly comparable unless they are for generation alternatives which are available to the consumer for the same proportion of the day, week or year. A hydro dam costing \$1200 per kW may have an availability factor of well over 90 percent, if not used in some multi-objective river basin management scheme, which would make it a little better investment, all other things equal, than a Candu reactor at the same price, which would have an availability of some 80 percent. Coal and wood-burning plants typically have availabilities of 60 to 70 percent. These intermediate-load plants can, within limits, be turned on or off as system demand requires. Many of the renewable resources can provide electricity, but their availability is typically around 30 to 40 percent, and worse, is temporally unpredictable. Thus, the assignment of capacity credits for a utility's capital expenditure becomes doubly problematic: what good is a wind machine, for instance, if for every MW installed another full MW of conventional generation capacity is required as backup? Actual system planning is of course much more complex, especially when rate structure arguments are introduced, but to a first approximation, the investment cost per kW of a system which is available upon demand needs to include appropriate energy storage costs and be matched to the availability factor of scheduled generation equipment before valid comparisons can be made.

Solar energy: space and water heating

The total size of the solar resource may be appreciated comparing the 7000 TW intercepted by the disc of the earth with the 7.5 TW of primary energy used by mankind. In the populated parts of Canada, the energy density of sunlight averages only 140 W/m^2 --

about half the flux incident on the Sahara, to be sure, but highly diffuse nonetheless. The central problem for solar technology is the cheap concentration of a diffuse source, a problem which will turn up over and again in this discussion.

The best-known solar technology is the flat plate collector for space and water heating. Descriptions abound.[(1-3)] Along with biomass, hydro, and the Bay of Fundy tides, it is the renewable energy resource of greatest promise in the Canadian context. The basic problem is that its present life-cycle cost is two to four times that of conventional heat resources. Appendix 2 shows how a rational consumer ought to perform the calculation (cf. 4, 5). The present price ratio is daunting but impermanent. First, the price of conventional fuels is likely to rise in real terms. Second, as manufacturers and installers gain experience and as improved designs come onto the market, the real price of solar heating systems can be expected to decline. They are not expected to fall dramatically, like the price of much electronic equipment, since they have an unavoidably large material component, but a learning curve in the 85 - 90 percent range ought to be achievable for several doublings of market size, if no great heterogeneity of products is involved. The price problem is thus likely to be short term one. Even the private forecasts of multinational corporate planners indicate that solar will be the economic choice in important markets by the early 1990's. These markets are expected to be, first, domestic water heating -- because the householder has a steady year-round use for his expensive piece of capital equipment -- second, space heating in new multiplex and single-family dwellings, and a distant third, retrofit of existing housing.[6]

Therein lies a more fundamental problem for solar heating: though the potential market is huge, it is limited by the slow turnover of the housing stock. The Canadian market for low-grade (less than 100°C) heat is probably about 50 percent of total energy consumption. In 1974, 31.5 percent of energy consumption went for space and water heating in the residential and commercial sectors; adding industrial demand for low-grade heat plus the low-temperature end of high-temperature processes like steam-raising would bring the total to something in the range of 45 to 50 percent of consumption, or about 2 EJ (2×10^{18} J). The demand for low-grade heat, moreover, is expected to remain a roughly constant fraction of total energy consumption: EMR's long-term demand model, for instance, puts the year-2000 demand for residential and commercial space and water heating at 29.9 percent, down only 1.6 per cent from 1974.[(7)] Thus the long-term upper asymptote for solar market penetration potential is very high indeed. However, housing starts are probably at the highest point of the century now and can be expected to drift down from the present 230,000 per year to something less than 190,000 by the turn of the century. If substantial market penetration is delayed until 1985-90, it is clear that no great fraction of Canada's energy requirements will be met from solar in this century.* Projection at this point would be idle speculation, as government policy will have an overwhelming effect on the relevant prices in the decades ahead; still, something of the range of possibilities is presented in Figure 2. It should be noted that point A on Fig. 2b corresponds to installing enough collector annually to provide half the heat for 170,000 new houses.

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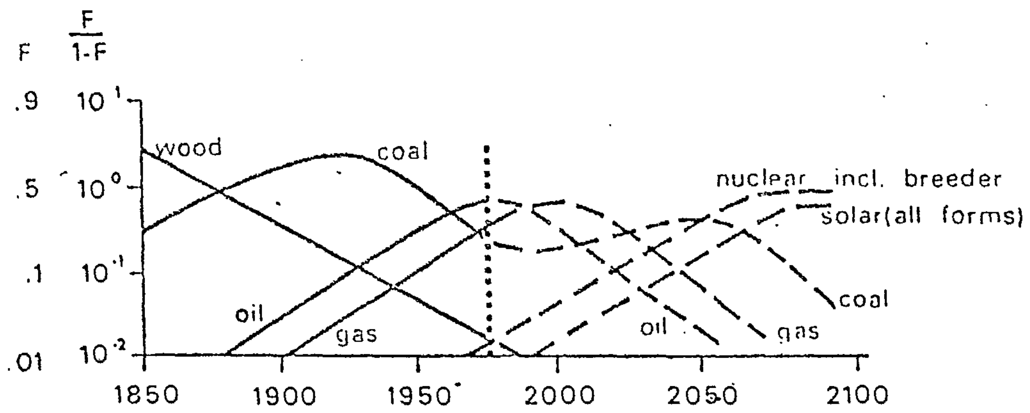
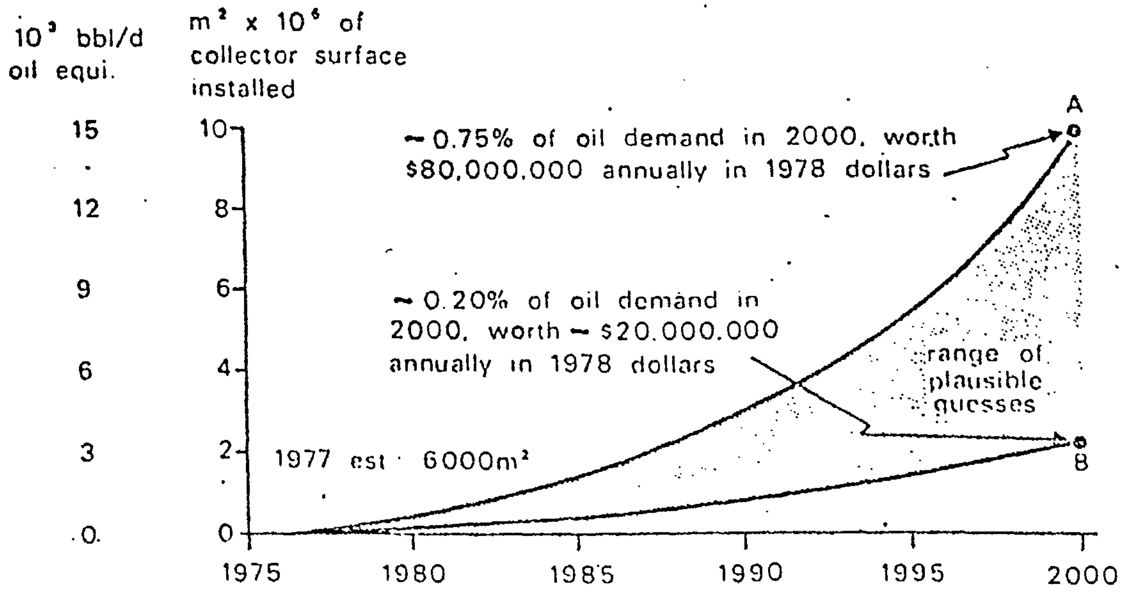
* The true conserver's riposte must be that of Nubar Gulbenkian, who prospered mightily on 'only five percent.'

Figure 2a: A speculative view of the place of solar energy (all forms) in the global energy budget



F: market share
Data to 1975 from (8,9)

Figure 2b: Possible solar sales for space and water heating in Canada



Hard solar

There are a number of other ways of turning sunshine into a saleable commodity. Most concentrate on conversion to electricity, since the flexibility, ease of control, and ready convertibility of that energy form is worth all manner of thermodynamic excess. For small to medium sized applications, light may be concentrated on a tube containing a fluid whose vaporization can be made to run a turbine: Renault, for example, sells such machines for water pumping and desalination in arid regions. In the U.S., much attention has been focused on the "power tower" concept, in which computer-controlled mirrors focus sunshine on a boiler on top of a tall tower. Very high temperatures can be achieved -- in fact, the first such machine, at Odeillo in the French Pyrénées, was originally built for the military to simulate the effect of thermonuclear blast. (So much for l'énergie douce!) As a method of making grid electricity, however, solar thermal-electric conversion, or STEC as it is known south of the border, has a long way to go before becoming economic. An experimental 10 MW_e unit is under construction at Dagget, in the California desert, and smaller ones are being planned for Mediterranean Europe. There is no present indication that power towers will ever become economic in Canada.

If STEC and Rankine-cycle conversion is the brute-force method of wresting electricity from sunlight, photovoltaics represent comparative elegance. A photovoltaic cell generates power directly from light essentially by exciting electrons and allowing them to move only in one direction. Progess in photovoltaics depends on advances in the basic physics of semiconductor materials as well as on ingenuity in production methods. Their future price behaviour is thus hard to predict: the uncertainty is greater than with any other source under discussion. Since solar cells have no moving parts and require no purchased fuel, it is common to compare their performance in terms solely of capital cost per watt of output, noting that it is an electrical, not thermal, watt, but one which is available only when the sun shines. Present prices are in the neighbourhood of \$12/W_{ep}. Counting the capacity factor, photovoltaics will have to come down in price by a factor of 40 to be competitive with conventional electric generation. The U.S. government is putting very large sums behind its belief that market size is the key to achieving \$0.46/W_{ep} by 1986. Should they succeed, American industry will move into a commanding and virtually unassailable position in the provision of electrical energy all over the globe, a prize well worth the gamble. Even if they do not succeed, getting down to the \$2 to \$4 range will open markets many times larger than their initial investment.(10)

That is the most interesting thing about photovoltaic energy: it is the only ringer, the only energy sector with a potential for a truly dramatic price decrease. All other prices can with some confidence be predicted to drift slowly, up or downward.

Elegance can be turned into brute force, of course. Some enthusiasts at NASA are proposing to put huge arrays of solar cells into geostationary orbit and to transmit the energy earthward in microwave form. The cost figures given are somewhat ambitious, and such a technology is not believed to have a future in (over?) Canada.(11)

Forest Biomass

Biomass is what is produced by solar radiation through photosynthesis. The main biomass resources available for energy purposes are forests, agricultural crops, organic wastes, and animal residues.

The solar energy captured by Canadian forests has been estimated to exceed total primary energy production by 2.5 to 1 (20 EJ to 8 EJ) annually. Canada is thus almost unique in the world in biomass resources per capita. As with heavy oils and heavy water, development of these resources cannot await the results of research elsewhere, for no other nation has the opportunity open to Canada.

Collection and conversion of any large fraction of this enormous resource would be economically unsupportable, though for comparison it should be noted that the forest industry currently harvests and hauls each year to the mills the energy equivalent of 1 EJ of wood for pulp, paper and lumber production, of which about one-third winds up as mill waste. The existence of such a large, widely distributed industry with its efficient mechanical harvesting techniques and forest management expertise leads to the identification of three scales of usage of forest materials for energy.[12] The first would extend the present 3.5 percent of Canada's primary energy which is supplied by the combustion of wood by a factor of about two. This would be done almost entirely within the present forest industry through the substitution of mill residues, bark, yard wastes and so forth for purchased oil and gas. The aim would be the replacement of about 60 percent of the oil and gas now used by the forest industry over the next decade -- not a trivial goal, as that industry is presently the largest consumer of petroleum products in Canada. This first scale will be achieved because it is in the companies' own interest do do so; the role of government will be to aid in the development and refinement of technology and to provide fiscal measures to encourage a rapid switch.

The second, medium-term, scale, involves the harvest, through onsite chipping, of branches, tops and other slash now left in the forest, as well as the harvest of non-commercial species and smaller boles in clear-cutting operations. Part of this material would be used to power the industry, and part would end up as forest energy export commodities -- solid fuels, electricity, perhaps methanol -- which would constitute a major long-term addition to the financial stability of the industry. Another 0.6 EJ annually would be available at this level, enough, if fully utilized, to make the forest industry a substantial net exporter of energy. On the longer term in the post-petroleum era, a third level in the exploitation of forest cellulose could form the basis of a large energy or synthetic chemical industry producing the equivalent of 2 EJ each year by means of harvesting areas and species presently ignored and through intensive forest management on selected lands. This last is a version of the "energy plantation" concept, and will require a considerable period of experimentation in forest genetics and ecology and in harvest and conversion technologies before its use becomes widespread. Moreover, in this last scale the harvest and transport costs are not shared with a co-product. Highly promising early results may presently be seen in eastern Ontario, where the Ministry of Natural Resources has been working on the cloning of fast-growth broadleaf species for a decade.

Wood burning for space heat is enjoying a certain vogue these days. We estimate that some 200,000 Canadian homes use wood as their primary energy supply, a figure which does not count the esthetically motivated but highly inefficient combustion of wood in fireplaces in homes and summer cottages. Though the federal sales tax has been removed from wood-burning equipment in the name of conservation of petroleum products, it is not clear that net social benefit results. Where rural or small-town Canadians cut and haul wood from their own well-managed woodlots and heat their homes with well-designed and safely installed modern stoves, benefits arise on a number of accounts. However, much wood is presently cut with chainsaws many miles from its point of use, a distance which is bridged by gasoline using pickup trucks, only to result in urban air pollution, fire hazards from unsafe stove or furnace installations, and often more light than heat. In some cases a net saving of energy could, in principle, be achieved by simply burning the gasoline in a home furnace. In sum, the use of wood for space heating is limited by the urban nature of most of our population and by the availability of cheap enough wood. Worse, even the largest conceivable Shift would make comparatively little impact on the nation's energy budget. Shifting to wood for the heating of 10 percent of our homes from the present 2.8 percent would replace only 2.3 percent of our conventional energy supplies. On the other hand, every little bit is worthwhile, especially when the potential for ancilliary pleasure is so high. Legitimate concerns about safety and efficiency can best be allayed by the widespread distribution of such practical literature as Nova Scotia's recent publication, Wood Heat: Answers to your Burning Questions.(13)

Peat is a renewable resource only on a 4000 to 7000 year cycle and hence is not often thought of as a renewable resource. Still, the conversion routes are chemically similar to those available for other biomass resources, and there are interesting possibilities for the further use of mined peat bogs in intensive forestry.

The Canadian resource base, last estimated in the 1930's, is poorly known, but reserves of 5×10^8 tons, equivalent to 4.5 EJ, have been identified. The total area covered in peat bogs is estimated to exceed 520,000km^2 though only about 2,500 km^2 has been properly assayed. Ireland, Finland, and especially the Soviet Union use peat on a large scale for electricity generation, and it is possible that peat-fired generation may find a place in the supply mix of certain Canadian utilities. The Swedes and the Irish are particularly interested in reclaiming exploited bogs for forestry — perhaps for the very kind of short-rotation energy plantation now being developed on the abandoned farmlands of the St. Lawrence corridor.

Agricultural Biomass

Agriculture is associated primarily with food, to a lesser extent with feed and fiber, and hardly at all with energy. Yet the energy content of Canadian cereal production alone amounts to 0.6 EJ annually, and forage materials which can only be converted by ruminants have a similar primary energy content. Like forestry, agriculture generates large quantities of waste materials, though in general these rarely occur in concentrations dense enough to make them worth exploiting. Only when the collection costs are borne for other purposes does it make sense to contemplate their use for energy. In Nebraska, a large-scale experiment with the use of "gasohol" — an ethanol-gasoline mix, with the ethanol made from spoilt grain — is underway, much to the gratification of farmers who reportedly go out of their way to buy the stuff even though it costs 20 cents per gallon more than ordinary gasoline. In general, fermentation of biomass to ethanol is a more expensive process than any of several alternative routes; pyrolysis being the basis of economic comparisons for getting from biomass to methanol.

In Canada there has been considerable progress in the experimental conversion of animal wastes to methane by anaerobic digestion in farm-scale units. The process looks to have reasonable economics which applied to intensive feedlot operations with environmental problems: only if some of the capital and operating costs can be charged to pollution abatement, in other words, does it seem profitable. Straw and spoilt cereals are also being examined as feedstocks for various conversion processes. An advantage in principle of fermentation and digestion techniques is that important soil nutrients are retained in clean form for re-application to the soil, a feature which is lost in most pyrolysis or combustion processes.

Problems in Large-Scale Biomass Use

The main routes for biomass conversion are summarized in Table 1. The major constraint on its large-scale use is the lack of cost-effective conversion technology capable of making energy intermediates compatible with machinery optimized for petroleum. The secondary constraints are the production, harvesting and collection technologies, together with the congeries of environmental management problems that would be entrained by any large-scale use of biomass.

The primary constraint is an interesting one. Take the example of methanol, which could be made in very large quantities from forest biomass. It could also be made from natural gas, coal, lignite, peat, municipal solid waste, or indeed any carbonaceous material, and biomass is not necessarily the cheapest of these. There is enormous flexibility on the production side, in other words, and the possibility of benefits to poor regions and to an ailing forest industry make the prospect attractive to many. But flexibility on the upstream side is more than matched by the necessity to undertake vast investments on the downstream side to make efficient use of the product. Anhydrous fuel-handling systems, engines without materials which are attacked by methanol and which have much higher compression ratios than present automobile engines, and, in the case of blended fuels, development of dual-fuel or emulsion technologies to get around the problem of phase separation in the cold Canadian winters are but some of the changes in fixed capital which would be necessary.

Consider the secondary problems. While some waste materials are already in one place (0.3 EJ annually of forest waste at mill sites, only a third of which is currently utilized; 0.1 EJ of municiapl solid waste), the collection of other biomass materials implies costs on the order of $1-2 per GJ. In other words, before any conversion, distribution or marketing, costs on the order of half of those of conventional petroleum-based fuels have to be borne. There is much scope here for technological development, but it will be a slow process.

Large scale utilization of biomass raises general questions of risk to the environment including the preservation of soil nutrients and structure, erosion, water balance, methods of pest control, and the stability problems engendered by monoculture. Each of these questions must be answered well in advance of a commitment to significant utilization: a flow concept of energy production, unlike the traditional reserve concept, relies on the continued viability of the ecosystem from which the harvest is taken.

One immediate problem that has beset attempts at assessing the potential contribution of biomass is the serious lack of reliable inventory and yield data. Forest inventories typically give the standing stock of merchantable boles of commercial species, arithmetically converted into an AAC, or annual allowable cut.

Table 1: Renewable Energy Resources and Technologies

Resource	Conversion Technology	Secondary Energy Form	Applications	Cost-Competitive When?	"Lovins Malleability"	Approx. Current Cost/GJ	Comment
Solar	low/medium Temp. collectors	heat < 100°C	wide	1982	soft	$8-15	Problems largely institutional
	Rankine	heat 80-200°C; mech., elec. power	developing countries	2000+	fairly soft	$50+	requires high availability of direct sunlight
	STEC	heat 1000-2000°C; electricity	limited	2020?	quite hard	$30+	
	photovoltaic	electricity	wide	1990?	firm	$275	
	satellite-based	electricity		never	superhard	N.A.	weapons potential
Wind	small WECS	heat, electricity, mech. power	rural	now, in places	soft	$20-150	needs windy site, storage
	large WECS	electricity	limited	2000?	quite hard	$15-25	needs wind, storage
Biomass	Combustion	Hot gas, steam, electricity	Industry, utilities	now, for waste wood	mod. hard (but old)	$1-2$_{th}$, 4_e$	Already 3% of Cdn. energy production
	Pyrolysis (gasification)	Low Btu gas	forest ind: oil/NG subst.	1980-83	harder, also old	$2-3	Not transportable
		Medium-Btu gas, Synthesis gas	NG subst; town gas	1983-87	ditto	$4-5	Transportable over shorter distances
			NH_3 for agric.		1985-90	ditto	?
			methanol	1990	hard, new	$8	Assumes large costs to transport system
	Hydrogenation	Synthetic liquid fuel	transport	2000+	quite hard	?	New technology
	Fermentation, hydrolysis	C_2+ alcohols;	transport	1990s?	soft, but...	$8-10	Assumes large costs to transport system; some new tech.
	Digestion	CH_4 from manures	very limited	1980-82	squishy	depends on environmental credit	
Tidal	Fundy Barrages	electricity	regional	now	hard	$7-8	Lunar-cycle supply; may need storage or retiming
	Coastal currents	electricity	limited	unknown	quite hard	?	New technology
Waves	Salter duck	electricity	regional	?	fairly hard	?	ditto
	Masuda buoy	electricity	regional	?	almost as hard	?	ditto
Geothermal	Hot rock flashing	electricity	limited	1985?	hard	$10?	Cordillera only
	Sedimentary basin pumping	heat 100-300°C	space/water heating	1985?	moderate	?	Prairies only
Environmental thermal	Heat pump	heat < 100°C	wide; combines well with low-temp. solar	1980-85	moderate	$8-[illegible]	[illegible] new

Biomass production may be 1.3 to 2.3 or more times as much as the AAC in any particular place, but detailed studies have yet to be done.

Wind

The extent to which wind power may contribute something significant to Canada's energy future is uncertain, and is likely to remain so for some time. Generating power from the wind is constrained by two fundamental facts. First, the available power from the wind depends on the cube of the wind velocity. That is, it is possible to extract twice as much power from a wind of 25.2 km/h ($25.2^3 = 16000$) as it is from a wind of 20 km/h ($20^3 = 8000$). For this reason wind turbine performance is highly site-sensitive at both regional and local scales, particularly for small machines, and only places with vigorous wind regimes can be regarded as suitable for exploitation. Aside from local, and unassessed, opportunities arising from orographic effects, particularly in B.C., appropriate wind regimes seem to occur in regions of low population density: along the Labrador coast, around the shores of the Gulf of St. Lawrence, and on the western shore of Hudson's Bay.

The second fundamental constraint is variability. Periods of calm are periods without power. Compensation by battery storage is too expensive to contemplate for all but the most extraordinary applications. In consequence, wind turbines are suitable only for those applications with inherent storage characteristics. Historically these have included water pumping for livestock, irrigation, and land drainage. Recent applications include primary power for remote sensing units, meteorological stations, and communications sites where even the cost of batteries is trivial, and for larger machines, in integrated generation in parallel with diesel generation in remote regions.

It is worth considering small (2 - 20 kW) machines separately from larger ones. In general, the propostion of installing a wind turbine with associated generator, inverter and control circuitry together with adequate storage to meet daily needs will remain hopelessly expensive in comparison to the price charged by the utility, even if the consumer lives in a windy part of Canada. The outlook for small machines is thus not all that promising, though traditional and hobbyist markets will justifiably attract some smaller firms. More interesting are the possibilities offered by turbines in the 200 kW - 2MW class, if used by utilities in conjunction with pumped storage or a grid design that could take account of the uncertain nature of power availability. Such circumstances are rare, and the machines to take advantage of them rarer, but paper studies and some experimentation indicate that the economics are not overwhelmingly unfavourable. In this connection it is worth mentioning that the vertical-axis or Darrieus turbine first built by the National Research Council has certain basic design advantages over the horizontal-axis type on which the bulk of US experimentation has been focused, especially for these high power applications. The world's largest Darrieus, a 200 kW machine, is now under test as a diesel fuel saver on the Magdalen Islands, courtesy NRC, Hydro-Québec, and the builders, DAF-Indal of Mississauga.

Tidal Power

The tides of the Bay of Fundy have attracted power engineers for half a century. Harnessing even a small part of the Bay's 400,000 TWh annual potential could add substantial and inflation-proof capacity to the Maritime grid. Phase 1 of the present feasibility reassessment looks reasonably promising[14]. Suffice at this point to say that the best economic alternatives have plant capacities ranging from 1085 to 3637 MW_{ep} and would cost (in June 1976 dollars) $1.2 to $4.0 billion. The particular operating regime chosen would give a capacity factor of about 37 percent.

There are still a number of uncertainties surrounding the Bay of Fundy projects. The next study phase, a necessary prelude to engineering design, would involve detailed hydrological and silt transport modelling, the assessment of environmental impacts and the design of ameliorative measures, and investigatory drilling of foundation conditions. This is not all. Even the smaller version would be more than four times the size of La Rance, the world's largest tidal plant, which has nothing like Fundy's abrasive silt. The fifty-minute mismatch of the solar and lunar days may dictate a need for complex methods of load or supply management, or both. A number of key environmental assumptions, none more crucial than those relating to the health of the inshore fishery, need to be rigourously tested[15]. Institutional and financial arrangements, yet to be studied in detail, will be critically important.

There are concepts other than barrage-and-turbine for exploiting the tides. Conceivably, moored fans or submarine waterwheels could harvest power from tidal currents, as opposed to tidal heads, and do it at lower capital cost per kW of capacity. The idea is particularly appealing for locations like the B.C. coast, where the currents can be very powerful without Fundy-like heads. The disadvantages are that only a small portion of the tidal energy could be harvested, and that, as for windmills, site selection problems would likely limit the gross output to a tiny fraction of system demand. The concept may be of interest in certain low-head-river hydro situations.

Ocean Waves

Some appreciation of the power available in ocean waves may be had by comparing the scale and frequency of ocean swells with the tides -- waves of similar scale but much lower frequency. Alternatively, waves can be thought of as a concentrated form of wind energy. While the resource is large enough to be interesting, the extraction and transmission of power pose formidable engineering problems.[16]

At present there are sufficient data to estimate the wave energy potential at only three sites off Canada's coasts.[17] Some 10 kW per lineal meter of wave machine could potentially be harvested on a continuous basis, which is to say that a five-km. unit in deep offshore water could meet the average power requirements of Prince Edward Island or that a 200-km. unit could meet over a quarter of the present requirements of British Columbia.

Realizing such potentials would require decades of work in three different areas: the design and testing of wave machines of sufficient efficiency to be worth-while, and sufficient durability to withstand a fearsomely harsh and corrosive environment; of methods to moor such mechanisms off the continental shelves; and of electrical (or other) power generation and transmission from a mobile device in deep water. Each is a formidable problem. The necessary technical development before large-scale commitment that could take place would extend for many years and cost tens of millions, at the least. An evolutionary step could involve the dual-purpose use of machines in shallower water as generators and breakwaters combined. If a steel plant at Gabarus, N.S., is ever built, for instance, $\$10^8$ will be needed for harbour construction, much of it for a breakwater; who knows what could be achieved if that money were to be credited to a dual-purpose structure. Such a device would avoid the worst problems of mooring and transmission, and the fact that its coastal location would mean less wave power would be a blessing for a developing technology.

In summary, while the generation of power from ocean waves promises to be a most challenging engineering task, the potential is sufficiently attractice to be of long-term interest. While costs cannot be known with any precision for years to come, informed judgment puts it at something like four times the cost of James Bay or nuclear electricity.

Ocean Thermal Gradients

The concept of using the significant temperature differences between surface and abyssal ocean waters is not new, having been proposed a century ago by the French scientist d'Arsonval. Only now is the concept being studied in depth, though to date none of the paper studies have been rendered into hardware. The principle is familiar: a temperature difference is used to drive a vapour cycle. In this case, the difference is only on the order of 15°C, so that the working fluid must be something normally regarded as a refrigerant, such as ammonia. Liquid ammonia, cooled by abyssal water, would be pumped through a vaporizer or boiler whose heat source was the surface water. The vapor would then be expanded through a turbine, from which power would be extracted, before being condensed and recycled.

The efficiency of all such processes is strictly constrained by the Carnot limit. The efficiency of the conversion of heat to power cannot exceed the ratio of the temperature difference divided by the absolute temperature, viz. 15/270 or 5 percent. Since the machine's internal needs for power for pumping the enormous quantities of water to drive the heat transfer process are an order of magnitude more than for a conventional plant, the likely system efficiency will not exceed 2 or 3 percent. Even lower values have been estimated by proponents of the concept.[18, 19]

In this context efficiency deals not primarily with resource conservation but rather as a guide to estimating the capital investment needed to produce a unit of energy. Error in estimating system efficiency is directly reflected in the capital cost per kilowatt. The small numbers and large flows make the probable error of estimate rather large, but recent U.S. work suggests that machines might be built at reasonable capital cost. Whether their performance would degrade sufficiently slowly to repay their cost is another matter.

The conventional ocean thermal gradient machine described above does not, however, appear attractive for Canadian coastal waters owing to the lack of sufficient temperature differences and to the presence, in the Gulf of St. Lawrence and the Atlantic, of substantial winter ice. One variant has been suggested, namely an air-water system exploiting the temperature difference between the ocean and the Arctic air. It is conceivable that such a machine might find an application in the next century in remote Arctic locations, but it should be remembered that Arctic air temperatures are not as cold as popularly suspected. For example, the January 1973 mean temperature at Alert, N.W.T., latitude 82°30'N, was only -29.5 C, which while uncomfortable, does not provide an unusual potential. Moreover, in the water-air configuration, one is attempting to use water which is very near the freezing temperature as a heat source. This would require a complex system to remove ice from the necessarily large, low-efficiency heat exchanger.

Useful perspective on the thermal gradient concept may be had by recalling that thermal dumping takes place in every utility with fossil or nuclear fired plants: roughly two-thirds of the energy content of the fuel is rejected to air or water as waste heat. The temperature differences are typically larger than those offered by the oceans and the resource is already at or near load center. Only when we have thoroughly exploited this wasted resource will it be sensible to look to ocean thermal gradients. (The same comment probably applies to salinity gradients also, though the concept has not yet been studied in detail.[20]

Geothermal Energy

There is a continuous slow transfer of heat from the earth's molten core to the surface amounting on average to 0.63 W/m^2 [21]. This relatively trifling flux, about one-half of one percent of the year-round solar energy density in southern Canada, would not be useable at all save for the remarkable energy storage capacity of the outer mantle. The two established geothermal energy technologies both exploit reservoirs of heat which have taken hundreds of thousands of years to accumulate, and in that sense, like peat, are not necessarily renewable in humanly meaningful times.

The better-known technique involves trapping naturally pressurized hot water from geyser or hot spring areas, allowing part of the water to flash into steam, and running turbines to make electricity. Well-known examples are found in northern California, Italy, and New Zealand. In Canada, most hot spring zones are remote from load centres, scattered as they are through the western cordillera, though exploratory drilling continues near Meager Mountain, north of Vancouver. Geothermal steam frequently has associated with it large quantities of noxious solutes, like the various compounds of sulphur, as well as other salts and sometimes heavy metals and radionuclides.[22] Unless these are carefully controlled, unpleasant and occasionally dangerous surface pollution may occur.

Less well known is the use of hot water from deep sedimentary basins for space heating. Underlying large parts of the Prairie provinces and the western Arctic -- in fact, often in the places favoured with the most abundant oil and gas -- are huge volumes of water-saturated strata. While this water may occur at temperatures exceeding 300°C owing to geopressurization, it may also contain very large quantities of dissolved minerals: brines with 20 percent salt content have been reported [23]. Use of this subterranean heat will depend on bringing these hot brines to the surface, passing them through a heat exchanger (or possibly even a heat pump) and reinjecting the brine into the original strate -- all at a cost lower than conventional sources impose. Since the temperature of these sedimentary waters is not high enough for efficient steam-raising, the primary use would be for space and water heating. An individual geothermal well pair, however, will typically cost more than a million dollars, which means that that the connected heat loads will have to be quite large. Commercial or possibly academic building complexes, which in terms of heat load are rather like small district heating systems, may provide useful markets in Canada.

Hydroelectricity

As a reference point in the discussion of renewable energy resources, it is useful to contemplate the traditional renewable source, hydro. At the end of 1976, Canada's hydro electric capacity was 39,475 MW, which accounted for 293.4 TWh or 72.6 percent of the nation's total electric generation(24). About three-fourths of this capacity was installed before the onset of rapid inflation in the 1970's, thus constituting an enormous endowment of low-cost base power. It is estimated that another 40-60 GW remain to be exploited in Canada(29), but the costs of so doing will be higher than the present steep marginal cost, and many times more than the cost of our historic endowment. The Gull Island cost for transmission and generation, discounted back to 1976 dollars, is estimated at $1.6 billion; if built for commissioning in 1985, the sum of current-dollar costs will be some $2.9 billion. Figure 3 gives some useful comparative cost figures, all normalized to 1976.

The Contribution of the Renewables

It is clear from this tour through some of the alternatives that the renewables are a highly diverse set of energy resources, presenting special problems but at the same time, special opportunities. One of the most appealing of the arguments adduced in their favour is that, as a class, they are less likely to lead to the alienation that accompanies gargantuan scale. Amory Lovins has put the case most persuasively: the "soft" technologies of sun and wind pose fewer dangers to the world's habitat, enhance personal and community self-reliance at the expense of remote technocratic elites, and do not conduce to nuclear terror or accident(26). In Table 1 we have, somewhat lightly, attempted to characterize various renewable energy technologies in terms of their relative softness under the heading of "Lovins Malleability." The two major conclusions to be drawn are that renewables, as a class, are neither technically or economically ready to replace fossil and nuclear fuels, and that "renewable" is a much larger category than "soft". There is no present possibility of a society with the consumption habits of Canadians running itself fully on renewable, much less soft, energy. Time and the changing of many deep-seated values may indicate that a conserver society is not so limited. Whether it would be an agreeable place to live for libertarians(27), and whether indeed we can get there from here without tearing the social fabric(28), remain open questions.

On the other hand, the question of a broad transition away from fossil fuels of all kinds over the next half-century is not seriously in doubt: cf. Figure 2a. Limits to the exploitation of the earth's vast (compared to conventional oil and gas) deposits of coal, tar sands and oil shales are likely to be set by the greenhouse effect of atmospheric carbon dioxide(29, 30) -- which in turn will pose a global common property resource problem of unparalleled difficulty. The varieties of

TABLE 2: **Marginal Costs of Electricity ($1976)**

Project	Generation cost $/kW installed	Generation cost mills/kWh $/GJ	Transmission cost $/kW installed	Transmission cost mills/kWh $/GJ	Distribution cost $/kW installed	Distribution cost mills/kWh $/GJ	Fuel cost $/unit	Fuel cost mills/kWh $/GJ	Total cost $/kW installed	Total cost mills/kWh $/GJ
James Bay	691	12.47 3.46	330	6.49 1.80	230	4.53 1.26	-	- -	1251	23.49 6.53
Gull Island	412	7.94 2.21	516	10.85 3.01	230	4.84 1.34	-	- -	1158	23.63 6.56
Nuclear	739	14.17 3.94	102	1.88 0.52	230	4.23 1.18	$110/kgU	3.55 0.99	1071	23.83 6.62
Coal-fired	375	7.19 2.00	102	1.88 0.52	230	4.23 1.18	$32/ton	12.00 3.33	707	25.30 7.03
Oil-fired	308	5.90 1.64	102	1.88 0.52	230	4.23 1.18	$11.85/ bbl	16.93 4.70	640	28.94 8.04
Gas-fired	308	5.90 1.64	102	1.88 0.52	230	4.23 1.18	$1.50/kcf	13.50 3.75	640	25.51 7.08

Notes:

1. Costs shown are the mid-1976 dollar costs of ordering the projects in question, including interest during construction. Inflation in capital and fuel costs would make the sum of current-dollar costs, by the time of plant delivery, greater by factors which can range from 1.5 to 3.
2. The options listed are affected differently by inflation after commissioning, that is, during plant life. The first three options are almost unaffected by future inflation.
3. Nuclear capital cost assumes $97/kg for heavy water. Nuclear fuel cost includes 1 mill/kWh for waste management, increased safety and environmental measures, and R&D.
4. Delivered costs assume Ontario loads. Unit sizes for fossil and nuclear plants are 750 MW.

Source: Electrical Branch, Energy Policy Sector, Energy Mines and Resources Canada renewable energy technologies will simply have to take over. In this global revolution wealthy Canada, spectacularly endowed with all manner of energy resources, will not be a leader. Other nations will precede us, though through necessity rather than choice. For some time to come, then, the choice is not between hard and soft technologies, but has to do with a sensible combination of both. How should such choices be made?

Roles for Government, and Others

This paper began with caveats regarding the use of market prices as guides to optimal behaviour. Prices, at any given moment, will exclude many (most?) environmental and social impacts, will include an historical accretion of taxes, subsidies, and other financial consequences of corporate structure, and will be dismayingly subject to the whims of governments and oligopolies. Comparing alternatives on a resource cost basis, all externalities accounted for, and being careful to specify what kinds and parts of energy systems are at issue to avoid the problem of weighing apples against oranges, was suggested as the path of economic righteousness. We can go further.

Energy policy may in many respects be likened to an investment game, the question always being what to do with the next billion dollars. The elementary economic principle involved is equalizing the marginal productivity of investment dollars over the range of choices available. The production, or saving, of energy ought to be the same for the last dollar spent on oil wells, dams, home insulation, nuclear plants, solar systems, more efficient industrial processes and so forth through the spectrum(31). But even this counsel of perfection is flawed. Buying an energy system is like buying a house: it is in reality a bundle of goods: the return for the monthly mortgage payment is measured in housing amenities, neighbourhood quality, commuting trauma, social prestige and other elements of lifestyle, as well as sheer square footage. Likewise, an energy investment, whether for demand reduction or supply enhancement, is characterized by many factors in addition to the classic price: quality: quantity ratios. Some options involve flooding valleys, polluting air, or scarring landscapes; others entail certain small probabilities of radioactive contamination, falling off roofs, or pneumoconiosis. Any choice offers a unique balance of regional and sectoral benefits, of present austerity and future consumption. All choices entail penalties. Since those who pay and those who benefit are never the same among the available alternatives, even options having the same overall ratio of benefits to costs will be evaluated differently by society.

Therein lies one key to the role of government. At any given time, the range of energy investments under consideration tends to be broadly indistinguishable in terms of price: those which are markedly more expensive simply are not seriously evaluated, or are sent back to the research labs to ripen awhile. At heart, it is the social evaluation of the rest of the bundle which is decisive. That this is so is demonstrated by the surprise in some technical quarters, at the impact of the Inquiry headed by Mr. Justice Berger, the proximal agent of Canadian society's evaluation of northern pipeline externalities.

C.S. Holling once remarked that there are two classes of people, those who make policy and those on whom policy is inflicted. The latter may reasonably expect the former to set out in full and objective detail, quantitatively where possible and qualitatively where not, the whole range of social and environmental consequences entailed by specific energy options. Citizens and their elected representatives would then have something substantial to evaluate — and it is they, of course, and not the analysts, who must make the ultimate choice. There is a duty for the experts to cast a broader analytical net, and for them, to publish their results; likewise, for citizens to make informed choices.

Governments at all levels have less exalted tasks to perform, particularly with respect to reducing artificial barriers to the use of renewable energy resources. Insofar as governments, through taxes, subsidies and rate regulation, have important impacts on the prices of energy commodities, they should ensure that inappropriate signals are not inadvertently given to private consumers. An Ontario envelope manufacturer whose solar installation reduced his gas purchases found himself tipped into a new and higher gas rate category. Property taxation discriminates against solar heating, energy conservation, or indeed any capital improvement which reduces the stream of energy the householder must buy(32). PEI was the first of several provinces to recognize its responsibility with respect to property taxation, and gas and electricity rate structures are under examination in several jurisdictions. Other matters of provincial responsibility include zoning, development control, and rights to sunlight, all highly relevant to solar heating, as is the regulation of forest lands to biomass utilization. All governments have responsibilities to foster research and development, to develop standards, to ensure a reasonable level of consumer protection, to educate, inform and demonstrate(33). These are necessary, if relatively passive and permissive, roles.

There are good reasons for a more active role to be considered. Higher real prices for conventional energy commodities are likely. Canadian technical and entrepreneurial wit could put in place the means to substitute for imports and to compete abroad. The marginal social cost of putting unemployed resources to work is small. But Canadian manufacturing, already in a dolorous state(34), is in no position to undertake long-term speculative investments, no matter how glittering the prize. Under these circumstances, it is possible that a modest but sustained social investment in these early stages may save Canadians of the 1990's from, for example, having to import the equipment with which to exploit Canadian sunshine.

Such a program could advance substantially the time when soft and other renewable technologies become economically attractive. Government and industry can work well together on technical and economic matters. Building a conserver society, on the other hand, involves fundamental attitude change and as such is peculiarly ill-suited to centralized governmental impetus.

Appendix 1: Units and Conversions

Abbreviations

W = watt	E = exa - 10^{18}
J = joule	P = peta = 10^{15}
e - electric	T - tera - 10^{12}
th = thermal	G = giga = 10^{9}
p = peak	M = mega = 10^{6}
Btu = British thermal unit	k = kilo = 10^{3}

Thus, for example, \$20/GJ_{ep} means twenty dollars per billion joules at peak electric output.

Power units

1 kW = 1.34 horsepower (hp)

For comparison, the James Bay development at approximately 10.2 GW is 13.7 million horsepower. A Syncrude plant at 125,000 barrels per day (b/d) is equivalent to a continuous thermal output of 9.16 GW, which in turn would give 3.2 GW_e if converted to electricity at 35 percent efficiency.

Work and heat units

1 kWh = 3413 Btu = 3.6 MJ

Cost

\$1 per GJ = \$1 per 277.8 kWh
= 3.6 mills per kWh.

Appendix 2: Life-cycle Costing and the Rational Conserver

The comparison of capital-intensive (solar, insulation...) and fuel-intensive (most conventional) energy systems requires calculation of all costs over the whole life cycle of the system. The life-cycle cost of any energy system can be calculated from the following (cf. 35):

$$LCC = K_O + \sum_{t=1}^{n} \frac{E_t}{(1+i)^t} - \frac{RV_n}{(1+i)^n}$$

where:
- LCC = life cycle cost (\$)
- K_O = initial capital expenditure (\$)
- RV_n = residual or scrap value in year n (\$)
- n = lifetime of system (years)
- i = discount rate (percent)

and,

$$E_t = K_t = (1 - F)\, D_t\, P_t + M_t$$

where:
- K_t = capital expenditure in year t (\$)
- F = fraction of total heat demand provided by system in question (percent)
- D_t = heat demand in year t (GJ0)
- P_t = net delivered cost of fuel in year t (\$/GJ)
- M_t = operation and maintenance cost in year t (\$)

For the algebraically faint at heart, this is nothing like as daunting as it looks. It is merely the net present value of the stream of costs involved, over time, of keeping warm. The tricky parts have to be done before the calculation begins, as it is necessary to project the real (not inflated) prices of conventional fuels over the life of the system. If the system has an expected lifetime as long as a mortgage, one has to make a guess about the course of oil, gas and electricity prices over a period of time which has fooled many experts in the past.

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RENEWABLE ENERGY SOURCES: OPERATIONAL EXAMPLES

William Zimmerman
Consultant
Island Earth Designs

in association with

Dr. Larry Bogan
Citizens for Responsible Tidal Power

A.J. Hendry
Operations Manager
Halifax Developments Limited

Dr. Charles H. Miller
Department of Mechanical Engineering
Nova Scotia Technical College

Dr. John C.O.C. Young
Department of Chemistry
Saint Mary's University

Abstract

This paper looks at a sample of renewable energy sources. The Scotia Square complex is evaluated as an example of energy efficiency in building design. Biomass conversion is considered in various wood burning techniques and methanol production as well as direct solar conversion for low temperature heat. Finally, wind energy conversion systems are discussed focusing on the vertical axis designs and CANVA, the NRC turbine.

Introduction

Our country has a history of using renewable energy sources. The winds, forests, and running water were the only energy sources available to heat our homes, run our industry, and transport our people and products.

But the only renewable source of energy still significant in today's market is hydro power; and the major remaining untapped hydro sites in Atlantic Canada are located in Labrador, far from regional markets. The sail and wood have been replaced by oil for marine transportation and heating fuel.

In addition, we have developed whole new ways of consuming energy largely based on the availability of cheap oil. During 1975 over 20% of the secondary energy consumption went for motor vehicles; almost 10% went to run the energy industry itself. But there is no such thing as cheap oil today and as oil prices continue upward it is time to reexamine the role of renewable energy resources in our energy economy.

The Basis of Renewable Energy Technologies

For the purpose of this paper we define "renewable" energy sources as sources which allow us to accomplish a task requiring the expenditure of energy without depleting natural resources after the initial investment. By using this definition we can examine conservation measures as well as actual energy producing technologies.

Workshop organizers suggested we direct our attention to the following limited sample of renwable energy sources: conservation in building space conditioning; the direct use of solar energy for low temperature heat; biomass conversion; and wind energy conversion systems.

The Economic Question

Any attempt to provide an economic comparison of energy sources, renewable or otherwise, that would be widely accepted is doomed to failure.

The price of the major competing energy form, oil, is dictated by the old economic principle, "whatever the market will bear", not by normal market forces. Consumers appear to be operating on a discount rate of over 30%, while many engineers use as low as 8% in their calculations. Interest rates on capital are not shaped by market forces, but are used by government to shape the market for energy sources.

In the face of this confusion, no attempt will be made to make rigorous economic comparisons of the different energy technologies considered; rather, cost estimates will be presented with assumptions clearly stated. This may be rather disturbing, for the government approach seems to focus on the economic analysis and hope that the technology will take care of itself.

Conservation in Building Space Conditioning

As our basic premise let us assume that conservation measures should not unduly compromise either comfort standards or severely restrict building form (such as eliminating single-family housing). However, lower temperature setpoints are often justified and we should revise our expectations in buildings. Presumably new building design standards will be largely affected by the new "Canadian Code for Energy Conservation in Buildings" when finally adopted.

Roughly 20% of the secondary energy consumption in the Atlantic provinces is used to heat residences, while close to 10% is used for space conditioning in commercial establishments. In general, the systems used to heat homes are badly designed, inadequately maintained, and poorly operated. Oversized heating plants and poorly-laid-out distribution systems lead to low seasonal efficiencies in fossil fuel heating plants. On the other hand, commercial installations tend to be better designed, at least partially maintained, and operated with some care. After all, businesses succeed by controlling costs.

But business still has a long way to go toward more efficient energy utilization. An examination of the energy conservation approach at Halifax's Scotia Square complex, one of the largest commercial energy users in the Atlantic provinces, might be instructive.

When the Scotia Square complex was originally designed, electricity was a relatively cheap and plentiful commodity. Therefore it was chosen as the primary source of energy for both heating and cooling of the complex.

Because good efficiencies were required both to meet the load factor of 60% necessary in an all-electric building and to provide overall operating efficiencies, a reclaim heat-pump system was chosen for heating and cooling.

The heat pump circuit operates as follows: Interior areas of the complex, such as the office tower and the stores within the shopping mall, are continuous daytime heat generating sources. Heat is removed from these areas by means of air handling systems which transfer the heat to water circuits; water circuits carry the heat back to the centrifugal refrigeration machines; heat is then transferred by way of the refrigeration gas to a condenser.

At this point a conventional system condenser would transfer heat to the atmosphere through cooling towers, not only resulting in a total loss of valuable heat, but also necessitating the production of heat for perimeter area from raw energy.

Maintenance

Only a well tuned, properly maintained automobile can achieve maximum gas mileage, and so it is with building mechanical systems.

The need for a planned maintenance system, well conceived and properly executed by trained personnel cannot be overstressed. Even the best designed and constructed system will immediately begin to deteriorate and create excessive energy use without a proper system of maintenance by trained personnel.

Controls

After developing a short history of performance, control systems can be tailored to better suit the areas served and to achieve maximum performance of the equipment. For example: night setback controls; system shutdown and fan cycling to retain overnight temperatures; revised occupied area setpoints; time clock control of equipment such as small auxiliary airconditioning units, exhaust fans, and fresh air dampers.

Many conservation techniques can be controlled by very economical equipment immediately adaptable to any size building.

Power Demand Control

In all-electric buildings where minimizing the peak demand on the total energy use is of prime importance in obtaining the maximum load factor, the control unit will shut off unnecessary electrical loads during times of peak electrical demand and will turn them on again as demand lessens.

Heat Exchangers

Many public spaces, particularly those in which food is prepared and consumed, require large quantities of preheated fresh air. A heat exchanger can recover between 60% and 80% of the heat normally lost in exhaust air and therefore effect excellent savings on the energy normally required to preheat the fresh air. Currently efforts are under way to isolate several critical spaces in the Scotia Square complex to allow them to be separately ventilated through heat exchangers, particularly while other parts of the complex are shut down at night.

Computerized Control Centre

The original control centre installed into the Scotia Square complex could remote stop/start and monitor certain system temperatures.

The central core had a time-clock control night-cycle feature that closed fresh air dampers and shut down exhaust fans, effectively sealing the building overnight. The perimeter system employed conventional indoor/outdoor reset programs so that at 4°C outdoor temperature the heating supply air temperature would be 36°C . As the outdoor temperature dropped, the supply would increase so that at -7°C the supply would be at 47°C.

As the night temperature dropped within the sealed spaces, considerable overheating occurred which required the cooling plant to operate at full capacity for hours every morning to exhaust excess heat. Obviously energy was wasted.

The problem was corrected by simply installing a control thermostat set at 20°C in a typical wall within the structure. The night cycle control would automatically switch over the indoor/outdoor control to the indoor thermostat.

With this sytem, however, we had no way of knowing the temperature within the various occupied areas. During the winter months it was necessary to keep perimeter fans operating twenty-four hours a day to prevent temperatures from dropping too low. If the indoor temperature of an all-electric operation falls much below 20°C overnight, it requires a sacrifice of the maximum demand level in order to recover temperature.

Although to date this system produced excellent energy savings, we felt that there were considerably more savings possible, but were limited by the existing control centre. We turned our attention to computer control.

The JC-80 computerized control system was considered primarily from the point of optimized control. Three programs were selected for initial installation: fan cycling; optimized start up; and supply air reset.

The fan cycling program shuts down all systems, monitors the space conditioning, and cycles the fans on and off to maintain 20°C overnight temperatures.

At midnight the optimal start program measures outdoor, wall, and space temperatures. The computer, fed with the necessary parameters for occupation time, temperature, and humidity, calculates the latest possible start-up time for each system each morning.

The supply air reset program is used during the normal operating day to replace the conventional indoor/outdoor reset program. By sampling the temperature in various areas of the perimeter system, the computer can program the supply temperature as low as possible to maintain space temperature (outdoor temperature is ignored). This allows the system to make full use of solar heat gains as well as internal heat loads, while simultaneously restricting the use of secondary chilled water to a bare minimum.

The computer was put into operation on February 10, 1976. Comparative figures for the period February-December 1975 and 1976 (334 days) appear below:

1975	54,226,800	kWhr
1976	49,657,450	kWhr
	4,569,350	kWhr saving

This amount of electricity would provide almost 600 homes and will yield a three-year payback for the computer control system.

We are currently converting the demand control of the complex over to the computer to enable us to control additional loads such as domestic hotwater heating systems. Daytime cycling control of the various ventilation systems is also being converted."

This 10% saving was achieved by an already well operated commercial facility. This is but one example of the tremendous potential for energy saving throughout our society.

Biomass Conversion

Biomass is the stored energy of the biological processes around us. If biomass is utilized for energy production faster than it is created, the resource can be destroyed. Thus we will examine two aspects of the biomass conversion situation: the spectrum of possible energy uses for the biomass resource; and the nature of the existing resource base and possible means of extending it.

Wood is by far the most important form of biomass in our region. It is used directly as a fuel for cooking as well as space and water heating. 1971 census figures indicate that 7.4% of Nova Scotia homes heat with wood. Although a decline occurred during the early 1970's, some feel that the trend has been reversed and that usage has at least returned to 1971 levels. The simplest and most common biomass energy conversion device is the wood stove.

Recent interest in wood as a heat source in Canada has renewed efforts to improve the traditional hardware, although some manufacturers still take pride in the fact that their products has remained unchanged for the past 100 years. Firms have copied Scandinavian stove design principles in welded steel, while others have experimented with other techniques to improve combustion and heat transfer efficiencies.

Improvements in traditional wood furnaces have also been made. Duel fuel furnaces have been introduced and become quite popular as they allow unattended operation. One firm in Nova Scotia is preparing to offer a home-sized wood-fired boiler to round out the line of wood heating appliances designed to use round wood.

This recently designed equipment has greatly improved efficiency, allowing the conversion of between 50% and 70% of the chemical energy stored in the wood into useful heat.

These basic wood burning devices are very simple, but along with the simplicity come several problems. The presence of very hot surfaces directly in the living space present potential dangers to small children and careless adults. Although furnaces avoid this problem, there are as yet no safety standards for wood furnaces and there is some concern about possible high temperatures resulting from the limited ability to control heat output when heating demands are minimal and large volumes of wood are loaded to permit extended burn times.

Wood stoves and furnaces share the potential problem of creosote buildup in flues when combustion rate is controlled by throttling the combustion air supply. This practice leads to incomplete combustion and low flue temperatures which results in the buildup of unburned products, creosote, in flues.

Duel fuel furnaces present a unique potential problem. Extended periods of wood-only operation at low combustion rates can create severe creosote buildups. When the oil section of the furnace cuts in for the first time a backfire could occur due to a restricted flue. This was suggested as the cause of at least one house fire.

Proper cleaning procedures for flues are fairly straightforward, but unfortunately are not followed as often as they should be. Good maintenance could control some of the hazards associated with creosote buildup, and at least one firm in Prince Edward Island is attempting to market chimney sweep services.

And finally, Professor Butcher, of Bowdin College in Maine, has done studies for the Maine Government which indicate that extensive usage of wood stoves to heat homes in other than rural settings could lead to potential problems due to particular emissions.

Two methods of eliminating the use of combustion air throttling to control heat output have been developed for small buildings and constitute the next level of sophistication in wood burning equipment.

The office building of the Maine Audobon Society in Falmouth, Maine, makes use of a prototype wood furnace designed by Professor Hill at the University of Maine at Orono. The furnace burns large logs at a high rate with substantial excess air, storing the resultant heat in either a pebble bed (the Audobon building) or in water tanks (subsequent experiments). By using very high temperature combustion and excess air, the flues are kept clean. Heat is drawn from storage as required to heat the building.

In other work at the University of Maine, Professor Reily and others are developing an automated chip-burning system that fires much like a conventional oil furnace; similar units are available from Sweden. Again high temperature combustion and excess air gives low flue gas residuals. It is hoped that these techniques will also at least partially solve the particulate emissions problem.

In installations larger than single-family heating systems, wood forms which lend themselves to automated handling are required, not just desirable. Wood chips are one possible candidate; sawdust might have limited application; and pellatized wood has potential value due to the possible standardization and the capacity of including combustible components of the solid waste stream. Such fuel could be used in three ways: direct combustion (including fluidized beds); gasification and combustion of the resultant low energy gas; or gasification and the use of the resultant gas in internal combustion engines.

The heat produced through combustion can be used either for space heating, process requirements, or raising steam for turbines. The large scale equipment for this type of use seems well developed and several pulp mills in the area are already using residuals of their paper making operations in this way. However, there is considerable disagreement in the technical community with regard to the relative economics of the combustion/steam turbine and the gasifier/internal combustion engine approach to using wood to generate electricity. Both appear to be approaching the economics of competing methods of generating electricity, if waste heat can be utilized.

The most sophisticated level in biomass energy conversion technology is the use of wood to produce liquid fuels. Although the resultant product has an overall reduced energy content, the relative compactness of the resultant fuel and its compatability with certain existing equipment are often cited as advantages of this conversion.

A recent study commissioned by Environment Canada ("Economic Prefeasibility Study: Large Scale Methanol Production from Surplus Forest Biomass") located 20 forest zones in Canada capable of supporting at least one fifty-million-gallon per year methanol plant; two in New Brunswick and Newfoundland and none in Nova Scotia or Prince Edward Island.

Based on an electrolytic hybrid process to produce supplementary hydrogen, the study concludes that methanol production from surplus forest biomass is economically attractive for 15% blending into gasoline where electricity is available for 10-14 mills/kWhr, assuming rebate to the producer of all motor fuel taxes on the methanol fraction of the blend. In light of foreign exchange considerations, employment opportunities, and other subsidiary benefits, Environment Canada considers these preliminary findings encouraging from a national point of view and plans to proceed further with its studies.

Yet another possible process for the conversion of biomass to liquid fuel is proposed by N.A. Wikston in "Using Wood for Fuel," where he urges serious consideration of the Scholler-Eickemeyer process for the production of ethanol and many other byproducts of significant economic value.

It would seem that there is no end to the potential uses for wood in our forests. Currently the major user of forest biomass in our region is the pulp and paper industry and there are suggestions that local overharvesting already occurs. What would be the use of wood for fuel due to the long-term productivity of our forests?

The amount of wood available for energy use (in addition to current use) is greatly dependent on the form in which the wood is used and assumptions concerning the availability of wood in private wood lots. Estimates of the amount of unharvested merchantable hardwood available for fuel use in Nova Scotia are in the range of 1.3 million m^3 (46 million ft^3) per year. This assumes that only 50% of the wood in small private holdings and 90% of the wood in large private holdings and provincial Crown holdings is available for harvest.

If, however, chips were acceptable for fuel use, Wikston suggests that total free harvesting would yield an additional volume of wood equal to the current annual allowable cut: a total of 3 million m^3 (106 million ft^3) of hardwood and 4 million m^3 (141 million ft^3) of softwood available for energy use in Nova Scotia alone. This would amount to the energy equivalent of over 9.4 million barrels of heating oil or over 32% of the 1975 Nova Scotia secondary energy consumption.

Using fuel oil at 55 ¢/gallon for comparison and allowing $13.80/tonne ($12.50/ton) for the higher cost of equipment and the inconvenience associated with using wood for fuel one could afford to pay $28.10/tonne ($25.50/ton) for stumpwood chips.

More intensive silvicultural practices are probably justified and would give even higher forest yields. The energy plantation concept might even prove economical and further increase biomass supplies. An energy plantation is a biomass farm in which selected species are planted, tended, and harvested to produce raw materials for energy production. The concept involves advanced and as yet unproven agricultural/silvicultural techniques, although the results of scattered pilot studies have been encouraging.

For example, research on fast-growing poplar species has been going on for ten years on agriculturally poor soils in Eastern Ontario, and five crops have been taken thus far without detectable depletion of the soil. Biomass production of 16 tonne/hectare (7 ton/acre) has been achieved.

Jerusalem-artichoke production in excess of 34 tonne/hectare (15 ton/acre) has been reported on the Canadian Prairies.

Studies by the Canadian Forestry Services indicate that red alder, a nitrogen fixer, would be an attractive energy plantation species. If mineral ash from the power plant were returned to the soil, it is conceivable that a 168 km^2 (65 mi^2) alder plot could fuel a 150 MW thermal electric plant on a continuing basis.

Studies made in Maine, where climatic conditions are somewhat similar to those in Nova Scotia, indicate that sustainable forest biomass yields of 6 m^3/hectare-year (5 cords/acre-year) should be achievable be advanced forestry practice.

Field trials of total tree harvesting to determine its impact on forest conditions in the Atlantic provinces, along with investigation of more intensive silvicultural techniques, should proceed along with the development of wood energy using equipment to guarantee a truly renewable energy resource.

Safety and operating improvements in heating equipment for homes and small commercial installations would probably provide an excellent market for a wood supply industry. The resolution of the debate over the design of small electrical generating stations with waste heat utilization would also be a very significant factor in firmly establishing wood in the energy market.

Direct Solar Conversion for Low Temperature Heat

The use of devices for converting solar radiation into useful heat has a long history. The first large-scale commercial solar activity heated domestic hot water in Southern California around the turn of the century. When inexpensive natural gas was discovered in California, activity moved to Florida, but material shortages associated with World War II and the advent of inexpensive electricity reduced the industry to a service level by 1955. Drastic oil-price increases in the early 1970s and increased technical capabilities have led recently to a strong revival of interest in the use of solar energy for domestic hot water and space heating as well as heating for process applications in industry and commerce.

That is in the United States, but what are the prospects for direct solar energy utilization in Canada? For many years it was a commonly held conviction that solar heating just would not work in Canada. Recently it has become generally accepted that it would work, but not economically. Some will now admit that, for certain applications, solar may be the most appropriate energy source.

In order to understand how this technology can work effectively in our cold climate, it is necessary to examine the workings of a typical solar heating system. Consider a house with an active solar heating system which also preheats domestic hot water; this case will not try for total solar heating, although this is possible, and air will be used as a heat transfer medium.

The solar system, shown schematically in Figure 1, consists of: solar collectors; a heat storage unit; preheating heat exchangers for domestic hot water; a solar central unit; and the auxiliary heat source.

Sunlight passes through one or more layers of a clear material (either glass or plastic) and strikes the surface of the solar collector designed to absorb the sun's rays. The solar radiation heats this surface which, in turn, heats a stream of air in contact with it. The glazing layers, insulation, and possibly special surface treatments on the absorber reduce heat losses from the absorber and the air stream.

In general, the performance of such a collector may be described by a plot of its efficiency in transferring the incident energy to the air passing through the collector versus the temperature difference between the average temperature of the air in the collector and the outside air divided by the solar energy striking the outer layer of glazing. In most cases the plot may be approximated by a straight line. Figure 2 shows the characteristic curves of several different collectors, along with sketches of their construction.

Obviously a fluid could be used to carry the heat away from the absorber, but provisions must be made to protect the fluid from freezing.

Heated air leaving the collector would be directed by the control unit either to the house, if required, or to the heat storage unit. Heat may be stored in a rock bed, an array of containers filled with water or a material which melts at an appropriate temperature, or a large tank of water with heat exchangers. Storage volume will be roughly 0.1 to 0.2 m^3/m^2 (0.33 to 0.66 ft^3/ft^2) of collector. If water or some other liquid were used as the heat transfer medium in the collector, a single water tank with heat exchangers where necessary would probably be used.

If the house requires heat when none is available from the collectors, the control unit would draw heat from the storage unit. If inadequate heat is available from either the collectors or storage, the auxiliary heat source would automatically turn on. At all times domestic hot water feed water passes through domestic hot water heat exchanger.

Several factors will affect the yield of a solar system such as we have described: the solar energy striking the surface of the collectors; the outside air temperature; the load imposed on the solar system; as well as the characteristics of the collector and other parts of the solar system.

Low levels of radiation not only reduce the energy available but also will reduce the efficiency of the collector in capturing what is available. In order to maximize the radiation, one should ideally point the collector directly to the sun at all times. Since this generally is not practical, we would choose the orientation which would maximize the useful solar energy available. For space heating, this is roughly due south with the collector tilted at an angle equal to the latitude plus 15°.

During the summer months there will be plenty of radiation hitting the collector, but little use for it, so collectable energy will have to be dumped, while during the winter, climatic conditions will keep collection efficiencies low. But the cold Canadian climate offers a greater load for the solar system on a year-round basis. Based on a design procedure known as F-Chart, which was developed at the University of Wisconsin, Figure 3 shows the predicted performance of the solar system described in a Charlottetown climate. Interestingly enough, the vastly different climatic conditions across Canada yield only minor variations in the overall economics of solar space heating systems. K.G.T. Hollands and J.F. Orgill conclude, in Potential for Solar Heating in Canada, that:

> "The cost of solar energy, expressed per unit of solar energy delivered to the building is relatively insensitive to the Canadian city considered the maximum variation due to location being about $\pm$10% from the mean. Edmonton and Winnipeg proved to have the lowest unit price of solar energy, Vancouver the highest. The eastern cities of Toronto, Ottawa, Montreal, and Fredericton have about the same unit price of solar energy."

Solar space heating of the type described may not be the most economical way of using the sun for low temperature heating. Applications which would allow lowering the temperature of the medium passing through the collector would improve collector performance or allow the use of less expensive collectors. The solar heated building erected by the New Brunswick Electric Power Commission in Shediac makes usé of a heat pump to upgrade the heat produced by the solar collector, thus allowing lower collector temperatures.

Solar pool heating systems not only allow lower collector temperatures but also eliminate the need for a separate storage system and simplify the central requirements. Most of the commercial solar activity in Canada appears to be in pool heating systems.

Solar heating systems for domestic hot water have the advantage of fairly constant loads throughout the year, giving much better collector utilization. In single-family installations the relatively high fixed cost of the piping, system controls, and other components (as opposed to the collectors) make the economic advantages less significant, but commercial sized installations look rather attractive.

Even the economics of single-family solar space heating systems look fairly attractive. The Charlottetown example referred to earlier is based on the economic optimum system assuming an interest rate of 11%; a discount rate of 8%; a current auxiliary fuel cost of 2.16¢/kWhr with an annual increase of 7%; a projected system cost of $6,410 for 52 m^2 (560 ft^2) of collector; and a 20-year analysis period. The present worth of the yearly total costs with solar is $9,610, and the present worth of yearly costs without solar is $10,300.

Why are not more people building solar heating buildings?

First, the consumer is probably operating at a discount rate higher than 8%, probably at least 15%, and some would argue as high as 30%. This means that the consumer would rather buy wall-to-wall carpets, a colour TV or anything else which yields immediate "rewards," than invest in long-term energy supply. A combination of more extensive "energy" loan programs and consumer education might change this situation.

Second, possibly because of the lack of a demonstrated market there are not many well developed systems available, much less those which can deliver the desired performance for the specified price. The "backyard solar furnace" is the most developed system, but it costs two and one-half times as much per m^2 as our previous example. It is to be hoped that a well developed system designed to integrate with the building structure would lower costs. So far, only scattered attempts with carefully supervised site-built systems, such as Nick Nicholson's work in Quebec, have approached this goal on a commercial basis. Unfortunately, Mr. Nicholson has been too busy building and experimenting to actually go through the careful development of a system which might receive general acceptance. The Institute of Man and Resources, in Charlottetown, is currently working with Mr. Nicholson in an attempt to advance the development of such a system.

Equipment availability problems are also evident in the Institute of Man and Resources domestic hot water demonstration program. It is not uncommon to wait for components six months after promised delivery. The large American companies are not better in this regard and in some cases much worse. Both of these programs at the Institute are funded by the Canada-Prince Edward Island energy research agreement.

Many of the smaller companies are in a trap: they cannot demonstrate the viability of their products until the market has matured, and therefore, cannot attract the financing required to carry out engineering and marketing. This means that they are unable to last until the market matures. It is likely that the solar market will be dominated by much larger companies, mostly based in the United States, where significant funding has gone directly to assist big firms in developing their solar expertise and to develop a market for the equipment.

There is no doubt that solar heating will take its place in the energy supply picture in the near future, but the big question is: Who will supply the hardward?

Wind Energy Conversion Systems

During the age of sail in Atlantic Canada, the relatively water-scarce areas of North America were dotted with thousands of small, low-powered, horizontal-axis wind turbines. The turbines provided direct mechanical energy for pumping underground water to the surface for ranch and farming operations. These units have been so useful and reliable and so ideally suited to their applications that they still exist and function in the thousands. According to a recent study, there are approximately 13,800 of those in operating condition and their use has conserved approximately 10 million kWhr/year.

To date, the largest modern experiment in wind powered generation was in the nearby state of Vermont. On March 3, 1945 the 1.25 MW Smith-Putnam wind turbine began feeding AC power into the Central Vermont Public Service Corporation grid. After 23 days of operation, one of the two 7.3 tonne (8 ton), 27 m (88 ft) long blades broke loose and landed 750 feet from the turbine; fortunately no one was injured. The problem which caused the failure could have been easily rectified, but the failure occurred one day prior to the unit's formal acceptance. Also, with World War II still in progress, there was no hope of replacement parts being manufactured in the near future. The project was abandoned.

A less drastic example of a relatively recent wind energy conversion system (WECS) is the 200 KW unit at Gedser, Denmark. This simple, well-designed, unit had fixed pitch blading, and was constructed by semi-skilled labour at a cost of $250/m^2 ($23/ft^2) of swept area. The Gedser unit represents a milestone in WECS design and operation; it combined simple reliable design, low technology manufacture, medium output and extended satisfactory service.

Looking towards larger machines, a small 100 kW experimental horizontal-axis WECS was built in Sandusky, Ohio, as the first step in the development of a series of medium-to-large units designed to explore the performance and reliability of the state of the art in horizontal-axis machines. Two aspects of this program are unique: it is the first significant continuing program devoted to the development and construction of WECS to the state of the art limit; and the major aerospace firms are involved in the design and development, applying their expertise in aeroelastic and structural problems. The program for the 1 MW WECS is now well under way and the studies on design limit blading in the order of 100 m (326 ft) diameter are advancing. Firms such as Boeing, Kaman, Lockheed, and Grumman have been active in these efforts.

The most prominent Canadian WECS installation is the 200 kW vertical-axis wind turbine installed in the Magdalen Island by Hydro Quebec. The Magdalen

Islands have an excellent wind profile, with an average annual wind speed of 8.5 m/s (19 mph). All electrical energy on the islands is supplied by diesel-powered generators with an installed capacity of 26 MW.

The Canadian turbine, CANVA, designed by the National Research Council with detailed design and fabrication by Dominion Aluminum Fabricating Ltd., is probably another milestone in WECS design. With a maximum diameter of 24 m (80 ft), the two troposkein blades are symmetrical airfoils with a cord of 0.61 m (2 ft) and are connected to a 37 m (120 ft) vertical column at the ends and by two horizontal struts. The entire structure rotates on top of a 9 m (30 ft) tower and is geared to a 224 kW induction generator. The generator is also used as a starter with an autotransformer used to reduce voltage to eliminate line surges. An additional transformer to match line voltage; a capacitor bank to correct power factor; and protection and control equipment are also included in the system. See Figure 4.

In 1976 dollars the cost of production model of the CANVA was estimated to be $128,000. The annuity cost for a 30-year amortization period was calculated to be 2.49 ¢ / kWhr for this turbine. Figure 5 shows the expected annual output of a similar turbine plotted against the average wind speed.

At the same time, NRC has been exploring the upper limits of vertical-axis WECS design. Operational experience with the Magdalen turbine will form the basis for even larger demonstrations. Canada currently is the world leader in vertical-axis turbine technology.

While the large-scale turbines attract considerable attention, the small end of the WECS spectrum, relatively well developed in the U.S.A. in the 1930s, is receiving renewed research. Bristol Aerospace Limited, in Winnipeg, has just received a contract for over $700,000 from the Government of Canada to extend its research in small vertical-axis WECS, and the United States government has let a similar contract with Windworks, in Wisconsin, for the development of a horizontal-axis unit rated at 8 kW in 9 m's (20 mph) winds.

A study for the American government carried out by Lockheed-California predicts a potential market for WECS of less than 30 kW of over 10 million units by 1995. One of the prime uses for wind energy produced by these systems would be for space heating.

A look at Figure 6 might suggest the wisdom of this approach. It shows the total energy requirements for a hypothetical 167 m^2 (1800 ft^2) house of tight construction in Sydney, Nova Scotia, with the wind energy availability superimposed but with a different scale. It is apparent that a 100 m^2 (1000 ft^2) WECS would supply adequate energy, if short-term storage were available, for <u>all</u> the energy needs of the home. Thermal storage is relatively inexpensive and could be used to match more closely the variable output of the wind turbine with the loads of the house; then a relatively small electrical storage system could still meet most of the electrical needs of the home.

Such a system would require a new design philosophy but may have interesting applications both in Atlantic Canada and in the Canadian north. The wind turbine might even be used to power a heat pump allowing better utilization of the high-quality output of the wind machine.

There seem to be possibilities for effective applications of wind energy at both large and small scales. The key to wind energy application will be the development of dependable WECS which can either stand alone or interface with the utility system, without causing disruption in their operation. The recently announced study of integrating a wind turbine with the Wreck Cove hydro project is an excellent example of such utility interfacing.

Conclusion

This brief examination of several renewable energy sources obviously leaves many questions unanswered. It would have been much easier and immediately satisfying to focus on any single renewable energy source and carry out a more thorough study of the potentials and problems implicit in its implementation, but in some ways this survey may be more useful.

First, the issue of scale finds its way into all discussions of renewable energy sources. These examples have shown that the potential applications are evident throughout the spectrum. A solar domestic hot-water heating system producing an average of 1/4 kW may be able to provide energy at the same price as 200 kW wind turbine or a 5 MW wood-fired generating station. It becomes very important to examine the real energy needs and attempt to match these needs with appropriate and available resources.

But where will the initiative come from? Will the entrepreneurs wait for some form of government involvement to start commercializing more desirable technologies?

Although not all renewable energy sources are now clearly economic from the consumer's point of view, if national economics or other imperatives make the implementation of these sources desirable, what kind of financial incentives should be offered to change the consumer's economic evaluation?

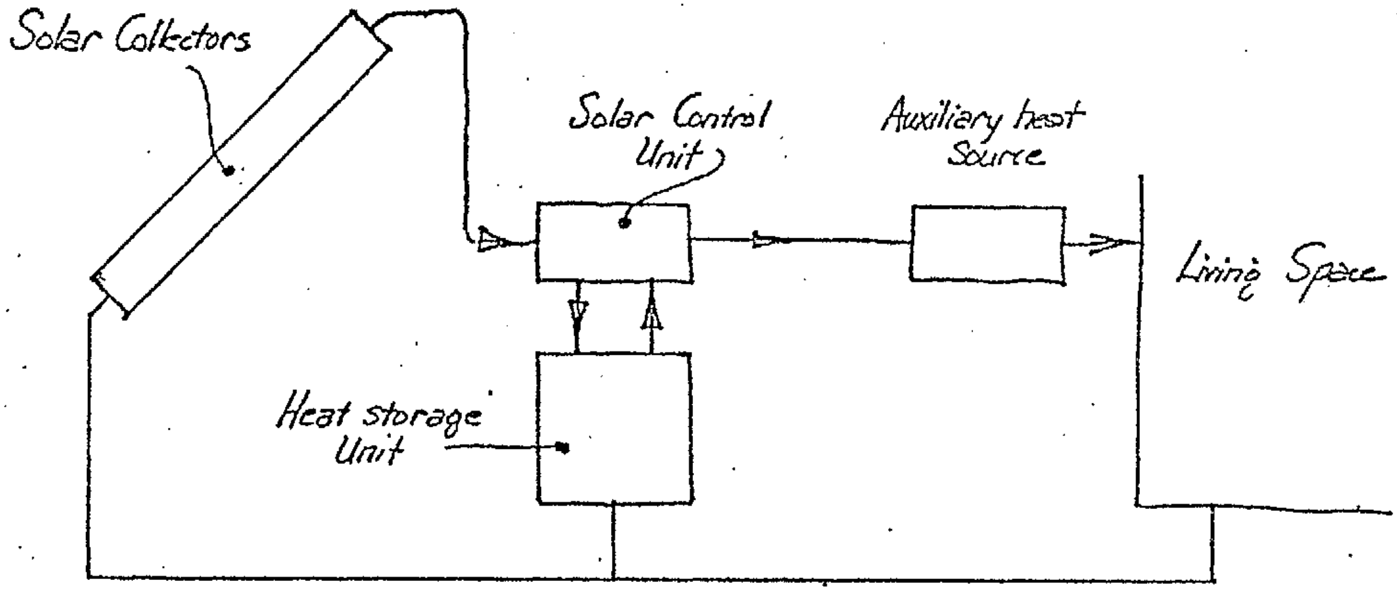

Figure 1 Schematic of Solar Air Heating System

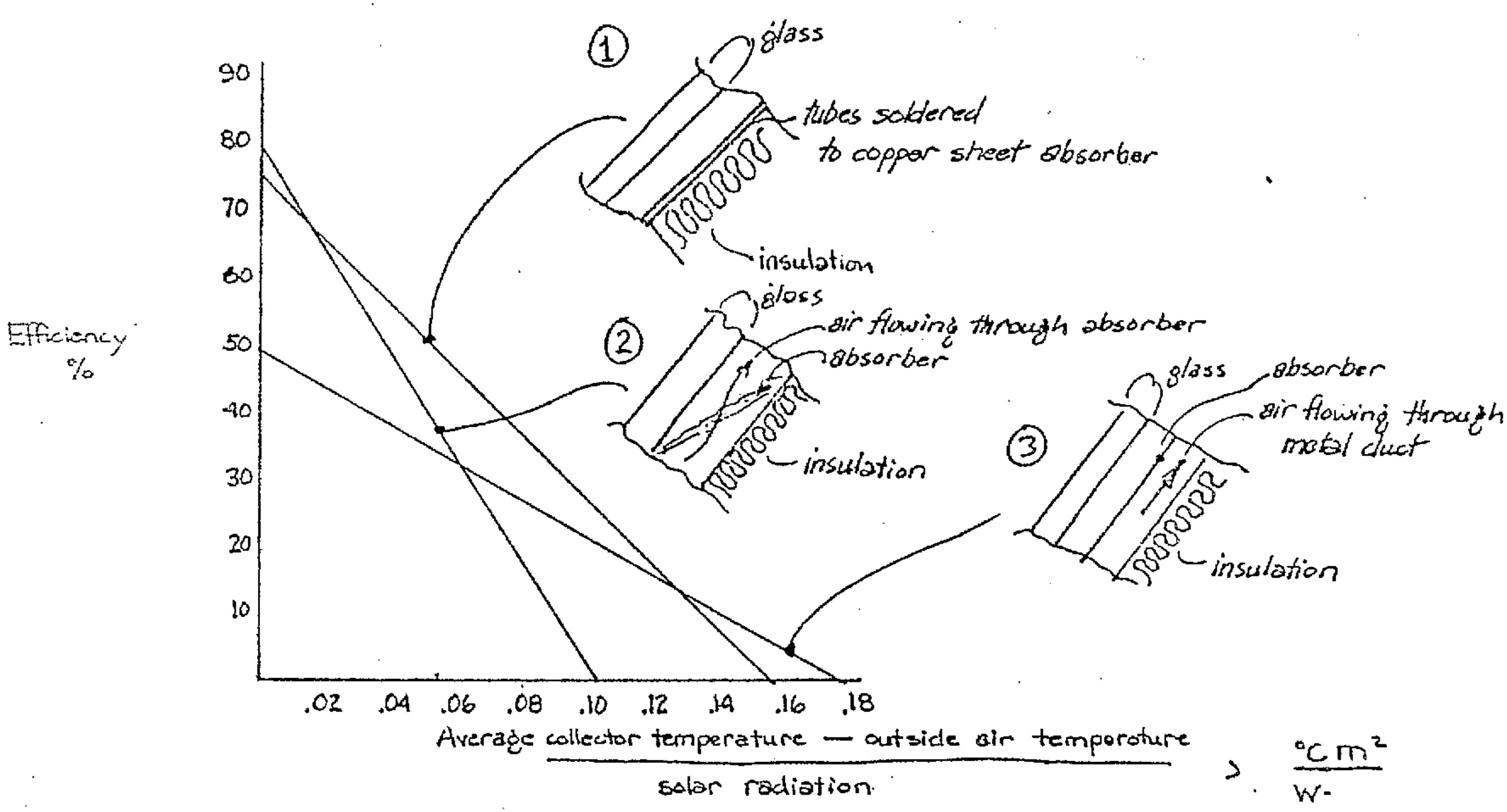

Figure 2 Performance Curves of Some Typical Collectors

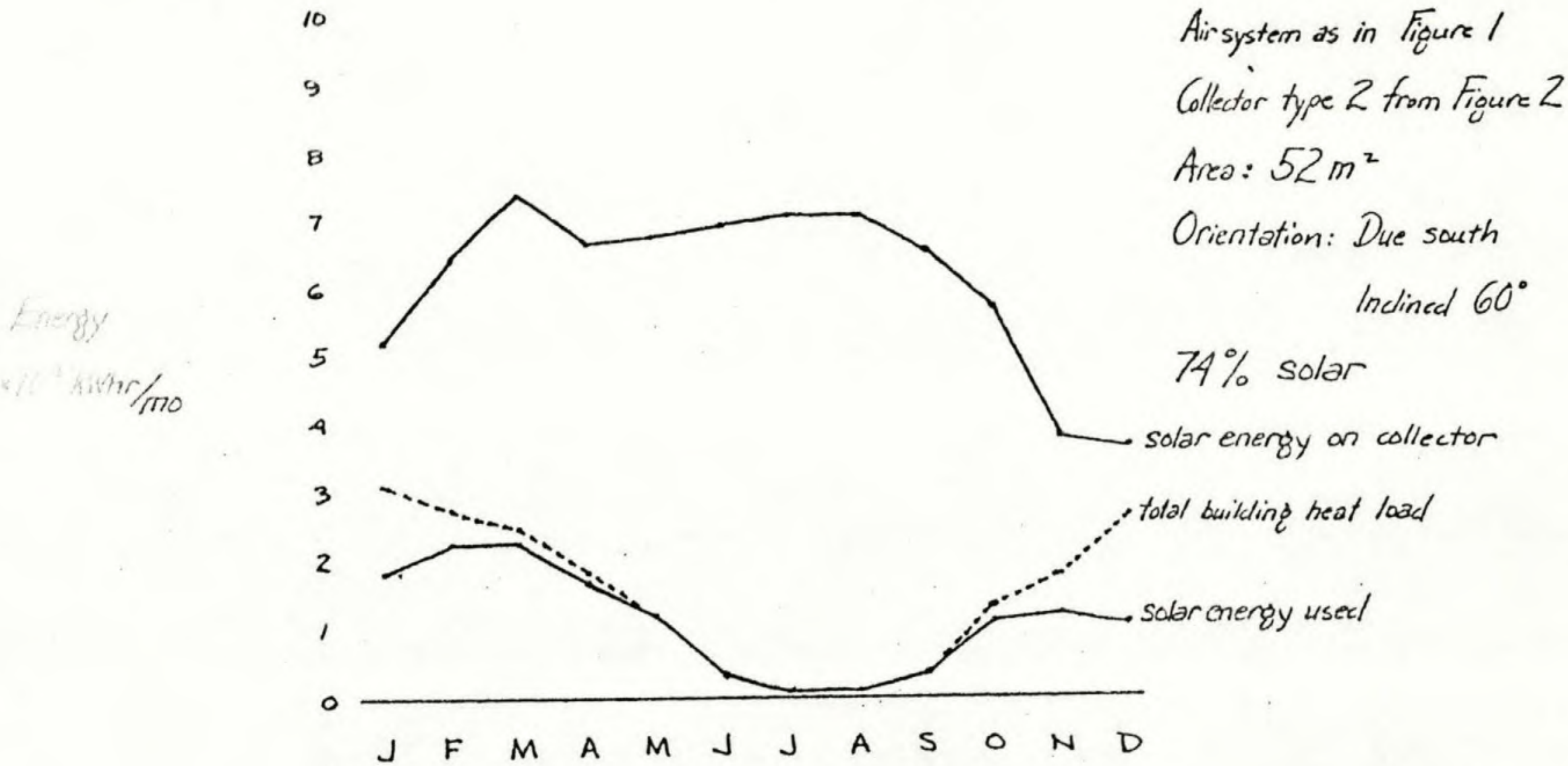

Figure 3 Performance of Solar System: Charlottetown

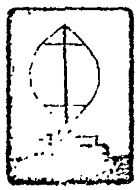

Fig. 4

Figure 4 The Magdalen Islands
CANVA Turbine

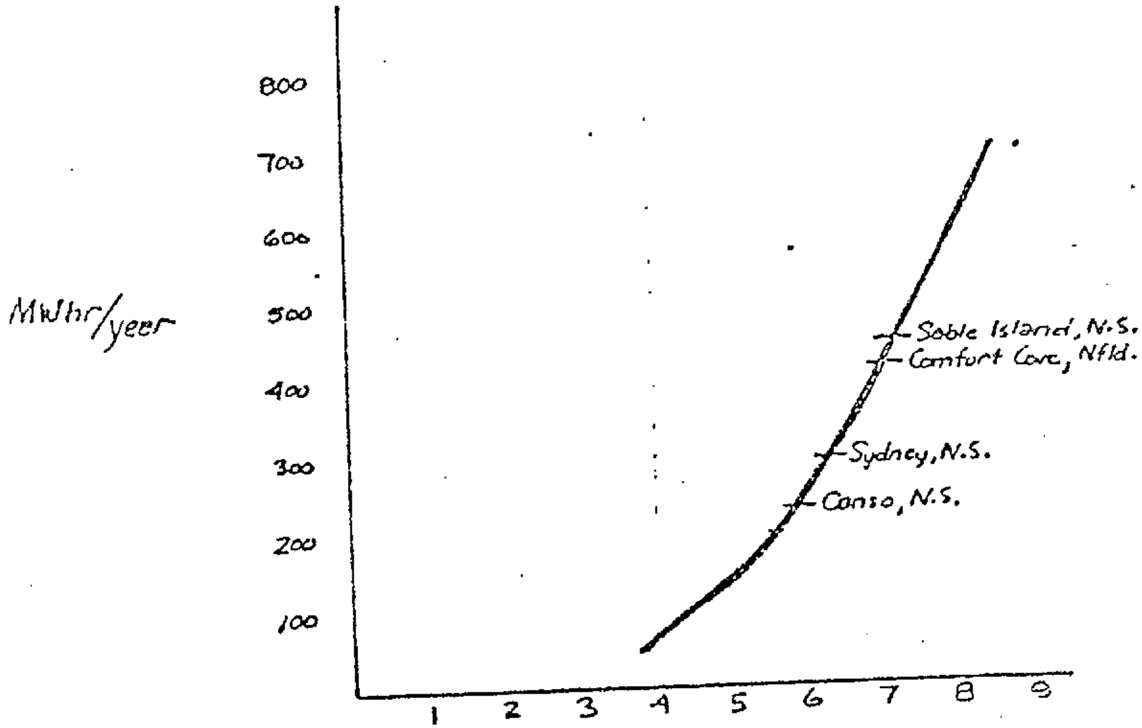

Figure 5 Maximum Output of Magdalen Sized Wind Turbine In Different Wind Regimes

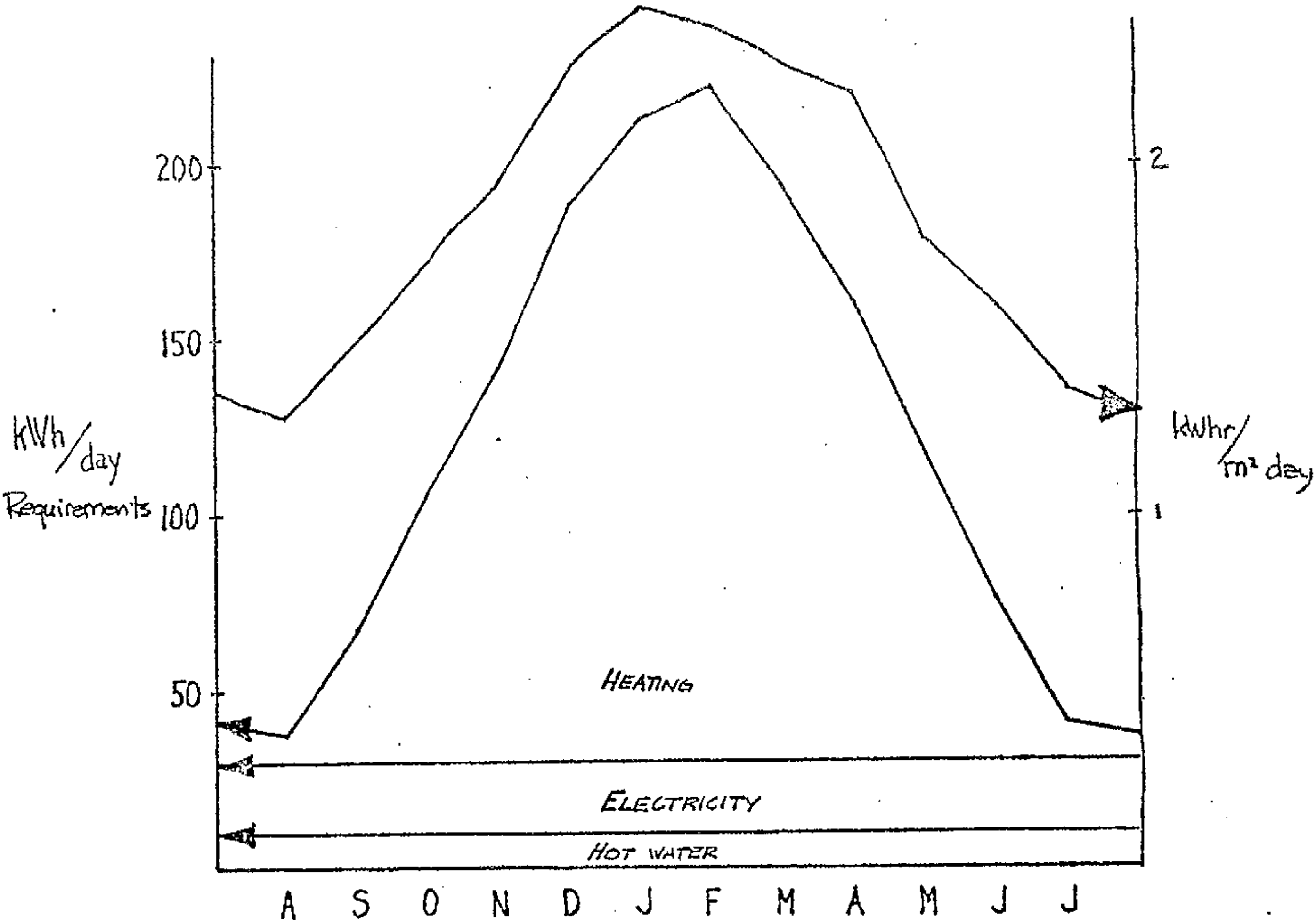

Figure 6

ESTIMATED ENERGY REQUIREMENTS FOR A WELL INSULATED 1800 FT² HOME IN SYDNEY AND WIND ENERGY AVAILABILITY ($\eta = 0.3$)

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INSTITUTIONAL FACTORS

Andrew Wells
Executive Director
Institute of Man
and Resources
P.E.I.

Abstract

This paper undertakes a discussion of the roadblocks that exist to the aggressive development of solar energy in Canada. The author considers J.W. Benson's three major perceptions of the energy problem: that development of supply must meet expanding demand, that energy demand must be cut by legislation, that the energy problem is a manifestation of the basic assumptions of industrialized societies and that radical changes must be made in our values and institutions to avoid global catastrophe.

The characteristics and assumptions behind each of these perceptions are analysed and evidence from contemporary studies is used to support the three views.

In 1952, a study commissioned by President Truman of the United States (the Paley Commission) came to the conclusion that solar energy could play a greater role in energy supply than could nuclear fission. The Commission projected that if an aggressive effort were made, 13 million homes and commercial buildings could be heated by solar energy by 1975.(1)

Twenty two years later, 1974, an Atomic Energy Commission study concluded that by the year 2000, solar energy could provide 30% of the U.S. energy needs.(2)

One cannot help but ask: What barriers to solar energy development were present in the United States between 1952 and 1974 and again between 1974 and 1978? Further one must ask what barriers or roadblocks have existed and still exist in Canada to an aggressive development of solar energy? (It must be remembered that the United States definition of "solar" is comprehensive, and includes wind, biomass and other energy forms related to the sun: Canadian terminology is more often, simply "renewable energy.")

The intent of this paper, then, is to examine some of the institutional and societal factors at play in the renewable energy field. These factors are virtually limitless but a close examination of the situation would suggest technological factors per se, are not paramount.

Rather, it will be argued that it is not so much a question of information or knowledge gaps in the hard science (technological and scientific) areas which prevent meaningful strides in renewable energy development, as much as it is governmental, private institutional, educational, business goals and values, and information transfer at the individual level. In a two year study completed in 1976,(3) political scientist Don E. Kash and his colleagues at the University of Oklahoma, have concluded that the problems of energy supply are not primarily technological. Research, development and demonstration efforts must focus on social and political factors, the report says.

Benson has postulated that "Because goals and values are related to social structure, radical changes in values will require radical changes in social, corporate and political institutions."(4)

Benson further suggests that "three major perceptual patterns can be seen which reflect different ideologies.... Each of these views has significant representation among decision makers, analysts, and the public. Each appears to have its own validity and is the result of personal experience and of selective exposure to certain facts. The overall pattern these make are then individually and subjectively shaped by the prejudices of the viewer. <u>Each of these major perceptions leads to quite different actions</u>. So when persons appear to be arguing about technical issues or choices among options, they may in fact be arguing from different fundamental perceptions of the nature of reality. <u>This fact has specific implications for national policy</u>."(5) (My emphasis.)

When considering the Canadian situation, the implications of this proposition on the role and influence of federal and provincial technical and scientific advisors, as well as Canadian business (including multi-nationals and branch plants) and the managers of that business, are potentially, if not actually, massive.

Benson's definition of the three major perceptions is as follows:

1. The energy problem is essentially a problem of developing new supplies to meet the ever-expanding energy demands of a growth-oriented consumer society: simultaneously, conservation technology needs to be adopted to reduce wasted energy.

2. The energy problem is basically a matter of increasingly intolerable social, environmental, and economic costs of continued energy usage. Energy demand needs to be cut with changes made equitable by supporting legislation.

3. The energy problem is but one manifestation of a far more fundamental crisis involving nothing less than the basic assumptions and goals of all industrialized societies. Radical changes in our values and institutions must be made soon in order to move to a more democratic and ecologically sustainable society and to avoid global catastrophe.

The remainder of this paper will attempt to "speak" to these three major perceptions. An effort will be made to place all three in the perspective of Canadian society, past, present and future. Unfortunately, due to there being few relevant Canadian statistics (one might even say relevant Canadian thought), heavy reliance will have to be made on information from other jurisdictions. However, in global terms, such information is likely to be very close to our national situation.

The first of the major perceptions is that our energy problem is essentially a problem of developing new supplies to meet the expanding energy demands of a growth-oriented consumer society, while at the same time promoting energy conservation.

For examples of this perception, we need to go no further back in time than the First Ministers' Conference held in Ottawa on February 13, 14, and 15. On February 14 (Oh, the irony of it!) the Federal Minister of Energy, Mines and Resources outlined the various possible large, centralized, and capital intensive energy supply projects which could be undertaken, jointly with the provinces, over the next eight to ten years. The previous day (February 13) a majority of Provincial leaders pressed for the development of major, high technology energy supply options. The thread of argument from both the Federal and Provincial spokesmen was that such projects would meet our present and projected future energy needs as well as supply a large number of necessary jobs. (The Federal Minister estimated his shopping list of projects would create one million man years of employment during construction at a cost of $180 billion. It was projected that such a program would create 72,000 permanent jobs.(6) This would amount to $2,500,000 per job. Such an approach says nothing about the massive dislocation of labour, the effect such an amount of concentrated capital would have on other desirable social and economic programs, the tying up of engineering, technical and managerial skills in one economic activity, or what the next massive series of projects will be to make good use of the trained labour force that will be created).

In addition, the formally stated policy of the Federal Government ties in very closely to the first perception: "The advantages (domestic source of oil, natural gas and other resources) however, will not sustain us over the longer term without a strong national effort to use energy more carefully and to develop our energy potential - a task which will be extremely costly. Failure to make the effort could mean a high degree of dependence on foreign oil in the next decade - a risky source in an uncertain world....

"In the Atlantic provinces, as in many parts of the country, there are opportunities to replace oil, in part, with other energy sources, notably coal and nuclear energy....

"Obviously it remains of utmost importance to establish new sources of Canadian oil and natural gas....

"Important exploration ventures in the Beaufort Sea and other frontier areas have gone ahead.... A sustained exploration effort backed by the Federal Government, has confirmed that a substantial natural gas resource exists in and around the Arctic Islands, but further exploration will be required (and has been committed) to establish whether gas exists in sufficient quantity to make a pipeline practical.

"Western Canada's heavy oil resource has in the past been overshadowed by conventional light oil. With prices rising to more favorable levels, new interest is being shown in the possibilities of substantially increased heavy oil production [illegible] next [illegible] years....

"An expanded effort to pry more oil from the Athabasca oil sand deposits is also required....

"An increased flow of information on Canada's energy possibilities - frontier hydrocarbons, electrical power from uranium, hydro and coal - is vital in deciding our best options for the future...."

And then:

"Increasingly, the federal government will be examining energy forms which have not had wide use in the past but which, because they are self-renewing, <u>may in the future</u> become more important. This will be a factor in deciding research and development priorities in future. This research <u>may improve the chances</u> of using energy from the sun, the winds, the tides and from animal and vegetable matter."(7) (My emphasis.)

The funding of federal energy research and development programs(8) speaks for itself:

	1976-77	1975-76
Nuclear	\$93.7 million	\$85.3 million
Fossil fuels (oils, gas and coal)	14.0	9.2
Conservation	9.1	5.9
Renewables (hydro and tidal, solar, wind, geothermal and biomass)	4.7	2.9
Transportation and transmission	6.1	6.8
Co-ordination	0.2	-
TOTAL	\$127.8 million	\$110.1 million

It can readily be seen how precisely federal and, in large measure, provincial energy approaches fit the first major perception: "developing new supplies to meet the ever-expanding energy demands...simultaneously, conservation technology needs to be adopted to reduce wasted energy."

Benson outlines the basic broad assumptions of the first perception as follows:

- The benefits of a high-consumption, high technology society as compared with any feasible alternative are obvious and generally agreed to.

- Life is perceived as a "zero sum game" i.e., for any individual or institution to gain, a competitor must lose. Short term interests are maximized, long term consequences ignored.

- Major decisions in the past have been greatly influenced by the leaders of the financial and military - industrial sectors (I would add, in Canada, the technical elite). This should continue because an economically healthy industrial sector means "trickle-down" benefits for the less fortunate.

- The high consumption, high-growth society provides the only hope for raising incomes of the nations poor, and the poor of the world, ("We in Canada have a duty to share our Candu-reactor technology with the developing world.") to a higher state of material and therefore social well-being.

- While it is recognized that the United States (Canada) is running short of petroleum and can ill afford to become too dependent on foreign sources, there are ample alternative energy sources which merely await development (i.e., coal, shale, solar, the fission breeder reactor, and eventually nuclear fusion).

- A technological approach to the problem of insuring adequate energy supply will receive strong public support because of the proven accomplishments of technological solutions to past problems. (A recent report on <u>Canadians' Perceptions of an Energy Crisis</u>, found that:

  (1) only 12% of Canadians feel Canada has enough energy to meet all domestic and export requirements now and in the future;

  (2) 34% believe there is enough for Canadian needs as long as we don't export supplies to other countries;

  (3) 38% feel Canada has enough energy to satisfy only her present needs;

  (4) 12% see a shortage of available energy in Canada at the present time;

  (5) 64% are unsympathetic to the idea of rationing gas and oil;

  (6) 72% oppose the idea of a sharp increase in the price of petroleum products;

  (7) 72% are in favour of reducing oil and gas exports;

  (8) 66% favour the construction of new coal-powered electric generating plants:

  (9) 64% favour new nuclear plants:

(10) 90% gave favourable response to the idea of developing alternative forms of energy, such as wind and solar power for commercial use).(9)

- The public must be made to understand the need to subsidize industry's development costs and risks to assure the timely development of new energy sources and the nation's energy independence: (A recent flurry of advertisement from the commercial sector carries this implication).

- The inevitable environmental costs of large energy projects will be chosen in preference to the economic and social penalties of running out of energy;

- Regional sacrifice (in Canada, the North, and the Atlantic provinces) will be accepted to help insure continued G.N.P. growth;

- There is inadequate current public support to adopt a policy of voluntary frugality while awaiting a solution (such as a soft energy path) to long-term energy needs;

- The perception seems rational to those holding it. Believers are optimistic that technological solutions will be found for all present and future problems. Non-believers are viewed as prophets of doom and gloom.

Assumptions of this sort are implicit in utility companies, commercial energy operations, and most government energy planning. However, it is interesting to note that in the United States from 1961-1973, electric utilities increased their kilowatt output about 130%, their revenues about 260%, their construction costs about 340%, but <u>employment</u> in electric utilities increased only 21%.(10) Yet, Canadian policy makers would have tremendous amounts of social capital and manpower allocated to the construction of large electric generating plants, presumably for the jobs created during the construction phase and the promotion of growth of industry, not permanent jobs in the utility industry.

Robertson cites the "hyper-industrial" society as envisaged by futurologists like Herman Kahn(11) and Daniel Bell.(12)

"They conceive the future in the image of professors at MIT and of other male North Americans like themselves. They foresee the expansionist, high technology, knowledge-based society: meritocratic, authoritarian, dominated by a technically sophisticated elite: a society whose principal end will continue to be economic growth, and whose means will include space colonisation and the worldwide development of nuclear power. In other words, they still see the new frontiers as predominantly geographical and physical; and they believe that economic and technical strength will enable us to break out of any geographical or physical limits that might otherwise close in."(13)

Denis Hayes sounds a warning note:

"We are not running out of energy. However, we <u>are</u> running out of cheap oil and gas. We are running out of money to pay for doubling and redoubling an [illegible] to accept the social costs of continued rapid energy expansion. We are running out of the environmental capacity needed to handle the waste generated in energy production. And we are running out of time to adjust to these new realities."(14)

The overriding factor considered in arriving at energy policy in this country has been economics – economics as viewed by the traditionalists. Mounting evidence suggests such an approach is no longer appropriate to rapidly changing circumstances, E.F. Shumacher put it this way:

"I am asking what it means, what sort of meaning the method of economics actually produces. And the answer to this question cannot be in doubt: something is uneconomic when it fails to earn an adequate profit in terms of money. The method of economics does not, and cannot, produce any other meaning. Numerous attempts have been made to obscure this fact and they have caused a very great deal of confusion; but the fact remains.

"About the fragmentary nature of the judgements of economics there can be no doubt whatever. Even within the narrow compass of the economic calculus, these judgements are necessarily and methodically narrow. For one thing, they give vastly more weight to the short term than to the long term, because in the long term as Keynes put it cheerfully brutally, we are all dead. And then, second, they are based on a definition of cost which excludes all "free goods", that is to say, the entire God-given environment, except for those parts of it that have been privately appropriated. This means that an activity can be economic although it plays hell with the environment, and that a competing activity, if at some cost it protects and conserves the environment, will be uneconomic."(15)

Let us look for a moment at the effect this view of economics has upon such factors as employment, social programming, energy inputs and social capital.

We have already seen that the proposed eight to ten year energy program discussed at the recent Conference of First Ministers, would produce approximately 72,000 jobs at a cost of about $2,500,000 per permanent job. Given the following record, such sums should not be too surprising:

- In the agriculture sector, the use of energy (fertilizers, chemicals and automated equipment) has increased productivity. This in turn has led to a steep decline in the number of people employed. In the United States in 1970 employment was less than half of what it had been in 1920. During the same period energy input increased more than four times.(16) It now seems only a question of time before it ceases to be economic to use fertilizers in Canada. It is well documented that the use of artificial fertilizer eventually meets with diminishing returns. In the United Kingdom, the amount of nitrogen fertilizer used has increased by 700% since the Second World War,(17) with an increase in yields of less than 50%. In the United States between 1951 and 1966, there was a 146% increase in the use of nitrates and a 300% increase of pesticides resulting in a 34% increase in crop returns.(18)

- Total U.S. employment in all sectors between 1950 and 1971, increased by 41%: but jobs in the energy producing industries only increased by 5.5% over the same period of time.(19)

- It has been calculated by Hannon that for each consumer dollar spent on electricity, 502,473 British Thermal Units of coal, gas or oil were required. But only 44/1000 of a job unit per dollar of expenditure was produced. Gas and oil purchases reflect similarly large energy requirements per dollar spent by the consumer, and relatively small units of labour.[20]

- Most significantly, all the major energy-producing and energy-using industries consume one third of U.S. energy, yet these industries directly provide only about 10% of the jobs in the United States.[21] Those involved in energy production often claim that indirect employment created by energy production and energy use is significant. However, as Daley points out, any investment - even social welfare and unemployment insurance - leads to indirect job creation.[22] This fact, when taken along with the known situation that energy, when used in industry, invariably replaces jobs, makes the whole cycle extremely suspect as being socially useful.

Hayes puts it this way:

"Most policy analyses do not emcompass (these) social consequences of energy choices. Most energy decisions are based instead on the naive assumption that competing sources are neutral and interchangeable. As defined by most energy experts, the task at hand is simply to obtain enough energy to meet the projected demands at as low a cost as possible. Choices generally swing on small differences in the marginal cost of competing potential sources.

But energy sources are not neutral and interchangeable. Some energy sources are necessarily centralized, others are necessarily dispersed. Some are extremely vulnerable; others are nearly impossible to disrupt. Some will produce many new jobs; others will reduce the number of people employed. Some will tend to diminish the gap between rich and poor; others will accentuate it. Some inherently dangerous sources can be permitted widespready growth only under authoritarian regimes; others can lead to nothing more dangerous than a leaky roof. Some source can be comprehended only by the world's most elite technicians; others can be assembled in remote villages using local labour and indigenous materials. Over time such considerations may prove weightier than the financial criteria that dominate and limit current energy thinking."[23]

It will by now have become apparent that the first major perception is, in large measure, representative of current Canadian official thinking about energy. What then of the second major perception?

From the perspective of our second perception, the energy question is basically the problem of the increasingly intolerable social, environmental, and economic cost of continued high energy usage. Viewed from this perspective, energy consumption needs to be cut back drastically, with legal and institutional changes provided to make energy consumption more equitable.

The second perception has the following characteristics:

- An understanding that the public interest is not necessarily being served by elected officials, corporate citizens and public servants who have their own peculiar perception.

- A strong awareness of the "new scarcity" - of physical resources, waste absorbing capacity of the environment - all qualitatively different from the scarcity problems "solved" by modern industrial production.

- An appreciation of the virtues of voluntary frugality or simplicity, "doing more with less" particularly if frugality is made fair by equitable laws and simplified regulations.

- An attraction to a more simplified life and virtues, of relationships with the environment; pleasure and satisfaction in "doing for oneself" as opposed to having a "professional" do it.

- A leaning toward "appropriate technology".

- Sympathy with the rising demands of developing nations for more equitable distribution of the earth's resources.

- A reaction against the predominance of materialistic values; against tendencies to put human affairs and even lofty goals in traditional economic terms, to assume that the wisest decisions are made on an economic basis, and to elevate means - production and consumption of goods and services - to the position of ends.

The second major perception views energy production and energy use, now and in the future, in a quite different fashion from the first perception:

- The supplies of fossil fuels are limited, not immediately and necessarily by applying traditional economic thought, but by the social and environmental consequences of their extraction and utilization.

- Nuclear power, both the conventional and breeder variety, involves problems of public acceptance that are far from resolution and in the long run perhaps beyond resolving. Fusion is still the gleam in the eye of the expectant father.

- Dependence on foreign oil imports for a significant portion of energy supply involves serious economic and political problems. Burning domestic resources at an ever increasing rate to provide "energy self-reliance" at present rate of per capita consumption, steals from future generation.

- It is necessary to shift in the direction of husbanding energy resources through energy conservation, use of low-energy materials and processes, and altering habits of consumption. It is also necessary to develop renewable energy sources as rapidly as possible. This is a sound course, even if some satisfactory way is ultimately found to provide much of our energy needs through the fusion processes. Following this course will avoid committing future generations to an apparently unsustainable course as well as committing the underdeveloped countres to permanent poverty.

- The role of coal and oil is essentially to sustain the economy through a period of transition from fossil fuels to renewable energy sources. The role of conservation is to facilitate this transition and minimize the impact.

- Large energy projects are likely to be subject to delays, increasing costs, and perhaps cancellations due to problems of safety and concern for the environment and social impacts, as well as increasing difficulty in obtaining investment capital. This is an additional reason why conservation will be an important element in energy policy.

A number of "new-age" energy strategists have advanced approaches which should be taken to reduce the need for fossil fuels for nuclear energy. Lovins (24) among others has suggested the following steps:

- removal of institutional barriers to energy conservation;

- reduced use of high-quality energy (e.g. electricity) for end uses that do not demand it (e.g., the nearly half of electric end-use energy going directly to low-temperature heat);

- increased use of "soft" or "appropriate technology" - largely owned and controlled by the operator; and

- sophisticated use of fossil fuels on a transitional technology to renewable energy sources.

In a study done for the Science Council of Canada, (25) Lovins categorizes energy demand according to the quality of energy ultimately used, and then develops a supply mix that thermodynamically matches the different end uses. This thermodynamically matching, together with conservation measures such as increased car efficiencies and better insulation, yields startling results: for the year 2025 Lovins suggests that Canada may need only 50 to 80% of today's total energy needs, with almost twice today's population. However, it is perhaps the social implications of increasing resource consumption and growth which most trouble advocates of the second major perception.

Bender writes "This (decreasing resource availability) is a fundamental and permanent change in our condition that even our wildest dreams of fusion power and unlimited energy cannot alter. Even if such dreams would prove technically possible, they would only move the timetable back a few years until we have to meet the same unrealities of infinite growth in a future world with a larger population and closer to the absolute limits of our planet. We must face the realities that any attempt to sustain our growth, or even to maintain our style of life without basic changes will result in a steady, if not catastrophic, worsening of our quality of life." (26)

It is the kind of concern expressed by Bender which leads some to the third major perception. From the perspective of the third perception, the energy problem is but one manifestation of a much more fundamental crisis involving 'nothing less than the basic assumptions and goals of all industrialized societies. Proponents of this perception believe that radical changes in values and institutions must be made in order to move to a more democratic and ecologically sustainable society and to avoid global catastrophe.

Edward Goldsmith writing about the Canadian scene put it this way:

"...the discontinuities we must expect are of a nature to justify a fundamental change in the course upon which an industrial society such as Canada is set.

"At the same time, it must be realized that the implications of a program designed to move Canadian society along this course would undoubtedly be slow and difficult. Among other things, it would require a radical change in the values with which people are imbued: in the conventional wisdom imparted in Canadian schools and universities, which very much reflect these values; in the way your society is organized, in its physical infrastructure and in the institutions whose influence increasingly pervades more of its activities. For this reason it should not be adopted in extremis, when all else has failed and catastrophe looms ahead, but should be decided upon in time so that it may be carefully orchestrated over a sufficient period of time.

"Unfortunately, these considerations do not appear to have affected the way the Federal Government is looking to the future, nor, afortiori, the nature of the policies it continues to pursue, which can only be regarded as being based on the implicit assumption that <u>the future will be like the past</u>. Indeed, the accepted methodology for making predictions remains uncritically to project the trends of of the last decades into the future, without taking into account the implications of significant global changes that have already occurred, are now visibly occurring and that can logically be expected to occur in the none too distant future."(27)

The third major perception can be characterized in the following way:

- A strong ecological ethic; identification with the environment, fellow beings, and future generations.

- A search for meaning and commitment, which are seen as lacking in modern industrialized society; a search for more humane guiding values and goals for the individual and society.

- Short term interests are subservient to long term societal stability and flexibility.

- Believers are optimistic that future disruptions can be avoided and society can become more humane and democratic. Non-believers are viewed as basically good people, but "hypnotized" by the almost irresistible lure of personal gain through economic and technological "progress".

It has been argued(28) that society, to function effectively and usefully, must fulfill two basic or fundamental requirements. First, a society must give the individual members of that society some recognized form of social status and function; and second, a society has to provide decisive social power which is legitimate power.

Benson (29) has pointed out what he considers to be current evidence which indicates neither of these two fundamental requirements are being adequately provided. In respect to the individual member of society having status and function, Benson makes the following points:

- Worker discontent, that modern work (except for those positions held by the managerial and technical elite) fails to be satisfying and meaningful:

- Chronic structural unemployment, even during times of prosperity (except during wartime), since the great Depression (thought not before);

- Widespread reports of persons feeling "caught in the system," impotent, victims of institutions that are impersonal and unfeeling;

- Widespread feeling that capital-intensive "big" technology, from assembly lines to centralized computers; is dehumanizing and impoverishing;

- Popularity of the concept of appropriate or "soft" technology which is compatible with a humane environment and which the individual can feel control of;

- Women's liberation and related movements which claim to have "person liberation" goals;

- Complaints of the aging that they are culturally isolated, pushed out of productive work by compulsory retirement rules.

On the second point of decisive power not being perceived as legitimate, Benson has this to say: "there appear to be two points, namely the accelerating concentration of economic power in large corporations and financial institutions and the concentration of intellectual power in a scientific and technical elite."(30) To those two points might be added the increasing concern about "big" governments, bureaucratic control and regulations as well as the increasing size and power of big labour unions.

It is suggested(31) that the fundamental trends of society lead directly, in advanced stages of industrialization, to dilemmas in six discernible areas:

1. Industrialization and automation, coupled with hierarchical institutions and the domination of one person by another, lead to less and less intrinsically rewarding work for a populace with ever-increasing technical training (called education). Furthermore, ecological destruction and resource scarcities place limits on expanding production while increasing "productivity" reduces employment.

The net result is chronic or "structural" unemployment and underemployment (i.e., work which falls short of employing abilities and fostering individual growt h).

2. Industrialization and the goal of material progress lead to conditions of "new scarcity." The problems of resource depletion, environmental deterioration, hazardous substances, and destruction of portions of the planet's life-support eco-systems are not accidental but fundamental and intrinsic to the industrial pattern of human dominance of nature. They arise partly because the pressure to keep productivity increasing, necessitates increasing automation (so that it takes ever faster expansion of the economy to create the same number of jobs - hence, intensification of environmental and resource depletion impact and ever greater inflation).

3. Energy (so far largely fossil) is increasingly vital to an industrializing world society; it is the high energy mode of modern industrialized society that brings the most basic international confrontation. But the paradigm of industrial society contains no rationale or incentive for more equitable distribution of the earth's resources, or of the power and wealth which has come from the exploitation of those resources. The goal of stability of world society demands that some effective counteracting force be found to the natural tendency for the economically and technologically powerful nations to further increase their advantage.

4. The dominance of material and economic values (e.g., efficiency, bigness, standardization, organization) and increasing dependence of the individual on unresponsive centralized systems tend to obscure humane values and to diminish humankind. This leads to problems of apathy and alienation, distrust of big business and government, and individuals feeling a loss of liberty and meaning.

5. Predominance of the goal of material progress leads to the failure to foster socially responsible management of the development and application of technology. The technology assessment movement is an indication of recognition that the Faustian powers of modern technology require increasing societal control. This is ever more difficult to achieve, however, without threatening basic principles of democratic government.

6. The rising prestige of "rational" science has lead to a serious eroding of traditional values, and an inability of the society to provide goals that will enlist the deepest loyalties and commitments of its citizens. Technological growth and material progress alone are not enough, and they tend to overpower and push aside other goals, leading to social alienation and estrangement of humankind from Nature. Thus a reaction has arisen against further industrialization of organic and human activities (e.g. agriculture, health care, use of leisure time). The industrial system has immense drive but no clear and satisfying guiding images and goals.

Writing of the automation and educational systems in the United States (Can Canada be far different?) Lewis Mumford had this to say:

"Here we face the great paradox of automation, put once and for all in Goethe's fable of the Sorcerer's Apprentice. Our civilization has cleverly found a magic formula for setting both industrial and academic brooms and pails of [illegible] work by themselves, in ever-increasing quantities at an ever-increasing speed. But we have lost the Master Magician's spell for altering the tempo of this process, or halting it when it ceases to serve human functions and purposes, though this formula (foresight and feedback) is written plainly on every organic process."[32]

I expect that some questions are being raised as to the relevance and pertinance of this later material to the question on hand: Institutional Factors of Renewable Energy. The point being made here is that within the present institutional framework and given the predominant perception held in this country, there is very little likelihood of renewable energy systems ever attaining the prominance, opportunity, and degree of support needed to fulfill the technological promise. Must we wait for the catastrophe?

Tom Bender sums up the present dilemma in respect to our institutions.

"Our institutions have become counterproductive - producing less health, less transportation, less learning, less justice - while consuming more energy, dollars and time. Education is required that is never used. Research is done for marketing rather than product improvement. More money is spent processing bills than the amount of the bills. More money is spent administering welfare than is received by the poor. Freeways use so much land that places are farther apart and require more freeways to get to. Air conditioning makes cities hotter, necessitating more air conditioning."(33)

It would be possible to cite a number of steps, programs, approaches which could be taken to further advance the development and implementation of renewable energy. However, it is my view that such action will have only marginal effect upon the energy patterns of Canada because of the institutional reluctance and inertia as well as the general indifference to the kind of society renewable energy implies. Until the mass of the Canadian public becomes convinced that perceptions two and three are preferable to perception one, and acts upon that conviction, little constructive change will occur.

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Such a conference as this, and the conference to follow are of immense value to the process of creating a better understanding and appreciation of the options and opportunities before Canadians.

Lewis Mumford perhaps best summarized the present situation and the hope of the future:

"Those who are unable to accept William James' perception that the human person has always been the "starting point of new effects" and that the most solid-seeming structures and institutions must collapse as soon as the formative ideas that have brought them into existence begin to dissolve, are the real prophets of doom. On the terms imposed by the technocratic society, there is no hope for mankind except by "going with" its plans for accelerated technological progress, even though man's vital organs will all be cannibalized in order to prolong the megamachine's meaningless existence. But for those of us who have thrown off the myth of the machine, the next move is ours: for the gate of the technocratic prison will open automatically, despite their rusty ancient hinges, as soon as we choose to walk out."(34)

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ENERGY CONSERVATION

MEANS AND END

Giulio Maffini
Development Planning Associates Ltd.

Abstract

In the short-term, the "Conserver Society" can, at best, be a way of improving the efficiency of the "Consumer Society." Short-term efficiency measures will buy us valuable time. During this time, the goals, institutions and infrastructure which govern the consumption of resources in our society must be reassessed.

The woeful inadequacy of measuring and managing our society by the health of economic indicators is now obvious to many. Our future collective behaviour must come into balance with the sustainable yield of our environment even though it may not be immediately politically or economically rewarding. Our efforts in finding a better balance should not be limited to developing new technology that make more efficient use of energy.

The Atlantic provinces should move cautiously prior to making further long-term commitments to an energy technology that will bind us to ways that are no longer viable. The long-term challenge for the Atlantic provinces to evole into a conserver society is primarily not technological but economic and social. Some suggestions and opportunities are identified.

1. Introduction

As its price rose the previously invisible ingredient of our economy, energy, has become a topical concern to all. Both energy and its conservation are complex and simple issues and a great deal has already been committed to paper discussing them in both ways. This paper attempts to identify in relatively simple terms the role which energy has played in the economies of Canada and the Atlantic provinces. An effort is made to note the differences between the energy consuming characteristics of the National and Regional economies. In the latter part of the paper the present energy policies of our governments are reviewed to see whether they are in fact leading us towards an " Energy Conserver Society." Finally, some basic questions and recommendations for the Atlantic provinces are identified.

2. Past Patterns of Consumption and the Existing Situation

A. At the National Level

The remarkable increase in the consumption of energy in Canada over the past 30 years is illustrated in Table 1. Within this period of time, total primary energy consumption has almost quadrupled and consumption on a per capita basis has nearly doubled. The present level of energy consumption when placed in a historical perspective is even more staggering. One hundred years ago an average industrialized man consumed about 100 million btu's per annum;[1] in 1945 the average Canadian consumed 177 million BTU's: by 1976 his consumption had reached 345 million BTU's.

Why has our per capita consumption been rising so steadily? A comparison of energy consumption with Gross National Expenditure (GNE) presents some clues. During the period in which primary energy consumption increased by almost four-fold, our gross national expenditure increased by slightly fourfold. As our gross national expenditure has increased so has our per capita energy consumption. The amount of energy required to create a dollar of gross national expenditure has oscillated over the years with a gentle downward trend declining to its lowest level in the past 30 years in 1976. In 1976 a dollar of gross national expenditure required slightly over 66,000 btu's of energy to create it. Based upon an international energy price of about \$15 a barrel, this energy input is equivalent to about 19¢ for each dollar of GNE.

Energy, therefore, is an essential ingredient for the economic engine which we have constructed.

While every country seems to exhibit a steady relationship between GNE per capita and energy consumption per capita, these relationships are not always identical. In the industrialized world, significant differences can be found between countries with approximately similar gross national products per capita. A favourite example is to compare Sweden and North America. Figure 1 illustrates the relationship between GNE per capita and energy consumption per capita for Sweden and Canada. It is clear from this graph that Swedish society can convert energy more effectively into Gross Domestic Product than Canada.

Why is Swedish society more efficient?[2] In order to explain this difference I would like to describe a rather simplistic model of society. Let us assume that a nation can be represented by a black box. Within this black box there exists a set of goals, a control mechanism and some capital. The nation's behaviour is influenced by external factors including the size of the land mass and where it is situated. Together these forces determine the actual rate of consumption and production of the nation.

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[1] See "The Flow of Energy in an Industrialized Society" Earl Cook, Scientific American 1971.

[2] [illegible] differences in energy use in Sweden [illegible]

TABLE 1

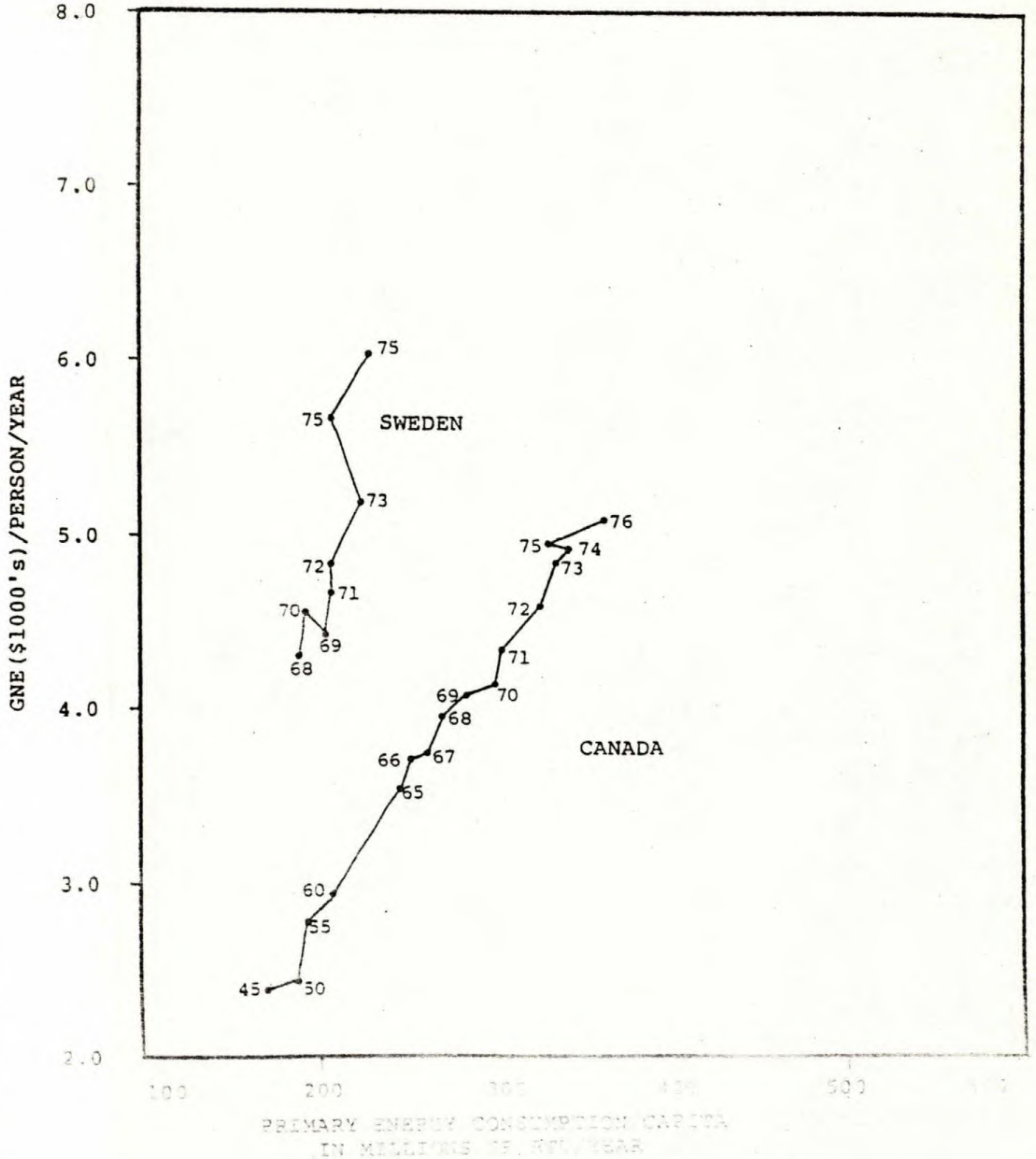
POPULATION[1], GROSS NATIONAL EXPENDITURE[2] AND
PRIMARY ENERGY CONSUMPTION IN CANADA[3]
(1945-1976)

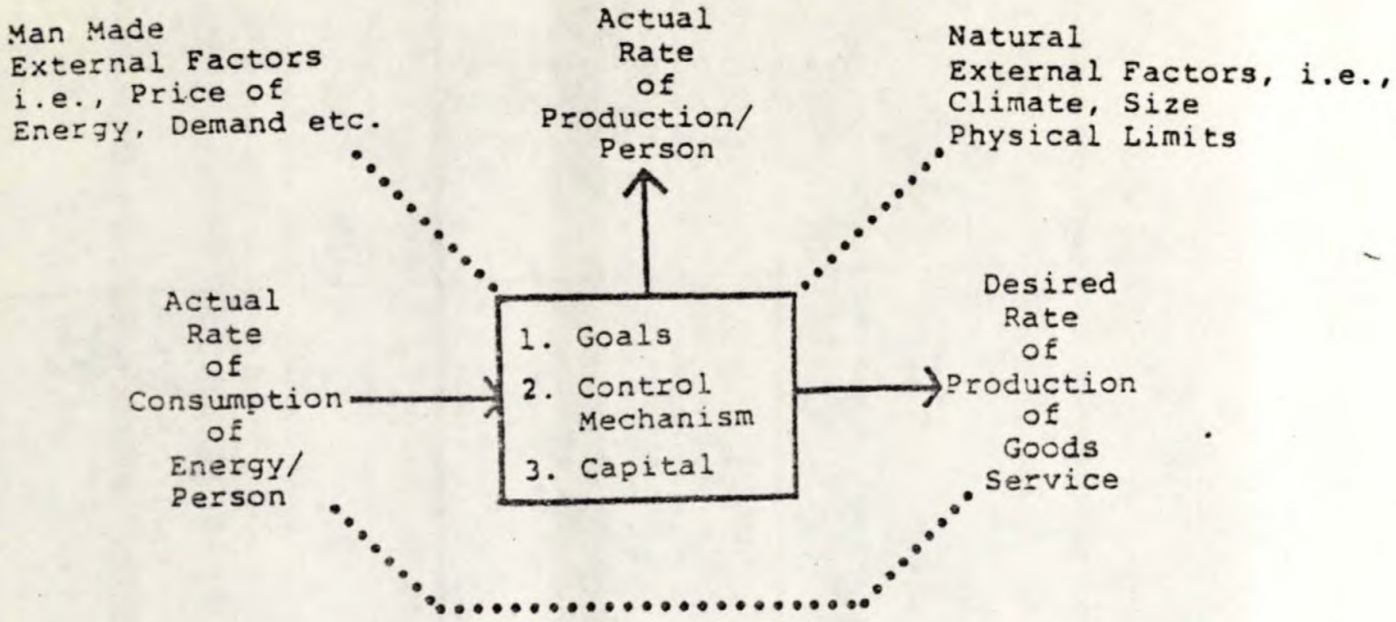
Year	(10^6) POP	(10^9) GNE(1971$)	BTU(10^{12}) Primary Energy Consumption[1]	(10^3) BTU/$GNE (1971)	(10^6) BTU/POP	(10^3) GNE/POP 1971
1945	12.1	29.1	2145	73.71	177.3	2.40
1950	13.7	33.7	2573	76.35	187.8	2.46
1955	15.7	43.9	3057	69.64	194.7	2.80
1960	17.9	53.2	3740	70.30	208.9	2.97
1965	19.6	70.0	4888	69.83	249.4	3.57
1966	20.0	74.8	5023	67.16	251.2	3.74
1967	20.4	77.3	5257	68.01	257.7	3.79
1968	20.7	81.9	5620	68.62	271.5	3.96
1969	21.0	86.2	5932	68.81	282.5	4.10
1970	21.3	88.4	6345	71.78	297.9	4.15
1971	21.6	94.4	6564	69.53	303.9	4.37
1972	21.8	100.2	7008	69.94	321.5	4.60
1973	22.1	107.8	7445	69.06	336.9	4.88
1974	22.4	111.8	7706	68.93	344.0	4.99
1975	22.8	113.0	7605	67.30	333.6	4.96
1976	23.1	118.5	7866	66.38	340.5	5.13
1976/1945 % Inc.	90.91	407.22	366.71	-9.94	92.05	213.75
Average Rate of Growth %	2.1	4.6	4.3	-.3	2.1	2.48

1. Population of Canada by Provinces, Estimated for Intercensal Years "(91-201)SC.
2. National Income and Expenditure Accounts (13-201)SC.
3. 1945-1965 "An Energy Policy for Canada" 1973 Vol. 1, 1966-76 BP Statistical Review of World Oil Industry, 1976.

FIGURE 1

PRIMARY ENERGY CONSUMPTION
PER CAPITA COMPARED TO
GROSS NATIONAL EXPENDITURE
PER CAPITA





The internal workings of the black box can be described in more detail as follows:

a. Goals: The goals of the collective society including those of government, business and other institutions. Collectively these goals define a desirable set of conditions or state. An example of a set of social and economic goals are:

- full employment
- a high rate of economic growth
- reasonable stability of prices
- a viable balance of payments, and
- an equitable distribution of rising incomes.[3]

b. Control Mechanism: The responsibility and authority for making decisions is theoretically divided between government, business institutions and the individual. In the field of energy, the individual's responsibility for providing his own needs has been largely abdicated to or assumed by these institutions. It is these institutions that affect the reaction time and change the direction of the economic engine in response to changes outside of the nation.

c. Capital: The age, disposition and relative effectiveness of our factories, transportation equipment, energy conversion systems and the structure of our habitats (especially urban) directly affect the amount of primary energy that we need to consume to achieve our goals.

Using the above workings as a guide for comparing Sweden and Canada, the following general observations can be made. 1) While politically, the two countries differ somewhat, there is little observable difference in the goals of the average

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[illegible] Annual Re[illegible] [illegible]

TABLE 2

POPULATION[1], GROSS DOMESTIC PRODUCT[2]
AND PRIMARY ENERGY CONSUMPTION [3]
IN SWEDEN
(1968-1976)

Year	(10^6) POP	(10^9) GDP	(10^{12}) BTU	(10^3) BTU/ GDP	(10^6) BTU/ POP	(10^3) GDP/ POP
1968	7.93	34.2	1490	43.6	187.89	4.31
1969	8.0	36.3	1533	42.2	191.63	4.54
1970	8.08	35.8	1650	46.1	204.21	4.43
1971	8.12	37.8	1685	44.6	207.51	4.66
1972	8.13	39.5	1697	43.0	208.73	4.86
1973	8.14	42.3	1817	43.0	223.22	5.20
1974	8.18	46.5	1693	36.41	206.97	5.69
1975	8.21	49.7	1919	38.6	233.74	6.06
1976	8.24	----	2024	-----	245.63	----

1. Swedish Embassy, Ottawa.
2. Swedish Embassy, Ottawa, in KR adjusted to 1971 Canadian $ by OECD Main Economic indicators, Historical Statistics.
3. BP Statistical Review of World Oil Industry. 1976.

citizens or the institutions in these two countries. Generally, both countries are committed to the general improvement and expansion of the economy. 2) While the institutional structure of Sweden is different from that of Canada, the significant difference in government policy is in its attitudes to energy pricing. In Canada, there have been continued (but now declining) steps taken to buffer consumers from sudden changes in prices. In Sweden, increases in energy costs through imported sources such as oil have been reflected immediately in higher consumer prices. 3) The capital of Sweden has, over the years, been consistently more efficient than that employed in Canada due to the generally higher energy prices in that country. Consequently, cars have a higher average miles per gallon rating than Canada, electrical generation in the country produces less waste heat and urban areas are more compact with a greater proportion of multiples and attached housing units.

Some factors external to the economy also contribute to the difference in consumption; for example, although Canada and Sweden experience similar climatic conditions, they differ considerably in terms of size and compactness: this undoubtedly contributes to higher transportation costs in Canada.

B. At the Atlantic Provinces Level

Just as there are differences in energy consumption between nations, there are also significant differences between the regions of a nation. Table 3 and Figure 2 describe the population, economic and energy consumption characteristics of Canada and the Atlantic provinces. The energy data used in these tables are not comparable to those presented in Table 1. Secondary energy refers to the amount of energy actually available to and used by the consumer in its final form; it does not include the conversion losses and waste incurred by the energy supply industries in delivering the energy to the consumer. Over the years, for Canada, secondary energy consumption has accounted for between 78 to 80 percent of primary energy consumption.

It is apparent from the table that over the last 15 years the Atlantic provinces have consistently consumed less energy on a per capita basis than Canada as a whole (in a range of 78 to 85 percent). The Atlantic provinces' economy, on the other hand, has been far less efficient in converting this energy into income. On average, the Atlantic provinces have required between 20 and 30 percent more energy to create every dollar of Gross Provincial Product. Depending on how we view the world, the Atlantic provinces' situation today can be seen in two different lights. If our primary concern is to increase our per capita product, then we must improve the efficiency of our capital so that the amount of energy required to produce a dollar of Gross Provincial Product is approximately equivalent to that of the rest of Canada. If conservation is our concern, then we can view our lower energy consumption per capita as an asset, since less adjustment will be required to become accustomed to lower levels of energy.

If we are interested in both conservation and increased production, then the task of increasing our energy efficiency becomes an even more important challenge.

SECONDARY ENERGY CONSUMPTION
PER CAPITA COMPARED TO
GROSS NATIONAL PRODUCT PER CAPITA

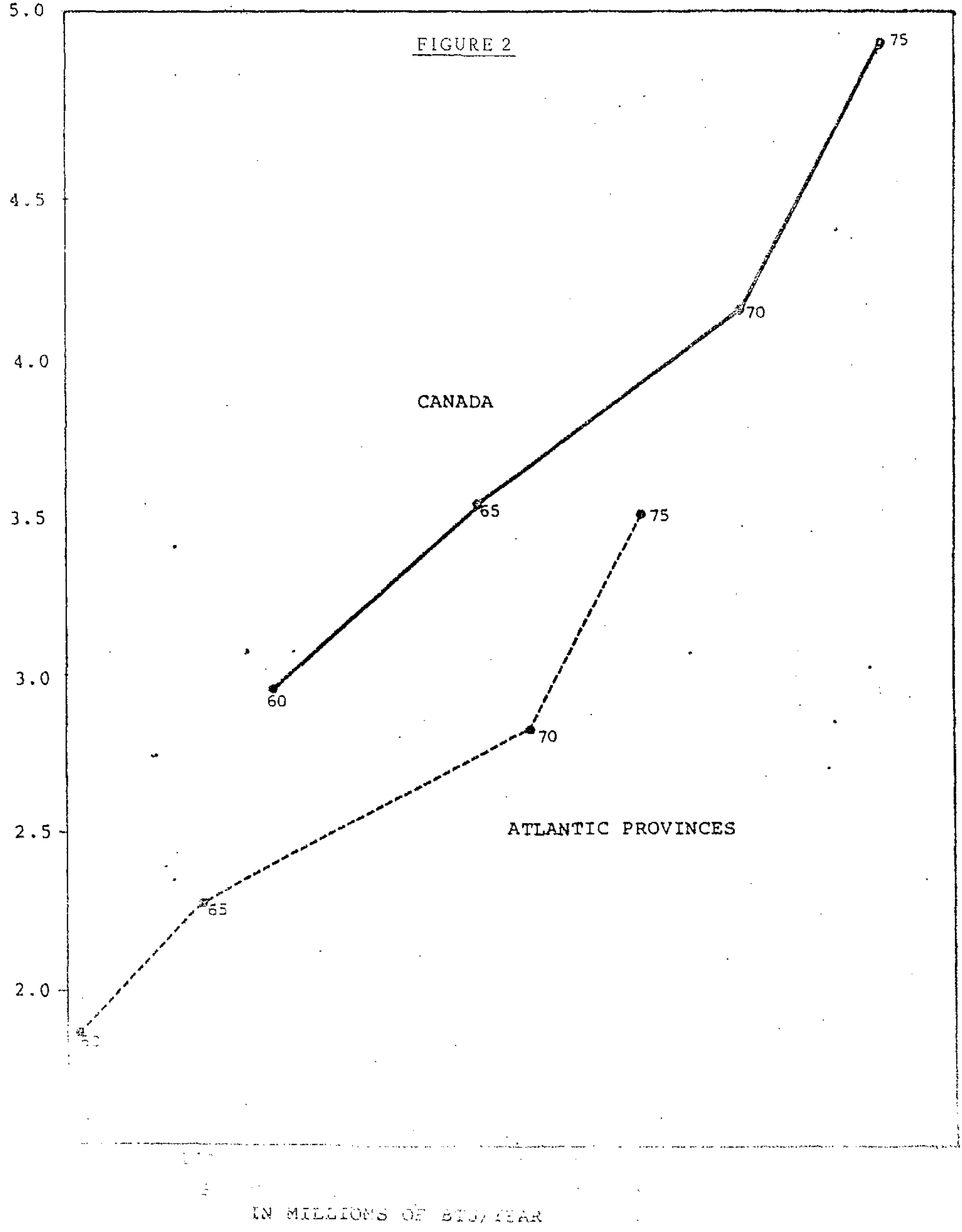

TABLE 3

POPULATION,[1] GNP EQUIVALENT (in 1971$)[2]
AND SECONDARY ENERGY
CONSUMPTION (1960-1975)[3]
FOR
CANADA AND THE ATLANTIC PROVINCES

CANADA

	POP 10^6	GNE 10^9	BTU 10^{12}	BTU/GNE 10^3	BTU/POP 10^6	GNEB/POP 10^3
1960	17.9	53.2	2916	54.81	162.91	2.97
1965	19.6	70.0	3833	54.76	195.56	3.57
1970	21.3	88.4	5052	57.15	237.2	4.15
1975	22.8	113.0	5886	52.09	258.2	4.96
% Inc.	27	112	103	-4	58	67
Rate of Growth	1.6	5.2	4.8	-.3	3.1	3.48

ATLANTIC PROVINCES

	POP 10^6	GPP 10^9	BTU 10^{12}	BTU/GPP 10^3	BTU/POP 10^6	GPP/POP 10^3
1960	1.867	3.477	247.2	71.1	132.4	1.86
1965	1.968	4.508	298.6	66.24	151.7	2.29
1970	2.036	5.800	416.4	71.79	204.5	2.85
1975	2.151	7.541	473.9	62.84	220.3	3.51
% Inc.	15	117	92	-12	66	89
Rate of Growth	1.0	5.3	4.4	-.8	3.5	4.3

1. Statistics Canada.
2. National Income and Expenditure accounts and APEC inflated to 1971 $.
3. "Detailed Energy Supply and Demand in Canada" Statistics Canada [illegible]

C. Sources and End Uses

In order to gain a better understanding of both the type of energy and the uses to which we apply that energy in Canada and the Atlantic provinces, I have compiled two Tables, 4 and 5. From Table 4 it is apparent that in terms of energy sources, petroleum provided nearly 55 percent of Canadian consumption, gas almost 26 percent, electricity 15 percent and coal, approximately 4 percent. The single largest user of energy in Canada was industry (28.2%), followed by transportation (26.2%), domestic and farm uses (19.8%), commercial (12.3%) and energy supply industries (11.9%). A residual amount (2.6%) was absorbed in non-energy uses and losses and adjustments.

In the Atlantic provinces for that same year, nearly 84 percent of all of the energy consumed was provided from oil, 14 percent by electricity and the remainder by coal. Significant differences in the use of energy in the Atlantic provinces are also evident. The highest single use category was transportation (32.3%), followed by domestic and farm use (24.2%), industrial (21.7%), commercial (11.0%) and energy supply industries (9.6%). In both Canada and the Atlantic provinces about 10-11 percent of the total energy consumed was used by energy supply industries. While these tables are highly aggregated, they suggest some of the underlying causes for the different energy efficiencies of the Atlantic and Canadian economies. The table also clearly documents the enormous dependency of the Atlantic provinces upon oil, a resource which we do not yet produce. Both tables show that Canada and the Atlantic provinces are, to a very large extent, dependent upon non-renewable resources. The rising demand and declining domestic availability of oil will combine to make us net importers. Based on current estimates, it is a little more difficult to gauge whether we will also become net importers of natural gas. Since both of these resources are priced according to the policies of international cartels and since it has become evident that no industrialized country can afford to subsidize energy prices indefinitely, our dependence on these external resources places a potential grave burden on our balance of payments.

D. Causes

How is it that both Canada and the Atlantic provinces, with other sources of fossil fuels (coal) are so dependent upon a resource which must be imported? The detailed answer to this question could probably occupy a number of technical texts. A simplified explanation might take the following form. 1) Since the end of the Second World War, fuel producing companies and countries discovered very large and easily exploitable oil fields. 2) The oil industry followed a marketing policy of providing oil at a price low enough to be competitive with other traditional sources such as coal. 3) The labour intensive coal industries of Canada suffering from under-capitalization were unable to effectively compete with these low prices. 4) The rapid expansion of capital that has occurred since the Second World War was designed to function and operate on the lower cost oil base. 5) By the 1970's most industrialized countries, including Canada, were fully converted to the oil technology. 6) When the oil producing countries began to aggressively increase the price of oil, we were unable to convert our capital rapidly enough to function on our indigenous resources and were thus forced to bear the brunt of the increased prices.

TABLE 4

SECONDARY ENERGY
CONSUMPTION[1]
IN
CANADA
BY
SOURCE AND USE
IN 1975
(BTU's x 10^9)

	Coal	Petroleum	Natural Gas	Electricity	Total
Energy Supply Industries	.4	239.9	309.0	95.0	644.3 (11.0)
Transportation	1.4	1538.8			1540.2 (26.2)
Domestic & Farm	4.7	640.0	299.2	218.8	1162.7 (19.8)
Commercial		208.2	291.8	224.3	724.3 (12.3)
Industrial	215.8	522.3	554.4	369.3	1661.8 (28.2)
Non Energy		31.0			31.0 (.5)
Losses & Adjustments	9.8	45.1	67.0		121.9 (2.1)
Total	232.1 (3.9)	3225.3 (54.8)	1521.4 (25.9)	907.4 (15.4)	5866.2 (100.0)

1. "Detailed Energy Supply and Demand in Canada" Statistics Canada, 1975.

TABLE 5

SECONDARY ENERGY
CONSUMPTION[1]
IN THE
ATLANTIC PROVINCES
BY
SOURCE AND USE
IN 1975
(BTU's x 10^9)

	Coal	Petroleum	Natural Gas	Electricity	Total
Energy Supply Industries	.2	38.4		6.8	45.4 (9.6)
Transportation		153.0			153.0 (32.3)
Domestic & Farm	1.5	96.6		16.6	114.8 (24.2)
Commercial		38.4		13.7	52.2 (11.0)
Industrial	12.8	62.3		27.8	102.9 (21.7)
Non Energy		.5			.5 (.1)
Losses & Adjustments	-1.5	6.7			5.2 (1.1)
Total	13.0 (2.7)	395.9 (83.5)		65 (13.7)	473.9 (100.0)

1. "Detailed Energy Supply and Demand in Canada" Statistics Canada. 1975.
(%)

In the Atlantic provinces, the conversion from coal to oil has had a double impact. Mining, which in the past had been a major industrial activity in the region, declined substantially, adversely affecting the local economies of many communities. The lesson that the past thirty years has taught us is that we should be wary of making long-term decisions on the capital that we use in our society on the basis of the international price of energy. It is interesting to speculate on the state of the Atlantic provinces' economy if we had maintained our traditional dependence upon the coal resource.

3. Goals, Policies and Strategies

A. National

In response to the crisis in the price of energy, Canada has had to seriously reconsider its energy policy. Since 1973 the Ministry of Energy, Mines and Resources has carried out a number of analyses of our situation. In 1976 an energy strategy for Canada was released. The main theme of the strategy was directed towards achieving self-reliance within the next 15 years. The targets for the strategy can be summarized as follows: 1) To move domestic oil prices towards international levels. 2) To reduce the average rate of growth of energy use in Canada to less than 3.5 percent per year. 3) To reduce our net dependence on imported oil to one-third of our total oil demands by 1985. 4) To maintain our self-reliance in natural gas until we can market our northern resources under acceptable conditions. 5) To at least double our exploration and development activity in the frontier regions. Programs developed to achieve these targets consisted of energy pricing, energy conservation, increased exploration and development, increased resources information, inter-fuel substitution, new delivery systems, emergency preparedness, increased research and development and greater Canadian content and participation.

B. Atlantic Provinces

What of the Atlantic provinces' policies with regard to energy? At the present time it is fair to say that most provinces are in the process of searching for operational policies with regard to energy. A brief capsule of each province's present position is presented.

1) Nova Scotia: The province has recently established an Energy Council to assist in developing policy and advice in energy related matters. The present direction of the Council is to:

   1. Attempt to reduce dependency on foreign energy sources.

   2. To bring energy costs in line with those throughout the country.

   3. Make use of the Province's indigenous resources, i.e., coal and wood.

   4. Pursue co-operation with neighbouring provinces through joint development of large resources (tidal), and

   5. To use energy as efficiently as possible.

ii) New Brunswick: The Province has not yet declared an official energy policy but its objectives are consistent with those of Canada. These are:

1. Self-sufficiency;

2. Tidal power:

3. Renewable energy resources, such as solar and wood pulp:

4. Investigating the use of indigenous resources such as coal and peat;

5. Investigating nuclear energy.

iii) Newfoundland: The Province has two main thrusts which it is pursuing. The most immediate and most important of these is the development of Labrador's hydro potential and further development of the offshore oil potential. In an effort to diversify the energy base, the Province is also investigating:

1. Wind power;

2. Renewable resources such as wood;

3. Studying the potential of operating small power stations on peat;

4. The use of solar energy for the production of vegetables in northern regions.

iv) Prince Edward Island: While Prince Edward Island is the smallest of the four Atlantic provinces, it is a leader in the field of research and development of renewable energy resources. Through its Institute of Man and Resources and under an agreement with the Government of Canada, a program comprising of 8 elements is underway.

1. Develop wood as an energy source;

2. Determine wind power potential;

3. Develop solar heating;

4. Reduce energy demand;

5. Determine low head hydraulic power potential;

6. Develop low energy community concepts:

7. Research and information at the Ark Experimental dwelling:

8. [illegible] Man & [illegible]

In addition to their own separate policies and programs, three of the Atlantic provinces (New Brunswick, Nova Scotia and Prince Edward Island) have, through the council of Maritime Premiers, created a Maritime Energy Corporation to pursue energy projects of joint interest. The Government of Canada has indicated its willingness to support projects carried out via this regional agency (i.e., Fundy Tidal Power).

The Federal Government has also been of assistance to the provinces in areas of: 1) substitution of coal for oil; 2) extension of regional electrical interconnections; 3) research and technical investigations re Fundy Tidal Power; 4) capital funding for some nuclear development; 5) a grant program for home insulation.

C. Scenarios of Future Consumption

Where are the present government policies, strategies and programs leading in terms of energy consumption? Are we headed towards the "Energy Conserver Society?" While no one can predict the future, our policies do have some general targets. Most of the numerical information available at this time on our future consumption is based upon our national policies and are aggregated at the national level. As mentioned earlier, each of the Atlantic provinces is in the process of developing its own policies and it will probably be a year or two before targets, forecasts, or scenarios will become available at this level.

Necessarily then, this assessment must be limited to our national policies as described in "An Energy Strategy for Canada: Policies for Self Reliance." This "Strategy" document is a valuable and well presented handbook of our past and present condition with a clear description of the issues we face.

The "Strategy" considered a number of alternative futures ranging from High Price and Low Consumption to Low Price and High Consumption. Recently,[1] another scenario "Conservation" based upon "disciplined measures by individuals, corporations and governments" would keep our average increases in primary energy consumption to about 2.1 percent per annum. Table 6 describes the various scenarios considered in Canada's energy strategy in terms of the same indicators examined in Table 1. It is evident that all three scenarios anticipate a continued increase in per capita energy consumption. Only the Conservation scenario assumes a reduced rate of growth in per capita energy consumption. Both the High Price/Low Use scenario and the Low Price/High Use Scenario expect higher rates of growth in per capita energy consumption that has been experienced in the past 31 years. While it is not possible to compare the assumed efficiency of the economy to produce GNE under the "Conservation" scenario[2] the High Price/Low Use scenario has a remarkably similar thousand BTU's/GNE$ (66.36) to our 1976 level (66.38). An examination of our 1990 scenarios in the context of Figure 3 suggests that the High Price/Low Use Scenario (intended to reflect the recommended

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[1] Notes for an address by G.M. McNabb, Deputy Minister, Energy, Mines and Resources, Canada. Halifax Energy Seminar. October 5, 1977.

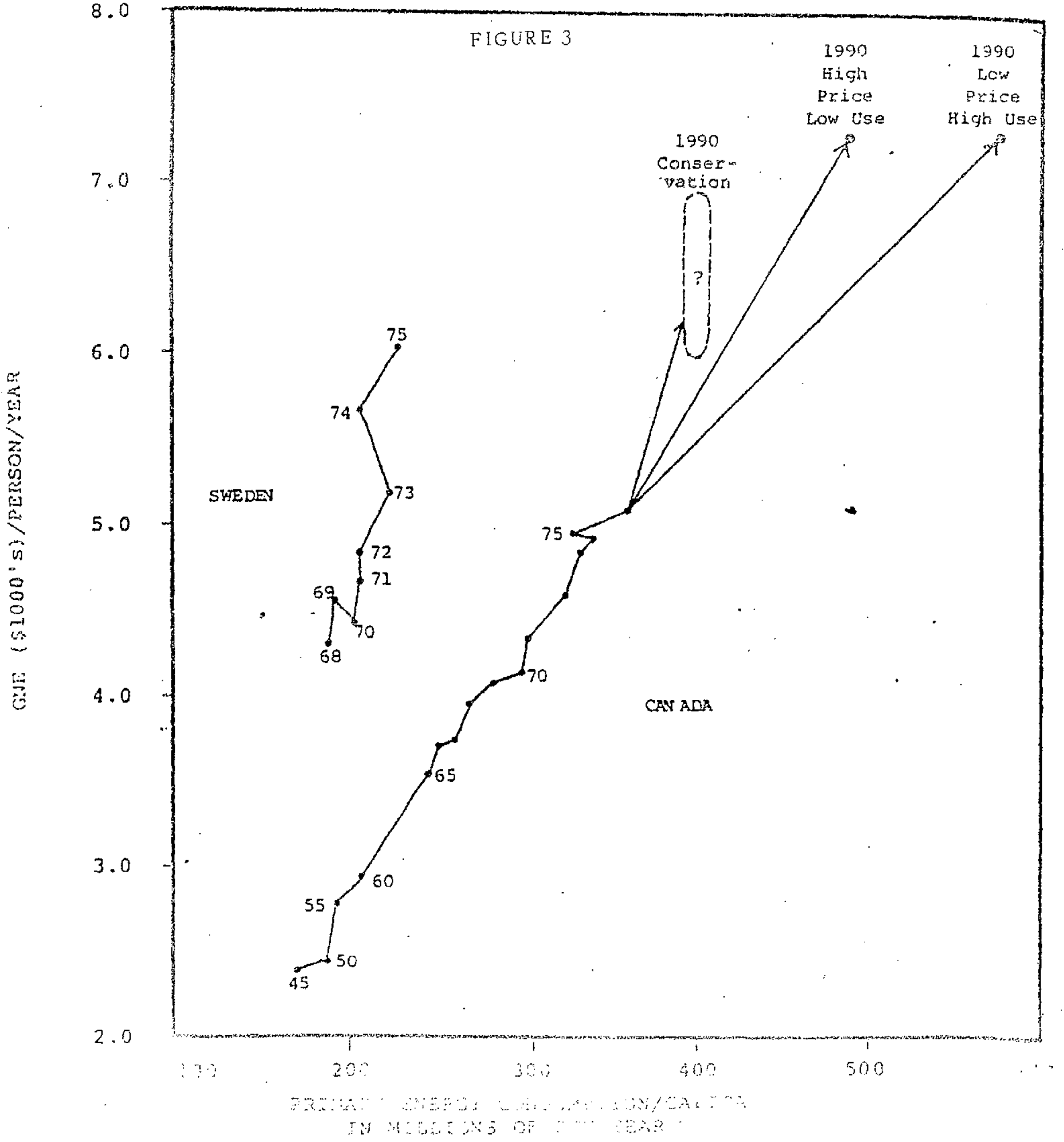
[2] ... the McNabb paper it is suggested ... Conservation Scenario would ...

TABLE 6

POPULATION
GROSS NATIONAL EXPENDITURE (1971$)
AND PRIMARY ENERGY
CONSUMPTION
SCENARIOS DESCRIBED IN
"AN ENERGY STRATEGY FOR
CANADA"

	(10^6) POP	(10^9) GNE	(10^{12}) BTU	(10^3) BTU/ GNE	(10^6) BTU/ POP	(10^3) GNE/ POP
Conservation	27.5	N.A.	11000	N.A.	400.0	N.A.
% Increase 1976-1990	19	N.A.	40	N.A.	17	N.A.
Rate of Growth	1.25	N.A.	2.42	N.A.	1.16	N.A.
High Price Low Use	27.5	203	13472	66.36	489.9	7.38
% Increase	As Above		71	0	44	44
Rate of Growth	As Above		3.92	0	2.63	2.63
Low Price High Use	27.5	203	15930	78.47	579.27	7.38
% Increase 1976-1990	As Above		103	18	75	44
Rate of Growth	As Above		5.17	1.2	4.1	2.63

PRIMARY ENERGY CONSUMPTION
PER CAPITA COMPARED TO
GROSS NATIONAL EXPENDITURE
PER CAPITA
NATIONAL SCENARIOS 1990



strategy for Canada) is an extrapolation of the past efficiency of our economy. The scenarios suggest that the structure of our economy, the type of its capital and its disposition will continue with the same energy efficiency that it has had in the past.

Upon closer examination it is evident that the national strategy, although recognizing conservation as an important element, is primarily directed towards substituting imported non-renewable resources for domestic (non-renewable and renewable) resources.

B. Capital Requirements

The energy strategy for Canada also provides an estimate of the amount of capital which will be required to be invested between 1976 and 1990 in order to achieve the objectives of self-reliance. The combined capital investment expressed in 1975 dollars under the high priced scenario is expected to be $181 billion. Of this, $91 billion is directed towards primary electrical power, $3.2 billion towards coal, $27.9 billion towards gas (in the form of pipelines) and $58.7 billion for oil (exploration, refining and marketing). The strategy recognizes that this level of investment will represent a large portion of our future Gross National Expenditure, especially during the 1980-1985 period. This expenditure expressed in a more understandable term is equivalent to almost $18,500 per household existing in 1990 (about $6500 per person).

It is interesting that, with the exception of some unspecified share of primary electrical power investment, most of the estimated capital would assist in delivering non-renewable resources for consumption.

If we assume that the projected expenditures made in each of the categories of energy capital can be distributed proportionately according to the expected percentage of energy demand for each energy source, some interesting results emerge. Table 7 distributes the total capital requirement by each energy source according to the forecast percentage of energy that will be used by various sectors. It can be seen from the table, for example, that some $30 billion can be assumed to be required in order to accommodate residential uses. This is equivalent to nearly $3100 per 1990 household.

An examination of the categories of expenditures raises some pertinent questions for the Atlantic provinces. For example, where will most of this capital investment be made? Will the Atlantic provinces, in fact, capture their fair share, or is it likely that most of these expenditures will occur outside of the region? If the Atlantic provinces could deploy their fair share of this total capital investment (on a population basis, this would be about $16 billion), would the investment be directed into the same capital projects that are a priority nationally? Is it conceivable that with these levels of capital expenditures, that some "local" or even decentralized renewable energy options might become competitive? For example, by 1990 the Halifax Metropolitan area will have a population of approximately 300,000 persons; if we assumed that the metropolitan area was, over the years, to capture its per capita allotment for energy capital (excluding non energy uses and transportation categories) the allotment would amount to approximately $1.55 billion by 1990, a little over $100 million a year. Is it conceivable that through the development of various renewable [illegible] community such [illegible] Halifax Metro could

TABLE 7

DIVISION
OF
CAPITAL REQUIREMENT[1] TO 1990
ACCORDING TO
PROPORTION[2] OF ENERGY
DEMAND
IN 1990
IN BILLIONS OF 1975$

Energy Source	Type of Capital Requirement	Total[3] Capital Requirement 1976-70	Thermal Elect & Energy Supply	Non Energy	Transport	Industrial	Commercial	Residential
Primary Elect.	Electric Power	91.2	6.75 (7.4)			36.66 (40.2)	27.54 (30.2)	20.25 (22.2)
Coal	Coal	3.2	2.28 (71.2)	.02 (.5)		.90 (28.2)		
Gas	Pipelines	27.9	4.35 (15.6)	2.54 (9.1)		9.65 (34.6)	6.05 (21.7)	5.30 (19.0)
Oil	Exploration	58.7	7.51 (12.8)	8.04 (13.7)	29.17 (49.7)	4.46 (7.6)	5.05 (8.6)	4.52 (7.7)
	Refining Marketing	58.7						
Total		181.0	20.89	10.60	29.17	51.67	38.64	30.07
% of Total Capital		100%	12%	6%	16%	29%	21%	17%

1. An Energy Strategy for Canada. Table 15 (High Priced Scenario).
2. An Energy Strategy for Canada. Fig. 5-9 (High Priced Scenario).
3. Errors due to rounding.

in fact become self-reliant based upon a very local small-scale renewable energy system? Certainly, a level of capital investment of this order made in each community would do a great deal for the local economy.

A review of our national energy strategy reveals that: 1) The primary objective of the strategy is to achieve self-reliance in a national sense. 2) While a number of worthwhile programs and research at the regional level has been supported by the Federal Government, there is no evidence to suggest that the national strategy will result in regional self-reliance. 3) The national energy strategy is based upon continued rapid increase in the amount of energy consumed in order to sustain economic growth. The effectiveness of the nation in converting energy into dollars is assumed to remain the same as in 1976. 4) The overwhelming bulk of our expected investment in energy capital will continue to be directed towards the delivery of non-renewable resources.

Although under the present constitution the Provinces have, on paper, considerable authority over energy resources and energy policy, it is apparent that today the Federal Government, as far as Atlantic Canada is concerned, has the financial resources and much of the influence that can determine our energy production and consumption in the future. While national self-reliance is a rational and desirable objective, there are many ways in which it can be achieved. Canada's present strategy is founded upon a continuation of the same basic energy consuming economic structure that has existed in the past 30 years. The capital investment program envisaged for energy would not achieve any increased energy efficiency for our economy. While the strategy foresees a reduction in consumption in total terms, it is apparent that most of this reduction is relative to the extrapolation of past geometric trends, and that, in fact, per capita energy consumption is expected to continue to increase in order to maintain economic growth.

4. Questions for the Atlantic Provinces

A. Energy Efficiency Can It Be Achieved?

There is continuing debate as to whether increased Gross National Expenditure need occur at the cost of additional energy.[1] Some argue that as conservation measures are implemented and our technology is replaced by more efficient energy conscious machinery that we can, in fact, sustain continuing economic growth without the corresponding increase in energy consumption.

In order to gain some appreciation of the amount of increased efficiency that would be required in order to continue to experience economic growth under a variety of energy per capita consumption rates, Table 8 was constructed. The table illustrates the primary energy consumption, GNE, and average GNE per capita that can occur for a combination of per capita energy consumption and energy per Gross National Expenditure rates. The energy per Gross National Expenditure is varied from its estimated level in 1976 of 66,380 BTU's per dollar of GNE (in 1971 dollars) in 10 percent increments to 70 percent of its 1976 level. Energy consumption on a per

TABLE 8

POSSIBLE PRIMARY ENERGY
CONSUMPTION, GNE (1971$) and
GNE/CAPITA IN 1990
ASSUMING A 27.5 MILLION
POPULATION

Primary Energy Consumption/Person
Expressed as a Fraction of 1976 Consumption

Primary Energy Consumption/$ of GNE in 1971$ expressed as a Fraction of 1976 rate.

	.8	.9	1	1.1	1.2	1.3	1.4	1.5
	7.491	8.427	9.364	10.300	11.236	12.172	13.109	14.045
.7	161.21	181.36	201.52	221.65	241.79	261.93	282.10	302.24
	5.86	6.59	7.33	8.06	8.79	9.52	10.3	10.99
	7.491	8.427	9.364	10.300	11.236	12.172	13.109	14.045
.8	141.07	158.7	176.34	193.98	211.61	229.24	246.88	264.51
	5.13	5.77	6.41	7.05	7.69	8.34	8.98	9.62
	7.491	8.427	9.364	10.300	11.236	12.172	13.109	14.045
.9	125.39	141.06	156.75	172.41	188.09	203.75	219.44	235.11
	4.56	5.13	5.70	6.27	6.84	7.41	7.98	8.55
	7.491	8.427	9.364	10.300	11.236	12.172	13.109	14.045
1	112.85	126.95	141.06	155.17	169.28	183.37	197.49	211.59
	4.10	4.62	5.13	5.64	6.16	6.67	7.18	7.69

NOTE: Elements in Matrix in the following order:

1. Primary Energy Consumption in Trillion BTU's.
2. GNE in Billions of 1971$.
3. GNE/Capita in (1000's) 1971$.

capita basis is varied from the estimated 1976 level of 340 million BTU per capita from 80 and 150 percent of the 1976 level in 10 percent increments. It can be seen that if we wish to sustain the rate of economic growth similar to that assumed in the "Strategy" (GNE=$203 Billion by 1990) without increasing our per capita energy consumption, that this can only be achieved by reducing the energy consumption/$GNE of our economy some 30 percent. Is this kind of performance (46,500 BTU/$GNE) possible in Canada? (Remember that in Sweden only 38,600 BTU/$GNE were required in 1975). A rather simplified test follows. Assume that the average life of our energy consuming and producing capital is 30-35 years and that, therefore, in the next 15 years, we will replace one half of it. What would the energy performance of the replaced capital have to be to ensure that the average economy was equal to 46,500 BTU/$GNE.

or stated more simply

$$.5\,(66{,}380) + .5(x) = 46{,}500$$

$$x = 26{,}630 \text{ BTU/\$GNE}$$

In order to continue with an expanding economy and maintain our current level of energy consumption per capita, we would, within 12 years, have to replace 50 percent of all of our old capital with new capital, 60 percent more efficient than our current stock. This might be difficult to achieve.

Viewed in another light, if we implement the "conserver" scenario and keep our energy consumption by 1990 down to about 11 Trillion BTU's without any change in the energy efficiency of our economy, then according to the table our GNE would be about $170 Billion (instead of 203) and our GNE per capita will only rise to $6200 instead of about $7400. While the two examples chosen are both extremes, they nicely illustrate our dilemma and point to the value of some intermediate solutions.

Can Canada and the Atlantic provinces improve the efficiency of their economic engines to generate each dollar of the economy? Undoubtedly, simply on the basis of other countries, in the long term we can. The difficulty is that a sudden change in performance is unlikely due to our large existing stock of hardware and technology. Even in our disposable society, most capital investment in the energy consuming and producing fields lingers with us for 15, 25 to 35 years. Once these investments are made they create an inertia which is difficult to overcome, regardless of how dramatic the change to the original design energy economics. We should, therefore, keep this well in mind as we replace and expand our energy capital.

The Atlantic provinces especially should have a real interest in the way in which Canada replaces and expands its energy capital in the next 15 years. As was indicated earlier, the Atlantic provinces' economies are less efficient energy consumers than the rest of the country. The massive capital expenditures envisaged for the next 15 years could play a major role in improving the overall efficiency of the Provincial economies in the Atlantic region.

Just as the provinces need to be concerned and must influence the ways in which we reconstruct the capital structure of our society, it is also essential that the responsibility for self-reliance and conservation be shared within each province. At the present time, it is clear that communities and individuals have little scope for affecting their energy futures. The decisions regarding the capital and sources of energy [illegible] remote from and inaccessible to most individuals. Only with a closer correspondence between the responsibility and authority for determining one's energy consumption can we hope to expect some moderation in the future energy consumption.

B. Means, Limits and Ends

Is the efficiency with which we convert energy into dollars an adequate measure of how we will fare in the future? Fortunately for all of us, it is not. Efficiency is a concept which can be used to evaluate means, it is not an end in itself. Efficiency in energy consumption will increasingly preoccupy us as long as we continue to be dependent upon non-renewable resources that are constantly diminishing in size (and increasing in price) while there is further expansion in our economy. How is renewable energy different from non-renewable energy, is it really renewable and how will it change our economic attitude as we use more of it?

The term renewable energy can be loosely defined as the energy which is produced in a relatively short life cycle of a day (solar energy) or a few generations (trees). Non-renewable energy sources, on the other hand, accumulate over extremely long life cycles of thousands or millions of years (oil, coal and gas). In shifting from non-renewable to renewable energy sources, we will have to pay increasing attention to the rate of reproduction of a particular energy source. In order to maintain a constant inventory of renewable resources, our rate of consumption must come into balance with the sustainable yield that the inventory can produce. The resource conservation adjustments which we must make are conceptually not new to us. In business, for example, this would be equivalent to abandoning the practice of covering the operating costs of a company from the retained earnings and, instead, seeking to reduce operating costs in line with the operating revenues.

It is apparent that the theme of the conserver society should be to temper economic growth to the level of energy available on a renewable basis. Depending upon the importance that we place on future generations, our short-term attitude to the depletion of our non-renewable energy will vary in severity.

During the past ten years a considerable body of evidence has accumulated which suggests that apart from the physical limits of our renewable and non-renewable energy and resources, there are also pollution limits to the continued consumption of energy.[1] The ultimate form of pollution, thermal, may be our final constraint. Climatologists have suggested that the use of more than 1 percent of the incoming solar radiation will have undesirable effects for our climate. If the energy consumption of each country or region were limited to 1 percent of the solar radiation, then some countries such as Japan and Germany could reach their energy quota by the 1980's.[2]

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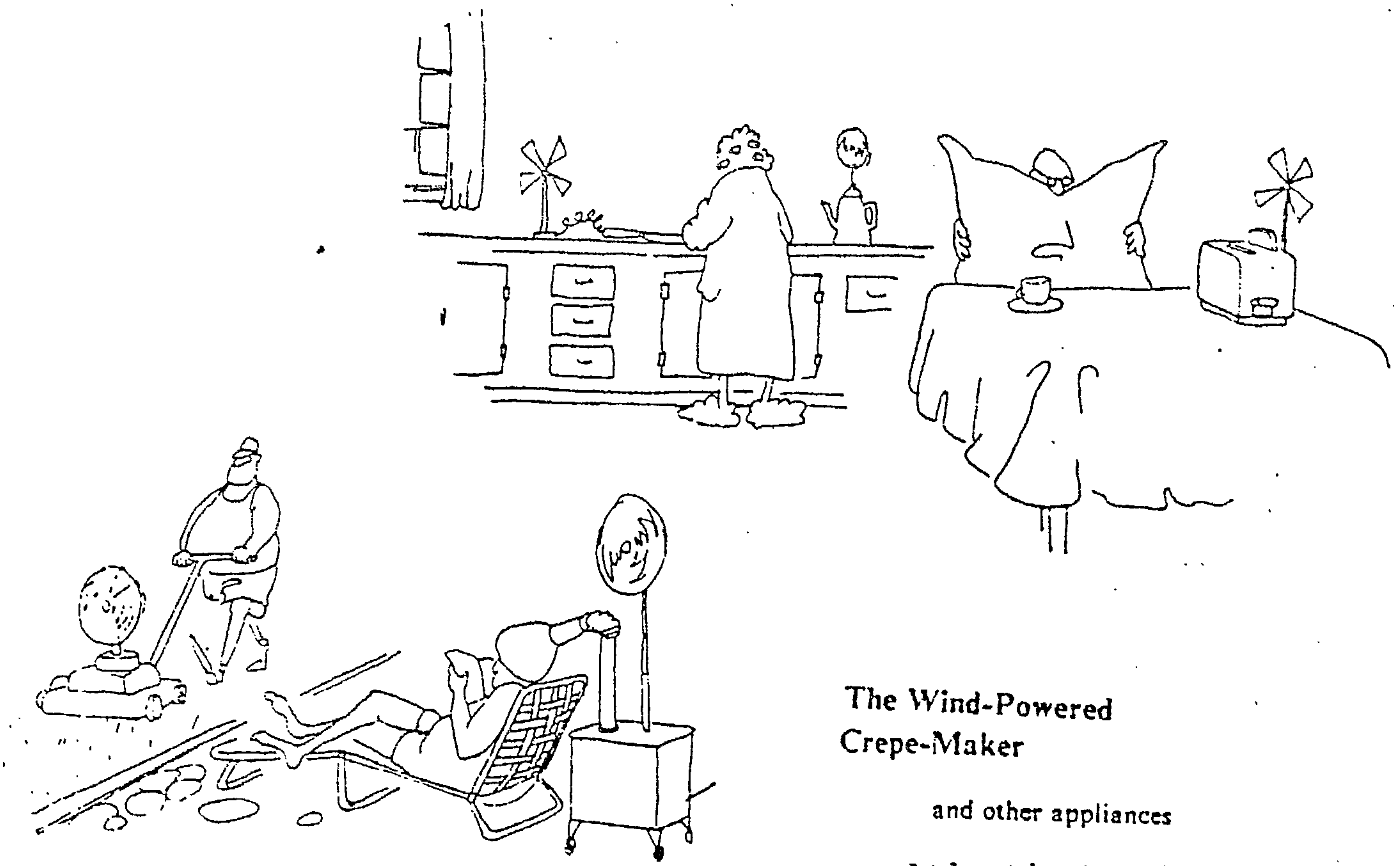
[1] See works sponsored by the Club of Rome (Limits to Growth; Mankind at the Turning Point et al).

[2] [illegible] Malcolm [illegible]

While it is difficult to believe that in a country as vast as Canada any limits will ever be encountered, there is daily evidence that we are exceeding them on a global scale.

In the long term, Canada and the Atlantic provinces should give serious thought to how we continue to measure our quality of life. The humorous but pertinent distinction between means and ends illustrated below reminds us that we should regularly review our purpose.



The Wind-Powered Crepe-Maker

and other appliances

Atlantic Monthly
Nov. 1977

5. Conclusions and Recommendations

In order to make some of the observations and comments of this paper a little more useful, I have attempted to focus the conclusions and recommendations for the Atlantic provinces.

Recommendation #1: Develop Self Reliance Strategies at the Regional Level

Extend the national strategy for self reliance to the regional and/or provincial levels. Identify realistic self reliance targets that minimize the degree of dependency of each province on external energy resources. Once a provincial energy framework has been developed, extend the concept of self reliance to the community level. Include the energy supply function as a responsibility of regional and municipal planning.

Recommendation #2: Decentralize Responsibility and Authority for Energy Planning and Development

Re-examine the political, economic and institutional responsibility and authority for making decisions on the replacement of energy producing and consuming capital. Search for, test and implement new political and institutional frameworks that permit the Federal Government, the Province, the community and the individual to achieve the self reliance targets for which each is responsible.

Recommendation #3: Deploy Energy Investment According to Regional and Provincial Strategies

Ensure that the capital investment required to meet a national self reliance target is deployed according to the agreed upon requirements identified in the Provincial self reliance strategies.

Recommendation #4: Achieve Improved Energy Efficiency in the Short Term

Consciously seek to improve the energy efficiency of our capital stock. This should be sought in two ways: 1) in the short-term by reducing waste energy consumption which contributes little to our economic productivity. 2) Carefully consider the impact that new major energy capital investment will have on the overall energy efficiency of the economy. This will require careful consideration of not only renewable and non-renewable energy sources but also a comparison between centralized and decentralized solutions.

Recommendation #5: Encourage Diversity in Values

Undertake research in and support the development of communities founded upon new social systems. It has become apparent that the paradigm of economic growth which has served us well in the past may not be capable by its very nature to bring contentment in equal measure.[3] There is a vacancy for the position it once occupied and although a few candidates[4] have applied, a replacement has yet to be found .

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[3] "Social Limits to Growth" Fred Hirsh. 1977.

[4] "Small [illegible] Beautiful" E.F. [illegible], [illegible].

PRAIRIE REGIONAL WORKSHOP

THE TECHNOLOGICAL CHALLENGE FOR SMALL COMMUNITIES

Organized by
Canadian Plains Research Center
University of Regina

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Dr. Lloyd Axworthy, Moderator
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CHARACTERISTICS OF PRAIRIE COMMUNITIES

David Lange, M.L.A.
Government of Saskatchewan

Abstract

The characteristics of small prairie communities in the early decades are described as well as the changes brought about by mechanization both in farming practices and lifestyles. Multi-national corporations are destroying the farmers' self-sufficiency and promoting consumption. Centralization is seen as a major alienating force. The old communities have the infrastructure (i.e., energy and sewage) to handle a revitalized population. The need is stressed for education at all levels about social and economic changes taking place in our society which do not relate to our real needs and are eroding our culture and vitality. Despite our forefathers struggle to make the Western communities self-sufficient, there is now another battle to be fought to restore a sense of heritage and community.

I have been asked to outline for this conference, characteristics particular or unique to prairie communities in order that these characteristics may be analysed to provide direction for application of conserver society technologies to those communities. For purposes of this workshop, a Prairie Community has been defined as one having a population of 1,000 to 25,000 people. Conserver society technologies are generally of such nature that they can be applied to concepts of smallness. In fact, very often these technologies, by definition or development, apply best to notions of small. Now, why this conference would want to apply its results to only those communities of greater than 1,000 persons, and leave out the other 60% of the population in smaller communities, is beyond me. It seems, that to not include communities of every size, would defeat the very purpose of this conference - to try and apply conserver society philosophy to the small prairie community.

I assume then, that the definition of community size was either an error or was written by someone from Eastern Canada. (In either case, it can be forgiven...)

Since this conference will serve no purpose whatever for most prairie communities if this definition is used, I will change the definition of a small rural community to include those centres with population up to 25,000; but also those as low as one dog. I will try to show how extremely small communities are likely candidates for conserver society technology.

An analysis of present characteristics of prairie communities cannot be given without alluding to the past. In fact, these present characteristics are inseparable from the trends which have developed over the past several decades of Canadian Prairie rural life. Moreover, on the prairies where most of the commerce has been agrarian, it is impossible to speak of prairie communities without talking about agriculture and the farm.

During the several decades which have preceded 1960, it is safe to generalize about rural communities and say that they were almost self sufficient in the sense that every human need was provided for in the community. The farm family provided most of its own food including vegetables, eggs, milk, butter, bread and meat. And there was generally a surplus to be bartered in town for those other styles foods not grown on the farm. The town provided virtually every service imaginable - mechanical, spiritual, cultural, recreational and social. Those services and goods not available in the local community were acquired through the Eaton's mail-order catalogue. There was little need for anyone to leave his community often, and when he did, he usually travelled by rail since the efficiency and service of that mode of transportation far exceeded roads and automobiles. Rail was the life line of every community. It brought staples and machinery to town and exported agricultural products. Both farm and community work were very labour intensive.

Mechanization changed that. With the advent of progressively more sophisticated pieces of machinery, labourers were displaced to more urban centres. Farm machines were expensive but the capitalization could be justified by available long-term credit, cheap energy and the fact that machines didn't ask for days off. Moreover, their cost could be rationalized with the purchase of more land. Mechanization was a predominant factor in farm size increase and depopulation of rural areas. Labour and population gave way to higher capitalization, greater cash flow and larger control of land by individual farmers. Long-term, government guaranteed loans enhanced the farmer's ability to buy out his neighbours (they also enhanced the price his neighbour received ...), government taxation policies encouraged larger farms and newer machinery. Machine capitalization and farm interest payments have been a deductible item. So rather than paying tax, the farmer purchased larger machinery which in turn, enabled him to buy more land, displacing more people. These policies and trends, while contributing to an easier physical lifestyle for the farm family, have resulted in a rural exodus from Saskatchewan farms of over 300,000 people in 35 years. Considering the exchange of people for the capital and energy consumption of machines, there has not been a proportional increase in production or quality of product per acre of land. (Although it must be acknowledged that considerable increase in both production and quality has occurred, it is necessary to question whether that increased need have been at the expense of population).

The irony is that by replacing people with machines, capital and energy, less taxes have been paid to Canada by those remaining in agriculture than would have been the case if more people were located on the prairies. The national coffers have suffered. The greatest proportion of benefits from these tax incentives has accrued to foreign machine manufacturing companies (since relatively small amount of agricultural machinery is produced in Canada), and foreign-dominated energy companies.

Because mechanized work was easier for the remaining farmers, and since he had a slight amount of extra cash due to larger acreage, he could afford to get out of livestock and perhaps vegetable production. The family farm then, went from a diverse, relatively self-sufficient and cashless operation, to a specialized monoculturel requiring considerable cash flow. Monoculture has created other problems. For example:

1) Because there was financial and technological incentive for farms to get larger, emphasis has been placed on number of acres farmed rather than the quality of production per acre. Incentive has existed to summerfollow large tracts of land for moisture conservation and weed control rather than practice crop rotations which include green manuring practices. This has led to an increase in the prevalence of solenetz or alkaline soils. This is a serious problem to which this generation of farmers will have to find a solution. (It should be emphasized that these problems have not been caused by poor farming practices, but rather by exceptionally good farm management applied, perhaps, in the wrong manner).

2) During this same period of time (i.e. the last 3 to 4 decades), automobile technology has greatly improved, complimented by a prodigious growth in road and highway construction. This facilitated the consolidation of schools from single-teacher country schools to composite schools with bussing of students.

School consolidation may have been one of the largest factors in the death of many small communities. For as students and their parents became a part of a larger educational community, they tended to by-pass their own smaller community for repairs, parts, groceries, and eventually cultural and recreational activities of the larger centre. Better care and more roads facilitated this mobility.

Soon, the many diverse services that had been provided in each of the smaller communities were like the schools and farms consolidated into larger areas.... The smaller communities became uneconomic and died. More people were forced to leave the rural areas and in many cases they left the prairies.

Over several decades, the small relatively self-sufficient rural towns and farms have been absorbed into larger service centres. Because of the mobility provided by the automobile and cheap energy, and because of short-sighted government transportation policies, the railroad which used to provide such an efficient link between communities has been allowed to degenerate. Self-sufficiency of communities and farms has given way to dependency upon sources outside of the community for capital, energy and technology.

Does the Life-Style of a Small Community Have Value?

Is there a lament about the disappearance of small communities? Is the centralization of farms, services and communities harmful in any way? Well, many people will say that, far from being harmful centralization has created a great many benefits for society: Life for the individual is easier. There are more personal conveniences resulting in less manual labour and physical strain. Above all, because of technology, Canada can produce and export a bushel of grain at a relatively low, world competitive price. All of this would not be possible, these people would say, without energy intensive technology. And that technology requires a particular economy of scale to produce and purchase. So why lament the loss of a few communities which were destined to go anyway? Besides, people made the [illegible] themselves, - no one forced them to buy out of their own community.

While it is true that the standard of living for those who are left in rural areas has improved immensely, the tragedy is not technical but rather human. Because of centralization and consolidation of goods and services, rural society has moved from one of self-sufficiency and independence to one of virtual dependence upon others, outside their community, for their way of life. Their society has been changed from one in which they had a large degree of control over economic, social and technical decisions about their community. Now, there is more and more external control over their lives and economy. Although surrounded by conveniences which make physical life easier for them, people have less control over their society. Before consolidation people could make local decisions about their schools, their roads, their telephone systems, or the direction their farm economics would take. Now, those decisions are made by others, for them; and this, often in spite of the fact that the vehicle for local decision making may still be there. (For example, very few people will come to an annual school board meeting to help to make decisions about their education system).

As a community's orbit grew, and the service system became larger, people became less involved directly in that system's decision-making. This is not to say that the resulting system functioned less efficiently. On the contrary, often the technological efficiency of that system may have been greatly enhanced. But when the control over that system was diluted away from the small local community, apathy for the system grew; and mobility of the individual compensated for it. Often it is not the decision itself that is so important, it is the process of involvement of people and familiarity with their community that is important.

It is this alienation of the individual caused by largeness of systems and mobility which is the tragedy of centralization. Many of the human factors have been removed from community life - the ability to make decisions; a full understanding of an individual's surroundings; not producing one's own goods; lack of personal skills; close acquaintance with those in the community. This lack of familiarity with one's community has produced alienation.

This present day alienation is manifest in the nostalgic reaction of people to the movie "Who Has Seen The Wind?" There is a certain controversy in people's minds about why they would want to go back to the setting of that movie. Their nostalgia is not a lament for a way of life, since they realize that so many things about life today are better. Their nostaliga is for a lost sense of community. It is the human aspects of community life portrayed in that move which evoke nostalgia in those who have lived in a small rural community. The affinity of people with nature and their environment; their friendships; their personalities, their skills. These have been eroded or lost as centralization has occurred. Instead, people are alienated by systems into which they have very little input, little or no familiarity, and over which they have only moderate control.

Other tragedies are evident from centralization. There is a predominate exodus of young people from rural areas. Many would go in any case. But there is a large number who, if given an opportunity, would stay in a rural community. Often the education system does not reflect the virtues of local community involvement, (e.g., High School and University prepares students to work for large companies, but not for a local municipality). The economic system does not provide opportunity for the young to remain in a community (e.g., the cost of entry into farming or a local business is too high for many young people who would otherwise be interested).

The social system does not encourage young people to stay in a rural community, (e.g., television commercials depict city life as glamorous and swinging. Little mention is made about the qualities of rural life). The political system has made little effort to retain rural population, (e.g., a major long-term strategy integrating transportation and rural secondary processing industries would provide for young people).

While most young people are forced to leave the community, most retiring farmers and businessmen choose to remain in the community. This has caused a predominance of older people in communities. These people have the knowledge and experience of a life time. These qualities are being wasted in terms of the education and guidance that these older people could pass along if only there were programs to keep young people in rural areas.

Centralization has caused yet another form of waste - wasted plant facility. Rural areas presently have in place power, telephone, water and sewer, roads which are paid for, fully depreciated and not subject to inflation; and which could easily handle double or triple the population of those rural communities and which could accommodate people much more cheaply than cities.

So the tragedy of centralized communities is certainly not the standard of living which it has given to those remaining in the communities. It is rather, the alienation felt by the individual as a result of lack of familiarity with, and affinity for his surroundings and those systems which provide for his living. The tragedy is the move away from self-sufficiency towards a high cash flow economy controlled and directed externally by someone else.

This offers an excellent opportunity to draw a rare perspective on the need for education, within society at large, about the social and economic changes that may well be facing our way of life, and which may have little to do with our real needs or even our real desires.

Of course the first thing we need in order to undertake such a perspective is a definition or understanding of economic development. Well, a tentative definition of economic development might be "the maximum utilization of existing social systems, with their primary goal being self-sufficiency."

On the prairies, economic development must be recognized as having, as its mainstay, the production, processing and distribution of foodstuffs. Rural farms and communities are already in place with a vast amount of experience to produce food on the 43% of Canada's arable land that lies in Saskatchewan. With an expanding world population and a limited land base on which to produce food, those areas which are able to produce food for export will hold the international political and economic power of tomorrow.

It is for this reason that we find multinational corporations attempting to gain control over the financial, technological, human and land resources which combine for food production. Only by controlling production and supply can they hope to manipulate the global supermarket which they have created. If we do not have self-sufficiency as our primary goal in economic development then our economic development will become the undersirable result of control and manipulation by multinational corporations.

As they have already accomplished in developing countries of the world, the multinational corporations are now attempting to gain control of the land base, the inputs and capital for production, and the markets for distribution of foodstuffs here on the prairies and in Canada as a whole.

To avert this control, and the resulting corporate feudal system into which farmers will be thrust, it is necessary to predicate our economic development upon self-sufficiency. We must be in full control of our own inputs for production, our own supply of capital, our own processing plants and our own means of distribution to international markets. This necessitates a degree of self-sufficiency within any jurisdiction. The objective would be to make our self-sufficiency operate in as small units as possible - ideally the family farm within its respective community.

However, on the Prairies, the population is presently low compared to the land base that it occupies. This produces a disproportionately large amount of export commodity compared to what the population consumes. We are therefore heavily dependent, and always have been, upon external markets for agricultural viability. But this important truth does not preclude our being able to control, to a large degree, our own inputs, capital and marketing organizations. We have a geographical advantage which could allow us to be relatively independent of external, that is non-Canadian, sources of supply of, say, fertilizer, capital and technology.

By relying on and encouraging small-scale, partially self-sufficient (for example, in terms of supplying our own fertilizer through proper crop rotation) family-operated farms, complimented by supportive social and physical infrastructures within communities (for example, educational and medical systems and farm machinery agencies), we can aspire to a society composed of relatively self-sufficient modules.

It would be naive to suggest that each of these "social modules" could be completely independent and self-sufficient. But a small-scale family farm could be relatively independent under a government tax system which encourages and protects the notion of smallness. That independence can be further enhanced by a local elevator system geared to handle grain with the future and life style of the family farm in mind. The local elevator system in turn must be protected by government from assimilation into philosophies of centralization. Necessarily, a marketing system which protects both the small farmer and the local elevator system, keeping in mind at the same time the contribution that the farmer's family, his community, his local elevator company and his grain are making to the Gross National Product of Canada, must be the responsibility of a much larger political, or social, jurisdiction. This sort of system is exemplified in the government-controlled Canadian Wheat Board.

Self-sufficiency, then, is relative. Few people or structures in society are completely self-sufficient. Any jurisdiction can be self-sufficient provded that: a) it has within its boundaries all of the necessary components for self-sufficiency (or can trade something for those components it cannot produce but does need), and most important b) that all of the principals in the jurisdiction agree to cooperate to achieve, first and foremost, self-sufficiency. This provides a balance between production and consumption. Co-operation is often not the case. For example, an individual may purchase outside of his community, at a lower price, an immediate benefit to himself, only to find at a later date that his local dealer in that commodity has gone out of business. The individual is thus deprived of the option of purchasing at anything but the remaining dealership, outside of his community.

It follows that self-sufficient jursidctions may be defined as social or economic. Moreover, a jurisdiction may be self-sufficient technologically, geographically or politically. And if independence of the individual within his community is a desired "good" in society, it will be achieved only by co-operation among the balanced, self-sufficient jurisdictions. An important objective of self-sufficiency is to use the independence gained from any degree of self-sufficiency as a bargaining tool. This reduces that dependency of that jurisdiction on external organizations, for example, giant corporations, for inputs or markets. In this manner, striving towards self-sufficiency can help a particular jurisdiction to counter the monopoly power of multinational corporations.

The maximum utilization of existing social systems, with its primary goal self-sufficiency in any jurisdiction, must involve all of the elements of our present social structure - private, community and government. One of the most important parts of this structure is the individual entrepreneur. To make any social or economic system work, it is essential to have the expertise, and the drive, of the entrepreneur. A project must have a "wheeler" to put the variables together. He is indispensable.

As well, we must have a community in which to place the social and physical structures, and that involves the human factor. The community provides the back-up services and support, both financial and human, to make an enterprise work. It is also essential to have the various levels of government involved. In rural Saskatchewan these elements and their potential for sound economic development can be clearly seen. They need only be used. All of these elements of the social structure — the entrepreneur, the community, and the various levels of government - must operate within the framework of co-operation rather than competition.

Most communities have basically the same infrastructure and if they are competing against one another, all groping for the same kinds of industries, the logical outcome will be that they will destroy themselves in the competition for limited new projects. We must recognize that some communities are already viable even though they may not have an industry in the traditional sense of the word. Communities that have, for instance, hospitals or schools or clinics, actually already have industry. Of course traditional economic planning would not include a hospital in its definition of viable "industry", principally because last year hospitals in this country did not turn all that much profit. Clearly the basic definition of "industry" will have to be changed.

Economic credence will have to be given to communities that have institutions such as hospitals, because these provide a payroll and a wide range of related social benefits. Now, if certain communities have this degree of economic development already and if there are only so many industries - processing plants and such — to go around, then the fair decision becomes most obvious. The communities that do not have service and social industries -- hospitals and schools -- will be the communities that get the processing industries. That kind of planning can make every community viable and at the same time make the best use of all the social infrastructure that is in place.

In making decisions for economic development, governments can play a positive role in lessening this destructive competition. This it can do by defining industrial or economic development in more truly social terms. It is important for government to oversee these operations, because government is the only organization that has no axe to grind. Furthermore, it is government that can define and affect economic development in terms of long-range planning and profitability which include human and social factors.

Projects for communities should be made viable, first and foremost, in the human sense. It is fundamental that any economic system must include the human factor. Recently, technology has displaced human beings and decreased the labour factor. That has not been healthy for society. The human factor has been taken out of a great deal of decision-making, which is just incredible.

We can decide as a society that we are going to change our definition of economic development, to include human factors; to include decentralization programs; to have small-scale, appropriate, intermediate, affordable and yet sophisticated technology; and small-scale technology. This leads logically, to conserver society technology. We should include in our definition of economic development and profitability all of the ancillary costs in economic development, that is, the ancillary costs such as physical infrastructure (housing, water, sewer) and of moving people back into the rural area. This does not mean that we must divest ourselves of large structures, merely that we must adjust those structures to accommodate small-scale technology, small-scale farms and industries. We certainly have the technological capability to decentralize to any extent that we find necessary in human terms.

It would be a tragedy to allow the present trends which are contributing to the rural population exodus to continue. As people leave the rural areas, leaving larger farms controlled by fewer people, they are also leaving the communities that have physical infrastructure in place. This infrastructure -- power, telephone, road, water and sewer systems -- is being under-utilized and could be capable of supporting more people than at present. Ironically, the population moves to the cities, which cannot now handle their present burgeoning social and physical demands.

As the cities grow and rural population diminishes, the political power also becomes urban. One can see the day when the urban politicans will cry for social justice to be done by removing the vast wealth of the renewable resource of food production from the hands of so few farmers and returning it to those who wish to flee from the oppression of the cities. It will thus become "efficient" to have planned programs to move people back to the rural areas. The future gigantic cost and social foolishness of this can be avoided by alternate planning now.

We have dealt with our definition of economic development in terms of inter-community development and how the definition must be broadened to incorporate human factors.

In terms of technology and energy, economic development should again encourage small-scale appropriate systems which can be easily understood, [illegible] renewable energy systems using this kind of technology will decrease the dependency of communities on complicated energy systems over which they have no control. This does not preclude the necessity for a larger, comprehensive and integrated grid system for power which is already in place and can continue to be well used. It merely suggests breaking that system into units which are relatively self-sufficient at least for short periods, in the event of a total system failure. The integrated system is, of course, essential because it affords the potential of using existing energy sources to a more efficient degree.

An example of this potential can be seen in utilizing existing generating stations, both thermal and hydro, to charge storage batteries in individual communities during off-peak periods, available for the needs of the communities but charged from an overall grid system. In this manner plant facility that is not presently being used during the night, but for which the capital, labour and distribution system is already in place, could be better utilized. The energy stored in this way could be released into the community the following day, or during peak periods. The same batteries could be intermittently charged by local renewable energy sources. This would provide the community with a degree of self-sufficiency and use the larger grid system more efficiently. It is encouraging to note that Saskatchewan Power is already doing experiments on thermal furnaces, which use sodium sulphate to store off-peak power as heat, for use during peak power periods.

In applying our definition of economic development to agriculture we have already alluded to the strategies which governments and communities must assume. It is possible to reverse the trends that we see now, to integrate plant, animal and soil husbandry, into small, diverse and intensive agricultural economies. I mentioned again here the possibility of farmers becoming independent of fertilizer suppliers by making their own fertilizer by use of proper crop rotations integrated with complementary livestock feeding programs.

I was asked to relate the definition of economic development to the local decision-making process. Decisions made for the local community should be cellular in nature, very small integral units, with control in that jurisdiction or community over future planning resting with the local people and organizations. It is the people within these communities who are most familiar with the resources, capabilities and needs of the area, and it should logically be their decisions that determine the development of that community.

It's important to maintain this perspective on the relationship between the individuals who make up communities in this province and the decisions that will determine the future quality of their lives. We can see that these individuals have not only a major and too often neglected contribution to make to their local decision-making. The stark reality is, that many of their local resources are being wasted through over-centralization of decision-making processes in jurisdictions beyond their control. We do not need multinational corporations or people from another cultural milieu to impose upon us a way of life or a set of values which may have little or nothing to do with the very real human needs which face every individual.

Now you may very well ask how such a situation could arise on the prairies and particularly in rural Saskatchewan where the people have led the way for decades in exercising individual and collective control over the production, movement and [illegible] of their most valuable resource — grain. The answer is painfully [illegible] [illegible] when we see just how successful the organizations we formed -- to overcome unfair marketing practices, to shortcircuit economic manipulation by Bay Street and to force the railway into giving us fair services -- have been. In the face of external interference, and sometimes total neglect, our parents and grandparents banded together in several organizations to make possible the highly successful way of agricultural life we enjoy today. Now we see clear evidence that the same sorts of oppressive interference -- unfair marketing arrangements; manipulation, not only by eastern interests, but this time by global interests; and centralization of decision-making beyond our control -- are being brought to bear again. Why should it be that a people who created such successful co-operative organizations are, in this generation, unable even to retain control over agriculture in the hands of family farmers?

Well, many of the organizations which have been involved in helpinng the farmer and helping communities to maintain their self-sufficiency have apparently not been able to develop any sense of purpose or underlying philosophy on which to build an ongoing contribution. It appears sadly true, as well, that many of the people involved in these organizations have attempted to emulate the life style of people who do not share the Prairie experience. The apparent glamour of cosmopolitan living has played a part in eroding our sense of heritage, in lessening our pride in the unique way of life we have developed. Over time we have lost a fundamental understanding of why our organizations have developed. We have lost the sense of continuity and tradition in these organizations.

From all of this we can draw the final conclusion and the one that is most cogent to the theme of this conference. What we, a people once drawn together against adversity and now driven apart by self-defeating competition, have done has been to fail in the basic obligation to educate. Our organizations have taken far too little responsibility in educating for the promotion of continuity in the traditions of Prairie life. As a result we have no sense of heritage and are all too willing to believe the urban image of us as unsophisticated farm boys struggling to be accepted by our betters in the three-piece suit world of the crowded cities. What need do we, who forged a unique and highly supportive social order alone on the Prairie, have for such an empty challenge?

Well, with too little sense of why we developed as we did, and overwhelmed by the sheer numbers who taunt us to go their way, we are highly vulnerable. Our vulnerability in turn is making it possible, bit by bit, for us to give up local control and local facilities. Not certain enough of the reasons behind our parents' struggle for self-sufficiency, we have allowed their accomplishments to die in the push for centralized, maximized and de-personalized progress.

How are we to restore a sense of heritage, a pride in what we are as a province, and a respect for what we are as an agrarian community? First, we have to dispell the notion that someone, somewhere else can do a better job of planning our future than we can ourselves. And how do we accomplish this?

Well, we will have to begin by acknowledging that we are as capable as anyone else of leading the "good" life, right here on the Prairie. That we can do only by making it a fact. And we can make that a fact by re-defining economic development in the terms of conserver society technology; by restoring the physical and psycho-logical dimensions of the [illegible] our communities, through utilization of [illegible] structure already in place; and by demanding that decision-making remain within the scope of small-scale farming and business operations.

The role of education in this process is going to be critical. At one end of the spectrum, it will be education within the communities, on a human level, that will restore our sense of heritage and make possible our goal of self-sufficiency. On the other end, it will be that achievement of self-sufficiency and pride of heritage that will convince the rural population that they indeed enjoy a satisfactory quality of life.

We have already taken a swipe at the organizations -- the co-ops, the pools, and so on -- for failing to educate. Their problems are not a cause of our cultural bankruptcy, however. They are simply another manifestation. There is certainly a part for the social and occupational organizations to play in restoring a sense of pride and heritage, because it is these organizations that are an integral part of our agricultural way of life. But there is a part to be played by adult education services and field agencies, too, in bringing people together to appreciate that we have the history, traditions, experience and culture to design, develop and enjoy our own future in our own way. Through community seminars, geared to the work and social conditions of those communities, we can provide a forum for that learning process.

Summary

I have been asked to suggest for this conference, those characteristics of prairie communities which might hinder the adoption of conserver society technologies.

The first characteristic which comes to mind is perhaps the most important: the trends towards largeness and consumption which are evident in the financial and machinery aspects of farming. So much momentum has been generated with present-day farm policies and practices, that it will be extremely difficult to slow them down, muchless, reverse them. (Especially over a short period). Most farmers could not afford to even "experiment" with, for instance taking a few acres out of production for green manuring even when they know it would produce better yields in the future. Their cash flow economics are so "tight" that they couldn't risk the reduction in productive acres. They can't afford to trade future improved soil for less present production. To encourage farmers to employ conserver society techniques to their agricultural operation would require financial incentive greater than that which thrust them into their present circumstances.

It is possible to offer this kind of incentive to the farmer from various government levels, particularly that of the Federal Government.

Another hindrance to the application of conserver society technology to prairie communities is our present educational system. This we have already reviewed. It hardly teaches prairie history, muchless the virtues of small communities and self-sufficiency, and local decision-making.

The irony of rural centralization is that it is occurring at a time when the production, processing and distribution of food is becoming the most important economic and political tool of our time. With an expanding world population, and a limited land base upon which to feed that population, food production is soon to become one of the most important industries in the world. Production, processing, and distribution of food could employ many, many people, and those people could live comfortably in an unalienated fashion in rural prairie communities.

A more human approach to prairie community development - the Conserver Society.

We recognize that there are considerable advantages to human well-being in the life-styles associated with small communities. (These advantages are also evident in small sectors of large cities). It is therefore desirable to try and promote small communities since their infrastructures are already in place and need only be used.

Any plan for promotion of conserver society lifestyle in rural communities must have in it, elements of local self-sufficiency and local control of decision-making. A basic tenet of conserver society philosophy is that people must be in control of their immediate social environment.

We have shown how control of that social environment has been transferred from the local community to the realms of financiers, machinery, chemical, and fertilizer companies.

Control of a social environment, or a conserver society, can only come with self-sufficiency and local decision-making. Young people are not taught about the richness of colour that might be in their community. They are not encouraged to stay in their communities. Naturally, they wish instead, to emulate the television commercials which speak of other places. Again, government can make a tremendous impact in changing the thrust of the educational system. This time, the onus is on the provincial government rather than federal.

Another hindrance to the application of conserver society technologies on prairie communities is the distances between the communities and the sparse population. This hindrance is partly real, partly psychological. (The distances between communities to which conserver society railroad transportation should be applied is exactly equal to the distance to which road and automobile technologies were applied to create the existing structure of communities....) Once again, it must be government which must take the initiative to promote a conserver society transportation system. Consideration of energy requirements for transportation also dictate government control and planning.

TECHNOLOGICAL CHANGE IN FOOD PRODUCTION AND PROCESSING IN THE PRAIRIE PROVINCES

Daryl Kraft
Dept. of Agricultural Economics
University of Manitoba

Abstract

Rural communities are examined in the context of a conserver society in terms of agriculture's relationship to the eco-system. The evolution of the present agricultural structure and resource utilization patterns are analysed in terms of past economic, political and technical conditions. This framework provides the underpinnings to examine what aspects of the western Canadian food system are at variance with the goals of the conserver society.

As fossil fuel related inputs become relatively more expensive then renewable energy substitutes, farmers will expand the usage of the less costly alternatives. Some of these adjustments will involve a reduction in tillage operations, expanded use of herbicides, inclusion of forage and cropping rotations, expansion of livestock production and utilization of their waste products for fertilizer and energy inputs. These and similar changes can largely be accomplished through the price system. Government can hasten the adjustment through providing rural communities with more information on conservation alternatives and tax incentives. Another series of adjustments associated with agricultural use of land, water and air can only be achieved with increased government involvement. Some of these include, the preservation of farm land, erosion control, reduction of livestock odors, improved water quality and water development (drainage and irrigation). A series of policy options are reviewed in terms of their effectiveness and comparative costs of meeting the goals of a conserver society.

Introduction

This paper will focus on the agricultural dimensions of the Prairie rural community. Agriculture is the most dominant industry in the Prairie economy and is linked more closely to the environment than any other. It provides food for much of the nation and on average exports over half the total annual production. In addition, agriculture bears much of the responsibility for resource stewardship. The quantity, quality and stability of the resources base inherited by future generations will largely depend upon the agricultural practices followed today. Therefore in the long run both purposes, food production and stewardship are compatible goals. The time frame, in which a farmer must economically justify his decisions is often much shorter than that of a conserver society. And therein lies the problem.

The paper addresses the relationship between agricultural technology and stewardship from three perspectives. Initially, a brief discussion of the historical evolution of the agricultural technology will be given. It is followed by an analysis of how contemporary agricultural practices may adjust toward the goals of a conserver society. Lastly, a number of policy options are examined in terms of encouraging optimal use of energy and land, upgrading the agricultural capability, and maintaining a stable environment.

Evolution of Agricultural Technology

In the Prairies the present soil formations and natural ecosystems were formed within the last 8,000 years after the glaciers receded. Agriculture intrusion into the ecosystem has occurred primarily since the construction of a transcontinental railway. The land use pattern and location of rural community and agricultural development was largely determined by the land survey and the Dominion Lands policy. Land acquired by the federal government from the Hudson's Bay company was distributed in the following checkerboard fashion:

a) the Hudson's Bay Company was to receive section 8 and three-quarters of section 26 (the whole section 26 in every fifth township).

b) sections 11 and 29 were designated as School Lands.

c) Free Homestead lands were all even-numbered sections (except 8 and 26).

d) land was granted to the C.P.R. railway (25 million acres) on all odd numbered sections in a belt stretching back on either side of the railway.

e) each section of land was to be bounded by a road-allowance.

In general, the railway, the schools and settlement were to be developed by the use of the land controlled by the Federal Government.

Under the Homestead Act passed in 1872, a settler could achieve title to 160 acres of land for a fee of $10 and after three year's residence.

The C.P.R. land on odd-numbered sections was either sold to Homesteaders who wished to enlarge their 160-acre holdings, or to new settlers.

At the turn of the present century, the results of the Dominion Lands policy were clearly evident in the Prairie provinces. Settlers were situated on 160 or [illegible] acre holdings. Towns and [illegible] along the [illegible] approxim[illegible]

With land relatively free and a steady flow of immigrants from Europe there was little economic incentive to develop land saving or labour saving technologies. The emphasis was on modifying European farm equipment, finding the most suitable crop and livestock strains to suit Prairie farming conditions. The need for unique Canadian technology was recognized and experimental farm systems were inaugurated in 1886. A significant problem for Western Canadian agriculture was securing earlier ripening wheats. Marquis wheat was developed to meet this need. Insufficient moisture also plagued Prairie crops. Summer fallowing practices were popularized by the experimental farms as a means of moisure conservation. Agricultural technologies at the turn of the century were directed to cope with pest and environmental problems limiting crop production. Over time the agricultural experiment stations have contributed to the search for new farming practices and high yielding strains to increase farm efficiency.

Mechanization of the grain harvest was well under way in the latter 1920's. Horse drawn combines began to replace the threshing gangs, but the ensuing economic depression during the 1930's postponed the eventual transition to the 1940's. Prior to the combine, the Western Canadian harvest hired up to 33,000 seasonal labourers from Eastern Canada and the United States. In 1928 some 8,500 unemployed men from Britain joined the threshing gangs in the Prairie provinces. The large expenditures required to harvest the crop and the revenues often lost because harvesting was not completed before winter were sufficient incentives to search for an alternative technology. In 1939 Massey-Harris unveiled the first self-propelled combine. Mobile power systems replaced farm labour and supplemented the land base. Within ten years the draft horses had nearly all disappeared. Beef cattle numbers expanded to utilize the pasture and grain formerly consumed by horses. Over time, mobile power systems have been phased into nearly all farming operations. Machinery driven by fossil fuel energy continually replaced farm labour. The substitution was economically rational, since fossil fuel and farm machinery were less costly than labour. Besides labour was attracted to higher paying jobs in other sectors of the economy.

Since World War II there has been a powerful push and pull effect on the population in every rural community. The push effect on the rural population -- pushing young people out of the local community -- has been caused by mechanization and electrification. The pull effect has come about because of the expanding job opportunities in urban areas.

The use of most energy intensive technology, namely fertilizers, occurred in the 1950's. However, fertilizer usage did not become a prominent practice until the 1960's and 1970's. Since 1961 fertilizer use has expanded at a compound rate of 12.5 percent/year. This land saving technology has been instrumental in raising agricultural productivity within the Prairie provinces. Hedlin and Rigaux concluded that 50 percent of the yield increases could be attributed to increased use of fertilizers. Approximately 30 percent of the increase was related to higher yielding and more disease reistant crop varieties. (See Tables 1 and 2).

Table 1

Annual Increase in Crop Yields[a]

Crops	Manitoba		Saskatchewan		Alberta	
	Stubble	Fallow	Stubble	Fallow	Stubble	Fallow
	...............bushels per acre.....................					
Wheat	.26	.15	.47	.47	.46	.61
Oats	.57	.57	.85	.95	1.05	.88
Barley	.75	.64	.72	.93	.88	.79

[a]R.A. Hedlin and L.R. Rigaux, "Crop Yield Changes in the Prairie Provinces, 1958-76."

Table 2

Annual Increase in Crop Yields[a]

	Manitoba		Saskatchewan		Alberta	
	Stubble	Fallow	Stubble	Fallow	Stubble	Fallow
	..........percent..........					
Wheat	1.6	0.6	4.0	2.6	4.6	2.1
Oats	1.6	.9	3.0	2.3	3.4	1.9
Barley	3.3	1.8	3.4	3.1	3.9	2.2

[a]R.A. Hedlin and L.R. Rigaux, "Crop Yield Changes in the Prairie Provinces. 1958-76."

Tables 1 and 2 show wheat yields increased between .15 bushels per year for fallow crops in Manitoba to .61 bushels per year in Alberta. These trends confirm that the Prairie provinces increased wheat yields at 2.5 percent per year during the last 18 years. In other words, the production levels of the latter 1950's could be achieved today with a 35 percent reduction in wheat acreage. Similar trends exist for oats and barley. Annual percentage changes in oats ranged from .9 percent for oats on fallow in Manitoba to 3.4 percent for oats in stubble in Alberta. Trends for barley yields ranged between 1.8 percent year year to 3.9 percent per year. These trends suggest the yield performance attributed to the improve crop management practices had the same effect of a 30 percent increase in the land base with no technological change. Whereas the Homestead Act fostered agricultural development in 19th century, agricultural technology is doing the same today.

The technological path along which Prairie agriculture has moved over the past thirty years shows increasing dependence upon fossil fuels. Between 1945 and 1975 the substitution of energy for labour and land was sound economically. However, because this technological path was followed Prairie farmers are extremely vulnerable to rising energy prices. Despite the subsidization of petroleum products for domestic use the farm price index for these inputs to fertilizers has increased 50 percent in the last three years. If Canadian energy prices had risen to the international levels a further 50 percent increase would have occurred. Because farmers have few viable options to reduce energy use the net effect in the short run has been reduced farm income.

In the very near future agricultural technology must be adopted that utilizes renewable energy supplies. These include: the recycling of organic wastes to supplement inorganic fertilizers, the use of renewable forms of energy (solar, wind and organic fuels) to contribute to rural power needs and the introduction of cropping patterns and methods that reduce the need for cultivation and reduce the use of pesticides. Without a broad approach to these alternatives, modern agriculture could well become self-defeating rather than self-sustaining.

Energy Use in the Food System

The production, processing and distribution of food is an energy-dependent process. Between 12-15 percent of Canada's total energy consumption is used to put food on the tables of consumers. United States and Australian statistics suggest that about 18 percent of the energy used in the food system is consumed on the farm. The remainder is used for transportation, processing, distribution and preparation of food (see Fig. 1). Therefore, somewhere between 2-3 percent of Canadian energy consumption is accounted for by agriculture.

The 18 percent of the food energy costs attributable to farm is distributed over the following activities:

Fertilizer production	-	57%
Crop drying	-	24%
Crop production	-	8%
Fuel and machinery	-	7%
Pesticides production	-	2%
Transportation to storage	-	2%
		100%

The manufacturing of fertilizer accounts for the majority of energy utilized in Canadian crop production. Higher natural gas prices are quickly reflected in higher fertilizer prices. The energy input into fertilizer varies by nutrient (N, P and K) and compound. The most common form of nitrogen fertilizer (anhydrous ammonia) requires about 38 million BTU of natural gas per ton and consumes another 4 million before it reaches the farm. Phosphorous (P_2O_5) and Potash (K_2O) are less dependent upon energy but utilize approximately 20 and 14 million BTU's/ton respectively. Table 3 shows the projected prices for natural gas and the influence on the manufacturing cost of anhydrous ammonia.

Table 3. Projected Price of Natural Gas and Cost of Anhydrous Ammonia

Year	Price of Natural Gas[1] $/1000 cu. ft.	Cost of Energy Component for Anhydrous Ammonia ($/ton)
1978	1.30	46.0
1980	2.20	83.6
1985	2.80	106.4
1990	3.60	136.8
1995	4.50	171.0
2000	5.50	209.0

(1) Energy, Resources Conservation Board, Report 77-6, February 1977, Calgary, Alberta.

At these projected prices for natural gas the use of coal as an energy source and feedstocks for anhydrous ammonia production becomes feasible. Coal costs are expected to range between $50 and $80 for an equivalent amount of energy during the next 20 years. Therefore, fertilizer prices may not show a four-fold increase as projected in Table 3. However, a cheaper source of fossil fuels is only a short term solution and Western Canadian agriculture must be prepared to adjust to more costly inorganic fertilizers.

The four most feasible options are:

a) reduced use of inorganic fertilizers;

b) improve the efficiency of applying and utilizing fertilizers;

c) substitute animal manures, sewage sludge and garbage

d) include legume crops in the cropping sequence.

Nitrogen fertilizer use in the Prairie provinces has increased at an annual rate of 14.1 percent during the past 15 years. It is followed by phosphates at 6.8 percent and potash at 4.9 percent. In spite of this increase the average application rates on stubble crops range from between 50 percent of the recommended rates in Saskatchewan to 80 percent in Alberta and Manitoba. Despite a decline in crop prices in 1977, fertilizer sales remained unchanged from 1976. This suggests that with the lower crop prices, farmers still viewed inorganic fertilizer use as a worthwhile investment. How farmers respond to increased fertilizer prices will depend upon the price level of cereal grains and oilseeds. It is doubtful that the demand for plant nutrients will decline and in Western Canada the possibility of reduced summerfallow indicates the requirements will be greater. Canadian farmers purchase inorganic fertilizer in a world market and similar prices are paid by farmers throughout the world. Therefore any reduction in world wide use will be reflected in a reduced supply of grains and higher crop prices. In turn, the higher prices will justify greater fertilizer use. World demand for cereal grains and oilseeds is projected to increase at a rate of 2.5 to 3.1 percent per year while supplies are likely to expand at a slower rate. The ensuing higher grain prices will justify farmers to pay more for fertilizer. Because farmers are likely to be able to pay higher prices, the fertilizer industry will be able to utilize the declining supplies of fossil fuels while other users will reduce their consumption. Therefore the need and the ability of agriculture to pay for plant nutrients will both increase in the future. What sources will meet these requirements?

Currently, the recommended application rates for inorganic and organic fertilizer supply more nutrients than the crop requires. However, because of denitrification, leaching and surface water runoff only between 30 and 70 percent of the nitrogen applied becomes available to the crop. Timing, method of application and compound utilized all influence the amount of nitrogen that will be available. The most efficient means of applying nitrogen is to band it with or next to the seed. This is the most time consuming and labour intensive method but as nitrogen fertilizer prices increase, it will become more attractive. Similarly, when the technology of slow release fertilizers is perfected it will improve the efficiency greatly when lesser amounts of nitrogen are made available throughout the growing season rather than all at the beginning.

The increased use of animal manures, sewage sludge and garbage will offer an excellent source of less costly nutrients than inorganic fertilizer. Because of their changing economic importance, these organic substances should no longer be treated as a waste product with a disposal cost but a secondary product. Because of the bulkiness of organic residues and manures and their low nutrient concentrations, the transportation costs reduce the possibility of extensive use within the Prairie.

Table 4 indicates that with the limited quantities of livestock manure, regional excess supplies should not be a problem.

Table 4. Total Nutrients Available from Livestock Wastes in the Prairie Provinces (1976)

	(tons)		
	Nitrogen	P_2O_5	K_2O
Dairy	8256	3373	6538
Swine	5626	4258	4403
Chickens	3743	2619	1659
Total	17,625	10,250	12,600
% Inorganic fertilizer used (1976)	4	3	100

While the savings associated with applying animal manure are favourable for all livestock, these savings could only meet 4 percent of the nutrient requirements in the Prairie provinces in 1976. While the estimates do not include waste from beef cattle, the addition would only increase the availability by 1 or 2 percent because much of the nitrogen is lost before the manure is collected.

Land Base on the Prairies

A breakdown of 435.7 million acres of land in the Prairie provinces reveals that only 117.7 million acres (27.0 percent) are suitable for the production of field crops and an additional 76.1 million acres (17.5 percent) are suitable for pasture. This low proportion (44.3 percent) is due to climatic, topographic, and soil limitations. Forest, muskeg, and wild land account for 211.1 million acres (48.2 percent), organic soils 30.2 million acres (6.9 percent) while urban transportation networks utilize 1 million acres (.4%).

The aggregate census statistics on farmland located in the Prairies indicate 133.6 million acres were utilized by agriculture in 1976. Total land on farms has remained constant for the past 10 years. Apparently, losses to urban encroachment and transportation corridors have been offset by extending the agricultural frontier. While the total farmland base remained unchanged, the acreage brought under cultivation increased at a rate of 1.1 percent year during the 1950's, slowed to 0.9 percent year during the 1960's and increased at only .2 percent/year between 1971 and 1976. This trend suggests the improved farmland base in the Prairie provinces seems to have stabilized in spite of the fact that 28 million uncultivated acres fall within CLI soil capacity classes III and IV. Most of the land is located in northern areas of Alberta and Saskatchewan.

Agricultural development is not likely to occur unless grain prices increase substantially or the governments subsidize land clearing and breaking. Efforts to improve land productivity will probably be concentrated on mitigating some of the factors limiting crop production. The chief problems with Alberta soils are poor soil structure, adverse topography and deficient soil moisture. In Saskatchewan deficient soil moisture affects over twice the area affected by the next three limitations combined, namely cool climate, soil structure, and adverse topography.

Table 5. Land Capability for Agriculture in the Prairies

Class	Acres (000,000)	% all land
I	4.8	1.1
II	30.3	6.9
III	44.4	10.2
IV	38.2	8.8
V	54.0	12.4
VI	22.1	5.1
VII	29.1	48.2
Organic	30.2	6.9
Urban & Transportation	1.0	.4
Total Land Area	435.7	100.0

Excess moisture and soil structure are the predominant limitations to crop growth in Manitoba.

Many of the physical limitations can be overcome partially. For example, increasing the capacity of the natural drainage network on many Manitoban soils will raise average cereal grain yields and reduce the acreage formerly seeded to other grasses and legumes because of periodic problems with excess moisture. Rigaux and Singhs analysis indicates that for every day water ponding occurs wheat yields are reduced by nearly 8 bushels/acre. Similarly supplemental irrigation on many of the moisture deficient soils has the potential of increasing forage yields threefold and cereals by 30 percent. Research trials and field studies suggest the soil structure limitations of the solzenetic soils in Alberta can be mitigated with deep plowing.

Table Use of Agricultural Land in the Prairies (million acres)

	Manitoba		Saskatchewan		Alberta		Total Prairies	
Year	Improved	Unimproved	Improved	Unimproved	Improved	Unimproved	Improved	Unimproved
1966	12.4	6.6	45.4	19.9	27.3	21.7	85.1	48.2
1971	12.8	6.2	46.4	18.6	28.5	21.0	87.7	45.8
1976	12.8	6.0	46.7	18.6	29.1	20.4	88.6	45.0

Table Percentage Changes (Over Previous Census) in Improved Agricultural Acreage in the Prairies

1951	1961	1966	1971	1976
+9.6	+11.9	+6.0	+2.9	+1.0

Prairie land resources can attain a higher agricultural capability. However, increasing the agricultural potential on these lands may not be the most efficient or desirable investment. Soils with lower natural capability require not only the capital expenditures to lessen the limitations but require more operating inputs and energy than do better quality soils. Energy considerations, when coupled with potential adverse environmental impacts of bringing poorer quality soils into production make it imperative that superior quality land suited to food production be reserved for that purpose.

Premature conversions of prime farmland to irreversible uses narrow rather than maintain options for future generations. The loss of future options imposes a cost upon everyone. The relative importance an individual places on a future benefit or cost may not differ from those of society but he/she will not act alone to maintain these options if it requires the cooperative efforts of everyone to assure a favourable outcome. If everyone is allowed to do their own thing today then future options requiring group decisions will certainly disappear. Maximizing individual choice and freedom today may minimize the options for future generations.

Preserving the option to utilize land for food production at a future date has national and international significance. As a privately owned resource, the use of land is determined through the market since it goes to the highest bidder. As a collective good, the available amount of prime agricultural land can simultaneously satisfy the demands of a large number of people who want these soils preserved for future agricultural use. Land is also a substitute for energy intensive fertilizer inputs and preserving a larger land base would require less energy to meet given level of production. Hence, value of farmland as a collective good might be higher than any urban developer would be willing to bid as a private good. The scenic and aesthetic values of the rural landscape, the attractiveness of open space and a preserved environment are also collective goods on which society has put a value. With expected resource scarceties looming in the future the demands for these collective good attributes of agricultural land must get due weight through government decision making process since they are not counted in the market.

Irreversible Transformation of Farmland

Records of the historical conversion of farmland to cities, transportation networks and reservoirs for water developments are not available in Canada. Furthermore, studies examining urban needs for rural land do not reach similar conclusions. Pearson estimated that under generous urban planning standards a 100 acres would be required per 1,000 increase in population. However, Crerar's analysis of the growth of London, Winnipeg, Toronto, Hamilton and Montreal showed an average of 382 acres lost per 1,000 increase in population. An extreme estimate of 785 acres lost per 1,000 residents was found for the urban growth patterns in the Peal Plain area of Ontario. According to these estimates then, if the Canadian population projections of an addition of 7 million residents by the year 2000 A.D. will require between one and three million acres. A farmland preservationist policy must not only address the land extensive development patterns but also examine the quality of agricultural land lost to the urban growth. How vulnerable is the best agricultural land? Five representative Canadian cities studied by the Land Directorate, Environment Canada indicated the following composition agricultural land lost to urban expansion:

Improved agricultural land	60 percent
Unimproved pasture	24 percent
Forest	13 percent
Other	3 percent
	100 percent

Also from the standpoint of agricultural productivity the data indicated that over half of the urban expansion took place on lands classified by the Canada Land Inventory as having the highest agricultural potential, namely Classes I and II. In the absence of a policy that discriminates on the basis of land's agricultural productive capability then urban growth will continue along the same path.

The question a conserver society must address is if the past trends continue how will this influence Canada's future options, and what legislative means are most effective in reducing or mitigating these losses. To exemplify these problems the impact of urban growth in the Prairie provinces will be addressed.

For the Prairies present population projections range between one and two million additional residents by 2001. Table 6 indicates four possible scenarios corresponding to adding 1.5 million residents to Alberta, Saskatchewan and Manitoba. The first reflects the past land utilization patterns that characterize urban growth. For this case every additional 1,000 people utilized 400 acres of which 60 percent was improved cropland. Assuming 10 year average wheat yields and 38 percent of the land is fallowed each year then the total decrease in production potential is 5.7 million bushels or 10 percent of the average production between 1967 and 1976. The second option provides the same density but directs urban expansion onto less productive farmland. The second option halves these potential losses with similar density because urban growth is assumed to be directed toward unimproved and forest lands. Option three would increase the density to 1,000 residents per 200 acres but not discriminate between the land classes used in the expansion.

In this case, the loss in agricultural production equals the second option. Lastly, if a plan preserved prime farmland with increased density then less than .2 percent of the improved acreage would be lost to urban growth. Illustrating the land use scenarios in terms of wheat production assumes other cereal, oilseed and forage crops will be maintained at their present level. Therefore, the relative loss in total agricultural productive potential is much less than the percentage shown for wheat.

In addition to urban encroachment there is evidence to suggest the production potential may be declining in the Prairie provinces. Rennie argues that unless farming practices change the undesirable trends associated with organic matter, soil nitrogen, salinity and soil moisture will reduce soil productivity. Excessive tillage associated with summerfallowing practices has resulted in marked decreases in organic matter, loss of soil nitrogen, deterioration in structure and an alarming increase in soil salinity. At the same time fallowing has lowered the efficiency of crop to use available water. The loss of organic matter causes deterioration of soil structure which in turn leads to lower infiltration of water and greater runoff. The soil is also less resistant to wind and water erosion. Acreage affected by saline conditions appears to be increasing at a rate of 1% per year in Saskatchewan. Although not irreversible, this factor alone may be far more serious than farmland loss to urban growth.

Table 6

Projected Loss in Wheat Production in the Prairie Provinces
for Alternate Urban Land Use Patterns[a]

	Plan 1	Plan 2	Plan 3	Plan 4
Land/1,000 population (acres)	400	400	200	200
Percent Improved Lost	60	30	60	30
Total Land (acres)	600,000	600,000	300,000	300,000
Cropland (acres)	360,000	180,000	180,000	90,000
Percent improved land in 1976	.6	.3	.3	.15
Wheat production (million bushels)	5.7	2.9	2.9	1.4
Percent 10 year average Wheat--1967-1976	10%	5%	5%	2.5%

[a]Population increase of 1.5 million by 2000 A.D.

One solution is a reduction in tillage and the elimination of summerfallow. However, before extension programs can present a convincing case to farmers these theories must be validated with extensive field experiments. Furthermore, regional planners need this information if rural land use guidelines can provide directives as to the permissible agronomic practices (crop rotations, vegatative cover, and summerfallowing).

Institutional Framework for Land Allocation

The British North America Act (Article 92, Section 13) indicates the provincial governments have exclusive rights relating to land resources within their own province. This suggests that they may pass legislation exclusively relating to property within their boundaries. These rights were upheld by the Supreme Court on the land ownership legislation of Prince Edward Island that restricts land ownership to non-residents of the province. However, the Parliament of Canada may from time to time make laws in relationship to agriculture and subsequently has an indirect influence on agricultural land use. Federal policies on agricultural research, farm credit, international trade agreements and regional development projects all have an indirect bearing on agricultural land use.

The predominate institution influencing the use of agricultural land is the market. While some agricultural land is held by the Crown most farmland is privately owned under the statutory authority granted by each province. Land use planning is generally decentralized with the local governments at the county, town, and municipal level. Historically, local governments have been reluctant to impose land use regulations. They generally believed the economic well-being of the community equalled the summation of each individual's welfare and since the individual was assumed to be the best judge of what made him happy he was permitted to manage the farm with minimal interference. The sale of land from farming to a higher bidder benefited the seller and community as the tax base was enlarged. However, attitudes appear to be changing because prime farmland is being valued as a public rather than a private resource.

The question arises at what governmental level should the evaluation of land use alternatives be undertaken and implemented. Local government interests may conflict with those of society because a desire to expand the tax base will not favour lower valued uses such as agriculture. The province may be reluctant to deny industrial growth if the only provincial location requires prime agricultural land. A policy must be found where the federal government can influence land use which is in the public interest.

Alternate Means of Preserving Farmland

Prior to the introduction of development rights four methods of exerting public influence on the use of privately owned farmland included: (1) acquisition of land by government, (2) purchase of easements, (3) zoning, and (4) taxation. The effectiveness, successfulness, and comparative public and private costs associated with these methods have been widely debated. Therefore only a brief review of these conventional methods will be presented here.

Public acquisition of land to preserve this resource for its agricultural productivity has not gained wide acceptance. Land banking is the most costly alternative. However, payment of the debt will be shared with the future generations. Therefore the temporal distribution of the cost is equitable because the land is preserved for the following generations.

Manitoba and Saskatchewan have attempted to establish farmland reserves through the Land Bank Act of 1972 and the Land Lease Program of 1973. The primary objective for both programs was to reduce the capital required to enter agriculture and ease the intergeneration transfer of farmland. Neither program assured the public that the land would remain in agricultural use since farmers leasing land retain an option to purchase. If the options specified that the public retained the right to develop the land for non-agricultural use then the farm land acquisition programs would also meet the objective of preserving farmland. Thus, farmers could, if they so wished, purchase the land from the government but would not be able to develop the land for recreational, residential, or industrial uses. The outcome would be similar to purchasing "development" easements.

Traditional easements on farmland have restricted owners from certain activities such as the construction of billboards which destroy scenic views and destroy wildlife habitat. Recently it has been proposed that governments acquire "development" easements on prime agricultural land. Such easements would remove the right to convert land from agricultural use to other specified "developed" uses.

New York's Suffolk County recently agreed to buy $21 million of " development" easements on Long Island farmland and thus protect it from real estate developers. Farmland owners could offer a development easement on their land to the county government. The transactions were voluntary between the farmland owners and the county government. Sellers of the easements retain ownership and are free to cultivate or let the land lie fallow, but could not sell for any purpose other than farming. By 1979, some $75 million could be expended from a fund established by the sale of bonds. The debt will be retired by a tax levied against all real estate sales within the county.

Taxation policies have attempted to bring public influence on private land use decisions. Most local governments purport to assess land on an ad valorem (market value) basis. A property tax levied on a strict ad valorem basis disregards equity questions because it does not vary according to current net income of the taxpayer. Thus it is argued that taxes on farmland within the rural urban fringe cause the land to be prematurely converted to non-agricultural uses because farming income is inadequate to meet the relatively high land tax. A lower assessment based upon agricultural use has been adopted by many states but studies analysing the effect of use-value assessment have concluded that: (1) There is minimal if any effect on land conversion to more intensive uses, and (2) It just reduces the taxes paid by owners who are temporarily holding the land for development.

The most common means of exerting public influence over private land use is zoning. Zoning is the designation of areas as districts with permissible types of land uses. Exclusive agricultural zoning is a concept frequently addressed in academic discussions and public meetings. It has not been widely practised in any rural areas other than through limitations on housing density. For example, some rural areas may permit no more than one dwelling every 10, 20 or 40 acres. Such zones are usually designated rural residential or agricultural. [illegible], variances to these density designations have been relatively easy to obtain. These actions suggest rural residents are not sufficiently concerned with changing the zoning variances to accommodate new subdivisions or are unwilling to accept more permanent zoning because it may infringe upon their personal future opportunities.

Under Canadian law, zoning does not require compensation to individuals whose well being may be reduced, nor does it extract a levy from individuals whose wealth may be enhanced. For example, the value of land zoned for commercial, residential, and agricultural use could be $3,000/acre, $2,000/acre, and $500/acre, respectively. These values are based upon the assumption that zoning classification cannot be changed. Assuming the land is of equal agricultural productivity, then the owners of the land zoned commercial and residential receive windfall gains of $2500/acre and $1500/acre. Furthermore, the owners of the land zoned for agricultural use lose the potential options of realizing higher prices. Because of the inequitable redistribution of wealth associated with permanent zoning, municipal governments are inclined to accept pliable zoning ordinances. This way they do not have to justify the redistribution of wealth. The upshot of this is a suboptimal land use but one in which each individual perceives an equal opportunity for development gains. The resulting settlement pattern of residential and commercial buildings are intersperced with farming operations. Besides the extensive use of land, conflicts may arise over livestock waste odors and similar neighbourhood effects. Local governments may be unhappy with the chaotic development plan but unless a system can be instituted to equitably distribute the gains from zoning, the pattern will continue. One means of accomplishing both equity and permanent zoning is by using development rights.

Development rights compliment rather than replace zoning bylaws. For purpose of illustration assume a municipality consists of 100,000 acres of farmland and is zoned into three districts, industrial, residential, and agricultural. The geographic areas for each of the activities are outlined in the zoning bylaw. In this plan each of the landowners within the area receives two types of transferable development rights in proportion to the area of land owned. Landowners in each of the three districts receive the same relative distribution of development rights, that is, an individual owning 100 acres of land would receive 10 acres of industrial development rights and 20 acres of residential development rights. Transferable development rights could be purchased or sold in the same manner as any other asset with transferable rights.

The use of land for commercial purposes is limited to the designated areas, but the land cannot be developed until a developer owns the requisite number of development rights.

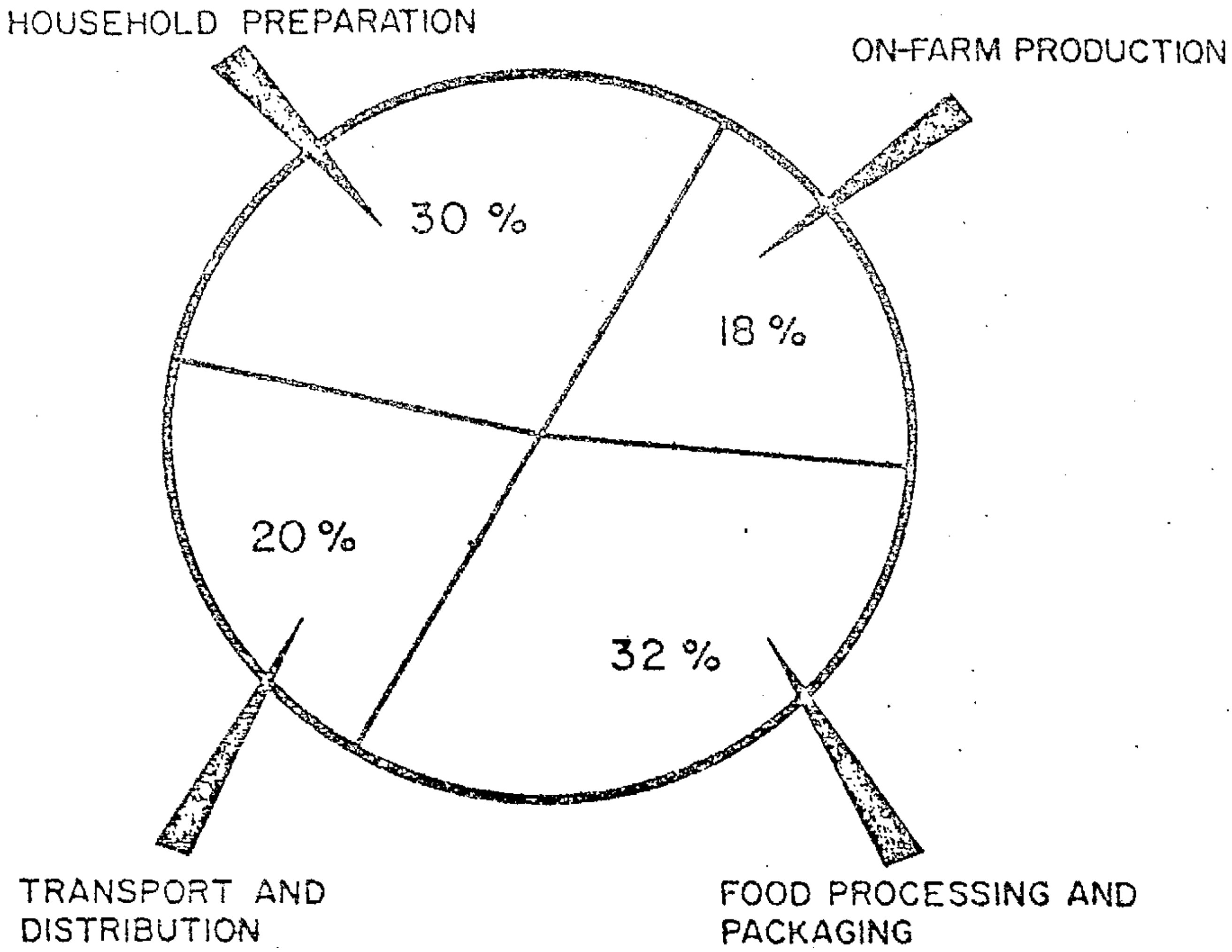


Fig. 1. APPROXIMATE CONSUMPTION OF ENERGY IN THE FOOD SYSTEM. (12 TO 15 % OF NATIONAL TOTAL)

WATER AND WASTE MANAGEMENT - SMALL PRAIRIE COMMUNITIES

Julian Kinisky

Abstract

The course of development of agricultural pursuits and human settlement of the prairies had proven to be disappointing because of the growth of knowledge and technological development has had little favourable impact. In some cases, early practice was favourable and superior to modern practice in terms of the preservation of renewable resources. Demographic changes brought about by changing agricultural practices have not favoured environmental integrity. Historical practice has apparently clouded the acceptance of new types of crop production. The growth of urban and western world industrialization coupled with monumental expenditures on consumer encouragement has directed our social attitudes in ways which have made us the worst wasters in history. The recognition of these problems, and the public support for the conserver society could provide another alternative.

Preface

The structure of this document is purposely designed not to follow the format of what is normally called a scientific paper. There is no intent to carefully qualify statements nor to avoid controversy nor to quote references because my objective is to stimulate discussion rather than to define my ability to produce a solid paper. Rather, I have chosen to venture into some areas of conjecture, of new direction and perhaps to stimulate a broader examination of the problems this conference is addressing itself to.

1.0 The Problem

Any treatment of this subject must recognize that attention be given not only to the dynamic aspects of water and waste management but also be given to the fact that small prairie communities are themselves in a constant state of change. The demographic characteristics of the prairie communities have strongly reflected the impact of the rapid development of transportation and communication technology. The very small, now unnecessary settlements, slowly die while their demise is accompanied by growth in other, recently small, communities. At this stage of development the population shifts from rural or small communities to the major cities appears to be levelled out but the growth of towns at the expense of hamlets continues. This continued growth of the favoured towns has generated new problems which were not foreseen in earlier times.

The historical establishment of most of the small prairie communities failed to recognize that unprecendented growth could occur. Water supplies were more than adequate for the foreseeable future and waste disposal was adequate because it was managed through wide dispersal. The new growth concentrated people with the attendant demands for much more water and new systems of waste management. These new problems are quite different from those of the major cities which have grown along the banks of the major rivers which have been able to supply large volumes of water while simultaneously acting as moving cesspools. The vast majority of small centres have not developed along major waterways while the small streams that may have existed have fallen victim to the ravages of land development and can no longer furnish dependable flows.

However, even the present situation is not static. Population dynamics is a continuing study and projections for the future are subject to the same vagaries which continue to plague the meteorologist. Even the short term projections should at best be used with great caution. The variations in economic conditions have strong influence on the demography of the prairies. Few of us have much confidence in economic predictions. World food needs are affected by growing world populations, changing climatic conditions and the varying demands of people for life styles which are as much conditioned by media advertising as by any real human need.

2.0 The Natural System

Over the centuries, the hydrologic patterns developed in a manner which efficiently accommodated climatic conditions, geological structure, green growth and the topography. These systems were in a constant state of evolution in which they endlessly continued to adjust to change. In the historical sense, these changes were slow and well within the evoluntionary capabilities of hydrologic change.

The complexity of the hydrologic systems, as in so many systems, was the key to stability. Beginning with tiny rills and moving to ephemeral water courses, streams and large rivers, the system included muskegs, backwaters, sloughs and even flood channels for emergency use. These surface waters were also tied into another interconnection with the complex system of groundwaters.

The quality of water before settlement was superior to the present time and this was reflected in the profusion of acquatic life which inhabited much of the surface water system. There were contributions of waste to the waters of pre-settlement times in the form of organics from the decay of vegetation and from animal waste associated with wildlife. However, such wastes were widely dispersed and of a total quantity which was well within the self cleansing capabilities of hydrologic systems. The shallow lakes which were subjected to wide variation in water levels moved through periods of equally variable water quality. Exposed flat shorelines produced heavy crops of plant life which went under in times of high water. The resulting degredation of the materials brought on a one or two year period of decreased water quality which then recovered after a few years of relatively stable water levels. These processes took place well before scientific efforts to measure water quality were available but are widely attested to by many of our senior citizens who were naturalists by inclination.

3.0 Changes Wrought by Man

Widespread settlement of the prairie region is only about 75 years old, a very brief portion of the post glacial period but in this short time, the changes attributed to settlement have been immense. The arrival of scientific approaches was relatively new and is still under funded but more importantly it seems now to be based upon engineering principles rather than upon an appreciation of the complexity and fragility of the natural systems. The occupation of the lands by native populations before white settlement appears now to have been a much more intelligent land use. The plains Indian never doubted his need for water, never lost his respect for the ability of hydrologic systems to temporarily go on the rampage and even had the good sense to spend his winters in the more favoured climate regions.

The white man, on the other hand, decided that he would change the face of the land to serve his own purpose. He cleared away vast tracts of vegetation, he broke the surface of the earth thus destroying some of the basic elements of the water shed. He has greatly increased the hydrologic system's capacity to run wild in floods while at the same time taking up permanent occupation of flood plains. To make matters worse, he then concentrated populations in his town sites where his demands upon a now inadequate system could not be met. I can almost see the wise Indian during the time of settlement laughing at the idiocies of a supposedly more sophisticated society.

3.1 Early Settlement

In my younger years, I was always impressed with the tales of what the land was like in the past. I can remember the high frequency with which my elders mentioned the problems of getting rid of water whch seemed to be everywhere. I recall tales of many tracts of land, now highly productive, but once under water. My most shocking memory involves an experience of my own. As a young boy, I swam, explored, fished and camped in and near a little creek whose name I didn't know. I described this marvelous place to my two growing sons many times and finally took them on a nostalgia trip to this memorable place. It was no longer there. The water was gone, the old swimming hole now a dry bottom, much of the tree growth removed and domestic animal wastes everywhere. The disappointment I experienced and the disbelief of my sons was problem enough. The great shock was that this had happened in only 25 years. No one had ever measured the stream flow or its variations, nor had its drainage basis been studied nor had there ever been a scientific evaluation of water quality. Now, the little village which still struggles for existence along this creek is short of water and cannot draw upon a resource which was once there. Growth cannot continue and demands are being made for the development of a regional water system to replace water which was once too plentiful.

3.2 Agricultural Development

The impact of agricultural development has had a powerfully adverse effect upon the entire hydrologic system. The most destructive features are related directly to the developing technology of new and bigger machines, the endless demand for ever increasing productivity and the trilateral push of government, industry and our institutions of higher learning to the evolutionary change from the family farm to giant agrobusiness.

The very words "economic farming units" and "the advantage of large scale" have become the essence of the destruction of our previous hydrologic systems.

3.3. The Early Times

The horse and the plow were, in their time, not serious threats to our water systems. The destruction of water courses was outside the capability of a cultivating practice powered by a horse. Hillsides of anymore than a very flat gradient defied the pulling power of even six to ten heavy horses. The result was that most quarter sections were only partially tilled with perhaps three or four patches of broken land in shapes which were dictated by the presence of water courses and other topolgraphic features. In those times, the first land to be chosen was that which was flat and open, devoid of any great topographic relief and preferably without water courses or permanent bodies of water. To this very day, the modern farmer still seeks a full "open" quarter. As a result, the last lands to be chosen for development were those which had only partial agricultural capability but at the same time were important parts of the local hydrologic system.

3.4. The Arrival of Machine and Technology

The first tractors were indeed an advantage to the farmer because they were more economical and faster than horses. Their early impact on the environment was not that great and because they were small as were the machines they pulled, they had sufficient horsepower to easily manage relatively small, odd shaped plots of land. But, modern technology was not satisfied with this advance and tractors became bigger and better. These new machines were indeed helpful especially to those southerly prairie farms where the big open sections of land were found. However, these same machines became available to other areas where they were not suitable.

It is easy to see that a 350 horsepower tractor pulling up to a fifty foot width of tilling equipment is simply not useable on small irregular shaped pieces of land. The farmer however, under increasing pressure to produce, simply used this power to overcome the former obstacles. With this kind of power, the capability of virtually ripping up any piece of land or climbing over steep slopes became available. With this technologic advance, many more pieces of land could be converted to the desired "clear, open" quarter section. However, this advance was accompanied by the total degradation of whatever surface hydrologic systems existed. It was now no problem to cultivate the land to the extent that small water courses were simply tilled out of existence and were only temporary problems during spring run-off or at times of heavy rains. We did accomplish the greater production of food but we also changed the hydrologic system to one which was intermittent and of much greater magnitude at those times it was active.

In terms of hydrologic change we were the architects of a system which now produced far too much water for short periods and virtually none at all at other times. We took the complexity out of the system, made it simple, greatly increased its responsive use to precipitation and created an era of feast or famine with our water supplies.

3.5 Agricultural Economic Pressure

Over the short two decades of heavy farm machine development economic forces came to bear which further caused significant change. Although the individual productivity of farm units grew, product prices failed to keep up with costs. Each farm unit had to grow larger and become more productive to sustain the individual farm. The smaller less productive farms simply failed and the whole concept of the family farm came into question. Every piece of land which could be tilled had to be pressed into production to sustain economic viability. The corporate farm came into being with the injection of large blocks of investment capital. These corporate farms were widely hailed as the answer to farm productivity while at the same time land management within these structures changed to reflect the need for profit at any cost. Environmental concerns quickly fell into the category of the unimportant and the whole concept of agro-engineering took a firm grasp on land development. Slowly but with a horrible certainty the pressure to destroy the family farm continued to build.

At this point in time, one can still compare the giant farm to the few small family farms still in existence in terms of how the hydrologic system has changed. The small farm still reflects a rather high degree of preservation of the surface water systems and with it, increased preservation of natural areas and excellent habitat. By contrast, the giant farm is nothing more than a food factory where the integrity of a water course is looked upon as nothing more than an impediment to greater production. The productivity of the land is also interesting when the large farm is compared to the small. Smaller, better managed farms are more productive on a per acre basis partially because environmental preservation is still a part of land management practices.

4.0 Demographic Impact

The dramatic change from rural to urban population shifts was inevitable under a system of increasing farm size. The earliest results were reflected in the closing of many local churches and the consolidation of schools. Shortly thereafter, the smaller hamlets and villages began to die while the larger centres expanded to accommodate a rural population which was not interested in moving to major cities. This process continues today fostered by the development of yet more machines which make farm labour less and less a part of production.

The new urban centres which are developing as the final integration of the smaller farms takes place are located where they are on a random basis. There was no planning in location with reference to adequate supplies of water or for ease of waste management. As they grow, the problems attendant upon urban growth could be much worse than in the large cities already in existence.

5.0 The Evaluation of the Southern Prairie Regions

That large area usually referred to as the Palliser Triangle has gone through changes which have reflected disastrous climatic variation which took a terrible toll because of man's poor land management practices and reflects to this day a lack of interest in putting in place a program which could at least mitigate a similar event. After the devastating drought of the dirty thirties, a program of tree planting and preservation of water courses was proposed throughout the area. The return of a moister climate regime brought this highly desirable plan to a halt and to this day.

a supposedly enlightened society has left this large agricultural area open to the ravages of drought should it ever occur again.

5.1 Agricultural Practices

Much of this area, now abandoned, was once a highly productive area where grains of high protein yield were common. It was also an area which conveniently lent itself to easy tilling because it was mostly flat rolling prairie. The fragility of the hydrologic system was not recognized at the time of early settlement with the result that even minor changes brought on by tillage had disastrous consequences. The final abandonment was a tragedy because the means were at hand to begin a program of renewal and had it been carried out, much reclamation of these lands would, by now, have been accomplished. Today much of the land lies idle and is used for some limited crop production and for extensive cattle grazing.

Many of those farm families moved northward into the Parklands where, as we have seen earlier, they began the process of ravaging yet more land. This whole area was visited by Dr. Prohodko, the director of the Hydrologic Institute of Kiev in 1959 in my company. He had been instrumental in recovering the productivity of similar lands in the Soviet Union. Coincidentally, the lost land which he had reclaimed had suffered degredation in much of the same manner of those of the Palliser Triangle. His description of the monumental amount of manual labour required recommends itself to a society which wants to conserve its finite land resources.

The recent relatively short lived drought of the prairies reflects the extremely poor management of the water resources still in existence. Rains of any magnitude are reflected very quickly in a quick and short lived runoff and an equally rapid return to dry water courses and prairie pot holes. The only recognition of continuing problems is the construction of large water storage areas. We simply will not apply ourselves to the total problem nor can we as long as we continue to believe that machines and engineering practices will bring about a solution.

5.2 Cropping Practices

We have traditionally been believers in growing grain and any change to new crops has always met with resistance. The introduction of sugar beets and even commercial potato crops had met with resistance and yet today, both are viable agricultural products limited to some extent by irregation. The southern prairies has a long history of climatological data which together with good soils indicate that the diversity of possible crops is huge indeed.

In the summer of 1977 I accompanied Mr. M. Shaddeck on a tour of this area. Mr. Shaddeck is an agronomic adviser to a good segment of the vegetable industry in the Salinas Valley of California. He was simply amazed that lands of such great potential were being used for cereal crops while the prairies; even in summer, spent millions of dollars to buy on the foreign market what could be grown at home as an excellent cash crop. He had pointed out that the production of table vegetables was a highly labour intensive agricultural practice. I was further surprised to learn that this industry can and does support relatively high labour costs. Our summer limitations in this field appear to be exactly the same as those of California, a lack of available water.

6.0 Waste Problems

The evaluation of the prairie farm unit has brought about significant changes in both the type of wastes produced and upon the distribution of these wastes. We have previously seen the demographic impact on population and the trend to the development of larger rural communities which are developing waste disposal problems similar to large urban centres on a smaller but growing scale.

Agricultural wastes have continued to be a problem because the basic farming structures have had a tendency to move away from mixed, widely diversified farms to units which concentrate their work in one area. Over the years, the trend to large grain farms and large feed lot operations has had a strong tendency to concentrate animal wastes. At the same time, the increasing use of agricultural chemicals ranging from fertilizers to pesticides are producing toxic wastes, some of which have residual times in soils and waters of up to several years.

6.1 Urban Wastes

Studies carried out by the Public Advisory Committee to the Environment Conservation Authority in 1976 showed some rather interesting results. In essence, the wastes of smaller communities are much the same as those of large urban centres. The major differences arise in that the management of wastes were of a lower standard. In many cases, waste management was of a nature which was in violation of Provincial health regulations. It was further shown the economic factors were the major casue of inadequate waste management.

Sewage treatment, in some instances, was non-existent and the dumping of raw sewage or poorly treated sewage into existing water courses is not uncommon. It should be kept in mind that many of these water courses, because of poor land management and increasing land utilization, have degraded to the point where constant flows are no longer reliable and winter flow are, for at least short periods, non existent. In some cases, even provincial government institutions were found to be in violation of their own health regulations.

In some specific instances, small prairie communities have managed sewage in very progressive ways. Brooks, Alberta is located in the irrigation district of the Province and has, for some years now, used its sewage effluent for the dual purpose of irrigation and fertilization with good success. In this case, the crop receiving the effluent is alfalfa and increased yields have been reported in each year. The town has found that it would have been much more difficult to manage capital costs with the normal sewage treatment facilities.

6.2 Animal Wastes

The mixed farms have historically utilized animal wastes by distribution back to the land and gained the huge advantage of recovery of organic material and fertilizer. However, as the specialized farms move away from mixed farming practice, two results are seen. The grain farmer has turned almost completely to chemical fertilizer while the raising and finishing of animals more and more falls into the hands of the feed lot where concentrations of waste are huge.

The agro-chemical wastes, some of which are toxic find their way back into already depleted or degraded water supplies. Some of these chemical residues remain in soils for varying times but are all eventually subject to leaching and a return to the drainage systems. We still do not know what the long term results of this action may be although there are indications in some areas that acquatic life is being adversely affected.

Concentrated animal wastes such as are found at feed lots are a continuing problem. Redistribution of these wastes on farm lands is economically impossible because of haul distances. Treatment of these wastes, their bacterial reduction to useable energy and fertilizer is not being done to any great extent. In many cases, such wastes have been dumped in sloughs and, in one instance, it was being dumped on river ice for disposal with the spring breakup. Local operators of food lots face the same economic problems as many farmers and are especially disadvantaged by labour shortages or high costs.

7.0 Why Do We Have These Problems?

I believe that you will all agree that the principles of the conserver society are not only correct but are in fact the only viable solution to the long range problems of water and waste management and indeed all of the problems of man and the biosphere. Our problems lie in the area of population masses not only failing to appreciate the consequences of our present direction but having their attitude shaped by those forces which are in fact the enemies of the conserver society. The previously recognized problems related to population dynamics, economic conditions, climate variation and political direction, agricultural development and consumption are all difficult to resolve because they are all dynamic and largely unpredictable. There is however a complex series of activities which are of paramount importance and which are largely predictable and which at least open the door to successful attack and these are the forces which shape the attitudes of the main stream of the population.

It is so easy to say that the problems are ultimately caused by people and how they behave but this is a simplistic approach to a problem which is highly complex. More likely, people respond to an endless series of pressures which are brought to bear by another endless series of forces trying to accomplish goals which are not compatible with the principle of a conserver society.

Why do people respond as they do? Who are the forces? What are they trying to accomplish? How do they do it? How can we cause changes in direction which are more compatible with our goals?

7.1 The Response of People

When we address the problem of water and waste management in small prairie communities we are examining a societal structure which is largely based upon agrarian pursuits. We are concerned with farmers and with those other activities which provide supportive services or goods for farmers. It is likely that these populations in the basic agricultural activities are the most independent people in the nation but even their independence is far from complete freedom. The black cloud of economic viability hangs heavily over their heads. They are forced every year to be more and more productive as individuals within a pricing structure which severely constrains their choice of options. They look to universities for help and guidance as they do to government. They are forced to call upon the products of the farm machine manufacturer, the supplier of agricultural chemicals and fertilizers. Hours of work become so demanding that there is no time left to pursue self sufficiency and they, like their urban friends become large consumers of manufactured goods and therefore producer of increasingly large amounts of waste. The tradeoff in horsepower for manpower has now placed us in the preposterous position of using more energy in agriculture than is produced.

7.2 Who Are These Forces?

No doubt, the major forces at play are directed by the worldwide manufacturing industry which has, in less than a century, changed the western world development from an agricultural base to an industrial base. A manufacturer produces goods which must be consumed. The usefulness or the necessity of such goods is never examined as long as consumption can be made to keep pace with production. Unfortunately, the production of unneeded goods also produces jobs.

Government has responded traditionally to the immediate needs and has a dismal record in long range planning because its basic goal is to stay in power. Government responds to the most powerful forces acting upon it and it should be clear that the influence of economically powerful giants such as the major industries of both multinational and national character have more clout than most classes of individuals. Government will respond more to labour than to the farmer simply because the large majority of labour resides in industry rather than in agriculture or other individual pursuits.

Government does not initiate it merely responds to worldwide economic pressures. Balance of payments become more important than the protection of our agricultural lands and capabilities. We are directed to produce more exportable resources and food to balance the cost of imported manufactured goods where necessity is determined more by fashion than real requirements.

The institutions of higher learning have been supportive of and have contributed to the philosophy that, with present demands and constraints, agriculture must move toward bigger units of greater economic viability without examining the long term implications of this direction. But, the universities are not solely to blame. Funding for research in agricultural mechanization, the use of biological control agents, fertilization and tilling methods to best utilize these products originates from industry itself. Plainly, no industry will fund research which may result in decreased activity and profits for that industry.

World populations and the attendant increases in demand for food have shown little sign of abatement and those demands may well double over the next 35 years. To bring the present world population up to acceptable levels of nourishment is beyond our apparent ability and even if this were accomplished it has been predicted that it would only accelerate population growth.

And finally there is the force of industrial sales promotion by the advertising industry which has had an unbelievably successful history. Like all the other forces, it works within narrow bounds and does not concern itself with broad prospectives nor long range implications. This industry with a multi billion dollar annual budget assures the consumption of manufactured goods and products and thus the employment of industrial workers. All of the above mentioned forces are some of the major causes of the problem related to water and waste management.

7.3 How Are We Directed:

It is interesting to reflect upon the reasons we have moved in the directions we have. It appears that there were few times when man had a broadly accepted need that was finally filled by technological development. Rather, technological development took place, was efficiently marketed and shortly thereafter became a "need". It is the precise mechanism whereby unneeded technology and manufactured goods began to move through the hands of consumers. The development of need has been a triumph of the advertising field where, in the recent past, the role of behavioral scientist has greatly increased. The power of the media to make us move in particular directions is funded to the tune of about 36 billion dollars annually, something like $600 annually for each household in the United States and Canada. The power to offset this gigantic thrust at consumerism is measured in the meagre dollars which fund conferences such as this one. By the time that the children of North America reach the age of eighteen they have been, on the average exposed to about 1800 hours of television commercial messages or, in terms of a 35 hour work week, to one year of consumer direction. As if this horrible waste of time itself were not enough, the energies of about 150 private consulting firms of behavioral scientists contribute their skills to making the messages more compelling. These firms psychologically teach you to develop a "need". Every psychological weapon is used from fear to pleasure to sexual response. Our defense has been in the slow process of education and an appeal to common sense with a budget which dooms the approach to failure. How do we defeat the subliminal advertising which makes coloured toilet paper a need? How do we defeat the forces which more and more decrease the diversity of human thought while pyschologically moulding more and more people to become the garbage disposal system of unneeded products and productivity? How successful can we hope to be when we ourselves are admitted victims of this type of endeavour? Is it at all reasonable to direct ourselves to the management of water and wastes in small prairie communities at the local or regional level when the problems are caused initially by an international economic system which is an uncontrolled orgy of biospheric degradation? Finally, shall we direct our attrition to the accommodation of industrial depravity when we know that there is no long term accommodation? The obvious answers tend to lead us to despair.

8.0 A Different Approach

In recognition of these problems, the community of people who were the architects and are still the supporters of the Conserver Society have banded together to develop their ideas and solutions. We have, however, failed to appreciate that all our conferences, all our papers and publications and all of our appeals to the powers that be have achieved nothing more than a pat on the head for our efforts. The whole system continues on its merry way without regard to our almost unanimous agreement that the entire economic structure is self defeating because at some time we will arrive at a point in time when the biosphere cannot sustain us. We all suffer the endless frustration of knowing now what has been done and I have chosen not to insult your intelligence by recounting all those strategies of which you are already aware.

I have little confidence that the traditional process of education will bring about the needed change. In fact, I am greatly troubled by the attitude of what I perceive to be a majority which look upon the current supporters of a Conserver Society with a high degree of suspicion. The academic community is frequently looked upon as the comfortable ivory tower, closed to the common man and insensitive to his needs. It simply doesn't matter whether such charges are true or not but it is important to recognize that this attitude does exist. We are faced with the problem of overcoming such attitudes in a way which will directly involve people. It is necessary therefore to move away from the traditional student-teacher relationships and to develop a dialogue involving what is now the small core of members of the conserver society and the public at large.

8.1 The Public Hearing Process

Over a five year period I have learned, to my own satisfaction, that the general public, when given a chance to be informed, is an excellent judge and will support those moves which we, as a body, advocate. My own experience is that, given a chance, the general public agrees with our goals and is able to express those goals with admirable skill.

Until the defeat of the Environment Conservation Authority, Albertans by the thousands appeared at public hearings which ranged over many different subjects related to the environment and the vast majority were strong advocates of the principles we usually refer to as those of the conserver society. I have no reason to believe that other Canadians on the Prairies would be different. We have seen the Berger Commission listen to our northern populations as they too expressed concerns favoring conservation and the perpetuation of even that relatively hostile environment.

We are concerned with small prairie communities which is especially appealing because these are precisely the people who have the strongest feelings of environmental preservation. They are, at the same time, the group which is under the greatest economic pressure to ignore these principles.

8.2 People Response

At this time, there is no forum in which our average man and woman can express and advocate those notions in which he believes. Every one of us wants to be heard, to have an opportunity to publicly express our thoughts and aspirations, to be able to point out the failings of our society and to make recommendations to adjust our directions. Given the opportunity, people will spend many hours preparing for the opportunity to speak out. I cannot stress too much how grateful people are for the mere opportunity to appear publicly nor how strongly they will support those public opinions which are demonstrated to have the support of the majority. It is urgent that all of us have confidence in the general public ability to understand our concerns and that the principles of a Conserver Society will be adopted by them. At the same time, we must understand that our objectives must be articulated by the population at large. It is the only way the forces of industrial demand and consumption can be beaten.

The cause of the Conserver Society will only move forward when it gains public popularity. Our job now is not to continue with closed conferences, nor to publish more papers, nor to invent more conserver technologies. We must instead devote ourselves to directly involving people so that the adverse forces of industrial promotion, governments and even the universities will be defeated in democratic fashion.

That job is, in my opinion, best accomplished through public hearings. A victory can only be won when the public at large rather than such small groups as ours becomes the Conserver Society.

ENERGY AND THE CONSERVER SOCIETY ON THE PRAIRIES

Laurence W. Vigrass
Energy Research Unit
University of Regina

Abstract

Canada is no longer self-sufficient in crude oil and faces the prospect of energy supply being a major constraint to growth and development during the remainder of the 20th century. Excessive energy usage and the conspicuous consumption of other materials with high energy content is likely to lead to deleterious effects on our natural environment. The twin threats of energy shortage and pollution can be diminished by adopting the principles inherent in the Conserver Society.

To understand consequences of our actions or our inaction, we should know something of the unique nature of the energy resource. Energy is a commodity that is not destroyed during use but it is degraded and cannot be recycled. In analyzing energy production and usage, "budgets" are prepared in order to scrutinize energy inputs and outputs. A common error is to consider only direct energy inputs (such as fuel oil, natural gas or electricity) and not to include indirect energy inputs (in the form of materials which use energy in manufacture, transport and so on). While recognizing that serious problems may result from obtaining and using massive amounts of energy, we must recall that two major benefits accrue from ready availability of the commodity: by using cheap energy, the worth of human labour is enormously increased and the resulting industrialization has allowed specialization of employment that has brought indisputable benefits to mankind. In Canada, continued availability of energy is not just a matter of convenience: it is crucial to our survival because of severe climate, vast distances involved in transportation and communications, and dependence on widely-dispersed natural resource industries. Fostering conserver-oriented guidelines now will allow Canadians more energy options in the future.

Introduction

In Canada today, one can detect two opposing voices speaking out on energy issues. One voice, which represents the high energy position, says that we should pull out all the stops to meet a future demand expected to grow at rates not much different than we have experienced in the past. The high energy position focuses on economic growth and the impressive technological capabilities with which we are able to confront problems of supply. The other voice, which represents a low energy position and the Conserver Society, questions the ever-growing per capita demand for energy and energy-related commodities which it claims is encouraged by modern marketing techniques. The low energy position focuses on the magnitude and complexity of the problem, pointing out that there are limits to exponential growth in industry just as there are in a biological community where only a limited number of doublings of the population can occur before strong retarding influences appear. Low energy spokesmen are particularly concerned about adverse environmental effects and foreclosure of future energy options. They advocate slow growth or no growth of energy demand through a Conserver Society approach.

No doubt this is a simplistic view of the situation. Many people, of course, take an intermediate position to have a view quite different from those expressed above. It is only fair to state as well, that a great many of the high energy advocates realize that we must practise conservation and give their unqualified support to conservation measures.

This paper is intended to initiate discussion. The position taken is that we must be assured of an adequate supply of energy for the survival of Canadians and Canada. Crude oil accounts for 44 percent of our current energy needs and the domestic supply is declining so that we are increasingly dependent on high-cost foreign oil. Security of supply is worrisome and there are deleterious effects on our balance of payments. We can develop heavy oil and tar-sands oil and bring in gas from the frontier areas but there is a sizeable time lag and it will be costly. In the longer term, we face depletion of the world's oil and gas resources. On the supply side, no single source is going to solve all our problems and a mix of conventional ("hard energy") and alternate ("soft energy") sources is the most practical solution. The mix has the added advantage of diversity and flexibility.

On the demand side, there are very good reasons why the growth of energy usage should be diminished. It is doubtful whether Canada's growth rate in energy can be sustained without taking capital funds, resources, and manpower away from other sectors to which we attach a high priority. On a worldwide basis, the problem is even more difficult. If we bring energy usage for the world's population up to our level in Canada and the United States, world usage would increase by at least twelve times. With an increasing world population and increased per capita demand in North American, the levelled world demand -- according to some prognosticators -- could grow to 60 or 100 times current world usage. Proponents of the Conserver Society point out, with justification, that these inflated demands will be impossible to meet. Additionally there is concern that excessive energy usage and the conspicuous consumption of materials with high energy content will lead to deleterious effects on our natural environment.

Canada faces the prospect of energy being in short supply in the last two decades of the 20th century even though continued availability of energy is crucial to Canadians. Excessive energy demand may lead to serious environmental, economic and social problems. Concepts of a Consumer Society, basically opposed to waste and pollution, will diminish these threats and will allow society a broader range of future energy options.

This paper presents a survey of major energy issues including historical perspective, description of the benefits of energy availability, prospects for future energy supply and some of the problems of pollution. These are worldwide issues and concern all of us. Several issues are of special concern to the prairies and to smaller communities on the prairies. The second part of the paper is an examination of specific proposals that relate to energy usage in small communities within a Conserver Society. These proposals must differ in scope and emphasis from conserver principles for metropolitan communities.

Energy Issues

Nature of energy. Energy, commonly defined as the ability to do work, has many forms including mechanical, heat, chemical, electrical, and nuclear-binding energy. Energy may be changed from one form to another or it may be transferred from one body to another and, withthis transformation or transference, energy is neither lost nor gained. Heat energy will not pass from a body at lower temperature to one at higher temperature unless energy is supplied from some external source. The last axiom, a form of the Second Law of Thermodynamics, leads to the concept that temperature is a measure of the availability of heat energy. Hot bodies in the universe tend to become cooled and the cooler surroundings are warmed up. The total amount of energy in this system remains the same but its availability becomes less as cooling takes place and the energy is degraded. Energy sources of high temperatures (or other forms such as natural gas or electricity readily converted to high temperatures) are spoken of as high-grade commodities whereas low temperature sources (such as luke warm water) are referred to as low-grade commodities. Available energy is what we are interested in so that it is important for us to use efficiently the high-grade energy commodities and to utilize the low-grade energy sources where it is possible to do so.

Engineers and others commonly use a form of energy bookkeeping where they first define a system and then analyze it in terms of energy inputs, energy outputs, and the change of energy stored in the system. Such an analysis leads to an energy budget where certain forms of energy input, output, and storage are recorded. Energy budgeting is a complicated game but an extremely important point in energy conservation measures is that we consider not only direct use of energy commodities (such as the consumption of fuels) but that we also consider indirect input (such as use of a machine, chemicals or building materials that required high-grade energy for manufacture and transport). Only by including indirect inputs can we really determine effectiveness of conserver measures such as recycling.

Historical perspective. To evaluate our present position and future outlook on energy, historical perspective is desirable. For a more complete account, the interested reader is referred to the papers by Hubbert (1974 and earlier).

The astronomical process that produced the earth occurred about 4,500 million years ago and there is a record of life on earth that extends back about 3,200 million years. Life is supported, either directly or indirectly, by energy from the sun with about 0.02 percent (one-fiftieth of one percent) of the sun's energy being converted to chemical energy photosynthesis. During the past 600 million years life of various kinds has been abundant and a minute fraction of the earth's organisms have been deposited in coal swamps and marine muds to be buried and subsequently converted to the coal, natural gas and crude oil that make up our fossil fuels. The amount of energy stored in any one year is relatively small but the amount of time is large (300,000 times the length of the Christian era) so that our fossil fuel resources, by some measures at least, are large.

During the past several hundred thousand years members of the human species, relative newcomers on the scene, have distinguished themselves by being able to control energy that orginates outside of their own bodies. This was accomplished successively by the control of fire, then using the power of other animals, wind and running water. The rate at which the human species could use energy was greatly increased when he began to utilize the great storage house of fossil fuels. Coal has been used on a continuous basis in northeast England for 900 years, first for domestic heating and subsequently for smelting metals. A high level of industrialized society became possible about 200 years ago with the development of the steam engine (Fig. 1) which led to the locomotive, steamship and steam-electrical power. About 100 years ago a large new energy source in the form of petroleum began to be tapped and with the development of the internal combustion engine came automotive transport, the aeroplane and diesel-electric power. Hydroelectricity, based on large water-powered turbines, was successfully demonstrated at Niagara Falls about 1895. With the controlled splitting of the atom in 1942, the vast new source of nuclear-binding energy through fission was added to the energy available to the human species.

Coal usage became significant about 1800 and world usage grew rapidly from 1860 to 1910 with a doubling of the demand rate every 16 years. A slow period of growth ensued but since 1945 there has been an acceleration of the world's usage rate with a doubling of demand about every 20 years (Hubbert, 1974). Currently coal fulfills about 40 percent of world energy needs and about 8 percent of Canada's energy demand.

Crude oil began to be used in significant amounts about 1900 and the production rate has doubled seven times up to 1970 (see Fig. 1). Currently crude oil supplies over one third of the energy requirements for all major energy consuming countries. The present demand is about 20,000 million (20 billion) barrels per year or about 55 million barrels per day. We think of our province as a significant producer of crude oil but Saskatchewan's current annual production of 50 million barrels would last the world about 22 hours. Cumulative world crude oil production up to the end of 1975 amounted to 341 billion barrels (WAES, 1977). Of this, the first half was produced in the 108 year period from 1857 to 1965 and the second half was produced in the 10-year period from 1965 to 1975. In Canada crude oil consumption, accounting for 44 percent of our primary energy, is currently 650 million barrels per year and about one-sixth of this is imported.

Natural gas markets have been determined largely by practicality of transportation and distribution by pipeline. Usage in major energy consuming countries varies widely fromvirtually nil in Sweden, Denmark and Japan to 20 percent of primary energy in Canada, 30 percent in U.S.A.. and 47 percent in the Netherlands.

Hydroelectricity supplies only 2 or 3 percent of the world's energy but is much more important in Canada where it accounts for about a quarter of the country's energy needs.

Other world energy sources are currently small or difficult to quantify. Nuclear power accounts for about 2 percent of energy supply in both the world and in Canada. Despite this relatively low level, there are 10 nuclear reactors now operating or under construction in Canada and 133 in the United States. Currently the aggregate energy derived from geothermal, solar heat, solar electric, wind and tidal sources accounts for much less than 1 percent of the world's energy needs. The amount of heat energy supplied by the direct burning of wood, animal manure, and wastes of various kinds is considerable but the amount is difficult to assess.

Benefits of energy availability. In a major energy-consuming country like Canada and during this period of high technology it is easy for us to overlook the benefits of ready availability of energy. We tend to lose sight of the reasons why the human species has travelled the course it has and why it has taken advantage of using fossil fuels and the other sources of readily available energy. From the start of the Industrial Revolution in 18th Century England the effect of fossil energy, innovation, improved technology, and new ways of organizing capital has been to reduce the amount of human labour to produce a similar measure of goods and services. Nowhere has this been more evident than in agriculture. Before 1730, four out of five workers in England and Wales were required to work on farms, mostly to provide food for those countries. At the present time on a United Kindgom farm that raises wheat, a single worker has to work half an hour to produce the yearly calorific requirements (2,000 Calories/day) for an adult (Leach, 1976). Figure 2, adapted from Leach's book, shows that the reduction of farm labour with increased energy input has continued into the modern era. From 1952 to 1972, energy input into United Kindgom farms has increased by 70 percent, the calorific and protein outputs have increased by 38 and 46 percent respectively, and the labour input has been reduced to 40 percent of the 1952 input and the energy input has been increased to 120 percent. The farms have become markedly more labour efficient and somewhat less energy efficient and one would expect the reason for this is that the worth of labour has risen relative to the cost of energy. In Saskatchewan during the past 25 years the productivity increase per man-year of farm labour has been even more radical and we are in the process of quantifying this in a University of Regina study.

It can be argued with some justification that the increased labour efficiency illustrated by Figure 2 need not reflect an improved quality of life for most members of society. One cannot deny, however, that industrialization based on availability of abundant energy has brought a greater division of labour and increased specialization leading to developments in almost every field of endeavour. All but the most cynical agree that the division of labour has brought great benefits to the human species; all but the most naive recognize the problems that have accompanied this phase of human development.

As residents of western Canada, we are quite aware that a severe energy shortage, if it occurred in winter, would be extremely uncomfortable and could well endanger our survival. As residents of isolated communities, we are equally aware of the high energy demand for transportation. Energy has been cheap and plentiful in Canada and we are "locked in" to many energy intensive industrial activities. Energy availability is crucial to the survival of Canadians and Canada. It need not necessarily follow that extravagant energy usage results in increased benefits.

Population and energy. A complex relationship exists between energy usage and population growth. We tend to think that increased population causes an increased usage of fossil fuels. We tend to disregard the fact that increased population has also resulted from increased availability of fossil fuels. In 18th Century England and Wales, the population grew from 5 1/2 million in 1700 to 6 1/2 million in 1750 and thereafter grew rapidly to 9 million in 1800. Improved medical practice and improved diet, the latter the result of increased prosperity and increased trade, have been cited as reasons for the marked population increase after 1750 (Fuller, 1969). The better standard of living resulted in part from the widespread introduction of coal to fuel the new factories and workshops. In more modern time, a remarkable growth of world population has occurred since 1900 (Fig. 3). Doubtless this has had a multiplicity of causes that include improved standard of living and better medical care. The population increase is presumably related to industrialization with its higher productivity; technological improvements, greater division of labour, and improved opportunities for research. These benefits, in turn, are related to the availability of abundant energy.

Problems of pollution. During the recent past we have become aware of the fragility of biological systems and concern has been expressed for entire ecological systems such as the Mackenzie Valley and the Prairie Grasslands. Much of this concern stems from industrialization and our use of energy commodities. There has been a tendency for the human species to attempt to dominate the biosphere rather than to live within the natural system. The biological system can handle a certain amount of pollution in the form of chemicals, organic wastes and excess heat but there is a limit which must not be exceeded.

Air pollution directly related to energy usage is generally associated with thermal processes. Thermal power plants, especially those using coal, release particulates such as fly ash and oxides of sulphur and nitrogen to the atmosphere. We are fortunate in western North American because our coal contains little sulphur. Energy-intensive industrial processes are major contributors of dust or other particulate matter. This may be a problem in small communities where plants are handling large quantities of rock or other earth material, agricultural products, or chemicals. Automobile pollution is not likely to be a distressing local problem in small communities but it is certainly a concern on a continent-wide and worldwide basis. Engine emissions of hydrocarbons, carbon monoxide, and nitrogen oxides have been alleviated by pollution control equipment but not without cost in the form of energy efficiency and materials. Burning of municipal, industrial, agricultural and domestic refuse -- an energy waste -- contributes particulate matter (smoke), carbon monoxide, and other pollutants.

Burning fossil fuels is returning to the atmosphere large volumes of carbon dioxide which has not been in circulation for hundreds of millions of years. Carbon dioxide content of the atmosphere has increased during the past 200 years since the start of the fossil fuel age. This is cause for concern in the medium to longer term because carbon dioxide gas is largely transparent to incoming solar rays but reflects the longer-waved radiation by which the earth's heat escapes outward. The effect is similar to a glass window and is called the "greenhouse effect." At the present time we do not understand climate well enough to know what the eventual result will be but a small change in the earth's average temperature would have disrupting effects. Possible effects include shifting of weather patterns, shifting of climatic zones, and -- potentially the most catastrophic -- melting or expansion of the ice caps in Anarctica, Greenland and elsewhere.

Conspicuous energy usage has resulted in concern over "thermal" pollution. Constant degradation of energy means that most of the energy commodities used end up as heat that is dissipated into the environment. Much of this is "waste heat" that is at too low a temperature to be recovered readily: a steam power plant fueled by fossil fuel dumps two units of heat energy for each one that it converts into electricity; the waste heat from nuclear plants is comparable or somewhat larger. The waste heat is dissipated into cooling waters or into the atmosphere. The effect is two-fold. Fresh water runoff must be diverted through the generating plants with a disrupting influence on inland fresh water life. The second effect could be even more serious over the long term if uncontrolled and inordinate growth of energy usage occurs. If energy consumption were to double in amount every 10 years, within 100 years the energy release in North America would be almost the same as incoming solar radiation. Long before we reach this level of thermal pollution something must change.

Pollution of inland waters, of the soil, of the subsurface, and of the ocean are subjects so wide in scope that we can only mention them here. Many of the problems are related directly to energy supply and usage. Oil spills at sea, into inland waters, or on the land surface are related to petroleum production and transportation: they are likely to increase in frequency and severity as the world production of petroleum is increased. Widespread surface mining of coal is likely to result in spoilage of land and adverse environmental effects of various kinds. Handling, transport and storage of radioactive wastes from nuclear reactors is a special type of pollution problem because the wastes remain radioactive for hundreds and thousands of years. Justifiably this is a matter of public concern and public debate on the issue has decelerated introduction of nuclear power in many countries. Building of dams and diversions for hydroelectrical sites, while not pollution in the strictest sense, results in environment disruption which has been of considerable concern to many of us here in Saskatchewan.

Where there is high energy production and consumption, there is almost certain to be high throughput of materials. High throughput of material inevitably increases disturbance of the natural environment and the likelihood of serious pollution.

<u>Outlook for energy supplies</u>. We have examined the context within which the world and the nation have become heavily dependent on fossil fuels with very much lesser dependence on hydroelectricity, nuclear energy and the various nonconventional forms like solar, wind and geothermal. What, then, is the outlook on a worldwide basis and on a national basis? Are there special problems of local concern? How long will our supplies of fossil fuels last and how will they be replaced?

The world is over 90 percent dependent on fossil fuels, a resource that is being depleted because it is being used up immensely faster than it is being formed. To appraise the seriousness of the supply problem, we would like to be able to map out the life cycle of usage and depletion of the major fossil fuels. An estimate of the world life cycles for conventional crude oil and for all of the fossil fuels (petroleum fuels plus coal) is shown in Figure 1. To map out the complete cycle of usage, one must know the total amount of usable resource and the rate at which it will be used.

Specialists cannot estimate exactly the extent of fossil fuel resources but the subject has been confused unnecessarily by misuse of terms and misunderstanding of the concepts involved. It is advantageous to restrict the term reserves to economically recoverable material in identified deposits. Resources refers to these reserves plus identified deposits that are presently uneconomic plus deposits that so far have not been discovered (undiscovered deposits) but are considered to be present in favourable geological environments with some degree of certainty (McKelvey, 1974). The presently uneconomic deposits will become usable with progress in science and technology and with shifts in economic conditions. Undiscovered resources are quantified on the basis of geology and this assessment will change as our knowledge of geology increases. We must expect to revise our estimates of total resources periodically to take account of new developments. We must recognize that some of our estimates (especially of the undiscovered resources) are incomplete and provisional but even these estimates help to define the supply problem and provide a basis for policy decisions.

As early as 1962, M. King Hubbert had mapped out the essential cycle of usage and depletion for fossil fuel resources in the United States. Hubbert pointed out that the production of such a commodity begins at zero, undergoes a period of increase, reaches a maximum or culmination and then undergoes a period of more or less continuous decline. He contended that the increasing and the declining side of this usage curve are essentially symmetrical. To prepare the curve, one needs the total size of the usable resource and a significant portion of production history. A critical point on the production curve is the date when production of the commodity will peak.

An estimate of the world usage schedule for conventional crude oil as prepared by Hubbert (1974) is shown in Figure 1. The usage schedule is based on production up to 1970 and a total resource of 2,100 billion barrels. The curve shows a production peak of double the present world demand at year 2000. The total resource estimate agrees well with more recent figures of 2,000 billion barrels of usable resource and peak world production sometime between 1990 and 2005 (WAES, 1977). Other informed observers consider that peak world oil production will occur as early as 1985 and no later than 2000 (Daniel, 1977). The remarkable thing about the usage curve is that it is so sharp: 80 percent of the world's conventional oil will be used up between 1967 and 2031; it is doubtful whether these dates are out by more than a few years.

World usage schedules for tar sands oil, shale oil and natural gas have not been prepared. At 40 percent recovery, the total usable resource for tar sands oil is likely to be about 1,000 billion barrels and there may be a similar amount of shale oil available. Because of technological problems and capital costs for recovery plants, significant amounts of these resources will not be available before 1990. The total usable natural gas resource for the world is estimated to be 50 to 100 percent of the size of the conventional oil resource (WAES, 1977). These three petroleum - related commodities will fill some of the supply gap as conventional oil production declines but they will be largely used up in the first half of the 21st century.

Plausible estimates of the world's usable resource of coal range from about 2,500 billion (metric) tonnes (WAES, 1977) to 7,600 billion tonnes (Hubbert, 1974). An intermediate estimate by Hubbert of 4,300 billion tonnes is accepted as the probable usable coal resource. The usable coal has an energy content about seven times that of the world's conventional oil resource.

From these figures and Hubbert's usage schedule for coal, an approximate usage schedule for the world's fossil fuels is shown in Figure 1. The diagram illustrates their ephemeral nature with 80 percent of the resources used in the period 1970 to 2330 with peak production about 2150.

A disturbing aspect of this scenario and of other predictions of fossil fuel supply is that the highest performance on world supply that we can reasonably expect is to double our curruent production rate by the year 2000. In order to "level up" the energy supply of the lesser developed with energy supply in North America, a twelve fold increase of the world production rate is required. Even if there is no energy growth in the developed countries we will fall short of such a levelling up and the developing countries will be denied the advantages that adequate availability of fossil fuels would bring. If we accelerate the production, the faster we will use up the resource and precipitate shortages.

On the national scene, there are no easy answers to Canada's energy supply problem to the end of the 20th century. Currently we are importing about 300,000 barrels of oil (at about $12.00 per barrel) per day. McNabb (1976) has shown that this crude oil shortfall will likely increase to 700,000 barrels per day in 1984 before decreasing to 450,000 barrels per day in 1990 and possibly diminishing still more in the 1900's. McNabb says that shortfall could be considerably worse than this unless the following measures are in effect: 1) Domestic oil prices are raised to current international levels so that exploration and development are encouraged and the demand moderated; 2) Oil sands and heavy oils are brought on quickly by paying the required price, building upgrading plants, overcoming environmental-social problems, and resolving provincial-federal difficulties. The plants would require $15 billion dollars capital and an operating labour force up to 20,000 people for 800,000 to 1,000,000 barrels per day in 1990: 3) Demand in 1990 is reduced back to the 1977 level of 1,750,000 barrels per day through mandatory miles per gallon standards for automobiles and other conservation measures including a new building code, a nation-wide retrofit insulation program, and savings in industry, heating systems, and appliances.

The situation for natural gas is considerably better than it is for oil. There is currently an oversupply of gas in Alberta due to higher prices and a drilling incentives program. There has been a slight slackening of the demand growth rate. In addition to the established gas areas, significant reserves have been outlined in the Mackenzie Delta and in the eastern Arctic Islands. Pipeline connection of this gas is possible by the middle or late 1900's. We would do well to bring this gas to market fairly quickly for two reasons: to fulfill our export commitments and cover some of our balance of payments deficit on imported oil and to prevent the potential gas market from turning to imported oil.

Canada has very adequate total measured resources of coal with the energy equivalent in excess of 110 billion barrels of oil. The resources are mainly in Alberta and British Columbia with lesser amounts in Saskatchewan and the maritime provinces. The coal occurs long distances from the major markets in central Canada with the result that Canada is simultaneously the sixth largest coal exporter (largely coking coal to Japan) and the third largest importer (mostly thermal coal from the U.S.A. into central Canada). In 1990, coal production may be about 150 percent of its present level, used mostly for thermal electrical generation. In the 1990's, sizeable amounts are likely to be required for gasification and there may be one or more liquefaction plants built as well.

There is considerable undeveloped hydroelectric capacity in Canada, especially in Quebec, British Columbia and Alberta. It is estimated that hydroelectric generating capacity in 1990 will be at 184 percent of 1977 capacity (McNabb, 1977).

Public acceptance and continued growth of nuclear electrical power generation depends on the successful continuation of safely handling nuclear wastes, the continued high safety record for fission reactors, continued avoidance of large scale accidents, and satisfactory safeguards to keep fissionable materials safely guarded from extremist or terrorist groups. Ontario Hydro currently has 4,000 megawatts of nuclear power or 20 percent of their generating system. The total in Canada will be about 14,700 megawatts in 1988, an estimated 25,000 megawatts in 1990, and a possible 82,000 megawatts in 2000 (Boulton, 1977). Nuclear power could well account for 10 percent of Canada's energy supply in 1990 and considerably more than that in 2000.

New energy sources require a long time to be significant energy suppliers. It is estimated that the non conventional technologies (solar, biomass, geothermal, wind) will supply 3 percent of Canada's energy in 1990 (McNabb, 1977); this is equivalent to 120,000 barrels of oil per day and is a sizeable amount of energy. The non conventional sources may supply 10 percent by 2000 (Hart, 1977).

Summary of Energy Issues

1. Energy availability is crucial to our continued well-being and existence.

2. Conspicuous energy usage intensifies the problem of environmental disturbance and over the long term energy usage may be limited by the disruptive effect it has on the earth's environment.

3. For the next 10 or 20 years we are largely dependent on the sources of energy we already have, mainly fossil fuels. Production of conventional crude oil will peak about 2000 and decline thereafter. Tar sand oil, shale oil and natural gas will be used up in the first half of the 21st Century. Production of fossil fuels will decline after 2150.

4. It is impossible to continue on our present growth path, especially if to bring the lesser developed [illegible] up [illegible] our [illegible] energy [illegible]

5. In Canada we face importation of crude oil during the next 10 to 15 years despite prices being raised, conservation measures being introduced, and tar sand - heavy oil recovery being accelerated. Natural gas availability appears to be adequate at least until 1990.

6. Provided it is accepted by the public, nuclear electrical generation is likely to increase 20-fold in the next 22 years.

7. Renewable sources may supply 3 percent of Canada's energy by 1990 and 10 percent by 2000.

8. In the medium term, in 20 to 50 years, we will have to find suitable substitutes for most of the petroleum mix that dominates our near term energy supply. Renewable technologies will be important but liquids from coal will be used for portable fuels.

9. The fossil fuel epoch is a temporary period of a few hundred years, a brief span of human history. In the long term conversion of solar energy will be a dominating process. Nuclear fusion, currently in the earliest experimental stages, will be a possible energy source. Hydrogen is possibly the portable fuel of the long-term future.

Conserver Society and Prairie Communities

Conserver principles are relevant to our near term problems because they gain time to maneuver and an opportunity to exercise desirable future options. A conserver-oriented society is concerned with the future of the environment. In Canada -- where energy availability is crucial -- a diversity of sources, flexibility of supply, and local responsibility for usage offer advantages of greater energy security, lower distribution costs, responsible participation, and possibly lower overall social and environmental costs. According to proponents, technical innovation and new social and technical models are welcomed in a Conserver Society.

There are certain conserver principles concerning energy which we can all practise but which may have special relevance to smaller communities on the prairies. Many energy conservation principles follow directly from economical considerations: the greatest savings in dollars are commonly savings in energy and energy-intensive materials. The two areas with greatest potential for direct energy savings are space heating and automotive fuel consumption.

Space heating. An immediate concern is to improve energy utilization by the prudent use of insulation and reduction of air exchange. New buildings should be built with adequate energy saving features. We should retrofit where we can, and, within the limitations imposed by our existing buildings, bring these up to high energy saving standards. (Some excellent information is now available to a person who is not a specialist in the building industry. The Energy Conservation House in northwest Regina displays many energy saving features including insulation, reduced air flow, recovery of heat from outgoing air and waste water, reduction of [illegible]dows on north side, use of [illegible] and [illegible] passive solar heating. [illegible] [illegible] Canada.

In the area of legislation and government initiatives, we should be pressing for higher standards of insulation and other energy saving features on new buildings. Economic incentives should encourage energy conservation including removal of taxes on insulation and more effective subsidization or grants for retrofit insulation. We should be telling our legislators and our utility companies that we do not agree with rate structures that offer a lower unit price for larger volumes of natural gas or electricity.

Multiple-unit housing with common walls and a higher ratio of living space to cold exterior surface is more energy efficient than the single family dwelling. This is counter to the life style of many Canadians but there are situations where such housing would be desirable in small communities as well as large ones. We should look more closely at the feasibility of district heating for new housing projects. This would be especially advantageous where the district heat source could be low-grade waste heat from industrial processes or power generation, low-grade geothermal heat, or a solar mini-utility. Similar low-grade heat sources could be used for heating of greenhouses or for preheating water for industrial, commercial, residential or institutional use.

Maximum energy savings will accrue in multiple-unit housing and district heating with individiual metering of energy users. For low grade heat supply this is not easy to accommodate but should be possible with miniaturized controls.

Automotive fuel consumption. Individually we can improve automobile efficiency by keeping our vehicles in good operating condition, reducing driving speed, and practising other good driving habits. There are many other ways that we could reduce gasoline consumption if we had the incentive to do so: driving a smaller car; reduce usage by walking, cycling or ride-sharing; and use of public transportation. I am skeptical that these measures will really take effect until the penalty for non-conformance is quite high.

We should be questioning the usage of our public transportation systems: in some situations, I feel sure, improved service would result in a total energy savings but in other cases the reverse may be true.

Alternate energy sources. Biomass — which includes wood, straw, manure converted to methane, etc. - could contribute substantially to the energy supply of small communities but there are possible shortcomings. The cost of collecting and processing the biomass may be high and the net energy saving may be quite small. A conflict may arise over land usage if agricultural land is used to raise fuel rather than food. Removal of biomass from agricultural land may lead to deterioration of soil texture and fertility. In some areas firewood may be an excellent alternative to high cost fuel oil or electrical heat.

Solar energy is being demonstrated in more than 100 buildings in Canada and on the prairies is practical insofar as it will supply a sizeable portion of the space heat for residences. Currently it appears that solar heating will save money in competition with natural gas or oil only if there is no charge or a minimal charge for installation. Systems are reported to be economically attractive for grain drying, domestic hot water heating and for swimming pools. Many components and systems have not been adequately tested under western Canadian conditions for long periods [illegible]

University of Regina, and information is available from the Solar Energy Society of Canada Inc. Solar energy for space heating will be economically viable within a few years as fuel costs rise and it will supply large amounts of low-grade energy. Research, development, testing and demonstration should be continued and consideration given to the support of local suppliers.

Southern Saskatchewan and large parts of Alberta have the potential to supply low-grade geothermal energy by using warm waters (above 122°F or 50°C) from depths of 5,000 feet or more. Research and testing of this energy source is at an early stage with development and demonstration planned for the University of Regina. Under some circumstances, the energy source may be suitable for space heating of institutional buildings, shopping centres, sport complexes, apartments or groups of residential houses.

Wind is a large potential energy source but wind plants are still prohibitively expensive per unit of output. Much more research and development is needed to reduce the cost. Small units may still be practical in isolated locations.

Other considerations. All materials in the marketplace represent an indirect use of energy. If goods are more durable with a longer life cycle or if they are designed so that they can be easily repaired, the result is a saving of energy. Planned obsolescence and the "use and discard" philosophy are wasters of energy and other resources.

Many recycling schemes involve large expenditures of energy for collection of materials. These schemes should be examined carefully to see whether there is a net saving of energy.

Conclusion

We should be assuring the availability of energy in the near term and in the more distant future by researching, testing and developing the broad spectrum of our energy resources. Energy supply problems can be reduced and environmental problems diminished by a reduction of demand and adoption of many conserver-oriented guidelines.

EPISODE OF FOSSIL FUELS
(AFTER HUBBERT, 1974)

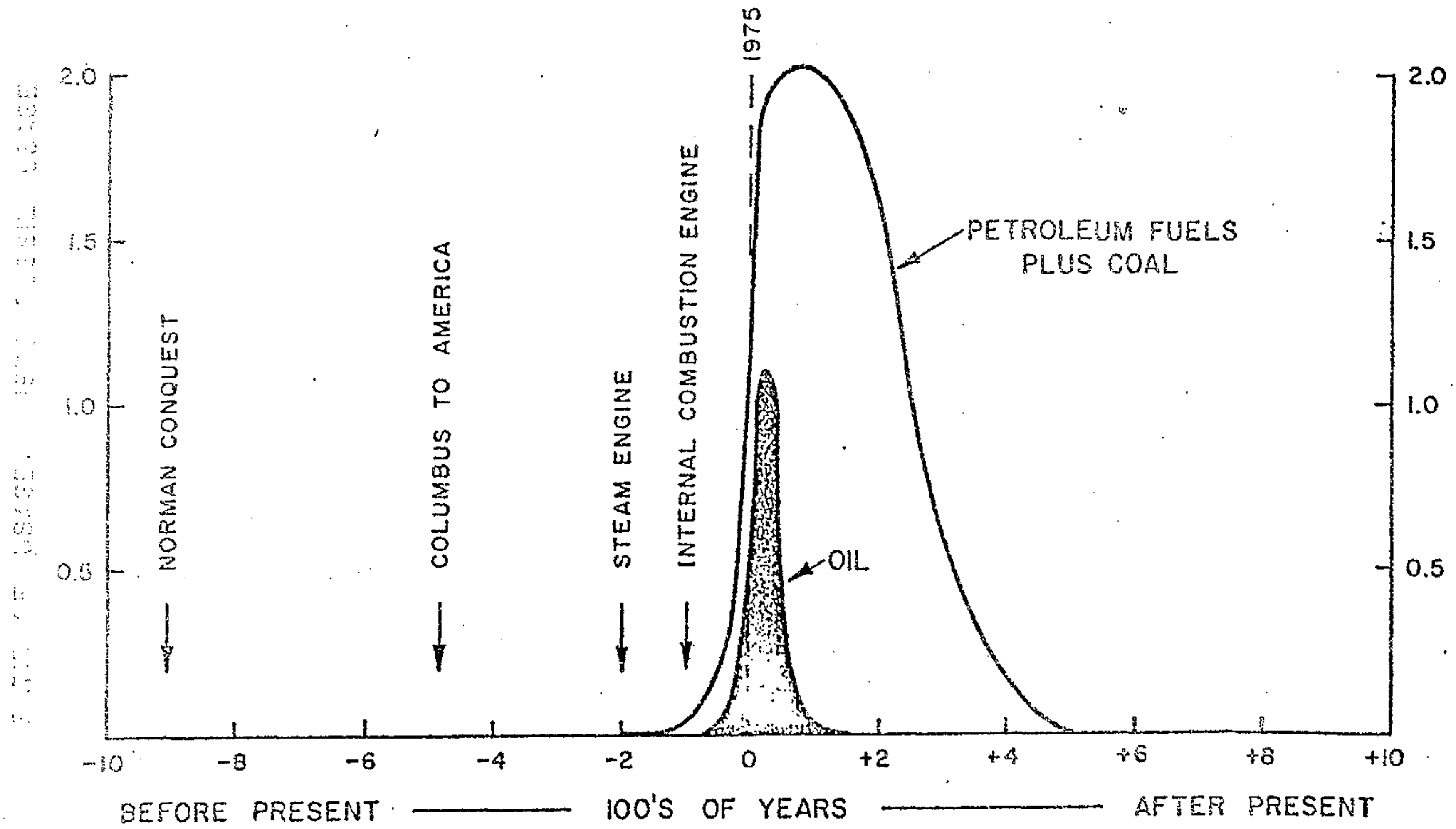
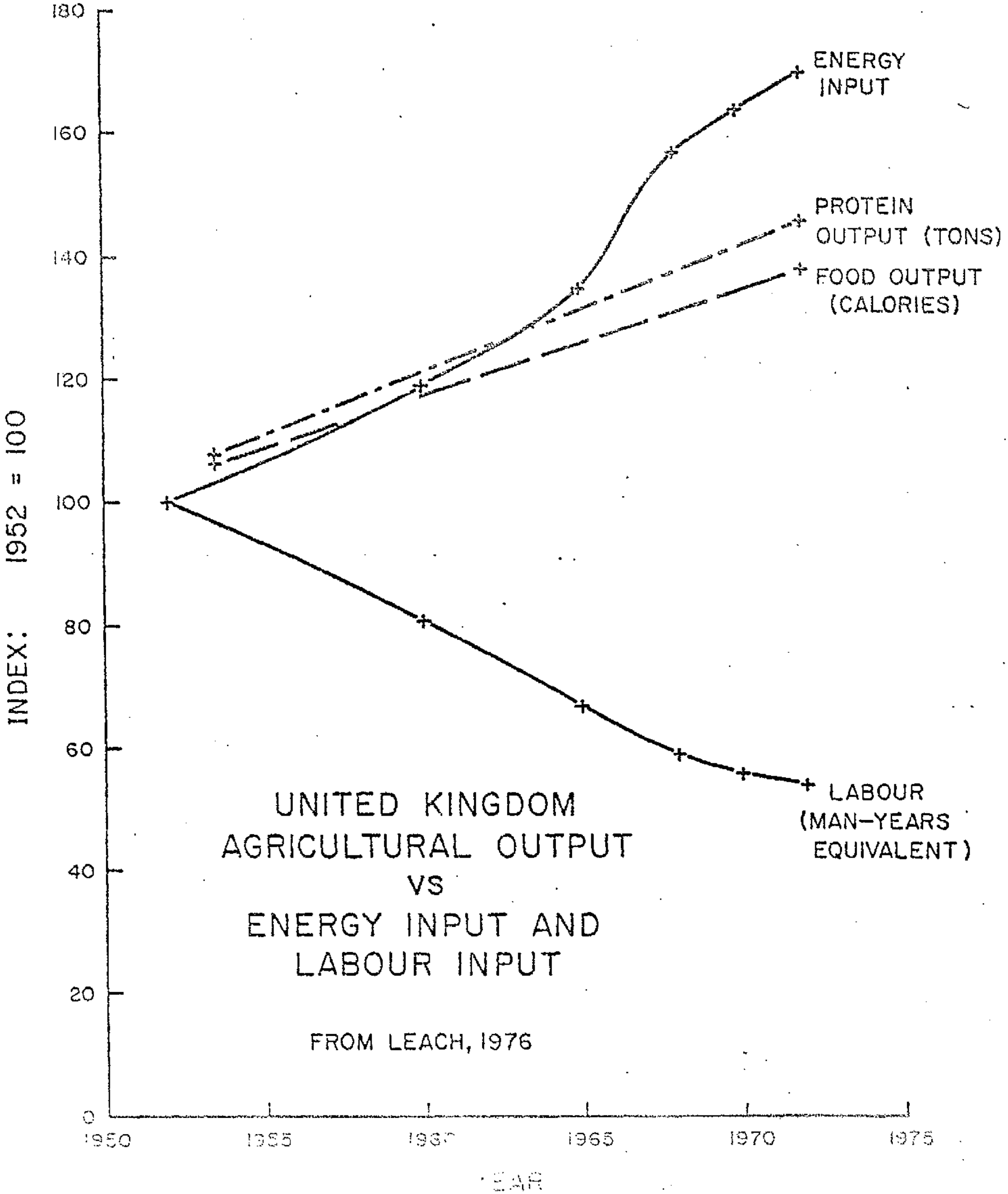


Fig. 1


180
160
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120
100
80
60
40
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0
INDEX: 1952 = 100
ENERGY INPUT
PROTEIN OUTPUT (TONS)
FOOD OUTPUT (CALORIES)
LABOUR (MAN-YEARS EQUIVALENT)
UNITED KINGDOM AGRICULTURAL OUTPUT VS ENERGY INPUT AND LABOUR INPUT
FROM LEACH, 1976
1950
1955
1965
1970
1975

- 156 -

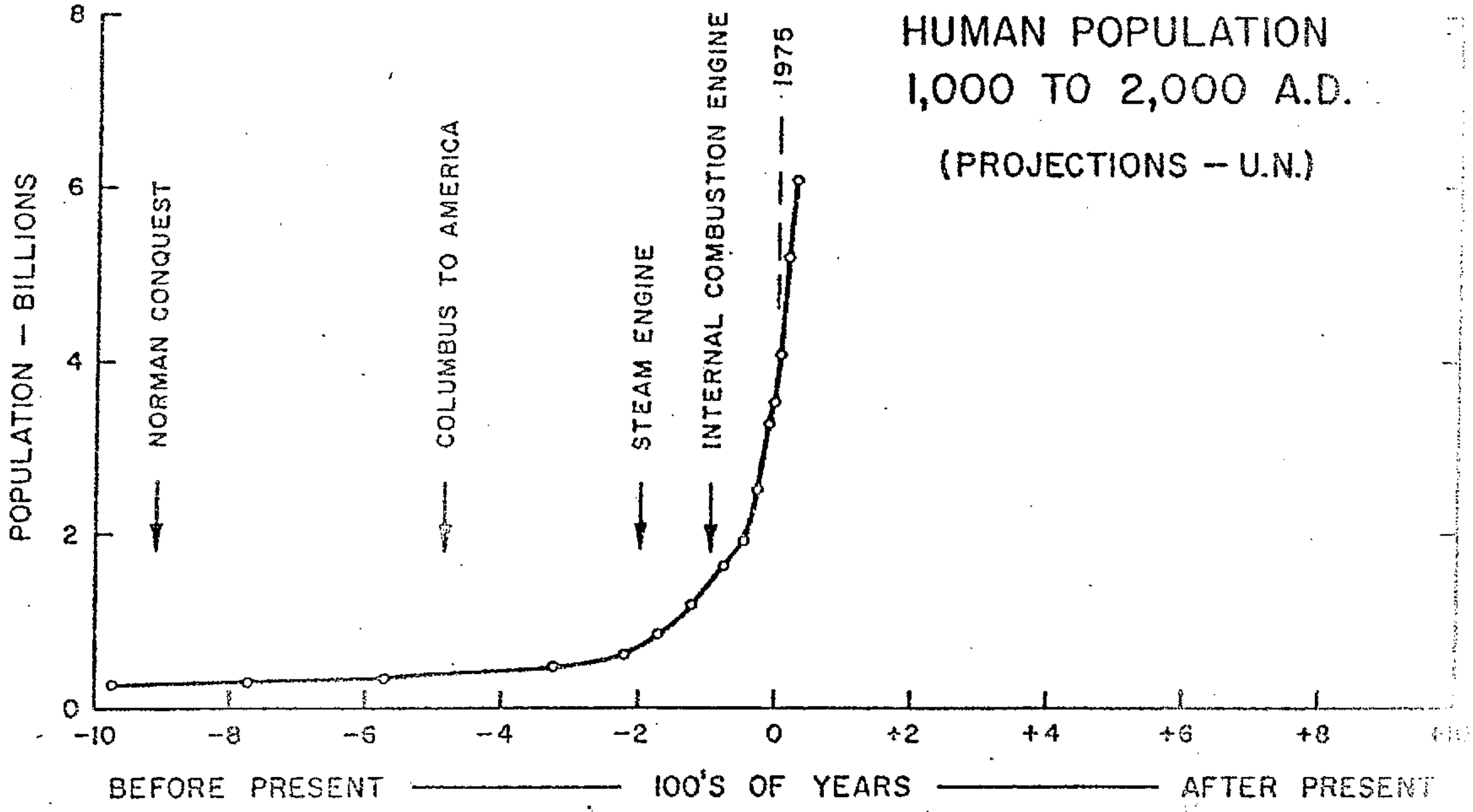
HUMAN POPULATION
1,000 TO 2,000 A.D.
(PROJECTIONS – U.N.)
POPULATION — BILLIONS
8
6
4
2
0
NORMAN CONQUEST
COLUMBUS TO AMERICA
STEAM ENGINE
INTERNAL COMBUSTION ENGINE
1975
-10
-8
-6
-4
-2
0
+2
+4
+6
+8
BEFORE PRESENT
100'S OF YEARS
AFTER PRESENT

Fig. 3

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PACIFIC REGIONAL WORKSHOP

RECYCLING AND SOLID WASTE MANAGEMENT

Organized by
Recycling Council of B.C.
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PACIFIC REGION

Vancouver, March 30-31

SOME POTENTIAL STRATEGIES FOR THE RECOVERY AND REDUCTION OF MUNICIPAL SOLID WASTE

Richard Goodacre
Recycling Council of B.C.

Abstract

Municipal solid waste is examined as a source of materials and energy. Two approaches to recovery, technologically complex mixed waste processing and source separation recycling, are analysed in terms of volume reduction, material and energy savings, economics, and implications for a Conserver Society. Additionally, the potential of reducing at source the generation of solid waste is reviewed. When possible, British Columbia serves as a frame of reference.

Mixed waste processing, while still in the developmental stages as a technology, is found to be capable of eventually handling high volumes of solid waste. Negative features include high capital cost, limited potential for material reclamation, and emphasis on disposal rather than recovery. Source separation recycling, with the current state of the art, can divert at best only a fraction of municipal wastes. Recycling does recover material of high quality, and industrial processes utilizing recovered materials experience significant purchased energy savings and reduction of pollutant outflow. Because it directly involves the waste generator, recycling has an educative value as well.

Source reduction is the most effective means of achieving the Conserver Society goal of doing more with less. However, source reduction is a highly controversial issue, striking as it does at the heart of our highly productive Consumer Society. Therefore, while source reduction measures are the most promising, they are also likely to be the most difficult to implement.

1. Introduction

Until a relatively short time ago, garbage disposal was a simple affair: open the window and throw it out into the street. On the whole, such practice made for rather unsavory, not to say unsanitary, conditions in the city streets. It also meant that a simple promenade could be a dangerous venture, what with the remains of the morning meal, along with other unmentionable wastes, flying out the upper storey window. Hence the chivalrous, or chauvinistic, practice of men keeping to the outer portion of the sidewalk.

Naturally, such disregard for public health meant that cholera, typhus and plague periodically ran rampant, decimating a good portion of the population. Evantually, a growing intelligence about the origins of disease led to a general concern with health conditions, and in the year 1870 England passed the first Public Health Act. One of the foremost intentions of the Act was to bring the disposal of garbage under control. This was achieved by requiring citizens to get hold of some kind of container, into which garbage was to be placed, and put it out for collection at regular intervals. Such an imposition by government must have been met with overwhelming opposition being, as it was, an invasion of individualism and privacy, as well as a rather monumental inconvenience. But the populace adjusted to the decree, health conditions improved, and municipal refuse disposal has since become a habit we can live with.

The problem of what to do with municipal wastes have generally been dealt with in the most simple and economic fashion. For the most part, wastes were hauled to the community margins and dumped. In some instances, the trash was further treated by burning it to reduce the volume or kill noxious odors.

In a stable system, waste disposal might possibly be handled indefinitely through such facile techniques. However, the past several decades have been a time of anything but stability. Growth, while not necessarily continuous, has been possibly the most distinguishing characteristic of the present century. For no other period does this hold more true than that of the past thirty years. Since the Second World War, we have enjoyed the fruits of rapid economic growth and tremendous leaps in technological "know-how". Productivity and purchasing power have reached all-time highs, resulting in an ever-increasing flow of consumer goods, giving rise to the most aptly named Consumer Society. An unavoidable concomitant of our geometrically increasing stream of wastes. Population in the U.S. grew by 13 per cent during the 1960's, while waste increased by more than 30 per cent.(1) To put it succinctly, "garbage is the effluence of affluence."(2)

Being a consequence of consumer goods production, this new influx of solid waste tends to be changing qualitatively. Certain categories are increasing faster than others. Since the early 1950's, the product and packaging component of municipal solid waste (waste from homes, commercial sources and institutions) has more than doubled.(3) While the consumption of beverages (beer and soft drinks) in the U.S. rose by 29 per cent between 1959 and 1969, consumption of containers (bottles and cans) for these beverages increased by 164 per cent over the same period.(1)* Currently in Canada, all types of containers and packaging constitute 38 per cent of household refuse.(4)

For solid waste management, the increasing volume of refuse to be disposed of signifies cost increases. Even if relying exclusively on the most economic methods, refuse disposal has become more and more expensive. Before it can be disposed of, garbage must be collected. What with wage increases and other costs, collection expense has risen to the extent where it now costs generally three times as much as disposal. The U.S. Environmental Protection Agency (EPA) estimates that combined collection and disposal costs have doubled over the past six to eight years,

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* Given the similar standards of living, likeness of cultural trends, etc., rates for the U.S. should, in general, approximate those in Canada. Beverage container [illegible]

now averaging about $30 a ton.[3] Victoria now pays $32 a ton, and Seattle a startling $45 a ton.[5]

Solid waste managers have attempted to counteract spiralling costs by developing more effective methods. The compactor truck for collection was designed to reduce waste volume, thereby extending load capacity. Transfer stations, where refuse is moved from collection vehicles to larger transport trucks for a long haul to the disposal site, were added to the system. Computer programs are now used to determine the most effective collection routes, cutting down on costs per ton. Caterpillar tractors for compaction and incinerators are both common ways of further reducing the volume of waste at the site of disposal.

Growing awareness of waste, and wastefulness, has set off reactions in various social sectors. Some developments arising out of these reactions have had significant consequences for perspectives on solid waste management. Of these, the concern for our environment and the threat of critical energy shortages have been pre-eminent.

Environmentalism has affected attitudes about solid waste in two basic ways. Traditional refuse disposal practices, while often economical in the short term, were also frequently environmentally deleterious. Incinerators and dump fires produced high quantities of airborne particulates; rats and insects at disposal sites caused health problems. More recently, pollution of surface and ground water by leachate, a highly toxic liquid produced by solid waste, has been identified as a common problem.[3] Growing concern for environmental degradation caused by garbage has resulted in stricter regulations for solid waste management. For example, the U.S. EPA has as top priority an inventory of all disposal facilities in the country. A report on methodology for a national inventory of disposal of municipal refuse in Canada has been prepared for Environment Canada.[6] Open dumps are to be converted into sanitary landfills, in which garbage is buried in layers, with a covering of dirt on top of each layer. Incinerators are being forced to meet particulate emission standards. This means high cost for solid waste managers. Electrostatic precipitators, the best means of controlling air emissions, are extremely costly. Sanitary landfills are more expensive to operate than open dumps, and choosing a disposal site located away from water courses may mean greater hauling distance from the source of waste generation.

The second major environmental thrust has been a concern about depletion of natural resources. Our affluence is based on high productivity, which, in turn, relies on the conversion of natural resources into consumer goods. However, natural resources are not infinite, and unmonitored extraction will inevitably lead to depletion of non-renewable resources and over-running of the replacement rate of the renewable ones. Therefore, while the generation of waste is on the one hand an indication of our level of affluence, it is also an index of resource depletion.[3]

Our highly productive economy is based also on cheap supplies of readily available energy. However, like raw materials, energy resources have their limits. Events of the past few years have illustrated how dependent we are on a steady flow of fuel: a large portion of which originates from foreign sources.

Solid waste offers potential conservation of energy in two ways: the latent biological energy in wastes can be recovered, or the waste material can be reclaimed and remanufactured in a manner that requires less energy than virgin material processes.

Reclaiming wastes also obviously means conservation of natural resources that do not have to be extracted as a consequence of substituting the recovered materials.

Municipal solid waste has, therefore, become the object of a number of pressing and somewhat disparate concerns. Finding it increasingly difficult to acquire feasible landfill locations, solid waste managers are seeking disposal alternatives that are both environmentally sound and economical. On the other hand, solid waste has come to be regarded as a likely source of both useful materials and energy.

Currently, there are three approaches that recover resources and/or reduce waste volume:

(a) energy recovery -- employing one of several complex technologies to retrieve the energy in waste;

(b) source separation recycling -- reclaiming wastes at the source of generation before they are mixed and contaminated; and

(c) source reduction -- reducing the amount of waste generated.

In this paper, the three options will be reviewed in terms of the amount of solid waste they can handle, material and energy savings, environmental consequences, economics and implications for a Conserver Society. When applicable, British Columbia will serve as a frame of reference.

To establish total municipal solid waste volume in B.C., we have taken the population, based on a 1971 census, of 2.2 million and applied per capita generation rates ranging from .8 pounds to 3.3 pounds per day, depending on the degree of urbanization. Thus, we arrive at a figure of 933,400 tons of municipal solid waste generated annually in the province. Municipal refuse is exclusive of the industry, mining and agriculture sectors. Sewage is not considered solid waste.

2. Mixed Waste Processing: Energy Recovery

Energy recovery is a process whereby the latent biological energy value in mixed waste is extracted. The most obvious way to achieve this is to burn the waste, producing heat. About 70 per cent to 80 per cent of municipal waste is combustible.[1] Incineration is an established practice for volume reduction; now the heat produced can be put to useful application. Commonly, the waste is fired in a waterwall incinerator to produce steam, which is used either directly or applied to the generation of electricity.

Other more complex technologies produce a fuel, which, in turn, is burned for its energy value. A solid fuel, known as refuse derived fuel (RDF), is produced by first shredding the wastes, then separating the light and heavy fractions by means of an air classification system. The lighter fraction, without further processing, is called fluff RDF. Generally, this fuel has an application as a partial replacement for other fuels, such as coal, in existing boilers. RDF can be further processed to produce densified RDF, a pellitized fuel, and dust RDF, which has a higher BTU value.

Yet another process breaks down organic wastes chemically and physically through the application of heat in an oxygen deficient atmostphere. Known as pyrolysis, this complex technology is still in the development phase and has yet to demonstrate feasibility. The product is either a gas or liquid fuel, the latter resembling a heavy low-grade oil.

Theoretically, all municipal wastes could be processed by any of the energy recovery processes. Several waste components, such as glass and metals, are not broken down and yield no energy, but these can be separated out of the mix by mechanical means before processing, or removed after as part of the residue. Wastes are reduced on the average 90 per cent by volume or 75 per cent by weight.(3) Residues must be landfilled.

Estimates of the energy value of solid wastes vary somewhat, depending on the ratio of combustible to noncombustible fractions, percentage of moisture content, and so on. Here we have taken a median figure of 5000 BUT per pound, or 10×10^6 BTU/ton. Of course, not all of this energy can be made available, as steam for instance, because some energy is always lost in the conversion process. Energy efficiency, that is the ratio between energy produced and latent energy in the solid waste, can be expressed as follows:(7)

$$\text{Energy Efficiency (\%)} = \frac{\text{Energy Output (as steam)} \times 100\%}{\text{Energy Input (refuse, electricity, fuel)}}$$

Some recovery facilities produce a fuel which, in turn, is used for energy generation. Calculating the efficiency of the fuel producing recovery systems involves two steps. Firstly, the energy value of the output fuel is assessed (as, according to the second law of thermodynamics, some energy is always lost in the conversion process); secondly, a further calculation is made to determine the energy that will be lost in converting the fuel into an energy form (i.e., steam).

On the average, the energy efficiency of solid waste is about 60 per cent. With fossil fuels at around 85 per cent, this means that a ton of solid waste to be used as fuel has about the energy value of .7 tons of coal.(7) Thus, for every ton of solid waste there is a potential energy value of $.6 \times 10 \times 10^6$, or 6×10^6 BTU. In terms of the annual generation of municipal wastes in B.C., we can conclude the following total energy values:

$$933{,}400 \text{ tons } (6 \times 10^6 \text{ BUT}) = 5.6 \times 10^{12} \text{ BTU}$$

or, in terms of fossil fuel equivalents,

$$933{,}400 \text{ tons} \times .7 = 653{,}380 \text{ tons/coal}$$

The U.S. EPA,* which is spending a great deal of time and money in the attempt to develop energy recovery technology, prefers to present recovery plants as facilities for reclaiming materials as well as energy. In reality, material

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* We refer repeatedly to the U.S. EPA because it is the leading agency in the development of resource recovery in North America, and the information compiled as a result [illegible]

Table 1

EFFICIENCIES OF SELECTED ENERGY RECOVERY SYSTEMS

TYPE OF SYSTEM	IDENTIFICATION OF SYSTEM	COMMENTS ON SYSTEM	ENERGY EFFICIENCY (solid waste to steam)	SOLID WASTE TO FOSSIL FUEL EQUIVALENT MULTIPLIER
DIRECT-FIRED INCINERATOR	-Incinerateur No. 3, Montreal -Incinerateur C.U.Q. Quebec City -Boston North Shore System Saugus, Massachusetts	Von Roll Grate Systems	65%	.74
REFUSE-DERIVED FUEL	-Canadian Industries, Ltd. SWARU	semi-suspension fired steam generator	66%	.75
	-Ames Solid Waste Recovery System	electricity generation	55%	.63
	-Monsanto LANDGARD	gas pyrolysis with steam production	51%	.58
	-Andco-Torrax, ANDCO-TORAX PROCESS	gas pyrolysis with steam production	68%	.78
	-Union Carbide PUROX	gas pyrolysis	56%	.67
	-Syngas Recycling SYNGAS PROCESS	hydro-gasification		.68
	-Occidental Research FLASH PYROLYSIS	oil pyrolysis	33%	.39
	-Combustion Equipment Associates ECO-FUEL II	powder-like dry fuel	61%	.70
	-American Can AMERICOLOGY	dry fuel	45%	.51

SOURCE: Middleton associates, Net Energy Savings from Solid Waste Management Options. Environment Canada, Ottawa, 1976(report EPS-3-EC-76-11) (7) recovery has been marginal at best. Of the 21 operational units in the U.S., 19 "... are either exclusively or primarily in the energy recovery category."(3) When material extraction does occur, it is largely to remove noncombustibles which can be damaging to the incinerator. Thus ferrous extraction is the most common form of material recovery; the process is simple, requiring only a magnetic separator, and the material removed is noncombustible. Nevertheless, the actual amount of material recovered in this manner is minimal. Scrap ferrous metals separated magnetically amount to "... a very small percentage of the ferrous metal available in the U.S. mixed waste stream."

Technologies do exist for extraction of other materials. For glass separation, wastes are first broken down in a shredder or hammermill, followed by air classification of light and heavy fractions. The latter is run through a set of screens which sort out the glass from other heavy materials. Glass can be further classified into coloured and clear by means of an optical scanner. The system is as expensive as it sounds, and, so far, has not been worth the effort, because the resulting product is of very low value. The glass container industry, the major buyer of cullet (crushed glass) has very stringent specifications for material. Screening does not eliminate all non-glass refractories from the mix, and these cause flaws in glass containers. Froth flotation is another method of separating glass, in which the heavy fraction is placed in a tank to which chemicals are added, causing the glass particles in the mix to float to the top. While the resulting cullet is 99+ per cent pure, it still does not meet industry standards.(3) Alternative markets for cullet offer a much lower price. Yvonne Garbe, director of the EPA's San Diego pyrolysis project, reports that they are receiving 50¢ a ton for the cullet extracted.(8)

A wet separation process, called hydrapulping, extracts the paper fraction from mixed waste. However, the fibre produced is of such a poor quality that it may be better as fuel than as a material for remanufacture.(17)

Aluminum recovery has a similar history. While the material is highly valued ($300/ton), the process of extraction is simply too costly. In a recent article, the EPA's director of resource recovery stated that, due to high costs "... aluminum and glass recovery technology is not operationally feasible." (9)

Resource recovery plants, then, are, in effect, energy recovery plants. How effective are they in achieving this objective?

First and foremost, recovery facilities have a very high capital cost, generally in the tens of millions of dollars. Last year, the EPA estimated that initial cost for a plant would range between $5,000 and $50,000 per ton of daily processing capacity.(3) A recent list of new projects in California shows this to be an underestimate: $75,000 to $85,000 is not unusual.(10) With cost effective daily capacities starting at 200 to 250 tons per day,(1) the indication is for initial costs of $15.000.000 and up. In actual fact, most cost-effective operations require much higher volumes, in the range of 1000 tons per day. The San Diego pyrolysis operation, with a capital cost of $13.000.000, has a capacity of 200 ton per day, but cannot be economical at that volume.(8)

High capital costs mean staggering amortization expenditures. The Hempstead, [illegible] York, plant, which is to produce RDF, will cost $[illegible]. This will grow [illegible] full capacity, and to date very few have, the amortization cost alone works out to about $24 for each ton of waste processed.[11] Since collection costs will be approximately the same as for traditional landfilling methods, this particular facility does not look very competitive from an economic point of view.

Net cost per ton is the bottom line figure that will make or break any disposal option. Aside from initial capital expenditures, there are three basic variables which determine the cost per ton of waste processed, and, hence, the ultimate viability of a resource recovery operation.

Firstly, there are revenues from sales of recovered energy or fuel. As we have already seen, material recovery is generally minimal, and mostly of low quality. Recovered materials are now entering a period of full-scale market testing. So far, the materials have not commanded viable prices, on account of low quality and limited supply. Any substantial revenue will have to come from the sale of energy or fuel.

To the present, the most common product is steam. Steam is used for heating and cooling buildings, and manufacturing. There are, nevertheless, some inherent difficulties; steam is not storable, and has a short transportation range. Demand is very seasonable, while garbage generation is not. The revenue return for steam generation may be low. The Baltimore plant produces steam from its pyrolytic fuel, but the return is only $9.90 for every ton of waste processed.

Finding a market for steam often proves to be a problem. Plants in Northwest Chicago and Harrisburg, Pennsylvania in the U.S., and Montreal and Hamilton in Canada have all been unable to find a buyer for their steam. A refuse-fired steam generation plant, to be built near Ottawa, will have a ready market for its steam in the Capital. However, there is some doubt about the practicality of the original site; if the decision is made to go with the alternative location, which is at a great distance from downtown Ottawa, then the cost of construction will rise from the estimated $33 million - $35 million to about $125 million, largely on account of the cost of piping steam the extra distance.[22]

The second variable in assessing recovery plant economic feasibility is the processing expense per unit of commodity to be sold: 1000 pounds of steam, ton of RDF, or barrel of pyrol fuel.

The two test projects involving the production of pyrolytic fuel have, to date, looked unpromising. The Baltimore Landgard plant, developed by Monsanto, was designed to handle 1000 tons per day. Operating since 1975, the plant has yet to manage a throughput of 51,000 tons of solid waste in a 60-day period, one of the original performance guarantees. In addition, the residue separation system, intended to segregate the residual fraction, has functioned for only a few hours at a time. To make matters worse, atmospheric emissions do not meet the State standard, another performance guarantee.

The problems of the Baltimore plant have been traced to inadequate design corrections for scaling up from the 35 ton per day prototype to a larger capacity. Monsanto contributed another $4 million while the EPA added a supplementary $1 million to cover the costs of corrections. Yet by February 1977, a successful [illegible]-day run still had not been [illegible], persuading [illegible] to give up the attempt.

The city has refused Monsanto's suggestion to shut down the plant and continues with the project. Further work required will cost between $8 million and $12 million.(3)

The other pyrolysis project supported by the EPA, has been operating since June 1977. As of October last year, the plant had yet to produce its first barrel of oil.(3)

Another option is to convert solid waste into electricity. This can be done in two ways: steam-electric boilers, and gas turbines. A recent report suggests that neither option is viable, at least not yet:

> The economics of steam-electric boilers are most favourable when they are large enough to have economies of scale and when the heating value per unit of volume of the fuel is high (and thus less boiler area is required for combustion). Steam-electric boilers designed to burn only solid waste appear to be less economical than boilers designed to burn waste in combination with fossil fuels because (1) the heating value of waste fuel per unit of boiler combustion area is lower than fossil fuels and, (2) the amount of waste that can be delivered economically to one site is far lower than fossil fuels. Gas turbines using solid waste as an energy source are encountering technical difficulties.(1)

Clearly, the energy recovery industry is beset with problems. While steam generation is probably the best developed technology, the product is difficult to market unless there is a buyer ready at hand. Electricity has broad-based applications and a ready market, but is expensive to produce using garbage as a fuel. Pyrolysis has yet to prove itself as a technology, and it is unknown whether the product, either gas or oil, will find acceptance on the market. Compared to other recovery alternatives, RDF may turn out to be the best option. The test project in St. Louis was apparently successful, and a full-scale operation using similar technology is operating in Ames, Iowa. The Toronto Watts from Waste project which will use solid waste as a supplementary fuel in the Lakeview Power Station is designed along the same lines.

Being a solid fuel, RDF is readily transportable. Although a low-grade fuel, it can be fired in existing boilers, particularly coal burning types that are equipped to handle the ash, which RDF produces.(1) In light of these advantages, it is not surprising to note that five of the 10 new recovery facilities to come on line in 1978 and 1979 in the U.S. will use RDF technology.(3)

In discussing the Baltimore operation, it was said that meeting a certain processing capacity level was one of the performance guarantees. It is self-evident that in an operation involving large capital cost, economies of scale play a crucial role in determining success or failure. We mentioned that the Hempstead facility will have to operate at full capacity to keep amortization costs down to $24 a ton. Clearly, if optimum capacity is not obtained, then the cost per ton increases. Hence, we arrive at one of the inherent dilemmas of an expensive energy recovery operation: all other things being equal, the more garbage there is, the cheaper the operation. [illegible] problem arises if a recovery facility is running at optimum efficiency but there is [illegible] garbage to feed [illegible] steam for a nearby paper mill, which requires a steady supply of energy. The incinerator cannot guarantee a regular supply based on waste firing alone because waste supply is not constant, and auxiliary oil burners have been installed to take up the slack.(7)

An energy recovery operation will find itself in trouble if there is not enough waste to feed it, which means that a guaranteed stream of waste is one of the prerequisites for an economically successful program. Since one of the objectives of resource recovery should be to reduce the quantity of waste, a basic contradiction arises:

> the concept of burning all ... of our garbage to recover energy will make increasing garbage production seem to be a "social good" rather than a "social evil". In reality, this course of action totally ignores the economic, environmental, and material and energy costs of producing all of that solid waste to feed the incinerators.(13)

The value of a resource recovery plant can very well be extremely negative when regarded from a truly conserver-oriented perspective.

There is a danger in a commitment to the technologically complex and expensive type of recovery system. A certain rigidity is a natural consequence of such a large commitment because efforts will be directed toward making it work; i.e., cost-effective. Other reduction or recovery options may be overlooked:

> the options will become mutually exclusive. A large scale implementation of straight-through incineration of garbage will exclude for many years the more desirable option of reduction, reuse and recycling because large capital, technological and legal commitments will be made that are difficult to undo.(13)

Moreover, design of more integrated systems which are predicated on reuse and recycling will be considered detrimental to the established interest. For example, in Saugus, Massachusetts, where a steam-generating resource-recovery plant is in operation, source separation of paper is prohibited.

One might well ask at this point why there should be any commitment toward expensive energy-recovery plants. That there is commitment is plain enough; while the U.S. currently has 21 operational facilities, 10 more are under construction, 33 are in the planning stages, and an additional 54 communities have commissioned feasibility studies.(3) Toronto has three systems currently in planning.

There is a number of reasons for this sudden swell of interest. For one thing, recovery plants do not interfere substantially with existing disposal operations. The waste is simply hauled to the receiving area rather than the disposal site. The problems with operations and markets discussed above may be more or less glossed over through the expedient of pointing out that the technology is still in development. Like any new technology, it has to get over the initial development and shakedown phase. The federal governments in both Canada and the U.S. (Environment Canada and the EPA) are making commitments to energy recovery, helping the technology through this difficult period.(14)

Yet the greatest appeal of energy recovery stems from the traditional concern of solid-waste management, namely disposal. Like the incinerator of old, the new recovery plants are very effective when it comes to getting waste down to a manageable size. Pyrolysis reduces incoming wastes by 95 per cent; while recovery in general reduces waste by 90 per cent.[15] The EPA prefers the term, "combustion unit" rather than incinerator because of the possible pejorative connotations of the latter. Even so, it is evident that the primary function of energy recovery units is disposal, not recovery. The Hamilton RDF plant is called SWARU, which stands for "solid waste reduction unit." The funding for recovery facilities must eventually come from municipal budgets managed by solid waste specialists whose job is refuse disposal, not the management of natural resources. Which brings us finally to the third variable in determining cost efficiency in a recovery operation: diversion credit.

For every ton of waste disposed there is an associated cost. When disposal is averted by incineration or other energy recovery means, an amount equivalent to the cost of disposal goes as a credit to the energy recovery operation. In Saugus, Massachusetts, for example, the tipping fee (a charge for dumping at landfill) is $14 a ton; the waterwall incineration unit in Saugus, therefore, legitimately receives a diversion credit of $14 for every ton it keeps out of landfill, and is thus economically viable.

What with the high volume of waste now being generated, and the predicted rates of increase for the future, volume reduction is of primary concern for the solid waste manager. If energy recovery facilities, with their high capital cost, are going to compete for solid waste budget dollars, then they are going to have to demonstrate volume reduction ability. The major competition will come from traditional landfilling which, where land is available, is likely to be the cheapest alternative. When available sites become scarce, then the option of energy recovery will receive serious consideration.

At this point in time, the future of energy recovery is yet undetermined. The various technologies are still under study, and the results so far have been far from reassuring. Local level decision makers find themselves in a position of considering commitment to systems which ential "... large capital investment in equipment that might soon become obsolete or depend on processes still in the experimental stage."[16] Nor are the economics yet sorted out. Exactly how expensive the net operating cost is per ton will not be known until the various systems have operated at peak capacity for a number of years, and full-scale market testing of products is completed. The proponents of energy recovery find themselves competing with operational costs of conventional landfilling on the one hand, and virgin material and fossil fuel supplies on the other. Nevertheless, community decision makers faced with spiralling costs for collection and disposal of wastes and no reasonable prospects for new landfill space may not have the time to wait for the final verdict on resource recovery.

3. Source Separation Recycling

The only other extant method for recovering resources from municipal wa[illegible] [illegible]ling. In its current popular usage, recycling has come to mean the recover[illegible] [illegible] home (paper, glass and metal containers, possibly aluminum), office (ledger and computer paper, tab cards, newspaper), commercial business (corrugated paper packaging), and so on. A recycling program involving recovery at source is called a "source separation recycling program" (SSRP).

With current technology, only some components of municipal waste are recyclable. What percentage these constitute varies from one region to another, just as refuse composition varies, and depends furthermore on whether the material in question comes from homes, businesses or institutions. Most source separation has dealt with residential waste, and we will concentrate on this type of program.

4. Residential Recycling

Of the estimated 933,400 tons of municipal refuse generated annually in B.C., approximately 50 per cent is residential. Of these 466,700 tons, only a portion is currently recyclable; estimates range between 20 per cent and 50 per cent. We have taken a figure of 30 per cent and arrived at a total of 140,010 tons a year of B.C. residential waste as potentially recyclable. This includes only newspaper, glass containers and metal in the form of tinned steel cans:

MATERIAL	TONS
newspaper	40,136
glass	63,938
metal	35,936
	140,010

There is the additional possibility of removing the organic component of solid waste for composting. Organics constitute up to 35 per cent by weight of municipal waste. As a disposal option, composting is generally overlooked because of high cost of processing and poor market value of product. The price for compost may be as much as $17 a ton, but there is strong competition from peat moss. The cost of composting mixed waste is high on account of the extensive process required to remove contaminants. Source separation of organics would lower the contaminant level, and possibly reduce the cost of composting by 30 per cent.(17)

The energy conserving value of recycling derives from energy saved by manufacturing processes that utilize reclaimed rather than virgin materials. The relevant figure is the net energy saved, that is, the difference in energy consumed by one complete process as opposed to an alternative. Properly, a net energy analysis includes calculation of the energy required to obtain, process, and transport material before manufacturing, as well as capital related energies, i.e., energy expended in the construction of capital equipment. These requirements hold for net energy analysis of resource recovery options as well as recycling. However, as comprehensive data are not available on all facets of energy recovery, we presented simply the net energy value of solid waste as a replacement fuel. For recycled material, the figures here represent the difference between the energy required to manufacture and [illegible] materials on the one hand, and [illegible] materials [illegible]

Table 2

POTENTIAL ANNUAL ENERGY SAVINGS FROM RECYCLING HOUSEHOLD WASTE IN B.C. (17,18)

material	quantity (tons)	energy saved BTU/ton of new product	total (BTU)	fossil fuel equivalent barrels/oil
newspaper	40,136	10.1×10^6	405.4×10^9	69,892
glass	63,938	2.5×10^6	159.8×10^9	27,559
metal	35,936	7.6×10^6	273.1×10^9	47,088
	140,010		838.3×10^9	144,540

Energy conserved through recycling is not achieved by extracting the biological energy in the material, but rather by making use of the industrial energy that was used to bring the material to the point of disposal.(13) The recoverable material in solid waste embodies two forms of stored potential: order and energy.(19) Energy recovery takes advantage of the latter potential but destroys the former. Recycling utilizes the order created in the manufacturing process, but does not affect the biological energy potential which remains latent in the material and available for later recovery.

At present, not all energy savings from recycling B.C. wastes can be realized in the province, since the actual conservation of energy occurs at the point of material utilization. The only detinning facility in the Northwest is in Seattle, so ferrous metals sold to that market normally end up being reprocessed in the U.S. and do not save energy for B.C. Additionally, recycled materials used in manufacturing industries that never rely on virgin sources are difficult to assess in terms of net energy value. Cellulose insulation made from old newspaper is a case in point. Here it might be legitimate to compare the energy consumption of cellulose manufacturing techniques with some functional equivalent, such as fibreglass insulation.

In almost all cases, there is a diminution of internal and external costs arising from pollution when recycled stock replaces virgin materials. For example, newsprint made from 100 per cent old newspaper reduces airborne pollutants by 74 per cent and waterborne wastes by 80 per cent.(7)

Over the past decade, recycling operations have emerged in hundreds of communities throughout North America. Typically small-scale, usually motivated by environmental concerns, the recycling project has often been more successful as an educational tool than as a means of resource recovery. The most common operation involves a centralized processing-warehousing facility, to which householders bring materials separated from their refuse.

Recycling centres have had limited success in achieving material reclama[illegible] requiring residents to separate their refuse. Berkeley, California, recycles almost 15 per cent of its waste stream through recycling centres. The overall picture has been less impressive. In the U.S., recycling centres are estimated to achieve an average waste diversion of one per cent.[20] Effectiveness in diverting materials is the critical index of financial success in recycling just as with energy recovery. Economic feasibility is calculated in terms of revenue from the sale of materials, solid waste diversion credit, and the ratio between operating costs and volume of material handled. All of these depend ultimately on throughput.

The question, then, is why have recycling centres failed to get a more substantial portion of the waste stream? The key is participation. Recycling is labour intensive, and most of the labour occurs at the source of generation. If the waste generators won't participate, then the recycling operation won't get the material. The real question, therefore, is what is the reason for lack of participation? While the answer in depth is complex, there have now been enough successful projects to isolate the two elements of primary importance: householder convenience and adequate promotion.

Most of the available information on SSRP's is based on household waste recycling. To participate, the householder is usually asked to keep different materials separate, and store them until they are either collected or delivered to the recycling depot. The most common materials are newspaper, metal containers and glass containers. In some instances, glass must be colour sorted, and different types of metal cans separated into tin coated, bimetal and aluminum components. Some preparation of the materials is also required, depending on their ultimate application. Papers are bundled to facilitate handling and reduce volume. Glass and metal food containers are washed as a health precaution, and usually the paper labels on cans are removed.

Looked at in total, it appears that recycling places a rather onerous burden on the householder. Nevertheless, a recent study by SCS Engineers, California, indicated that the total time required to process materials is about two minutes a day. Cost of preparation is negligible; storage space averages nine square feet a month.[21] The major inconvenience is delivering the materials to the recycling centre. Given the amount of gas consumed by individual families delivering their recycled wastes to a central depot, there is a questionable energy conservation aspect as well. The solution to these objections is to have recyclage (recycled garbage) collected at the source in the same fashion as mixed waste.

Separate collection programs deal mostly with paper, because of the high market value, but some are starting to pick up other materials as well. In the same SCS Engineers study, it was discovered that five of the 17 separate collection programs examined handled other wastes beside paper. In B.C., the Kelowna Recycling Society has recently commenced separate collection of newspaper, glass and kraft bags in one neighbournood.

Basically, separate collection involves having a vehicle follow the same route as trucks on the mixed collection system. Householders are asked to place their recyclage on the curb on collection day, which may be once a week, every other week, or possibly once a month. Separated refuse is taken to a central [illegible]

Separate collection programs have some critical advantages. Most importantly, they achieve a high participation rate, five to 10 times better than recycling centres.[20] The obvious reason for the difference in householder response is the convenience. When recyclage is picked up at the curb at regular intervals, preferably on the same day as mixed waste collection, it is easily assimilated as a behavior pattern. Instead of taking just the garbage can to the curb, the recycle box goes out as well. Moreover, having a truck come around for recyclage adds to the program's credibility, which further encourages participation.

Participation rates can vary greatly from one collection program to another. A Toronto paper pickup program has been active for a few years, but has achieved only 10 per cent participation.[22] The collection day is regular, but not the same as mixed waste. Furthermore, the program has not been promoted to the fullest. Frequency of collection is another pertinent variable. Forth Worth, Texas, has two systems with different collection frequencies, one weekly and the other every two weeks. The former has a participation rate of 40 per cent, while the latter has only 25 per cent.[21] The positive relationship between quantity of material and collection frequency indicates that people will divert more material if they have fewer storage problems. Furthermore, there is also a strong correlation between length of program and participation.

The other prerequisite for success of a recycling program is sound promotion. Recycling involves large numbers of people, and they must be well informed about the objectives and methods of the program, and what is expected of them as participants. Adequate lead time for disseminating this information is critical. Regular advertising channels, letters, telephone calls, and door-to-door canvassing have all been used to effect in developing awareness and establish credibility. If the program is not run by the municipality, then a letter indicating official city support is a top priority.

A pilot study in Marblehead and Somerville, Massachusetts, is demonstrating the effectiveness of a well organized program. Lead time was six months to allow for completion of the promotion and education phase. Collection is done by specially designed compartmentalized trucks on regular garbage days in both communities. In Somerville recyclage is divided into two categories: glass and cans, and paper. Marblehead has a three category system consisting of paper, clear glass, and coloured glass and cans. In the first seven months, recycling in Marblehead diverted between 23 and 33 per cent of the total residential waste stream each month. Since the estimated percentage of recyclage in the waste stream was 50 per cent, the implication is that between 46 and 66 per cent of the recyclable component is being recovered. It is further estimated that between 75 and 80 per cent of the residents participate in the Marblehead program. Somerville, which experienced labour problems at the inception of the program, averaged between seven and 10 per cent of the residential waste stream.[5,20]

The substantial participation rates of the Marblehead-Somerville project are due to good promotion and householder convenience. Beside having recyclage collected at the curb. the residents are required to separate materials into only two or three simple categories. The resulting material commands a lower price, but it is felt by the program managers that the greater convenience justifies the loss of revenue:

Table 3

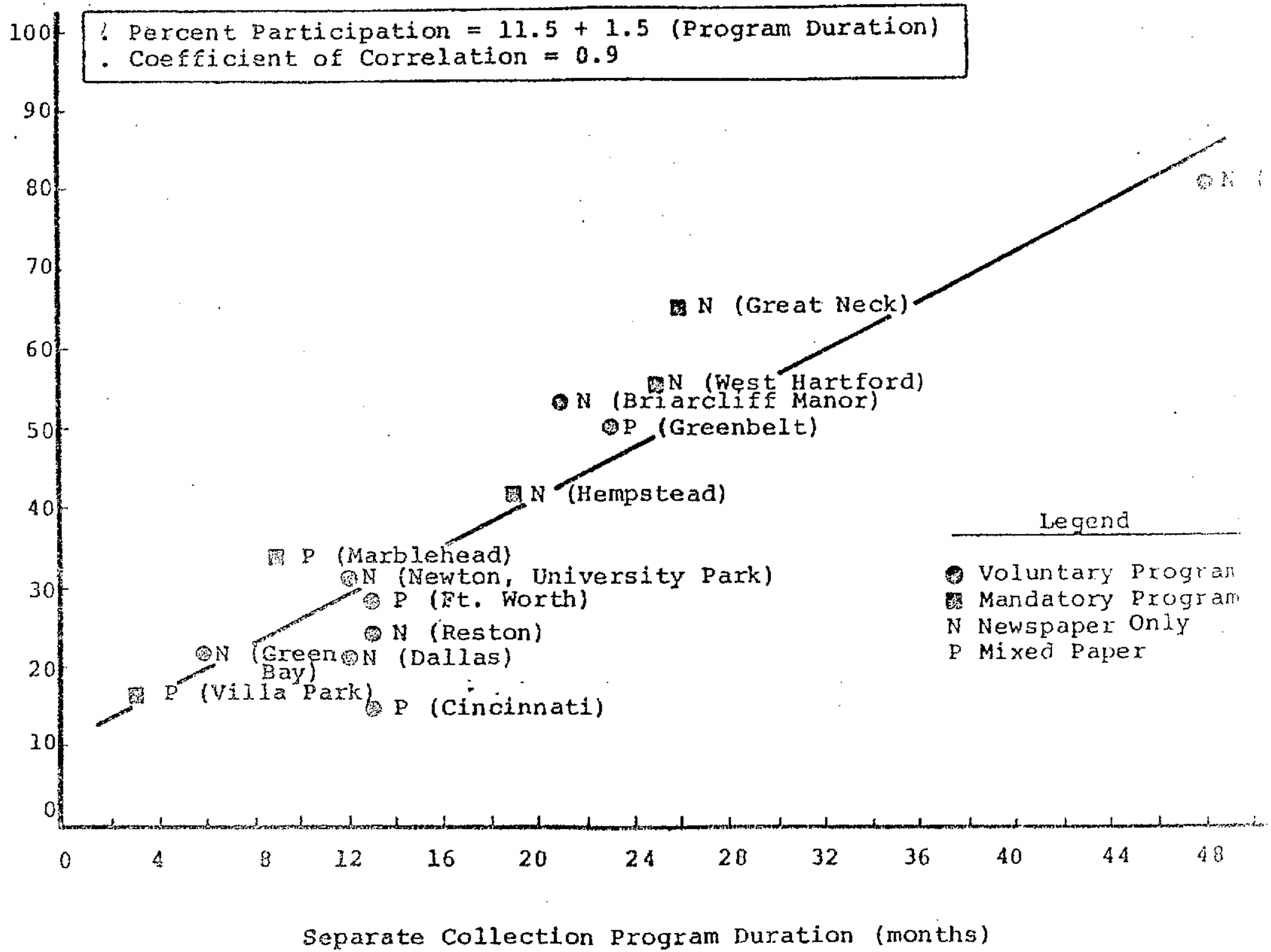

Figure 5. Participation rate as a function of program duration.

Source: SCS Engineers, Analysis of Source Separate Collection of Recyclable Solid Waste.

> Since the mixed glass and can fraction must be mechanically separated by the purchaser, the revenue received by the town is lower than it would be if the materials were separated when purchased. However, it is felt that eliminating the separation of cans and glass, (and reducing householder effort) significantly adds to the volume of materials recovered to the point where the lower revenue received per ton is more than justified by the increased volume.[20]

During the six months lead time, residents in both communities were repeatedly informed about the upcoming project. Calendars indicating pickup days were distributed, and lesson plans about recycling were prepared and taken to local schools, By the time the first collection run was made, virtually everyone in the test areas was aware of the program.

The separate collection program recently initiated in Kelowna, B.C., used many similar promotion techniques, including radio and television broadcasts and personal distribution of written material. Possibly the single most important feature was the provision of special recyclage containers to each household, to be used for storage and placement at the curb. Uniform containers further institutionalize separate collection and encourage confidence in the program. At the time of writing, insufficient data were available to determine program effectiveness; an initial door-to-door survey had indicated a 97 per cent willingness to participate.

An EPA supported separate collection program began last year in San Luis Obispo, California. Known as SORT (Separation of Office and Residential Trash), it is supported by a grant of $43,750, almost a quarter of which went to education and promotion. The actual collection of material was put in the hands of a private hauler. In its first six months, the program has achieved a 65 per cent participation rate, "... that is, 5,200 of the California city's 8,000 households took part in the curbside collection of newspaper, glass, and mixed metals. This was even better than the 63 per cent participation indicated by a door-to-door canvass of residents."[23] As a consequence, officials have decided to expand the program to five other cities in the county.

Regardless of participation rates, no recycling program can operate on a long term basis without proven cost-effectiveness. Critics of recycling have charged that it cannot achieve cost-effective levels. Indeed, many collection centres have shown dismal financial records, like the Los Angeles depot that lost $169 for every ton of waste processed.[24] Yet, how should cost-effectiveness be measured? Ideally, a recycling operation is performing the same function as a solid waste disposal system: getting rid of the garbage. Therefore, if recycling can process waste at a net cost equivalent to that of traditional disposal methods, it should be considered cost-effective. Unfortunately, this is not the case. Solid waste systems are already in place, and constitute one of the largest expenses for most cities. Recycling operations do not replace these systems, but rather complement them. The same is true for any solid waste disposal alternative; they cannot be subsidized by solid waste budgets already taxed to the limit, except when a cost reduction can be demonstrated. Thus, in discussing the economics of recovery plants we described [illegible] a credit was alotted for the diversion of wastes for disposal. The same [illegible]
[illegible]

Both cities pay private haulers to collect and dispose of unrecycled wastes. Marblehead pay $18.95 a ton and Somerville $14.50 a ton for disposal services (exclusive of collection). Each ton of waste recycled is thus a ton that does not have to be disposed at a cost of $18.95 or $14.50 a ton. With paper, glass, and cans constituting approximately 50 percent of the residential waste stream, source separation and recycling clearly offer both communities significant savings in disposal costs.(3)

TABLE 4
MARBLEHEAD PROGRAM ECONOMICS,
JANUARY-SEPTEMBER 1976

Month	Revenues from sales	Diverted disposal savings	Incremental collection costs*	Net savings
January (12-31)	$1,870	$2,990	$2,930	$1,930
February	2,560	3,390	3,570	2,380
March	3,790	3,680	4,450	3,020
April	3,500	3,640	4,470	2,670
May	3,400	3,390	3,850	2,940
June	3,730	3,850	4,240	3,340
July	3,280	3,350	4,040	2,590
August	4,340	3,850	4,240	3,950
September	3,360	3,580	4,030	2,890

*Includes labor costs as well as operation, maintenance, and capital amortization for the compartmentalized trucks and all other equipment added as a result of the source separation program.

Source: U.S. EPA, Fourth Report to Congress (3)

A similar situation occurs in Davis, California. Here, the private hauler who holds the mixed waste collection franchise also runs the weekly curbside pickup program. The company states that it cost them $16 for every ton that they recycle, but in comparison with the $31 for mixed waste, this is quite satisfactory. Part of the cost difference is the $2.25 tipping fee at the county disposal saved by recycling.(25)

Another major factor in determining cost-effectivness is revenue from sale of materials. Like large scale recovery plants, recycling has had some difficulty in establishing markets. Marketing recyclage has one fundamental advantage over the material recovered from mixed waste plants, however. Contaminants are relatively low, and the material is proportionately more valuable. Still, markets vary from one area to another, and recycling feasibility is extremely site specific. Local markets may not offer good prices and transportation costs limit access to more distant buyers. Nevertheless, there is always room for entrepreneurship. In British Columbia, for example, recyclers had difficulty receiving a fair and consistent price for their newsprint. They were able to overcome the problem by selling their paper collectively in large enough volume to impact on the market, and through the development of overseas customers. When prices had been established at an international level through exporting paper, it became [illegible] (25)

Undoubtably the crucial element in marketing recyclage is the procurement of long term contracts. Without a contractual relationship with buyers, a recycling operation is the potential victim of the vagaries of the reclaimed materials market. While the prices for glass and metal are quite stable, paper, the primary money maker in almost every recycling operation, has been very unreliable over the years. Without large cash flow or extensive stockpiling capabilities, it is difficult to weather even a short depression in prices. Both the Marblehead-Somerville and SORT programs have contracts for materials, with guaranteed floor prices. The Recycling Council of B.C. is now negotiating long term contracts, including floor prices, with paper buyers. During the recession of 1974-75, no municipal program in the U.S. that was based on long term purchase contracts failed.(5)

The third consideration on the recycling balance sheet is the incremental costs incurred from collecting and processing the material, including labour, facilities, promotion, and the operation, maintenance and amortization of equipment.

Low capital cost is one of the advantages of source separation recycling. For a well supplied facility, equipment may involve no more than a forklift truck, a baler for compacting material, a glass crusher and possibly a conveyor. For curbside collection one or more vehicles will be added. Referring again to the Marblehead program, initial capital costs amounted to $40,000, including a newly designed collection vehicle. Somerville expenditures were $41,000, which, considering Somerville's population of 90,000, is a relatively low cost per household. Total costs, including equipment amortization, are absorbed by the combination of revenue from sale of material and diversion credit.

Every SSRP is labour intensive, but it does not necessarily follow that labour costs are high. Citizen involvement is the pivot upon which the entire system articulates, with the householders performing the first stage of processing. The type and quantity of jobs created in the secondary processing facility can be more or less labour oriented depending on the view of the solid waste manager, or public policy. Generally, total labour costs tend to be low.

Good promotion is indispensable, and costs money. SCS Engineers found that for 17 separate collection systems studied, the average initial publicity expense was 5¢ per household. Not all of these programs could be called successful, and inadequate promotion may have been part of the reason. The SORT project budgeted $9,000 for education and promotion, and achieved the participation of 5,200 homes, which works out to about $1.75 each. In Seattle, it was calculated that the most effective promotion technique would cost an average of $1.06 per household.(5) Promotion expense is concentrated at the initiation of a program; as part of on-going expenses it would be less costly. On the whole, promotion appears to constitute a relatively minor expense.

If separate collection is made part of the existing refuse collection system, actual costs can be minimal. For example, there is always a certain amount of slack in a municipal disposal system. If a separate collection program can make use of some of this unused labour and equipment, then additional costs to initiate and maintain the program should be limited, quite possibly less than the combination of revenues and diversion credit. The SCS Engineers used this incremental cost [illegible] management expense, ranging from a high of 23 per cent reduction to a low of one per cent increase, with an average of seven per cent decrease.(21) Present market prices should improve these figures.

Still, there is a potential problem in using the incremental cost approach. If a separate collection program expands beyond the point where extant equipment and labour are capable of providing the necessary services, then additional services will have to be acquired, but at fully allocated costs. Therefore, expansion beyond a certain level may involve unsustainable expense increases. Yet expansion is the means of achieving the highest possible throughput, which should normally mean a more cost-effective operation. For instance, the Seattle project concluded that it would need a 8620 household target area to generate revenues necessary to meet costs, well beyond the initial 1,100 in the test area. On the other hand, an expansion of separate collection might divert sufficient material to warrant redesign of the total solid waste system, incorporating new efficiencies and related economies.

5. Recycling of Commercial and Institutional Wastes

We have so far discussed only residential recycling. While refuse from homes accounts for about 50 per cent of municipal waste, the residual fraction contains a large component that is readily recoverable. Commercial outlets and institutions generate in quantity clean, homogeneous wastes. Stores create corrugated cardboard refuse, while restaurants and hotels dispose of enormous quantities of glass containers. These wastes, which represent expensive disposal charges for the generators, can be incorporated into a separate collection system.

A recent survey indicated that corrugated cardboard, the major recyclable material in commercial refuse, accounts for 9.2 per cent of total municipal waste, while office paper makes up 3.8 percent. About half of the paper waste from offices is high grade ledger which commands a sufficiently high price to warrant recovery. For corrugated we assume that 70 per cent is concentrated in commercial sources and therefore economically recyclable. Thus, recyclable office paper and corrugated cardboard generated annually in B.C. amount to:

office paper	17,735 tons
corrugated	60,111 tons

Given net energy savings of 14.5×10^6 for every ton of ledger made from recycled fibre, and savings of 6.4×10^6 for each ton of corrugated, we arrive at the following totals:

POTENTIAL ENERGY SAVINGS FROM RECYCLING MUNICIPAL WASTE IN B.C.

material	quantity (tons)	energy saved BTU/ton of new product	annual total	fossil fuel equivalent barrels/oil
office paper	17,735	14.5×10^6	257.2×10^9	44,344
corrugated	60,111	6.4×10^6	384.7×10^9	66,327
			641.9×10^9	110,672
residential	140,010		838.3×10^9	144,540
total municipal	217,850		1.5×10^{12}	255,206

Office paper recycling, the most recent development in source separation, is also the most promising. Offices which generate high quality paper waste are beginning to reclaim this material by what is called desk top recycling. EPA headquarters, for example, generate almost two tons of waste a day, 85 percent of which is paper, 40 percent being white ledger. Recovering office paper is a simple proposition; each office employee has a desk top holder or tray in which used paper is placed, instead of the waste basket. When the holder is full, it is emptied into a larger central container by the employee. Full containers are taken to a central storage area, where the buyer picks it up. The economics of office recycling depend on the type of paper used, the size of the building, and general layout. A study done for Environment Canada suggests that the best plan is to separate mixed ledger (white and coloured together) because the higher volume thus obtained justifies the lower price of the material. In the U.S., the EPA favours white ledger only, proposing that the higher selling price allows the office to purchase exclusively white ledger, thereby maintaining a high recovery rate. A contract study for the EPA of 12 private office paper separation programs led that agency to conclude:

> programs of this type should reduce solid waste management costs an average of 21 percent, reduce waste volume an average of 39 percent, and achieve a 90 percent participation rate, with minimal incremental labour costs to collect the source-separated paper... In sum, it appears that office separation of waste papers for recycling is increasing as private companies, universities, government agencies at all levels, and other institutions which [illegible]

A six month study in office recycling was carried out at the Place Vincent Massey Building, which houses the Department of Fisheries and Environment. The 21 storey office complex with 955 employees sustained a 81.4 percent participation rate, and reduced its disposal load by 54 percent. Even with initial implementation expenses of $3,723, a net profit of $1,623 will be realized at the end of one year if savings in disposal costs are included. Projections for the second year indicate savings of $5,248.(27)

In brief, there is now adequate evidence to show that source separation recycling is capable of diverting significant quantities of valuable materials from the waste stream, and can do it economically. On looking at prospects for the future, the EPA had the following to say about recycling:

> New techniques for separate collection and an increased interest on the part of industry to engage in long-term contracts for the purchase of recovered materials will increase the economic feasibility of source separation, and this form of resource recovery may become an attractive alternative or complement to landfilling or high technology resource recovery systems.(3)

6. Recycling and the Conserver Society

Since our topic is ultimately the implementation of a Conserver Society, perhaps it would be germane here to address briefly the social consequences of recycling.

In discussing energy recovery, a concern was expressed that using waste to produce energy is potentially deleterious to what should be our final objective, namely the reduction of waste. Complex technology to recover energy is a "black box" solution to our garbage problem; the waste is made to disappear and the illusion is created that the problem is solved. It should be remembered, however, that the waste is only symptomatic, and while treating the symptoms may be satisfactory on a short-term basis, ultimately we must deal with the issue of waste generation itself.

Central to the problem is consumer irresponsibility. While it is industry and commerce that aggravate solid waste problems by making available products which encourage waste (disposable or over-packaged goods, for example), it is the consumer with his or her purchasing power who has the ultimate control over what succeeds in the marketplace. When purchasing power is restricted, the consumer rejects functionless packaging or accessories and their associated cost. Increasing disposable income and the proliferation of consumer goods have made it less necessary and more difficult to evaluate products carefully. Frequently advertising encourages irresponsibility in buying practices... selecting for form rather than function, impulse buying, and so on. The lack of consumer responsibility undermines the ability of the marketplace to ensure sound resource management. The waste problem is one indication of incautious resource consumption, and is, therefore, "...the logical place for consumer involvement and education."(17) [illegible] the simple [illegible] of becoming [illegible] with waste management, at home or [illegible] ork, he [illegible] "waste" [illegible] Unlike [illegible] technology energy recovery, which masks the garbage problem and possibly even encourages wastefulness, recycling fosters an awareness of unnecessary waste:

> Waste management must involve itself with the waste generator... source separation is the most effective means of involving the consumer in waste management and of recovering materials from waste. (17)

7. Barriers to Recycling

What are the future prospects for source separation recycling? Comprehensive figures are not available for Canada, but in the U.S. approximately eight million tons of waste were recycled in 1975, or six percent of the total. At that time, high technology recovery plants were processing no more than 300,000 tons of waste, and are not expected to reach the million ton mark before 1978 or 1979. Very little of the 300,000 tons were actually recovered material, which leaves recycling as the only viable extant method of diverting resources from the waste stream: "virtually all of the waste paper, aluminum cans, and glass containers currently recovered from post-consumer wastes are separated at the source..."(3) Even so, the six percent diversion is marginal, and this figure did not increase during the first half of the present decade.

The reasons for the limited success of recycling come from many sectors. Solid waste management has only recently been forced to seek alternatives to traditional, economic means of disposal... "by allowing cheap, environmentally damaging waste disposal, we have caused alternative waste reduction and recycling options to be undervalued."(3) On the market, recyclage must compete with virgin materials. Our highly productive economy has been the consequence of plentiful supplies of readily available materials and energy. While the situation is changing, with concomitant increases, price increases, virgin material economies have been kept attractive through artificial means: tax laws and depletion allowances encouraging virgin material extraction. Federal governments in both Canada and the U.S. subsidize exploration, research and development in virgin material industries, resulting in disadvantages on the market for recovered materials:

> when financed out of general tax revenues, these R & D costs do not become reflected in the market price of the relevant raw material and energy products, thus understating the full social costs of these commodities in the marketplace. In effect, this represents a hidden subsidy that encourages higher market demand for these materials and less economy in their use than the free market would have otherwise encouraged. (3)

Recycled materials must have an equal opportunity to compete, which means the commitment of research and development support from the government equivalent to that dedicated to virgin materials, and the removal of discriminatory legislation:

> governments must undertake to stimulate and then stabilize markets for recycled products not in an artificial way but through the removal of the economic, legal and perceptual blockages in our system. (13)

Given a fighting chance, recycled materials will find acceptance, and greater demand will increase their dollar value, and in turn stimulate further material recovery. Rising prices for raw resources and energy add to the appeal of resource reclamation: recycling not only recovers materials, but manufacturing with recyclage reduces purchased energy costs. Aluminum cans produced from recycled aluminum require only five percent of the energy consumed by virgin material manufacturing. The high energy consumption of aluminum production led industry in the U.S. to start an extensive recycling program in which cans are bought back at about one half cent a piece. The first return centre opened in 1967; there are now 1,300. In 1975, 3.9 billion cans, 25 percent of the amount sold, were collected.(3)

Recycling involves simple technologies relative to the mixed waste processing plants and therefore has not enjoyed a great deal of attention from the engineering profession generally or agencies of the government more attuned to romantic design activities. This lack of interest has placed recycling at a serious disadvantage vis a vis other solid waste management options. Monies expended in North America on mixed waste processing are in the tens of millions, while the total budget for recycling is in the tens of thousands. Since it deals with many and varied social habits and industrial attitudes, recycling must have the ability to do many and varied things. Of primary importance is the creation and refinement of separate collection systems which span both the generator of waste and the solid waste manager. Some first generation separate collection vehicles are now on the road but much more study and development are needed to produce a viable system. A complicating factor is that both social science and engineering technologies must come together to design the best system.(28) No longer is it possible to simply engineer mechanical collection-disposal systems where the individual is not really a factor. Disposal designs should include the internal workings of houses, apartments, and public buildings. This requires the special abilities of architects, planners, and similar professionals. We must take a more inclusive, holistic approach to the management of our wastes. As long as recycling is nothing more than an appendage to a system that was never intended to recover and reuse its waste in the first place, it can never achieve maximum productivity.

Increased recycling will come about partly as an automatic consequence of material and energy shortages, and partly through deliberate policy. Legislation should be reviewed to ensure that there is no discrimination against recycled products. Recycling should be a target for research and development. Commitment by the Federal Government to the development of energy recovery technology should be matched by efforts in other disposal alternative areas. Like energy recovery technology, recycling needs support to sustain it through the difficult development phase. For example, research is needed in the area of new products made from recycled materials. The sudden resurgence of cellulose insulation has doubled the price of used newsprint in many parts of North America over the past year. Pollution control regulations must be enforced if the advantages of manufacturing with recycled materials are to be fully appreciated.

8. Source Reduction

The third option for dealing with excessive waste is to not produce it in the first place. Called source reduction, this is both the most effective and most [illegible] strategy

Source reduction can be achieved in a variety of ways:[1]

(a) product reuse -- i.e., return to refillable beverage containers.

(b) reduce resource intensiveness -- i.e., smaller cars.

(c) increase product lifetime -- i.e., 100,000 mile tires.

(d) decreased consumption -- i.e., reduce packaging.

Refilling beverage bottles makes good energy conservation sense. If bottles have an average trippage rate of 10 (are used an average of 10 times before disposal) the energy required to wash them is 65 percent less than that used to manufacture new bottles. It has been estimated that at least 7×10^{12} BTU could be saved annually in Canada by a return to refillable beverage containers,[7] which is the equivalent of 1.2 million barrels of oil. Increased employment would be another benefit.

It is also possible to include wine and liquor bottles in a refillable system. A small company called Encore in San Francisco began washing wine bottles for reuse in 1975. They sell the bottles for 10 to 40 percent below the price of new containers, depending on the size of the order. The demand for washed bottles has been such that they have tripled their throughput within the first two years of operation.[29]

As we pointed out earlier, the fastest growing solid waste component is packaging. A recent estimate is that 42 percent of municipal waste consists of some form of container or packaging.[30] It has been projected that a return to the 1958 level of packaging in Canada would save 40.7×10^{12} BTU annually.[7]

In Minnesota, the Pollution Control Agency has been authorized to review new or revised packaging. Under the regulations established, packages are evaluated according to a number of criteria and any which are considered to constitute a solid waste problem are prohibited.[3] It would appear that legislation of this nature must become more common to combat the proliferation of needless waste, particularly in light of the lack of consumer responsibility alluded to above.

A further legislative option is the adoption of a product charge incentive. A product charge "...is a special sales or excise tax, most likely at the Federal level, levied at the point of product (or package) manufacture or point of wholesale or retail distribution..." the function of which is to "...provide an explicit financial incentive to producers and consumers to alter their jointly determined product and packaging decisions affecting solid waste quantities and characteristics."[3] The charge would be tied directly to projected solid waste management costs. For example, the expense of disposing of a non-returnable bottle, which is external to the industry that produces it and therefore not reflected in the retail price, would, with a product charge, be partly accounted for in the purchase price. A product charge would help to sort out in the marketplace what is desirable and what is not from a solid waste point of view.

There are, thus, a number of [illegible]

Based on an estimate of the energy savings that could be associated with a number of source reduction options (principally a return to 1958 levels of packaging and the advent of a 100,000 miles auto tire), something in the order of 55×10^{12} BTU or 58×10^{6} GJ could be saved per year across Canada. This represents a savings of about 2.6% of the total industrial energy demand in Canada in 1975.(7)

From a purely common sense perspective, source reduction is the most viable option for more efficient utilization of resources. Source reduction means doing more with less, without diminishing our quality of life, and is therefore central to the concept of the Conserver Society.

9. Conclusions

None of the options described here is independently capable of complete and optimum treatment of solid waste. A comprehensive approach to solid waste management should integrate the different approaches, employing an established set of priorities which recognize the following:

(a) where possible, waste should be reduced at the source.

(b) recovery of materials is favourable over recovery of energy.

(c) source separation recycling is the most efficient and economic means of recovering materials.

(d) where feasible, energy recovery is preferable to disposal.

REDUCE Source reduction will result in the conservation of resources, both material and energy, and a reduction in the volume of solid waste. Reduction initiatives will not come from the municipal level, but rather should originate with provincial or federal governments.

RECYCLE Generators of waste should become involved in its disposal. Source separation recycling has educational value as well as resource conservation benefits, and secondarily reduces solid waste volume.

RECOVER ENERGY After materials have been reclaimed, the residual fraction should be treated for energy recovery. It may appear that recycling and energy recovery are competing for solid waste, but in reality recycling should not detract from the energy value of the non-recyclable component. In residential refuse, for example, removing newspaper results in a BTU loss of two to five percent.(31) When the revenues from paper sales are used to subsidize collection of glass and ferrous elements, the BTU value of the residual waste is enhanced. Recycling and energy recovery are therefore compatible. The crucial point is that energy recovery system designers take into account the recyclable portion of waste so that systems do not rely on receiving that component to meet daily throughput requirements.

DISPOSE Even with maximum possible resource recovery, there is still a residue that requires sanitary landfilling. More realistically, given the current state of the art, resource recovery will not be able to handle more than a fraction of our solid waste in the next ten to twenty years. One U.S. estimate is that, with maximum development of the technology, energy recovery capacity will be no more than 20 percent of the total solid waste by 1985.[9] With maximum recycling at 30 percent, this leaves 50 percent of solid waste needing disposal by traditional means.

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WOOD WASTES AS AN ENERGY SOURCE FOR THE B.C. PULP AND PAPER INDUSTRY: ECONOMIC IMPLICATIONS AND INSTITUTIONAL BARRIERS

John F. Helliwell and Alan J. Cox *
Department of Economics
University of British Columbia

Abstract

This paper analyzes the use of wood wastes (hog fuel) to replace fossil fuels and generate electricity in the B.C. pulp and paper industry. Models are constructed for each of the B.C. mills, and the hog fuel projects are evaluated from two different viewpoints; that of the firm and that of the economy as a whole. From the viewpoint of the economy as a whole, there are large returns from both sorts of investment, and possibilities of very large reductions in B.C. Industrial use of fuel oil, natural gas, and electricity. The returns from the viewpoint of the firm are much smaller, especially for investment in electricity generation, because of the current pricing structures for natural gas and electricity.

After demonstrating the large returns available from the use of wood wastes as an energy source, the paper examines the various institutional barriers that hamper these developments. The conclusion is that the obstacles are fairly surmountable, and that new hog fuel projects are likely to provide an important addition to the demand for wood wastes and an important source of additional energy supply in British Columbia.

1. Overview of the Issues

If the conserver society concepts are to lead to action rather than talk, they must make economic sense and be consistent with institutional goals for all the parties involved. This is a tall order, but the order must be filled if progress is to be achieved. To fill the order, the first step must be to delve deeply into specific issues, to gather the necessary evidence on the technical and economic feasibility of alternative ways of doing things, and to analyze how the costs and benefits of the alternatives would, or could, be distributed among the groups and individuals involved.

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When important economic and technical changes are in prospect, research resources are amongst the scarcest, and their careful use must be a central concern of the conserver society. Thus research efforts must be focused on areas where the likely payoff is greatest and where the possibilities of improvement are obvious, even though there may be economic and institutional barriers that might be blocking a normal evolution towards establishing a conserver society.

We have chosen to study the use of wood wastes as an energy source because it seems, from almost all points of view, to be an idea whose time has come (or come again, since the forest industries were once much more self-sufficient in energy use than they are now). Why does it seem so obviously a good idea at this time?

First, the final report of the Pearse Royal Commission on the forest industry in British Columbia noted that the close utilization standards applied (by regulation) to the forest industry make logging more costly than it otherwise would be. This fuller utilization of forests, which has primarily been instituted for environmental and silvicultural reasons, will be more effectively attained if reasonably secure and profitable markets can be found for forest residuals. Second, there are many areas of the province in which there are large and growing surpluses of wood wastes which are residuals from the production of sawn lumber, pulp and paper, plywood, and other manufactured forest products.

When these two sources of waste supply are seen in conjunction with the rapidly increasing costs and prices of the main sources of energy purchased by the forest industry, it does not take a great leap of imagination to suppose that the conversion of forest residuals and wood wastes into energy may well be one of the most profitable avenues for future innovation and investment in the forest industry. Looked at from the viewpoint of society as a whole, the use of wood wastes to produce steam and electrical energy provides the attractive possibility of large reductions in the use of valuable natural gas and fuel oil plus a lowering of the overall costs of electricity.

On the other hand, there were a number of economic and institutional barriers to these developments. For example, some natural gas distribution companies rely heavily on their forest industry customers, so that large-scale conversion of gas-using pulp and paper mills to hog fuel (the name used for wood wastes in the form in which they are burned) would impose large financial losses on the distribution company or its other customers. Another complication is that the B.C. Petroleum Corporation, the crown corporation that buys natural gas from the producing companies and sells it to distribution companies and to the export market, is soon likely to find itself with an excess supply, and may be more inclined to encourage low-priced (and thereby wasteful) uses in British Columbia rather than increasing exports or deferring production for future use. In addition, although pulp and paper mills have had, and still face, substantial increases in the costs of purchased natural gas, electricity, and fuel oil, these prices are still well below, especially for natural gas and electricity, the export values and the costs of new sources of supply. Thus the forest companies see themselves as caught in the middle, since the increase in energy prices that may be necessary to make profitable the use of wood wastes as sources of energy may [illegible] raise the average price paid by the firm for the energy it consumes.

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that are likely to lead to excess capacity and surplus electrical energy in British Columbia until the middle of the next decade, or longer. Thus, even though the costs of electricity generated by the pulp and paper industry may be substantially less than the costs of electricity from projects now under construction, B.C. Hydro may well not wish to undertake the changes in rate structure, and to offer to purchase electricity on comparable terms, to encourage substantial increases in the production of electricity in the pulp and paper industry.

Many of the B.C. pulp and paper mills have substantial amounts of capital invested in their current fossil-fuel burners and low-pressure boilers, and may thus be less attracted than otherwise by the prospect of converting to the use of hog fuel and higher pressure boilers. Finally, there are doubts throughout the industry as to who will receive the potential profits from wood waste utilization: The potential energy producers may fear that all the gains will show up as a higher price for hog fuel; the hog fuel producers may fear that this increase in price for their product won't transpire, or that, if it does, it will also show up as a higher price for logs; the logging firms may fear that this won't transpire either, or that, if it does, the higher price for logs will disappear through the imposition of higher stumpage payments.

All of the broad generalizations listed above seem likely to have some truth in them, and lead us to think that there is likely to be a high payoff to applied research at a fairly detailed level. We have therefore undertaken a fairly comprehensive study of the economic and institutional implications of the use of wood waste as an energy source. We have based our research on models of energy use and potential energy production in each of British Columbia's nineteen largest pulp and paper mills connected to the provincial power grid. As will be shown in the next section, these mills together are responsible for about 16% and 12% of British Columbia's industrial use of natural gas and fuel oil, respectively, and about 20% of electricity purchased by provincial customers. Eventually we may extend our analysis to include possible new mills and new pulp and paper technologies, and to deal with sawmills as well as pulp and paper mills. Even for the pulp and paper mills, we have not addressed all of the economic and institutional issues, but we have come a long way in our research over the past year.

The plan of the rest of the paper is as follows: in the next section we shall briefly describe the model we have developed and summarize the direct economic costs and benefits of different ways of using wood waste for energy production; and in section 3 we shall describe the implications for the economy and for energy pricing. In section 4 we shall deal specifically with some of the institutional barriers and make some suggestions for policy changes that might help to remove the barriers. In the final section we shall provide a brief summary of our results and recommendations.

2. Outline of the Research

The research outlined in this paper is aimed at evaluating two strategies for energy conservation at pulp and paper mills. The first is, simply, the burning of wood wastes instead of non-renewable fossil fuels for the production of process heat. [illegible] second is [illegible] process heating. [illegible] using the conventional non-condensing technique (with its very high thermal efficiency) and replacing purchased electricity with this "co-generated" electricity. All pulp and paper mills in B.C. deliver their process heat requirements to production sites in the form of steam at a pressure of about 100 pounds per square inch (p.s.i.), but generate this steam in boilers at about 600 p.s.i. This pressure drop can be utilized to produce electricity through the use of non-condensing (or back-pressure) turbines. Larger amounts of electricity can be produced, for the same process steam requirements, with higher boiler pressures. The results presented in this paper indicate the increase in the non-condensing potential of pulp and paper mills through the construction of new power boilers rated at 1250 p.s.i. Because only the loss of thermal energy in the turbines counts as the thermal cost of producing electricity (that is, not including the condensing loss, which takes place in the pulp and paper production process) the heat-conversion efficiency of non-condensing turbines is twice that enjoyed by B.C. Hydro at its thermal electric plants, or to put it more graphically, it takes half as much fuel to produce a kilowatt-hour of electricity.

The model generates, from average hourly production figures, the amount of steam required per hour. These steam requirements set an upper limit on the amount of electicity that can be produced from back-pressure turbines. The model can then be used to assess the economic consequences of utilizing different proportions of this non-condensing potential. For any given proportion, the model calculates the amount of additional steam that must be produced from the boilers. This figure, after a suitable allowance has been made for production of steam from recovery boilers dictates the size and capital costs of the hog fueld boiler to be built.

The model then calculates the operating costs of the hog fuel project, and provides a credit for the fuel and operating costs of the fossil fuel burner that is thereby replaced.

All of the net costs of the hog fuel project are subsequently split according to the proportions of the steam energy used for process heat and electricity, with most of the burner and boiler costs being thus allocated to the replacement of fossil fuel, and the rest of the burner and boiler and all of the generator costs to the costs of electricity.

The hog fuel projects can be evaluated from several points of view. The two most important are those of the firm itself and of the economy as a whole. From both points of view, we have designed our model to calculate the flows of costs and benefits for each year of the project's life, and to calculate present values of the total costs and benefits for each participant.

From the point of view of the firm itself, the benefits are the reductions in payments for fossil fuels and electricity, and the costs are the extra capital and operating costs of the plant, with due account for the effect of income taxes, sales taxes, and the like. We have set up our modelling of the firm's analysis so that it can easily be recalculated for different prices for oil, gas, electricity, and hog fuel. For our "base case" analysis, we use 1978 natural gas prices, 1978 fuel oil prices, and the new electricity rates announced by B.C. Hydro to come into effect in 1980. The 1978 natural gas and oil prices are henceforth assumed to rise [illegible] general rate of inflation (as forecast by the Economic Council) and the [illegible] no net transport costs or disposal credits for hog fuel; and we then compute this value as a ratio of the total quantity of hog fuel required, thus calculating the net value of hog fuel delivered to the mill. This then tells us how much the firm can afford to pay for hog fuel and still keep the project economic at today's costs of energy to industrial users.

From the point of view of the economy as a whole, the value of the hog fuel project is based on the same quantities of fuels saved and electricity generated, but the prices used are the export price of natural gas, the price of oil imports, and the estimated cost of electricity from expansions of B.C. Hydro's generation and distribution system. In addition, the effects of sales and income taxes are removed, as these affect only the distribution of costs and benefits between governments and firms.

By looking at the value of the project from the point of view of the firm, we can tell whether it is likely to be currently perceived as profitable. If the privately perceived net profitability is negative, while the overall economic criterion suggests that the project is worthwhile, then we have identified cases where institutional barriers, by way of energy pricing policies or whatever, stand in the way of economical use of wood wastes.

We have established models of 18 hog fuel projects (one of which serves two mills) and have distributed our results and assumptions to all of the mills. We have received a considerable and very helpful flow of comments and additional data, and are publishing a comprehensive report of our model complete with revised results on a mill-by-mill basis.[1]

Although this is not the place to discuss our results on a detailed basis, some detail may help to set the stage for the points we raise in the later sections of the paper.

The most pervasive feature of our results is that for both oil-burning and gas-burning mills there is a substantial incentive to switch from fossil fuels to hog fuel to supply process steam. The incentive is especially great for the oil-burning mills, as the price of oil is currently much higher than the price of natural gas for B.C. industrial users. The nine oil-burning mills, according to our latest calculations, could pay between \$27 and \$37 per unit (1 GPU = 200 cu ft) of hog fuel, the amount varying according to mill circumstances, and still make a profitable conversion.

For the gas-burning mills, the net value of hog fuel for replacing gas is slightly lower on average, although it still appears to be above \$20 per unit for all mills.

The private value of hog fuel to generate electricity is much less, and the apparent value to the firm of this investment is very low. According to our calculations, the average cost of electricity produced by all the eighteen hog fuel projects tends to fall in the range of 8 to 11 mills (.8 to 1.1¢) per kwh in terms of 1978 prices. Although this is less than half of the 1978 \$ cost of power from

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B.C. Hydro's new projects, it is not much less than what B.C. Hydro charges for power to industrial users, if the recently announced 1980 prices are converted back to 1978 price levels.

From the point of view of the economy as a whole, the hog fuel projects show much higher values than appear to the firms, principally because the value of natural gas and the costs of new electricity projects are much higher than the prices currently paid by industrial users. The net present value of the projects, from the viewpoint of the economy as a whole, after covering all costs except payment for hog fuel, generally runs in the range of 70 to 100 million $1978 for a normal sized mill, with the total for all mills being well over 1 billion dollars in terms of 1978$.

We plan to distribute, at the time of the seminar, our latest mill-by-mill results that will show not only the costs and benefits of each of the individual projects, but also the net requirements for hog fuel at each mill. We have compared our estimates of hog fuel requirements with the recent estimates of hog fuel availability made in January 1978 by Reid, Collins and Associates for the B.C. Energy Commission. We shall present tables that show the supplies and demands matched by region. In general, there appear to be few regions that are likely to have shortages, and hence there is not likely to be much need for long distance transport of hog fuel. We plan at the next stage of our analysis to consider in more detail the economics of transport of hog fuel within the forest regions, and to estimate more carefully whether the high apparent value of hog fuel as an energy source will be sufficient to attract the required supply in all regions, taking account of transport costs as well as alternative uses.

It is fitting to end this section with a few qualifications about our results thus far. For one thing, we have based our estimates of steam and electricity requirements on existing patterns of use. To the extent that mills are able to be more efficient in their future use of process steam, the amounts of hog fuel required and the estimates of by-product electricity produced will be correspondingly reduced. To the extent that mills are able to be more efficient in their future use of electricity, the amounts of hog fuel required will be unaffected as long as surplus power can be sold to the grid, and the amounts of surplus electricity available for the grid would be increased.

Second, the estimates of hog fuel availability are based on existing recovery of forest residuals, current patterns of alternative uses (e.g. for particle board) for waste materials that might otherwise be available for hog fuel, and current sawmilling practices. All of these factors are likely to change in the future. Wood wastes are likely to increase as the average size of saw logs becomes smaller, but improvements in sawmill technology and practices are likely to reduce wastes. Turning sawmilling and forest residuals into valuable energy sources is likely to alter logging and milling practices so as to increase the supply of hog fuel, perhaps to a very considerable extent. Other by-product uses of sawmill residuals are also likely to increase in the future, and thus absorb some of the available supply of hog fuel. Putting all of these factors together, we are inclined to think that current estimates and projections of hog fuel availability are more likely to increase than decrease as these other [illegible] work themselves out, but the matter clearly deserves much more detailed [illegible].

New pulp and paper mills, and the associated logging activities are likely to raise the total demands for and supplies of hog fuel, and there are likely to be sufficient price and technological incentives to encourage full use of hog fuel. Forthcoming improvements in the efficiency and cleanliness of hog fuel burners, and the possibilities for generating low-btu gas as one of the products, make future use of hog fuel even more likely than our models would indicate, but may cause some projects to be deferred to await the perfection of new burner technology.

3. Overall Economic Implications

We shall deal first with crude oil, natural gas, and electricity pricing, and shall then consider the broader economic consequences of higher energy prices and the greater use of wood wastes as an energy source.

The current centrepiece of Canadian energy pricing policy, as outlined in the 1976 An Energy Strategy for Canada (pp. 126-7) and reiterated since, is to move the domestic price of crude oil towards world levels. The B.C. Energy Commission apparently adopted a similar policy when it asked participants in its 1977 petroleum and natural gas hearings to assume that the price of refinery crude oil will rise to $14 (Canadian) by 1980, measured in terms of 1977 prices. In terms of 1978 prices, using the Economic Council's assumed 7.4% rate of inflation for 1978, this represents a 1978 price of approximately $15.00 per barrel.

The federal policy for natural gas pricing is less easy to identify. In the 1976 document An Energy Strategy for Canada (p. 128) it was stated that "the federal government remains committed to removing any undervaluation of natural gas relative to crude oil within two to four years." Subsequent circumstances, including the continuing surplus and discount pricing of heavy fuel oils, and the continuance of new gas discoveries, suggests that the 1976 policy will not be carried out, in terms of natural gas being priced at btu parity with crude oil. It seems more likely, as the B.C. Energy Commission asked participants in its 1977 hearings to assume, that the city-gate price of natural gas will be at 85% of the refinery price of crude oil. This is about the current relationship in Ontario markets, but in B.C. the current ratio of the wholesale natural gas price to the crude oil price is much lower, about 55%. This is after the March 1, 1978, increase in the wholesale price from .96 to $1.16 per mcf.

As the B.C. Energy Commission noted in its September 1977 Report, the current B.C. wholesale price (the average price at which Westcoast Transmission delivers gas to the three distribution utilities) is less than the average price (on which no royalties need be paid) at which the B.C. Petroleum Corporation is buying gas. New gas is being bought in the field, with no royalty return to the government, at a price that is 16¢ per mcf higher than the wholesale price being charged to B.C. users, after processing and transportation charges have been allowed for.

The current under-pricing of natural gas in British Columbia is even greater when viewed in the context of the export market, where there are still delivery shortages on existing contracts at current prices of over $2.40 (Canadian) per mcf, more than twice the comparable B.C. wholesale price of $1.17 per mcf.

As we showed in section 2, the low prices charged for natural gas have the effect of reducing the profitability of hog fuel projects for the pulp and paper mills now using natural gas. The current level of underpricing of fuel oil is much less, and is due almost as much to soft markets as to government policy, so that a suitable rate of conversion from fuel oil to hog fuel is likely to take place without any fresh policy initiatives. What is the net effect of the present low price of natural gas to B.C. pulp and paper mills? Our calculations show that the primary consequence is sheer waste of resources, because the natural gas burned in the pulp and paper mills is worth far less to them than the export value of $2.40, with the difference being an economic loss against which there is no offsetting gain by anyone.

It should be noted that the prices actually charged to pulp and paper mills are more than the wholesale prices quoted above, by amounts ranging from about 30¢ for pulp and paper mills in the Inland Natural Gas service area to about 40¢ per mcf for Canadian Cellulose at the western end of the Pacific Northern Gas service area. This is good news and bad news. It is good news because it increases the incentive for the mills to convert to hog fuel, and thus to avoid wasteful use of natural gas, but it is bad news because the loss of large customers reduces the revenues of the gas distribution companies. This raises an institutional barrier to the conversion from natural gas to hog fuel; and as such will be dealt with in the next section.

Even if and when natural gas and oil prices reach levels that reflect more adequately the costs of new sources and their value in alternative uses, many hog fuel projects are not likely to include high pressure boilers and full back-pressure turbine capacity unless B.C. Hydro rate structures are altered in important respects. The most important change, and the one that would be most eagerly welcomed by the pulp and paper mills, would be to ensure that surplus power from the pulp and paper mills would be sold to B.C. Hydro at the same prices that B.C. charges for power. The next important change, which is necessary if the first change is to actually mean much in dollars and cents, is that B.C. Hydro's charges for energy and capacity should be adjusted to better reflect the costs to B.C. Hydro of acquiring additional energy and additional capacity. A recent detailed study of the B.C. Hydro system[1] has supported B.C. Hydro's own view of itself as an "energy critical" system, which means that the main expansion costs for B.C.'s predominantly hydro system relate to the provision of extra energy (in this case an annual flow of water) rather than the generators and distribution structures required to meet peak demands. B.C. Hydro's own allocation of costs and rates has moved somewhat in this direction. The 1977 rates for a pulp mill with a 90% load factor, were 60% capacity charge and 40% energy charge, for an average price of 1.08¢, or 10.8 mills per kwh. By 1980 (the rates are announced two years in advance) the energy charge will have doubled and the capacity charge increased by 16%, giving an average price of 1.5¢ (in terms of 1980 prices). This is still some distance from an appropriately cost-based rate structure, however, because Osler has estimated that the appropriate division of costs and rates for industrial users would be 85% energy and 15% capacity, with an average industrial price of 23 mills, or 2.3¢ in terms of 1977 prices or 28 mills in terms of 1980 prices (using the Economic Council of Canada base case inflation rates to 1980). The B.C. Hydro energy charge for 1980 will be 8 mills, only one-third of Osler's estimate of the 1980 cost of new energy.

Another electricity pricing problem, as reported by Hawkesworth in a 1974 study done for B.C. Hydro, is an excessive stand-by charge and the establishment of capacity charges that relate to the user's own peak demand and does not give the interior pulp mills due credit for producing electricity in the winter when the B.C. Hydro system as a whole is facing its peak demands.

In the next section we shall consider what, if anything, might be done to deal with the institutional barriers that prevent electricity pricing from giving appropriate incentives to pulp and paper mills for generating electricity using wood wastes.

Finally, we wish to address briefly the overall economic consequences of using wood wastes as energy sources. In terms of fuel oil saved as a result of using hog fuel, the direct financial savings are measured by a corresponding drop in the requirements for imported oil, and the direct continuing employment consequences are measured by the number of jobs involved in the transportation of hog fuel and the operation of hog fuel burners and boilers. The total capital requirements for hog fuel burners to produce process heat at all of the remaining oil-using B.C. pulp and paper mills would be 153 million $1978 (we shall consider later that portion of burner costs attributable to electricity generation). This would cut B.C. oil consumption by about 16,000 barrels per day, cutting annual oil imports by $88 million at a landed price of $15 per barrel. Alternatively, the size and cost of the oil savings can be compared to the costs of oil from oil sands extraction. The oil saved amounts to about one-eighth of the production of a Syncrude-scale oil sands plant, at a capital cost less than 5% as large as those now estimated for a new oil sands plant.

Adding or increasing the scale of hog fuel burners at all 9 of the gas burning mills would involve capital costs of about $220 million at 1978 prices, and would reduce gas consumption by about 70 million cubic feet per day. The export value of this gas, at today's prices, is about $60 million per year.

Turning to the effects on electricity production and costs, the conversion of all boilers at oil-burning mills to 1250 psi pressure and the installation of back-pressure turbines of sufficient size to utilize the available steam would add about 275 MW (megawatts) of capacity to the B.C. system. More than 90% of this extra capacity would be on Vancouver Island, where it could serve to postpone substantially the construction of a controversial and expensive second high-voltage supply line to Vancouver Island. This would involve capital costs, for the additional boiler and burner capacity and generators, of about $105 million in 1978 prices. For the mills currently burning natural gas, the use of high pressure hog-fuel-fired boilers and back pressure turbines would add 350 MW of capacity to the B.C. Hydro system. This would involve additional capital costs of 120 million 1978$. The total additional generating capacity due from additional hog fuel use would exceed 600 MW, almost 15% of B.C. Hydro's peak one-hour demand of 4258 MW in the 1976/77 fiscal year. The indicated annual electricity energy output of about 4500 MWH from the additional generation at pulp and paper mills is more than half of B.C. Hydro's 1976/77 industrial sales, and almost 20% of B.C. Hydro's total sales in B.C. in the 1976/77 fiscal year.

In terms of employment, the hog fuel projects generally involve more direct employment and much less capital than comparable hydroelectric projects, and probably use less labour and less capital than large coal-fired thermal projects such as Hat Creek. In this respect, the hog fuel projects to some extent reverse the high capital intensity and low job-creation potential of the larger-scale energy projects being undertaken in B.C. and in the rest of Canada. This is, of course, consistent with the notions of greater labour-intensity and greater decentralization that generally mark the application of conserver society concepts. One major advantage of this is that there is less likelihood of labour market bottlenecks during construction, no need to create town sites and other special overhead capital, and no requirement for goverment policies to coordinate and cushion big labour market flows.

4. Breaking Down the Barriers

In the introductory section, we outlined in a general way some of the institutional barriers standing in the way of more extensive use of wood wastes as an energy source. Now that we have presented the results of our research, we can be more precise about some of these barriers, and can suggest some possible ways of removing them.

It is apparent from the results reported in sections 2 and 3 that the overall economics of using hog fuel to replace fossil fuels and to generate additional electricity are very attractive, and that the chief barriers to implementation are provided by existing pricing structures, the costs of changing existing facilities, and the possibly uneven distribution of the benefits. In this section we shall deal with only a sample of the institutional difficulties.

We shall concentrate on two important issues; first the effect of rapid conversion on the financial position of the existing pipeline distribution companies, and second the problems that may arise in making appropriate revisions to electricity pricing so that pulp and paper mills can buy and sell power on terms reasonably comparable to the costs of other new electricity sources in the province.

First the problem posed for the natural gas distribution companies. Almost all the gas-burning mills are on the Pacific Northern Gas and Inland Natural Gas systems. In the case of the Inland system, the full use of hog fuel to replace natural gas to the greatest feasible extent (keeping natural gas for about 15% of the requirements of each mill) has been assumed in the load growth forecast study presented by Inland to the B.C. Energy Commission in June 1977. Although this leads to a 15% reduction between 1976 and 1985 in Inland's forecast of sales to the forest industry, total sales (including sales to the forest industry) are forecast to rise by 32% from 1976 to 1985. We believe that Inland's forecast of sales growth is unrealistically high, but their 1985 forecast could be too high by over 30% and there still would be no serious underutilization of the existing system, and no need for tariff increases to other users to make up revenue lost from sales to pulp mills. Indeed, in the light of Inland's sales forecasts, other users would be better off with hog fuel use than without it, because Inland would have to undertake more system expansion if the mills did not convert, and the conventional tariff-setting system used by Inland means that system expansion works against the interests of existing customers.[1] Thus the conversion of mills in the Inland Natural Gas service areas is not likely to raise any problems for the utility or for the rest of its customers.

For Pacific Northern Gas, however, the situation is more difficult, as the system is much more heavily dependent on its sales to pulp and paper mills. For example, the Canadian Cellulose mill at Prince Rupert was responsible for 56% of Pacific Northern's actual 1975 sales, and Eurocan Pulp and Paper (at Kitimat) took another 19%. The utility is already anticipating a substantial increase in the use of hog fuel by its pulp and paper customers, as witnessed by a forecast 1979 sales volume 22% less than actual sales in 1976.[2]

Our research suggests that most of the gas used at both mills can be, or is already being, replaced by hog fuel. Current and potential reductions in gas use by these two mills could be of the order of 50% of PNG's 1976 sales. Some of this drop has already taken place, and rates have been adjusted accordingly. Under the present rate structure (established March 1, 1978), Canadian Cellulose pays $1.58/mcf for firm gas, while PNG pays something less than $1.16/mcf. At these prices, each further cut of 1 billion cubic feet in Canadian Cellulose's use of gas would reduce PNG's net annual revenues by about $400,000.

Each reduction of 1 bcf per year in Canadian Cellulose consumption of natural gas saves $1.58 million for Canadian Cellulose, costs $.4 million to PNG, and provides additional profits of $1.24 million for B.C. Petroleum Corporation as the gas saved from domestic use at $1.16/mcf can be used to make up deficient export deliveries at $2.40 (Canadian) per mcf. This poses an institutional barrier to the increased use of hog fuel by Canadian Cellulose, and other smaller mills on the PNG system. In the final report of its 1977 "Petroleum and Natural Gas Prices and Incentives Hearing", the B.C. Energy Commission noted this problem (at pp. 66-7), and emphasized that the loss of industrial customers with their regular year-round use could raise the average costs of the utility even after peak demand reached its previous level once again. The Commission concluded (at p.68) that the wholesale price should be further increased in stages, and that any very large increases might require "action to mitigate their impact... to ensure that the position of any utility's remaining customers was not compromised."

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[1] The conventional tariff method provides a "front-end loaded" tariff that charges the highest tariff to early users. Once the system is fully loaded, existing users are best served if there is no subsequent load growth, so that they can reap the advantage of the declining book value of the rate base. These issues are explained more fully in J.F. Helliwell and J.M. Lester, "A New Approach to Price Setting for Regulated Pipelines" The Logistics and Transportation Review, Vol. II, No. 4, 1975.

[2] The 1975 figures are from PNG's "Application to Amend Certain Rate Schedules, October 1976". The 1976 sales figure and the 1979 forecast are from PNG's "Submission" of June 1977 to the B.C. Energy Commission's 1977 Petroleum and Natural Gas Price and Incentives Hearing.

We agree with the Commission's general view that it would be a mistake to "advocate the maintenance of low prices solely for the purpose of protecting utility load factors." We would be more aggressive than the Commission has been so far in pushing up the wholesale price of gas, and would advocate that any damage to the financial viability of PNG through very fast conversion to hog fuel could be compensated by payments from the B.C. Petroleum Corporation to PNG. Any loss of load below some base value, say 8 bcf/year, would trigger payments from the Petroleum Corporation to PNG of some fraction of the cost of service that would otherwise have been paid by the vanishing customers. According to our calculations, even a full compensation for lost revenues would amount to less than one-third of the extra profits made on the additional export sales, and the compensation payment would soon disappear if PNG's estimates of growth of other sales have any validity.

We turn now to consider briefly the problems of ensuring that pulp and paper mills pay a high enough price for the power they purchase, and receive an equivalent price for the power they sell, so that the co-generation of steam and electricity is developed to an appropriate degree. A recent major U.S. study[1] reported that electric utilities vary widely in their attitudes towards electricity generation by their customers. By the same token, industrial firms vary in their willingness to invest funds and management effort in a utility-type operation that is, or seems to be peripheral to their main line of business.

Consider what might happen if each organization was negatively inclined toward the project. The pulp and paper firm would do its calculations assuming the high test rate of return often employed when new investments are being considered. Current rather than expected future purchase prices for fossil fuels and electricity would be assumed. Full administrative overheads would be charged to the project. If the firm would itself be a purchaser of hog fuel, it would assume high prices for purchased fuel and would downplay the importance of the disposal costs that might otherwise need to be paid to get rid of surplus wood wastes. Finally, as we noted in the introductory section, the firms might be concerned that the higher values for hog fuel might trigger higher log prices and higher stumpage payments.

Right at the centre of the ambivalent attitude of many pulp and paper firms is the knowledge that they are currently paying energy prices, especially for natural gas and electricity, that are far below the export values and the costs of new supplies. The firms quite rightly worry that the energy price increases that would make energy production from wood wastes profitable for them would also raise their costs as energy consumers. At one stage this was probably a decisive factor in determining the attitudes of pulp and paper firms. However, as our calculations reported in section 2 reveal, energy prices have by now risen so far that hog fuel projects make economic sense to the pulp and paper firms even if there are not any further increases in the relative prices of fossil fuels and electricity. This has already changed the attitudes of forest firms markedly, and we expect to find that pulp and paper producers will soon be encouraging the reform of electricity pricing in four respects: First to ensure that they

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can sell energy at the same price they have to pay for it; second to increase the energy charge relative to the capacity charge; third, to relate the size of the capacity charge to the timing of the system peak, and not to the user's peak; and fourth to raise the general level of electricity prices to match more closely the costs of B.C. Hydro's new energy projects. Enthusiasm for the first three reforms will be general among the pulp and paper industry, while support for the fourth may be restricted to the minority of firms that are likely to be net suppliers of electricity to B.C. Hydro.

The oil burning pulp and paper mills no doubt foresee a fairly early end to the diminishing subsidy for domestic users, and are planning accordingly. The gas burning mills still face a much lower price for their fuel, may not foresee an early end to this situation. For these mills, the pressure to convert comes more from the nearby and often very excessive supply of hog fuel that must somehow be disposed of. They have nothing direct to gain from higher prices of natural gas, so the possibility exists that there may develop a fairly strong coalition of producers (who want high prices and large markets), distributors (who want large sales volumes) and the industrial users (who will still need some gas to supplement their hog fuel, and certainly don't want to pay more for their present use) to sustain the current situation wherein the B.C. Petroleum Corporation is selling new gas to B.C. distribution companies for less than it is paying for it, and for about half what the gas would be worth if used to make up the export shortfalls. So long as the shortfall remains, (new B.C. discoveries and purchase contracts for new Alberta gas may cause it to disappear before 1980) this institutional barrier to more efficient use of natural gas and hog fuel might be bypassed in part if pulp and paper mills were given a direct payment by the B.C. Petroleum Corporation for reducing their use of gas. Our calculations suggest that most hog fuel projects for gas burning mills are likely to be profitable even at 1978-level prices for natural gas, so this kind of policy will probably not be necessary. The conversion to hog fuel will be hastened by higher natural gas prices, and will be made more profitable for the firms if the National Energy Board resists Westcoast Transmission's bid to raise capacity charges relative to energy charges. Similarly, the B.C. Energy Commission should ensure that energy charges carry the weight of any price increases under their control, as that would, among other things, facilitate the economical use of natural gas as an aid to clean and efficient use of hog fuel.

Turning to the electric power utility, we might expect to find an ambivalent attitude. On the one hand, B.C. Hydro is itself facing ever increasing costs, both economic and environmental, of its own new power projects, and the prospect of debt and interest payments that are expected to mushroom over the next fifteen years.[1] On the other hand, B.C. Hydro is a monopolistic seller of electricity for most of British Columbia, is the only potential customer for surplus electricity produced by pulp and paper mills, and is likely to have substantial excess capacity in its own system for at least several years. In these circumstances, it will not be surprising if B.C. Hydro is somewhat reluctant to purchase power from

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[1] The general problems that this poses for utility management and rate-making are outlined in John F. Helliwell, "Some Emerging Issues in Utility Regulation and Rate-Making" forthcoming in a special issue of The Logistics and Transportation [illegible].

"unreliable" independent sources, and offers prices that resemble the lowest of the potential export prices (i.e. the Bonneville Power Authority is occasionally dumping surplus power at 3 1/2 mills) rather than the costs of B.C. Hydro's own new energy projects, which run over 20 mills in terms of today's prices.

From the point of view of the conserver society, we must hope that the market for export power will be excellent during the period that B.C. Hydro's over-fast expansion comes on stream, and that Hydro will therefore be receptive to pulp and paper mill proposals to cut power use and periodically contribute electricity to the provincial grid. In the past, as reported by Hawkesworth's 1974 report for B.C. Hydro, the utility was only willing to offer about 5 mills, or even less, for surplus power. We have been informed by Hydro officials that higher prices are now being offered, but the exact terms are not being released. We are assuming that the energy charge is the same for purchases and sales. The appropriate policy, as we have already outlined, would be for Hydro to raise the energy charge substantially relative to the capacity charge, and then charge (or pay) firms according to the net capacity and energy drawn from or added to the provincial power grid. In the absence of a broadly defined and open policy of this sort, there is a risk that B.C. Hydro will be tempted to treat each mill as a special case, and to be less than encouraging in the terms and conditions that they will offer to the pulp and paper mills.

Breaking down the institutional barriers that may stop B.C. Hydro and the pulp and paper firms from making mutually advantageous use of hog fuel must be the task of B.C. Hydro and the pulp and paper firms. From the policy point of view, major reforms of B.C. Hydro pricing and planning procedures are desirable, and B.C. Hydro's public accountability are very low by any standard. Whatever research, complaining, investigation, or policy direction is provided from outside B.C. Hydro, it is apparent that effective and efficient progress towards the fuller use of wood wastes for electricity generation requires the ungruding support of B.C. Hydro itself.

Summary of Conclusions

In this paper we have shown that there is a very large potential for economic use of wood wastes to replace fossil fuels and to generate electricity in the B.C. pulp and paper industry. All of the necessary conditions appear to be present: Ample supplies of wood waste; relatively small and decentralized projects not imposing any major problems of construction or operation; the prospect of profits, or at least the potential for avoiding losses, for each of the major participants; and an economic environment soft enough that cost-reducing investments can for once take precedence over expansion investments.

We have found that firms with recent experience of hog fuel projects have been very willing to share their experience with us, and we have found substantial industry interest in the results of our research and in the prospect of new hog fuel projects. We have identified the economic implications, which are potentially favourable for all of the interested parties, and we have noted a number of institutional barriers, few of which appear to be very large, and none of which seem to be insurmountable.

For at least one major type of industrial waste, therefore, we conclude that the concepts of the conserver society are likely to find themselves in action. The firms undertaking the projects will not see themselves as applying the concepts of the conserver society but as making investments to cut costs, and to get rid of wastes. That is as it should be, for such projects are the most secure foundation for a conserver society. Our calculations indicate that the use of wood wastes as an energy source in British Columbia offer substantial returns to the pulp and paper firms themselves, and even larger returns to the economy as a whole.

WASTE UTILIZATION IN INDUSTRY - PART 1

ENERGY FROM WASTE IN THE PRODUCT INDUSTRY

R.S. Evans
Western Forest Products Laboratory

Abstract

Information exchanged at the Energy Imperatives Conference indicated that the B.C. interior sector of the industry has the potential for energy self-sufficiency based on utilization of mill residues, and, in fact, that the then remaining residue surplus may be adequate to support some thermal electric power developments. However, despite the potential for energy self-sufficiency, industry has not moved substantially in this direction, largely because of doubts as to what wood waste energy conversion systems to adopt. Traditional steam plants have the disadvantage of high capital and operation costs. Newer systems, exemplified by wood gasifiers and fluid bed combustors promise some economies but have not been demonstrated sufficiently to gain the confidence of the industry. Thermal power developments are likewise impeded by complex issues related to distribution and ownership.

Introduction

The forest products industry is the major industrial consumer of fuel oil and natural gas in British Columbia. Rising cost of these fossil fuels, and uncertainty of future supply, has focused attention on possibilities for energy substitution based on wood and bark wastes of the industry, which are currently discarded at some stress to the environment.

An "Energy Imperatives" conference sponsored by the Council of Forest Industries of B.C., in June 1977, brought together managers and executives from the industry and from provincial and federal government departments. This meeting resulted in formation of a wood waste energy co-ordinating committee to help guide efforts toward energy self-sufficiency within the industry. This Committee, chaired by Norman Gish, Chairman of the B.C. Energy Commission has representation from the following agencies:

B.C. Development Corporation

B.C. Ministry of Environment

B.C. Ministry of Forests

Council of Forest Industries of B.C.

Energy, Mines and Resources, Canada

Environment Canada

Information exchanged at the Energy Imperatives Conference indicated that the B.C. interior sector of the industry has the potential for energy self-sufficiency based on utilization of mill residues, and, in fact, that the then remaining residue surplus may be adequate to support some thermal electric power developments. However, despite the potential for energy self-sufficiency, indusry has not moved substantially in this direction, largely because of doubts as to what wood waste energy conversion systems to adopt. Traditional steam plants have the disadvantage of high capital and operating costs. Newer systems, exemplified by wood gasifiers and fluid bed combustors promise some economies but have not been demonstrated sufficiently to gain the confidence of the industry. Thermal power developments are likewise impeded by complex issues related to distribution and ownership.

As a first step toward resolution of these problems, the Wood Waste Energy Co-ordinating Committee commissioned three consultant studies.

1. A review and evaluation of wood combustion systems having application to the forest products industry.

2. A design study and cost estimate for a demonstration-scale wood waste gasification system.

3. A study to identify sites where wood waste fired thermal stations might be located and to examine the economic feasibility of one such installation.

Reports on these studies are at a final draft stage of preparation and can be discussed on a later occasion. The purpose of the present paper is to review the background to these activities, for the benefit of those unfamiliar with the industry or its energy substitution options. Extensive references are not given since relevant material is cited in a recent report on energy self-sufficiency prospects for the industry (Evans 1977).

Production and Use of Mill Residues

A major feature of the forest products industry is the symbiotic relationship between the sawmilling sector and the kraft pulp sector, such that the former is the raw material supplier to the latter. This is not to denigrate sulphite and groundwood pulp mills, paper mills, shingle and shake mills, or veneer, plywood and particle board plants, but simply to emphasize that sawmills and kraft mills dominate the industry and interact for mutual economic benefit.

More than 600 B.C. sawmills produce a prodigious amount of lumber (approximately 10 billion board feet in 1976) while some 18 pulp mills make kraft pulp (about 5 million tons in the same period) from residual wood chips which are a sawmill by-product. Energy for the pulping process is obtained by combustion of the kraft black liquor in chemical recovery boilers, and by combustion of purchased wood and bark wastes in hog fuel boilers, supplemented to some degree with fuel oil or natural gas.

Residue yields vary with sawmill type and to some extent with wood species. For a typical interior white spruce mill with a band headrig, about 31 percent of a sawn log will emerge as pulp chips, about 12 percent as sawdust and about 11 percent as planer shavings (Dobie and Wright, 1975). The sawdust, shavings and bark from the log are termed "hog fuel", when comminuted in a hammer hog to suitable size for burning. The spruce band mill would yield about 43 cubic feet solid wood equivalents of hog fuel per thousand board feet of lumber produced. This would have a recoverable energy value of about 5.5 million BTU., fired in a steam boiler.

Total hog fuel production in B.C. is 10 million dry tons per year, of which only 4 million tons is used as fuel. The remaining 6 million tons represents, 70 percent of the surplus hog fuel in Canada, and is an unused energy resource having an energy value of approximately 60 trillion BTU. This is nearly equal to the 63 trillion BTU equivalents of fuel oil and natural gas consumed annually by the B.C. forest products industry.

Patterns of Energy Use

Table 1 and 2 show the energy forms and annual requirements of the pulp and paper and the wood products sectors of the industry, excluding that from burning of black liquor and the small quantity of hydroelectric power generated within the industry. The pulp sector is already 33 percent self-sufficient and the wood products sector 50 percent, in respect to energy derived from hog fuel. Self-sufficiency to the extent of about 85 percent, with dependence only on purchased electric power would appear to be possible on the basis of the 60 trillion BTU surplus hog fuel resource already identified.

However, these are broad statistical generalizations for the sectors at large and do not take regional patterns of energy use and hog fuel supply into account. In particular, they do not reflect the very great differences between the industry on the coast and the industry in the interior.

The Coast industry is characterized by large sawmill complexes that operate steam plants to dry a relatively small percentage of their lumber production: over 80 percent of coastal lumber being shipped green to offshore markets. Substantial use of hog fuel for process heat has been traditional within the coastal pulp mill sector. Because of moderate cost, water transport from the sawmills by barge is the transportation method used. In consequence, hog fuel supply and demand are very nearly in balance, with an estimated surplus of less than 800,000 volumetric [illegible] in 1973 and a projected [illegible] deficit by 1980.

Fossil fuel usage on the Coast is predominantly fuel oil, because of isolation from natural gas lines. Points of use are supplementary fuel in hog fuel boilers and direct firing in kraft mill lime kilns. Four new high performance hog fuel boiler projects initiated recently at Crofton, Alberni, Elk Falls, and Powell River, will reduce coastal use of fuel oil. However, completion of these projects is likely to exhaust the surplus hog fuel supply and eliminate prospects for further reduction in oil usage, unless use of logging residues or import of interior hog fuel can be justified.

The interior industry is characterized by many medium sized sawmills, which ship dry lumber by rail; and by kraft pulp mills that supplement hog fuel with substantial quantities of natural gas and which for the most part, fire their lime kilns with the same gaseous fuel. The sawmills have found it economical, as well as convenient to dry their lumber by direct firing with natural gas, and to dispose of their hog fuel by sale to pulp mills, or by incineration, or burial in landfills. Thus, the larger part of the 6 million ton annual surplus of hog fuel is in the interior or B.C., where the industry is heavily dependent on natural gas. The quantity of the former is far in excess of that required to displace the latter, when adequate technologies are available.

Wood Waste Energy Conversion Systems

While pulp mill lime kilns account for a major percentage of fossil fuel use in the industry and are a logical target for inter-fuel substitution, no promising system for lime kiln firing with wood waste, on the scale required, has yet appeared. Displacement of natural gas in sawmill dry kilns is the next logical target and is the focus of current questions on energy conversion systems.

Steam plants, whether large or small, are not a favored conversion system for energy supply in sawmills because of the statutory requirement for licensed steam engineers, which results in high operating cost. Alternative systems are of recent development. These are many and varied but can be classified into generic types as follows:

Single Chamber Burners	Multiple Chamber Combustors
Suspension Burners	Fluid Bed Combustors
Wood Gasifiers	

The coordinating committee report will elaborate on these systems, their merits and shortcomings. However, they are briefly described here.

Single Chamber Burners

These are typified by the locally developed lockhead-haggerty unit (Figure 1) which attempts to obtain complete clean combustion of even wet fuel in a small travelling-grate furnace by careful metering of feed and by careful temperature control. The unit produces a hot flue gas which can reportedly by used directly in lumber kilns and dryers. The system is relatively new and a first unit is currently under trial and development at a Vancouver Island shake and shingle mill.

Multiple Champer Combustors

These are typified by the lamb-cargate wet cell vertical burner (Figure 2), developed in B.C., and by the multichamber horizontal burner developed by the Automatic Combustion Division of Michel Lumber Co. in Washington State (Figure 3). In both systems, fuel is burned with inadequate air in a primary chamber and the gases evolved are burned in a secondary chamber. The hot flue gas generated by these units is reportedly acceptable for direct injection into kilns and dryers.

At least one unit of the automated combustion system has been operating for 5 to 6 years. The lamb-cargate unit is a prototype, recently purchased by Plateau Sawmills in B.C. to directly fire two lumber kilns.

Suspension Burners

In principle, these systems involve combustion of finally divided dry fuel, while in air suspension in a vortex or cyclonic burner, yielding hot gas. The energex and the peabody, Gordon-Piatt SF burners, developed in the U.S.A. (Figures 4 and 5) and the Waycot burner developed in B.C. (Figure 6), are the best known examples.

The Waycot system has two operating units heating dry kilns and one on a rotary dryer. More than 30 peabody Gordon-Piatt units are on line, in a variety of operations. Over 60 energex units are in place heating dry kilns, veneer dryers and rotary dryers, largely in the U.S.A.

Fluid Bed Combustors

These systems are typified by the York Shipley-EPI fluid flame system and by the combustion power system both developed in the U.S.A. The fluid flame (Figure 7) has been in commercial use for at least four years while the combustion power system (Figure 8) has only recently come into full scale captive use by Weyerhaeuser Corporation, of which combustion power is a subsidiary.

The operating principle of both systems is combustion of hog fuel in a hot fluidized bed of sand, yielding a hot dry gas which reportedly can be used directly in drying applications.

Wood Gasifiers

Wood gasification is an old and abandoned technology now being revived. Gasifiers generally are vertical, cyclindrical, reactors in which hog fuel can be heated in the presence of moisture and a deficiency of oxygen, to produce a combustible gas. This gas is a mixture of hydrogen, carbon monoxide, and methane, diluted with nitrogen and carbon dioxide, plus some condensable [illegible] water, tar [illegible]. The gas has a low heat [illegible] [illegible] products, can be piped moderate distances; burned in kilns and driers now using natural gas; or used in internal-combustion engines driving generators to produce electric power.

The only modern wood gasifier of commercial scale yet constructed in North America is that designed by Moore Canada Ltd. for the Ainsworth Lumber Company, near Clinton, B.C. (Figure 9). Operating difficulties have prevented its sustained operation for the intended direct firing of lumber kilns. On-site modifications are being made by Westwood Polygas Ltd., a new company formed to improve and commercialize the design. Moore Canada has withdrawn from the gasification field.

Another Canadian development is commercial production of the Gas-O-Dyne wood gasification system by Nelson Iron Works, in Dartmouth, Nova Scotia. This is a copy of the old British Crossley gasifier (Figure 10) that operated in many parts of the world, including B.C., during the first quarter of this century. One unit is now operating in the State of Maine. A second has been purchased by the Government of Manitoba for a demonstration project on production of diesel electric power from wood gas.

A third gasifier of interest in Canada is the pilot scale unit (1.5 million BTU/hr.) designed and operated at the B.C. Research Council (Figure 11). This gasifier differs from the polygas and gas-0-dyne systems in being designed on the "fluidized bed" principle. Instead of a "fixed bed" where the hog fuel is not in motion, the fuel particles are "fluidized" and mixed by a stream of air moving upwards. This permits operation at lower and more uniform temperatures with possible reduction of oils and tars.

The B.C. research design has not yet been commercialized but the Saskatchewan Power Corporation has ordered a 5 million BTU per hour unit. This will be operated coupled to a diesel set for power production demonstration purposes, as in the Manitoba project.

Thermal Power from Wood Waste

As a general rule of thumb, it can be stated that kiln drying of lumber requires about 2 million BTU per thousand board feet of product. This is approximately the fuel value of the shavings produced in planing one thousand board feet of lumber. Thus, if sawmills used their shavings as fuel to dry their lumber, the sawdust and bark from the mills would still remain surplus, for potential use of pulp mills in further reducing their fossil fuel usage.

In the interior, where more than 5 million tons of hog fuel annually is now surplus, the displacement of natural gas from both sawmills and pulp mills would still leave a very large quantity potentially available to fuel thermal electric power plants.

Gross estimates as high as 300 megawatts of installed capacity have been made for the generation potential of this surplus. In reality, much of the surplus [illegible] too widely distributed geographically for economic collection by realistic [illegible] power [illegible] identified three regions having significant centralized hog fuel surpluses. These are Williams Lake, Quesnel and Mackenzie, with an aggregate potential of nearly 150 megawatts. A fourth area centred at Prince George might draw on several surrounding centres for another 150 megawatts but at higher transportation cost.

TABLE 1

ENERGY CONSUMED

B.C. AND PULP AND PAPER INDUSTRY, 1973

Energy Form	Trillion Btu	Percent
Petroleum	33.4	31
Natural Gas	22.8	21
Hog Fuel	35.7	33
Electricity	15.6	15
TOTAL	107.5	100

Source: B.C. Energy Commission

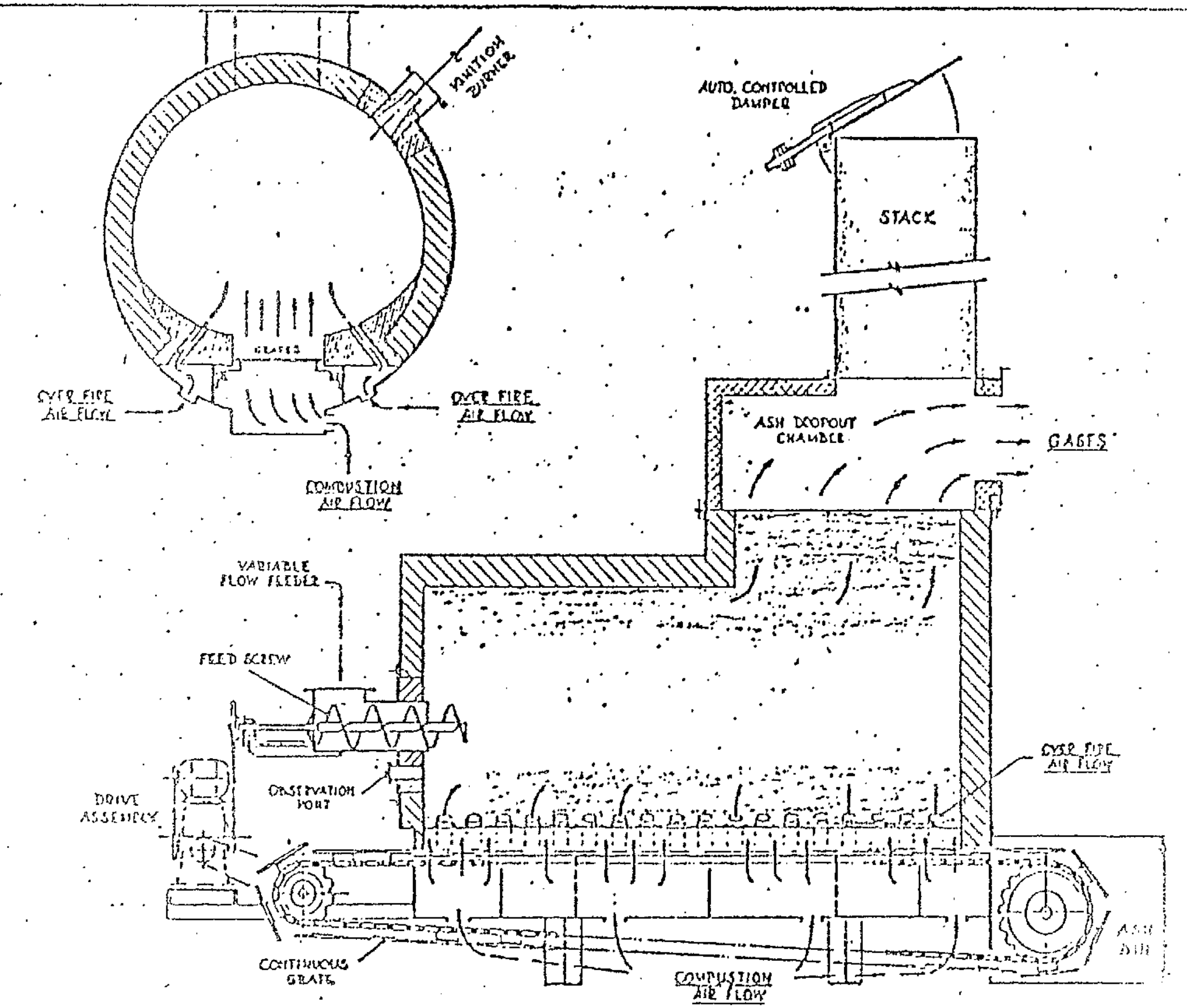
TABLE 2

ESTIMATED ENERGY REQUIREMENTS

B.C. WOOD PRODUCTS INDUSTRIES, 1973

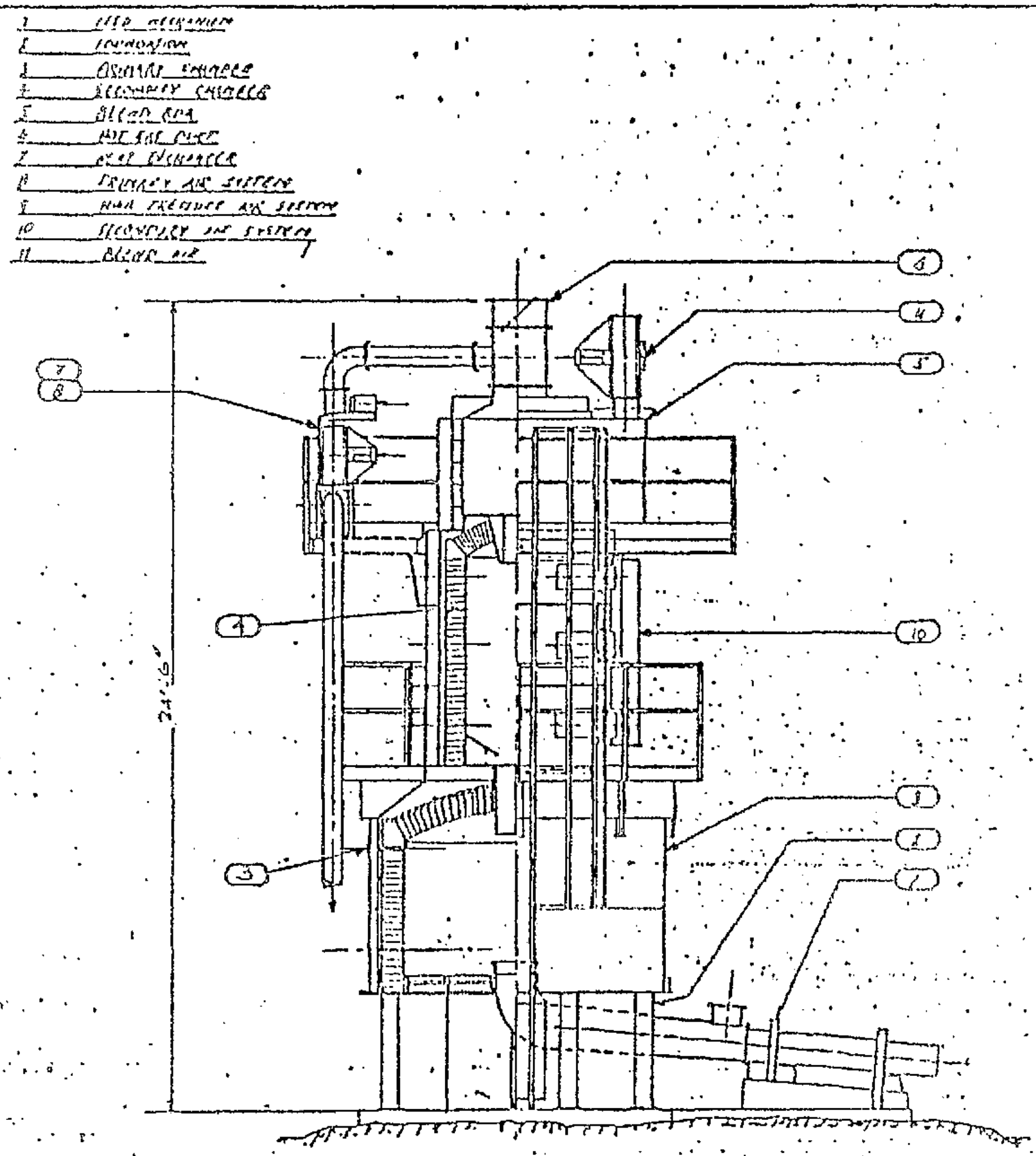
Energy Form	Trillion Btu	Percent
Petroleum	2.9	12.5
Liq. Petroleum Gas	0.7	3.0
Natural Gas	4.3	18.5
Hog Fuel	11.5	50.0
Electricity	3.8	16.0
TOTAL	23.2	100.0

Adapted from B.C. Energy Commission



Lochheed / Haggerty

Single Chamber Combustion



Lamb Wet Cell Burner

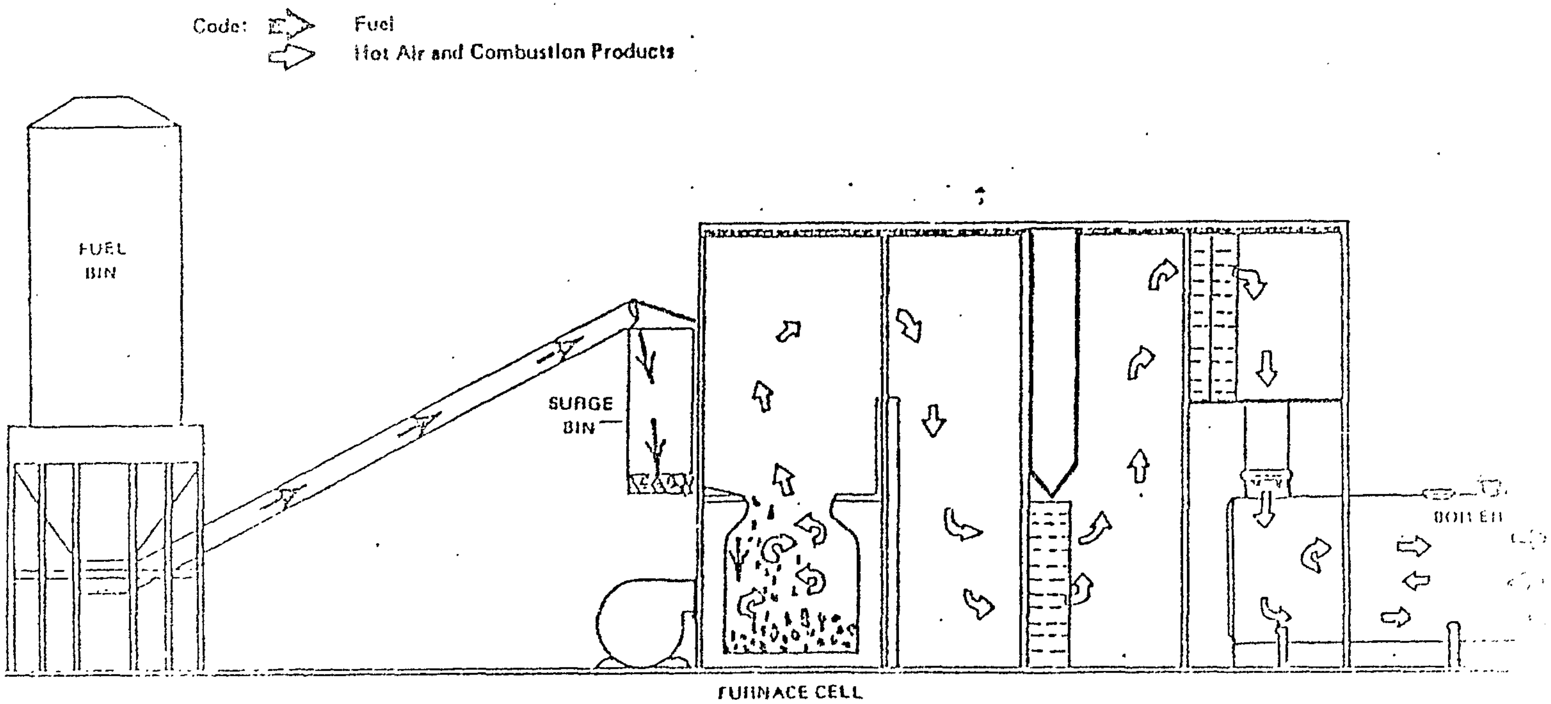
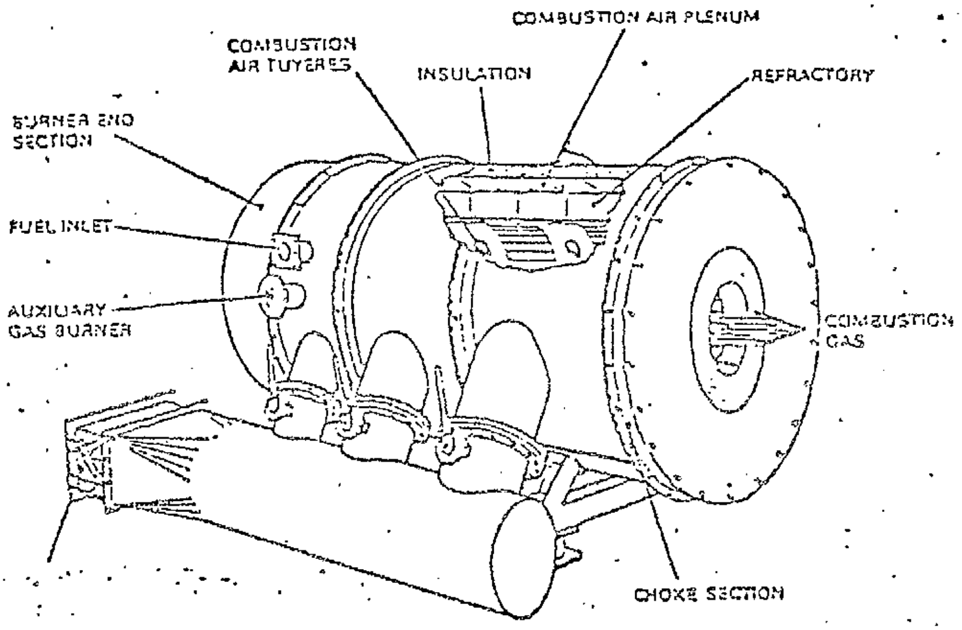
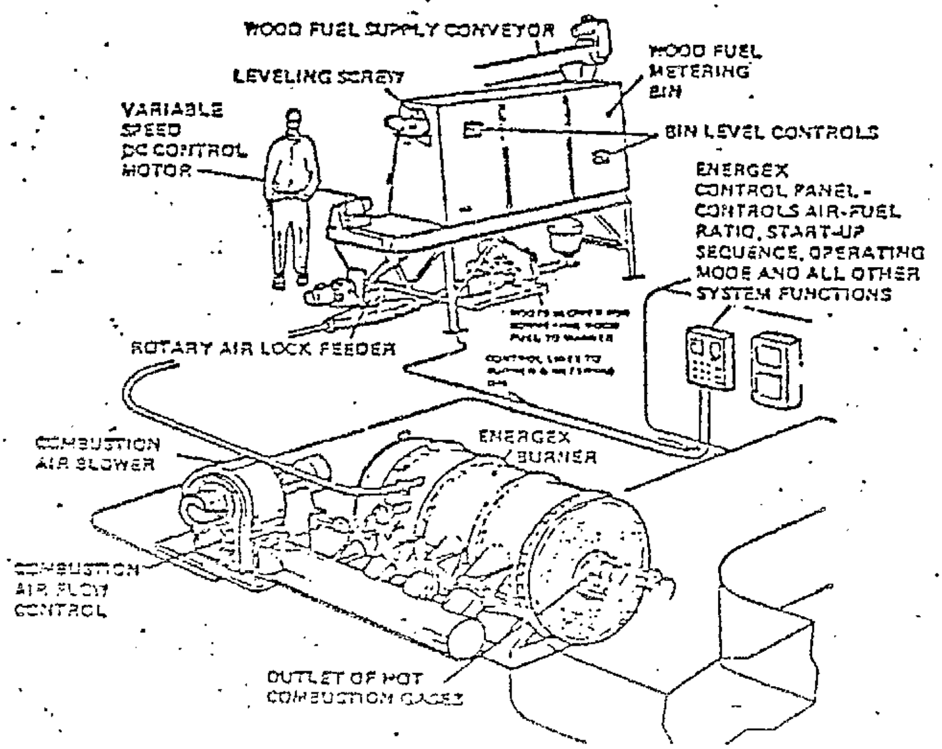


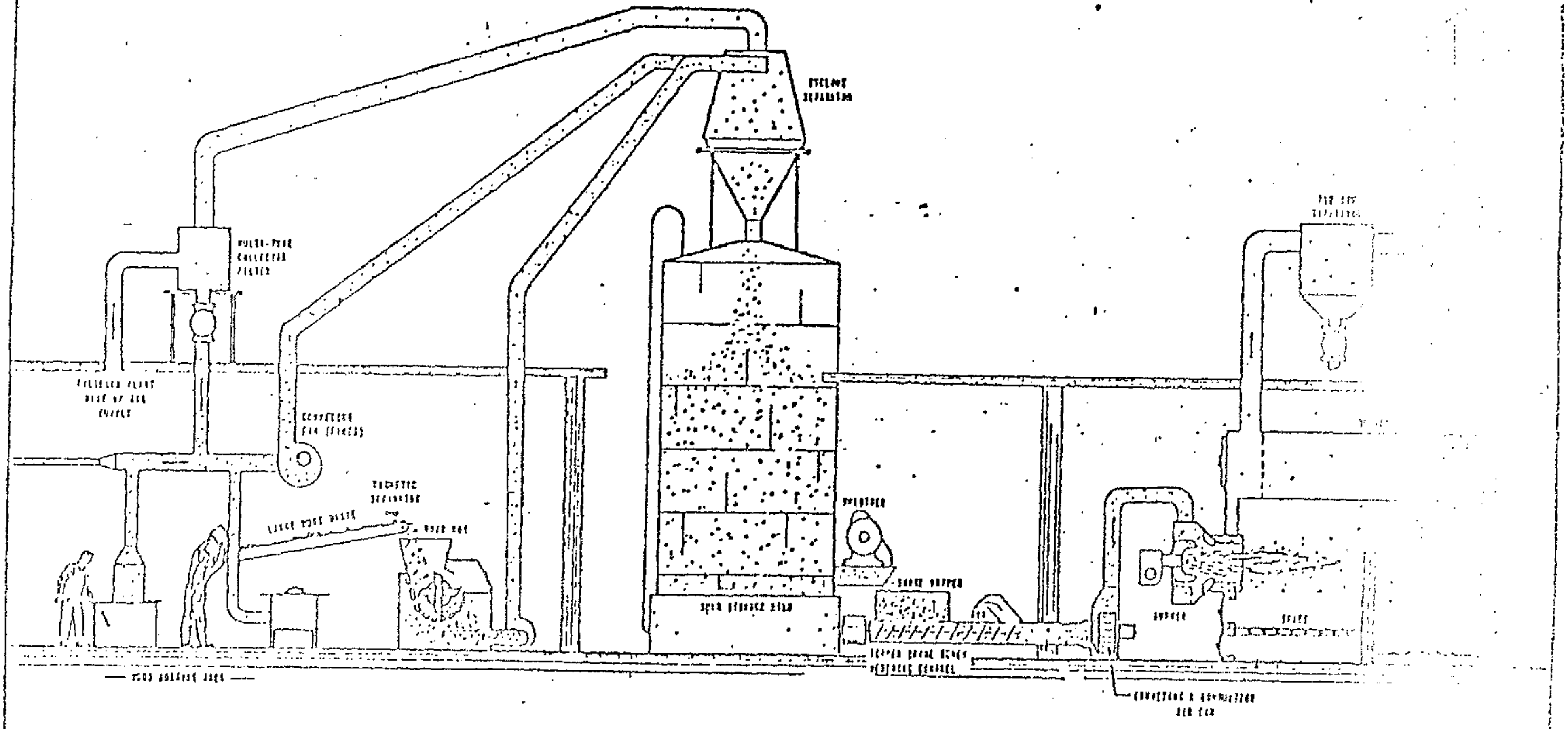
FIGURE 3 . TYPICAL CROSS SECTION AND FLOW OF A MODEL '60' AUTOMATED COMBUSTION FURNACE FIRING A BOILER



Energex Burner Assembly

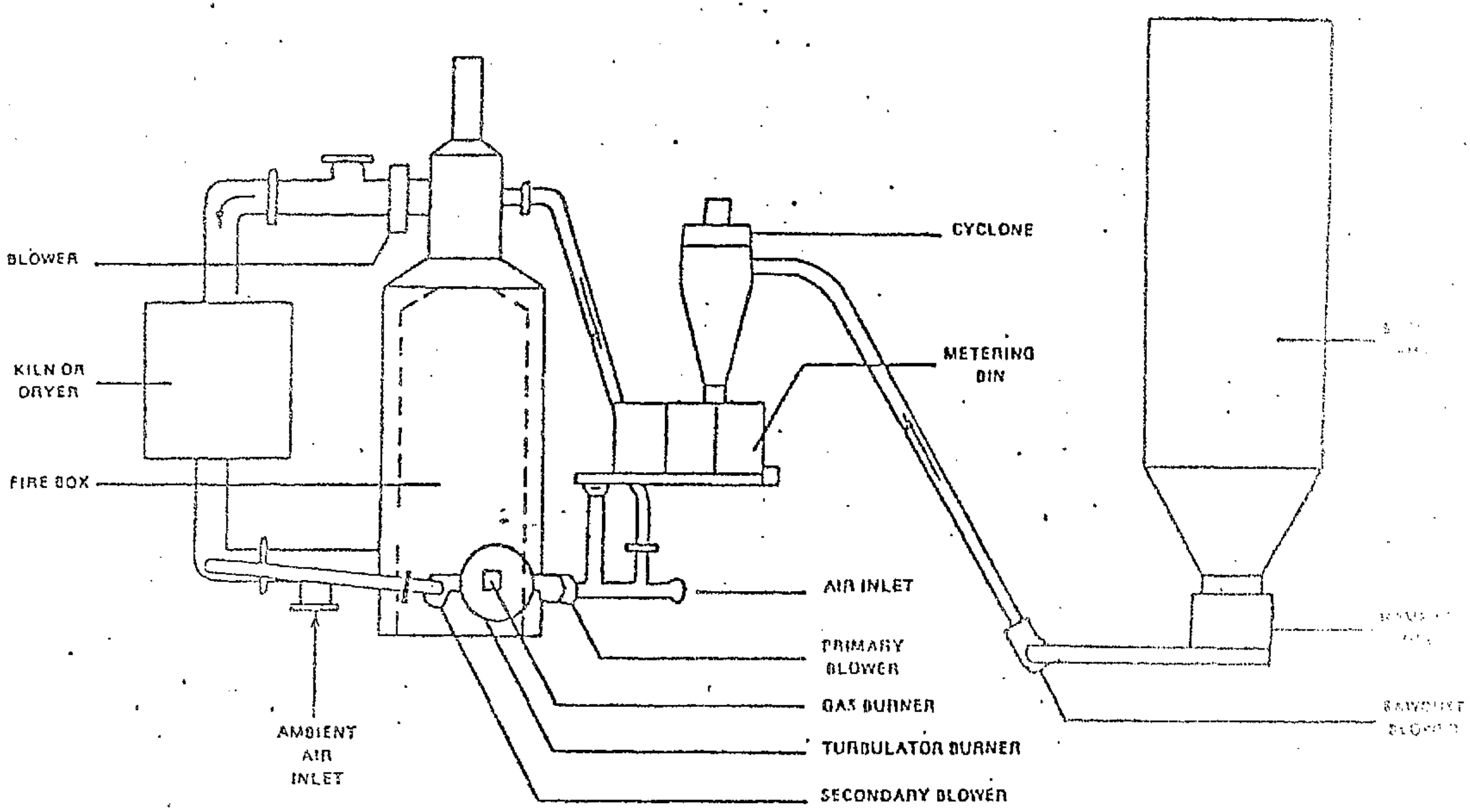
Energex System





Peabody Gordon – Platt
Wood Burning System

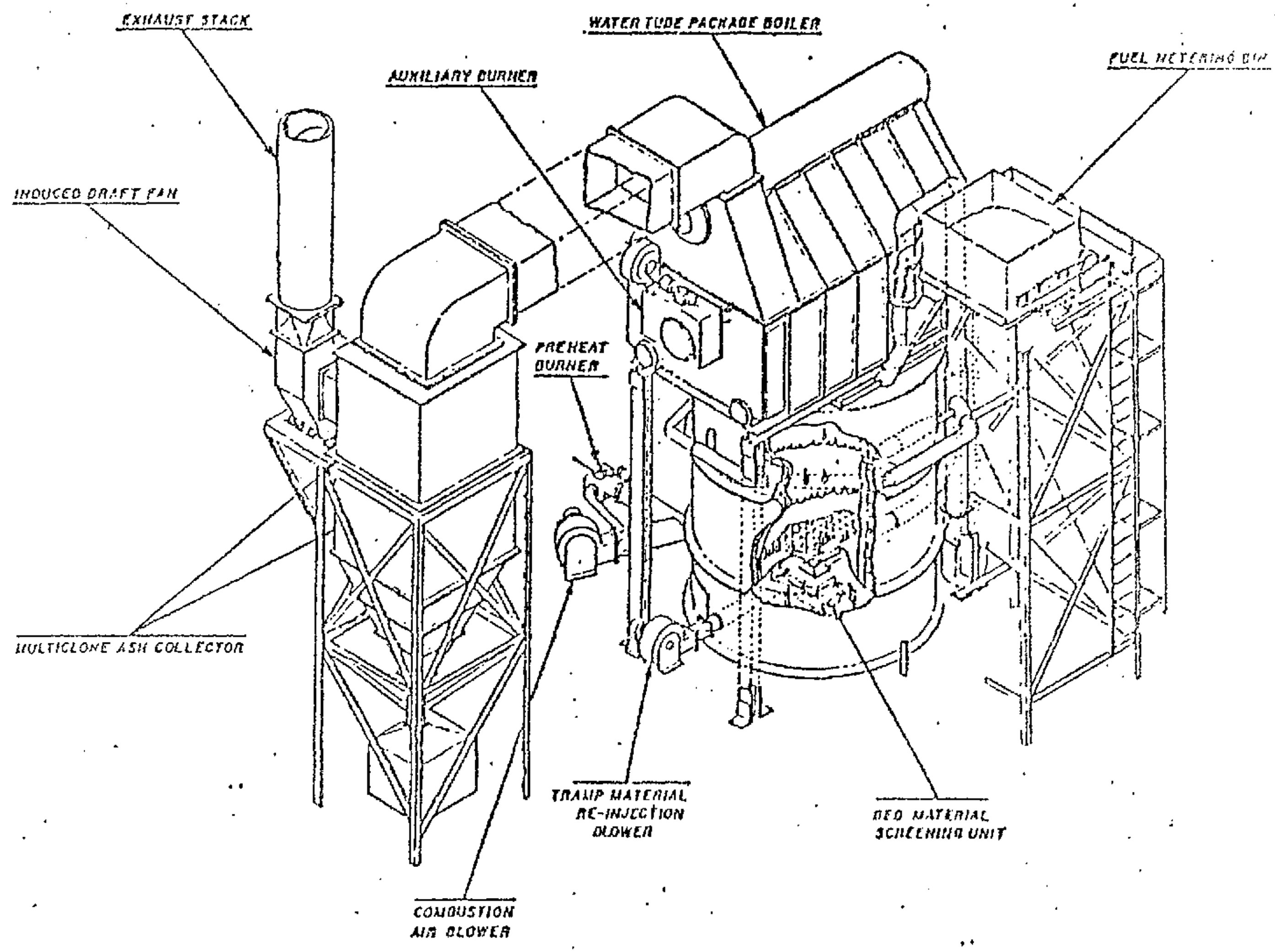
Figure



Waycot Systems Ltd.

Suspension Burner

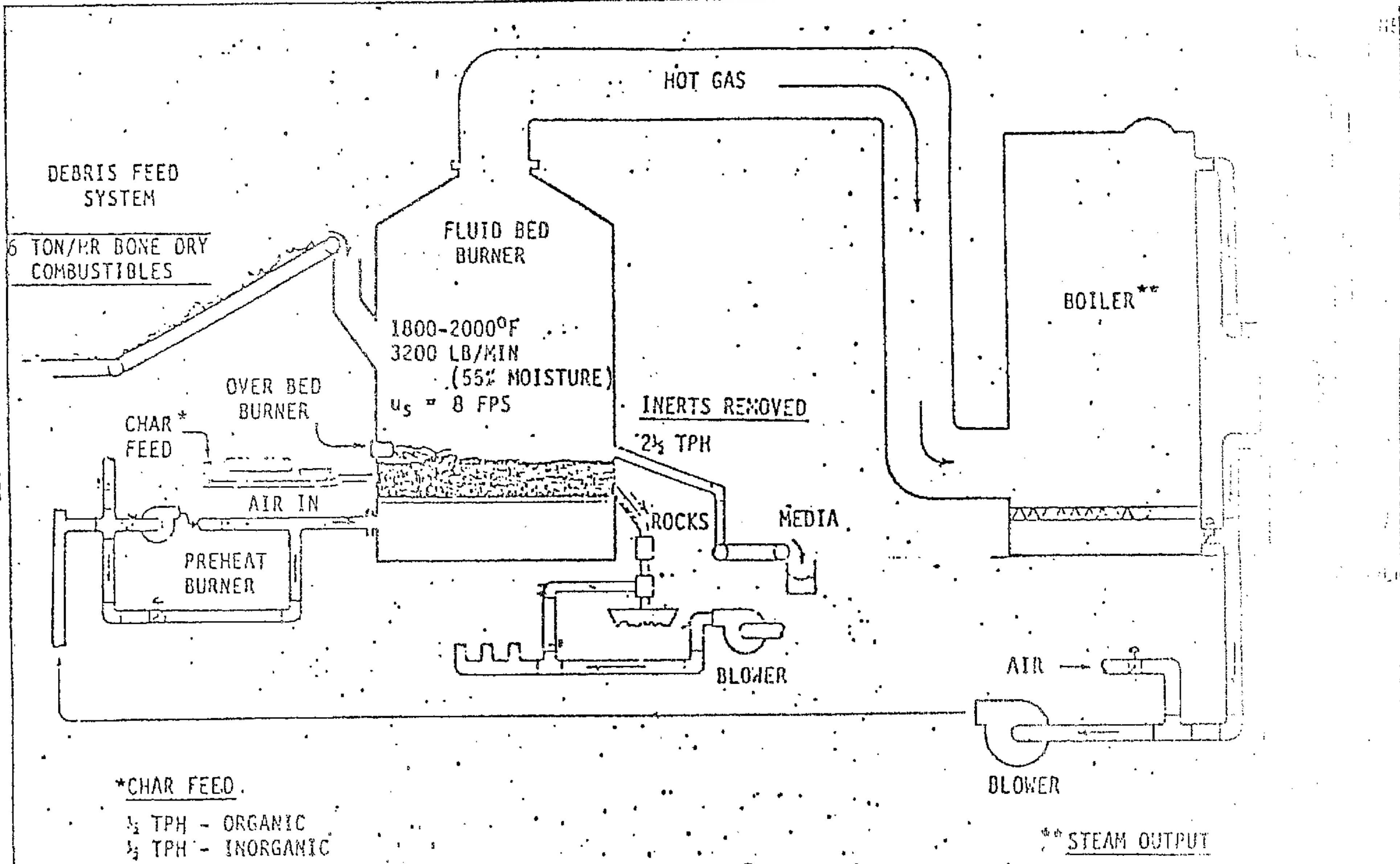
Figure



Energy Products of Idaho

Fluid Flame – Fluid Bed Combustion

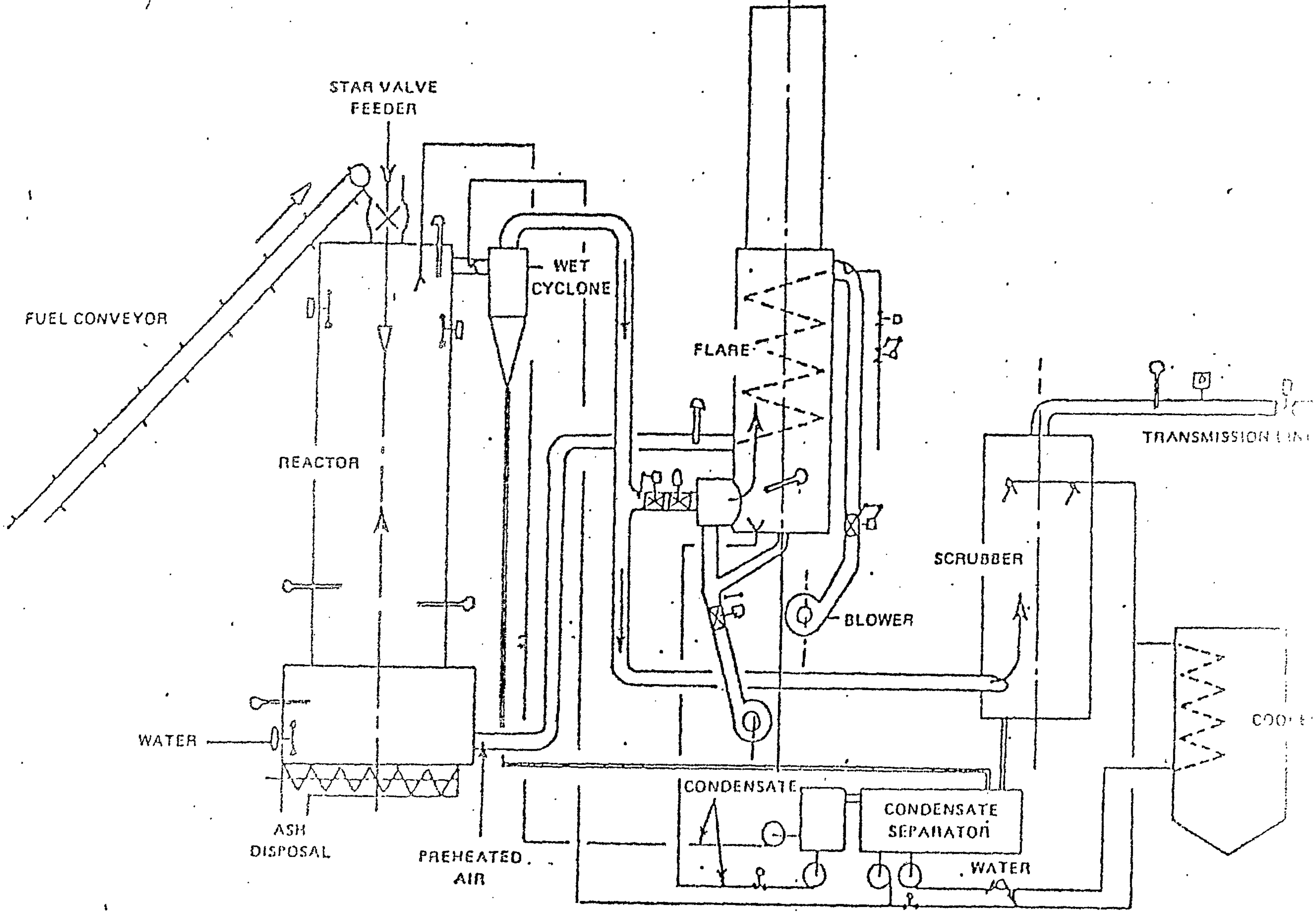
Fig.



Combustion Power Co.

Fluid Bed Combustor

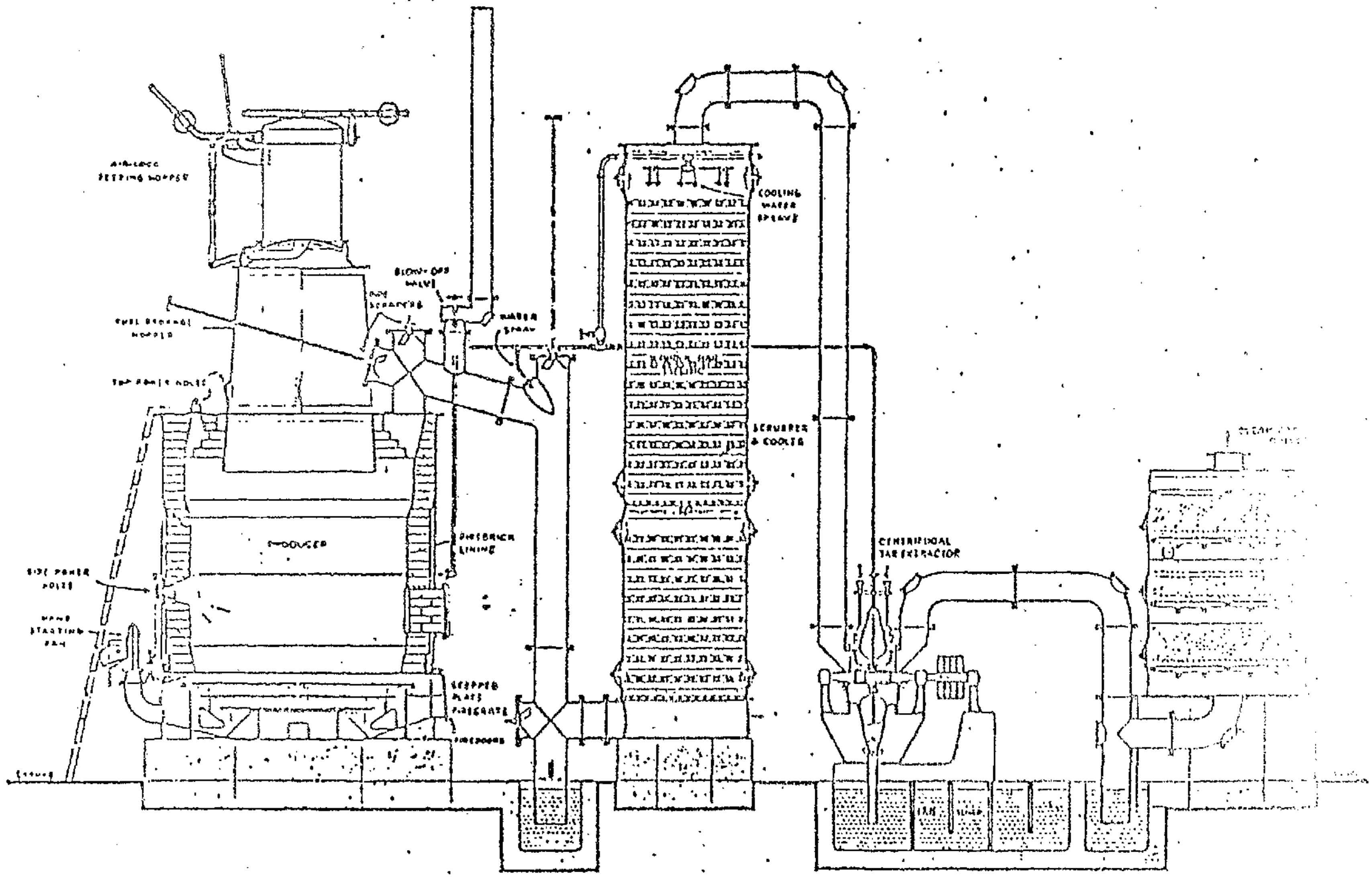
Figure



Westwood Polygas Ltd.

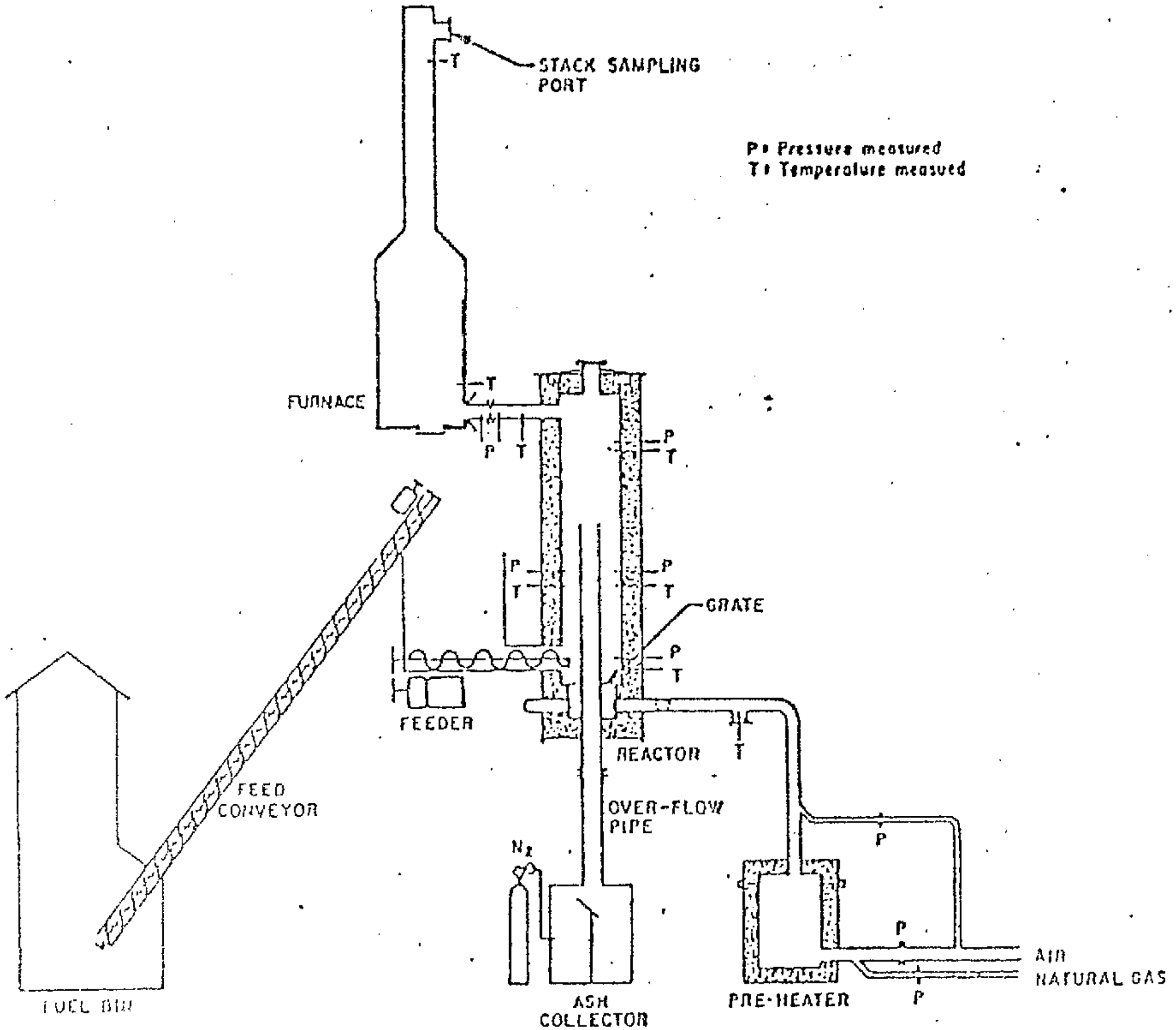
Wood Gasification System

Figure



Original Crossley Gas Plant

Figure



B. C. Research

Gasification System

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WASTE UTILIZATION IN INDUSTRY - PART II

SOLID WASTE HANDLING IN THE FISH PROCESSING INDUSTRY

F.G. Claggett
Recycling Council of B.C.

Abstract

Fish processing is a major industry in the economy of British Columbia. For example, in 1972 the seventy or so fish processing plants in the province employed some 3,500 workers. These plants processed more than 337 million pounds of fish with a total landed value of 75 million dollars. While fluctuations in the landings of fish vary from year to year, it is expected that a substantial increase in production will be realized as the result of a salmon enhancement program presently being undertaken.

When an industry such as this handles such large volumes of raw material over a short production period, the problems associated with solid waste can be considerable. This paper attempts to define the magnitude of the problems, how industry presently copes with them, and what the prospects in the future are for alternative uses.

1. Sources of Solids Waste

The processes which characterize the fish processing industry in British Columbia can be divided into the following major groups:

Groundfish Processing

Salmon Processing

Herring Processing

Miscellaneous Species

Groundfish Processing

Cod, halibut, ocean perch, sole and flounder are the major species in this category, with the exception of halibut, the species are processed similarly. The fish are stored whole in the ship, usually in ice. At the wharf, the fish are unloaded, weighed and washed. Most groundfish require no pretreatment prior to filleting, but ocean perch must be descaled. The fillets account for about thirty percent of the landed weight, with the balance as potential waste.

Halibut is normally gutted at sea, and landed in ice or refrigerated seawater. The head is normally removed prior to filleting or freezing for subsequent processing. About fifty percent of the fish is waste, but only about thirty percent is available for recovery.

Salmon Processing

The five species of salmon processed on the Pacific Coast are spring, sockeye, coho, pink and chum. About eighty percent of the catch is processed for canning: the balance is processed for fresh or frozen sale.

A mechanical device guts the fish, removes the head, tail and fins, and cuts the fish into steaks. These are pressed into cans, and processed in a normal canning procedure. About seventy percent of the salmon ends up in the can. Waste from salmon directed to the fresh or frozen market varies from ten to twenty percent of the landed weight.

Herring Processing

Herring is processed into a number of products, including fish oil, fish meal, herring fillets, marinated herring and herring roe. While the market for other products is gradually developing, the quantity is small compared to that taken for roe, since the roe is only five to ten percent of the herring weight, and only recovered from the female, the carcasses represent ninety-five to ninety-eight percent of the landed weight.

Miscellaneous Species

Although numerous other species such as crabs, shrimp, abalone and sea urchin are processed, the volume is small. The type of waste varies, and the solids waste may often be a major problem since the processing plants are small, and may be remote from other plants.

2. Nature of the Waste

Fish flesh is characterized by a high protein content, with a good balance of the essential sulphur-amino acids. Depending on the species, the flesh also contains varying quantities of oils which are highly unsaturated. These ingredients make fish and its waste products subject to rapid spoilage by bacterial breakdown and oxidative rancidity.

The bones of fish contain calcium and phosphorus which are also important in animal nutrition, or as plant fertilizer.

3. Disposal Methods

[illegible] Disposal Methods

[illegible]

When it was determined that this practice could lead to water quality problems, the waste was ground and dispersed in the waste water from the plant.

Disposal on land required burial, even where it was used as fertilizer. The rapid putrification, with release of noxious compounds such as putriscine and cadaverine meant wastes had to be disposed of rapidly.

Current Disposal Methods

Solids currently being wasted in plants can be reclaimed in the form of protein foods, supplementary additives, or non-edible products, depending on the particular raw material. Solids from the following sources can be economically processed to yield one or more of the three basic product groups:

1. Carcasses, frames and trimmings from filleting operations;
2. Groundfish categorized as too small to be economically filleted;
3. Trimmings and portions from butchering operations;
4. Whole or portions of industrial fish not suitable for human consumption;
5. Trimmings and waste portions from frozen fish, fish blocks, or other ends from the frozen state;
6. Frozen sawdust from sawing frozen fish;
7. Fresh or frozen undersized shrimp;
8. Fresh of frozen waste from shrimp peeling operations;
9. Dark meat fish that cannot be sold as fillets, but may be blended in extruded products;
10. Waste from collars retrieved from salmon canning operations;
11. Shrimp, crab and other shell meat after primary extraction;
12. Combined solids removed from effluent streams by screening, flocculation, precipitation or other techniques.

Raw Materials for Protein Foods

Machines are now available that remove edible meat from most any carcass, waste portion or shell waste. In fact, with the world-wide demand for seafood products, there is no reason that any sanitary portion of seafood now treated as waste cannot be used in edible products. These include formed patties, pressed and cleaved frozen formed fillets, specialty hords d'oeuvres, and specialty products. The wide variety of batter and breading materials adds even further latitude to the array of products possible.

The deboning facility is capable of removing more than ninety percent of the edible flesh from waste. The principle of most of the machines currently on the market depends on forcing the meat through perforated plates under pressure while retaining cartilege, skin and bones. The extruded meat is flakey in appearance and [illegible], and is an excellent material for forming.

Raw Material for Supplementary Additives

Since the flesh of fish is mainly protein, it is possible by chemical means to produce a stable, tasteless, odorless, highly nutritious supplement by chemical means, either by solution and subsequent precipitation, or by extraction of the liquids.

The literature is replete with processes for accomplishing this, and the failure to date in mass preparation of these products is due to economic factors and cultural barriers rather than a lack of technical know-how.

However, preparation of protein concentrates, or fish meal, for animal consumption, has proven to be highly profitable, in fact, certain species of fish not prized for human food are used extensively for production of these meals. Regardless of whether the raw material is whole fish or waste, the process is similar. The only difference is the scale in which the operation is carried out. Plants designed for processing of industrial fish can range to 1500 tons per day, while small batch plants handling five ton per day of waste may be used where waste disposal is more important than a profitable operation. Often, reduction plants, as they are called, are sized to handle wastes from several plants. Figure 1 shows a continuous fish reduction plant. The main process for meal production involves cooking and pressing to physically remove much of the water and fish oil, with subsequent drying, grinding and packaging. The press liquor may have the oil removed by gravity or centrifugation for recovery and sale in the animal oil market. The rest of the liquid which contains soluble protein and vitamins, may be concentrated for sale in that form, or mixed back into the meal prior to drying.

Raw Material for Non-Edible Products

Most of the products from fish and shellfish can be directed to the market for human or animal consumption. The exceptions are such items as skins, shell and bones. While they can be added to meal products, they add little to the value of such products and may find uses in alternate ways.

Bones in fairly pure form can be processed to product bone meal for specialty feeds, and as a fertilizer.

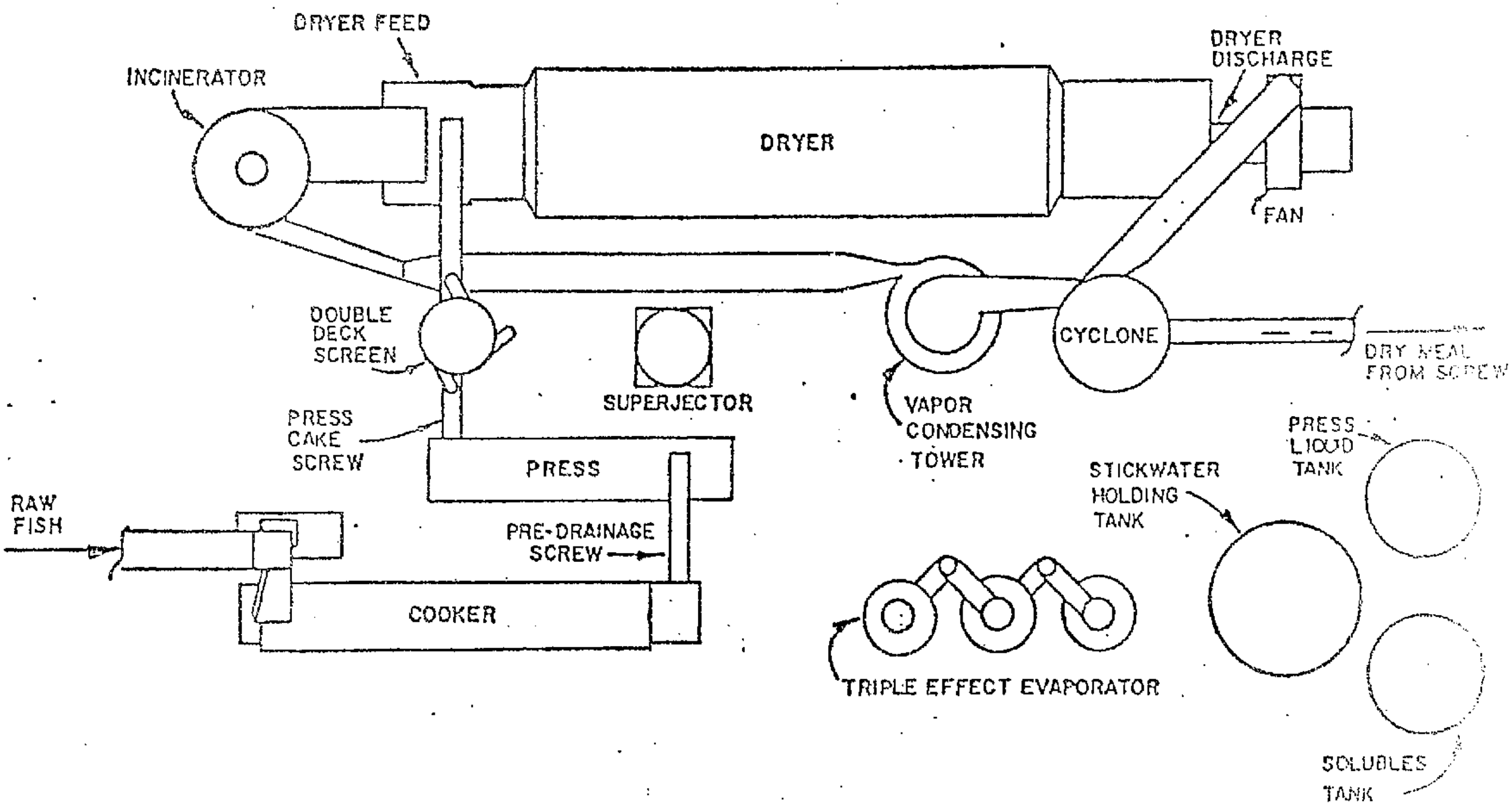
Skins of certain fish species have been used to produce specialty leather products.

The shells of many shellfish contain a material called chitan which has many potential industrial uses. An extraction process has been pioneered by a Seattle firm with the help of the U.S. Government and is currently in limited production using the waste from king crab processing.

Summary

In the preceding I have [illegible]

The future promises several new techniques for conversion of current "waste" to a source of "secondary raw materials." As the cost of protein escalates, and the price of land fish increases accordingly, it will be the progressive companies able to combine technical knowledge with the ability to recognize opportunities who will survive best. In the meantime, every industry has a responsibility to its community to efficiently utilize its limited resources and to ensure that its waste does not pose a threat to the environment.



Continuous fish reduction plant with soluble recovery and odor cont

WASTE UTILIZATION IN INDUSTRY - PART 111

RECYCLING AND SOLID WASTE MANAGEMENT IN THE FRUIT AND VEGETABLE INDUSTRY

Frank Green
Sun-Rype Products Limited

Abstract

In the Fruit and Vegetable Processing Industries, many forms of solid waste are being recycled by using as animal feed supplements.

Other solid wastes such as scrap metal and cardboard are produced in small quantities at such scattered locations that freight costs to the point of reclamation impose a severe deterrent.

The recycling of liquid wastes by spray irrigation is under intensive study on a full-scale basis.

It must be admitted that in many instances there is no incentive or economic justification in recycling waste. Legislating industry into recycling may be one answer, but the cost will ultimately fall on the consumer.

Fruit and Vegetable Industry

Examples of Solid Waste Materials and Methods of Handling

Unused portion of food products such as:

a) Corn waste

b) Cauliflower, sprout stems and leaves

c) Pea vines

d) Fruit pits

e) Residues after pressing out of juice

f) Paper and cardboard and plastic

g) Sludge from liquid waste treatment plants

It is significant that the Food Industry, on average, discards 20% of all purchased raw product as waste.

Present Methods of Handling Solid Wastes

a) Corn wastes are generally sold back to the farmers for incorporation in feed material, due to their relatively high nutritional value.

b) Waste from cold crops, such as sprouts, cauliflower, etc., is given away and can be used for feeding. However, pesticide levels tend to limit its use.

c) Pea Waste is used by Dairy farmers as a hay.

d) Fruit Pits - in general the quantities involved in British Columbia are small and the waste goes to sanitary landfill.

There has been interest in apricot pits over the last few years. A company is extracting oil from the kernels and selling as stright oil or manufacturing cosmetics from the oil. The outside shells are gound and used for blasting clean diamond drills used in oil exploration.

To quote other examples of the utilization of fruit shells and pits:

- The Diamond/Sunsweet Company in Stockton, California, has installed a pilot plant to generate low BTU gas from walnut shells. Although problems have been encountered with the continuous operation of the plant, it should be possible in theory to supply all their energy requirements from the gas generated from walnut shells by 1979.[1]

- A second example is the Lindsay Olive Growers plant in California. They were generating 27 tons of olive pits in a day and having trouble disposing of them. Because of the high cost of drying, storing, packing, shipping and marketing, they could not compete with materials already on the market in such items as fireplace logs, soil conditioner, charcoal briquets, plastics filler, bug bait carrier. They finally decided to use the pits as boiler fuel. By installing equipment capable of handling material containing up to 60% moisture, they began turning the pits into a profitable venture for the first time. They are producing 25% of the company's steam requirements.[2]

e. Residues Remaining after Pressing Juice from Apples and Grapes. At present, these are being used in British Columbia as a fibre source in cattle feed. Other profitable methods of disposal are difficult to find. The material contains up to 70% moisture and so is of little use as a fuel. The nutritional value is very low, it being mainly fibrous with a little sugar. The cost of setting up manufacturing facilities for growing yeast as a source of protein or for extraction of pectin has, so far, proved prohibitive. Cellulose in vegetable wastes cannot readily be broken down by natural enzymes within the constraints of time and economy required by industry. However, with the future development of engineered enyzmes, this may become feasible. The simple carbohydrates then produced could be used in the production of alcohol.

f. Paper and cardboard waste. [illegible] is hauled to sanitary landfill as collected [illegible]

g) Scrap metal from cans, strapping, etc. - also hauled to sanitary fill in most cases, since freight costs of hauling away for melting down are prohibitive.

h) The sludge from the treatment of liquid waste produced in food processing is suitable for return to the land as a soil conditioner and weak fertilizer and is being used for this purpose. Work is proceeding on the evaluation of sludge from conventional food waste treatment plants as a poultry feed ingredient.[3]

Liquid Wastes from Fruit and Vegetable Processing can be divided into the following categories:

1) Wash water from initial cleaning of the product
2) Wash down water from floors and equipment
3) Blanching and cooling water from processing
4) Cooling water from container cooling equipment

The use of waste water from fruit and vegetable operations for spray irrigation of crops would seem to be an obvious method of recycling. In fact, there are over 800 processing plants of various sizes in North America where this is being done.

Land application can be adapted to a wide range of soil types and site drainage conditions. The key to a successful system is the determination of site characteristics, soil type, soil drainage, subsurface conditions, topography and climate conditions - and then the adaption of the most suitable technique for application.

The Food Industry has taken a leading part in developing land application as an economic alternative to conventional treatment of waste. Many uncertainties still remain, however, regarding long-term effects of waste water in soil, plants and groundwater. For example, if the waste waters contain alkali, particularly sodium, there is a hazard that the sodium will accumulate in the soil due to the ion exchange effect and, eventually, induce salt affected soil. This was discovered in a research program at Canadian Canners in Ontario.[4]

Work has been carried out for three years at Snokist Growers in Yakima on the use of water reclaimed by a waste treatment plant for floor and gutter washdown, equipment washdown, initial product conveying, container cooling and steam generation. The greatest beneficial use appears to be for container cooling and subsequent floor and gutter washdown. A 50% reduction in treated water discharge is anticipated. However, to ensure complete safety standards, the water must be analyzed for temperature, pH, COD, BOD, suspended solids, nitrogen, phosphorous chlorine, turbidity, hardness, alkalinity, total and fecal bacteria count, heavy metals, peticides and herbicides.[5]

The reuse of can cooling water would seem a simple method of recycling. This water must be cooled, chlorinated and tested for absence of bacteria, however, before it can be reused. The ready supply of cheap water is many areas has discouraged the capital investment involved in cooling tower, chlorinators, etc.

in cheese manufacture for the recovery and concentration of whey constituents. In the future, the reclamation of soluble carbohydrates from fruit and vegetable processing waste water could possibly be achieved by ultrafiltration followed by reverse osmosis. The sugars and starches so reclaimed could then be converted to natural sweeteners for use in food products.

Summary

In the Fruit and Vegetable Processing Industries, many forms of solid waste are being recycled by using as animal feed supplements.

Other solid wastes such as scrap metal and cardboard are produced in small quantities at such scattered locations that freight costs to the point of reclamation impose a severe deterrent.

The recycling of liquid wastes by spray irrigation is under intensive study on a full-scale basis.

It must be admitted that in many instances there is no incentive or economic justification in recycling waste. Legislating Industry into recycling may be one answer, but the cost will ultimately fall on the consumer.

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OVERCOMING THE OBSTACLES TO THE CONSERVER SOCIETY
THE INDIVIDUAL, THE INSTITUTION AND THE CO-OP

Felix Reuben, LL.B.
Specialist in Environmental
and Natural Resources Legislation

Abstract

Barriers to recycling of wastes and to the conserver society can be divided into two groups:

(i) the Individual; and

(ii) the Institution.

We are presently witnessing the transition of the consumer-person into the conserver-person. This has vast philosophical implications. The success or failure of this transition is heavily dependent on our perceptions of reality, our psychological make-up, and the direction which media and education will take us.

The term "institution" is used in the very widest sense to describe entities or processes which are beyond any small group of individual's control.

We can successfully look for barriers to the conserver society and seeds of solutions to these barriers in the areas of technology, employment, the market place, fiscal measures, industry, unions, agriculture, government and legislation.

We then turn to a very real story of real people who are already creating the conserver society as their environment - Spring Ridge Housesavers.

A major conclusion which should be emphasized is that the regional district of Victoria would be an ideal location for a conservation society demonstration project.

Introduction

The barriers to recycling and to the conserver society can be divided into two groupings:

(i) the Individual; and

(ii) the Institution

The barriers found in these two groupings must be lowered concurrently. Yet, it is on the battlefield over the individual's mind, heart and soul where the major option facing us will be resolved. That option is will we move into the conserver society voluntarily, in natural stages and with each of us in a fair measure of control over our own lives; or, will we be plummetted into it, with a great loss of personal freedom by a Mother Earth grown weary of a species which is out of balance, and by world strife over limited resources.

Recycling is the closing of the great circle. The main contribution of the environmental movement of the late 1960's was not that it has led to cleaner air, water, or less litter than would have occurred. Rather, it has caused us to see ourselves as we really are -- a mere component in a highly complex world eco-system. Just as Copernicus challenged the man-centered universe of his time, so do environmentalists, energy conservationists and recyclers challenge the consumer-person-centered universe of today.

John A. Livingston, a man who sometimes prefers the company of nature, once wrote that:

"Contemporary Western man in the overwhelming majority considers himself fundamentally different and distinct from the living world that gives him both substance and sustenance. This imagined separation between man and "nature" has provided the conceptual framework for a further doctrine, that of absolute human power and authority over the non-human. These ludicrous but terrifying notions have become solidified in our collective thought in a ridiculously brief period of human and Earth history."[1]

Each individual must prepare himself or herself to enter the conserver society by challenging their own basic attitudes, perceptions of reality, and by evaluating their own goals as human beings.

Institutions are also playing a critical role. The question is whether each institution will aid or hinder us on the path towards the conserver society.

Traditionally, it has been said that:

"Institutions define and delineate collective social action and political response. Our lives at the personal, local, national and international levels as Canadians, are molded by our institutions; collectively, we mold these."[2]

The problem is that we are living in an accelerating world. Massive problems demanding immediate attention are arising ever more frequently in Canada and abroad -- inflation, unemployment, pollution, alienation, escalating energy costs, world food shortages, and so forth.

Institutions in Canada change slowly. If institutions are to serve people, rather than vice versa, the question becomes whether these institutions are able to adapt quickly to the conserver society or whether they will, in fact, become serious impediments to Canada becoming a conserver society.

One can be forgiven for being cautious when evaluating the potential of institutions to readily adapt themselves and facilitate the flow towards the conserver society when one realizes that institutions in Canada have not been highly successful in dealing with such problems as the distribution of our wealth, or with the problem facing all post-industrial societies -- leisure -- which we call unemployment.

1. The Individual

Philosophy and the Conserver Person

Who are we? Why are we here? What does it take to make our lives relevant and fulfilling?

We are on the threshold of a humanist revolution similar to the one undertaken by the peoples of the renaissance who rebelled against the stultifying classism of that period.

What have we to rebel against? A successful marketing executive is quoted as saying that:

"Our enormously productive economy demands that we make consumption our way of life, that we convert the buying and use of goods into rituals; that we seek our spiritual satisfactions, our ego satisfactions in consumption.... We need things consumed, burned up, worn out, replaced, and discarded at an ever increasing pace."[3]

Growth in consumption for its own sake finds only one analogy in the natural world -- the cancer cell.

Many Canadians still evaluate themselves and each other by what they can accumulate, display and consume.

Compare this to how the need for prestige was satisfied by the Kwakiutl Indians of what is now northwest B.C. In that culture, an individual was ranked by what he "recycled" through the tribe, by giving many of his material possessions away at the Potlatch. European culture held this practice in such abhorrence that they made it illegal and took every step necessary to stamp out the practice.

One can't help wondering if our forefathers had been more flexible and compassionate whether part of our culture today would have included the city block or community potlatch party.

Our society must shift emphasis from growth in material possessions to growth in human awareness in the individual, the family, and the community where people are in touch with their true feelings and needs. This society would place a high value on co-operation, a sense of community, personal growth and a sense of spirituality.

The [illegible] conserver [illegible]

"If Canada is to become a conserving society then significant changes must occur in the way in which we look at the world, make choices and organize our social, political and economic activities."[4]

The very prominent economist, E.F. Schumacher, has revolutionized the philosophy underlying the consumer society. In his book, "Small is Beautiful," he has adopted Eastern philosophy and his experience with developing countries in setting out a series of economic and philosophical guidelines for the Western conserver society.

He points out that:

"...the Buddhist sees the essence of civilization not in a multiplication of wants but in the purification of human character."[5]

Schumacher further shows that the modern Western economist,

"...is used to measuring the "standard of living" by the amount of annual consumption, assuming all the time that a man who consumes more is "better off" than a man who consumes less. A Buddhist economist would consider this approach excessively irrational: since consumption is merely a means to human well-being, the aim should be to obtain the maximum of well-being with the minimum of consumption."[6]

Once these basic tenants become an integral part of our philosophical underpinning, then Canada will be prepared to transform itself into a conserver society.

Finally, I wish to quote a short poem written 2,500 years ago by Lao-Tzu in his "Tao Te Ching" -- The Way of Life:

"The Sky is everlasting
And the Earth is very old
Why so? Because the world
Exists not for itself;
It can and will live on.

The Wise Man chooses to be last
And so becomes the first of all;
Denying self, he too is saved
For does he not fullfillment find
In being an unselfish man?"[7]

This passage, written more than 2,500 years ago sets out a philosophy towards the environment and materialism which is still very relevant to us today.

Nature has abundance for all, but we must live in balance with it, not against it. Personal fulfillment can be found in a lifestyle based not on hoarding and accumumlating unlimited material possessions, but rather on a life characterized by frugality, moderation, compassion and careful thought in all actions.

[illegible]

Perceptions and the Conserver Society

Our perceptions of reality dictate what we consider is possible and what we consider is impossible.

Garbage has always been perceived at best as a nuisance which was to be put quickly out of sight and out of mind. Now garbage is called "urban ore" and it is said to have a richer metal content than some of the natural ores presently being used.

In Sudbury, Ontario, it was perceived that the smokestack from Inco was giving off a lot of contaminants which would be very costly to contain. When precipitators and a larger stack were put in after great environmental pressure, it was discovered that there was gold, silver, and many other valuable minerals in the flue gases which were now easily capturable and which quickly paid for the extra costs of the new system. The main limitation to dealing with many problems is our perceptions of what is possible.

Traditional economists tell us it is impossible to have high inflation and high unemployment at the same time. Yet our perceptions tell us that not only is this occurring, but that there are abundant resources and needs to be filled, all existing at the same time.

Perceptions are conditioned by training. Many people react against the concept of the conserver society without really knowing why. It has been documented that:

> "Many members of the public, including specifiers (i.e., those who make the critical decisions as to what secondary materials will be acceptable for purchase specifications), suspect that somehow, recycled material must be less pure, worn out from previous use, contaminated with dirt and generally unacceptable. Recycled scrap for many people evokes an image of something old and used. Many people consider it below their dignity to deal with scrap."[8]

In Europe and Israel, incinerator flyash is perceived as a valuable resource and is used in the manufacture of building materials.

It is only perceptions which dictate that "one man's garbage is another man's gold." During spring clean up day, people in various Canadian cities would sift through piles of garbage in front of houses and retrieve valuable and useful items without causing any harm. Ironically, this is often illegal.

The media has modified our perceptions so that we are convinced that ownership of possessions in and of itself is enjoyable, even if these items are stored away or left unused, year after year.

Our perceptions of what can be done to bring on the conserver society is limited by a severe lack of information on all aspects of recycling wastes. As more information is generated, our perceptions of the feasibility of a conserver society will adjust accordingly.

Are our perceptions of reality correct when they say that only multinationals can maintain our present standard of living? Would there be a net gain or loss if small and middle-sized domestic industry took over on a decentralized basis?

At the human interaction level, perceptions are often a critical factor in whether communication on the conserver society can take place or not. How much success does an applicant for "seed money" to start up a recycling depot have if the administrative decision-maker insists on buying everything new in his own personal life and has never entered into the world of second hand shops and used clothing, goods and appliances. This administrator cannot relate to the conserver society, his own perceptions define his reality and this does not allow him to see that the conserver ethic and lifestyle has always been a continuous thread in our social fabric.

Psychology and the Conserver Person

The consumer-person has found some measure of comfort and security in the present state of doing things. He or she faces stress, tension and anxiety caused by the fear of change and fear of the unknown as society changes. This stress results in people fighting for the status quo and against any change. Attitudinal and lifestyle change that will transform the consumer-person into the conserver-person may well take generations because of this basic conservativeness of human nature.

Yet, during World War II, people quickly adapted themselves to the prevailing conditions and separated household garbage and saved, helped collect and recycle all strategic materials. This lifeboat psychology may well be with us today and be a primary force in moving us towards the conserver society.

A recent experiment in source separation was conducted in two U.S. municipalities, Somerville and Marblehead, both of which are in Massachusetts. The question was whether people could make the psychological adjustment to an important aspect of the conserver society in a relatively short time, namely, recycling.[9]

The general conditions were that people were prepared to separate garbage at the household level in order to facilitate resource recovery if their conserver society awareness level was raised. This meant that the whole process was explained to them and they were educated as to the importance of recycling and what the conserver society meant to them personally and, also, if the separation procedures and receptacles were set up.

The present consumer-person has a psychological need for conspicuous consumption and high through-put of resources and energy. This is how his existence is reaffirmed. This could be one of the more important reasons why Canadians are the largest per capita users of energy in the world, surpassing even the U.S.

Another very interesting study involved a comprehensive survey and interviews [illegible] important decision-makers in the three levels of government, in the [illegible] and in the private disposal [illegible].[10]

[illegible]

was based on a serious lack of economic, technical and public response information.

Generally, recycling and resource conservation programs succeed when participants see a direct benefit accruing to themselves in the short term. The Housesavers example discussed later in this paper will show how this fulfillment of basic and psychological needs is an extremely important source of momentum for the whole conserver movement. The fact that recycling and resource conservation are not alienating processes in and of themselves, and that people are more important than machines in the conservation society may ultimately prove to be the single most important factor bringing on the conserver society.

Thus, the psychological satisfactions of being in tune with one's self and with one's neighbour, and with the biosphere, is and will continue to be a primary motivation and driving force behind individual decisions to adopt the conserver society lifestyle.

Media, Education and the Conserver Person

This is the battleground over the human mind. We now have the technology and know-how in media and education to maintain the consumer-person as he or she is, or to create the mental climate which will allow the transition to the conserver-person.

This raises exceptionally important questions, but first let us put media into context by discussing what power it has on the individual.

A book which should be mandatory reading in schools in Canada is "Subliminal Seduction", by W.B. Key. His main thesis is that no matter how much you think you have the influence of media on yourself under control, they still have slipped messages into your conscious or subconscious mind which will have a direct bearing on your behaviour. The dangerous effect of T.V., for example, is not that you will buy Brand X over Brand Y, it is the artificial, illusory world which flashes images into the mind, and in some minds takes the place of reality.

Key argues that:

"North Americans have constructed an enormous mythology about the role of advertising in media helped, of course, by the media themselves. Few are willing to concede the relevance or importance in their lives of advertising. Most simply say they make up their own minds -- a very necessary illusion media must perpetuate in order to succeed in making up their minds for them."[11]

Does advertising provide information or does it stimulate wants? Many would argue that the latter is the predominant focus of advertising, i.e., that advertising is a "want creating mechanism" which is used to create instant markets for the most needless items.

Most people would agree that there are two kinds of needs: real and artificial. Real needs would include food, clothing, shelter and social interaction. Artificial [illegible] would [illegible] looking like the latest sex symbol, body cosmetics, overeating, [illegible]on.

When advertising gives true information on real needs, it is serving a useful function in society. When advertising creates artificial needs and manipulates people to feel uncomfortable till they possess the article, then it is acting in a socially undesirable way.

Advertising and media are presently geared very heavily towards the consumer society. In fact, many would say it is leading the consumer society. Information is widely available on what there is to consume, but precious little information on what there is to conserve.

Again, the major danger to the conserver society is that it can maintain us as consumers.

> "...the mass media conditions our image of ourselves as seen by others and guides our perceptions and image of others in this kind of society."[12]

The conserver movement can only do some recycling and other important but superficial level work as long as the consumer-oriented media retains its powerful role as shaper of ideas and perceptions. How can the conserver society concept of sharing in a cooperative manner various resources ever take root when the potential converts are subjected to a constant barrage of inputs which add up to the self-image of the consumer-person?

Advertising must come under stricter scrutiny in order to ensure that it is a tool of society rather than a tool of those who have vested interests in the consumer society.

Most Canadians today have grown up and been educated in a mass consumption society which was based on the two assumptions of unlimited energy and resources, and the value of unlimited exponential growth. Only in the last few years has this "education" been challenged by the publication of such books as the "Population Bomb", "Greening of America", "Silent Spring", "Blueprint for Survival", "Limits to Growth", "One Cosmic Instant", "Spaceship Earth", and many other books too numerous to mention.

Also, world conferences on the environment and on food have challenged many of our beliefs. Our collective consciousness has evolved to the point where we are questioning and challenging many of the basic presumptions and conceptions of reality of the consumer society.

Our educational system is a major vehicle for inculturation. It must begin emphasizing sharing, less competition between individuals, more group involvement in decisions that affect them and helping each other and the community move towards a common goal. Much could be gained by looking at the educational process in the socialization system in other countries, for example, the Swedish day care centres, and the kibbutz in Israel.

The conserver society must becme an integral assumption and part of the curriculum in our educational system.

II. Institutions

What role will institutions play in the transition to the conserver society?

One small example might be instructive at this stage. We know that we are burying ourselves in our own garbage, and that for example:

"Municipal solid wastes (refuse) accumulates in Canada at a rate of about 6 pounds per person per day (or about 1 ton per person per year). Moreover, the volume of refuse grows by some 40% per decade."[13]

Most people would agree that this is not a good situation. Where have our institutions failed?

Surely a technology that can put man on the moon should be able to deal with garbage.

It has been said that waste represents a net loss of jobs. Why has the market place allowed this condition to arise in the first place since it is obvious that it is not good for society to have waste, economic costs and environmental degradation being caused by the misuse of potentially valuable resources.

Why isn't the government doing something and why isn't it using its powerful arsenal of fiscal measures and legislation? What role does industry and agriculture play in this loss of valuable resources, or what some call externalities.

Technology and the Conserver Society

Technology is neutral. It has no values, beliefs or goals. Those are provided by the people who are in control. Thus, technology will facilitate our move into the conserver society if those in control in government, industry and the unions allow it to happen.

Technology can be used to develop products which will fall apart after a specific length of time or amount of use. This is the so-called planned obsolescense technology. Or, technology could be used to develop products which are easy to dismantle and easy to recycle.

A very critical block to recycling is that, at present, it is not a criteria at the engineering design stage for the vast majority of produced goods. In fact, new materials, especially in packaging, are being designed with such a hybrid of coatings, layers and alloys that they will be impossible to separate into their component materials. Thus, in at least some cases, recycling ability is not only a poor-ranking criteria, it is obviously disappearing as a criteria at the design stage.

Many people urge that resource conservation must begin at the engineering design stage and that we must:

[illegible]

materials. Increase the chemical/physical separability of complex materials. Design with materials that create minimum contamination problems."[14]

There may well be a need for new full-cost pricing mechanisms and some tough legislation to ensure that the price of goods designed for consumption rather than for conservation have price tags which truly reflect their societal cost.

Manufacturers must be concerned with their products, not only before and during consumer use, but also during the post-consumer stage. If manufacturers set durability, quality and recycling ability of their goods as goals, this would allow technology to evole towards an emphasis on conservation.

Generally, if recycling ability is made part of the infrastructure of industry, agriculture and the market place, technology will quickly develop to maximize recycling ability and materials and energy efficiencies at the lowest possible cost.

It is cheaper to society to have recycling ability built into infrastructure now than to have add-on technologies later. An example of this is in new housing stock. A waste reclamation study on Burlington, Ontario, recommended:

"...that municipalities seriously consider requesting that all multi-family buildings and commercial areas be designed and constructed to provide adequate facilities for the storage and collection of their refuse."[15]

Thus, recycling facilities and technologies would automatically become part of new residential and commercial buildings and would ensure efficient and much cheaper handling of materials and energy throughput.

Technology could develop new uses for recycled materials which could take advantage of their particular properties. Technology could also help ensure that domestic renewable materials could be substituted for non-renewables and that recyclable materials could be used whenever possible in place of non-recyclable materials.

Canadian technology should be developed taking into account the unique situation that prevails here: a cold climate, small and widely-scattered markets, a wide range of resources, small population and huge distances. Thus, the development of technology should emphasize small and medium-scale technologies which would be labour-intensive and should allow for decentralization -- rather than big, massive, capital-intensive technologies which require centralization of all factors.

Canadian conserver technology must not itself become a centralizing force. With communications becoming more sophisticated, decentralization should be enhanced.

A Canadian, small and medium-sized conserver technology could become a specialty of ours and open up the possibility of exports. Thus, the technology and techniques of the "Ark" in Prince Edward Island, where people with time and comm- [illegible] have created their own life support system of housing, heating, recycling, [illegible] conservation and food production, may [illegible] contribution [illegible] of Canada and the world. [illegible]

Many people are optimistic about technology; others have labelled this as blind faith in the technological fix, i.e., that technology can get us out of problems created by technology. In any case, most agree that:

"There exists, currently, technology (in some cases alternative approaches) for reclaiming virtually all of the resources constituent in refuse. It should be noted that this technology is in most cases relatively new and, thus, holds promise of major improvements in the future, leading hopefully to significant cost reductions."[17]

Conserver society technology must be human scale technology. Self-help and the cooperative movement which lies at the roots of the conserver society are themselves based on minimal dependence on technical systems beyond the control or grasp of most people. A whole host of writers has attacked inhuman technology because it causes alienation, misuses labour, and is sometimes inefficient in the macro sense.

These themes are very well dealt with in such works as Theodore Roszak's, "Where the Wasteland Ends," and "An Anthology of Contemporary Materials Useful for Preserving Personal Sanity While Braving the Great Technological Wilderness," and in Ivan Ilich's "Tools for Conviviality," and in many other books and papers.

Jobs and the Conserver Society

A major argument constantly raised by people who have vested interests in the consumer society is that any move from the present status quo will cost jobs. Let us take a close look at this.

If we assume for the moment that we continue on the same consumer path that we are on, will this create more jobs? Probably not. The worker is rapidly becoming obsolete. Many economists have concluded that:

"In an industrial system which is constantly becoming more capital intensive and less labour intensive in search of efficiency and profits, it clearly becomes difficult to ensure full employment."[18]

We are presently experiencing high rates of unemployment; these estimates vary depending on who you talk to. Most would agree that it is generally running at 10% of the labour force. Yet profits of many of the largest industries, especially the banks, have never been higher. Certainly there is a lot of wealth being generated, the real problem is to find a system to overcome the lack of distribution.

Large energy projects such as the James Bay Hydro Development, and the Alcan Pipeline are being touted as the solution. This is just not true and represents classic cases of how perceptions of the consumer-person do not allow him to see reality. Most of the jobs created will be concentrated in the relatively short construction phase which only lasts a few years and we all know that local labour rarely gets the construction jobs. The operation and maintenance phase creates relatively few jobs. These are capital intensive projects and represent serious drains of capital from other possible uses, such as, development of alternate energy [illegible] manufacturing industries, [illegible] pollution control industries, resource [illegible] labour intensive.

Statistical proof is available to support all the above. For example:

"In its quarterly report to the Department of Labour, the Environmental Protection Agency has determined that the number of jobs created by environmental legislation greatly exceeds those lost. According to the report, more than 100,000 jobs have been created by the sewage treatment plant construction grant program, with an additional 125,000 more jobs expected by June 30, 1977, from other EPA-financed construction activities. The study further reveals that industrial plant closings and curtailments due to environmentally-related reasons have resulted in the loss of 17,890 jobs over a five-year period, January 1971, through June, 1976."[19]

The "conserver society costs jobs" argument is just as wrong and is just as coldly and calculatedly cynical a red herring as the "jobs versus environment" myth -- a myth which has been proven wrong "ad nauseum." Yet industry and media have been so successful in portraying this myth as reality that unions seem, even today, still to believe it.

Obviously, there will be some job readjustment as we move through the transition phase between the consumer and conserver society, but insurance schemes should be available. Recycling technology will be a fast growth industry just as the computer industry was in the 1960's.

Recycling technology encourages local production with more labour content and will result in the reduction of capital and energy content per unit of production. Nothing could be more timely. Canada has excess labour capacity; it is already mortgaging its future in order to bring in capital for energy related projects, and Canada is a net importer of oil with the prospects that this net import figure of world-priced oil will only increase in a consumer society.

Let us get back to the basics. Schumacher beautifully sums up how jobs in a conserver society can be a means to an end and an end in themselves. He states:

"The Buddhist point of view takes the function of work to be at least threefold: to give a man a chance to utilize and develop his faculties; to enable him to overcome his ego-centeredness by joining with other people in a common task; and to bring forth the goods and services needed for a becoming existence."[19A]

Communities based on recycling resources as part of the closing of the energy and resources throughput system, with some input of virgin materials to make up for losses and increased demands, have much more stable jobs and thus much more staying power as communities.[20]

Communities based solely on exhausible, non-renewable resources have jobs which are highly dependent on factors outside the community; such as, constantly fluctuating export markets. Thus, when export markets fall off, many communities based solely on the exploitation of one resource for export find themselves in great difficulty because when the mine or mill closes, so goes the jobs and the perceived economic base of the community.

business cycle. They have been able to limit the imports into their community and thus have minimized the need to export out of the community. Thus, jobs are based on local economics rather than national or international economics.

The Market Place and the Conserver Society

The market place is generally defined as the price of goods or services which results from the supply and demand for those goods or services. In a perfect market place, i.e., where there are no other factors interfering with this process, an equilibrium point would be reached between supply and demand at the lowest possible price.

The market place has never been this perfect since the first Company of Gentlemen Adventurers was given a monopoly. The market place is a theoretical construct based on optimalities with respect to information, the individual, equality, and institutions, a world which never has existed.

The market place per se is not under attack by the conserver economist. He is levelling his criticism at the assumption that the market place can and is allocating scarce resources such as capital, labour, natural resources and energy in a way that is optimal for society.

The conserver economist can quickly point out that the market place cannot take cognizance of long-term questions and that it neglects to include externalities in its calculation, and that if there is any aspect of the real world such as alienation which cannot readily be translated into dollars, then the market place is all too ready to gloss over that factor's very existence.

The market place has failed to full-cost price the consumer society when it causes recycling to be considered uneconomic; while waste, planned obsolescence and the throw-away technological process is considered economic in a world of environmental degradation, growing scarcity of resources and energy, and terrible poverty. We all know that something is amiss.

Dr. David Brooks, former director of the Federal Office of Energy Conservation, now with Energy Probe, points out that:

"In achieving a conserver society, we need to overhaul our bookkeeping practices: there is no free garbage dump.... Cost accounting would incorporate such things as pollution costs and wilderness destruction as real expenses...."[21]

The Science Council of Canada also shows dissatisfaction with the present market system:

"In a Conserver Society, the pricing mechanism should reflect, not just the private cost, but as much as possible the total cost to society, including energy and materials used, ecological impact and social considerations. This will permit the market system to allocate resources in a manner that more closely reflects [illegible] needs, both [illegible] and long term."[22]

The conserver economist does not want to do away with the market system; he wants to improve it so that it is more reflective of, and a better model of, the real world. He argues that the market system is capable of being an efficient manager of all resources, once the true value of all resources (used in the widest sense) is incorporated into the system.

The consumer economist argues that recycling is uneconomic, but he is arguing on the basis of a market place which has not in the past been comprehensive enough in including all costs. As a society grows and changes, new costs and benefits are identified. Thus, environmental degradation as a cost is only now being identified and, therefore, should be allowed to play its role in the market place. In the future, such intangibles as aesthetics, alienation and a feeling of well-being may also be assigned some form of number, thus giving it entry into the market place as a factor.

With respect to recycling:

"... secondary materials prices do not yet reflect the energy inherent in the material or invested during the product's lifetime. Nor does the pricing mechanism make adequate provision for the fact that certain resources have a greater value because of their relative scarcity... they contain no measure of the reduced environmental impact which occurs each time a choice of secondary materials obviates the need for virgin materials."[23]

A concrete example might prove useful at this stage.

Supermarkets have externalized the costs of not having returnable containers or selling in bulk and having packaging on the spot which would have the attendant increased costs of floorspace and labour, by just not offering these services. (The consumer economist argues that these externalities can be ignored by the market place). The conserver economist argues that these externalities will eventually reappear as costs in some other sector of society.

Thus, to continue our example, the supermarket decides to sell only highly packaged foods. Of course there is the immediate cost of the needless packaging, but this has been internalized by higher prices to the consumer and the market will reflect it. What happens to the packaging? It becomes waste, which eventually translates into higher municipal taxes because of the costs of collection, transportation and disposal. The externalized costs thus reappeared as increased municipal taxes.

Many people do not realize that there is a direct cause-effect relationship between the externalities caused by the supermarket taking a capital rather than labour intensive approach to packaging, and an increase in municipal taxes.

The conserver economist is now insisting that the market place reflect the true costs of all goods and services. He argues that once this is done, then recycling solid wastes and many other aspects of the conserver society will become economically feasible. Garbage becomes "urban ore" by simply moving the market place closer to [illegible], which then allows for full-cost pricing.

[illegible]

costs easily because activities take place in relatively removed and sparsely populated areas.

Recycling industries can't externalize any costs as they are often in the heart of a municipality, subject to many by-laws and legislation. Their operations are always being carefully watched.

The conserver economist concludes that if the market place is kept tied-in to actual societal value costs, then many, many barriers to recycling and to the conserver society itself will disappear.

The full costing of all goods and wasteful activities will result in a feed-back in our economic system to the point where someone makes a decision that may be favourable to the bringing on of some aspect of the conserver society.

That a secondary product is, after all, viable as a component of a machine; that a recycling depot can pay for itself and keep ten people employed; that use of land fill sites are resulting in net losses to a municipality as compared to the income from recycling the wastes generated; that all bottles can be recycled economically after all; that since the price of paper was allowed to rise to its real level, paper manufacturers have been begging for old newsprint; that since the true materials, energy and litter costs were incorporated into the price of all containers, the industrial designers have surprised themselves at how easy it was to discover packaging concepts, techniques and materials which facilitate recycling without any compromise of health, safety, durability and convenience; and that hand dismantling of old buildings boats and other structures has significantly reduced unemployment in many areas of the country and has dramatically brought down the cost of new housing using these recycled building materials.

One could go on with this conserver society scenario forever.

A consulting report once concluded that:

"... the greatest obstacle to economic recycling of material from municipal wastes... has been a combination of lack of markets for separated products, and the high cost of separating materials and processsing or upgrading them to a state where they would be acceptable for re-use...."[24]

The conserver economist would say that these are symptoms of the problem, and that the main barrier to "economic recycling" is the definition of "economic." The market place must give a more rational and real estimate of true costs when costing out consumer and conserver approaches to a resource management problem. When the market place grows to this level, it will have put the conserver society on a sound footing.

Fiscal Measures and the Conserver Society

One of the reasons that the market place is imperfect is because government [illegible]

Many fiscal measures have been developed over the years, in a consumer-oriented society, which have proven highly effective in promoting growth, greater consumption, increased exploitation of natural resources and energy, and so on. These fiscal measures were based on the same assumptions that underlie the consumer society: that growth should be stimulated by all possible measures; that only growth creates jobs: that growth and increased consumption will solve the problems of our society: and that the bigger and more centralized a production unit was, the more utilitarian it was for society.

Thus, we have the situation that the present body of fiscal measures will help perpetuate and sustain the consumer society unless they are replaced by a body of fiscal measures based on the assumptions of the consumer society. They may well be the "litmus test" of the extent of the government's commitment to aid and become part of the evolution towards the conserver society.

At present, the recycling industries are at a competitive disadvantage to the primary resource exploitation industries which have major tax breaks, such as, two year depreciation periods, lower income tax rates, 100% write-off of exploration costs for virgin materials, magnanimous depletion allowances, and so forth. Investment capital is drained away, for example, from recycling and energy conservation technology into primary resource production.

Recycling industries have to pay the 12% Federal tax on processing equipment -- while the manufacturing and processing industries are exempt. At this point, we can neatly tie-in our previous discussion of perceptions as a barrier to the conserver society.

The Gamma Report concludes that:

"The result of the poor image of recycling in the public eye is its difficulty to qualify as "manufacturing or processing." The result of the limited perception of the term "mineral resource" is the exclusion of resource recovery from the "mining" tax category. These two effects may combine to exclude recycling from a broad range of benefits, for example, depreciation privileges, available to manufacturing or mining activities."[25]

As long as recycling enterprises are not perceived as a legitimate and vital industry, they will be deprived of equality with consumption-oriented industries with respect to fiscal measures. Some would argue that the time is long overdue when conserver enterprises should be given better fiscal support measures than consumption-oriented industries.

On other fronts, the conserver society and its supporting techniques and technology will evole more quickly if some or all of the following measures were implemented.

Freight rates presently subsidize the transportation of virgin materials and gives them an unfair competitive advantage over recycled materials which have [illegible] transported. [illegible]

Increased taxation on imported non-essentials, i.e., luxury goods, should be a matter of policy. Of course, our international treaties and obligations would have to be taken into account. The effect of this policy, as has occurred in Israel, would be to stimulate domestic production of these goods or acceptable substitutes. This would ease unemployment.

Direct subsidies should be given for scientific and technological research and development on all aspects of conserver techniques and technology. Something of the magnitude of the money and effort expended on the Candu nuclear program would be a good start. A time limit could be set on these subsidies as this technological base of the conserver society developed beyond the difficult initial stages.

Externality taxes would recycle money to clean-up industries and encourage all industries to internalize all costs they create. This, in turn, would act as an incentive for these industries to recycle wastes and develop cleaner technologies.

The removal of sales taxes on 100% hand crafted goods would stimulate labour-intensive production and increase employment.

There are many other fiscal measures which our various levels of government could legitimately take to bring on the conserver society. But first, the perception that,

> "In a broader sense of capital allocation, recycling enterprises ... are not recognized as legitimate and vital industry, and thus are deprived of the taxation incentives needed to attract captial and talent for growth."[26]

must be overcome.

Government and the Conserver Society

There are many ways in which government affects individuals, other institutions and our society. Each of these influences must now be identified and re-evaluated and the question asked: Does each influence encourage a consumer or a conserver society? As this paper is already suffering from exponential growth (originally it was supposed to be 20 pages long) I will only touch on a few illustrative examples.

Also, various federal departments and British Columbia Ministries will be looked at for some examples of how government can help to bring on the conserver society.

A very important way that Government could encourage recycling would be to use its spending power and expand its policy of purchasing recycled materials. Thus, not only paper, but recycled building materials, glass, etc., would be given preference over virgin materials. Of course, a concurrent policy would be to reduce demands for these resources by more efficiency in use. A small example -- mandatory two-sided copying - could potentially cut the demand for paper by Government by up to 50%.

Recently, the B.C. Development Corporation announced that it was preparing a financial package that would be available to a sawmiller who would require assistance in installing wood waste burning combustion equipment. It was estimated that:

"This hog fuel (bark and other wood waste) will displace about a million barrels of bunker C oil now being used each year...."[27]

Here is a classic case where a small input by Government can greatly accelerate a particular conserver trend and thus help us to move toward the conserver society. Here is an example of one of the roots of the conserver society and what Governments should be encouraging; namely, the replacement of non-renewable resource use by renewable resource use.

It is said that:

"Resource recovery in Europe is largely directed to heat recovery incineration, paper recycling, and composting, with small pilot projects involving glass recycling, and pyrolysis."[28]

The Government could play a major role in distilling the European experience and creating policies and programs to adapt this to Canada. It could also identify areas where the Canadian experience could be successfully marketed in Europe and then develop policies and programs to carry this through.

The Government itself must become conservation oriented in the whole range of its internal activities. Thus, for example, only small cars should be used, all government buildings should be well insulated, all lights should be automatically turned down at night, bus and rail should be used over the automobile and plane where feasible, and so on.[29]

A brief look at a few departments and ministries will illustrate the wide range of areas and activities the government could move towards conservation. Only a few examples are given here. Certainly this is one area where another government report reviewing all departments and ministries may well be justified.

Federal

Manpower and Immigration - Should fund or give training programs geared towards the conserver society industries, such as, water and air pollution control and recycling.

Statistics Canada - Must ensure that a wide range of statistical information be available on the conserver society. This would be the knowledge-base from which policy, planning and implementation programs could grow, and would help ensure a strong feedback mechanism to decision-makers, as to how the various programs were doing.

Finance - Should re[illegible] the Canada [illegible] [illegible]

Environment and Energy, Mines and Resources - Should accelerate research and development in conserver techniques and technology. In 1976, the latter department budgeted 99% of its energy resource and development budget on non-renewable energy resources. This emphasis should be rapidly turned around in both departments in favour of R&D in renewable energy and other renewable resources.

Regional & Economic Expansion - Should finance recycling projects and other conserver society labour-intensive projects in depressed and high unemployment areas of Canada.

Transport - Could alleviate such barriers to the conservation society as where:

"... transportation costs of salvaged materials may in itself be greater than the market value of the material. Freight subsidies could be provided for scrap materials to aid recovery in non-industrial areas."[30]

Consumer & Corporate Affairs - Would have a role with respect to excessive and thus misleading packaging, advertising, standardization of containers and package and product design to facilitate salvage and recycling.

Supply and Services - Should continue to give preference to purchasing recycled paper and expand this policy to cover other secondary materials.

Industry, Trade & Commerce - Should retool its many aid and subsidy programs in order to make them applicable and available to conserver society techniques, technologies and industries.

British Columbia

Agriculture - Should develop programs aimed at recycling agricultural wastes so that they do not become pollution, and the use of biomass as an energy source, and so on.

Economic Development - Should develop conserver industries which are labour intensive and which could be decentralized into the depressed areas of the province.

Education - Must make the conserver society concept an integral part of primary and secondary education. Education should also give full support and help expand the programs in our colleges and universities which deal with various aspects of the conserver society.

Energy, Transport and Communications - Should re-evaluate its policies and programs in light of the fact that B.C.'s major renewable resource is wood and that we are moving toward the conserver society.

Environment - Could help fund demonstration projects on recycling, more R&D on wastes as valuable resources and help discourage solid waste disposal.

Finance - Should review and reconsider any of its fiscal measures which might mitigate against recycling or energy and resources conservation, or which might put conservation industries at a competitive disadvantage.

Forests - Must continue the development of hog fuels and many other conserver society uses of this very valuable renewable resource.

Highways & Public Works - Could experiment with glassphalt as a building material. Also, where buildings are to be demolished the Ministry should ensure that they are dismantled so that the building materials are recycled.

Human Resources - Should develop, in concert with other government agencies, programs to get people off welfare and into meaningful, labour-intensive recycling and conservation industry activity.

Labour - Could study the potential problems and profferred solutions of labour-intensive recycling industries.

Municipal Affairs & Housing - Should develop programs to deal with conservation in the urban environment, such as garbage separation. It should also support recycling of housing as well as new cooperative housing as a way of providing inexpensive housing.

Recreation and Conservation - Should become an important agency in defining the parameters of a conserver society.

Again, it should be emphasized that this has been a very cursory glance, and that many more suggestions could be made. Certainly more research is needed in evaluating what each Department and Ministry could or should do in bringing on the conserver society.

Agriculture and the Conserver Society

Canada must become self-sufficient in foodstuffs. A conserver society would reverse the decline of the family farm by escalating the rise of the cooperative farm which, through self-help and sharing of knowledge, techniques and technology, could make farming satisfying and economically viable.

One has only to look at the co-ops of the Mennonites and the Hutterites, and other similar groups, which through cooperation, labour-intensive activity, and practical conservation measures have created a good standard of living and a meaningful existence. But this was in spite of government and fiscal barriers.

Organic fertilizers should be used instead of chemical fertilizers, which are based on non-renewable resources, wherever possible.

Natural pesticides rather than non-specific and accumulative chemical pesticides [illegible] be used wherever possible. Presently, chemical pesticides producers and [illegible] have a [illegible] in the [illegible].

Funds and many forms of technical aid must come to the assistance of young people who wish to go into farming. The average age of the farmer in B.C. was recently estimated as over 50. A country which wishes to be a self-sufficient, conserver society cannot afford to have a weak agricultural sector.

Farmers markets should be encouraged because they encourage decentralization of food production towards the small and medium-sized scale which can locate closer to the points of consumption. This is more efficient because it tends to minimize transportation, storage and spoilage with the resulting energy and resources savings.

The Gamma Report develops:

"A scenario for a mixed food production system (which) would have cereals and most animal products produced on a large scale with only minor modifications of the present agricultural system. Fruits, vegetables, some fish and meat products would be produced on a family or small group basis in an urban food production system. This latter would provide perishable foods of high quality, would introduce diversity of food production, would provide the food system base for family organization, and would fill the psychological need for contact with the natural world. A family of four could produce one-half of their vegetable and one-quarter of their fruit requirement in an area of less than 200 square feet."[31]

In Russia, which has a similar climate to many parts of Canada, especially Ottawa, it was found that the yield from the very small private plots which farm workers on state-owned farms were allowed to keep, produced fully 33% of all agricultural crops, even though the involved acreage was very small in comparison to all the land in production.

We should not underestimate what labour-intensive agriculture on small garden plots in cities could do.

Food is one of the most important true needs. A conserver society would emphasize co-op farms and family garden plots, cooperative wholesale and distribution and the use of bulk foods to cut down on packaging.

Industry and the Conserver Society

Much of what has been set out in this paper with respect to perceptions, media, technology and the market mechanism should be kept in mind here.

Briefly, industry in Canada is very energy inefficient. Thus, for example,

"... a recent study indicated that West German industry used 28% less energy per dollar of value-added than U.S. industry. In terms of energy usage per unit of output, in some key sectors - such as iron and steel, cement and pulp and paper - energy usage was around 35% less in West Germany than the U.S.A. Some Canadian sectors have a better energy performance than their U.S.A. counterparts, but overall there does not appear to be much difference between [illegible]

Industry in Canada is capital intensive to the point where the worker is becoming obsolete. Industry is very centralized and.

"... the increasing complexity and sophistication of industrial practices today tend to reinforce any temporal rigidities which there might be in industrial structures."[33]

Canadian industry must become more flexible and more decentralized. Durability and recyclability must become part of product design. Industrial wastes are too valuable to let loose on the environment: keeping in mind the Sudbury smokestack example and the B.C. hog fuels case discussed earlier. These wastes should be recycled.

Industry must be given incentives through the market place and by government so that it will move away from providing the consumer society with disposable and planned-obsolescent products and towards providing the conserver society with production of more labour-intensive goods which are both long-lasting and easily recycled.

Canadian industry will make a contribution to the conserver society by decentralizing and concentrating on small and medium-scale technologies and plants, and using labour-intensive, clean technologies.

Unions and the Conserver Society

Unions are faced with a dilemma. The present consumer society is leading to fewer and fewer jobs as industry becomes more capital intensive in search of maximization of profits. Unions find themselves in the unfortunate position of fighting to keep antiquated systems going because they were labour intensive at one time. Of course, our all-Canadian example is the Post Office. The jobs in these industries are often meaningless and alienating.

Unions should be a major force in bringing on the conserver society, where capital and large size will be de-emphasized in favour of smaller, labour-intensive enterprises. This would also bring the factors of production closer to the average worker and, therefore, decisions affecting his life would be more within his reach. This will result in less alienation.

Unfortunately, union executives have a vested interest in the status quo - large industries naturally justify large unions - their power base is in very large groups of workers engaged in a uniform activity. If, as a result of moving into the conserver society, large industries are decentralized, this in turn will decentralize the large pools of workers.

Union executives must realize that it would be very good for their members if [illegible]ralization occurred and labour-intensive and, therefore, job-intensive sma[illegible] [illegible] increased. Most likely, [illegible] would decrease.

Unions [illegible]

Legislation and the Conserver Society

Legislation is the body of Acts, Regulations, and so forth, formally passed by a provincial or federal parliament. It is the nature of legislation that it freezes in time a certain ethic. It has been said that legislation often follows rather than leads society. It can generally be said that the present body of legislation in Canada has engrained a past era's philosophy of all our development and growth for the sake of growth. The present trend towards the concept of a conserver society has only recently been reflected in new legislation.

Legislation as an art form is strictly neutral. It is given colour and direction by the underlying assumptions, goals and perceptions of those who have input into its drafting. Thus, legislation becomes an obstacle to the conserver society when it is based on consumer society ideals and creates or perpetuates mechanisms that maintain these ideals.

Recently, I did a review of all existing Acts in force in all 10 provinces and at the Federal Government level.[34] The purpose of this review was primarily to see if the existing legislation had any direct or indirect effects on the move towards energy conservation in Canada. Since energy conservation is an integral part of the conserver society, some of that report's conclusions would be highly relevant here.

During this review, it soon became apparent that there was only a handful of Acts which pertained directly to energy conservation. It was decided to cast the net very wide and include in this review legislation which was related only tangently to energy conservation. It quickly became apparent that most of today's legislation, passed in an energy-abundant era, not only did not deal with ways of reducing demand for energy and increasing energy efficiency, but implicity assumed that there was no need to conserve energy.

In many cases, legislation can become energy conservation and conserver society-oriented by reinterpreting its provision at the administrative level and administering it with energy conservation and the conserver society goals as a criteria. For example, a number of federal and provincial Agricultural Acts provide funds for "improvement of farms and farming operations." It would be a fairly simple matter to direct administrators of these funds that part of their criteria for granting aid would be the increasing of energy efficiency of farm buildings and operations, setting up of a recycling scheme of some sort, and so on, and that these activities should be considered "improvements" within the meaning of the Act.

In many cases, I concluded that there would have to be a new regulation under an Act, or the Act itself would have to be rewritten in order to orientate it towards the conserver society.

Much more work is needed in identifying institutional barriers to the conserver society to be found in the present legislation in Canada. Once these barriers are identified the legislation in question could:

a) be reinterpreted and administered with the bas[illegible] [illegible] of the [illegible]

(b) the legislation's emphasis could be shifted towards bringing on the conserver society by adding regulations or by slight amendments; and,

(c) in some cases where the primary effect of the legislation was to encourage waste and inefficiency, then it should be repealed and replaced by conserver-oriented legislation, i.e., legislation dealing with exactly the same subject but coming from a completely different way of thinking.

Each government should undertake to review its legislation in order to identify and remove institutional barriers to the conserver society which may have become ingrained in it's legislation.

At least two of many possible spinoffs of this would be:

(a) the administrative bodies, tribunals, regulatory agencies, etc., who draw jurisdiction and guidelines from their enabling legislation would thus come under review and there could be identification and removal of barriers to the conserver society in their philosophies, practices and procedures; and

(b) gaps in the present legislative framework with respect to bringing on the conserver society could be identified and filled.

Spring Ridge Housesavers and the Conserver Society

This Co-op is presently living and working in Victoria. Recycling and resources and energy conservation is so integrated into their very lifestyle that they take for granted techniques and modes of handling natural resources and energy which have become an assumed part of their daily activity and which the rest of us are still trying to conceptualize and adjust to.

By talking to various members and working along side of them, I was able to get an insight into what I believe is an actual functioning model of where society is going. Here is a case study of a successful, functioning community which has already entered the conserver society.

Background to the Co-op Movement

The late 1960's were characterized by massive higher level education, nuclear bomb testing, accelerating environmental problems, the Vietnam war, student unrest, reaction to big government and big industry, and generally an atmosphere of analysis and questioning of all society's values and goals.

People began [illegible]

Much Eastern philosophical thought had become available to the West and was widely read. This, and people's intuitions, told them that something was wrong.

Why was there so much poverty and why was the gap between rich and poor growing? Why was waste and mass consumption so necessary a part of western society? There was a growing reaction against what the media portrayed as the good life. People perceived that materialism and increasing consumption did not enhance their quality of life. Alienation set in when their consciousness raised to the point where they realized they were cogs in a big consumer machine which had no direction except to make profits for the few.

Birth of the Co-op Movement

People began to drop out. Communes formed as people began experiments to find alternative, more fulfilling lifestyles. People began to realize that there was strength in numbers, that the group working in harmony could attain much more than isolated individuals. People of like minds came together to discuss their mutual problems and their goals in life. The most immediate problem was, of course, to organize alternative systems which would supply food, clothing and housing.

People had rebelled against the plastic society where the quality of food, clothing and housing declined as their prices increased. People reasoned: why should I work harder and harder in a job that is irrelevant and meaningless for more and more money, to spend on acquiring more material possessions, most of which I don't really need.

People began to use their technical and communication skills, but for goals that the consumer society had not set. These talents were brought together in the cooperative movement via goals set by the consensus of the individuals involved. These goals differed markedly from those offered by the prevailing society and, in fact, challenged many of its basic beliefs as to the role of individuals and institutions.

The outlet for these new creative energies was through the extended family, the cooperative and the communities which were evolving. Conservation of resources and minimization of throughput resources and energy was a basis of the cooperative movement from the start. This conservation approach satisfied the basic human requirement of feeling that one was in harmoney with oneself, the group and the environment. Of course economics played a role; but economics cannot explain the almost religious fervour with which conservation and the limiting of personal wants to necessities has been viewed by the individuals in the co-op movement.

The co-op movement is much closer to seeing the underlying value of natural resources and human beings than the consumer society. There is no overt economic rationale for a recycling lifestyle according to present economic utilitarian theory. Many of these thinking people could have been leaders of industry and government if they had chosen to maximize their personal wealth. Instead, many consciously [illegible]
[illegible]

The co-op movement felt it was a creative force rather than a destructive force. The strength of the group insured continuity and helped the individual deal with the surrounding consumer society which was often hostile to this alternative lifestyle in its midst. Books arose which become part of the group's collective consciousness.

As this new conserver society developed a new language and a new perspective, the language of the mass consumer society became slightly ridiculous. Such phrases as: "bigger is better," "live better electrically," "time is money," "keeping up with the Jones," etc., were seen for what they were - empty phrases which masked empty lives.

The Co-op Becomes Reality

In 1969, a full scale food co-op was commenced in James Bay, Victoria. This was an extension of the sharing and wholesale handling of food on a cooperative basis which had already been naturally occurring.

Individual consciousness raising had led to formation of collectives based on equality, mutual help, and sharing of skills and talents for the good of everyone. This, in turn, had led to community funding of a local enterprise which was based on the strength of shared resources. A food co-op had brought nutritious and less expensive food to the people. People could decide to do away with unnecessary packaging and cut out the middleman by buying in bulk. Individuals felt the satisfaction of being involved in the decision-making and in putting their time and energy into a local, small-scale, labour-intensive activity which gave back immediate and direct physical, psychological and social rewards.

What was the consumer society's reaction to this?

An interesting story, related by Rollie Thompson in an article entitled: "People Do It All The Time" speaks volumes.[35] The first Trumart general grocery store was opened in Nanimo under the sponsorship of the Hub Co-op. The local Safeway store, part of a multinational grocery chain and often importing large quantities of food stuffs from California despite availability of high quality local produce, decided to start a price war and crush this competitor. It's a known fact that large corporations have vast resource of capital to call upon and can undercut prices even below cost price in order to rid themselves of competition and maximize their monopoly. Safeway dropped its prices, sat back and fully expected the Trumart store to shrivel up and die, thinking that man was primarily an economic creature. But man is also a social creature.

The Co-op advised all their members to buy the specials at Safeway and continue to buy the rest of their goods from Trumart. Also, a lot of voluntary community energy went into supporting Trumart as everyone was aware that not only this community resource, but the community itself was under attack by a [illegible] institution.

Many of those who have vested interests in the continuance of the institutions in the consumer society realize that the coming of the conserver society will mean a dramatic shift in power to new institutions which are more in keeping with conserver society goals and ideals.

In 1970, the Local Initiatives Program (L.I.P.) was announced. Applications were prepared to use LIP money to set up a Community Waste Prevention Program (remember this is 8 years ago!) and the Co-op Community Program for such activities as food, laundry, day-care, and a recycling depot.

These applications were rejected out of hand, even though administrators admitted that the proposals were well within the LIP criteria as a make-work project. The main obstacle was the philosophy, perceptions and psychology of the administrators. Here was a group of people with a different philosophy, attitude to life, even language. The administrators were afraid of this unknown -- which we call the cooperative conserver community.

The community went ahead and established the first recycling depot in Victoria. It was located in a backyard in Fairfield. It was realized that government itself was a major obstacle to conservation.

On another front, when the community tried to incorporate as a Co-op, it was met by tremendous resistance. Government insisted that the group hire a lawyer. They could not understand that part of the co-op philosophy was to do as much as possible within the group so that this would generate experience and expertise in the Co-op. It took 1 1/2 years before the application finally went through. Once again, the consumer society mentality, where one purchases everything, had clashed with the conserver society mentality where self-help is emphasized. One side effect of this was the preparation of a kit and a how-to manual which has been successfully used to incorporate over 60 co-ops.

About this time, the Consumer Resource Service (CRS) was set up as an umbrella group for member-run projects, such as, the food brokerage which imports food from across Canada and the Third World, and markets foods produced by the local cannery, bakery, etc.

In 71-72, Opportunities for Youth (OFY) came into being and a grant was made available to set up a recycling depot; a film was also made. Still, labour was always voluntary.

In 1973, Spring Ridge was incorporated as a result of the identified need for non-profit, affordable co-op housing. The object was to buy old, run-down housing and use co-op labour to restore the buildings and make them habitable. CMHC, Victoria, dismissed the application out of hand. The manager at that time thought it was a joke. The CMHC senior administrators could not relate in any way to what Spring Ridge was attempting to do, even its mandate was to bring housing to the people. They took it as a personal attack on the system they had grown up in. Here were poor, non-materialistic, co-op people who were educated, fluent, politically-aware and well organized. The doors were shut.

techniques on inexpensive housing in order to make housing more available. There was to be no private ownership; it was to be held in trust by the Co-op for the members.

The Ministry tried to apply consumer society solutions. It wanted the housing industry to build more new highrise and townhouse developments, i.e., major new capital intensive construction.

The Co-op wanted to recycle old houses into new accommodation. It couldn't see the logic of demolishing excellent building materials to be replaced by new materials. It also wanted to utilize the labour resources of the community.

The housing industry, which saw what the conserver society might mean pushed for large scale production so that it would be out of the scope of small co-op groups.

At this juncture, the government refused to fund renovation of old houses or the building of houses from recycled materials. The provincial government also wanted the traditional nuclear family in each unit. The Co-op argued that people had the right to define their social grouping, including an extended family.

Finally, later in 1973, communication was established between the Co-op and the government. The latter was prepared to lease land to the Co-op if the Co-op put the package together. At that time, many demolitions were occurring in Victoria. The government was developing a site on which seventeen 45-year old houses were to be demolished. The Co-op got the contract to clear the site. It moved six of the structures and hand-dismantled the rest for materials. It also saved the government $12,000 over the nearest bid.

CMHC was to help cover the cost of moving the houses. The Victoria office resisted. Only after intense political pressure did Ottawa intervene.

The Manpower office was approached with a scheme to get people off welfare by having them paid while they learned to hand-dismantle houses and investigate new techniques of recycling building materials. A separate entity, known as "Housesavers" was created to market recycled building materials that were in excess of what was needed. Manpower resisted the concept and finally agreed only on the basis of removing people from the welfare rolls, i.e., short term creation of employment rather than to support recycling and conservation of resources.

This difference in perceptions came to a head in the second year. All funding ceased, even though unemployment was just as high. The local manger had decided that all these new ideas were too radical. Thus, even though an additional 10 more hard-core unemployables had been recruited, all funds and all manpower programs were made unavailable -- even the right to apply was refused.

This basic conserver society concept of recycling valuable building materials had been stopped dead. Many of the institutions of the consumer society -- government, the housing industry, the local media, the new building materials industry, etc., brought enough pressure to stop this interference in the consumer society status quo [illegible] things.

CMHC, in 1974, even cut off RRAP money at the last moment which it readily admitted the Co-op was entitled to. This alone came very close to destroying Spring Ridge and left them $20,000 under financed. Financial institutions also balked at the idea of recycling. They were not enthusiastic about funding a new conserver society concept.

This represents a classic case of where a consumer oriented administration can effectively stop a program geared towards the conserver society. It indicates how the present institutions who have vested interests in the consumer society will fight the move towards a conserver society.

Finally, after much hard work, Spring Ridge was able to complete the project. The conclusion of the story is that 12 people were taken off welfare and gainfully employed for nine months in hand-dismantling old houses and creating new houses from these materials. Altogether, four duplexes with eight large comfortable suites were built. Each duplex houses six people, an average of three per unit. When one adds up the capital costs of things that had to be bought, the mortgaged land, the present cost of utilities, taxes and maintenance, the present monthly cost of this housing (which was based on conserver society principles) is $275/month per duplex, or $48.50 per person per month.

The approach and concepts of the Spring Ridge Housesavers prototype could be applied anywhere in Canada, and in other sectors of society besides the housing sector.

Conclusions and Recommendations

Conclusions

A major question raised by the Spring Ridge Housesavers example is how hard will individuals and institutions who have vested interests, or who strongly believe in the outmoded consumer society concept resist changes toward the conserver society?

We are at a crossroad. Will Canada remain a highly capitalized, high technological, consumer society? Or will it become a labour-intensive, small and medium-sized technology, and decentralized conserver society? We have seen that the former is leading to unemployment and alienation.

Another interesting thought I would like to leave with you is that Schumacher and other economists argue that "governments are good at collecting money, but people are better than bureaucracies at spending it!

The major barriers to the conserver society are not institutions per se, but individuals who still subscribe to the outmoded philosophy, perceptions and psychology of the consumer society.

It will be individuals and the cooperative movement who in their own incremental way will help us evolve towards the conserver society, mainly by always reminding us, by example, that the alternatives of the conserver society are always present in every [illegible]

Recommendations

This paper contains many express and implied recommendations under each heading which should be read in the context of each section.

One recommendation which I would like to re-emphasize is that the regional district of Victoria should be made a conserver society demonstration project pursuant to Recommendation 8 of Volume 1 of the Gamma Report.

Victoria is closer to a post-industrial society than most other cities because, being largely a "government town," communication and information processing are important.

There is an excellent cross-section of socio-economic classes, rural/urban mix, and a variety of activities and lifestyles.

Just as Prince Edward Island, the Island off the East Coast, has been made a demonstration project for renewable energy, so, too, should Victoria, an Island off the West Coast, be made a demonstration project for the conserver society.

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IMPACTS OF THE CONSERVER SOCIETY ON THE BUSINESS SECTOR

George Leonidas, George Haines, Monty Sommers
Faculty of Management Studies, University of Toronto

Abstract

The implications of the Conserver Society are examined as they relate to four general areas of business.

The first examines the reality and urgency of the limits to growth theorem and what this means to business and industry in dealing with the whole concept of conserverism. The emphasis is on the imperative need for long range planning.

The second section discusses Canada's flexibility to deal with major structural problems and the associated business and industrial consequences. The issues of foreign dependence, regional disparity and centralization of business, industry and government are raised.

Ways of coping with our international and national problems are then suggested. Various incentives are discussed and the advantages of decentralization detailed.

Finally, the fourth section examines management decision areas and how they can be effected by conserver society concepts. Included are product planning and development, costs and prices and managerial responsibility.

Part 1

The Reality and Urgency of The Limits to Growth Theorem

We would like to begin our discussion with the basic proposition that in an age of uncertainty, in an era of unrest and turmoil, it seems wise to search for ways of dealing with our problems with a minimum disturbance to ourselves and to others. The fact that there are major areas of our society in which significant changes appear to be essential for survival make it all the more necessary to search for sensible ways of changing. The complexity of our problems also suggests that technological, political or economic pat answers, from whatever sources, will turn out to be ineffective and that formal rigid planning and pronouncements by so called experts will be inappropriate.

The problems in our society today differ from similar ones in the past in magnitude and complexity, and probably in the magnitude of the changes which will ultimately be [illegible]

No one knows all the answers, or even all the questions, at this point in time. So all of us - government, business, labour, academics, citizens at large - must engage in an on-going learning process to learn more about ourselves and each other. Moreover, and most important of all, in this learning process, because the age of the expert is gone, maximum use must be made of all of our individual and collective knowledge and experience to work out solutions, assisted by a light rather than a heavy governmental guiding hand.

So we commend the Ministry of State for Science & Technology for bringing us together today to engage in a learning process on the conserving society. While this problem is not among the most urgent in Canada at this particular time, as we are conserving all kinds of material and human resources during our present serious economic difficulties, it is worthwhile to learn more about this issue from each other before it may be too late. It is in this spirit of learning and inquiry that we would like to share with you some ideas we have developed on the impacts of the conserver society on Canadian business.

Aside from the Federal Government's recognition of the conserver ethic, senior management has additional reasons for recognizing this reality. Their organizations have faced extraordinary cost increases in most areas, extraordinary levels of regulation and suasion, and varied patterns of market, capital and labour responses and pressures. For management, the realities come through in daily operations and forward planning problems. The same realities exist for other members of society.

If we turn from the realities of our present and near future situation - where we know what we are facing - to longer term matters, the question of urgency and how to proceed can fall into a clearer perspective. Right now, input supply conditions (energy materials, skills, capital, etc.) are being dealt with by management in primary, secondary and tertiary industry through the usual factor price mechanisms. These factor prices are distorted from what might be called normal market reality by government views of social requirements primarily through regulation and taxes. This is not to say that such distortions are wrong, only that they exist and are currently having effects. Thus, we are in transition - some would say we always are - with respect to our realities. The urgency on some fronts has already been well recognized. Managers are doing things about shortages, waste and other social problems insofar as these are reflected in factor prices, market and competitive conditions and regulations which channel decisions. Canadian management is working on those real issues which are most urgent - those reflected in price, market and regulatory mechanisms. They are not working on issues, problems or questions which - while they may be real or nearly real - are not reflected in a manner which can sustain concrete, justifiable action. We submit that this is an exceedingly positive response to conserverism, and in keeping with the essential spirit and ethics of its concepts.

At the same time, this is not to say that all is well - the system will [illegible] and leave [illegible] [illegible] management acts [illegible] it does not readily act. The urgency does not exist to act in such areas simply because it is not clear enough to decide what is to be done about what.

As a positive response to the challenges of the limits to growth theorem, it is clear that most senior managements in this country can say that they are already dealing with those issues for which reality and urgency have been clearly established.

To move with greater urgency will require that we analyze the implications of conserver society concepts much more fully than has been done so far. Specifically, we must:

1. Determine the planning organization and resources needed to provide the required facts and analysis;

2. Identify the international and national constraints which must be taken into account if we wanted to pursue the conserver concepts more rigorously;

3. Take a look at some ideas on how we may implement conserver society concepts and their possible consequences.

Let us begin with the first requirement - the need for more data. Lack of clarity can be dispelled and urgency to act increased by having all business, government and other important organizations work on those issues which are most concrete in their terms. Thus, the requirement for long-range planning activities - the sensible phasing of urgency - can be established and the work of clarifying the reality of issues and scheduling and marshalling of resources to enable appropriate action can go on apace.

To move forward in the application of conserver society concepts it is important to lengthen our planning horizons in business, to generate the information in those areas of sequential immediacy that are amenable to a high degree of validation as opposed to a high degree of speculation.

Moving into more and better forward planning is no easy talk... problems exist...

- in designing effective planning organizations

- in planning methodologies, and

- in funding the required planning resources

First, planning organizations...

1. We oppose the creation of a single unit or organization to undertake planning activities, such as the Gamma recommendation for a Canadian Conserver Corporation. Diversity in approaches is essential [illegible]
in the [illegible]

2. We caution against the temptation of shifting such activities to government for the sake of perceived efficiency and cost savings for obvious reasons.

3. We do suggest clear support from and involvement by senior management in long-term planning. We know that many of us are not enthusiastic about long-range planning over longer periods of time ... such activity has not been too successful in the past five years. But we must continue to try in large organizations and at the association level for small firms. Finally, in the conserver society context, long-range planning may call for greater co-ordination among competitors than is currently appropriate under combined legislation designed for other circumstances.

Secondly, planning methodologies. Management will have to cope with dealing in areas of relatively more speculation and uncertainty than was previously the case.

1. Senior management will have to become more sensitized to the conserver society concepts and to approaches to long-range planning. It may seem easy to leave such things to specialists, but the specialists will need senior management guidance in making certain judgments and assumptions in dealing with soft data not easily quantifiable.

2. It will be necessary to reorient more organizational tasks to both longer time-horizons and greater "systemness" ... to look at the broader consequences of events and developments. The methodologies employed in this work are unusually perceived as relatively soft and inexact, but we must work at developing better technologies and methods to get better results.

3. Much of the planning effort with respect to the conserver society concepts will have to deal with, and calculate, not only those direct costs to the firm, industry of sector, which can be identified, but also those costs which are externalized to others, future populations, into the air, or water, or noise in the environment, which are not taken into account in calculating the prices of the various products we sell. This information will be required, however inexact, to enable management to deal with conserver concepts, pressures and initiatives.

Thirdly, the availability and cost of planning resources in this context:

1. Relatively short-term planning with the prospect of benefits in the near-term are normally funded by business without hesitation. The cost of long-term wide-ranging research and planning such as we envisage will be difficult to justify [illegible]

knows the system better than anyone else, and besides, if we do not, somebody else, no doubt the government, will do it, then inform and regulate us after the fact.

Finally, it goes without saying, that if such investigations are appropriate for business, they are equally appropriate for government and quasi-government units which have planning and regulatory responsibility and concern themselves only with direct costs. They too, we submit, should get a handle on external or social costs which they incur for others to bear.

Part II

International and National Exigencies

Now we move from the planning imperative and its implications to the amplification of some international and national factors which must be taken into account if we wished to pursue conserver society concepts more vigorously.

These factors are as important in indicating the kind of business and industrial activity currently in transition as in providing direction for planning and action on behalf of management. It should also be said that the discussions and papers which deal with future worlds, various scenarios of social segments and industrial structure, do not, in our opinion, explore these exigencies and draw implications in any fashion commensurate with their importance. We emphasize them so that management can deal positively with the realities of our situation and more clearly view conserver society concepts.

Foreign Dependence

The most obvious and crucial factor with which we must deal is the extent of our dependence on foreign countries as important markets for primary and some secondary goods, as competitors in such markets as sources of investment capital, and as sources of necessary imports. Let us draw the implication very clearly: any moves which we in Canada make in a unilateral fashion where the effect is to threaten or reduce the competitive position of any dependent sector - for the sake of conserverism or otherwise - must be viewed as disastrous for Canadian business. The key problem areas with which Canadian management and the government must deal in the dependency context include, foreign responses to the limits to growth theorem, the bases for such responses, their effects on our own foreign market interests and the manner in which they constrain and allow us to move towards conserver concepts and practices as required.

The operative term in this discussion is unilateral. Changes in regulations and the shifting of costs from external to internal categories which are reflected in higher [illegible]

Close attention must be paid to the manner in which the United States, Western Europe and Japan handle similar situations in sectors important to us. Both the nature and timing of their responses have a great effect on our ability to adjust where required in the least painful fashion.

Clearly, the need to be competitive as a result of dependence will require careful sifting and analysis of the moves of our competitors in other countries before we make any further moves. Canadian management has a host of serious problems in competing internationally, without yet another constraint.

Other aspects of dependency concern GATT and the nature of development in the Third World. The members of GATT – and it appears to be Canadian policy as well – are moving towards a lowering of tariff barriers over, say, the next ten years. This movement will put pressure on all secondary manufacturing but most on those sectors which are domestically oriented and vulnerable to import competition. Manufacturing will be under extreme pressure to do more with the same or more with less. As long as our major foreign competitors face similar costs and reflect them in net prices, at least competitive parity is maintained. If not, our domestic desires to cope with some conserver concepts (i.e., include some external costs in our selling prices) are severely constrained.

As countries in the Third World proceed with their own development plans, they will increasingly pre-empt those manufacturing sectors which operate with a high labour content. Further, one can expect the coming availability of many resource suppliers which can cause us interesting problems in export markets. It is fair to say that the reality and urgency which we may associate with the limits to growth thesis does not exist in the developing countries. They have their own problems of an extreme and immediate nature which are viewed as the obverse of our own. With respect to many conserver society concepts, however, we can learn from their experiences as either traditional societies or in terms of attempting to develop appropriate and intermediate technologies. It is in the appropriate technology areas where we may have much in common and can support each other.

<u>National Strains</u>

A full litany of our domestic woes would not be productive in this paper. Two closely related issues should be emphasized – regional disparity, and the centralization of both business and industry and government. Again, we are in transition with respect to centralization of government. The dialogue between the provinces and the federal government very likely will result in the granting of wider powers to the provinces to deal with their perceived needs and priorities. The implication is that we will have <u>more regionalism</u> than now exists and the positive aspect of this is that a regional approach can very well be a much more productive approach than a centralized one, depending on which powers become available or enhanced and how these are used. It is also clear that the level of regional or provincial competition will be raised. Not only will this mean that the central government will have to undergo some interesting adjustments, but also that senior management will have to reconsider such questions as [illegible] leadership of the provinces that decentralization of business and industry will take place. It will be beyond what we now see in the case of Alberta.

The immediate reaction of management to the exercising or shifting of political power - again as in the case of Alberta - appears to be one of business as usual unless and until constrained or provided with incentives. For the short-run this may be the only sensible response, but the evidence of shift would be read more closely and viewed not just in terms of pressure to be defended against but in terms of the restructuring implications for centralized operations where they may be amenable to restructuring.. Then the positive dimension of such moves can become more apparent. Lack of responsiveness can unnecessarily invite a host of provincial crown corporations and assorted institutions in the picture. This is particularly the case if and when the provinces become more competitive in exercising their powers.

Changing Behaviour and Values

Most of the future worlds that are being urged upon Canadians are said not only to require a change in the use of material and consumption patterns, but also to require that we change our values and attitudes. The arguments and assumptions made are that our values and attitudes are directly related to our consumption patterns, and since we are too materialistic and wasteful, we must undergo a sharp change in values and attitudes. In our own defence we must say that Canadians are not deliberately and maliciously wasteful nor deliberately and wantonly materialistic. People, on the whole, are responsible given the conditions under which they operate. And when conditions change, people will adjust and adapt insofar as they can see that adaptation and change is required and is in their interest.

The exhortations to change values on the assumption that this will change behaviour in general and material consumption in particular is very heady stuff for social engineers - be they academic or bureaucratic. One clear effect of such exhortations is to frighten people - including many managers. Frightening consumers on this score, who from time to time happen to be voters, seems to be unnecessary. The option that we recommend is that, where necessary, behaviour be changed by providing either incentives or what are currently termed disincentives, and that the behaviour change advocated be reinforced in traditional terms - not new terms. The price system is well understood by all Canadians - they know how to adapt to increases and decreases in price. They are currently becoming conservers through this kind of adaptation - reinforced with sometimes useful information. They will continue to do so. As a result of this form of adaptation, their attitudes towards some material goods and services will change and such goods and services will no longer be associated or identified with whatever social and cultural value exist. The process of change can be speeded up by, in addition to operating directly on behaviour through the price system, making behaviour reinforcing information available to aid in the attitude adjustments and to demonstrate that modified attitudes and life-styles do represent important values and elements of culture. [illegible] attempts to change attitudes and values without [illegible] behaviour [illegible]

Part 111

Coping with International and National Exigencies

Now we would like to present some ideas on how we may implement conserver society concepts more vigorously and their possible consequences.

To begin with we must examine our priorities. We emphasize at this point that we cannot begin to apply many of the fundamental concepts of the consumer society concepts unless and until we define an industrial strategy for Canada. Surely the time has come for us to stop drifting with regard to industrial strategy as it is clearly and painfully impairing both domestic and international confidence. We have not formulated and agreed upon broad industrial goals and directions in this country - to attempt to introduce conserver society concepts which alter industry structure, costs and prices would be a calamity.

Any changes which are rooted in conserver society notions must be related to and be a part of an industrial strategy. Our approaches here must be selective. We must sort out those sectors and organizations where it appears we have limited scope for unilateral action on these concepts and concentrate on them first to assure their competitiveness and viability. In some cases we are so dependent, that we can do nothing other than accept the situation. In most cases of these types of dependency situations, the time frames for action will be determined outside of Canada and the subject of international business and government negotiations.

In those industries and sectors which are not export dependent or threatened by cheaper imports, we may wish to pursue conserver society concepts further, and to do this we must take another look at the cost question.

Time and time again we are told that economics is dead, the market does not work. Our response can only be that while the market system does not produce the results that some desire, on the whole it does produce the results that situations warrant. Some resources, materials, etc., do cost more than do others and do get allocated in areas where they bring higher yields to those who control them. We are not talking about perfection in market operations; we mean pretty good adjustment to circumstances and we mean better adjustments than one gets in a command system even with the distortions that are produced both by governments and private monopolists.

The real question is the shifting as between private sets and public or social costs. The conserver concept of developing total or full costs for product systems, production systems or distribution systems should be pursued. All relevant constituencies should be involved in identifying external and social costs of business divisions which are not reflected in product prices. But the decisions with respect to the internalizing of external or social costs and [illegible] them through product prices [illegible] they [illegible] as well.

In some cases it makes sense to load full costs, in other cases less, in other cases more. The root answers to the loading of full direct and external or social costs on to a sector are answers to our perennial business and industrial strategy questions. We cannot answer these questions until we resolve the broader question of industrial strategy.

Incentives for Action

Business and industry will generally attempt to operate in the future as they did in the past - adjusting incrementally as do other consumers - to change in prices and expected returns. Insofar as the difference between internal costs and full costs - total system costs for an industry - can be ascertained, it is this discrepancy which potentially provides the lever for adjustment for a sector. We propose the consideration of the Value Added Tax (V.A.T.) approach as the mechanism for dealing with the internal cost - full cost difference

We suggest the elimination or the maintenance of a very low corporate income tax rate and a heavy shift to a value added tax fiscally. /

With a value added tax approach, organizations in a sector pay a specified rate on the value added by their operations. (Value added = value of goods sold - cost of materials, supplies, fuel). The value added component is the contribution of labour, management and capital for a sector (or for an individual firm). The applicable rate is the interesting question: a rate can reflect none, some, all, or more than all, of the social costs (based on a systematic approach) associated with the sector. And here we add a caveat: the present sector definitions are not necessarily the most appropriate and could well stand with review - thirty or forty sectors may make more sense.

It is through the tax rate set for a sector that the firms involved can respond to conditions. For those sectors which are heavily export oriented, the rate must reflect the realities of competitive parity. In some cases an industry may face an almost non-existent rate regardless of the social costs. These will be absorbed elsewhere in the economy because of the national and regional priorities set by the political and economic climate. In other cases, medium or high rates will apply. Regardless, the rate set provides the incentive to the sector. It may make sense in some sectors to reduce rates with increases in value added, in others to increase them: the rates can be tied to specific cost/investment components. Thus, if energy costs can be reduced, this can be reflected in a levered V.A.T., if renewables are substituted for non-renewables on a percentage basis, again a levered V.A.T. could apply.

Value added taxes are acceptable under GATT insofar as they are perceived as sales taxes and are appropriate for drawback with respect to export sales. A very low corporate tax may be necessary to ensure value added tax drawback under GATT rules as incentives for industries not presently exporting. Moreover, they are generally simpler and less costly to administer than the existing plethora of sales taxes.

It is beyond the scope of this [illegible] other countries. [illegible] tied back to important components of value added, that focus on the loading and unloading of social costs, in as simple a fashion as possible. Such an approach should make redundant many existing government incentive programs which are either difficult to manage or difficult to demonstrate as being successful.

It is obvious that such a V.A.T. approach requires a substantial degree of sector-government discussion. It also requires that social costs be looked at very closely and that they be sensibly aggregated. Our hypothesis is that government is at least as guilty as are business and industry in shifting costs into all sorts of nooks and crannies for others to absorb.

Moving Towards Decentralization

Important aspects of the conserver society are quality of life, quality of workplace, humanism, independence, self-sufficiency and choices of life-style. These elements are all part of the regional disparity and centralization/bureaucratization exigencies. A better job must be done with respect to what can be termed as pre and post industrial dualism. Outside of our twelve major metropolitan areas, we have a great deal of what has been called relative "under development". While provincial governments and DREE have worked at getting development in such areas, the record is not good. One reason for the lack of success has been the attempt at miniature replication of major metropolitan area development. Intermediate or appropriate technology approaches have not been attempted often enough. The most glaring examples of this kind of miniature replication and its attendant consequences exist in the native peoples' communities. Two types of development are necessary in such areas: one form (pre-industrial) which brings the quality of life and life-styples of inhabitants to a locally approved level; one (post-industrial) which provides alternative life-styles and qualities of life-alternatives to those that exist in the major metropolitan areas. These two may coincide from time to time and location to location but not necessarily so.

This paper will not "paint the scenarios" for these forms but rather indicate the types of structural changes which can enable them to develop. Regional and local control of requisite resources and their utilization is a necessary condition. This kind of control is most appropriate for those sectors which are primarily or importantly internally oriented - tertiary sectors: services, banking, insurance. Some secondary sectors may also be appropriate. This can best be discerned when a picture of a sector's direct and social costs becomes available.

Very few economies of scale exist in tertiary industry on a full cost basis and thus centralization is inimicable to both pre and post-industrial types of development. What flows from this is that wherever vertical integration and vertical marketing systems and horizontal integration and horizontal marketing systems exist, they are potential bottlenecks to local and regional development. Some insurance agents should be local brokers offering a locally relevant portfolio from competing suppliers, some of which [illegible] region. Some banks should [illegible] controlled single or [illegible] to provide [illegible] scope for the operations of local credit unions, the present local banking system in Canada.

Some secondary industry, if reviewed in full cost terms - and here the total system social costs are vast ranging from unemployment benefits to railroad tariff subsidies - would also be found to offer little if any advantages of scale. The development of regional suppliers of various products sold regionally would become feasible. This is simply a form of regional import substitution which can make use of locally developed or adapted appropriate technology. More employment alternatives as well as variety in life-styles would result from successful decentralization based on regional import substitution. To illustrate, the Atlantic Provinces Economic Council estimates that, in general, residents of the Atlantic provinces spend twice as much as they earn with the shortfalls made up by various transfer and equalization payments (social costs). These tax dollars, generated from, say, Ontario, arrive in the region and then move right back to pay for goods and services produced in central Canada. The estimate is that if one percent of the goods and services the region imports could be sourced in the region, the gain would be $85-million. Such an amount would not make much difference in central Canada; it is one-third of P.E.I.'s budget. If national retailers operating in Atlantic Canada can work to develop local sources rather than having a centralized buying office deal with a few or one large supplier, the local and regional effects would multiply. In terms of business opportunities, useful jobs, outlets for appropriate technology - which would hopefully be less capital and more labour intensive - the possibility of more craft type work as opposed to assembly work, all of these possibilities coming to fruition can immensely strengthen local infrastructure. More local communities could become more attractive as population concentration points with life-style options not available in major metropolitan areas.

A number of structural changes must be seriously considered for this kind of decentralization - rather than the miniature replication variety - to have a chance to develop. If provinces or regions were able to set V.A.T. rates, in conjunction with the federal government, that reflected regional sourcing and value added in regionally defined useful terms, business and industrial decentralization incentives will become sensible. Some will say that the country will be balkanized in development terms. For many years and for many dollars this has been the case. Rather than dealing with regional disparity on a transfer payment basis and with national problems which fit no region or province except the eleventh - the average one, it would seem appropriate that regions be enabled to attempt to solidify regionally appropriate levels and styles of living. <u>The concept of regional disparity may be the largest structural problem we have.</u> The substitution of acceptable regional alternative styles, with real provincial control over incentives to enable appropriate development and diversification appears more likely to satisfy people than continually discussed and demonstrated relative deprivation. Effective regionalism can shift the referent for deprivation, make it regional and more amenable to elimination.

[illegible]

conglomerates, chains and franchises - with the view to simply preventing some forms of chain and franchise development and some forms of mergers and acquisitions. At some point it should be demonstrated that these forms of business organizations do provide scale economies in an important sense and in both direct and total system cost terms. Transfer payments which enable one region to pay for imports from another too easily appear to be economically inefficient and socially debilitating. One more proposal for structural change must be entertained. If it is sensible to decentralize organizations and regionalize markets and production centres, it is equally sensible to decentralize that other, so far unmentioned member of the corporate consumer state - organized labour. Where sectors have a heavy foreign interdependence, there is a case for the internal co-ordination of unions relevant to such a sector. Where international interdependence does not exist, and where we are dependent on foreign markets, competitive parity is appropriate, not simple wage parity. Competitive parity here refers to the full cost concept, wage parity to the direct cost approved. In such cases, it would seem inappropriate for Canadian locals of U.S. based unions to exist - just as it is inappropriate for some chains to exist or some mergers to take place. For decentralization to take place, wage standards and reference points for negotiation of wages must be decentralized. National unions should exist where national employers exist; regional unions with regional employers. In any event, the value of work and the life-styles which work sustains, are regionally determined and the development of labour market structures which are based on an Edmonton or Vancouver or Toronto wage rate - which ignores the associated life-styles in these areas - is as inefficient in total cost terms as is the centralized sourcing in southern Ontario of a major retail chain with significant sales in Atlantic Canada.

Before we go on, we wish to underscore the spheres of responsibility of industry/sector trade associations, federal and provincial governments.

Industry/sector and trade associations must become much stronger and work together, as we have already discussed, to carry out effective long-range forecasting and planning, as well as develop systematic approaches to the definition of external or social costs in their respective sectors, in addition to already known direct internal costs. Just as importantly, we envision industry sectors working with governments, on a self-regulating basis, in the application of the desired incentives or disincentives through the application of the appropriate value added tax rate.

We envision a federal government which uses these incentives for consumers and business and industry (including crown corporations) rather than either exhortations or direct involvement in operations. We envision a federal government which provides clear regulations based on well done research and planning well co-ordinated with the provinces. While the federal government should maintain national responsibility for base line social programs, and for sectors with heavy international dependencies, the major responsibility for local development in economic and social terms should be at the provincial or regional level. It is here where relevant standards can best be set.

The federal government will have to become much more of a co-ordinative apparatus than it is at present. There will be growing contention among the provinces and regions that will have to be refereed.

The provinces and regions will have to become more sophisticated with respect to planning and priorities and obviously guard against the ever present danger at the local level of becoming overly responsible to vocal pressure groups.

Part IV

Managing Organizations Under Conserver Concepts

Finally, we conclude with a few remarks on managing organizations under conserver concepts. The adaptations currently being made, the trends in life and work styles which are appearing and will be projected, the changes in technology ... all of these combine with conserver society concepts to give direction to the manner in which organizations are managed, the opportunities that exist and some of the issues to be faced.

1. Organizational scale, design and commitment

Generally, business and industry are in touch with these developments and are adapting successfully. Organizations are being decentralized and the quality of work life is being improved. Firms have responded to these issues in a creative responsible fashion. While all the problems have not been solved, a good proportion have been and no doubt improvements will continue to be made.

2. Product Planning and Development

If any phase of business activity comes under great pressures as a result of just plain natural evolution of our system and the development of conserver society concepts, it is the product planning and development area. As long as prices reflect resource scarcities, our engineering systems will continue to adapt: renewable materials will be substituted for non-renewables processes will be changed to take into account energy costs, product concepts will be evaluated both in terms of usefulness and costs within every broadening use and total cost system. Being more and more systematic both in terms of product use and system effects and associated direct and indirect costs will be more time consuming, more expensive, more difficult, and likely to result in fewer "new" products. On the other hand, the new product success ratio may very well go up as a result of this process. The technical and managerial skills, systems and information needed for more systematic approaches are currently being developed. But much needs to be done in terms of external or social costing and the mapping out of use systems.

What is to be guarded against is a rising level of conflict between busin[illegible] pursues its [illegible] while in the state of continual adaptation and the [illegible]ments as regu[illegible] and protectors of the public. [illegible] sides [illegible]

[illegible]

things... the effect on the whole economic and social system of new products and other decisions ... which we were able to ignore in the past... and the cost in the system... the conflict will shift as to who will bear what costs.

With the move towards decentralization, the ability of domestic entrepreneurs to move to commercialization locally and regionally should be enhanced. Small and medium sized businesses should become more important in innovation and growth and it is desirable and likely that in the future such organizations will be able to maintain control over their inventions.

3. <u>Promotional Activities</u>

Fuller disclosure of product information will be necessary as the systematic nature of product use and effects become known. Business should move very quickly to much more comprehensive and stricter self-regulation in order to defend against a plethora of regulations and disclosure requirements. Such regulations will add to costs without necessarily adding to greater efficiency in the market place. It is likely that all kinds of product efficiency rating schemes will be devised by governments for the benefit of consumers. It is equally likely that most consumers will misunderstand them, pay no attention to them, at best, or take a long time learning them.

Some critics of the marketing process have underscored the materialistic approach of promotion. It is to be expected that where this was the case it will be ameliorated. This will come about as a result of the changes in product planning and development which will produce more explicit and accurate product use information relating to safety, proper handling and product functions and attributes. Thus, more factual information will move through the promotional system and replace common unsubstantiated puffery and some elements of life-style promotion. Since it is expected that consumer interest in certain facts will be heightened because of increasing price sensitivity and generally increasing concern, promotional personnel will cater to such predispositions.

Whatever is done in the U.S. will have a great impact on us given the overflow of U.S. television and magazines in Canada. A good deal of what might be done here will lose its effectiveness because of the openness of our communications systems. This is particularly the case with the promotion of materialism and life-styles. Substantial educational efforts and credible demonstrations will have to be undertaken in Canada where we depart from the continually visible U.S. approaches.

4. <u>Costs and Prices</u>

Business and industry will be forced to internalize some costs which are currently defined as social. Great pressure will have to be exerted on operations to assure low cost/high efficiency sourcing and more efficient technical and managerial throughout and distribution systems. It is difficult to see how technical and managerial productivity increases can outpace resource and other input and labour cost increases for an intermediate period. Prices will have to increase to [illegible]. These increases can be [illegible] by [illegible] and export drawbacks could operate to expand production for external markets, reduce unit costs. and increase profitability. Many secondary sectors will be in great trouble due to the current GATT round, and only a decentralization of labour markets and the attraction of new capital - enticed by the judicious use of V.A.T. rates - can help.

5. Capital Accumulation and Stakeholders

Getting governments out of capital markets as their spending is controlled is desirable. Decentralization in banking and insurance should cause more scurrying for investment opportunities at the local and regional level. The effective setting of federal and provincial V.A.T. rates should attract capital. On the other hand, huge energy projects will strain us, unless we share control and output in useful ways. More profit-sharing and employee stock plans would hlep not in raising capital but in increasing productivity and reducing costs. It is imperative that business and industry not be faced with series after series of regulations and prohibitions - independent of a tax-based incentive system - which can only result in private capital seeking other venues for returns.

6. Management's Responsibilities

As a concluding comment, we would like to point out that we are not ignoring such matters as the environment, quality of work-life and urban-life, the lack of humanism in daily affairs - all of the things that we come up against on a daily basis. Rather what we are saying is that these and other matters of everyday concern will be well looked after if we make some adjustments in our system so that people can be given the scope to act responsibly.

The coming years will be difficult because what we most likely have to deal with will be relatively slow growth coupled with the need for relatively rapid rates of adjustment. For the last twenty-five years we have lived with easy change and growth which submerged our adjustments under such conditions. We will now not have the excess of resources to cover up both our errors and slow rates of adaptation. The easy growth has made us less responsible than might otherwise have been the case. The times ahead require greater individual responsibility. But it is clear that some will have to lead in demonstrating this - Canadian management must take this lead, not because there is something called corporate social responsibility, but because for organizations to remain viable in all terms and serve their various stakeholders, that is the sensible way to manage resources ... with sensitivity to the environment and responsibility to others.

It seems to us that we are capable of assuming more responsibility... at the personal level, at the corporate and industry level, on the part of labour unions and among other power groups in our society. We cannot think of a better way to deal with the issue that concerns most people in this room - the conservation and curtailment of the role of government in our affairs.

IMPACTS OF CONSERVERISM – THE MARKETING PERSPECTIVE

John Coleman
Director, Government & Industry Liaison, CTV

Abstract

The marketing sector is very conscious of conserver society principles. Its members are actively aware of both government reports and independent studies that examine such issues as the social value of advertising, the tendency to overpackage and the equal promotion of rival products.

The current feeling is that people are generally dissatisfied with advertising. Ironically, the general public will not come to accept conserver thinking unless the concept is marketed effectively.

Once the philosophy is "sold", suitable products will also require productive marketing schemes. New marketing opportunities will offset any losses occasioned by the conserver society principles.

In November 1974 the federal Ministry of Supply and Services, on behalf of 13 other departments, agencies and other government organizations, invested close to $200,000 in an extensive study conducted jointly by McGill University and the University of Montreal. The government, in commissioning the project, asked this group of 15 senior and 10 junior researchers known as Gamma to "provide a perspective on the implications for Canada of a future period of controlled, socially oriented growth, generally described as the 'conserver society'..." Eighteen months, four volumes and 1660 pages later, the report was delivered and subsequently released publicly on December 14, 1976.

The notion of a Conserver Society was parented within the Science Council very early in this decade and the Gamma group owed a great deal of their directional thinking to the earlier stimulus from SCC.

The government sources co-operating in the Gamma Study included the Privy Council; Environment; Energy, Mines and Resources; Industry, Trade and Commerce; Agriculture; Indian and Northern Affairs; Secretary of State; Science and Technology; Science Council; National Film Board; Canadian Mortgage and Housing Corporation; Canadian International Development [illegible]

The public release of the Gamma Report, coming as it did shortly before Christmas and on the heels of the PQ victory in Quebec, didn't get a lot of attention in Canadian media. But it did strike an instant responsive nerve within the private sector of industry, especially amongst marketers, advertisers and commercially-oriented media.

That's not particularly surprising, however, since many who were busily at work in these areas were already sensitized to the stirrings of a new society. They'd twitched a bit when, just a year earlier, the Prime Minister had included in his annual state of the nation remarks a suggestion that Canada's free enterprise system might have outworn its usefulness. They'd fairly jumped in outright agitation in October 1976 when the government's "The Way Ahead" document carried the thought even further ...

"Finally, there are a number of other areas where government may have a role to play in ensuring that our limited resources are utilized for the greatest benefit. The advantages of recycling increasingly scarce and expensive mineral resources, the increasing concerns expressed that some forms of advertising serve little social purpose, and the growing resistance to wasteful, built-in obsolescence that seems to characterize growth as we know it, are all areas that merit further consideration."

The agitation turned to real discomfort by the end of the year when these statements were being read in the Gamma Report:

"Canada should explore the feasibility of enforcing even-handed advertising which would require the advertiser to present the pros and cons of whatever he is trying to sell. This could mean for instance that the qualities of rival products be given equal promotion or that a case for not buying at all be made ..."

"The public and private sectors should explore the possibility of introducing de-marketing programs to help prevent the further growth of high through put artificial needs ..."

"All advertising which tends to create new elitist needs and sell elitist commodities should be prohibited ... all non-informational advertising should be banned ..."

"We not only over-package our own consumer goods but, in a totally unnecessary fashion, even pet foods ... a significant proportion of the dollars we pay for commodities is used, not to enhance the objective quality of the products we buy, but to embellish their external appearance ..."

One of the immediate reactions from the private sector to the Gamma Report was a question of real concern ... since so many government interests had funded the project, did it represent new directions in policy and regulation of the central government. The answer, for the moment at least, appears to be no.

It may not be a new government direction but there is no longer a doubt about [illegible] growing interest in the Conserver Society. That's why we come together [illegible] and it's been [illegible] [illegible]

While the basic focus in the Conserver Society dialogue is on the economy, our resources and our environment, the relationship to marketing is inescapable, particularly if it is accepted that public attitudes and behaviour will have to change.

In the preparation of this paper it was a temptation to borrow the title from a fairly recent poll* conducted by Louis Harris in the United States for the Sentry Insurance company. He calls it "Consumerism at the Crossroads" and describes it as a "national opinion research survey of public, activist, business and regulator attitudes toward the consumer movement".

Harris discovered that 50% of Americans feel they get a worse deal in the marketplace than they did ten years ago; that 61% believe the quality of goods and services has gotten worse; that 73% believe that products don't last as long as they did ten years ago, and that 64% believe it's more difficult to get things repaired.

He notes that "mistrust of advertising, and the claims made by business in its advertising, runs through many of the findings of this survey. The public questions the honesty and accuracy of advertising. Almost everyone believes that some advertising is misleading ...

No such study has been conducted in Canada but it would be reasonable to assume that comparable public attitudes exist.

Marketing, of course, is not the only aspect of our society that the public has any concern about. There are many things that disquiet us ... the quality of education, the costs of housing, the standard of health care, the chance of getting a job - and keeping it, the rapidly rising expense of feeding the family and clothing it, the lessening ability to save for the future, the dilemma of the aging and, the concern about the future.

Ruben Nelson, in a paper for the Ministry of State for Urban Affairs published in 1976 and entitled "The Illusions of Urban Man" detailed his concern that "somehow the society and the lives we have created for ourselves are not convincing or deeply satisfying. So much that we have struggled and paid for in order that life would be better has not fulfilled its promise or our expectations. All too often the fruits of our labours have not been good and pleasurable to behold, but bitter. Clearly something has gone wrong."

Nelson had more to say about our social condition that is important to the point:

"As persons, but not yet as officials, we seem to be very much aware of the hurt that is within our society, the threat our present way of life poses to our future, and the fact that we are unable to take effective actions which even acknowledge, let alone deal with, the seriousness of our situation ..."

"If we are to deal with ourselves and our situation, we will have to 'go public', so to speak, with both our hopes and fears. The officially optimistic mask of our official selves will not do. We must no longer hide behind the official images which oppress us, and which deny us the painful but life-giving experience of coming to our senses, of coming to full consciousness regarding ourselves and our condition ..."

"The literature argues and clearly demonstrates that, whether we know it or not, or whether we intend it or not, our future as human beings is called into question by the way that we – Canadians included – now live ... A sustained upturn in the economy will not cure this. It may well be accompanied by an equally bullish market in fear, anxiety and frustration ..."

"It may seem paradoxical but it is nonetheless true that as long as we see ourselves as free men who are able to do what we want with this earth, to shape it according to our will, we will be trapped by the forms of our own creation ..."

Does Nelson talk of a society and a circumstance in a way that reflects how most Canadians perceive the world around them? Do his words describe a national malaise?

We may be able to identify, as Nelson does, a deep-seated dissatisfaction in our society yet we are less able to be certain of why it exists, whether it exists for the same reasons amongst all people. Is this the new age of uncertainty and, if so, is it conducive to the propogation of a Conserver Society?

In the context of the discussion about conserverism we need to consider a different aspect of the issue of environment ... the environment of our society by attitude.

It's easy to assume, for example, that everyone wants clean air, pure water, affordable housing, adequate education and preparation for employment, a reasonable balance between incomes and the cost of living, the expectation of a properly managed development and use of natural resources, an assurance that health care requirements are within financial reach, and a hopeful and positive sense of the future. Only the most unreasonable cynic could argue against these obvious social aspirations.

In fact, even given the present challenge to all or most of those desires, does anyone honestly doubt that, if they really are important to life, we aren't going to find the way to ensure their realization?

But to have positive assurance that is so, we're going to have to recognize some uncomfortable truths.

The individual's sense of social involvement is going to have to be fine-tuned to the future. He and she may have to significantly alter some very basic attitudes about the way they live and the personal contributions they are now making to the future ... whether they be good or bad. Many proponents of conserverism believe that individual sacrifices are required. There is, at this moment, a serious doubt whether enough people in Canada are prepared to make significant sacrifices. How are we to persuade them that such changes in attitude and behaviour are necessary, perhaps even critical?

Much of the thinking and planning for a Conserver Society represents a [illegible] challenge to business, especially to marketing. Given the profit [illegible] within the context of an openly competitive free enterprise system, [illegible] turns out that there is an alternative and practical marketing opportunity in wind energy, can we anticipate the equivalent of a cadillac class windmill?

Canadians, by and large, appear generally content to let the government resolve the headier dilemmas of our society. That's sufficiently argumentative a point to cause a workshop all on its own but, in the absence of discernible and measurable public action otherwise, we'll let it stand. It's true, also, that governments have been exhibiting a great deal of initiation, not always provable as a reaction to known public pressure. Yet, in the case of conserverism which is likely going to require an extraordinary degree of initiative in policy planning and action if left to the government, there is a real doubt about the vote-getting benefits within our political process.

It's at this point that the proposition that "there is a certain irony to the conserver confrontation to marketing" is re-introduced.

Marketing is both vulnerable and, at the same time, valuable to the Conserver Society idea. There may be a quarrel about what some see to be the harm done by marketing to our present society but there can or should be no quarrel that we must depend on the experience and success of marketing to move forward the general public acceptance of the Conserver Society idea.

We have no better means at our disposal to advance to the public, business itself and the government both the full realization of the situation and, at the same time, the workable and valuable alternatives.

Marketing, especially advertising, has gone through a remarkable transformation in the last several decades. We are now investing more dollars and creative ingenuities in promoting ideas than in selling goods and services. We're only just now beginning to appreciate the move towards this sort of an information-oriented society.

Although no accurate, current data exists to support it, observers of Canadian advertising contend that all government advertising, federal and provincial combined, now represents the largest area of investment.

John Kettle, writing in the January/February 1978 issue of Stimulus magazine, points out that "over the past ten to fifteen years the Government of Canada has become a much more prominent advertiser, and that trend seems well-established." In fact, as his tables show, federal government advertising expenditures have risen dramatically - from $1.8 million in 1964 to $16.2 million in 1976. No other advertiser has demonstrated such a growth.

But what is it governments hope to sell Canadians through their use of such a volume of advertising? Except for isolated cases, it's not tangible goods or services but ideas ... often political concepts.

While it hasn't always worked too well, just look at what happened to [illegible] program, consider how relatively well it has promoted public acceptance [illegible]

If, as some contend, marketing techniques and especially advertising have been successful in selling products, services or ideas that couldn't really have been classed as social necessities, consider what could be done on behalf of the Conserver Society concept.

It's dangerous to assume that there is a ready, knowledgeable acceptance of such a new society now, or to believe that it will be easy to sell the idea to the many millions of Canadians who have yet to give it even a passing thought.

Conserverism may, in fact, represent the greatest single creative challenge to professional marketers and advertising specialists.

But is conserverism our only option for the future? Is the only alternative to learn to do more with less?

Cy Adler, and other writers of the social condition, suggest it may all be a temporary tempest in a tea pot. In his article in a 1976 issue of Oui magazine titled "Death by Falling Watermelons" he puts his tongue against cheek and bedevils the issue:

"We live in mortal danger of being struck dead by watermelons that have been inadvertently dropped from passing airplanes. Obviously, technology is to blame for this hazard, because if scientists and engineers had not developed airplanes, we would not have to worry about a horrible death by falling watermelons".

"On the other hand, when we take a hard look at the statistical probability of being struck dead by a falling watermelon, we must inevitably conclude that this particular environmenal danger is not worth worrying about. Not more than once, anyway. And so it is with many issues that appear to be even more threatening than a rain of deadly watermelons".

Adler then sets out to compare what he calls the facts and the myths contained in the "enviroballoons ... filled with hot air and shoddy half-truths." His counter-arguments to the environmental issues are interesting but not really the point, since in any event there's neither time nor space to present in the context of this paper either side of what has brought us to discuss together "business and industry in the conserving society." It is sufficient that he and others of greater repute have suggested we may be barking up the wrong tree. That, at least, should cause a moment's fresh contemplation.

But it is both foolish and dangerous to attempt to dismiss or even diminish the realities of our general situation. We cannot create new fossil fuel deposits and we seem to have discovered most of the ones that nature has supplied. We cannot survive in a world where the degradation of our life-sustaining factors has reached a point where we can no longer breath the air, drink the water or rely on the atmosphere to adequately shield us from dangerous solar emissions. Nor can we sustain a reasonably acceptable standard of life for all humans if we continue to systematically bankrupt our resource management: our abilities to adequately feed, house and educate our population: the provision of proper medical attention when required, or if we fail to make available a security of the future.

We have an inescapable responsibility, each of us, to safeguard and protect the future for all mankind. But how? What alternative course must we follow?

William Leiss of the Faculty of Environmental Studies at York University wrote a paper for the Science Council of Canada in July 1975 entitled "The Problem of Human Needs in the Consumer Society." In it, he sets the thought that the consumer society "is one in which individuals are encouraged to interpret their sense of well-being exclusively in terms of a regular increase in material prosperity ... the overriding public concern in such a society is to assure uninterrupted economic growth ... an expectation of an unlimited increase in material prosperity on the part of almost everyone." He acknowledges that "rapid inflation, falling rates of real growth in GNP, warnings of possible shortages in essential resources, and the developing concern about environmental degradation" pose serious challenges for the consumer society and that alternatives must be examined.

"The obvious drawback of the conserver society image", he feels, "is the likelihood that it will be regarded as a 'return' to a lower 'standard of living', and thus to a lower state of well-being, for many persons - perhaps a majority of the population ... It may be objected that there are serious risks of social disruption involved in a transition from the consumer to the conserver society ... Whether they are greater or lesser than the risks involved in continuing to promote the material expectations associated with the consumer society in an age of uncertain resource supplies and serious environmental degradation is not yet clear."

Leiss provokes our thinking on the whole matter with some very difficult questions:

"Do individuals ordinarily distinguish between their wants and their needs? Are individuals conscious of needs for which they can find no obvious source of satisfaction in consumption activity? Are individuals aware of the ways in which their wants or needs have changed over time, and can they explain the reasons for such changes?"

Leiss concludes that the "great irony in this situation is that, despite its pervasive allure, the consumer society is simply a highly inefficient way of responding to our needs ..." whereas, in his view, "the paradigm of satisfaction and well-being in the conserver society, therefore, is primarily oriented toward improvements in the conditions of work and in the personal craft skills of individuals.

In his analysis of the proposition of zero economic growth, seen by some as a better alternative to our present situation, Lester Thurow contends that "while causing higher unemployment, greater inequality,and fiercer competition for smaller shares of a fixed pie" it wouldn't "even succeed in curbing pollution." In the article titled "The Implications of Zero Economic Growth", which was prepared several years ago for the Joint Economic Committee of the U.S. Congress, Thurow suggests that "if ZEG is not to imply a falling real standard of living, it must include the achievement of zero population growth. ZPG ..."

He projects some real difficulties in adopting ZEG. For example, he says that if it is to be achieved "without adverse effects, some radical changes must be made in the manner in which the economy works and in its institutions ... zero economic growth implies an ability either to satiate or to control individual wants for more goods and services ... In the dynamic version of zero economic growth, where advances in productivity are permitted, ZEG automatically leads to less use of nonrenewable natural resources, but it does not automatically lead to less pollution. Pollution occurs because pollution is a privately costless but socially costly method of disposing of unwanted by-products ... those interested in less pollution should focus on changing the incentive system rather than on ZEG. ZEG by itself simply will not lead to what they want ...

"While nonrenewable natural resources certainly present a limit to economic growth, the limit is not zero, but is given by the rate of increase in our efficiency in extracting and using nonrenewable natural resources ... A ZEG economy would necessitate a substantial increase in economic controls ... a direct clash between private incentives ... and the social objective .... This conflict could be eliminated if there were some technique for eliminating individual wants for more goods and services. This technique is as yet, however, unknown."

Is Thurow telling us something about conserverism as well? Can we alter the individual's desires and expectations? Do we really have to, or want to?

Before returning again to conserverism, there is another alternative to the status quo to consider. The Stanford Research Institute in California published in June 1976 its guidelines to the proposition of Voluntary Simplicity ... an idea almost fully identified in its title, "voluntarily taking up a simpler way of life."

To set the appreciation of the concept, Stanford turned to an earlier article by Richard Gregg in "Manas":

"Voluntary simplicity involves both inner and outer condition. It means singleness of purpose, sincerity and honesty within, as well as avoidance of exterior clutter, of many possessions irrelevant to the chief purpose of life. It means an ordering and guiding of our energy and our desires, a partial restraint in some directions in order to secure greater abundance of life in other directions. It involves a deliberate organization of life for a purpose."

Duane Elgin and Arnold Mitchell of Stanford, the authors of the guidelines, put it a different way. "This way of life embraces frugal consumption, a strong sense of ecological urgency, and a dominant concern with personal growth." Is this just a different approach to doing more with less? Is Voluntary Simplicity in the United States and a Conserver Society in Canada the same thing?

Those in the U.S. who currently practice VS describe it as a "non-consumerist life style focused on being and becoming, not having." To achieve that, four generally accepted criteria have been established by way of questions:

* does what I own or buy promote activity, self-reliance, and involvement, or does it induce passivity and dependence?

* are my consumption patterns basically satisfying, or do I buy much that serves no real need?

* how tied is my present job and life style to installment payments, maintenance and repair costs, and the expectations of others?

* do I consider the impact of my consumption patterns on other people and on the earth?

Those are each fascinating questions and should perhaps be put even within the context of a Conserver or Conserving Society.

There's more to VS, of course, especially with regard to the overall economic approach:

"The economic system espoused by advocates of simple living reflects the concept of a low-or-no-growth economy, highly decentralized institutions, and jobs designed primarily for satisfaction rather than productivity. The idea is to attack the problems of resource scarcity, environmental pollution, and global economic inequities by consuming less. This approaches the problem from the demand rather than the supply side."

To test public reaction to the VS ideas, and indirectly to conserverism notions as well, we again must look to the U.S. for the data, as is included in the Stanford guidelines. For example:

* a Roper poll in May 1976 showed that 51% of Americans believe the nation "must cut way back" on production and consumption to conserve resources and keep the economy strong.

* a Louis Harris study in late 1975 reported that 92% of Americans are willing to eliminate annual model changes in automobiles.

* a Harvard Business Review study in late 1975 showed that 70% of Americans desire a change in federal goals setting, leading to a social revision.

* a Yankelovich analysis, also conducted in 1975, demonstrated that about 80% of Americans were searching for better self-understanding through some form of innersearch for meaning.

Were these indications about Canadian attitudes instead of American, how would we feel about the prospects of conserverism? Probably very hopeful.

To bring this discussion into sharper focus and to relate it directly to the theme of this paper, let us consider some of the implications and possible or even probable impacts of a Conserver Society on Canadian business, particularly our marketing process.

We can do this by approaching the issue from four points of view ... products, prices, distribution and advertising.

With regard to products, the clear requirement will be to produce goods offering durability, design utility, easy (and relatively inexpensive) repair; that no longer incorporate planned obsolescence; that utilize natural or non-scarce materials; that have efficient and sufficient packaging; that will have a minimized impact in terms of waste, noise, pollution, toxicity and energy intensity. The public won't be looking for products that emphasize style, fashion or gadgetry. Moreover, producers are going to be a lot more carefully scrutinized when introducing "new" or "improved" products.

A new emphasis on the quality of goods (and services) will doubtless increase prices, in some cases quite substantially, but the marketplace will be far less tolerant of varying profit margins and the pressure to price on the basis of a cost-plus will become a powerful governing force. It's doubtful that marketing "frills" such as style, fashion or trend will generate the same sales value as before.

Distribution may become the big surprise in a conserving society. Conventional systems and outlets may be radicalized as larger segments of the population move towards second-hand exchanges, co-operative stores, cut-rate or discount outlets and even mail order services. Implicit in the Conserver Society approach, particularly as set out in the Gamma Report, is the prospect of "renting" just about everything ... which not only would affect distribution, but pricing as well.

The prospects for advertising are no less disquieting. Most vulnerable will be the somewhat sensational, emotional or essentially image-based appeals. A much greater emphasis will have to be placed on the information aspect of advertising. As we are already experiencing under existing and relatively new Canadian legislation, false or misleading advertising just won't be tolerated and stiff fines and penalties will be levied. In addition, but not necessarily directly related to conserverism, it will become difficult if not impossible to advertise some product or service categories and to advertise to some segments of the general population, such as children.

That tends to be a downside look at marketing within a Conserver Society but, in general, there appears to be no particular aspect of it that we couldn't adopt or adapt to ... if we had to.

There are two other aspects of the relationship between marketing and conserverism that very appropriately have been left to the last part of this paper. While essentially positive in nature, they do not necessarily reflect the upside of the situation.

On the one hand, we have the prospect of new products and services to market within a Conserver Society. On the other hand, we have a necessary dependancy on marketing to communicate and sell the new society.

In both cases, there may develop a sufficient volume of new enterprise for marketing that would off-set any anticipated losses.

Leading the list of new marketing opportunities is the development of industries that can utilize energy efficient technologies and produce the required equipment and services to meet the new public need. Included in this category would be the mass production and marketing of solar or wind energy kits. The apparent caution, if we are really to maximize the conserver concept for the future, is that we could end up with an unnecessary array of bigger, better and more expensive items to meet the same, relatively simple need ... the cadillac syndrome.

In the same context of energy conservation, there is a renewed interest in building and insulating better, more efficient places of residence and work. The current energy shortage, whether the actual consequence of resource depletion or of Arab marketing strategy, has caused the present renewal but a larger segment of the population than ever before senses the immediately extractable benefits of a more efficient energy use - both in real economic terms and as a sense of contribution to the future. There is great room in the marketplace for an entrepreneurial initiative in this area.

Solid and liquid waste management, for lack of a better description, represents another key area of marketing involvement. Equipment and processes have now been developed that facilitate the in-house collection and storage of all wastes and then process this natural household by-product into low-cost methane gas to heat the house and a most efficient and odorless compost/fertilizer for the garden. Only a small sector of the population is currently aware of this energy alternative and the necessary equipment and knowledge of use is not yet readily available in the marketplace. There is also the prospect of large-scale application of this new development.

The present marketplace already evidences the response by industry to the public's new interests in nutritionally valuable food stuffs. This represents a tremendous growth area for business initiatives in altering some present approaches to production of goods in order to be more responsive to consumer needs. It also suggests the prospect of new approaches to food distribution, packaging, promotion and outletting that, in itself, could create an entirely new marketing opportunity.

Junk dealers haven't been accorded a particularly high regard by society in the past but we've become comfortable with the proposition of recycling depots. There really isn't much difference between the two activities and, no matter what you call it, it's going to become an important element of our society in a conserver future. Here again we have the opportunity for entrepreneurial marketing skills applied to an important, new social need. In a slightly different context, CBS reports carried a piece a few weeks ago that indicated that the sheet metal parts of [illegible] American-made car were [illegible] times the purchase [illegible]

One of the features of conserver thinking is the suggestion that there are many personal or family acquisitions that could rather more easily, efficiently and economically be provided for use by renting rather than owning. We already have, since the advent of car rental services, a widening range of things and services you can rent. The prospect, imminent or not, of a new Conserver Society suggests great room and opportunity for marketing imagination in new and innovative rental services.

These are only six new possibilities for marketing opportunities in a Conserver Society. It is not a complete list and none of the suggestions made are intended to be a detailed setting-out of all that is possible.

The essential prospect of marketing in a Conserver Society, however, is much broader, more general, and more important.

It's going to take a great deal of creative ingenuity and the total resources and experience of marketing to sell what to many Canadians is going to have to be a radical alteration to their attitudes, behaviour and involvement within a Conserver Society. We have in hand, in fact, the potential of an entirely new marketing enterprise.

While Canada is not the only nation examining alternatives for the future, we do appear to have developed particularly imaginative ideas for what our tomorrows could/can be. The concept of a Conserver Society may even be a new Canadian export possibility.

"I am under no illusions regarding the ease with which we can form and articulate a new way of being in the world", Ruben Nelson writes, "those of us who live now, live during the death of one great culture and the creation and clarification of another. There is not, nor can there be, a guarantee that our transformation will be successful ...."

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THE CONSERVER SOCIETY AND THE NEW ECONOMICS

Rein Peterson
Faculty of Administrative Studies, York University

Abstract

The arguments for a conserver society usually emphasize social issues. In this paper, a case is made for the conserver society as an inevitable outcome of pressures in the international marketplace which will leave us no option but to move in this direction.

It is possible to justify a conserver society based solely on economic factors. The conserver society should be viewed as an opportunity for Canadian business rather than as a threat.

It is generally assumed that the Canadian economy is relatively open, very dependent on foreign countries, and that this gives us limited latitude to respond to such humanistic concerns of Conserver Society advocates as: "... the price mechanism must reflect not just private costs of production, but as much as possible, the total cost to society, including energy and materials used, ecological impact and social considerations ...".[1] At the same time, it is argued that the Canadian business community has already reacted and will continue to react to some Conserver Society concerns in response to free market forces" ... dealing with those issues for which reality and urgency has been clearly established."[2] Still others argue that conserver society proposals imply increased and undesirable , government intervention in the Canadian private sector.[3]

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[1] The quote is from Canada As A Conserver Society, Resource Uncertainties and the Need for New TEchnologies, Science Council of Canada Report No. 27, September 1977, p. 14. The Limited latitude arguments appears in G.H. Haines, Jr., J.G. Leonides and M.S. Sommers, "Some Impacts of the Conserver Society on Canadian Business", Ontario Regional Workshop, Ministry of State for Science and Technology, Bristol Place Hotel, Toronto. April 10, 1978, Part II.

[2] Haines, et al. IBID. p.4.

[3] [illegible] Regional Workshop, Ministry [illegible] for Science and Technology, [illegible] Place Hotel, Toronto, April [illegible]

In this paper we put forth the proposition that both internal (societal) pressures and those emanating from our international (economic) interdependence will push us toward many of the directions that are being spelled out by Conserver Society proposals. We are not just engaged in "theoretical" debate, but rather find ourselves upon the tide of a new economic and social revolution which threatens our undeservedly high life-style of the recent past. But as is true with any threat, it also opens up some great opportunities, especially through the challenge to develop a more adaptive, innovative, entrepreneurial capability with which to build a much sounder Canadian economy in the long run.

A. The International Challenge

It is difficult to imagine how any internationally competitive company can afford to pass up the opportunity, during the next two decades, to manufacture in developing countries components at costs which are significantly lower than those in Canada. Wage rates in Asian countries like the Phillipines and Korea, are currently below 50 cents an hour. These countries also offer many enticing incentives for industry to locate there -- a total absence of environmental controls, employment standards, and one is often free to export or import fee of duties. Some of the developing countries also are offering tax free holidays to corporations for periods from five to ten years. It is true that the political instability in these countries mitigates these cost savings. But, it would appear that most firms, who are currently putting up plants in developing countries, are expecting to recover their investments over relatively short periods of time and consider the risks well worthwhile.

It is very likely that for the next two decades, third world firms will produce many of the components needed to assemble the mass produced finished products of the wealthier Western nations. Final assembly of the finished product will be carried out closer to the places where the product will be ultimately sold because of rapidly increasing transportation costs and regional political considerations. It is estimated by some that already 20 per cent of world trade is of this form and that by the end of the century, 50 per cent of world trade in manufacturing will involve production sharing.

The respected economist, Wassily Leontief, in a report entitled: Toward a World Economy,[4] predicts a doubling of the share of world manufacturing held by the developing nations by the year 2000. He also predicts a return on investment in the developing countries of double the levels which will be possible in the developed world, as a result of the vast new market for goods and services there. How have these shifts come about?

More and more developing nations, for the first time in their history, now have a significant number of educated young people, many of whom have received their education in the Western world. These young people are entering the workforce, increasing the ability of developing nations to exploit industrial opportunities and natural resources that have been beyond their technological capability heretofore. Young Asians spend their evenings watching American made television programs that blatantly exhibit Western, materialistic values.

More and more of these young people are beginning to believe that they also are entitled to a standard of living which has less to do with that of their parents, and more with that which they see on television.

Contrast this with the workforce that is coming of age in most Western countries. Herman Kahn once described them as a group that has never been denied a single desire for longer than 20 minutes. They have been conditioned by relatively high wages and job expectations, the student revolts of the 1960's, the debates about limits to growth, the increasing fears about our deteriorating ecology? the oil and energy panics, and a mounting resistance against a materialistic, consumer society where patterns of living are seen as being imposed by large scale, impersonal industrial-technological considerations. Technology, which in the recent past was hailed as the single most beneficial factor in bringing about our high standard of living, has come under attack. The search for alternative technologies with a greater responsiveness to the "real needs of man" has begun in earnest.

To compensate for the loss of jobs in component manufacturing plants of the United States, assembly and component manufacturing jobs are currently being transferred from Canada to the United States or to the Third World. In the months ahead, we shall be reading of more and more branch plants closing down in this country and moving to the United States and elsewhere, as the United States tries to retain as many jobs at home as possible while maintaining its international competitiveness.

In the United States we are currently hearing calls for impenetratable trade barriers to the threat from the Third World. Politicians are urging that U.S. aid to developing countries should not include any "dumping" of technology that would reduce the competitive technological edge enjoyed by U.S. companies in the past.

John Orr, in a paper for the Science Council of Canada, has summarized the key proposals made in an important U.S. Department of Commerce Report, U.S. National Technology Policy, as follows:

> "It ... appears that the main thrust of future U.S. initiative ... will likely include ...
>
> a) A major effort to stimulate a technological innovation in U.S. industry upon which its international competitiveness depends.
>
> b) A corollory effort to restrict the export of commercially valuable technology so as to maintain the U.S. advantage in technology intensive manufacturers.
>
> c) Continuing pressure to gain free entry for U.S. manufactured goods into foreign markets so as to perpetuate their past dominance of world trade in capital and consumer goods.

d) An intensified effort to discourage off-shore production by U.S. multinational corporations, particularly where such production is intended for the U.S. market."[6]

Because of the dependence of the Canadian economy on trade with the United States and the predominance of U.S. ownership of Canadian industry, it is obvious that if the above trends persist and if the technology proposals are implemented they will have profound and far reaching adverse effects on the Canadian economy.

The have-not nations of the world have also discovered the Achilles heel of Western economies -- our insatiable need for natural resources and energy. According to Leiss:

"In the year 1972 the 210 million people of the United States, in pursuit of the satisfaction of their needs, used approximately 4.4 billion short tons of new material resources (minerals and non-food organic materials). This averages 42,500 pounds per person, for one year ... This total represented about 35% of the total world use of these materials, while the 210 millions represent about 7 per cent of the world's people."[7]

According to the Science Council, Canadians use more energy per capita than anyone else in the world except the United States. We also prefer very high value fuels such as natural gas to do work that could be done with lower value fuels. And the projected future demand for energy is frightening. It has been estimated that a one per cent decrease in annual growth rate in energy demand would save us the cost of 12 Syncrude plants by 1990. But, even if we are able to cut down drastically the growth rate of our energy and natural resources consumption, it is predicted that cost of bringing increasingly more expensive sources of energy and natural resources on stream is going to lead to tremendous capital shortages in Canada before the end of the century.

All this, of course, is well understood in the Third World. While it might be argued that the oil crisis caused as many problems as it solved for the OPEC countries, there is no doubt that its dramatic effect raised expectations in the Third World, demonstrated our vulnerability and encouraged others to consider sending similar shock waves through our economies in the future.

There are clear indications that the have-not nations are less willing to accept their current state of affairs in the future. In April 1974, the United Nations General Assembly, responding to mounting discontent, adopted the Declaration for the Establishment of a New Economic Order. This

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[6] John L. Orr, U.S. Proposals for a National Technology Policy and Their Impact [illegible]

charter has as its objective. the implementation of a new system of international economic relationships and priorities based on equity, sovereignty and the interdependence of the interests of the developing countries. The proclaimed principles include the sovereignty of each state over its own natural resources and wealth, as well as its right to supervise foreign investments. A high priority is given to the goal of increasing the self sufficiency of all developing nations. In sum, this document makes a persuasive case for the argument that if progress is not made, the result will be ever increasing resentment and the growth of the adversarial mode in world relations, leading to a series of "stockade societies", and the eventual collapse of World order and stability.

B. Internal Pressures

Compared to the past, we in Canada, must increasingly take into account world-wide movements. The basic economic factors upon which our economic well-being is based -- cost of labour, cost of capital, price of raw materials, import duties, etc., -- will change even more rapidly than in the past. As has been often stated, in the Canadian economy:[8]

1. The cost of labour has become relatively expensive. The quality of our labour, especially vis a vis technical skills, is relatively deficient.

2. We are relatively a very capital intensive (per capita) economy, highly dependent on foreign capital investment. Yet our productivity, however measured, is often not internationally competitive.

3. We are becoming energy dependent. Our domestic sources of energy are becoming relatively expensive and by the mid-1980's we shall become a net importer of energy.

4. Our traditional economic base is eroding as cheaper natural resources are becoming available in Third World and other countries.

5. We hear increasing demands for decentralization, regional self-sufficiency and self-determination. At the same time, there is an increasing realization, especially among young Canadians that high consumption rates are not equivalent to a good quality of life.

6. There is relatively little research and development being carried out. Our R & D spending ranks 14th in the OECD just ahead of Greece and Turkey. In the U.S., industry spends 40 times as much as we do, with IBM, Ford and General Motors, <u>each</u>, spending <u>more</u> than all of Canadian industry.[9]

[illegible] frightening description of the Canadian dilemma, see: Uncertain Prospects [illegible] in Manufac[illegible] [illegible] Council [illegible]

The above factors and trends have all contributed in some measure to our high unemployment, the declining value of the Canadian dollar, balance of payments deficits, rising national debt, and increasing regional disparities. Many people are starting to ask, would our problems with national unity be as severe if the Canadian economy were healthier? Is Canada on the verge of falling apart?

[illegible]. The Way Out

The Science Council of Canada report: Canada as a Conserver Society, defines a Conserver Society as follows:

> "A Conserver Society, is in principle, against waste and pollution. Therefore it is a society which:
>
> - promotes economy of design of all systems, that is, "doing more with less";
> - favours reuse or recycling and, wherever possible, reduction at source;
> - questions the ever growing per capita demand for consumer goods, artificially encouraged by modern marketing techniques; and
> - recognizes that a diversity of solutions in many systems such as energy and transportation might in effect increase their overall economy, stability and resiliancy."[10]

Most importantly, in a Conserver Society the price mechanism must reflect, not just the private costs of production, but as much as possible, the total cost to society, including energy and materials used, ecological impact and social considerations. This would permit the market system to allocate resources in a manner that more closely reflects societal needs, both immediate and long term.

Rodger Schwass, of York University, has pointed out that thrift, saving, efficiency and avoidance of waste all played an important role in the last Industrial Revolution.[11] The basic Conserver Society message is not really anything new. We are being reminded that:

1. We must once again learn to do more with less to be internationally competitive.
2. We must start to treat our natural resources as Capital, not to be squandered with no thoughts to its renewal.

[illegible]

3. We must consider technology as a national resource that must be nurtured.

What is new and helpful is that some of the Conserver Society proposals point to a way out of our economic and social dilemmas. For example, consider the work being done on renewable energy and the whole field of Appropriate Technology.

The respected U.S. economist, E.F. Denison of the Brookings Institution, has identified five key determinants of industrial productivity in the past. By far, the most dominant factor turned out to be technology and innovation. Calculations [illegible] that it outweighs the affects of capital investment and was approximately three times as important as the vaunted "economies of scale" of classical economics.

It is true that the search for alternative new technologies to meet the future uncertainties is, for the moment, characterized less by practical achievements than by the intensity of ideological debates that surround it. The reason for this is simply that the development of all technology is conditioned not only by the imperatives of engineering, but also by the cultural and ideological values of society which produce it. The modern, large scale technology of today, is basically the result of cultural demands made by Western society since the turn of the century.

While it is easy to say that cultural acceptability of technology is important, it takes time to sort out the complex of issues involved. Cultural factors are very subjective and ill defined, and there is always the temptation to favour more rational criteria of limited engineering efficiency or short-term economic viability during committee meetings where policy directions regarding technology are adopted. Furthermore, all radically new technology has to compete immediately not only against existing traditional technologies, but also against the whole technological system of extant "modern industry" which in many cases proves to be remarkably efficient (in the myopic sense) when compared against prevailing values and societal objectives. We also must become more alert to the dynamic nature of these values for what is societally acceptable today, may no longer be so tomorrow.

Most businessmen agree that politics, <u>per se</u>, is undesirable. They are also sympathetic with the view that other social costs should be included in the pricing of products. But at the same time, they fear being overtaken by an "environmental movement -- those who promote esthetics for its own sake." Some distrust what they take to be scare tactics in the debate about how much oil, gas or other reserves are left in Canada. But an increasing number are beginning to realize that the exact amount of Canadian reserves is not the real issue. Some fundamental societal and economic changes are taking place. "Maybe it's not such a bad idea to ease up on the throttle a little and take a careful look at where we are going. A cushion of more natural resources than we are being told about would give us a chance to ponder the alternatives."

Clearly there are products currently in the market place that fail to [illegible] real social costs. National planners [illegible] to take into account the [illegible]ers of regional [illegible] proposed [illegible] the [illegible] country's [illegible] [illegible] are pub[illegible] his money and his effort in a plant is interested mainly in making a profit, developing his company, and securing the cash flow which will allow him to pay his workers and buy his raw materials. There is no natural link between the national planner and the entrepreneur -- for instance by insuring that an entrepreneur will get a financial reward for reducing his relative competitiveness by including some social costs if his competition at home or abroad does not follow suit. The professional manager in a larger firm is in an even more difficult position because his actions are more visible and therefore more subject to public scrutiny. Nor is he that able organizationally to respond even when he personally wants to.

While many of the concerns expressed in the Conserver Society report are difficult to disagree with, we are a long way from understanding how to cope with them in practical terms. A businessman faced with severe competition from Third World countries is going to have little patience with Conserver Society principles that urge him to make "... the product more durable, repairable, and reuseable..." unless it can be demonstrated to him how such a strategy would help him meet his competition. The Conserver Society debate must deal with issues at this level during the next phase of discussions to be creditable. To argue that a Conserver Society is inevitable is not enough in itself. At the same time, it would be foolish to ignore the great international challenges to and internal pressures of the Canadian economy that push us in some of the directions spelled out in Conserver Society proposals.

D. Building a Balanced Economy

Many businesses regardless of their size will fail to adapt to changing conditions and deteriorate. Yet many more new small businesses will spring up as entrepreneurs start to exploit the need for goods and services that now become economic to produce regionally. The Conserver Society challenge and the competition from Third World countries will be viewed as exciting new opportunities by some and as further evidence that things are getting progressively worse for the businessman whose morale is already low.

Canada as a Conserver Society is not a blueprint for survival, some industries and approaches to business are not going to survive. The Conserver Society proposals do not present all the magic answers to our economic and societal problems. But for the first time in many years, they do offer us some positive, clear cut, paths to our salvation. A whole new approach and philosophy to human endeavour is about to take off. Let us be part of it! The economic and social changes we face are so profound and far reaching that it should be next to impossible not to get involved in some of the new developments which will sustain us during the next stage of Canada's growth into a more mature and balanced economy. Isn't this a happier prospect than complaining or arguing about the degree of foreign ownership in Canada, feeling that the situation is hopeless, making half-hearted forays at "buying back Canada?" We are standing at the frontier of a new era -- not unlike the men and women who founded this country a couple of hundred years ago. There are exciting times ahead during which [illegible]

As I documented in my book Small Business: Building a Balanced Economy, Canada has a proud history as a great producer of new ideas.[12] But in the past our ideas have not resulted in native technical industries of international importance. We have allowed our creative ideas to go abroad to be developed into products that now sustain the economies of other nations, rather than our own. But our distaste for native entrepreneurship and invention is really not a genetic defect as seems to be implied by some. It has resulted from being too comfortable in the paternalistic shadow of a great neighbour, who, along with other countries, has supported our unearned high standard of living, in past, by buying up our natural resources. More and more Canadians have come to understand that this is not the way to build an economy with a dynamic, adaptive-responsive innovative capability to meet future needs. The economic crises around us, graphically etched into our collective psyches daily by television programs and newspaper stories, and by the statistics of more than one million unemployed, are bringing about the collective political will to take action to meet our problems. There are still people who do not believe that we face a crisis, but their number is dwindling every day.

It is historical fact that innovation and great technological breakthroughs have seldom come from famous institutionalized research laboratories, but often from obscure, relatively unsubsidized individuals.[13] In making such statements, it is important to distinguish invention from that which is commonly called research and development. Invention consists of ideas that break entirely new ground, whereas R & D consists of creative ideas that carry a product or service to the stage of wide-scale commercial use. Both are crucial to the survival of a nation. Big business with its financial resources and administrative capabilities excels in the marketing of new ideas on a grand scale. We shall need more Canadian owned big and small businesses during the next phase of our economic development.

We need to increase our awareness and understanding of the various roles to be played by both large institutions and individuals in a more dispersed and balanced economy and to stress innovation, entrepreneurship and self-reliance as social goals. We shall need our combined wits and the efforts of all our people -- especially the talents of our entrepreneurial change agents in large and small companies -- to make the transition into the new world that lies ahead, rather than falling back on what Margaret Atwood, the Canadian poet and novelist, describes as our "intolerable anxiety about survival."[14]

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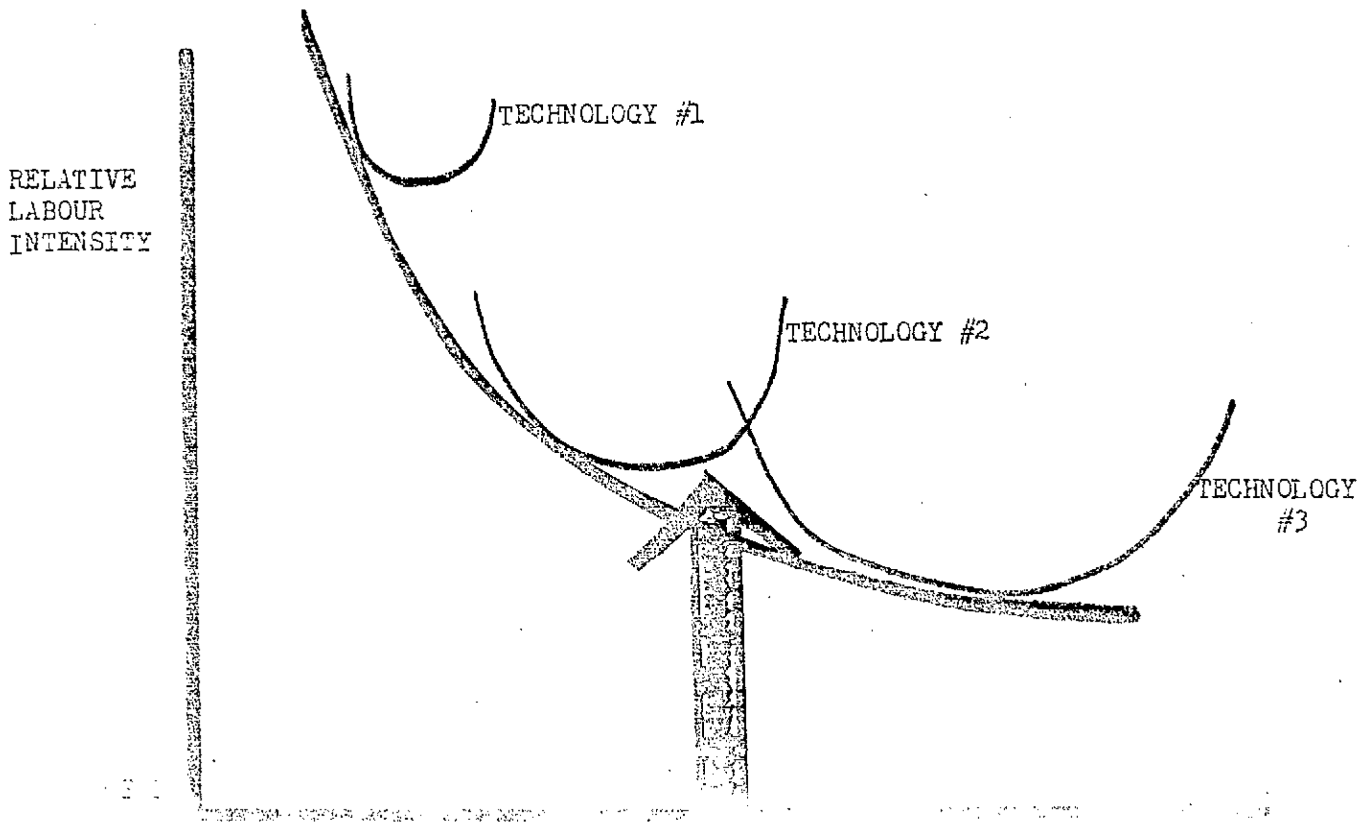
[12] Rein Peterson, Small Business: Building a Balanced Economy, Press Porcepic, Erin, Ontario, 1977, Chapter 2.

[13] [illegible] Brown, Ideas in Exile, McLelland and Stewart, Toronto, Montreal, [illegible].

E. The Role of Small Business and Entrepreneurship

It is also not generally understood that the productivity and efficiency of smaller firms should be judged on the basis of their dynamic ability to respond to changes in the environment. Most economic arguments which point to economies of scale tend to be static. Existing technology is accepted as given, rather than variable over time.

Let us consider what actually happens to any new product over time. It is generally accepted that at its inception the technological innovation tends to be very labour intensive. During the early stages most of the effort is spent on making the product function in the way it is supposed to and in filling newly found demand in the market place. As other manufacturers enter the market place, which now has grown considerably in size, volume production becomes the predominant preoccupation. Capital intensive machinery is used at an ever increasing degree. Developments, improvements take place in product design as well as in the machinery that is used to produce this product. These tendencies and relationships are illustrated in Figure 1. The actual shape of this curve is not in question, but the general tendency is correctly depicted. Note that the curve shows relative labour intensity per unit. Total employment over time would be a function of the curve and the total volume of products sold at any point in time.



A number of important things can now be illustrated. It is known that the highest profits accrue to new inventions at the early stages of the product life cycle when start-up problems have been overcome. Subsequently as capital is substituted for labour, profits fall and at some time in the future disappear all together unless new major innovation in the product design is introduced. This is indeed what was found by Wildgen who did a study for the Royal Commission on Banking in 1963.

Note also from Figure 1 that as the product becomes increasingly capital intensive, the available technology requires large volume production. This is illustrated by the economies of scale curves superimposed on the product cycle curve. Note that we have presented the optimal scale of plant as a dynamic concept. While technology 31 prevails, small firms can thrive. As technology becomes more capital intensive (for example technology 3) smaller firms may choose to sell out or try to grow to medium size, etc.

In Canada we've had the tendency to enter the product cycle curve somewhere in the middle, historically we have tended to import our technology from other countries. We have chosen to operate medium-scale branch plants. Individually and in groups, we as Canadians, have tended to resist domestically developed inventions and inhibit Canadian entrepreneurship, and thereby we have foregone the profitable and sustaining portions of the product cycles. The dramatic changes facing the Canadian economy, therefore, can be viewed as either, further fractures that will depress the Canadian psyche, or alternatively, as is more likely, they will be viewed as opportunities and challenges which will lead us out of our historical diffidence and reluctance to compete internationally. This time, let us not make the mistake of not building on our own inventiveness.

F. Concluding Comments

We are all well aware of the fact that during crises, such as the Wars, people tend to pull together and very creatively meet their challenges. In this sense the dramatic changes outlined in the Conserver Society report should be welcomed, for they force us out of our diffidence to face the new economics.

The Conserver ethic, when stripped of its rhetoric, promotes economy of design in all systems. This is something that businessmen have always pursued. The only thing that has changed is the relative costs of variables that go into a good design. The Conserver ethic also questions the ever-growing per capita demand for consumer goods, "artificially encouraged by modern marketing techniques." Here the businessman faces a tougher problem. For it is unclear how quickly the general public is willing to change its life style, by starting to distinguish between its wants and needs. But there is no doubt that significant changes are being forced upon us by events already well out of our control.

THE CONSERVER SOCIETY – BEGINNING THE DIALOGUE

Terry Mactaggart
Executive Director, The Niagara Institute

Abstract

There is little evidence to suggest that business will automatically embrace the principles of the conserver society. Many seem to view it, in fact, as an irritating "issue". The irony lies in the fact that the basic conserver tenet of "doing more with less" is obviously a highly desirable business practice.

Lack of communication is the major obstacle to understanding between conserver society advocates and the business community. It is necessary to convince the private sector that profitable operation is possible within a conserver society.

The answers to mutual understanding can be found in discussion, education, research, experimentation and possibly the creation of forums and organizations specifically to promote the necessary communication.

1. Business Perceptions of the Conserver Society

In the 20 years since Rachel Carson wrote "Silent Spring", we have seen mounting concern over the environmental impact of industrial society. The finite nature of certain resources is now clear, as is the braking effect of resource shortages on economic development. Much of the recent literature on the subject concludes that slower growth is inevitable and urges the adoption of a conserver ethic in a society which wastes less, makes more efficient use of resources, (both human and material), and encourages the development of gentler, more appropriate technologies.

Although there may be differences in the various models which have been proposed for such a Conserver Society, there is a common thread. Implicit in every address to the problem, (and explicit in most), is the requirement that men raise to the level of consciousness the myths, values and unexamined assumptions which govern Western attitudes towards life. "There appears to be only one viable approach", according to the editors of The Population Bulletin:

> "This is the long uphill route of encouraging people to modify their basic attitudes and behaviour so that instead of idealizing [illegible]

> so that instead of measuring our welfare by the amount of our consumption, we will become more deeply concerned about enhancing the quality and preserving the variety of life in the momentum of society".

But if any progress has been made on the task of "modifying basic attitudes", it is not apparent from the public's general response to the notion of a Conserver Society. Although serious work on the issue has been undertaken by a number of Canadian organizations – among them the Economic Council of Canada, the Science Council and the federally-funded GAMMA research group in Montreal – public interest and debate has been minimal. In particular, business reaction to suggestions that a universal conserver ethic is not only desirable but essential, has ranged from the mildly suspicious to the openly hostile.

Given the turbulence of the environment in which business now operates, and the rising volume of demands on the corporation, this is perhaps not surprising. The fact that support for a Conserver Society comes from those often perceived as hostile to the corporate sector, (consumers, conservationists, academics, public officials and social activists), only tends to confirm the business view that it is yet another manifestation of public antipathy to private enterprise in general, and big business in particular. Since, at the same time, the strategies proposed for the implementation of a Conserver Society include curbs on consumer demand and economic growth, punitive taxation of energy-wasting products and systems, and controls on the introduction of new technologies, business executives are understandably loath to admit that changes in their operations are either possible or necessary. Indeed, many business leaders contend that more growth, rather than less, is the only solution to current social and economic dilemmas. Demands for the adoption of a corporate conserver ethic are often regarded as a further burden on management which will add to the cost of doing business, interfere with the mechanisms of the marketplace, and further impair the ability of Canadian firms to compete overseas.

Some business groups, (the Association of Canadian Advertising for example), argue that the assumptions on which the notion of a Conserver Society is based, invite closer scrutiny. They point to evidence that the population is stabilizing and approaching zero growth; that energy conservation measures are taking hold; and that pollution is diminishing. In their view the interplay of market forces provides all the machinery needed to respond to energy and materials shortages. As resources become scarce or expensive, demand declines or substitutes are developed.

In part, business suspicion of the Conserver Society is the result of misconceptions engendered by such gloomy forecasts as the Club of Rome's "Limits to Growth", and the popularization of an apocalyptic vision of the future in which the modern industrial system is either replaced by the "back-to-nature" form of social organization idealized by the mid-60's counter-culture, or is rendered impotent by increased regulation and state intervention in the marketplace.

That these perceptions run counter to many of the models proposed [illegible] contained or "managed" in such a way that the threat it poses to the economic status quo will be diminished and eventually "de-fused".

As many observers have noted, however, the conserver ethic is firmly based on a principle dear to the hearts of all entrepreneurs - the idea of "doing more with less". Indeed, it is difficult to conceive any more powerful inducement to business creativity than the opportunity to maximize the return on a minimal investment. It is a curious irony that there is no fundamental conflict between the imperatives of business efficiency and the conservationist's desire to eliminate waste and make more effective use of resources. Motives may differ, but the net effect is the same.

Indeed, if the business community has failed to demonstrate any great enthusiasm for the far-reaching changes required to make the transition to a Conserver Society, it is clear that it has already responded positively and creatively to the constraints imposed by the growing scarcity of energy and materials. An increasing number of Canadian firms are developing policies and procedures designed to reduce waste, recycle materials, lower energy requirements, and control the emission of air and water pollutants. Other firms have turned their attention to the development of new or improved products and services which reflect consumer concern over the rising cost of energy and other resources in short supply.

That these responses represent a desire to reduce operating costs, take advantage of market opportunities, or avoid public criticism, rather than an affirmation of the principles of a Conserver Society should not be a source of great concern. Self-interest after all is the primary motivation of the impassioned conservationist, and the dispassionate entrepreneur alike.

Given this apparent mutuality of interests, it would seem that the opportunities for collaboration between business and conservationists favour a constructive alliance, rather than the suspicion which typically pervades any discussion of a Conserver Society. And if there is no profound cause for disagreement between conservers and corporations, it seems likely that the principal obstacle to cooperative effort is a failure in communication and a lack of understanding.

It is probably fair to say that the major task now facing the proponents of a Conserver Society is to convince the private sector that it can continue to operate profitably and effectively despite the reforms they propose. This does not mean that the efforts of the conservationist should be directed to teaching the corporate manager "the error of his ways". Such an approach has been tried all too often by high-minded reformers. It is not an approach likely to succeed. Propagandization, no matter how worthy the cause, is more likely to reinforce hostility than generate sympathy. A more effective approach is one which seeks to engage all who are affected by the transition to a Conserver Society in a continuing dialogue which explores all sides of the many issues it encompasses. Such a process could ultimately lead to increased awareness of the need for change, and consensus on the most appropriate ways to achieve [illegible]. It is clear, however, that [illegible] approaches to the management of such [illegible]

2. The Management of Public Issues in Canada

In recent years, responsibility for the management of public issues has increasingly been shouldered by government, primarily at the federal and provincial level. To an unprecedented degree, the impetus and direction for social change is now provided by the public sector. It is impossible to identify any significant dimension of Canadian life in which one or more levels of government are not either directly or indirectly involved.

Not surprisingly, the rapid growth of government has raised serious questions about its size, effectiveness and accountability. [illegible] note three fundamental concerns with respect to the public sector's management of issues:

... the failure to establish co-ordinated policies (both within the federal government and between it and its provincial counterparts), which is evidenced by a tendency to tackle problems in a piecemeal and fragmented way;

... the apparent lack of foresight in the formation of public policy, frequently resulting in reaction to problems only as they become critical;

... the apparent difficulty of involving the private sector in the solution of public policy problems and the resulting reinforcement of the perception that government alone is in a position to take action.

If these concerns are valid, they were perhaps less critical when times were good, when we believed that resources were unlimited, and the environment infinitely resilient. With the recognition that resources are finite, and the environment fragile, has come rising concern about the capacity of government to cope with its enlarged responsibility. There is particular concern that government does not involve the leadership elements of other sectors of society to a sufficient degree in the initial stages of issues research and planning.

The typical response of those who raise such concerns is to suggest the need for more, and better planning. In this context, however, "more and better planning" does not mean more of the same. Rather it reflects the strong and oft-expressed desire for wider participation in the decision-making process. As the Science Council's report #27 points out, "People are no longer content to leave decisions to a few government departments or to one or a few industries."

Rather than an unrealistic and rigid program which is imposed from the centre by a handful of faceless bureaucrats, the critics of government propose a more open form of planning. One which more clearly defines national goals, fully reflects the aspirations of all sectors of society, and allocates resources more effectively. In this view, the most desirable approach to the management of public issues is one which:

... [illegible]

... and offers real opportunities for public response throughout the process.

A key advantage of such a "bottom-up" approach to planning is that since it is based on consensus, it generates commitment to an agreed-upon course of action. At the same time, broadly-based participatory planning approaches can contribute to a reduction in the sometimes excessive degree of government intervention in the private sector and the lives of individuials.

Woodrow Wilson once urged public servants to "combine openness and vigour ... with ready docility to all serious, well-sustained public criticism." But where should this "sustained criticism" come from? At the present time, there is no shortage of criticism, but it is neither sustained nor particularly well coordinated. A variety of organizations, including the media, trade associations and "third-sector" groups, bring their respective viewpoints to the many concurrent debates now underway on the nature and goals of Canadian society. But for the most part, there is little in the way of consensus or continuity in these various overlapping dialogues. Contradiction and conflict appear to be the order of the day and government is probably more confused than enlightened by the conflicting demands with which it is confronted.

In part, this situation is a reflection of the fact that while Canadians are eager to participate in public decision-making, we have yet to develop the mechanisms which can permit them to do so. There is, of course, the media. At its best, it can offer audiences insightful commentary and analysis on public issues. But even at its best, the media remain just that - media. It is not, McLuhan's aphorism notwithstanding, the message. The quality of its content depends to a significant degree on the quality of the resources upon which journalists and broadcasters can draw. Clearly the media has an important role to play in "issue management", but it cannot do the job alone and to perform effectively it must be provided with more systematic analysis.

But if the media cannot sustain the dialogue, and if there are no accepted mechanisms to encourage participatory planning, how do we achieve the "sustained criticism" needed to effect constructive social change?

It has been suggested that the most likely place for the marshalling of informed comment on public issues by the private sector is the independent private sector institute. Through their networks such organizations can serve as effective catalysts and linkage points in the systematic scrutiny of public issues and the development of realistic policy proposals. The active participation of such organizations, collectively or individually, in managing and orchestrating discussion on public issues could contribute to a more coherent approach to policy development.

Within their own areas of interest, Canada's institutes have already begun the work of consolidation. In the past year, thirteen such organizations (including the Niagara Institute), have begun the attempt to exchange information on a more systematic basis. Recognizing that public debate on many issues [illegible] fragmented, those organizing the initial meetings saw the need for a clearer [illegible]

Just as this initiative can serve a useful purpose in the rationalization of specific areas of institute research and programatic activity . it provides a possible model for the rationalization of discussion on the Conserver Society and public issues whose impact extends across society. But at least as evident as the need for improved cooperation among institutes is the need for experts, scholars and in some cases advocates interested in such issues to meet, discuss, test and share systematically their knowledge about a particular issue with others from business, government, universities and labour.

As the activity underway with the Conserver Society issue attests, there is knowledge in Canada, relevant to the anticipation or solution of public policy problems. But it tends to be isolated, compartmentalized or locked away in different sectors of society, or even in different agencies of the same government.

A multiplicity of centres for the monitoring and evaluation of options in public issues is eminently desirable. What is less desirable is that such centres remain unrelated, incapable of contributing to the testing of values, the identification of evolving needs, and the assignment of suitable resources. Evaluation of major issues is always challenging, but it will become less so if there is better feedback from the field, if there are consciously devised ways to ensure the maximum degree of public participation.

3. Private Sector Institutes and Issue Management

In recent years, Canada's institutes have developed a number of skills which are directly applicable to the solution of public issue questions. Their unique competence in this area typically stems from a well-developed "process capacity" - the ability to address broad questions through bringing together people from business, government and labour who are concerned with a particular issue and the values which affect them in an ongoing process.

Such organizations as The Fraser and C.D. Howe Research Institute, the Canadian Institute for Public Affairs, the Conference Board in Canada and the Niagara Institute all have access to extensive networks of issue-minded supporters in the private sector, and in many other areas of society. Together, these organizations represent an important resource which, when linked together, can provide a powerful and extremely effective focus in the examination and assessment of important policy questions.

One thing is clear. Government alone cannot ensure adequate policy comment and evaluation. Neither can universities, labour unions, business associations nor other private sector groups which operate independently of each other. All can contribute to the debate, but they cannot mount it alone. Each tends to concentrate upon a single element or regional preoccupation. What is needed is co-ordination, and the creation of a learning [illegible]nning environment in which all points of view are represented.

> Citizens will deal with the subject in church discussion groups, in unions, in civic associations. Intellectuals will analyze. Informed people will argue over the dinner table. Special interest groups will make themselves heard. Enthusiasts for one or another view will form organizations."

But all this activity, potent though it may be, generally relates to current issues only, and there continues to be a disturbing dearth of places where those most actively involved in longer term issues can be systematically brought together, on the basis of a shared commitment, to share information and perceptions over a significant period of time.

The challenge facing concerned Canadians, with the Conserver Society issue in particular, is to develop a more constructive way to link up discussion in such a way as to generate more effective communications and deeper understanding of the issues.

4. A Modest Proposal

As noted, private sector institutes can collectively provide a forum in which those who have developed a position, and thought through the implications of a Conserver Society, can present their findings to a wide and influential audience.

At the same time, these organizations can assist in the management of the Conserver Society issue by:

... serving as a bridge between scholarship and public policy;

... exploring the relationship between humanistic and organizational values;

... identifying potential policy options available to various elements of society, (particularly in the business and labour sectors);

... bringing new knowledge from within Canada and from outside the country to the attention of those who are most involved in the policy decisions of their respective organizations;

... encouraging the re-evaluation of traditional attitudes and assumptions;

... moving away from linear thinking towards greater consultation and communication among the various sectors of society.

A few models for the way in which such a process might be put together already exist. Both the Aspen and Brookings institutions in the United States have begun work on the creation of learning environments and planning communities which address issues similar in scope to the Conserver Society. The Brookings' Advanced Study Program, for example, has been involved in a number of such undertakings including the management of a 1973 program which explored the future of Alaska, and the impact on its economy of new revenues from the North Slope oilfields. Perhaps predictably, the program fell short of its objectives. It did not "define" the future of Alaska, nor did it result in total agreement among those who participated in the effort. Many of the proposals it generated were rejected, buried, or substantially altered. But the process did provide the 120 Alaskan leaders who were involved in it with a unique opportunity to think beyond their immediate concerns, to consider their prospects in a framework broader than the bounds of their state. If the program was not a complete success, it was primarily because it consisted of only four-day sessions which did not provide any formula for continuing the process beyond the close of the final session.[1] In more recent years, this shortcoming has been addressed through the development of programs which seek to build and maintain a learning and planning community on an ongoing basis.

In considering how such a planning and learning process might be structured in Canada - one which specifically addresses the issues intrinsic to the idea of a Conserver Society - it is probably useful to begin with an outline of what such a process would achieve.

Looking ahead over the next five years, four major objectives suggest themselves.

(a) Education

First and foremost, by 1983 we would hope to have at least reached the point where there is widespread understanding of the issue and its implications at all levels of society. Currently, there is a superficial awareness of the issue, but much remains to be done in terms of educating the public at large, and those key decision-makers in business, in government and in labour who are in a position to bring about change.

This learning approach would, of necessity, be multi-dimensional in scope, typically involving a continuing series of conferences, workshops and seminars designed to bring together opinion-leaders from a variety of backgrounds with those who are performing research or who are responsible for the articulation of specific proposals.

A second element of this educational process might involve the media. Rather than involving journalists and broadcasters after the fact, however, it may be desirable to involve them directly in each stage of the learning experience. Thus, media representatives who are concerned with the Conserver Society should be active participants (as opposed to being passive observers) in [illegible]ence and seminar activity. With an [illegible] and understanding [illegible]

Another element of education might involve the formal education system itself. Again, it is hoped that the process would actively involve educators from a wide variety of instutional settings whose individual learning experiences might ultimately be reflected in changed curricula and a more pervasive approach to the issue within the school system.

A key consideration in the development of educational programs is the extent to which Conserver Society issues affect or are affected by other issues currently facing organizational decision-makers. Industrial productivity, the quality of working life, corporate social responsibility, unemployment, inflation, the implications of demographic change, the broad questions arising from the nature of technological development --- all these are issues which Canadians are attempting to deal with at the present time. All, to a greater or lesser extent, are affected by or can have an effect upon, our perceptions of the Conserver Society. Clearly, the interpenetration of issues should be reflected in the design of educational programs.

(b) Research

A second element of the process would focus on theoretical and practical research. Already a substantial body of information has been compiled which sketches out both the broad outlines of a possible Conserver Society, and many of the specific areas in which work remains to be done. However, two obvious problems must be addressed. The first involves the consolidation, interpretation and inventorying of Conserver Society research while the second involves the identification of specific areas in which further research is required.

Hopefully, the process would include the development of a clearinghouse system which could draw together available literature in a central database, provide for its broad distribution to those concerned with the issue, and make recommendations to appropriate bodies in both public and private sectors for the commissioning of further research activity.

In addition to economic and industrial development research, it may be appropriate to conduct attitudinal research on public acceptance or rejection of specific conservation issues.

(c) Experimentation and Demonstration

One tangible, albeit long-term indicator of the effort's success would be the degree to which Conserver "solutions" are seriously considered and implemented by various segments of society. Programs aimed at transferring or translating the experiences of those who have applied conserver techniques to others who have demonstrated an interest in them are of key importance.

To some extent, this dimension of the overall process is related to the larger research questions and to be managed successfully may require the development of some sort of clearinghouse or network management capacity. The identification of a network of third party "experts" capable of assisting with demonstration activity would be desirable. This consulting group could [illegible]

(d) Institutionalization

At some point, likely early in the process, it may well become evident that a viable, well-established organization (rather than some kind of ad hoc, loosely coordinated network), is required to support and manage the educational, clearinghouse and consulting functions integral to the effective management of the issue. A variety of options are possible. Individual tasks, for example, could be parcelled out to existing organizations whose experience qualifies them for such a role. The entire task could be entrusted to a single organization, although one which preferably operates outside the umbrella of government. A final alternative, assuming that funding were available, would be to establish a new, independent organization entirely devoted to managing the development of a Conserver Society.

The final decision on the applicability of these various options, it should be noted, is not important at the outset of the process. Indeed, the evolution and maturation of the issue and its management process will probably dictate the most appropriate organizational structure.

The purpose of this paper is not to provide a detailed blueprint for the way in which the process should be administered, or even to recommend a specific framework under which it might operate. If the process is to be participative, and if it is to engage the attention of those involved, it must be designed collaboratively. This may seem to be a clumsy and ineffectual way to proceed. But, to be frank, there is little point in trying to develop at the outset a complex structure and all-encompassing master plan which may or may not work and which, more important, would impose its own constraints.

Indeed, there is much to be said for a process which develops through "incremental muddle". Certainly, it is desirable to identify at the outset those groups who can and should contribute to planning the next step.

The major participants would include:

- members of the research community
- representatives from all levels and departments of government
- decision-makers from large and small corporations, trade unions
- spokesmen for the various business and labour associations and federations
- and finally, representatives from other stakeholders in the issue - members of the scientific community, educators, consumers, conservationists and other special interest groups.

The process by which the objectives outlined earlier might be achieved would most likely be invented by the players themselves, but having said this, three fairly distinct and definable phases of activity can be identified, each with an analytical and attitudinal component.

The first stage of the process would probably focus on conserver issues themselves. Clearly, the notion of a conserving society is not a single issue, but a collection of related concepts, each with major implications for economic development and social change in general. A central task facing those involved in the process would be to separate these various issues, breaking them down into manageable problems for closer scrutiny.

The analytical task of isolating the issues and examining them in a longer time frame might also result in some degree of "tissue-matching", for example, linking up the dilemma of unemployment with the conserver emphasis on more labour-intensive industry to attract the input of those sectors of society who share a concern in this area.

The analytical element of this first phase activity might also include the assessment of specific adjustment mechanisms. The effectiveness of market mechanisms, existing and proposed incentive schemes, and the need for public command and control tactics could all be assessed. At the same time, a better analysis of fundamental constraints, (the impact on international trade, for example), could be factored in.

While this sort of analysis is proceeding, work could also begin on the measurement of public attitudes. For example, studies could begin which are aimed at determining how the leadership of certain key constituencies views the Conserver Society.

Having completed this initial phase of activity, through a creative blend of education, research and demonstration, participants in the process may choose to either call it a day - assuming that the issues will take care of themselves - or move with greater confidence towards a second stage which would look more closely at specific options and at ways to increase awareness and support for them.

This in turn would lead to the third and final stage which would zero in on strategies and methods of implementation, as well as ways of influencing public attitudes and modifying social behaviour.

In outlining such an approach to managing and organizing the process, there is some risk that the task will be perceived as being relatively simple. Clearly, this is not the case. New possibilities, problems and participants will emerge in a dynamic and turbulent fashion. It is for precisely this reason, however, that the basic approach should be kept simple. After all, the whole point of the process is nothing more than to establish a system in which the real issues in question can be addressed in a genuinely participative way.

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APPROPRIATE TECHNOLOGIES AS OPPORTUNITIES FOR DEVELOPMENT

Tom Lawand
Director, Field Operations
Brace Research Institute - McGill University

Abstract

The principles of appropriate technology are well known and considered as elements of development in the Canadian context. In this paper, specific technical case studies are addressed in the field of:

a) Greenhouse agriculture dealing with food production, energy and employment;

b) The provision of energy in the form of heat for the domestic, commercial and industrial sectors.

Entrepreneurial opportunities are examined in each of these sectors through the utilization of appropriate technology and conservation techniques. Examples will illustrate current practices, outline short-term opportunities over the next five years, and project the long-term development of these opportunities.

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Introduction

Interest in the Conserver Society in Canada has stemmed from the studies undertaken by the GAMMA Group, Montréal,[1] which produced in 1976 a detailed outline of the concepts and implications of such a scenario. The question addressed in this paper is the role of Appropriate Technologies in implementing aspects of the Conserver Society. More specifically, an examination is made of some of the entrepreneurial or job creating opportunities that are presented when using Appropriate Technologies within the overall framework of the Conserver Society.

Discussion of Appropriate Technology:

It is not the intention, at this time, to embark on an extensive dissertation on Appropriate Technology. Rather a simplified definition of Appropriate Technology and the Appropriate Technology Process is discussed with its relevance to the Conserver Society. Many texts have been written on this subject including "The Handbook of Appropriate Technology," prepared in 1976 by the Brace Research Institute and the Canadian Hunger Foundation.[2] The Concepts Section of this Handbook addresses itself to the basics of Appropriate Technology with particular reference to problems relating to emerging areas of the world. It was very evident to the international groups of authors of this Handbook, that the principles of Appropriate Technology applied equally well to the industrialized areas of the world, and that some effort should be made to examine the modalities of the use of Appropriate Technology in developed societies.

Simply stated, an Appropriate Technology is one that is compatible with the human, material and financial resources of a given community or society. It deals with a wide range of topics ranging from a simple hand pump for water, to a telephone or computer, or to a group credit scheme, a decision making process, a banking system or appropriate methods of marketing. The scope of Appropriate Technologies is necessarily wide ranging.

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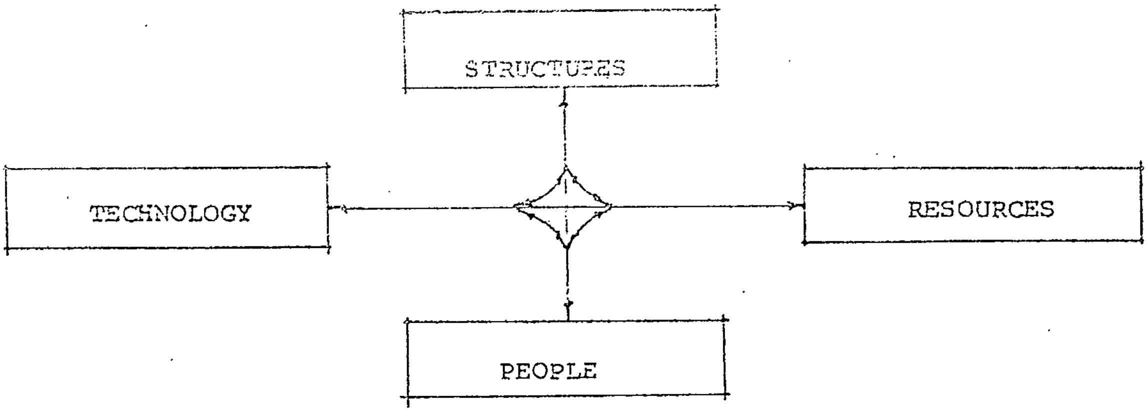
[1] GAMMA Study: "The Conserver Society," 4 Volumes. 1976.

[2] "Handbook of Appropriate Technology," jointly prepared by the Brace Research Institute and the Canadian Hunger Foundation, 280 pp, 1976.

"Appropriate Technolology - Problems and Promises," by N. Jéquier, Development Centre of the Organization for Economic Cooperation and Development. Paris. 1976.

It must be stressed that Appropriate Technologies should fit into an appropriate system in which the principal elements are in harmonious interaction, as indicated below. All elements, technologies, resources, structures and the people that administer, operate and use these technologies must be appropriate for the system to succeed in a given milieu, be it rural, urban, industrial or traditional, etc.



The technology, of course, must be adequate, technically, and economically sound, culturally acceptable and must respond to a real need within the community. There must be ample resources which can be developed as well as material resources to develop the hardware and systems necessaryto tap these resources.

People must be trained in the comprehension of the technologies and in resource and material handling. The best technology is unsuitable if no one can build, operate or maintain it.

Finally, there must be an appropriate structure within which the systems can operate, providing the legal, physical, and organizational framework in which to develop, build, maintain and expand these technological systems.

If any of these elements is weak or non-existent, then even a very appropriate technology will fail in its application. There are many examples of this throughout history.

Some of the principal criteria of Appropriate Technology are listed below. The list is by no means exhaustive but illustrates some of the salient features that would characterize the Appropriate Technology or the process of its operation, or implementation

a Appropriate Technology should be compatible with local cultural and economic conditions: i.e. the human, material and cultural resources of the communities;

c) Appropriate Technology, wherever possible, should use locally available resources;

d) If imported resources and technology are used, some control must be made available to the community;

e) Appropriate Technology should wherever possible, utilize local energy sources;

f) Appropriate Technology should be ecologically and environmentally sound;

g) Appropriate Technology should minimize cultural disruptions;

h) Appropriate Technology should be flexible in order that a community not lock itself into systems which later prove inefficient and unsuitable;

i) Research and policy action should be integrated and locally instituted wherever possible. This is in order to ensure that:

- the research undertaken is relevant to the welfare of the local population;
- utilization of local creativity is maximized;
- local inhabitants participate in technological developments;
- research is synchronized with field activities.

Obviously, in practice, it may not be possible to meet all these criteria. They do, however, provide general guidelines or goals to which the Appropriate Technology process should aspire.

It is evident that the choice of technologies faced by Society determine to a large extent the entrepreneurial and employment opportunities available, and to some measure affect the resultant quality of life. Poor or inadequate choices, while tolerable in a vibrant, active economy, nonetheless detract from the overall objectives that the Society may wish to attain. Our present day Society is faced with inadequate and often inappropriate technologies, which are suffered and tolerated by the mass of the population. It is only through the development of a National consciousness that these may eventually be replaced by more Appropriate Technologies or systems.

Specific Sectors Considered in the Report

In order to better illustrate the potential application of appropriate technologies [illegible] Society, it would be best to examine specific case studies of existing [illegible] the entrepreneur [illegible] case studies. This, however, in addition to being voluminous, would be at the same time very diffuse. For the purposes of this paper, it would appear to be more sensible to examine several specific case studies in related fields, constituting real needs for the Society. The areas selected for examination are the following:

a) Greenhouse agriculture for the production of food, or flowers, dealing with questions of energy and particularly with prospects for the establishment of business enterprise and employment opportunity.

b) The problems of heating of buildings encompassing the conservation of energy, the recycling of waste heat within the building envelope, the adaptation of new sources of energy, such as solar energy in meeting the building needs. Business and employment opportunities are also examined for each of these sections.

Appropriate Technology must be appropriate in space and time. Consequently, they must be adaptable to changing conditions and they must be up-graded to meet the realities of new situations. This will form the object of another section of the report using these two illustrated examples but projecting the potentials for opportunities during the next five year period given that certain courses of action have been taken concurrently. The long term projections are also made in these areas, to indicate their overall directions and potentials. It is axiomatic, however, that substantial areas of activity viewed, in their overall perspective, can also serve for this purpose to provide adequate employment and entrepreneurial opportunities in the Conserver Society. The approach however must be an aggressive and creative one. Nothing will happen in Canada, in these fields, if the traditional attitude of Canadian entrepreneurship is maintained, wherein the potential investor is often unwilling to take risks and expects guarantees on the return on his investment. Certainly the opportunities are there - the logical combination of appropriate technologies with a positive approach in developing our resources, through the effective use of our technical, manufacturing and administrative skills, can provide many examples of the opportunities that the Conserver Society offers to Canadians. This is one criteria that is fundamental, however, for these systems to be appropriate and adapted to the real needs and conditions prevalent in this country. This, in practice, has become difficult to achieve, even though it appears to be logical, especially when dealing with technologies and systems related to environmental factors (e.g., buildings, transportation, agriculture, etc.). Canada has become a major importer of technology to the point where our own technological developments are often regarded as inferior to imported systems and knowledge. This is a fundamental and serious problem. If Canadians entering the Conserver Era do not develop confidence in their own technologists and if Canadian technologists do not adopt an Appropriate Technology approach and methodology, then there is not really much hope for achieving any material, long term benefits from the Conserver Society.

It should be remembered that even elements of systems developed for a Conserver Society abroad, are not necessarily appropriate here. Rather than [illegible] adapting foreign technological developments to our needs (which we do not [illegible] adequately), we [illegible]

In this manner, through careful assessment, planning and undertakings, it may be possible to redress some of the serious deficiencies faced by our population. Given the current high rates of unemployment and our increasing balance of payments deficits, a fresh approach and adherence to the principles of Appropriate Technology cited earlier, might be well worth considering.

Option: The Case for Greenhouse Agriculture

In recent times, much attention has been paid to the problem of energy, and its implications on our future economic growth. Just as Canada imports a significant amount of fuel, so also does it import significant amounts of food. Given our Northern location, some effort should be made into ensuring that a greater quantity of food be grown in Canada, under our own control.

In the short run, there is little danger of problems developing in the availability of food from foreign sources - however, the following factors need to be considered when importing food from abroad:

a) The cost of foreign produce is increasing steadily;

b) The cost and difficulties in transportation may one day present a problem;

c) The populations in the warmer regions of the world are increasing significantly;

d) The standard of living of the warmer country populations is steadily increasing.

All of these factors will have the long term effect of making it more costly and difficult for the importation of adequate food supplies. No country should leave itself totally vulnerable to overdependence on foreign sources of supply, especially in vital areas such as food, water, energy, etc.

In the summer months, Canada is able to supply large quantities of food, though in recent times the costs of production have risen considerably. One of the reasons for this is the dependence on fossil fuels of our farming sector - an important subject which will not, however, be treated in this paper. For nearly 8 months of the year, on the other hand, the Canadian farming sector cannot produce fresh produce - vegetables, fruits, etc. It is during this period that the greenhouse industry can make significant contributions to our National requirements. In fact, in many European countries, greenhouses are operated as an industry on a year round basis - producing several times the amount of produce per unit area than could be grown in open fields.

A greenhouse is a transparent covered structure placed over an area to be cultivated in order to control the environment of the plants. The structure is heated by conventional fuel supplies and by the sun. Within the greenhouse, the optimum ambiant temperatures must be controlled by heating or ventilation to maintain reasonably [illegible] conditions.

overcast conditions, characterizing their regions. In parts of Canada, the levels of solar radiation are as much as 50% greater than those received in Northern Europe. Paradoxically, the external ambiant air temperatures in winter are 10 to 15 degrees Celsius colder in Québec than in the Netherlands, for example.

Traditionally, we have imported most of our technologies, and greenhouses do not differ in this respect. These classical units are inappropriate environmentally in this climate for the reasons stated above - they lose too much heat in winter and overheat in summer. To counteract high heat losses in winter, engineers in North America covered classical greenhouses with a double layer of transparent plastic film. This reduces the overall heating requirement but does not constitute an adequate response to the problem. The Brace Research Institute of McGill University, in 1973, working with a research team based at Laval University, developed the Brace greenhouse which has been copied and modified to a significant extent in the U.S.A. and more recently in Canada. Basically it consists of the following:

> The greenhouse is built of standard frame construction aligned lengthwise along an east-west axis. The north facing wall is set at an angle equivalent to the maximum elevation of the sun in summer. This wall is insulated and covered with reflecting material on the inside face. This has been done to reduce heat losses from the exposed greenhouse surfaces. Much less radiation normally comes in from the north side of a greenhouse in the winter months. The addition of a reflecting layer on the inner north facing wall tends to increase the amount of radiation reflected onto the vegetation growing in the greenhouse. The rest of the greenhouse is reasonably standard. Further attempts to reduce heating costs have been made, by incorporating a heat storage in the greenhouse, and using insulated night covers to reduce nocturnal heat losses. (See Fig. No. 1).

It is developments of this type, adapted for the single span greenhouse which can permit the greenhouse industry to become more competitive in Canada. Using the Brace greenhouses, measurements have indicated that it is possible to reduce heating loads by over 30%. It must be remembered that in colder regions, heating loads can constitute over half of the basic operating costs of a greenhouse. Current research programs at the Brace Research Institute are investigating heat storage and insulated night covers for the greenhouses, so as to reduce considerably heating costs.

Research and development over the next 5 to 15 year period should assist the greenhouse industry as follows:

a) The principles developed for the Brace greenhouse should be extended to large (10.000 square meters) growing areas to ensure that it is possible to reduce heating costs in multi-span systems;

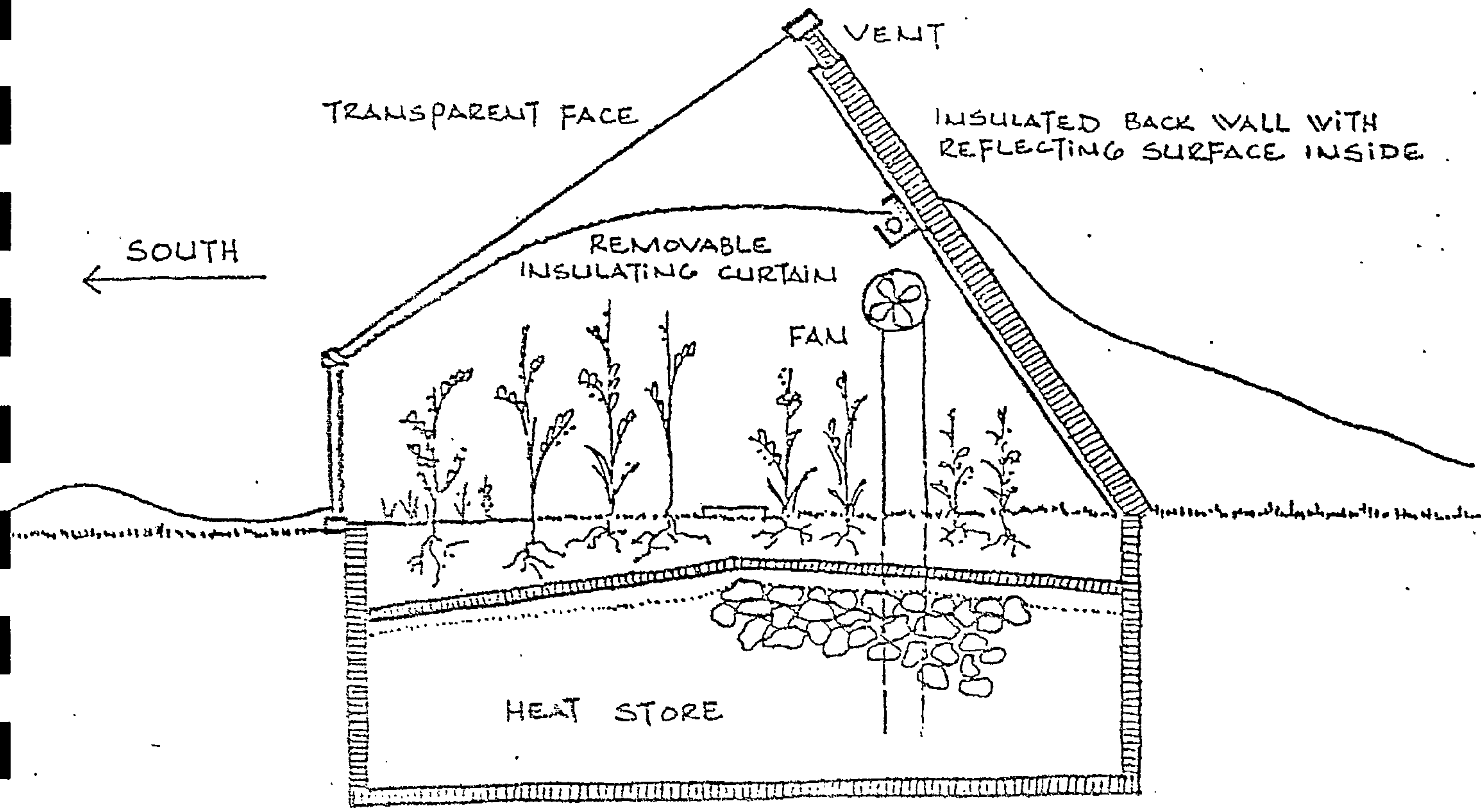
b) Heat storage and night cover that is, the enclosing of the growing [illegible]

c) Studies should be undertaken on the possibilities of integrating greenhouse systems into:

1. farm operations;

2. the roofs of large flat-roofed buildings, etc.

The economic potential of the greenhouse industry is described in the following section. Later sections deal with particular technical applications of greenhouse utilization. These denote the entrepreneurial and job creating opportunities that this industry holds for Canadians. On a more pessimistic note, it should be mentioned that there has been very little encouragement for this industry in Canada. It is treated neither as serious agriculture, nor as an industry. Until there is a basic change of attitude, it is very difficult to foresee any prospects for positive change in this field.



[illegible] VIEW OF MODIFIED [illegible] RESEARCH INSTITUTE
[illegible]

The Greenhouse Industry - Market Potential

Canadian agricultural production is, for a large part, governed by climatic considerations: seasonality and environmental conditions during critical growing stages seriously limit the volume of domestically produced fruit and vegetables.

A recent report prepared by Agriculture Canada shows that we produce only (1)

53%	of Canadian	consumer	needs	for	tomatoes
76%	"	"	"	"	vegetables
10%	"	"	"	"	fruit
50%	"	"	"	"	pulses & nuts

(1970-1973 average)

consequently we must depend largely on imports to supply these commodities. Table 1 illustrates some figures on vegetable, flower and plant imports for the year 1977. The volume imported obviously varies through the year. The summer season is, in Canada, one of greater self-sufficiency while, in the winter months, a large amount of produce comes from outside sources.

The values shown are for some fresh produce only. Canned produce is also imported. Statistics given are a good representation of the situation, but are necessarily incomplete.

Considering the amount of funds spent on imports, there is no doubt that it is desirable to examine the means of gaining greater autonomy and parallely ameliorating our economic situation by encouraging home production.

Increasing our production through the use of greenhouses could be an effective solution. At the present moment, greenhouse production is quite limited both in amount and in variety of produce. Current figures are illustrated in Table 2.

The import figures indicate that there is definitely a place on the Canadian market for greater yields. Also, in the past, competition with southern U.S. field crops, where labour and operation costs are cheap, made it difficult for greenhouse growers. Transportation costs are continually increasing and the consumer is now faced with high prices and only average quality during an important part of the year.

The greenhouse market thus has a chance to expand; it is a business which necessarily implies some economic input, but with a reasonable initial investment, a fair profit, especially in such markets as cut flowers and ornamental plants, is possible.

TABLE NO: 1

CANADIAN IMPORTS

QUANTITIES AND VALUES FOR SOME SELECTED PRODUCE (1977)

1977	FRESH TOMATOES		FRESH CUCUMBERS		FRESH LETTUCE		FRESH PEPPERS		STRAWBERRIES	
	QUANTITY		QUANTITY		QUANTITY		QUANTITY		QUANTITY	
	Metric Tons	$ Value	Metric Tons	$ Value	Metric Tons	$ Value	Metric Tons	$ Value	Metric Tons	$ Value
JAN	9,086	4,289,000	3307	1,037,000	17,345	3,817,000	2,276	1,371,000	141	11[illegible]
FEB	9,445	5,979,000	2895	1,010,000	17,920	3,515,000	2,123	1,475,000	302	2[illegible]
MAR	10,273	6,355,000	2360	1,140,000	19,079	3,839,000	1,988	1,784,000	1041	99[illegible]
APR	9,603	7,198,000	2236	902,000	19,602	3,473,000	1,820	1,883,000	2252	1,70[illegible]
MAY	12,823	6,287,000	2974	766,000	29,170	3,943,000	2,886	1,405,000	4989	3,13[illegible]
JUN	13,521	4,428,000	4220	1,074,000	21,070	3,613,000	3,154	1,311,000	2923	1,96[illegible]
JULY	9,784	4,432,000	2448	738,000	6,933	1,199,000	2,578	1,201,000	2165	1,40[illegible]
AUG	6,957	3,728,000	1363	290,000	5,263	985,000	1,597	836,000	1200	92[illegible]
SEPT	4,956	2,180,000	456	115,000	7,504	1,615,000	1,148	488,000	608	496,[illegible]
OCT	7,473	3,403,000	2107	558,000	14,418	3,533,000	2,195	990,000	418	353,[illegible]
NOV	7,503	4,539,000	2846	866,000	16,604	3,935,000	2,738	1,220,000	149	136,00[illegible]
DEC			NOT YET AVAILABLE - (MARCH 1978)							
TOTAL JAN - NOV '77	101,424	52,817,000	27,212	8,497,000	167,954	33,457,000	25,503	13,964,000	16,188	11,578,[illegible]

SOURCE: Statistics Canada. Cat: 65-007 Importations par marchandises (ISSN 0318-2398)

Mensuel, janvier - novembre 1977.

TABLE NO: 2

PRODUCTION FROM GREENHOUSE SOURCES

	1971 Canada	1971 Québec	1972 Canada	1972 Québec	1975 Canada	1975 Québec	19[illegible] Canada	
TOMATOES								
Quantities (metric tons)	12,428	24	13,595	99	14,214	159	16,[illegible]	
Dollar value ($)	8,428,778	17,680	9,214,598	75,899	14,727,000	177,000	15,241,7[illegible]	
Average price per kilogram ($)	0.68	0.73	0.68	0.77	1.04	1.12	0.[illegible]	
CUCUMBERS								
Quantities (doz)	1,886,537	3,111	2,019,899	26,284	1,898,000	25,000	2,148,0[illegible]	
Dollar value ($)	3,446,621	4,325.	3,596,372	28,487	5,975,000	47,000	7,047,000	
Dollar value/dozen ($)	1.83	1.45	1.78	1.08	3.27	1.89	3.[illegible]	
CUT FLOWERS AND HOUSE PLANTS								
Dollar value ($)	52,550,950	5,740,200	61,044,206	7,045,458	109,048,532	11,163,211	123,580,91[illegible]	[illegible]67

SOURCES: Statistics Canada - Greenhouse Industry, Catalogue 22202 (1971-1972)

Statistics Canada - Fruit and Vegetable Production, Catalogue 22-003 (1978)

Some economic considerations of the greenhouse industry, including production and heating costs, are given in Table 3. Heating costs have, to this day, been the major restraint to this market's expansion, but there can be substantial gains, particularly if we can reduce these costs.

Table 4 is an analysis of the internal structure of the greenhouse industry. It is quite interesting to note the dollar return values and the employment opportunities in the cut flower business. Considering we still import approximately 16 million dollars worth of cut flowers per annum, there is no doubt that opportunities to expand this sector of the market exist.

The above figures indicate that a substantial market potential exists for a year-round food producing industry in Canada. The importation figures given in Table 1, indicate the quantities and value of imported produce. Demand for these items is not entirely inflexible. In the colder months a good portion of the Canadian population cannot afford the high costs of fresh produce, and they substitute other cheaper items at those times. Even so, the figures indicate that imports alone amount to over $100,000,000 per annum. The availability of cheaper and certainly fresher produce may well stimulate an increase in demand. The economic potential for the greenhouse grower exists. It remains to determine whether the factors of production permit the establishment and growth of a viable industry in various parts of the country.

Several aspects are considered in the following sections. These deal primarily with the integrated greenhouse wherein greenhouses are envisaged as an attachment to buildings, both for the production of food and the provision of heat. Greenhouse opportunities on the roofs of buildings and utilizing waste heat sources are also considered.

An examination of the existing, traditional greenhouse industry is not attempted, though it is recognized that this industry is suffering from the current high costs of fuel. Energy conservation and the better use of solar energy should be considered as measures to relieve this situation.

Other Possibilities for Entrepreneurial Prospects in the Greenhouse Field

Background

With the advent of interest in the energy efficient greenhouse, it has not taken the entrepreneurial element, particularly in the United States of America, long to mate this greenhouse-come-"solar collector" to the universal classical heat demand - the family dwelling. The re-emergence of the greenhouse attached integrally to a building is a phenomenon of our day. Obviously, it is nothing new - at the turn of this century and before, the attached greenhouse or "conservatory" was a prominent feature of the Victorian houses of the well-to-do. Viewed from the Conserver Society perspective, it has several advantages:

a. Generally, during sunny periods of the heating season, it is a [illegible]

TABLE NO: 3

GREENHOUSE PRODUCTION - ECONOMIC CONSIDERATIONS

	1971		1972		1973		1974		1975		
	Canada	Québec	Canada	Québec	Canada	Québec	Canada	Québec	Canada	Québec	[illegible]ec
Area under glass & plastic (m^2)	2,981,357	136,185	3,307,541	21,543	3,189,920	226,182	3,349,520	245,641	3,356,320	258,[illegible]	[illegible],162
Mean area/firm (m^2)	2,844	1,284	1,668	1,025	26,758	1,148	2,671	1,204	2,647	1,2[illegible]	,184
$ Total sales	64564942	5768355	74067971	7163361	85218203	8460514	103462009	9795093	129940277	11411[illegible]	[illegible]907.
Mean sales/ enterprise	61,608	54,418	53,750	34,111	68,066	42,947	82,571	48,015	102,477	55,94[illegible]	.412
Mean sales/m^2 ($)	21.63	42.40	22.38	33.26	26.15	37.45	30.89	39.82	38.72	44.[illegible]	[illegible].64
Manpower part & full time	6,739	582	8,009	870	7,621	807	7,461	895	7,933	[illegible]	.030
Labour costs ($)	*	*	*	*	21,416,917	2,181,993	25,032,177	2,584,491	30,386,572	2,953,15[illegible]	[illegible]625
Total investments (land/equip/ machinery) ($)	79339553	5235855	94878946	7358870	105922733	9130399	125967209	10830286	149323413	12767492	[illegible]167
Total purchases (flower/plants/ seeds) ($)	8,942538	639,341	14467690	1802246	18124354	2440627	22096277	2,665935	27562744	3132495	[illegible]106.
Fuel costs ($)	*	*	*	*	5760313	549,163	8,955289	906,713	11139448	990633	[illegible],172
Fuel costs per firm (fraction of total respondants only) ($)					5,353	3,089	7,694	4,849	9,252	5,187	947

* NOT AVAILABLE

TABLE NO: 4

GREENHOUSE INDUSTRY

(Analysis of Existing Industry Conditions)

	VEGETABLE GROWERS		FLOWER GROWERS	
	1973	1976	1973	1976
Total area (m^2)	1,236,751	862,050	1,419,644	1,679,152
Average area (m^2) per firm	5,047	5,027	1,810	1,829
Total sales ($)	12,236,163	10,365,967	58,958,481	110,017,073
Total fuel costs ($)	1,345,682	2,690,032	3,319,179	8,568,427
Fuel costs per dollar sale ($)	0.11	0.26	0.06	0.18
Total investment ($)	20,622,470	33,578,339	64,650,633	111,112,904
Investment per square meter ($)	16.67	38.95	45.54	66.00
Investment per dollar sale ($)	1.69	3.24	1.10	1.01
Total wages ($)	1,601,929	2,940,573	15,915,408	25,093,204
Number of employees per firm	4	4	7	6
Wages per dollar sale ($) /$	0.13	0.28	0.27	0.23
[illegible] square meter [illegible]	9.90	[illegible]	[illegible]	[illegible]

b) Aesthetically, both from within and from without the dwelling, a properly designed attached greenhouse can be very attractive; it provides a bright sunny location, an extra room, a place for the growing of plants, surplus humidity essential to alleviate the dryness of overheated, northern buildings, etc.

c) While small greenhouses can only contribute minimally to a family's food requirements, a properly managed greenhouse can produce certain greens, fresh herbs, etc., at the coldest times of the winter, when the cost of these items is at its highest. This is also a time when fresh greens are most appreciated in Canadian homes;

d) Psychologically, the greenhouse contributes a healthy atmosphere to the family dwelling. Through the exposure to living plants, it can permit a year round educational experience for the younger members of the family. At the same time, it can provide a useful and gratifying hobby and activity for older and retired persons, particularly during the winter months. This latter element of the population is scheduled to increase in number in the next few decades. Efforts must therefore be directed to provide meaningful and productive activities for their benefit. Finally, a "sun room" filled with plants and flowers is certainly a welcome retreat for all members of the family and particularly the homemaker.

The Conserver Society, in utilizing renewable resources, must surely perceive appropriate technological systems not only from their strict functional and material benefits, but also from their contribution to the improvement of the quality of life of the community it serves. It is to be hoped that any future society, based on a conservation rationale, will be a humane one where the emphasis not only will be on efficiency and production but also on the creation of a healthy, happy and responsible citizenry.

Physical Considerations:

Generally, attached greenhouses for dwellings or buildings have the following characteristics:

a) They occupy a space on one or more levels on the South facing side of a building;

b) They are contiguous with the building itself and hence can be attached to the normal building services - heating, electricity, water and sewerage;

c) They are either fitted with a large thermal mass (in the form of rocks, water tanks, etc.) to prevent an excessive build-up of temperature, or they are provided with a ventilation system permitting the transfer of this heat to other parts of the building [illegible]

Davis,* working in South Carolina in this field, provides an interesting schematic on the modes of operation of a combined attached solar greenhouse–cum–building containing a rock column and rock bed storage area. His contention is that surplus heat from the greenhouse could be channeled to storage, and then used in turn to partially heat the building. During the warm summer months, the rock pile storage system could be used to store cool night air, thus reducing costly air conditioning loads. (See. Fig. 2).

Davis postulates the following conditions for the USA:

For Existing Homes:

20 million homes each use on the average 37,000 Kw hours equivalent of energy per year.

Fuel Costs (at 10.5 cents per litre) approximately $362.00 or 18.1 barrels or oil/home/year.

Assuming 10% of the houses use attached greenhouses (roughly 2 million homes) and assuming that this reduces the overall savings of energy by 20%, then the energy saved per home is:

$$0.20 \times \$362.00 = \$72.40 \text{ per year}$$

Barrels of oil saved per year:

$$18.1 \times 0.20 \times 2 \times 10^6 = 7{,}3 \times 10^6$$

Financial savings to the Society:

$$\$72.40 \times 2 \times 10^6 = \$144.80 \times 10^6$$

This is a considerable amount of savings on an annual basis. Given a 5 to 7 year payback period, it would permit an investment of roughly 3/4 to 1 billion dollars per annum in greenhouse addition construction.

For Canada, the figures are not available. However, given the longer, colder winters, and the greater number of heating degree days, the savings per house would be at least equivalent if not greater.

Already a number of studies have been undertaken to indicate the potential heat savings that might be realized using attached greenhouses to buildings. It must be remembered however that:

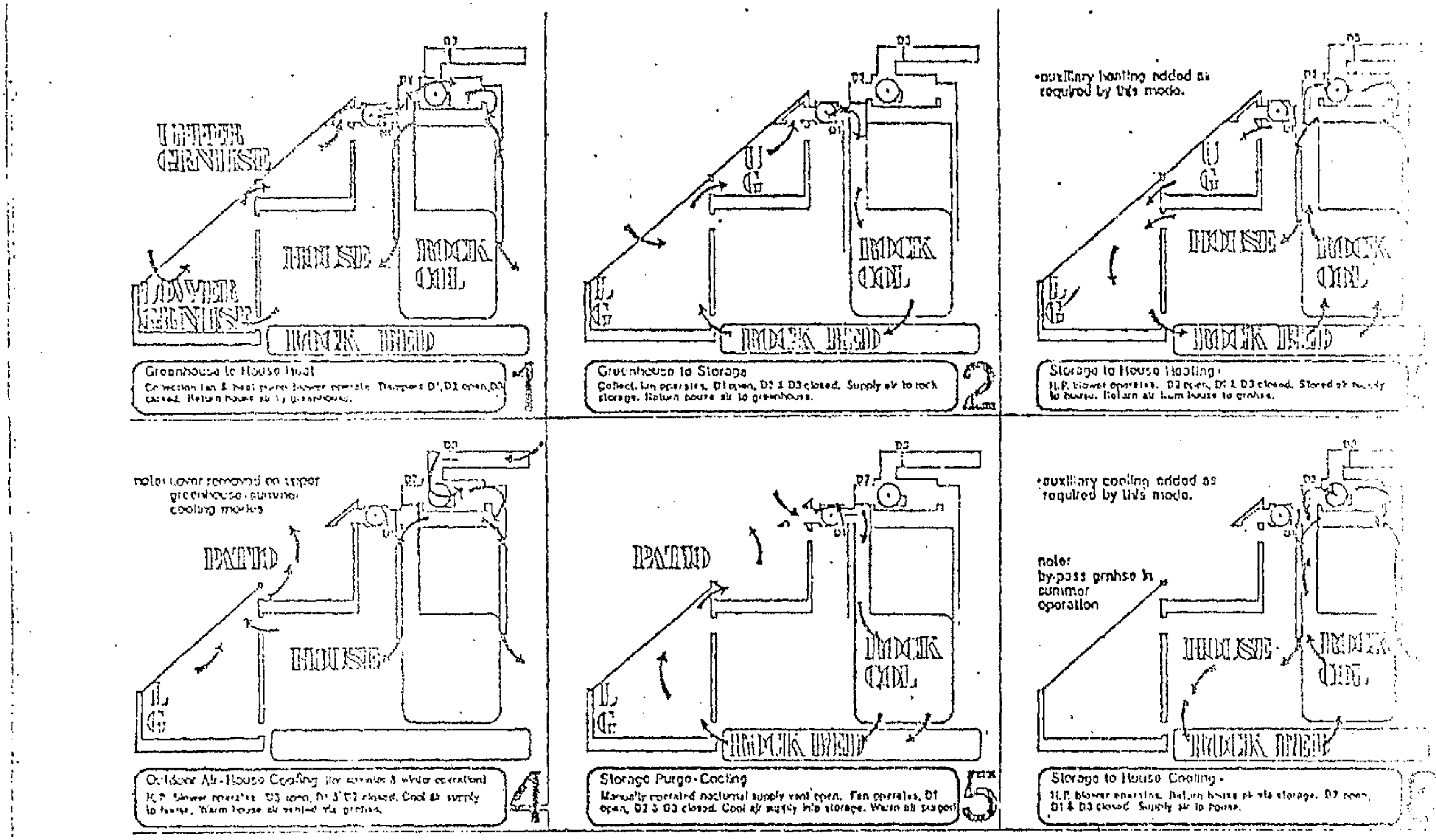
a) the greenhouse itself must be heated, on cloudy days and at night;

b) the use of thermal blanket type interior night covers can effectively reduce this heating load;

FIGURE NO: 2

MODES OF OPERATION OF A GREENHOUSE ATTACHED TO A RESIDENTIAL STRUCTURE

MODES DE FONCTIONNEMENT D'UNE SERRE ANNEXEE A UNE STRUCTURE RESIDENTIELLE



In essence, the building must increasingly resemble an insulated box, that is closed off from outside during the long winter nights and opened to permit access of light and heat during the daylight hours.

For new house starts in the USA, Davis assumes that 10% of 600,000 new houses might have attached solar greenhouses. (It must be recalled that it is not always physically possible or desirable to integrate a greenhouse onto the building envelope). Using the same figures as before ($362.00/year annual fuel costs), this results in a saving of 3.63 barrels of oil/house or 218,000 barrels saved per year by using solar greenhouses. This is equivalent to $5,340,000 saved per year.

In Canada, as in the USA, a good part of the oil is imported into the country. In times of unfavourable foreign exchange deficits and overall balance of payments deficits, these expenditures are often made at inflated prices. In addition, in Canada, any produce grown in these greenhouses during the winter would directly compete with and cut back on, foreign imports, due to our inability to grow any good under conventional agricultural means during the last autumn, winter and early spring seasons, owing to the severe nature of our climate. Benefits to employment, business opportunities and other areas would also have to be quantified.

The opportunities for entrepreneurial activities are many. They consist of the following:

a) Specialists in greenhouse fabrication, and their adaptation for attachment to houses;

b) Glazing for the greenhouse envelope, set into different structural frameworks, (wood, aluminum, steel, etc.);

c) Ventilation and ducting opportunities (particularly in reference to collection of air from a large extended volume). The development of adequate variable speed fan motors and controls may also eventually find a market;

d) Rock pile heat storage designers and specialists will be needed to carefully integrate storage systems into the building. These storage areas must be insulated and adapted for noise-free operations;

e) There is a need for control mechanisms for temperature and humidity operation of ventilation equipment, automatic dampers, monitoring of solar radiation levels, etc.;

f) The development of insulated night curtains which could easily be drawn at night to reduce heat losses from the greenhouse and practice energy conservation.

One should not limit the consideration of greenhouse attachments to buildings [illegible] plants often have a short life span due to problems such as overwatering, and they cost upwards of $100.00 each for a full-sized standing plant. As the use of these plants is often primarily to convey a certain image to visitors, their maintenance in a healthy and appealing condition can be important to a company. This maintenance could doubtless be performed more regularly and probably more economically by a qualified service located within the building.

In the case of commercial and industrial buildings, the presence of trained technicians should facilitate the operation and maintenance of these attached rooms. In the United States, several buildings incorporating this type of attached greenhouse have already been utilized in the commercial sector. Again the greenhouse serves to enhance the working environment of business enterprise.

These greenhouses are in reality "passive" low cost solar energy collectors, whose installed cost of $4.00 to $10.00 per square foot (approximately $40.00 to $100.00 per square metre) is far less costly than the price normally paid for the building itself. By assisting these "passive" solar collectors by means of forced ventilation, it is possible to greatly improve their efficiency and supply more heat for heating the building.

As the greenhouse will continuously be heated, the interior south facing rear wall is an ideal location to mount solar water heaters to supplement the hot water demand in the building. As hot water heating can account for approximately one fifth of the domestic heating and hot water energy requirements, a reduction of 50% of this load due to solar water heaters can make a significant contribution to the overall national energy budget. Also the solar water heaters can be specially built and adapted to work within greenhouses, be single glazed, with less insulation, and hence cheaper in cost. This represents an additional entrepreneurial opportunity for the imaginative Canadian innovator. It will also avoid the potential freezing problems with which all external solar water heaters in Canada are faced.

The sides of buildings are not the only areas available for adding greenhouses, as low cost solar energy collectors. There are also the flat roofs of our urban centres. This option is discussed in greater detail in the next section.

The potential of the Rational Utilization of Roof Spaces in the Conserver Society

The urban centres of Canada are characterized by extensive flat roofed areas, which are in the main, under-utilized. There exists a potential to utilize these spaces for:

a Recreation purposes:

b To collect solar energy for heating buildings, hot water, etc.

Installing greenhouses for food production.

Urban growth is inherently accompanied by economic pressures which prevent efficient land utilization. The magnitude of this economic pressure is a function of the city's size, its buildings' ground coverage, and its population density. Yet, even in the midst of the most dense city, there are hundreds of hectares of undeveloped space, that is, the endless series of unused rooftops. These areas could not only relieve the scarcity of space but also enhance the quality of our urban living environment. The potential of these underdeveloped areas is yet to be explored and their optimal use realized. Indeed, precedents of small-scale roof development in urban areas can be found, for example, penthouse accommodation for luxury dwelling units and less frequently rooftop office space. Moreover, the roofs of some apartments as well as office buildings are used for recreational facilities such as indoor and outdoor swimming pools, sun terraces and roof gardens. For the most part, however, roofs in cities are underutilized and represent an unsightly wasteland when viewed from neighbouring high-rise buildings.

The cultivation of horticultural produce in developed societies is relegated to farming areas remote from the city. Horticultural land use is considered economically incompatible with conventional urban land use. However, in the case of some market vegetables, for example, this view may no longer be strictly tenable, in view of recent technological advances pertaining to cultivation, particularly in energy conserving greenhouse structures.

Roofs obviously have a good exposure to sunlight, which is essential for plant growth. City air is a good source of carbon dioxide, another pre-requisite of plant growth. It is known that plants thrive better in CO_2 enriched air, and industrial cultivation could develop a mutually beneficial system which would not only provide suitable conditions for plant growth, but also improve the living conditions of city inhabitants. Increasing the number of green spaces in urban environments purifies the air; reduces the excessive city temperatures; creates a milieu aesthetically more pleasing, etc. By bridging the gap between agricultural and urban systems in this manner, we can certainly improve the quality of life in our cities.

The development of roof areas for horticultural purposes appears to be a viable proposition, not only from an ecological point of view, but may also bring about the following advantages:

1. Production of year-round garden produce in the urban areas where they are consumed. (See Fig. No. 3)

2. New employment possibilities for the unskilled urban labour market;

3. Reduction of transportation costs and thereby the lowering of food prices.

4. Alleviation of some vehicular traffic on city streets since the amount of food produce to be trucked to the city would be reduced;

5. Improvement in the balance of payment situation with warmer regions [illegible]

7. Enhancement of the quality of urban living;

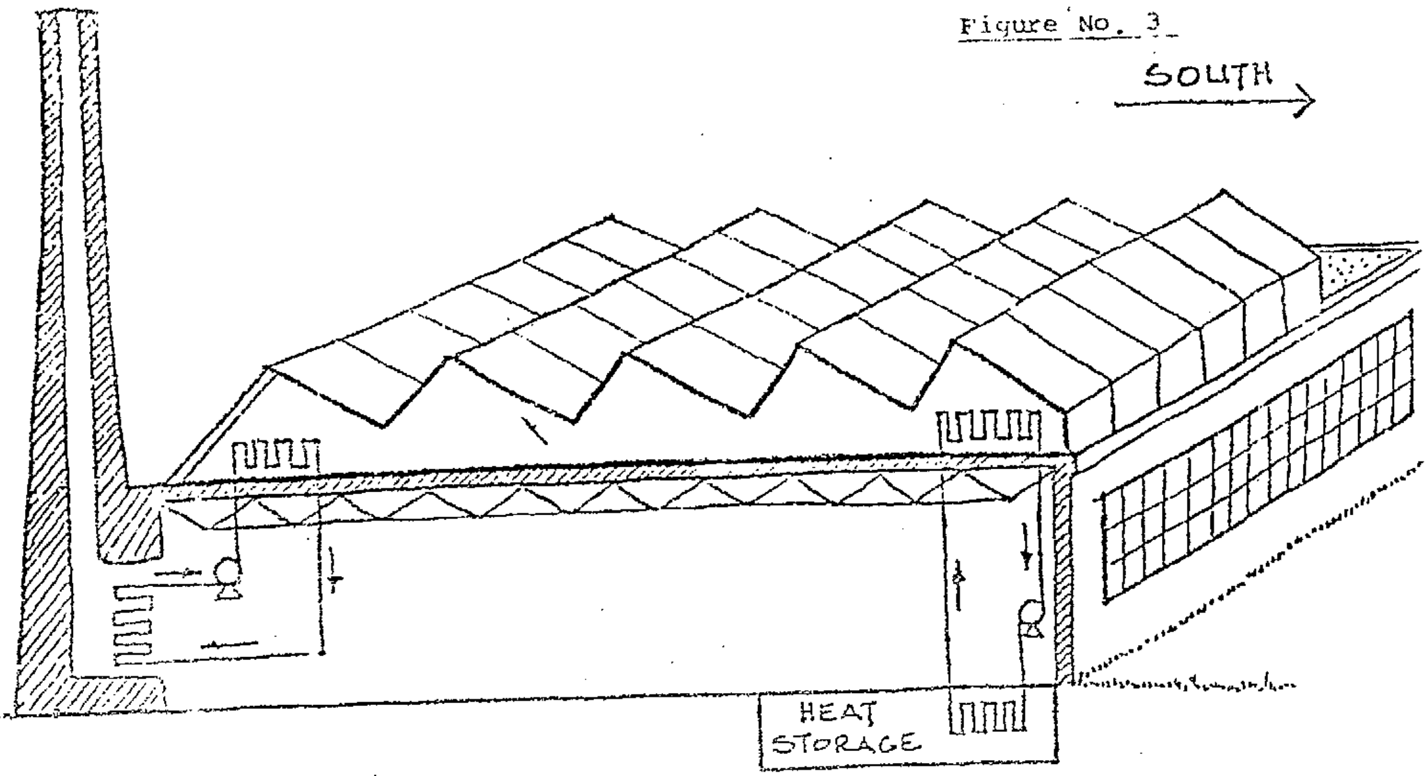
8. The creation of an industry for the provision and servicing of greenhouses, heat exchangers, etc.

9. The reduction of the overall heat loss from the building;

10. The recycling of surplus heat, produced in the roof greenhouse, for meeting part of the heating need of the building, as well as for the preheating of the building water supply. As the greenhouse can be allowed to be heated to 30–33°C by solar radiation, this can be used to preheat hot water to the building water heaters. In the winter, cold tap water can be as low as 2°C to 3°C. Hence preheating it by 25°C can effectively cut the hot water heating bill by approximately 50%.

Hence, it is evident that a host of entrepreneurial opportunities exist in the use of greenhouses, even within our cities which can make a positive contribution to our employment opportunities and the overal quality of life.

Figure No. 3



THE INTEGRATION OF A LARGE-SCALE GREENHOUSE INTO THE [illegible] A FACTORY BUILDING

Recovery of Heat from Chimney Flue Gases

It is possible to supplement the heating requirements of the roof top greenhouse during cloudy periods and at night by installing a heat exchanger in the boiler stack. A pilot plant operation of this type was installed on the boiler stack of a community center in downtown Montréal in conjunction with a large heating fuel distributor.* Waste heat was recovered in the following manner:

A heat exchanger was placed at the point where the hot gases first enter the breeching of the chimney. A circulating ethylene glycol solution was heated by the rising stack gases and pumped up to the roof area. It heated the soil beds of several cold frames built in a similar fashion to the Brace Research Institute greenhouse. By circulating this fluid during periods when the chimney is operational, it was possible to extract energy that would otherwise be lost up the flue. (See Fig. No. 4). It was estimated that 20-30% of the heat from the oil fired furnaces and just over 22% of the heat from gas fired furnaces is lost up the chimney. If ways could be developed to recuperate a portion of this heat, while not affecting the efficiency in the combustion chamber, it would be possible to reduce fuel consumption. It can be argued that the furnace efficiency itself can be improved - all of which will contribute to the reduction in oil consumption. When furnaces start and stop frequently, the overall efficiency of combustion is generally diminished.

The whole question of energy recuperation of this nature presents an interesting entrepreneurial possibility, which several companies have already begun to exploit. This permits added employment opportunities. At the same time, a proper research and development program should not be neglected so as to place the whole field on an acceptable technical basis - something which is not always the case in the Canadian heating, ventilating, air conditioning and insulation trades. In the long run, however, provision should be made for the eventual replacement of fossil fuel systems by other systems, as the availability of these fuel stocks diminishes.

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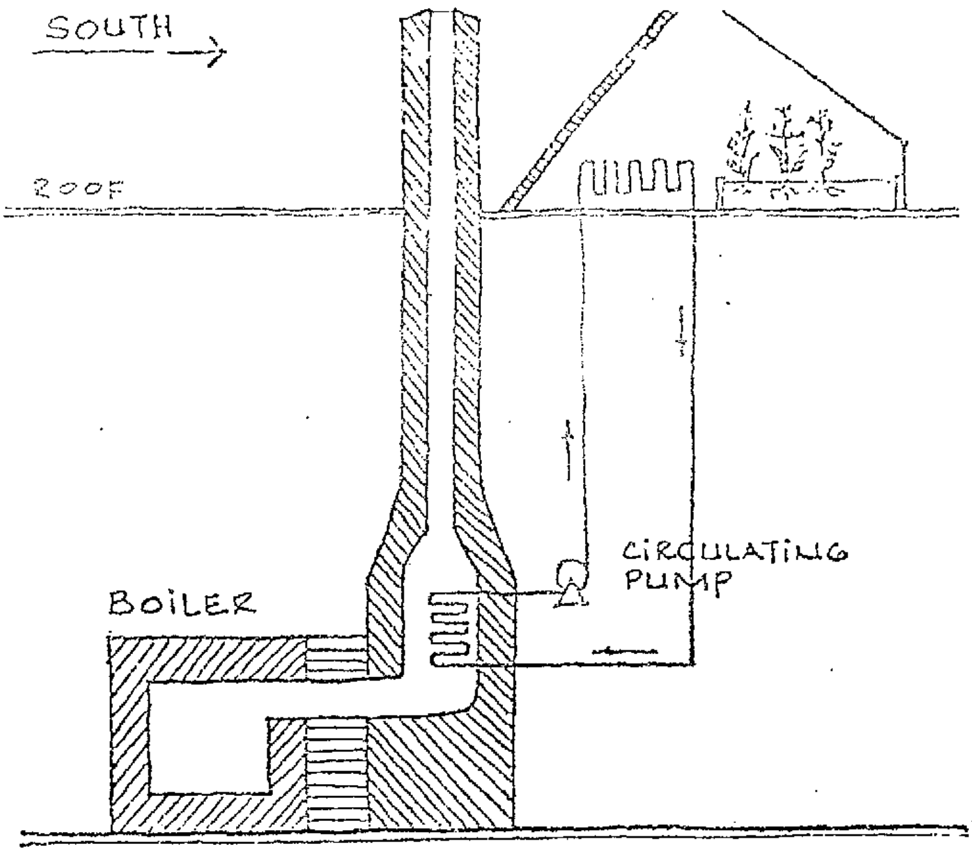
* [illegible] McGill [illegible] October 197[illegible], [illegible] pp.



HEAT RECOVERY FROM BOILER FLUE GASES FOR HEATING GREENHOUSE ON BUILDING ROOF

Fig. No. 4

On the short term basis, up to 5 years, Canada can do more to:

> Study the implications of such installations both from a technical, economic and marketing point of view. The greenhouses must not only be integrated technically into the operations, but must also be integrated into the market place of the region they will be serving. Government or local universities must provide technical services in this field to permit an adequate back-up support for these ventures - in the hope that the private sector will also eventually adopt this technology.

Research must be continued into heat conservation techniques for these large greenhouse complexes, and into the effects of small quantities of supplemental artificial lighting with a view to providing an adequate level of luminosity at all times of the year.

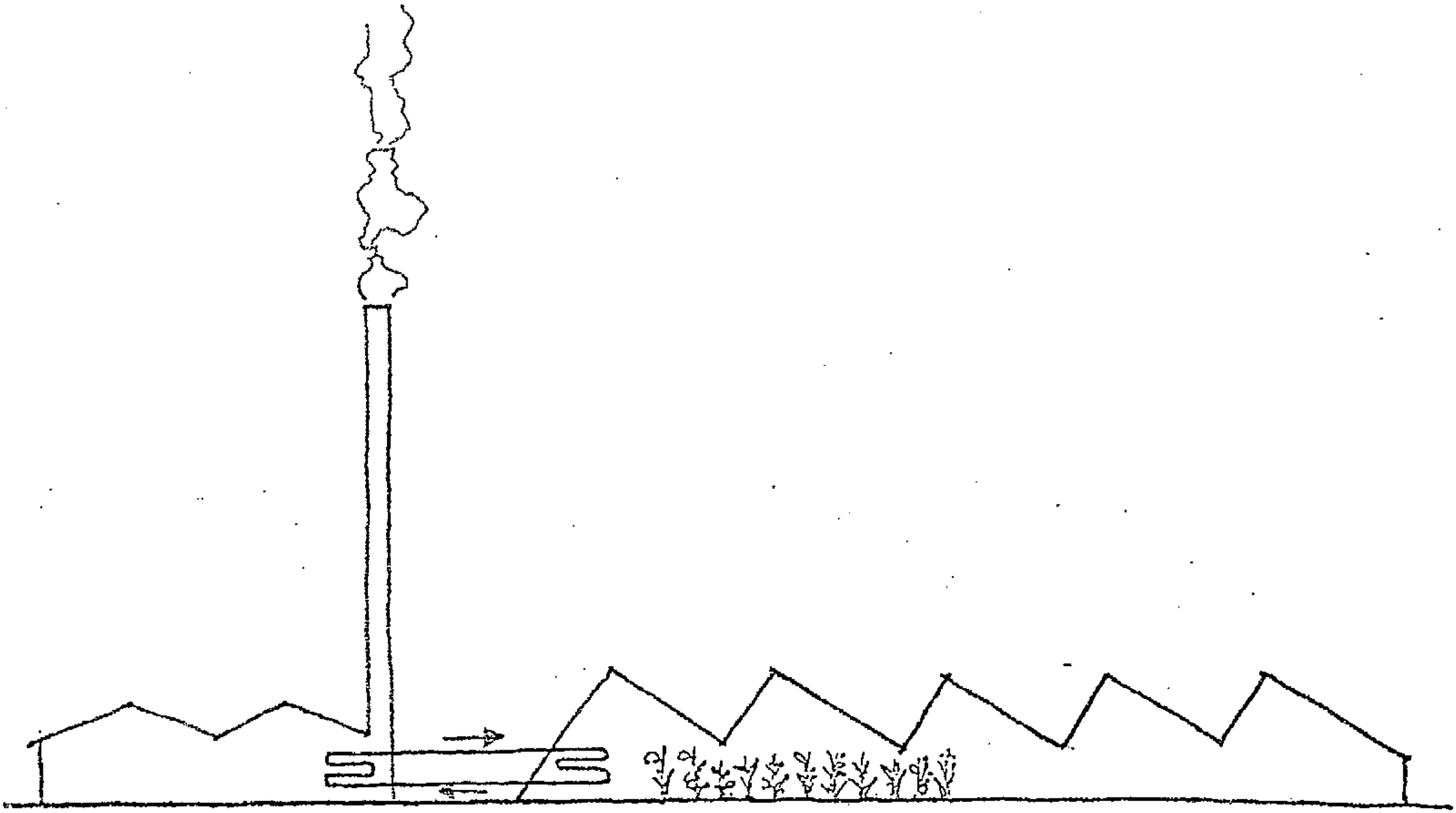
In the longer run, up to the next 15 years, it is hoped that plants throughout the country using cooling towers, or worse still, discharging waste heat streams directly into lakes or rivers, can be encouraged to utilize these sources productively. In some instances, waste heat sources may have to be upgraded through the use of heat pumps, if the temperature level cannot adequately meet the heating requirements of the greenhouse.

It goes without saying that this logical application of waste heat for the establishment of large scale greenhouse systems can create meaningful jobs in the community as well as a variety of entrepreneurial opportunities. Particularly in remote areas, it can permit the operation to assure the availability of supplies at all times of the year. Given the availability of supplies (even peat moss which can be used as a growing medium) throughout the country, there seem few obstacles to implementing this type of program.

There is one major drawback - Canada both on the federal and provincial governmental levels has had almost no commitment to the greenhouse industry. Recently, the Department of Supply and Services in Ottawa has issued a request for proposals for examining the role of solar energy and energy conservation in greenhouses. Whether this does indeed mean a slight change in attitude, remains to be seen. However, suffice it to say, that no significant progress can occur unless there is some commitment on the part of government, industry and the private sector to create the right climate for the establishment of this worthwhile sector of our economy.

Option: The Case for Energy Conservation in Buildings and the Prospects for Solar Heating these Buildings

Since the Autumn of 1973, the Western world has been deeply concerned with the cost and availability of its petroleum supplies upon which is based the operation of our industry. Unfortunately, this pre-occupation is a relatively recent one - hence [illegible] a great deal of technology and infrastructure which has been [illegible]



RECYCLING OF WASTE HEAT FROM INDUSTRIAL PROCESSES · TO HEAT COMMERCIAL GREENHOUSES

Fig. No. 5

and start over again for we have neither the structural, human or financial resources to undertake such a radical approach. As it takes a certain time period, for a society to change its philosophy of approach from one of consumption, irregardless of the cost, to conservation, bearing very much in mind the costs, we are even today, over 4 years after the so-called "crisis of 1973," continuing to produce and perpetuate inappropriate technologies, with respect to our energy consumption.

At this time, we will only consider the question of energy conservation in buildings, the recycling of waste heat and the possible use of solar energy. It must be recognized that the whole question of the use of energy in the society is vitally important. The emphasis herein is on the role of energy conservation and solar energy - some attempt will be made to examine the overall potential of these areas for the Canadian entrepreneur and job creator - and the prospects for employment that this element of the Conserver Society will bring to our country.

Energy Demand for Heating in Canada

Canada is considered to be well endowed in energy resources. Yet, Canadian petroleum imports now exceed exports and various projections show that the deficit will expand during the 1980s.

Table No. 5 summarizes some data on Canadian energy supply and demand for the year 1975. Dollar values are not shown, but in 1977, the quantity of imported barrels of crude oil was 218,876,153 from January 1977 to November 1977, amounting to a value of nearly \$3 billion. At the present time, this is the prime source of energy used in Canada.

The Québec situation is even more difficult; it has enormous hydro-electric power potential but, paradoxically, it is one of the most dependent areas of the world in terms of energy imports per capita. At the present time, it produces virtually no energy from hydrocarbon sources. The exploitation of hydro-electrical power is limited by the remoteness of rivers to be harnessed with consequently high prices of construction, transmission lines, etc.

In recent years there has been an increasing effort to reduce energy consumption in order to alleviate the overall supply problem, but these efforts are still not fully appreciated by the bulk of Quebec's society.

The following Table No. 5 shows the sectoral breakdown of the total primary energy consumption in Canada.

According to this study, the potential savings are in the order of 30 to 40% through increased thermal efficiency (mainly insulation, storm windows, caulking, weather stripping, etc.). Annually this amounts to 1.99×10^{11} Kw. hours equivalent (680 x 10^{12} BTU's) or 30.9 billion litres of oil equivalent used for space heating. These values were calculated for Canada in 1971. It has been estimated that [illegible] [illegible] litres of oil equivalent can be [illegible] annually if the country would be [illegible] [illegible]

TABLE NO: 5

ENERGY SUPPLY IN CANADA

Figures Quoted are in Billion BTU's

	COAL		LIQUIFIED PETROLEUM		CRUDE OIL		NATURAL GAS		ELECTRICITY		TOTAL
	CANADA	QUEBEC	CANADA	QUEBEC	CANADA	QUEBEC	CANADA	QUEBEC	CANADA	QUEBEC	CANADA
PRODUCTION	600,852	nil	232,905	nil	3,345,621	nil	2,699,544	50	731,035	258,664	7,609,95[illegible]
EXPORTS	338,437	nil	140,372	1,107	1,485,858	nil	946,848	4,122	38,927	3,129	2,950,4[illegible]
IMPORTS	449,744	16,191	nil	nil	1,743,535	1,071,727	10,220	nil	13,550	30	2,217,[illegible]
INTER-REGIONAL TRANSFER	nil	6,024	nil	6,454	nil	14,415	nil	86,260	nil	50,266	nil

SOURCE: STATISTICS CANADA DETAILED ENERGY SUPPLY AND DEMAND IN CANADA

1975 ANNUAL CATALOGUE 57-207 (SEPT 1977.5-3301-555)

7,000,000 residential units in Canada. The breakdown of these units heating consumption is given below:

	Number of Dwellings	Litres x 10^9 Oil Consumption
Single Family Dwellings	4.7×10^6	24.4
Attached Dwellings, Duplexes	0.6×10^6	2.2
Apartments	1.7×10^6	4.3
TOTAL	7.0×10^6	30.9

Source: SCANADA CONSULTANTS "Residential Heating and the Potential for Conservation," 1976, 17 pp. (prepared for C.M.H.C., Ottawa)

The value of the energy conservation program - 6.2 billion dollars - would be the basis for a substantial industry. The value of the oil savings annually is 1.25 billion dollars at 1977 prices.

For 1972, this amounted to 1.73×10^{12} Kw/hours equivalent.

TABLE NO. 6

PRIMARY ENERGY USE BY SECTOR

Residential	19%
Commercial	14%
Transportation	23%
Industry	25.5%
Energy Conversion (Primary to Secondary, i.e. Electrical Generation, etc.)	14.5%
Non-Energy Use (Petrochemicals, etc.)	4%

Source: Energy, Mines and Resources Canada Report EP 77-7. Energy Conservation in Canada: Programs and Perspectives, 1977.

Of the total amount of energy consumed by the residential sector, 80% is used towards space and water heating.

Commercial and industrial sectors make more diversified use of energy but still devote a large amount to space and water heating. A good part of this is process heat below 100°C which is within the realm of attainability using solar energy.

Recent studies[1] by the Central Mortgage and Housing Corporation and Scanada Consultants[2] have shown that the residential sector's energy demand can effectively be reduced by various conservation methods and consequently alleviate the energy situation in Canada.

Hence there is considerable incentive not only for the entrepreneur, but for the various levels of government to encourage and foster this industry.

Several case studies are presented which examine the overall problem of the provision of energy for heating in buildings. An appropriate methodology of approach is postulated as well as some of the options available to the designer involved in these fields. Each of these alternatives presents entrepreneurial and job creating opportunities which the Conserver Society must recognize. With the current allotment of over three billion dollars of fossil fuels, and the overall prospect of saving over one billion dollars per annum through the institution of a massive program of energy conservation, serious consideration should be given to this option.

Given the advent of the solar energy industry, a combined program of energy conservation and renewable energy utilization should provide, through the framework of a future Conserver Society, entrepreneurial and employment opportunities of significant magnitude. The economic potential for such a scenario exists and should be exploited in a rational, meaningful manner.

CASE STUDY

The Potential of Solar Heating of a Municipal Building in Montréal

In early 1978, several architects with the City of Montréal approached the Brace Research Institute with the view of determining the feasibility of using solar energy to heat one of their sport facilities, the Père Marquette Arena, which contains an indoor swimming pool, gymnasium and ice hockey rink. The initial proposal had been to investigate solar heating the swimming pool which is used during the entire year. The methodology of approach is examined to determine the optimum solution that should be expected in a Consumer Society, using technology appropriate to the needs of the building. These terms of reference were later broadened to that of partially solar heating the entire building. This is currently under investigation. The specifications of the Père Marquette Arena are given on page 356.

The Standard Solar Heating Approach:

For the case of the swimming pool, one simple, obvious solution would be to approach a solar collector manufacturer, in order to determine the area of solar collectors which could be coupled into the filtration pumping cycle of the swimming pool. As swimming pools often have a low pH, due to the addition of chlorine as a disinfectant, solar collectors using steel or copper absorber plates are inappropriate due to the high risk of corrosion, without adequate protection. Copper absorbers have been used in these systems extensively in other parts of the world. The pH is often balanced to some extent. It would be desirable to avoid this problem by utilizing solar absorbers made from fibreglass or plastic, which would be designed to withstand both moderate pressure and the high stagnation temperatures generated when the collectors were not in use. Solar equipment suppliers have been consequently contacted, and quotations received for providing solar collectors, which could be roof mounted. The question is technically feasible. The solar collectors would be mounted on the discharge side of the swimming pool filtration pump and in series with the heaters. It would be essential that an automatic drain down system be used if the pool water would be pumped through the solar collectors to avoid freezing in winter. Precautions must be taken to ensure that the pool water drains out of the collectors, during night time and cloudy periods, regardless of power failures, clogged check valves, etc.

Whilst this can be done, using equipment - solar collectors, pumps, automatic temperature controls, etc., which could be made in Canada, it basically solves only one problem and is not an answer to the overall problem of providing energy to a building system.

A brief examination of solar heating is given below as well as an insight into the appropriate technology approach which should be followed in the Conserver Society.

Solar Heating:

The overall problem of solar heating in Canada is particularly arduous given that it is possible to experience continuous external temperatures below freezing in excess of 100 days in the Southern regions and far longer periods further North. In addition, long periods of cloudy weather often render these systems inoperative. Solar systems often require large storage systems to be effective. It is therefore essential that appropriate technologies utilizing solar energy be developed which are well adapted to the severe Canadian climate.

A solar heating system consists of the following elements: (See Fig. No. 7).

Solar Collectors are generally located on the roof or sides of a building. The available solar radiation in Canada is of the order of 3 to 4 Kw/hr per square metre of surface area on a South facing solar collector placed at an optimum tilt for energy collection.

A heat transfer fluid is circulated through the collectors either by a fan [illegible] pump. The heat collected is stored in a [illegible] generally [illegible]

Heat is extracted from the storage unit to maintain comfortable temperatures within the house. Generally, solar systems contribute about one-half of the heating needs of a building, the balance of the energy coming from conventional sources - electricity, gas or fuel oil. Some systems have been designed and built which are meant to provide 100% of the building heating needs. In Canada today, the costs of these systems (i.e. for 50% heat provision) varies from $4,000 to $10,000 for standard homes. The costs are not really fixed as most systems are in the process of evolution and amelioration.

Given however the high proportion of our National energy budget spent on heating of buildings, the solar heating of buildings and hot water for residential, commercial and industrial use, and for the provision of other low temperature process heat, becomes attractive.

There are several ways in which entrepreneurial options exist:

a) in the design of appropriate systems;

b) in the manufacturing of component parts of the systems:

- solar collectors of all types
- fans, pumps, motors, piping, duct work, etc.
- automatic controls
- storage system components, etc.

c) in the installation and maintenance of the equipment.

Given the future development of Canada, the adoption of solar energy for the provision of part of our energy needs can effectively:

1. reduce imports of foreign fuel reserves, and save foreign exchange;

2. provide entrepreneurial opportunities for design manufacturing and servicing industries;

3. provide meaningful employment for Canadians.

The solar systems discussed above are generally referred to as "active" systems. Passive solar systems, sometimes assisted by simple fans, etc., are gaining increasing popularity and may one day overtake the active systems. There is nothing new in passive solar systems - a large window facing south is a perfect example of a passive system.

<u>Some Problems in Solar Heating Systems:</u>

Generally, air, water or some non-freezing solution (e.g. ethylene glycol or [illegible]) is used as the heat transfer fluid in solar systems. In selecting fluids [illegible] [illegible]

a) The fluid has no cost;

b) The installation of the solar collectors and the duct work is somewhat simpler than systems using liquid heat transfer fluids;

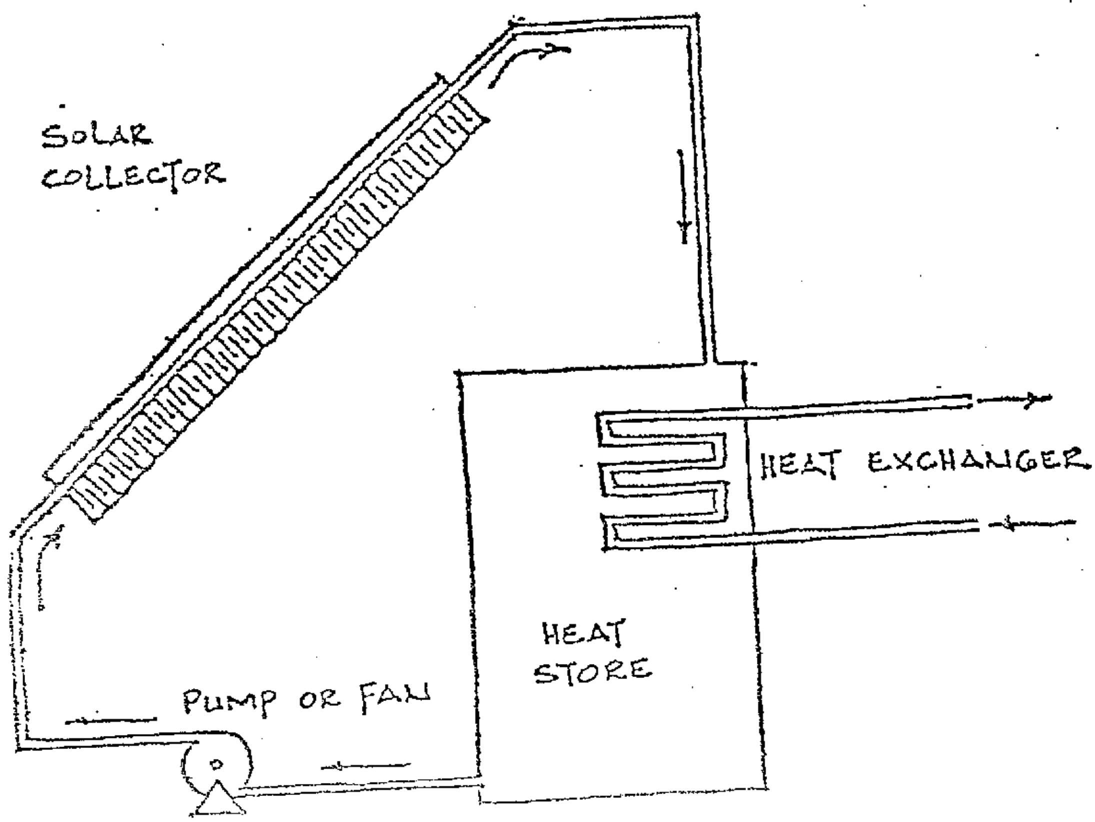
c) Properly designed solar air heater collectors can be more efficient and lighter in weight than solar liquid heating collectors;

d) Less skills are generally needed for the installation of solar air heating systems;

e) Small amounts of leakage of air from the system is not harmful, causes no damage and can be tolerated. This is not possible with liquid systems;

f) Air circulated through can be filtered, purified, humidified, supplemented with fresh make-up, etc., using standard known technologies.

g) Air does not freeze, and hence will not damage solar collectors. Air does not basically corrode solar collectors.



Specifications of Père Marquette Arena - Used in the City of Montréal Case Study:

The Architects of the City of Montréal investigating the possibilities for the conservation of energy and the possible use of renewable energy sources in meeting part of the building energy demands, have provided the following specifications of the building under study:

- The surface area of the roof available for solar energy collection is approximately 4200 square metres. Obviously not all of this area is available for solar collectors.
- Approximate volume of building to be heated: 31,400 cubic metres.
- The area of the swimming pool is 10.7 metres by 25.2 metres giving a total area of 270 square metres.
- The volume of the swimming pool is 600 cubic metres.
- The total cost of the heating the building per annum is approximately $27,700.
- The type of fuel for heating is natural gas.
- The volume of hot water used per day for showers is approximately 5 cubic metres per day averaging approximately 200 showers per day.
- The average temperature of the hot water used for the showers is 50°C to 55°C.
- The ice generating equipment uses a refrigeration cycle with waste heat generated per day exhausted to the roof area in the order of 300 Kw. hrs. heat equivalent per day.
- The electrical energy used in the building per annum costs approximately $25,000.
- The hot water is heated by natural gas.
- The heating bill for natural gas, which includes energy provision for hot water, amounted to $27,500 for the 1976-77 season. This was increased from the 1975-76 season when the cost of natural gas was $20,000. This represents an increase of over 1/3 in a single year.

Assessment of Municipal Building Energy Demand and Supply Requirements. The [illegible]ropriate Technology Approach.

[illegible]le the first [illegible] to reduce [illegible] ing cost [illegible] municipal [illegible] to follow [illegible]

1) Undertake a complete assessment of all sources of energy used within the building complex (or process industry for that matter). In the case of the example under consideration, this would entail a detailed assessment of the sources of energy used to:

   a) heat the entire building;

   b) heat the hot water used for the showers/lavatories, etc.;

   c) any other consumption of energy, e.g., electrical energy for lighting, etc.

   In addition, an assessment of the waste heat produced in the building is also critical. This would be in the form of the waste heat from the refrigeration plant for the skating rink, waste heat generated through the absorption of excessive solar radiation gained through windows, etc. This must often be ventilated to the exterior in order to maintain comfortable temperatures in the interior rooms. This is particularly true in the swimming pool area at certain times of the year.

   It is essential to note the variation of energy consumption and waste heat production during different times of the year, which serves as a basis for technical design and the economic yardstick by which the project will eventually be judged.

   Once a complete assessment of the existing energy situation within the building has been undertaken, it will be possible to examine the situation in detail in order to attempt to analyse the real nature of the problems to be solved. If this is not done properly, eventual solutions might be proposed, but the risk exists that one might be solving the wrong problems.

2) The next step is to make a careful examination of the energy conservation practices within the building itself. This would include an assessment of the insulation in the roof, walls, basement, etc., an assessment of the weatherstripping and all other forms of heat loss from the building. Obviously air infiltration and ventilation heat losses would also have to be taken into consideration. At this stage of the economic situation in Canada, it is generally more cost effective to institute proper methods of insulation and energy conservation than all other alternatives. This is a well known technology and Canadian entrepreneurs have begun to exploit this potential. The Federal authorities have set up a program called ENERSAVE, wherein Canadians are able to telephone or write regarding their energy conservation problems. There is also a program of incentives to the owners of older buildings at this time, to add additional insulation to their buildings. It goes without saying, that structrues designed and built during periods when the price of energy was very inexpensive, are necessarily less adequately insulated than newer buildings currently being erected. Minimum insulation standards are also being increased. The reinsulation of buildings is an example of [illegible]

Care must be taken to ensure that the reinsulation of an older building does not result in the furnace burner being off for longer periods of time. Efficiency of heat recovery from furnace burners operating continuously averages about 73%. Frequent cycling of burner operation, which could result from buildings which are better insulated, reduces the efficiency to 55 to 63%. Hence a global approach is needed in examining energy conservation schemes in buildings.

Needless to say, there are a number of abuses which are occurring in this rapidly growing energy conservation field. Property owners, whether they be in the residential, commercial or industrial sector are well advised to examine carefully the quotations for insulation jobs they receive from a number of different sources.

One principal fallacy of operations of official programs of this type, is that they are developed at bureaucratic levels by elements of the society with above average levels of education and income. The problem often arises that this small group of concerned policy makers cannot put itself in the position of the average citizen of the country who may have neither the technical capacity nor the business astuteness to fully appreciate the type of insulation options offered by the entrepreneurial sector. One excellent publication prepared by the Federal Government on the value of reinsulating homes, addresses itself solely to the problems of the private home owner. It must be recognized that many Canadians do not live in single family dwellings and some effort must be made to indicate what methods they might also take to reduce their basic energy consumption. According to a 1976 CMHC study, this was approximately 42% of Canadians. In Québec, only approximately 40% of the population lives in single family detached dwellings. Also, 53% of Québec families are tenants according to the 1971 census*.

3) The next step in the building analysis is to determine how energy consumed or generated within the building might be recycled. In the case of the municipal arena in Montréal, it is evident from the statistics provided earlirer that a large amount of hot water is generated for showers for bathers in the swimming pool. As this waste hot water still contains a fair amount of heat, it is possible to recycle some of this heat to pre-heat incoming cold water to the water heaters. This is particularly effective during the winter period when the inlet temperature of the cold water can be as low as 2°C. If reject shower water at 30°C to 35°C is available, it can be used to pre-heat the incoming cold water even to 25°C. It might economize up to 50% of the energy consumed for hot water heating. By assessing the various other low temperature energy demands, it may also be possible to partially heat the swimming pool water, etc. Heat exchangers of this type are available in the industrial sector of the society. Entrepreneurial opportunities exist both in engineering design, in the fabrication and in the installation of heat recycling systems of this nature. Technical problems do exist in the fact that shower water is [illegible]

capability of Canadian industrial capacity. It suffices that the problems should be recognized as one having an overall potential, in order to encourage the adequate allocation of time and resources to develop this mini-industry. At the same time, however, there are many similar instances in process industry, etc., where waste heat could be recovered from such low temperature heat streams. As other countries are applying themselves to these problems, no doubt we will follow the typical Canadian technological solution which is to import the know-how and equipment from abroad. The basic disadvantage of this scenario is that it saps the initiative and dignity from the Canadian technical community as they are continuously by-passed in favour of foreign systems and expertise.

The psychological role of the Conserver Society should surely be to place its confidence in the ability of its citizens to adequately provide services and goods to meets its overall needs and requirements.

The other form of waste heat known to be generated is that from the refrigeration plant at the ice rink. The operating characteristics of this system as a function of the demand loads for heat, hot water and swimming pool heating should be examined. As a result, it will no doubt be possible to recover some of this waste heat by integrating this into the overall system demand for energy.

If action were taken on the above sectors, one could readily apply the following equation to the energy requirements of the building:

$$\begin{array}{c} \text{Actual} \\ \text{Building} \\ \text{Energy} \end{array} = \begin{array}{c} \text{Original} \\ \text{Energy} \\ \text{Demand} \end{array} - \begin{array}{c} \text{Energy saved through} \\ \text{Conservation Methods} \end{array} - \begin{array}{c} \text{Energy saved} \\ \text{through Recycling} \\ \text{of Waste Heat} \end{array}$$

By examining the actual energy demand, as defined above, it is possible to now more effectively, adapt the Standard Approach discussed earlier. Other sources of energy available to the building are:

a) waste refuse which can be burned;

b) energy in the toilet waste;

c) wind energy;

d) solar energy.

There is sufficient waste refuse in a building of this nature to contribute to the energy needs. However, this is not to say that in another building, this option should not be examined. Regulations often restrict the use of this equipment during certain hours of the day, so that some method of heat storage would have to be envisaged. There is a minimum of energy available [illegible] contemplated. At the moment, energy generated from the small available wind machines on the market, is not effectively competitive with conventional sources. This option would have to await developments in the technological and legal fields involving the use of this renewable energy source. Clearly then, solar energy presents the most attractive renewable energy options for supplemental building heating requirements.

4 Once the energy conservation and waste heat recycling phases have been examined, it is possible to make a complete assessment of the potential solar radiation input to the overall heating load of the building complex. Solar radiation is already contributing to the solar heat gain in winter through the existing windows and other transparent fenestrations of the building. Stephenson and his colleagues at the National Research Council in Ottawa have published tables permitting the calculation of this heat gain as a function of time of the year, time of day and orientation of vertical surfaces, for clear sky solar radiation conditions. Solar radiation reception on horizontal surfaces can also be obtained from these tables*.

Solar radiation, does of course, add unwanted heat during the summer period as well. However, while ventilation and shading are used to get rid of surplus heat, there is nonetheless a demand for heating during the summer for hot water, for the swimming pool (to maintain a temperature of 27°C), and for maintenance of a minimum comfort level during cold periods in the summer. For Montréal, the heating degree days below 18°C during the summer months, amount to approximately 340 or 8% of the total heating load.

In addition to heat gain through windows, the Conserver Society designer, using the Appropriate Technology approach, can examine additional passive heat possibilities as well as the use of active systems.

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* Stephenson, D.G. 'Tables of Solar Altitude, Azimuth, Intensity and Heat Gain Factors for Latitudes from 43 to 55 Degress North", Division of Building Research. National Research Council of Canada, Technical Paper No. 243, Ottawa, April 1967.

Various Solar Options for Heating the Montreal Building:

There are several passive solar heating options open to the design engineers on the Montréal municipal building retrofit. Solar energy collection is attainable as follows:

a) direct solar heat gain through windows facing a general southern direction (this is actually occurring now), (See Fig. No. 8);

b) increasing the area of south facing windows by replacing non-load bearing, solid walls by transparent windows, to increase direct solar heat gain (See Fig. Nos. 8 and 9);
Both systems A & B are purely passive systems.

c) adding Trombe type solar walls (as discussed under this section), assisted by a ventilator to boost the output efficiency, assumed in this case to be 30%. (This is an assisted passive solar collection system);

d) adding solar collector arrays on the exposed roof area (This is a purely active system).

Preliminary calculations, outlined in the following table, have indicated the following potential, for the Municipal building in Montréal:

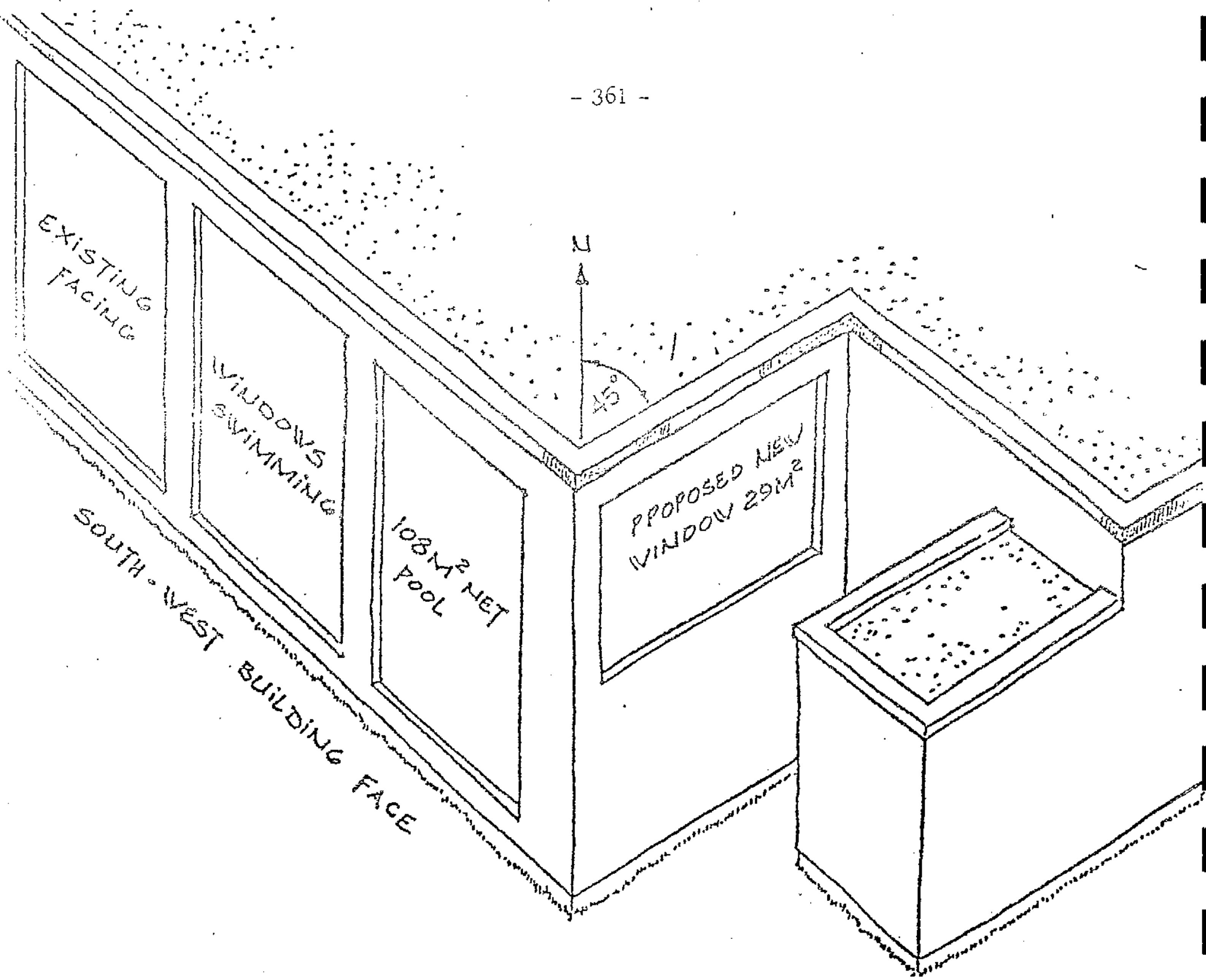
a) direct solar heat gain through the 108 square meters of south west facing glass facade on the swimming pool area = 131,500 Kwhrs equivalent, per annum. This energy is received at this time. As the swimming pool is heated in summer as well, for the benefit of the swimmers, augmenting this input is possible, even at this stage of the operations;

b) replacing of the south east solid wall by 29 square meters of transparent double glazing would produce a total solar heat gain of 35,300 Kwhrs equivalent, per annum.

Unfortunately, due to shading, only 29 out of a possible 58 square meters of glazing can be installed on this wall. The cost of undertaking these modifications would have to be balanced against the potential heat gain.

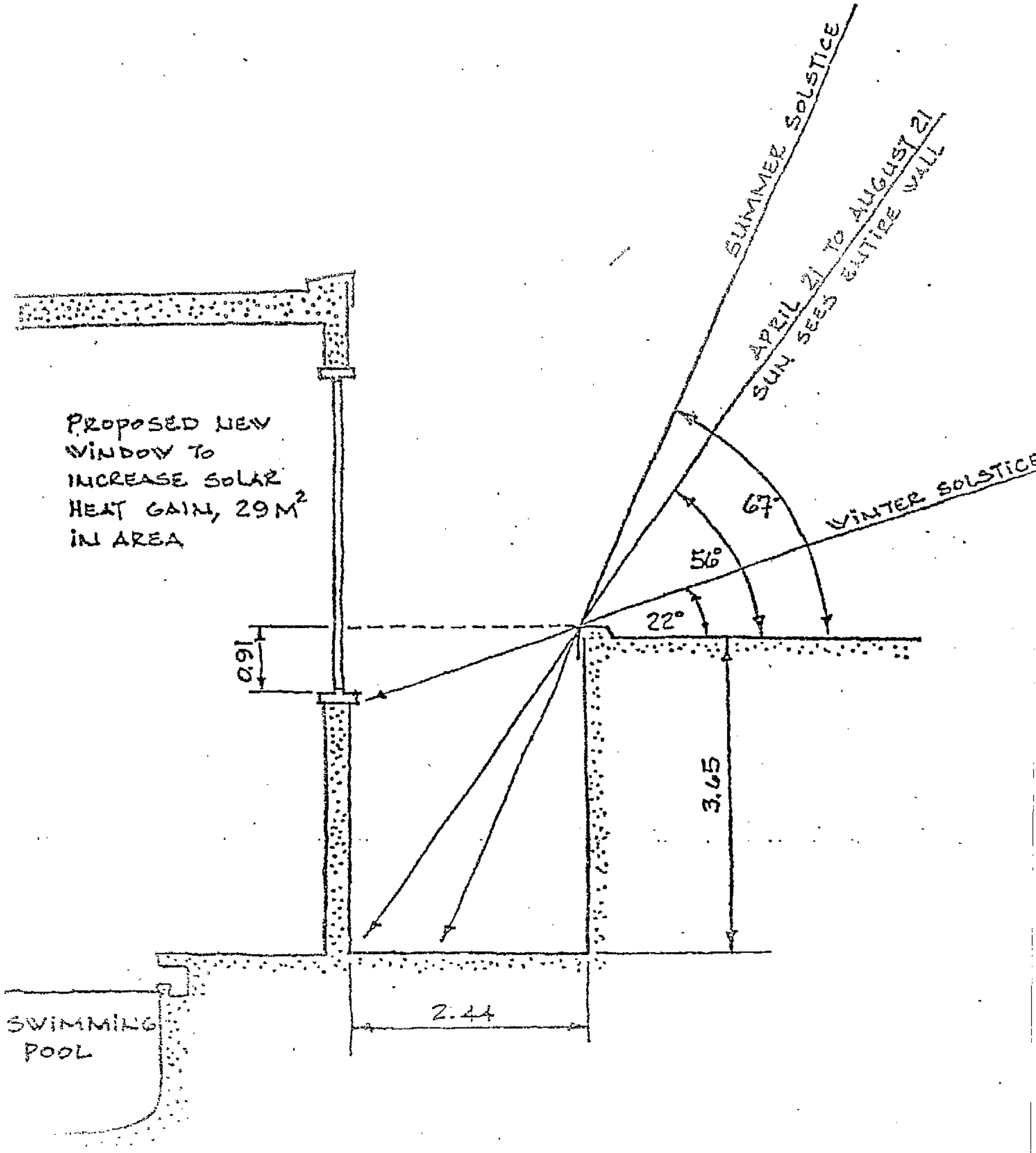
For both options A and B, it must be stressed that there is only the capital investment to consider. The repair costs are minimal, and the operating costs consists mainly of cleaning both the interior and exterior surfaces of the glazing.

Using these passive systems, there could be a certain loss due to the opacity of the glazing structural support and some of the heat would be reflected off the water surface. Because of the angle of incidence of the sun, however, most of the reflection would be directed towards the interior of the building. [illegible]
[illegible]



NATURAL SOLAR HEAT GAIN FOR SWIMMING POOL AREA AND PROPOSED NEW WINDOW AREA

Fig. No. 8


SUMMER SOLSTICE
APRIL 21 TO AUGUST 21
SUN SEES ENTIRE WALL
WINTER SOLSTICE
67°
56°
22°
PROPOSED NEW
WINDOW TO
INCREASE SOLAR
HEAT GAIN, 29M²
IN AREA
0.91
3.65
2.44
SWIMMING
POOL

OLAR HEAT GAIN FACTOR (SHGF) FOR A SOUTH EAST OR SOUTH WEST VERTICAL WALL IN THE MONTREAL AREA, FOR CLEA

ME OF YEAR st DAY EACH MONTH	SINGLE GLAZING WATT.hr/M^2	DOUBLE GLAZING WATT.hr/M^2	DOUBLE GLAZING FOR 108M^2 S.W. FACE TO POOL AREA WATT.hr	DOUBLE GLAZING FOR 29M^2 S.E. FACE TO POOL AREA WATT.hr	DOUBLE GLAZING TROMBE WALL ON S.E. FACE WATT.hr/M^2
OCT	3751	3376	364,608	97,904	1013
NOV	3338	3004	324,432	87,116	901
DEC	3045	2741	269,028	79,489	822
JAN	3406	3065	331,020	88,885	920
FEB	3896	3506	378,648	101,674	1052
MARCH	4258	3832	413,856	111,128	1150
APRIL	4020	3618	390,744	104,922	1085
MAY	3679	3311	357,588	96,019	993
JUNE	3513	3162	341,496	91,698	949
JULY	3621	3259	351,972	94,511	978
AUG	3892	3503	378,324	101,587	1051
SEPT	4072	3665	395,820	106,285	1100
CUMULATED ARLY TOTAL	1,353,420	1,217,944	131,537,950	35,320,376	365,383

LAST ... EAT
GAIN ...
USEFU ... TION

ALL ... HGF
ARE
SINGLE

NOTE: ... ARE
FOR ... ION
CONDITIO

ACTU ... OULD
PROS ...
VALUES

angle of the sun is higher. Thus during the summer months, most of the heat in the solar radiation would be absorbed directly by the swimming pool itself. Any excess heat generated from this swimming pool-cum-window collectors, could be stored inside the building instead of being vented to the outside. With the use of a heat pump, the low grade heat (collected in the human comfort zone temperature range), could be upgraded before storage. Heat pumps are generally efficient for this type of upgrading. The subject of heat pumps is treated in a later section.

Another option in solar heating of the building would be the installation of solar air or water heaters directly on the roof.

One option that needs further investigation is the installation of insulated curtains which could be drawn each night. The curtain materials and curtain tracks must be able to resist the high humidities and solar intensities experienced, adjacent to a swimming pool. This type of system can also be used for large store fronts, show rooms, etc., wherever large expanses of glazing are used in conjunction with heated buildings. An interesting additional entrepreneurial idea would be the development of automatic curtain openers, powered by electric motors activated by levels of solar radiation incident externally on the glazed surfaces.

c) per annum, the modified, forced air Trombe walls could produce, per square meter, approximately 365 Kwhrs of heat equivalent. These can be placed on south east and south west facing walls, and would be used primarily for heating purposes. The cost of operating the electrical ventilators would be an additional charge.

d) if arrays of solar collectors were used on the roofs, at an angle of 60 degrees to the horizontal, they would produce 345 Kwhrs of heat equivalent per square meter of solar collector*. Actually this method is somewhat less attractive at this moment than some of the other options. This data is given in Table No. 8.

There is sufficient area on this roof to install rows of solar collectors, properly spaced in order to capture solar heat which can then be stored in the building for subsequent use. The cost of solar collectors is of the order of $125.00 per square meter of collector. Most solar installations however cost approximately $380.00 to $400.00 per square meter of solar collector installed (this includes the installation of pumps, piping and insulated storage systems, controls, etc.). If the net heat production of units of this type gives the equivalent of approximately $5.50 to $6.00 per square meter of solar collector per annum, it can be seen that conventional solar heating systems of this nature are not very cost effective at this stage of their technological development.

POTENTIAL OF SOLAR RADIATION USING COLLECTORS IN THE SOUTH WESTERN REGION, QUEBEC

TIME OF YEAR	MONTHLY TOTAL AVAILABLE RADIATION WATT.hr/M^2	ASSUMED 25% USEFUL EXTRACTION WITH SOLAR COLLECTORS WATT.hr/M^2
OCT	102,390	25,600
NOV	52,130	13,030
DEC	70,750	17,690
JAN	87,590	21,900
FEB	108,520	27,130
MARCH	145,180	36,300
APRIL	128,230	32,060
MAY	139,350	34,840
JUNE	135,790	33,950
JULY	145,330	36,330
AUG	139,020	34,760
SEPT	126,080	31,520
YEARLY TOTAL	1,380,360	345,110

NOTE: SOLAR COLLECTORS ARE FACING DUE SOUTH WITH SURFACE INCLINATION OF 60°. DATA FOR THIS PURPOSE HAS BEEN EXTRAPOLATED FROM THE FIGURES FOR OTTAWA LISTED IN "TURN ON THE SUN", 1977, MINISTRY OF ENERGY, ONTARIO

One of the principal problems that the Conserver Society must face is that solar energy has been only examined in a serious fashion in some countries in the very recent past, that is, during the last 4 or 5 years. The Canadian program is only now beginning to gather momentum with the projected governmental research allocations this year in the order of just over 7 million dollars (1977 to 1978 Federal Energy R & D Estimates). This covers all investigations in the form of renewable energy (solar, wind and biomass) and does not include expenditures in the field of hydraulic energy R & D.

It is generally agreed that it takes approximately 20 to 30 years to develop appropriate technological systems in a given field of endeavour in order to work out the problems of suitability of the systems, availability and marketing, servicing, maintenance, and the like. It is therefore evident that we are just embarking on a long term program of renewable energy utilization in this country. It will necessarily take the allocation of funding and personnel in order to meet the challenge. Not all the emphasis should be placed solely on Federal Government initiatives. It will require an interdisciplinary effort with inputs being made by the provincial and municipal sectors, industry and the public at large.

Problems with the Conventional Solar Energy Approach for the Heating of Buildings

Once the energy conservation methods discussed earlier have been taken into consideration, for any building, the potential of solar energy heating can be considered. In large urban centers, large apartment, commercial and industrial buildings are prime targets for solar heating applications due to the large quantities of energy they consume. In addition, as they are often owned, or operated as a business, the decision making process is generally rational, with the managers seeking a reasonable return on their capital investment, be it for energy conservation or renewable energy purposes. Buildings of this nature are generally characterized by flat roofs which offer good exposure to solar radiation.

The conventional solar energy approach would be to:

a) calculate the heat requirements of the buildings;

b) determine the technical performance of an adequate solar heating system to meet a portion of these requirements*. Using life cycle costing, liquid solar system, with short term storage, Hollands and Orgill calculated that for apartment, office and warehouse building types, the unit costs in cents per equivalent Kwhr, would be the lowest for the solar system contributing approximately 40 to 50 percent of the total heating load;

c) once the area of solar collectors is known, the solar collectors are set out in the exposed roof area, with their orientation being as much as possible in a southern direction.

This constitutes some problems in that:

1) buildings are rarely oriented along the compass coordinates, consequently it is not possible to effectively maximize the area available for solar collectors (See Fig. No. 10);

2) when the solar collectors are set up in rows or arrays, space must be left between the rows to avoid shading of collectors by the next southern most row (See Fig. No. 10);

3) the heavy snow loads experienced in this region dictate that allowance must be made for snow shedding from solar collectors. Access must also be allowed for, which results in a fairly wide spacing between adjacent solar collector rows (see Fig. No. 10);

4) the location of rows of solar collectors on a roof building affects the loading to which the roof is subjected. Most solar collectors weigh between 35 and 60 Kg per square meter of collector area, including structural support stands.

   The construction of large (over 1.8 m) structures on existing roofs is problematic. The National Building Code is quite explicit about the additional loads due to snow drifting caused by any vertical obstruction on a roof. This "drifting area" extends twice the height along the horizontal plane and increases significantly (up to 3 or 4 times) the additional load that the roof must carry in this particular area.

   As a result, it is evident that in some instances, existing roofs must be strengthened to allow for the loads imposed by installing solar collector arrays;

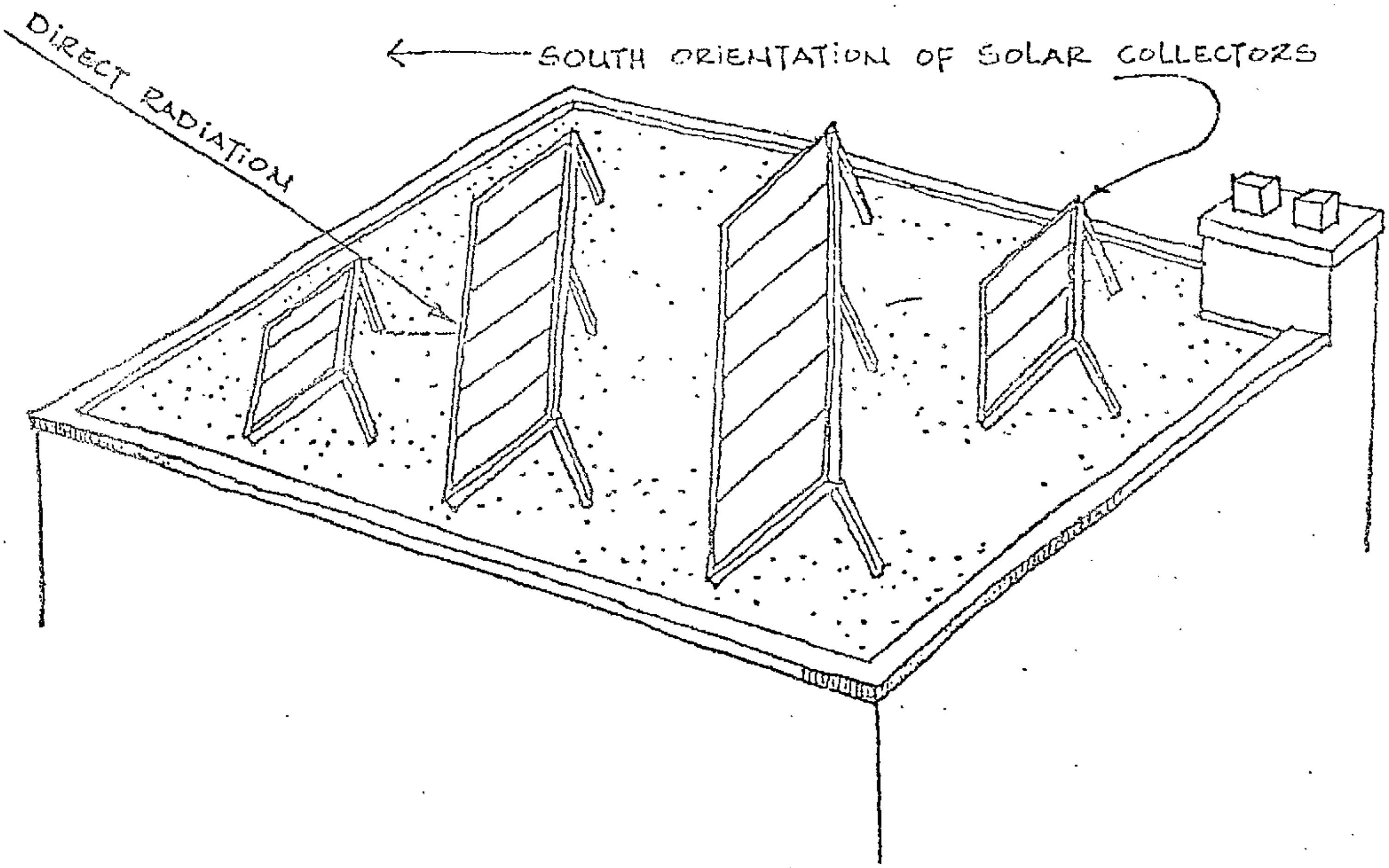
5) another problem inherent with the installation of solar collectors on roofs, is the increased wear on the roof membrane. The solar energy field is still relatively new, and time will indicate what precautions are essential to prolong the life of the weatherproofed membrane;

6) a further problem which must be envisaged is the damage which could be caused to a given solar system when the roof must be repaired or the entire membrane replaced;

7) the damages of fluid spillage, especially glycol solutions which can cause problems to some types of roofing materials, has already been experienced in the United States;

8) the cost of installed solar collector systems, including solar systems, pumps, labour, etc., ranges from $380.00 to $400.00 per square meter of solar collector installed. The capital investment in the solar collectors is of the order of one third of the total cost. This is the price for retrofitted, added-on system.

[illegible]



INSTALLATION OF SOLAR COLLECTOR ARRAYS ON THE ROOF OF A LARGE BUILDING

Fig. No. 10

At today's rate of installed capital cost and the expected payback of $5.00 to $6.00 per square meter of solar collector per annum, there is not much hope that this type of solar system will prove to be an economically feasible proposition, in the short run, even if some of the technical problems can be adequately overcome.

For all these reasons, it would appear that the Conserver Society should make every effort to develop some imaginative schemes which would rely on the overall needs of the country, while at the same time exhibiting some greater financial feasibility. The concept of utilizing solar energy in meeting the space heating, water heating and low temperature process heating needs of our society is rational, primarily because this is a renewable form of energy. The manner in which these systems are utilized will indeed decide whether or not, in the long run, they are appropriate. If the systems which Canadian technologists design for the Conserver Society, utilizing renewable energies are not satisfactory, even the fact that the resources are renewable may not be sufficient to render these systems acceptable.

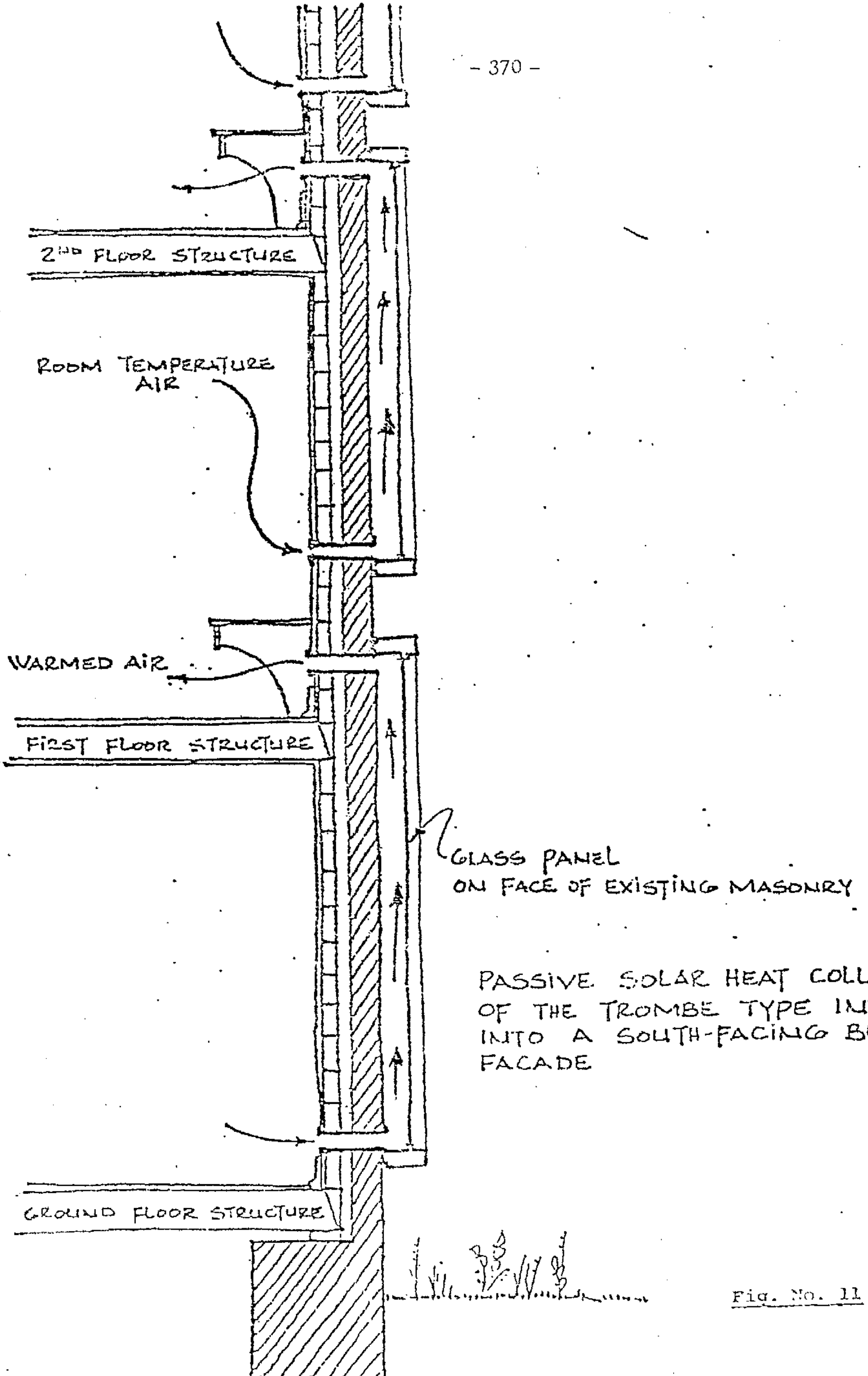
Passive Solar Energy Options

Existing buildings are rarely set up along North-South or East-West axes as this has generally never constituted a consideration in the building design. Passive solar wall heaters of the Trombe design were developed in France. They operate as follows: A south facing wall of brick, concrete or masonry is covered by an external doubled transparent layer of glass or fibreglass. The building wall is suitably darkened and during sunny periods the wall is heated up by the solar radiation which passes through the transparent cover and is absorbed on the south facing wall. This in turn heats up air which circulates (See Fig. No. 11) through openings in the bottom and top sections of the wall. This technique has been successfully used in a number of locations, with some basic modifications. In Québec, experiments at the Brace Research Institute have indicated that the unit has poor efficiency during the coldest winter months, as the heated area is adjacent to the transparent cover, with the resultant high nocturnal heat losses. Nonetheless, the system is relatively inexpensive to install and uses available component parts. Glass curtain wall components are manufactured in Canada and constitutes a successful industrial activity. It is very easy to provide a glass curtain wall to the external part of a building. It has the following advantages:

a) the system is effectively low cost, being ostensibly passive in nature - this cost amounts to the cost of the glass cladding, the openings in the wall, the suitable darkening of the exterior wall components, and the operation of adjustable dampers to control the flow of warm air into the building;

b) it makes use of spaces for solar heat collection other than south facing windows, still permitting access to the view and natural lighting;

[illegible]



PASSIVE SOLAR HEAT COLLECTORS OF THE TROMBE TYPE INTEGRATED INTO A SOUTH-FACING BUILDING FACADE

Fig. No. 11

d) in summer or during warmer periods by rejecting the hot air to the outside, it is possible to effectively use these passive solar walls to provide ventilation. As the heated air from the collector is rejected to the outside, it is replaced by cooler air taken from the north side through the building. This has been tried in Canada again at the Brace Research Institute and has proven quite feasible.

Hence these passive systems can provide today a viable entrepreneurial opportunity - given the relatively large amount of south facing surface area, that is to be found in existing buildings. Employment can also be generated as industries could modify their existing structures with a minimum of effort.

Care must be taken in installing the glass panelling. Obviously the greater amount of exposed glass surface is subject to damage through increased vandalism, and precautions must be taken in sensitive areas against this possibility.

It must be stressed that the passive solar walls herein described are best adapted to the retrofitting of existing buildings. In new construction, a total environmental approach would be the best option to consider.

Possible Improvements in Passive Systems Over the Next 5 to 15 Years

In the short term, it will suffice if Canadians could acquire additional experience in the construction, testing and operation of such passive systems. Already the National Research Council has awarded contracts for the study of such operational systems. Results of this nature will permit a better comprehension, both scientifically and technically of these systems.

Some improvements are obvious and will no doubt be tested and improved under Canadian conditions:

a) the installation of air circulating fans will permit the extraction of a more significant proportion of the heat in the wall. By operating the wall at lower temperatures, heat losses will be reduced and the efficiency of solar heat collection increased (See Fig. No. 12);

b) the addition of ventilators will permit the channelling of warm air to heat storage areas, thus extending the useful operating period of these units. They will, of course, no longer be totally passive, but will not be quite as complex as existing active systems;

c) the development and adaptation of thermostatically controlled dampers on the inlet and outlet of these solar wall units will increase the comfort level of the users of the building while tying in the solar system to the conventional heating system within the structure.

Other developments which may be longer term will no doubt be the development of:

a) some form of insulated cover which will enclose the glazing, thus effectively reducing the heat loss from the building envelope at night time and during periods when the building is not used. It may be that one day, the buildings we have currently erected, which consume enormous quantities of heating fuel and electricity for heating, hot water, lighting and power, may be closed in at night by external curtain configuration which will prevent excessive heat losses. Some efforts have been made to date, to blow insulation between the glass window panes. This type of process may one day be improved, as approximately 2 cm of blown insulation increases the R value by approximately 4.

b) heat of storage materials whose ratio of the quantity of heat collection per unit weight and unit volume is very high, may one day be placed at the hot air exit of these simple, vertical solar walls. Increased heat transfer into a heat of fusion or heat of reaction mixture, should be able to collect significant quantities of heat at 30°C. This will require breakthroughs in the field of heat storage technology which will hopefully permit large quantities of solar heat to be stored directly at the outlet of solar walls of this type.

Development of this type of system will revolutionize building interior design next to the ordinary window. By placing, for example, tubular sections of heat storage materials in the interior path of solar radiation transmitted through exposed south facing windows, it will be possible to absorb at relatively low temperatures, solar heat without recourse to the current overheating that occurs. This type of material which could be developed to absorb heat at levels as low as 25°C, should prove a boom to the greenhouse industry as well, as they no longer will need to be overheated.

This is a question of research and development, in order to develop the appropriate material systems, the above cost would be low, which possesses the ability to be cycled a greater number of times, etc. Research is being pursued into the field of heat storage in Canada and elsewhere. However, how much investigation is being directed at developing very simple heat storage systems which can effectively revolutionize our current operations? If the Conserver Society is to succeed, it must have a say in the direction of the long term research and development policies. As much as possible, our programs should be imaginative, with some effort being always directed to new ideas, with original thinking as long as the long term end use is relatively simple and easily adaptable by society.

Future Prospective Activities in the Field of Solar Heating of Buildings

An examination of the factors cited earlier have indicated the technical and economic problems inherent with conventional solar heating of buildings. Obviously bolder and more imaginative solar collector and heat storage systems are needed, if these systems are to make a significant contribution to Canada's energy needs in the future. As this is so intimately tied into any future Conserver Society, it would be well to dwell on some options which have future potential.

A study of a solar heating design recently undertaken for a Montreal apartment building revealed some [illegible] factors. The building has the following characteristics:

Construction:	Québec plank frame with brick veneer, relatively poorly insulated. Date of Construction: 1958
Physical Conditions:	19 apartment units, 3 storied building, oil furnace heating.
Size of Roof Area:	23.3 meters in length by 15 meters wide - tar and gravel construction, several skylights, vents, etc.
Annual Heating Requirements:	1.66×10^5 Kwhrs equivalent or approximately 27,300 litres of fuel oil.
Annual Hot Water Requirement:	1.54×10^5 Kwhrs equivalent or approximately 20,200 litres of fuel oil.

The solar heating design was prepared on the basis of at least meeting 30% of the annual heating needs and 50% of the water heating needs. This amounted to 1.27×10^5 Kwhrs equivalent of energy.

The methodology of the design was as follows:

A) Energy Conservation

- maximize energy conservation and thermal recovery;
- modulation controls for furnace and heated areas according to demand sequence and ambiant temperatures;
- retrofitting with insulation to reduce thermal losses. Reduction of ventilation heat losses.

B) Structural and Civil Considerations:

- compliance with Federal, Provincial and Municipal codes;
- reinforcement of roof to support solar panel arrays;
- provision for wind, snow and ice conditions.

C) Solar Heating System:

- marketing of systems and equipment to existing heating and hot water loads,
- selection of proven solar panels for durability and low maintenance;
- economic analysis of overall system, to ensure feasibility.

Following extensive calculations, it was decided that energy conservation measures could reduce the heating load by approximately 25%. A solar heating system was designed utilizing [illegible] square meters of solar collectors, augmented by one third this area by means of solar reflectors. Each collector array, north of the first row would be raised 15 cm to reduce the effect of shading. An ethylene glycol solution would be circulated through the solar collector arrays to prevent freezing. The existing heating system utilizes hot water varying from 50°C to 95°C. Hence in order to maximize operating effectiveness, it was decided to chill the solar collector fluid by means of a heat pump, thus operating the solar collectors at very low temperatures, increasing their efficiency. The heat pump would then upgrade the energy to a level suitable to directly meet the building requirements.

The overall proposed costs were as follows:

A) Price of Hardware: includes solar panels, reflectors, heat pump, circulating pump, storage tanks, instruments and controls, valves, heat exchangers, solar panel support system, etc. – $65,000.

B) Price of Installation: – $37,000.

C) Design and Engineering Costs: – $18,000.

The total cost of approximately $120,000 is high for the following reasons: (the cost per meter squared of installed collector is $960.00)

1) The roof of the building is weak and requires strenghtening. It was estimated that the roof could not take more than 50 Kg/m^2 above the normal loading. As there is a danger from accumulated snow load around collectors, care must be taken in the design of these systems;

2) The building can be considered a prototype retrofit installation hence the design and engineering costs are somewhat high;

3) Retrofitting existing buildings is always very expensive. The costs for energy reduction by energy conservation are far more cost-effective than solar heating;

4) Hawes and Wight, a Montreal engineering firm specializing in energy conservation and solar heating studied a series of large scale solar installations in the United States, mainly undertaken on U.S. Government demonstration programs. The average cost of solar systems, including collectors, labour and storage systems, is of the order of $800.00 per square meter solar collector installed. Given mass production methods, a better knowledge of the systems and privately contracted systems, it will be possible to reach the $375.00 to $400.00 per square meter figure quoted earlier. This figure has been achieved in some residential installations in Canada and elsewhere. The Ives solar house, near Hudson, Quebec, cost approximately $400./$m^2$ installed, built as a prototype with high design and installation charges.

5) Obviously, solar systems designed into a new building instead of as a retrofit, should prove considerably cheaper:

6) The solar collector and reflector panels themselves cost $1[illegible],000 – which is just over 10% of the system cost. However, the large labour costs, fittings, piping, valving, etc., raise overall costs on these matters.

While the costs outlined above are rather out of line, from an economic feasibility point of view, this is not the only problem faced in considering such an installation. The roof area is 350 square meters. However, it was impossible to install more than 125 square meters of solar collectors due to the poor orientation of the building (the length was 32° off of a true North-South axis), the need to allow spacing between the collector rows to prevent shading, to permit snow to slide down the collectors, and to permit servicing. It became therefore evident that a bolder approach was necessary. The idea of just accepting a technology from another (milder) environment and adapting it to local needs was wrong. Hence, an alternative was sought.

The Development of the Roof Canopy Concept

Given the problems faced by the conventional solar energy approach, the Brace Research Institute and its associates in 1977 began to recognize the need for a totally new approach to solar heating in Canada. The basic reasons for this are the following:

a) existing buildings are rarely properly oriented for solar radiation collection;

b) roof structures are often not designed to take the load of a solar system;

c) the roof membrane must be replaced periodically - the removal of arrays of solar collectors would cause considerably increased costs at that time;

d) the need to reduce the overall costs of solar heating systems;

e) the need to simplify the solar heating process;

f) the need to develop aethestically pleasing structures;

g) the inability to maximize the roof area for solar collection using rows of collectors.

Given the above reasons, it was decided to eliminate as much as possible:

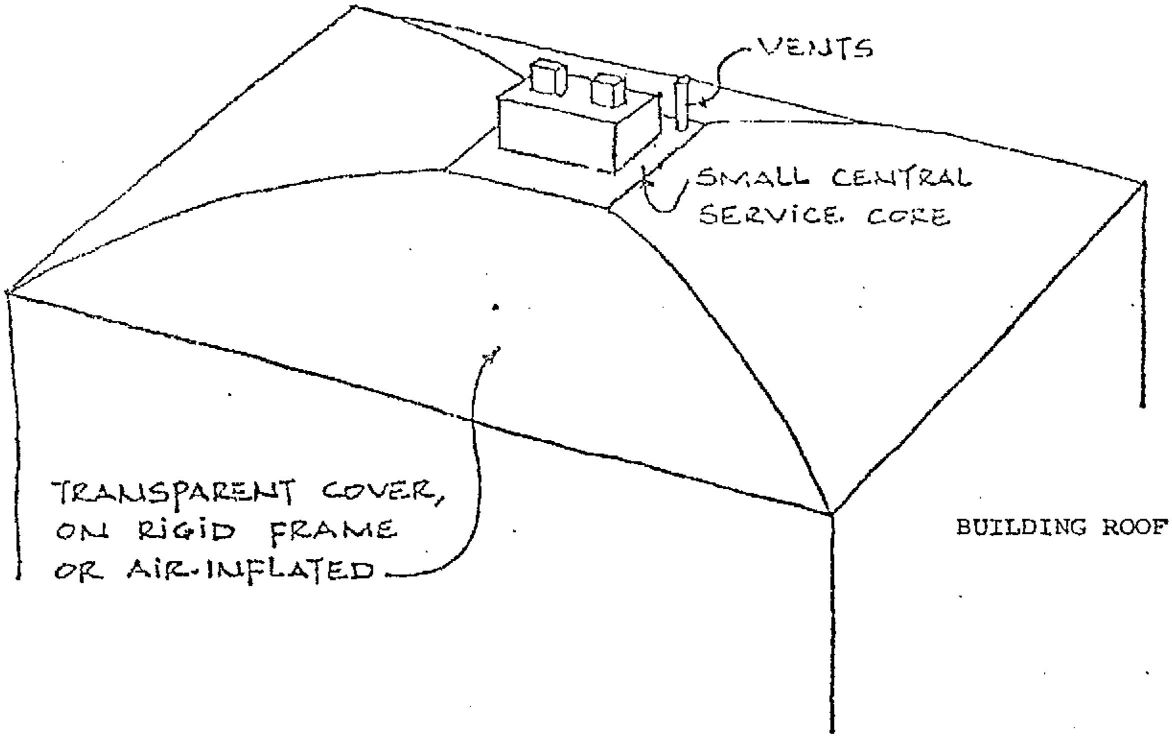
1) the solar collector;

2) the use of liquid systems as heat transfer fluids.

As a result, the concept of the canopy roof has been developed (as indicated). In this system, the entire roof is considered the solar collector. This can be done in a number of ways:

by setting up a central support core, a series of rigid frames can be established over the entire roof surface, to support a transparent cover;

Figure No. 13



CANOPY SOLAR COLLECTOR AS PROPOSED BY THE BRACE RESEARCH INSTITUTE

2) through the use of pre-stretched cables, a support system can be established for the transparent cover.

At the Brace Research Institute, studies have been undertaken and currently are underway on the structural aspects of these canopy collectors. Several different systems have been designed and further work is contemplated on the total systems approach using the solar canopy principle. It will take a number of years before appropriate systems can be developed, provided some support is forthcoming for the research and development of these systems.

The principal advantages of the canopy system are the following:

a) the entire roof is covered by a transparent layer, thus the roof membrane will last longer and can possibly be substituted by a less expensive system;

b) heat loss from the building roof is reduced and any heat loss, serves to warm the heat transfer area;

c) the canopy provides a larger area for solar energy collection than arrays of solar collectors. Although the angle of collection is not always as favourable as the collector array, the overall incident radiation should be increased;

d) costs will no doubt be reduced as the amount of hardware needed is decreased. The system envisaged will be simpler:

e) air, and not liquid, based systems, will be used as a heat transfer fluid. Ventilators or fans will be used to move the air. Heat needed for hot water heating will be transferred by means of air to water exchangers - all standard equipment from industry;

f) a central core, probably 3 x 3 x 3 meters will probably be left to allow vents and openings to the exterior - all will be integrated into an overall design;

g) some problems under investigation are those dealing with snow slide-off, municipal regulations, etc.

h) the original roof can now be envisaged to support some heat storage materials to absorb heat directly on the roof (approximately 200 Kg/m^2), with the advent of heat storage materials with a high heat capacity to weight ratio, it could be possible to store part of the heat requirements of the building directly on the roof.

The solar canopy collector holds promise for the future - it is with imaginative thinking of this type that solar energy can make a positive contribution to the national needs. The job creating opportunities are somewhat different in that each job will have to be custom designed, fabricated and installed individually. Nonetheless, the entrepreneurial opportunities exist. The development of a new concept of this type requires a flexible approach, as improvements will no doubt be generated.

Long Term Heating and Cooling Possibility

The question of providing the comfort energy for the interior of our buildings, factories, warehouses, greenhouses, barns, etc., is one which requires a variety of technical solutions. As heat storage materials and systems are being developed, resulting from the large amount of research and development funds being allotted to this area, plans must be made to develop new technologies to exploit these systems.

One system which could benefit from these heat storage materials would use environmental heat or cold air to condition fully the building. Basically, heat storage units would be set up, as a "hot" storage and a "cold" store. In summer, the "hot" store would take up heat from the ambiant air particularly when the ambiant temperature exceeds 23°C. By combining the forced ventilation unit with some simple solar collectors, will be possible to extend the "hot" storage useful operating cycle. By selecting a transition range of 24°C to 30°C, for the heat storage system, it will be possible to operate at a high efficiency.

The cold store would be operated during the winter with a transition range from -50°C to -10°C. The following table (No. 9) gives the average monthly temperatures for Montreal (for the year) indicating the periods of time when heat could be collected. By having several fans, it should be possible to store "heat" or "cold" in well insulated storage containers.

The following Table gives the variation of ambiant temperatures and heating degree days for the Montreal region.

The job creating opportunities will primarily lie in the development of heat or storage systems, controls and ventilation systems tied into the heating and cooling systems of the building.

Heat Pumps

Any discussion of energy conservation or solar heating technologies would be incomplete if the entrepreneurial opportunities associated with the use of heat pumps in conjunction with these systems were not examined.

Just as water flows naturally only from a higher level to a lower level, similarly, heat will only flow from a hot region (high energy level) to a colder region (lower energy level). To reverse these natural processes, pumps must be used.

A heat pump (analogous to a water pump in its objective but very different in technical principles), is very simply a machine which extracts heat from a cold region and sends this heat to a hotter region. Thus heat is being forced to behave contrary to its natural tendency. The refrigerator and air conditioner are typical examples of heat pump applications where the heat is extracted for cooling purposes and then thrown away to the surroundings. Another application for heat pumps is in extracting heat from an available low temperature source and sending it to a higher temperature heat storage area. This particular application is called upgrading the heat quality and becomes interesting when the low temperature source contains a relatively large

TABLE NO: 9

METEOROLOGICAL DATA FOR
DORVAL INTERNATIONAL AIRPORT

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	[illegible]
MEAN MAXIMUM (1941-1970) °C	-5.39	-4.12	1.81	10.56	18.04	23.54	26.07	24;86	20.24	13.86	5.55	-2.86	
MEAN MINIMUM (1941-1970) °C	-14.2	-13.3	-6.38	1.05	7.37	13.09	15.84	14.52	10.01	4.68	-9.9	10.3	
MEAN MONTHLY (1941-1970) °C	-9.79	-8.69	-2.2	5.83	12.7	18.3	20.95	19.7	15.12	9.29	2.31	-6.5	
NUMBER OF DAYS WHERE TEMP. IS OVER 26.4°C (1945-1965)				0.1	2.3	8.3	15.0	12.5	4.3	0.1			
MONTHLY DEGREE DAYS WHERE TEMP. IS BELOW 7.2°C	525	453	313	80	5	0	0	0	0	22.0	161	428	[illegible]
MONTHLY AND SEASONAL DEGREE DAYS. TEMP. BELOW 18.3°C	870	767	652	380	175	0	0	0	103	282	478	763	[illegible]

SOURCES: Villeneuve, Oscar. Sommaire Climatique du Québec, Volume 1, Ministère des Richesses Naturel[illegible]

Sommaire Météorologique Annuel 1974, Aéroport International de Montréal, Environnement Canad[illegible] amount of heat such as that obtained from a solar collector system. Presently, heat pumps have low performance efficiencies when the source temperature is low as in the case of outside winter air. High grade heat can be better used than low grade heat and has move applications, for example:

a) when storing or extracting equivalent amounts of heat, high grade heat requires less storage space than low grade;

b) high grade heat is much easier (and more efficient) to use in heat engine applications.

Thus it can be seen from the above that the heat pump can have applications in solar energy collection for residential, commercial and institutional buildings. Essentially, low grade solar generated heat can be collected, upgraded by a heat pump and then stored for later use.

Performance Indicators and Operating Principles of Heat Pumps:

Basically, the heat pump must use some form of energy (i.e. electricity, fuel, etc.) to operate; therefore, a measure of its performance (called coefficient of performance or COP), is given by the ratio:

$$\frac{\text{Heat extracted}}{\text{Net work supplied to extract heat}}$$

(NOTE: COP must not be confused with efficiency)

For a theoretical (reversed Carnot cycle) heat pump, the equation below describes the performance:

$$COP = \frac{T_2}{T_2 - T_1}$$

T_1 = temperature of heat source (^{o}Abs)

T_2 = temperature of heat extracted (^{o}Abs)

For example: If heat is available from a passive solar collector at 37^{o}C (310^{o}K) and the theoretical COP = 3, then;

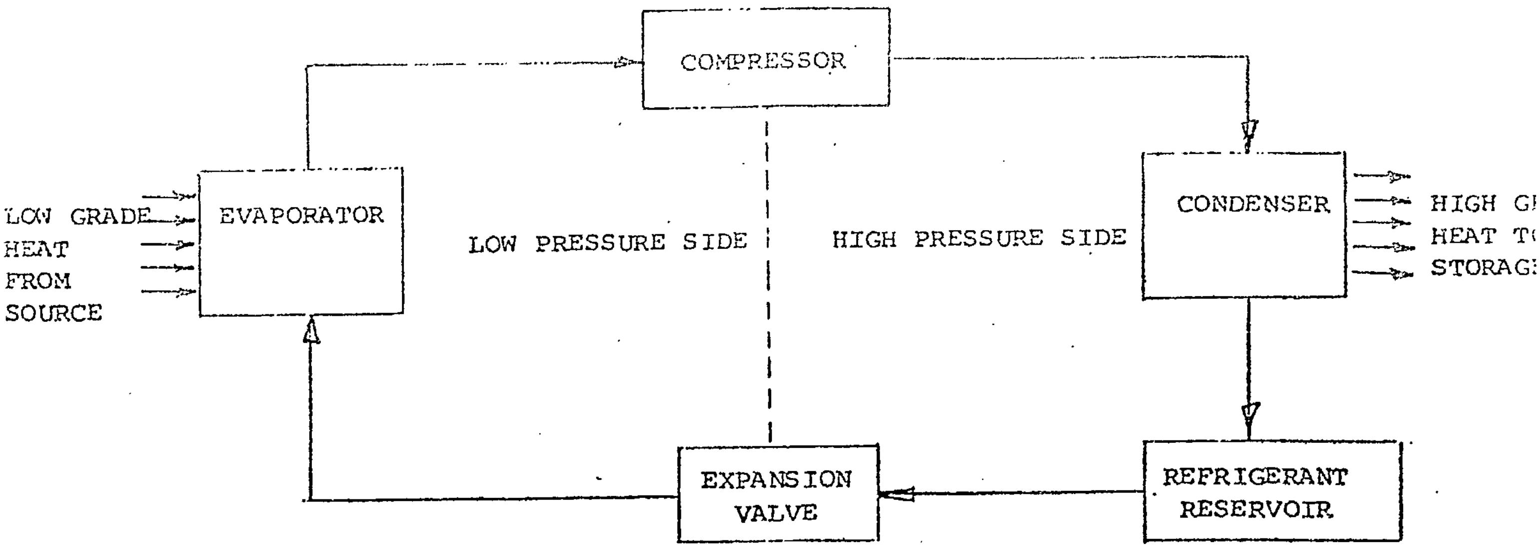
$$3 = \frac{T_2}{T_2 - 310}$$

from which T_2 = 192^{o}C (465^{o}K)

Thus 1 unit of energy is used to transfer 3 units of available solar energy from 37^{o}C to 192^{o}C. For the above problem, the theoretical efficiency is simply the reciprocal of the COP.

In real applications, the actual COP is much lower than that given by the formula above, and becomes very much a function of the source temperature (i.e. the lower the source temperature, the lower the COP).

Heat pumps work on many different type of principles. Consider a simple example of a heat pump which works on a vapour compression cycle shown in the diagram below:



SCHEMATIC OF SIMPLE VAPOUR COMPRESSION CYCLE HEAT PUMP

A working fluid (called a refrigerant) absorbs heat from a low grade heat source on the low pressure side (in the evaporator) of the system. This vapour is then pumped to the high pressure side where it is compressed thereby condensing (in the condenser) and giving up its latent heat. The condensate is then returned to the low pressure side where the cycle begins all over.

The compressor specifications and refrigerant properties are, of course, chosen so that evaporation and condensation take place within a desired working range.

If heat pumps can be used to improve the overall performance and working range of solar collector systems, there should be a definite market potential for such equipment including ancillary products and services. Therefore, the entrepreneur could develop a market for:

1) heat pumps;

2) solar collectors;

3) storage [illegible]

5) design and consulting services;

6) installation of systems;

7) heat exchangers for extracting heat from "cold" source with heat pump, and discharging to "hot" storage.

The first four items can, of course, be manufactured and sold as off-the-shelf units or as integrated packages.

At present, there are no Canadian manufacturers of heat pumps, however, the Canadian Electrical Association for example, has given research contracts to certain institutions for investigating the development of more reliable and efficient heat pumps and for computer simulations of solar collector heat pump storage systems.

Therefore, with such wide open market conditions there should definitely be room for developers, manufacturers, system designers and contractors in the Conserver Society. Even the fabrication of component sections of heat pumps and the necessary control systems needed to integrate these units into a given heating situation, offer job creating opportunities. The availability of a variety of heat pump systems which can operate over a wide series of temperature ranges will revolutionize the solar heating field. It is particularly suitable for Quebec where electricity from hydro-electric sources can be used to operate the heat pump motor. In this way, solar collectors can operate at low temperaturess (20°C to 30°C), which permits efficient operation.

Applications of Thermography to Energy Conservation for Existing Buildings:

The rising cost of energy for heating is making many existing Canadian buildings thermally obsolete because they are insufficiently or improperly insulated. The addition of insulation to either the inside or outside of existing walls is expensive because a new interior or exterior finish must be applied over this new insulation. Particle insulation that can be blown into cavities existing inside these walls, and also chemical insulations that can be similarly foamed in placed, are considered unreliable because it is difficult to determine:

a) beforehand exactly where insulation is most needed inside the wall;

b) afterwards if the insulation inserted into the wall has actually filled the cavities as planned.

Devices are now available that can detect the infrared radiation emanating from any body or structure (such as a building) and present this information in a pictorial format. As heat escapes from buildings, in the form of infrared radiation, such a picture can be taken of a building where the outside temperature is lower (at least 10 centigrade degrees) than the inside temperature. It will show then, precisely, if and where insulation or weatherstripping is necessary.

While the cost of this equipment is expensive (approximately $50,000), it [illegible] allow an insulation [illegible] provide a [illegible] service or [illegible] beforehand, establish accurately where it is most needed, and prove to the owner afterwards that the insulation installed has been properly installed and has been a worthwhile investment. Some contractors in the USA are presently using the services of independent test companies that operate these detection devices, enabling the contractor to offer a lifetime guarantee for his work.

This can provide lucrative employment opportunities for Canadian entre-preneurs, provide employment and reduce the overall consumption of energy for heating purposes. This would reduce the importation of foreign oil stocks, help reduce our balance of payments deficit and conserve Canadian oil reserves for the more lucrative petro-chemical industry. The potential of this industry needs proper study in order to identify the overall market prospects for such an industry. The equipment can be manufactured locally, given the significant proportion of our National energy budget which is allocated for heating purposes. To date, interesting infrared radiation detectors have been developed in the USA, Sweden and elsewhere.

In the case of buildings heated electrically, the energy saved can be better used by industry to increase our productive capacity. As a significant proportion of our electricity in Canada comes from hydro-electric sources, this should increase the comparative advantage we hold over other countries, currently using fossil fuels for electric generation, rendering our industry more competitive. A concerted National effort in this regard, along with a properly managed research and development program along these lines could make a positive contribution to our energy and employment situation. This is an example of the material benefits resulting from the application of technologies related to the Conserver Society.

Export Potential of Canadian Appropriate Technologies

Canada does not have a particularly good track record on the export of hard-ware and technological know-how. The resource industry, metals and some other products constitute the bulk of our exports. In the last few decades, however, a number of Canadian engineering firms, have begun to compete for the lucrative design consulting contracts available from the Third World.

In the area of appropriate technologies, some Canadian organizations have had considerable success in the export of technologies and systems, appropriate for the development of various regions in the world. The Brace Research Institute has for the past 15 years, been developing technologies for use in Third World areas. This includes solar water heaters, solar agricultural dryers, solar distillation units for the conversion of saline water to fresh water, solar pumps, solar ponds, solar radiation measuring instrumentation, solar greenhouses, a variety of windmills for water pumping and electrical generation purposes and the like. To date there has been little interest in the Canadian private sector to use these technologies to expand their export potential overseas. A specific example of this was a grant in 1970 received from the Canadian International Development Agency to develop pre-packaged solar distillation units which could be sold in [illegible] or used in Canada's foreign aid programs.

potential of these applications. Hence, while technical assistance in these very fields is continuously being offered to a wide number of firms* in the USA, Europe and the Third World, almost no interest is generated in Canada.

It would be beyond the scope of this paper to speculate on the net causes for this reticence on the part of Canadian firms. The technology was offered at no cost to the firm (perhaps this was one of the problems). Also, they may not easily see a market, but a London based export firm has been marketing and selling units of these types for more than 10 years now. There are other examples that can also be quoted.

Is this reticence due to the fact that Canadian firms are not sufficiently outward looking, are often foreign owned, so that export sales are handled by the head office in a foreign country, or is it the traditional fear of risk that Canadian entrepreneurs often exhibit? Without being unduly critical, Canadian overseas missions are not always the best informed on the availability of products and services from smaller Canadian companies. One sometimes has the feeling, in the over 75 missions visited overseas, that it is not worth the bother as these orders would only be a small contribution to overall Canadian trade figures.

In the United Kingdom, there are some organizations who use British Government Aid funds to sponsor the products of British industry, of some very simple equipment, adapted for use in the Third World. By working with the U.K. manufacturers, they are able to offer goods and services adaptable to the needs of various Third World countries. While this could be branded as a valid form of economic colonialism, it does nonetheless provide various options in the market places of the Third World which would not otherwise be available.

This scenario is most unlikely in Canada, as we don't recognize that it is even an area of interest or that it has any potential. Frankly, we also lack confidence in our ability to do something of this nature - perhaps it is due to the size of the country, with our widespread, thinly populated areas. Actually, we should be able to set out a scenario for a Canadian venture of this nature - using the mid and far Canadian north as examples wherein appropriate technologies could be nurtured, encouraged, developed and marketed for the needs of these regions. The Brace Research Institute set out the basic guidelines for the mechanisms involved for this type of scenario, in a position paper for the meeting of the Canadian Council for Rural Development on the Mid Canadian North, December 1976. These meetings are unfortunately far more often platforms for monologues of platitudes rather than action oriented activities. The challenge of the Third World lies right here in our own country but it is often too difficult for us to recognize its potential.

The Conserver Society, if it is to become a reality, must become ingrained into the thinking and action programs of the country as a whole, rather than being an intellectual exercise, as valid as this may be. For the Conserver Society to prove valid, we must believe in it which will cause a wealth of ideas to unfold regarding its implementation.

Some ideas in Appropriate Technology from Canadian sources have been directed towards the more developed sectors. Two of these ideas, the National Research Council vertical axis Darries Rotor Windmill and the Brace greenhouse will be examined in greater detail to determine the factors affecting their reaching the marketplace.

The National Research Council in Ottawa has been developing its vertical wind turbine, for the past decade. Through Government demonstration and testing programs, a Toronto based firm has taken up its manufacture. As there is effectively little interest in this area of technology in Canada, results have been slow in forthcoming, both from the technical viewpoint as well as from the user community. Last year, a firm based in British Columbia, advertised that they were also marketing a windmill based on this principle.

Several years ago, the Sandia Laboratories also began a program of research based on the NRC designs. After a while, the windmill became known, in many circles south of the border, as the Sandia windmill. It would appear that NRC often does not even get credit in some journals for being the source of this technology. Because the American program in renewable energies is far more vigorous than the Canadian program, increased activity and funding has permitted them to surpass Canadian efforts in this field where we had a decided lead and comparative advantage. In late 1977, an American firm contacted Canadian firms indicating that they had now begun to manufacture and market the Sandia (and by implication the NRC) windmill. These Americans were seeking agents in Canada to market these windmills. This is a case of an Appropriate Technology developed with Canadian funds which will probably end up being sold to us, in large part, by American manufacturers. What has gone wrong? Are the markets in Canada too small, or is there insufficient interest? Have the Canadian manufacturers not tried to enter the American market? Were the companies involved too small to envisage this export potential? Obviously this problem has its complexities - nonetheless it is symptomatic of the problems encountered in these fields. It is essential that Canadians adopt a more vigorous stance or else we face the prospects of having environmentally based technologies being sold to us by foreign companies, who develop these technologies for different climatic conditions. The automobile is a perfect example of this - the difficulties we face in operating these vehicles in severe winter weather is indicative of our failure to adapt these technologies to the conditions of the milieu of use.

In the case of the Brace greenhouse, the unit was first tested in late 1973, and the first published efforts were reported in the USA in the summer of 1974. By the autumn of 1977, there was sufficient interest developed in the USA to hold a conference (attended by over 300 persons), based entirely on this greenhouse principle. Naturally, modifications of the Brace greenhouse were undertaken, adapting to different climatic regions and other applications. Interest in Canada was confined to an element of the private sector. In Quebec, where the greenhouse was developed with small grants from the Provincial Ministry of Agriculture, the Ministry effectively ignored its existence till the winter of 1978. Two small Canadian companies are marketing versions of the Brace greenhouse. As it can be easily built by the individual farmer or rural dweller, a number have been erected privately. This is a field where there is much likelihood of foreign manufacture taking over in [illegible]

In Canada, the Brace Research Institute was given some additional support to further develop this greenhouse by Energy, Mines and Resources, Ottawa, in 1977 - a full 4 years after the initial funds were granted. Again this lack of support does not permit Canadian groups to maintain their competitive positions.

These examples signal one of the problems with appropriate technologies of this type. The final systems are not so complex that they cannot easily be copied. They are often not patentable. If Canadians continue to exhibit little confidence in one another, or little desire to take risks in the business field or frankly little interest in the concepts of the Conserver Society, then we should rightly expect to find these technologies to be sold to us from foreign sources. We must stimulate initiative and innovation within the Canadian community. It does not suffice, as indicated, in these two examples that we have developed the technologies. Meaningful support must be found for the development of technological innovation, the development of marketable equipment and systems and assistance to fabricate and market these technologies. Many programs no doubt exist - are they adequate, do they respond to the criteria set out by the Conserver Society - this remains to be examined in detail. Enunciating principles which might form the basis of a future, saner society is one thing. Implementing a transaction to this Society, particularly in the technological fields, is another matter which requires detailed study, attention and above all, commitment.

Summary

There is no easy solution to the problems of instituting entrepreneurship and confidence into Canadians, in order that they develop, adapt and expand the use of appropriate technological systems in our Society. As we enter the age of the Conserver Society, all of these factors must be taken into account.

What methods can be used to encourage this transition period? What role should various organizations charged with these responsibilities play? How can existing organizations modify their approaches to enhance current efforts to make better use of conservation techniques and better exploit our natural resources? Often the problems are one of definition and the recognition that problems exist. Canada suffers from the fact that a good part of our Society really believes that we are an advanced country, instead of a developing country with a colder climate than most developing areas. Canada displays all the hallmarks of a developing country and society - large importation of manufactured goods and technical know-how, the production of raw materials, often exported without any transformation, instability in our political structures. If Canadians recognized some of these problems as realities, we might be in a more favourable position to resolve these difficulties.

In the technological fields, we are often naive and backward in our knowledge of the basic technical processes dealt with in every day life. Relating this to some of the problems of energy conservation dealt with earlier in this paper, the state of knowledge in some areas needs strengthening. One or two are given below, but many more exist:

a) the often inefficient operation of our furnaces which provide vast quantities of heat to our buildings and process industries;

b) the inability of our siding (metal or plastic) industry to integrate extra insulation into their operations to provide not only an improved appearance to our buildings but also increased insulation, which would reduce heating costs for marginally increased charges.

It is the inability of many of our service industries to grasp a full technological appreciation of our processes which will hold back Canada's advances in these fields.

How does one provide better instruction to our technicians? There are different levels of government administration in Canada, who might recognize a need but do not wish to antagonize another governmental operation. If we are to operate in an appropriate technological mode, then the totality of a problem must be tackled, regardless of jurisdictional problems. This problem is certainly being addressed - but when dealing with new initiations as outlined in this report, undoubtedly some rearrangements of priorities and accommodation must be made. In dealing in some of these areas, which cross national, provincial, municipal, industrial and private jurisdictions, the National interests seem often to be overlooked, as each body addresses their day to day functions. This even applies for such sensitive issues as job creation, not withstanding current high rates of unemployment. One can only be pessimistic on our long term prospects unless Canadians learn to work more closely with one another. Obviously we have a serious problem in decision making, one which will not be easily resolved.

With specific reference to improving the opportunities for job creation within the Conserver Society, several mechanisms can be explored. The National curse in Canada is always to set up a new structure when we face a problem - should this be done, or can we use existing structures which are often not conducively set up, to accept innovations of the nature of the Conserver Society. It goes without saying that the average Canadian is leary and/or disenchanted with the impersonality of big bureaucracy, at whatever level it exists - federal, provincial, or other; the same applies to our large industries, often foreign owned, who display a similar degree of impersonalness. Surely we are a rich enough country to try to study what is wrong with our basic decision making process before rushing off to redress Society's ills, with short term, poorly thought out bandaid solutions. Hence, it is not possible, at this time, to offer adequate, and appropriate solutions to these problems.

One thing is evident. If we do not involve the average Canadian more fully in the decision making process, we will just drive him into a greater state of disenchantment. The ruling elite - be they politicians, bureaucrats, industrialists or academics, etc., must realize that a new and appropriate methodology is required to resolve the problems that we face. While the concept of a Conserver Society offers some hope for the future, a rational, reasonable implementation of these concepts will no doubt prove to be very difficult indeed.

LES OBJECTIFS DE RENTABILITE ET LA SOCIETE DE CONSERVATION SONT COMPATIBLES

G. Réal Boucher
Vice-président et directeur général
Brown Boveri (Canada)

Résumé

Ce document étudie les rapports qui existent entre la philosophie de la conservation telle que connue au Canada et l'utilisation rationelle des ressources énergétiques. L'analyse couvre deux domaines: le chauffage et le rendement des moteurs électriques. Basé sur des données statistiques, il est démontré qu'on peut réduire au minimum le gaspillage des ressources. Dans le premier exemple, la conservation de l'énergie de chauffage permet de diminuer les importations de l'énergie dont celle du pétrole en provenance de l'extérieur et d'augmenter l'exportation du gaz vers d'autres pays. Ceci améliore la balance nette des paiements du Canada. Dans le second exemple, un meilleur rendement des moteurs électriques conserve l'énergie mais ceci à un prix bien plus élevé pour les moteurs. En conclusion, le rapport stipule que "la société canadienne s'oriente plus ou moins consciemment dans la direction d'augmentation de ses profits tant financiers que quantifiés en termes de qualité de vie". A court terme, et pour quelques années encore, le moyen d'action le plus puissant pour réduire le gaspillage et conserver les ressources est l'action sur les prix.

EXPOSE DU PROBLEME

L'idée d'une nouvelle société fondée sur l'utilisation rationelle des ressources de notre planète, en un mot, une société "conservationiste" souffre d'être l'apanage d'une élite intellectuelle. On accuse souvent celle-ci d'utiliser les prouesses sémantiques pour véhiculer une philosophie irréaliste par son idéalisme inaplicable parce que contraire aux intérêts les plus directs des membres constituants de notre société.

Dans son sens le plus large la société de conservation est une société axée sur l'efficacité, sur l'utilisation optimale des ressources, sur l'élimination du gaspillage, somme toute, sur un ensemble de valeurs très pregmatiques. Il faut traduire les concepts de la conservation en données facilement assimilables par l'homme de la rue et les placer dans son contexte individualiste plutôt que par rapport aux objectifs globaux de la société dans son ensemble ce qui pour l'homme moyen est une notion assez floue. On en vient donc, en un premier temps à mesurer les effets individuellement pratiques de la société de conservation et, dans ce contexte, la notion de la date de réalisation de ces effets est primordiale.

Il s'agit de définir la conservation en termes de rentabilité individuelle d'abord de rentabilité pour certains groupes ensuite et, finalement en termes [illegible]ntages et d'inconvénients pour la nation. [illegible] rentabilité peut se quantifier [illegible]

LA MESURE DE LA RENTABILITE DE LA CONSERVATION

L'objectif premier des individus est d'obtenir la meilleure qualité de vie possible. Ils se dotent d'un ensemble de valeurs qui s'agrègent au niveau des sociétés. Les décisions individuelles sont toutes basées sur l'optimalisation d'un ensemble complexe d'équations économiques, philosophiques, émotionnelles et morales. Les décisions sociétales sont, elles, basées sur la solution simultanée de chacun de ces ensembles d'équations au niveau de tous les points individuels.

Dans cet exposé, nous nous limiterons aux aspects économiques de la conservation au niveau des individus, des groupes et de la société canadienne dans son ensemble.

LES BENEFICIAIRES DE LA CONSERVATION

Le moyen le plus universellement utilisé pour mesurer la rentabilité des décisions individuelles au point de vue économique est le volume des épargnes individuelles, le capital financier de chaque personne. Toute mesure est jugée utile si, au niveau individuel, elle augmente ou, à tout le moins, n'amoindrit pas ce patrimoine individuel. Au niveau des groupes des sociétés, ces patrimoines se mesurent par des termes tels que le chiffre des réserves, la valeur nette des investissements et, imparfaitement, par les valeurs des produits nationaux bruts ou nets par tête. Somme toute, ce qui compte, c'est la génération nette de capital qui provient des épargnes, elles-mêmes le fruit de l'utilisation passée de ressources humaines et physiques.

Au niveau des individus, la notion de temps favorise le court terme tandis qu'au niveau des sociétés, des horizons plus longs peuvent être envisagés. Cette importante notion indique que les sociétés agissent dans le sens d'une réorientation des objectifs individuels qui peuvent ainsi être partiellement brimés au bénéfice de l'ensemble. Le même raisonnement s'applique au niveau de la date de réalisation des bénéfices, les sociétés favorisant le long terme souvent au détriment du court terme.

En d'autres mots, la question peut se résumer par les trois interrogations suivantes:

a) Devrions-nous dépenser plus aujourd'hui afin d'avoir plus de bénéfices demain?

b) Devrions-nous dépenser moins aujourd'hui afin d'avoir plus de bénéfices aujourd'hui?

c) Devrions-nous léguer à nos enfants et nos petits enfants des coûts additionnels en dépensant plus aujourd'hui dans l'espoir que les enfants de nos petits enfants en retireront plus de bénéfices?

Les enfants et petits enfants en question n'ont pas aujourd'hui leur mot à dire pour répondre à ces questions, pour évaluer les risques et pour décider de la sagesse de dépenser plus ou moins pour des bénéfices plus ou moins grands. Ces réponses débordent sur des considérations morales hors des disciplines de l'économie et de la finance.

Les mesures d'impact de la conservation doivent donc tenir compte du fait que la valeur actuelle des bénéfices et inconvénients est inversement proportionnelle au temps où ils s'appliquent et que cette valeur escomptée des bénéfices et inconvénients est un facteur de gradation et de sélection parmi diverses options.

Par extension, la même "loi" s'applique au niveau des distances physiques i.e. les événements plus près de nous ont plus d'impact relatif que les événements prenant place plus loin.

Les conflits d'objectifs: l'individu vs la société, le court terme vs le long terme, le près vs le distant peuvent sembler insolubles à prime abord. Pourtant, les collectivités se sont données des mécanismes pour répartir équitablement ces risques; ces mécanismes sont les gouvernements qui font les choix qui s'imposent suivant le jugement collectif des individus qui les élisent mais qui par le fait même abandonnent une partie de leur liberté d'action. En d'autres mots, les gouvernements par leur règlementation plus ou moins correcte ou abusive suppléent à l'imperfection des égoismes individuels et égalisent les conditions suivant l'échelle collective courante des valeurs.

D'autre part, les bénéficiaires directs des efforts de conservation ne sont pas nécessairement ceux qui les effectuent. Comment, par exemple, convaincre un fabriquant de réfrigérateurs d'utiliser un moteur à rendement plus élevé que celui qu'utilisent ses concurrents et qu'il lui faille ainsi payer plus cher une pièce qui permettrait à un tiers, l'utilisateur final de la machine de diminuer sa consommation d'électricité et de sauver ainsi un peu d'argent qu'il pourra gaspiller ailleurs. C'est là un cas où le rôle coercitif des gouvernements peut s'avérer indispensable.

LA NATURE DES INVESTISSEMENTS DE CONSERVATION

L'éthique de conservation est orientée principalement vers l'utilisation rationelle des ressources. Ces ressources sont de plusieurs ordres:

- humaines – main d'oeuvre
  – capital (épargnes)

- physiques – ressources naturelles
  (énergie, mines, eau, environnement, etc.)

On se doit de considérer les coûts de ces ressources y compris, leurs coûts cachés, leurs coûts dans le temps et par rapport à la distance et, on l'oublie parfois, le vrai responsable du paiement des coûts.

Exemple I - Le Chauffage

Une ressource typique illustrant l'interdépendance de ces facteurs est l'énergie utilisée pour le chauffage résidentiel.

A titre d'exemple, prenons le cas d'un consommateur résidentiel qui disposerait d'installations de mêmes coûts en capital et qui aurait le choix d'utiliser soit de l'électricité, soit du gaz naturel, soit du pétrole, ce dernier pouvant être sous les formes suivantes: huile légère, huile à poêle, huile lourde, soit du charbon ou soit du propane.

Il y a lieu de considérer:

1) Pour l'utilisateur final de l'énergie

-Le coût net de l'énergie utilisée

Son coût net est le prix livré chez lui que lui coûtera une quantité d'énergie donnée exprimée, par exemple, en millions de B.T.U. compte tenu de tous les frais, l'achat de vente, coût de fonctionnement des appareils et compte tenu aussi, du rendement net de ses appareils. On assumera, pour fins de calcul que les unités de chaleur ont la même valeur finale pour l'utilisateur qu'elle soit fournie par convexion, radiation ou conduction.

Un calcul simple illustré au tableau suivant donne, en moyenne pour 1977, à Montréal un coût d'énergie variant entre $4.68 et $7.13 par millions de B.T.U. utiles.

TABLEAU I

Prix net moyen estimé de l'énergie utile consommée par un client résidentiel québecois en 1977.

Forme d'énergie	Prix net livré taxes incl. ($ par unité)	Rendement des appareils (%)	Prix net à l'utilisateur ($ par unité)	Prix net moyen ($ par million de BUT réellement utilisés)	% du prix de l'électricité (%)
Huile légère	$0.50/gl	65	0.78/gl	$4.68	67
Huile à poêle	$0.54/gl	55	0.98/gl	$5.87	84
Electricité	$0.02 kWh	85	0.024 kWh	$7.03	100
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

Ce tableau est très révélateur. Il indique, en effet, que le prix net moyen de l'énergie électrique coûte au consommateur final environ 50 pour cent de plus que pour l'huile à chauffage et 89 pour cent de plus que pour le gaz naturel.

Donc, au strict point de vue de conservation du capital-épargne, et tout autres coûts étant égaux, la source d'énergie la plus "conservatrice" à Montréal en 1977 était et demeure encore le gaz naturel; l'huile à chauffage vient ensuite et l'électricité s'avère être la forme d'énergie la plus chère pour l'obtention d'une quantité identique de chaleur. Evidemment, il faut considérer les aspects force motrice, éclairage, communication où la substitution n'est pas possible mais, malgré tout, le chauffage est le domaine où la majeure partie de l'énergie résidentielle est consommée.

2) <u>Pour le fournisseur d'énergie</u>

Le fournisseur d'énergie, lui, est motivé par de toutes autres considérations. Son but est d'effectuer un profit et pour ce faire, il minimisera à la fois ses coûts fixes et ses coûts d'opération tout en tentant de vendre au plus haut prix possible.

L'outil qu'il utilise pour comparer ses coûts est, en général, la méthode d'actualisation. Par le choix d'un taux d'actualisation suffisamment élevé pour rencontrer ses objectifs financiers, intérêts et impôts, l'industriel fournisseur décidera des parts optima de capital, de main-d'oeuvre et d'espacements dans le temps de ces déboursés. Pour lui, les ressources à conserver sont son capital et sa main-d'oeuvre et il fait les choix selon ses propres intérêts.

Poursuivant l'étude de l'exemple de l'énergie de chauffage étudié précédemment, on peut tenter d'évaluer les coûts en investissements des diverses alternatives de fourniture.

Il se pose un problème au niveau des unités de mesure et de l'endroit où les mesures sont compilées. Pour faciliter les comparaisons, nous utiliserons une unité de mesure en dollars d'investissement requis pour livrer un million de B.T.U. pendant un an.

Une autre distinction s'impose, aussi. Devons-nous considérer le coût moyen des investissements à date, le coût marginal des approvisionnements ou la moyenne des coûts prévus des nouveaux approvisionnements? Du point de vue du consommateur, cela importe peu car il paie le prix de l'énergie et non pas son coût. Du point de vue de l'investisseur, par contre, c'est le coût qui importe. D'autre part, vu qu'à la limite, si on fait un calcul long, les coûts marginaux des nouveaux investissements ont tendance à se rapprocher de plus en plus des coûts moyens sur lesquels les tarifications sont basées, nous pouvons donc nous limiter à utiliser les projections des coûts actualisés moyens des nouveaux investissements requis tout en notant que les différences que nous obtiendrons seraient beaucoup plus marquées si les coûts marginaux étaient utilisés. Enfin, il faut aussi bien faire attention de prendre la totalité des coûts normaux de capital, c'est-à-dire, qu'on doit tenir compte, dans tous les cas, des coûts du capital requis pour le transport, la transformation

Dans le cas du pétrole, il peut être obtenu soit à l'état brut pour être ensuite raffiné, soit importé sous forme de produit fini. A Montréal, peu importe l'origine du pétrole, ce dernier requiert en moyenne un investissement de $4,500. par unité de capacité en barils-jour incluent le raffinage, la mise en marché et la livraison. Cet investissement de $4,5000., en d'autres termes permet de livrer 2.12 milliards de B.T.U. par année. (1 baril de pétrole = 625 millions de B.T.U.). L'industrie, d'autre part, ne rembourse pas ses investissements pendant une seule année mais les répartit plutôt sur plusieurs années suivant diverses procédures comptables. On peut simplifier en assumant un rendement net, mettons de 10 pour cent sur le capital investi, ce qui veut dire que les 2.12 milliards de B.T.U. livrés par année et pour lesquels on a investi $4,500. devront rapporter au moins $450. par année après impôt ou environ $600. avant impôt soit $0.28 par million de B.T.U. livrés pendant un an.

Dans le cas du gaz naturel, les coûts de production, de transport et de distribution se situent aux alentours de $11,000. par baril-jour équivalent et, le barême utilisé dans le cas du pétrole, le coût en capital du gaz naturel se situe à $1,650. par baril-jour pendant un an (2.12 milliards de B.T.U.). Le calcul donne un coût d'investissement d'environ $0.78 par million de B.T.U. livrés pendant un an.

Pour l'électricité, si nous prenons le cas d'Hydro-Québec, le coût moyen des nouvelles livraisons se situera à près de 24 mills du kWh ($0.024) sur une base actualisée sur une longue période. En tenant compte des coûts de l'ensemble du réseau et lorsqu'on y ajoute les coûts de transformation et de distribution jusqu'à l'utilisateur final, on peut calculer que l'électricité exige au Québec un coût d'investissement d'environ $6.74 par million de B.T.U. livrés pendant un an.

En résumé, un million de B.T.U. livrés par année à un utilisateur final à Montréal, par exemple, lui coûte:

pétrole	$4.68 par an
gaz naturel	$3.73 par an
électricité	$7.03 par an

D'autre part, le fournisseur encourt des coûts d'investissements comme suit pour lui permettre de fournir à l'utilisateur final cette quantité de 1 million de B.T.U. par année

pour le pétrole	$0.28
pour le gaz naturel	0.78
pour l'électricité	6.74

Des résultats sensiblement identiques sont obtenus lors de l'étude des secteurs commerciaux et industriels du chauffage.

Dans l'optique "conservation" des ressources d'énergie et de capital, des conclusions intéressantes se dégagent des comparaisons précédentes:

-l'électricité est la forme d'énergie la plus chère en coût et en investissements. Elle coûte, en termes réels, cinquante pour cent de plus que le pétrole et près du double du gaz naturel.

-les consommateurs semblent faire leurs choix beaucoup plus pour des raisons intangibles que des raisons de prix.

-des efforts de conservation de l'énergie et des ressources en capital doivent porter vers la substitution vers les formes d'énergie les moins chères en termes nets à l'utilisateur final.

-les efforts d'amélioration du rendement des appareils, par exemple, bien qu'orientés dans la bonne direction, ont moins d'impact réel que les efforts de substitution vers des formes d'énergie moins chères.

3) Au niveau de la société

L'activité chauffage a un aspect conservationiste divers selon que le point de vue est individuel, provincial, canadien ou mondial.

Pour l'individu, sa motivation est de minimiser ses coûts et de laisser les investissements à la charge de ses fournisseurs, les hydro-électriciens, ou les pétroliers.

Au point de vue provincial, mettons, à prix égaux aux consommateurs, il semblerait opportun de choisir la forme d'énergie qui minimalise les investissements effectués par les résidents provinciaux. Suivant ce raisonnement, les provinces telles que le Québec devraient favoriser le pétrole plutôt que l'électricité car dans le cas de l'électricité, les investissements sont totalement à la charge des québecois (en plus d'être plus élevés pour une quantité donnée d'énergie) tandis que dans le cas du pétrole, les investissements sont faits par des intérêts en dehors du Québec ce qui "conserve" le capital québecois à d'autres fins.

D'autre part, si l'on se place dans une optique canadienne, les considérations d'autonomie et de politique à part, il pourrait sembler avantageux, à prime abord, d'importer au pays l'énergie et les centres matières en autant que les exportations nettes de capital. mesurées par la balance des paiements, pour l'ensemble des activités n'est pas déficitaire.

En somme, la conservation de la ressource énergie et de la ressource capital-épargne n'a pas le même sens pour l'individu, le citoyen d'une province ou le citoyen du pays. Dans certains cas, c'est l'aspect coût apparent qui compte; dans d'autres cas, le coût importe beaucoup moins que la conservation du capital. Cela revient à dire que les intérêts divergents de chacun de ces groupes [illegible] [illegible]

4) Au point de vue de certains groupes d'acteurs

La valeur économique de la conservation peut se solder par une augmentation nette de la ressource: capital (une conservation par le haut) de certains acteurs dans la société. Dans le cas simple à priori du chauffage mais combien complexe à l'analyse, la promotion de la conservation chez les individus, les provinces ou le pays ne peut faire autrement qu'avantager des groupes tels que des chercheurs, des consultants, des constructeurs, certaines industries et certains fournisseurs.

Les consultants

Les consultants sont les avant-gardistes des réalisations. Leur rôle est intermédiaire entre le scientifique et le constructeur et ils sont le reflet des préoccupations des clients. Il est donc normal que l'intérêt accru de la population vers la philosophie de la conservation affecte le volume et les domaines d'activité des consultants.

Poursuivant notre étude de la conservation appliquée au domaine du chauffage, les consultants trouveront des débouchés additionnels au niveau de la fourniture de l'énergie chauffage et au niveau de son utilisation.

C'est au niveau de la fourniture de l'énergie que le rôle des consultants est le plus efficace. Anciennement les décisions d'investissement se prenaient principalement dans l'optique de diminuer les dépenses initiales de capital, une ressource importante, nous en convenons. De plus en plus, avec la hausse des coûts énergétiques, les dépenses de fonctionnement assument une importance de plus en plus grande et, par le jeu de l'actualisation, souvent prépondérante dans les choix d'investissement.

Il existe cependant un domaine où le rôle des consultants pourra être grandement accru dans une société de conservation. Ce domaine est celui de la rénovation des sources d'énergie actuelles.

A titre d'exemple, en Ontario, aujourd'hui plus de la moitié de la capacité de production électrique provient de centrales thermiques avec des rendements thermiques de l'ordre de 35 pour cent i.e. qui gaspillent 65 pour cent de l'énergie qui leur est fournie par des combustibles non-renouvelables. Or, il existe un moyen bien simple de doubler le rendement thermique hors-tout de ces installations: il suffit d'utiliser la chaleur dégradée rejetée par les condenseurs des turbo-alternateurs pour des applications en chauffage. Evidemment, les coûts immédiats en capital sont accrus mais, dans certaines conditions d'application, des économies remarquables d'énergie peuvent être réalisées. C'est le cas, par exemple, pour les turbines industrielles à extraction.

Si l'on calcule que la plus grande partie de l'énergie électrique fournie en Amérique du Nord l'est par des centrales thermiques, cela crée des opportunités de [illegible] appréciables pour les consultants.

Un cas-type est un récent appel d'offres du "U.S. Department of Energy" qui sollicite des offres pour démontrer la faisabilité d'ajouter à des centrales thermiques de base ou à faible puissance de pic, des systèmes de chauffage ou de réfrigération pour desservir des communautés en chaleur, sous-produit de la production d'électricité. On suggère des groupements d'utilités, d'agences gouvernementales, de consultants et de constructeurs.

Ces conversions peuvent représenter un volume de travail tel que les consultants en thermique et les constructeurs ne pourront suffire à la demande une fois les premières conversions ayant démontré la rentabilité économique du procédé.

Cette application est un cas typique de conservation de la ressource-main-d'oeuvre car elle permettra d'orienter les talents vers la récupération de près de 50 pour cent de l'énergie rejetée à l'environnement plutôt que d'utiliser ces précieuses ressources humaines à essayer tant bien que mal à récupérer quelques faibles points de pourcentage de rendement au prix de sacrifices énormes en capital et en complexité de construction et d'exploitation. Un cas étudié récemment par le Central Electricity Generating Board en Grande-Bretagne et documenté dans l'Electrical Review du 13 janvier 1978, page 49, indique que pour une centrale thermique de CEGB, cette conversion et l'installation du système de chauffage associé fournirait un profit de un demi million de livres par année et cela en fournissant l'énergie de chauffage gratuitement aux utilisateurs; les gains en rendement supportent aisément les coûts additionnels de capital. Si cela est possible en Angleterre, pratiqué en Suède, cela devrait et sera bientôt pratiqué sur une grande échelle en Amérique du Nord.

Un autre domaine où les consultants bénéficient de la philosophie de la conservation est celui de la tarification. Jusqu'à récemment, encore, lorsqu'on se préoccupait de réduire les coûts d'énergie, on ne pensait qu'à réduire la partie coût du capital dans la tarification. On installera des limitations de demande, des contrôleurs de facteur de puissance mais peu d'attention était portée à la consommation totale.

Aujourd'hui on porte plus d'attention à réduire la consommation d'énergie elle-même parce qu'on prévoit que ses coûts futurs croîtront. Les consultants qui, anciennement, étaient des conseillers en tarification deviennent aujourd'hui des experts en conservation d'énergie. Ils disposent des mêmes outils mais aujourd'hui ils peuvent les utiliser dans un but beaucoup plus noble. La prise de conscience des coûts réels à l'utilisateur final et les économies substantielles à être obtenues par des substitutions intelligentes vont nécessiter un énorme apport de ressources humaines techniques. Les industries requièrent de plus en plus des expertises énergétiques qui, lorsque les recommendations sont appliquées, se paient en un temps très court.

Nous sommes encore loin du temps ou chacun sera conscient du coût total de chacun de nos apports énergétiques. Pourtant, cette considération est appelée à prendre de plus en plus d'importance dans les décisions de grands projets à haute teneur énergétique. Les consultants sont bien placés pour fournir des données pertinentes et influencer les décisions dans le sens de la conservation des ressources limitées.

Les Constructeurs et Entrepreneurs

Les industriels sont les bénéficiaires immédiats de l'impact de la philosophie de conservation.

Seulement, au chapitre de l'utilisation de l'énergie électrique à des fins motrices, ce dont nous traiterons plus loin, les bénéfices sont énormes.

Plus immédiatement, la conservation en réduisant les pertes inutiles tant en capital qu'en frais d'exploitation de tout ce qui touche le secteur industriel, force un raffinement de la conception des pièces et des mécanismes. Mieux étudiés, plus complexes bien que plus efficaces, ces pièces requièrent plus de frais de fabrication en matériel et en main-d'oeuvre. L'optimalisation économique se situe à un endroit différent sur la courbe investissement vs rendement et le tout se solde par la justification d'investissements qui autrement n'auraient pas été requis. La "conservation" de la ressource "environnement", par exemple, force les sociétés automobiles à installer des convertisseurs catalytiques et des systèmes anti-pollution qui à eux seuls génèrent une activité économique accrue!

Autre exemple: le Wall Street Journal cite qu'en 1978, les sociétés de fabrication de doubles portes et de doubles fenêtres vont voir leur volume de ventes augmenter d'au moins 40 pour cent. Encore, les sociétés oeuvrant dans le domaine de l'isolation thermique ont triplé leurs ventes depuis trois ans, à cause de la conservation de l'énergie de chauffage forcée, convenons en, par la hausse rapide des prix des combustibles. Les encouragements gouvernementaux dans le domaine du calorifugeage des habitations ne fera qu'augmenter les déboursés dans ce domaine d'activité.

Les gouvernements et l'économie toute entière

La conservation de l'énergie chauffage permet de diminuer les importations d'énergie dont celles de pétrole en provenance de l'extérieur et, d'autre part, augmente l'exportation de gaz, de pétrole et d'électricité vers d'autres pays ce qui a pour le fait d'améliorer la balance nette des paiements du Canada. L'effet direct sur l'inflation et le chômage de la réduction du déficit de la balance des paiements est évidente.

Il y en aurait encore long à dire sur les effets bénéfiques pour l'économie de la conservation de l'énergie thermique. On peut conclure que toute action dans ce domaine profite à l'économie toute entière mais qu'une difficulté demeure toutefois: les bénéfices ne reviennent pas nécessairement toujours [illegible]

A court terme, les prix de l'énergie seront le moteur de la conservation. A long terme, la conservation deviendra un véritable mode de vie, une nouvelle échelle des valeurs, une nouvelle éthique sans nécessité de contraintes par les prix.

Exemple II - L'énergie motrice électrique

Son importance

L'énergie électrique représente environ 25 pour cent de la consommation totale d'énergie sur l'ensemble du Canada. D'autre part, la consommation totale d'énergie se répartit à environ 21% dans le secteur résidentiel, 15% dans le secteur commercial, 29% dans le secteur du transport, et 35% dans le secteur industriel. Dans le secteur résidentiel, l'éclairage, le chauffage des locaux, et de l'eau utilise au delà de la consommation totale de l'énergie de ce secteur, la différence tant pour une faible part au gaz naturel et le reste, réparti à l'effet moteur.

Dans le secteur commercial celui qui croît le plus rapidement, le chauffage des locaux et de l'eau est aussi tout près de 80 pour cent, et le reste est chargeable à l'effet moteur tel que la climatisation, la réfrigération et le pompage.

Dans le secteur transport, l'effet moteur électrique est encore assez faible, moins de un pour cent. Malgré les espoirs d'utilisation de l'électricité pour le transport ferroviaire, ce dernier ne représentera pas plus de 5% de la consommation totale de l'énergie de transport au Canada.

Dans le secteur industriel l'utilisation de l'électricité est essentiellement thermique et motrice et représente environ 33 pour cent de l'énergie consommée dans ce secteur. La part motrice de cette consommation serait d'au moins 70 pour cent pour l'ensemble du Canada.

Si on examine ces données d'un autre angle et, en se basant sur l'ensemble de l'Amérique du Nord, on note qu'environ 64% de toute l'énergie électrique produite aux Etats-Unis et au Canada est utilisée pour actionner diverses pièces d'équipement.

En 1972, il s'est vendu près de 60 million de moteurs électriques d'une puissance supérieure à 1/6 de HP. 45 million de ces moteurs sont utilisés pour des équipements tels qu'accessoires domestiques, moteurs de systèmes de chauffage, outils, pompes, machines de bureau, et autres appareils du genre.

Au point de vue de la capacité totale, les moteurs jusqu'à un HP occupent 50% du volume, et les groupes de 1 à 5 HP, de 5 à 20 HP, de 20 à 50 HP, et de 50 [illegible]

Malgré ces données qui semblent privilégier les petites installations motrices, on doit noter que c'est l'industrie qui consomme la plus grande partie de l'électricité motrice dont 75 pour cent est dans les moteurs de puissance supérieure à un HP. Dans cette catégorie, les moteurs de 1 à 125 HP consomment 62% de l'énergie et les moteurs plus puissants que 200 HP consomment 38 pour cent.

Finalement, l'énergie motrice électrique du secteur industriel est consommée à près de 50 pour cent par seules quelques industries: les produits chimiques, les métaux primaires, le papier, les produits d'alimentation et les produits pétroliers.

Au Québec, en particulier, les deux seules industries du papier et de la métallurgie primaire consomment à elles seules plus de 62 pour cent de toute l'énergie absorbée par le secteur industriel (alors qu'elles ne comptent que pour 13.4 pour cent des emplois de ce secteur et ne contribuent que 16.7 pour cent de la valeur ajoutée de secteur).

2) <u>Le rendement global des moteurs</u>

Les pertes de rendement d'un moteur sont dues à deux causes distinctes. La première est due aux pertes de puissance qui sont dues aux caractéristiques techniques du moteur lui-même, telles que les pertes dans le cuivre, le circuit magnétique, la ventilation et la friction des paliers. Un autre type de perte est due à la façon dont le moteur est branché sur le réseau. Cela est dû au fait que le moteur est plus réactif que nécessaire et cette caractéristique cause des pertes additionnelles dans le réseau de production, qui doit être plus puissant et plus cher. Le premier type de perte de rendement est intrinsèque au moteur et ne peut être compensée. Les pertes de réactance peuvent être corrigées par des condensateurs attachés aux bornes du moteur. Cette dernière correction est rarement appliquée excepté pour les gros moteurs et seulement lorsque la compagnie fournisseuse d'énergie électrique contraint l'utilisateur par le biais de ses tarifs. Les inefficacités dues aux pertes réactives et dues aux investissements qu'elles occasionnent sont supportées par l'ensemble des usagers du réseau.

Les pertes intrinsèques d'inefficacité des moteurs ne peuvent être compensées par le remplacement éventuel des moteurs moins efficaces par des unités à meilleur rendement.

Les rendements publiés par différents manufacturiers varient de façon significative pour des moteurs de même type et de même taille surtout si on se fie sur les renseignements généralement disponibles chez les fournisseurs. De plus, ces mêmes rendement varient significativement parmi divers modèles de moteurs de chacun des fabricants et souvent même, suivant les échantillons. Un grand nombre de variables affectent la fabrication d'un moteur: la qualité de la main-d'oeuvre et des matériaux est le facteur le plus important. Importante aussi est la taille du moteur qui peut [illegible]

On peut donc, à priori, ne pas toujours prendre pour acquis les affirmations de taux de rendement cités par certains fabricants de séries surtout pour les ventes de petites unités en faibles lots.

Tout de même, depuis une vingtaine d'années, on a observé une baisse significative du rendement moyen des moteurs de puissance inférieure à 15 HP et on peut aussi noter une corrélation directe entre cette baisse des rendements et la réduction des prix de l'énergie électrique durant cette période. On pourrait dire que le rendement n'était pas une préoccupation majeure lorsque les prix de l'énergie électrique étaient relativement bas. Aujourd'hui, avec les coûts rapidement croissants de l'énergie électrique, l'industrie des moteurs qui est hautement concurrentielle se retrouve avec des moteurs à rendement plus faible qu'il serait souhaitable et il en résulte un gaspillage de la ressource énergétique et de la ressource capital par le biais de consommations inutiles. Ces dernières augmentent les taux de croissance de la demande d'électricité et le cercle vicieux des surinstallations.

3) La commercialisation des moteurs

En général, le consommateur achète un moteur comme on achète une denrée commune en autant que l'arrangement d'ensemble, la disponibilité et le prix sont convenables.

Les utilisateurs industriels et commerciaux des moteurs moyens ne portent guère attention aux variations de rendement des moteurs ordinaires et assument que les rendements sont semblables tout comme la tension et le nombre de phases. Leurs habitudes d'achat reflètent cette attitude: on achète pour la "qualité" (exprimée en termes de "durée") au plus bas prix possible.

Les clients, en général, achètent les moteurs via un personnel vendeur non technique et à partir de listes de vendeurs compilées sur la foi de l'expérience passée au sujet des prix, de la disponibilité, du service, et de la fiabilité.

Il est malheureux, par contre, que malgré tous ces handicaps, l'industrie continue de fournir des moteurs qui fonctionnent année après année et durent souvent plus longtemps que l'appareil auquel ils ont été attachés initialement. Le fait qu'ils durent est bon en soi mais si le rendement a été initialement sacrifié en faveur du prix, les pertes d'énergie ainsi encourues seront réparties sur de très longues périodes.

Plus de la moitié des moteurs vendus le sont à des (FOE) Fabricants originaux d'équipement, (OEM: Original Equipment Manufacturer). Ce sont des fabricants de pompes, souffleurs, machines-outils et toute une myriade d'équipement dont la force motrice est fournie par un moteur électrique. Un FOE n'est pas fortement intéressé au rendement - ce n'est pas lui qui paye les [illegible]

[illegible]

A court terme, la prise de conscience de la valeur du rendement ne se manifestera que graduellement, non à cause de la recherche de l'efficacité en elle-même mais plutôt à cause des prix rapidement croissants de l'énergie électrique. Dans ce cas-ci, le meilleur outil d'amélioration des rendements est une tarification régressive mais c'est un outil non spécifique aux moteurs inefficaces.

4) La rentabilité de l'amélioration du rendement des moteurs

Un meilleur rendement conserve de l'énergie mais ne peut être obtenu qu'à un prix de revient plus élevé des moteurs. De plus, les lois de la physique ne permettent pas au gain de dépasser 5 pour cent d'amélioration environ aux basses puissances pour tendre vers une valeur négligeable pour les puissances supérieures à 25 HP. Les économies potentielles d'énergie sont les plus marquées dans le groupe 5 à 20 HP bien que le plus grand nombre de moteurs se situe entre 1 et 5 HP. Au total, l'économie ne pourra guère dépasser 3 pour cent de toute l'énergie électrique consommée si tous les moteurs étaient redessinés vers le rendement optimum.

Evidemment, il va s'agir, dans un horizon de quelques années de remplacer graduellement les moteurs bon marché actuels par des moteurs à rendement plus élevé mais plus chers. On peut se demander si les économies d'énergie ainsi obtenues peuvent compenser le coût plus élevé des moteurs plus efficaces. A titre d'exemple, prenons le cas d'un moteur 15 chevaux utilisé dans une industrie typique où il opère 40 heures par semaine et où le coût de l'énergie électrique est d'environ $0.03 le kilowatt-heure. Une amélioration du rendement de 84 à 88 pour cent peut être facilement obtenue par un fabricant moyen. L'économie annuelle ainsi obtenue serait de $36.33 ou de $2.42 par HP par année. Elle pourrait ainsi justifier un investissement-moteur additionnel de l'ordre de $20 par HP. Un HP-moteur coûte environ $150., ce qui signifie que le moteur plus efficace ne pourrait pas coûter plus que 15 pour cent plus cher que le moteur ordinaire pour atteindre le point d'équilibre du point de vue de l'usager. En pratique, les moteurs à rendement amélioré coûtent entre 7 et 15 pour cent plus chers que les moteurs classiques. Le gain net pour la société est donc à peu près nul. Le bénéfice devient évident, par ailleurs, au niveau des installations de production d'énergie. Un kilowatt de puissance électrique installé et distribué coûte aux environs de $2,000. ou près de $1,500. par HP. Une économie de 4 pour cent par HP due à un moteur plus efficace diminue, de ce fait, les investissements de la société productrice et distributrice d'électricité d'environ $60. ce qui est environ 2 fois ce que le fabricant ou l'utilisateur ont investi par HP dans le moteur.

C'est ici qu'on observe une fois encore le dilemne que nous avons rencontré à l'examen de l'énergie de chauffage. L'utilisateur, d'une part peut, en utilisant un moteur à rendement plus élevé, obtenir une économie d'énergie qui compense à peu près le coût plus élevé [illegible] [illegible]
[illegible]

D'autre part, si l'utilisateur investit dans un moteur à haut rendement et, en assumant qu'il soit au point d'indifférence, il influence le coût des investissements de production chargé à l'ensemble de la société dans un rapport de 2 à 1.

Le dilemne consiste à convaincre l'utilisateur de sacrifier son propre capital à court terme en vue de bénéfice à moyen et long terme de l'ensemble de la société. On peut deviner quelle sera la décision de l'utilisateur: son propre intérêt prime sur celui de la société!

On en vient donc à la conclusion que l'introduction des moteurs à rendement élevé est une opération rentable au niveau de l'ensemble de la nation bien qu'elle apparaisse être plus ou moins indifférente aux fabricants et aux utilisateurs. L'action de promotion dans ce sens doit donc provenir des organismes qui se préoccupent du bien-être de l'ensemble de la communauté: les gouvernements qui agissent par le biais de règlements, d'éducation et de politiques tarifaires éclairées.

Somme toute, un programme d'amélioration du rendement des moteurs est un pas dans la direction de la conservation des précieuses ressources de capital et d'énergie mais il ne faut pas surestimer son impact qui sera de beaucoup inférieur à celui des économies qu'on peut attendre dans le domaine du chauffage et aussi qui ne deviendra apparent qu'après une longue période à cause de la longévité remarquable des moteurs présentement installés.

Au niveau des interventions, les gouvernements ont le choix entre augmenter l'intérêt des utilisateurs pour les moteurs améliorés ou encourager la fabrication de ces types de moteurs de façon à la rentabiliser davantage. Cette dernière approche est celle qui pourrait donner les résultats les plus immédiats.

Une étude récente de la Federal Energy Administration aux U.S.A. et transposée aux conditions canadiennes estime qu'une intervention de persuasion de la part du gouvernement économiserait une somme dans ce domaine d'environ $400 millions entre 1977 et 1990 et, que les économies persisteraient jusque vers l'an 2050 où les forces du marché dues aux coûts croissants de l'énergie auraient atteint sensiblement les mêmes résultats sans intervention publique. L'étude conclut que le meilleur outil est l'information continue du public sur la foi de renseignements précis au sujet des rendements réels des équipements plutôt que par la réglementation.

CONCLUSION

La philosophie de la conservation peut être ramenée au principe de l'utilisation rationnelle de toutes les ressources sans exception. Les ressources [illegible] sont [illegible] l'énergie, [illegible], et, tout [illegible]

Une analyse un peu poussée de deux domaines, le chauffage et le rendement des moteurs indique que nous possédons présentement les données nécessaires et suffisantes pour réduire au minimum le gaspillage des ressources. Cependant, on observe qu'une économie d'une ressource donnée peut s'effectuer au détriment d'une autre ressource aussi importante. Dans le cas du chauffage, l'utilisation abusive d'énergie gaspille les sources d'énergie des producteurs et le capital-épargne des utilisateurs. Le potentiel d'amélioration se situe au niveau de la substitution vers des formes d'énergie beaucoup moins chères en termes d'investissement et de coût par unité de chaleur. Dans le cas des moteurs électriques, les moteurs à rendement amélioré coûtent plus cher et les manufacturiers et les utilisateurs ont peu d'incitation à les fabriquer et à les utiliser; ils sont peu portés à poser des gestes gratuits en faveur du bien-être de l'ensemble de la communauté. Pourtant, les avantages de réduction des investissements sont élevés du côté des producteurs d'énergie et il semble que seule une forte campagne de persuasion de la part des gouvernements ait des chances de porter fruit.

Deux points ressortent de l'analyse. La philosophie de la conservation peut s'interpréter en termes d'utilisation rationnelle des ressources ou, en d'autres mots, l'élimination du gaspillage. Dans cette optique, la rentabilité de la conservation est évidente.

D'autre part, l'élimination du gaspillage est tout à fait conciliable avec la raison d'être des entrepreneurs de l'entreprise privée ou d'état qui sont régis par l'équation fondamentale

$$\text{Profits} = \text{Prix} - \text{Coûts}$$

Toute action qui réduit les coûts, et c'est le cas de la conservation, augmente les profits pour un niveau de prix donné.

La société canadienne s'oriente donc plus ou moins consciemment dans la direction d'augmentation de ses profits tant financiers que quantifiés en termes de qualité de vie.

A court terme et pour quelques années encore, le moyen d'action le plus puissant pour réduire le gaspillage et conserver les ressources est l'action sur les prix. Les hausses forcent l'économie.

A moyen terme et long terme, l'action portera beaucoup plus dans la direction de réduction des coûts. C'est la voie la plus rationnelle et la plus apte à permettre à tous les acteurs de bénéficier des économies ainsi obtenues, éliminant ainsi le dilemne actuel de la répartition des bénéfices et des coûts.

COMMUNICATIONS AND INFORMATION PROCESSING
CHALLENGES AND OPPORTUNITIES FOR CANADA

Trygve Ringereide
Director, Policy Development
Bell Canada

Abstract

This paper reviews some of the new technologies on the horizon in the telecommunications industry such as fibre optics and pulsed transmission, and looks at some of the associated social factors which could be conducive to the Conserver Society.

Industrial concerns, such as the duopoly of the Trans Canada Telephone system and CNCP Telecommunications and the relative advantage of the telecommunication sub-group in the Electronic industry, are explored. Broadcasting policy and federal regulation, and cable television services are discussed in terms of rationalizing the telecommunication distribution function.

The paper proposes that it is time to rethink and replan the Canadian Broadcasting system and to accept the basic concept of separation of the programming and distribution functions.

The creation of an efficient multi-user network, controlled by the CRTC and a Programming Authority is suggested to replace the present system. The paper concludes with a scenario of what could be accomplished in the next 5 and 15 year periods; the first 5 years consisting of organizational upheaval followed by 10 years of implementation and growth.

Introduction

We are at a turning point in Canadian public policy.

This is a time of great concern both as regards Canada's economic future and our cohesion as a nation. It is also a time of great opportunity for re-examination of national goals and priorities and for taking effective action to overcome our present difficulties.

You all know the problems: Our secondary manufacturing industry is no longer competitive in world markets and in some cases even in domestic markets. We are importing many products which we used to make in Canada and thereby exporting jobs while unemployment at home is soaring. The vulnerability of our branch plant economy is becoming very evident as many such plants either [illegible]

Yet, we are dependent on foreign trade more so than any other developed nation and will likely face a further reduction in protective Canadian tariffs as a result of the GATT negotiations.

Against this sombre background, the studies of the GAMMA group on "The Selective Conserver Society" take on added timeliness and importance. In particular, the recommended option for the Conserver Society, CS-1, "doing more with less," which stresses the need for efficiency, represents an important contribution to the search for viable policy options.

The topic of this paper is "Communications and Information Processing, Challenges and Opportunities for Canada" but it is obviously true that communications and information processing need to be considered in relation to the much wider concept of "the information society," "the electronic age," "the age of technology" or whatever term we may use to describe a future society where the use of and access to information will increasingly be more important than physical resources in creating wealth and providing an enhanced "quality of life." Once our basic material needs are satisfied, such intellectual goods as the pursuit of knowledge and various forms of non-material satisfaction become very important. "Culture" is a very wide term that takes in not only high-brow esthetics and the arts but most of the life-style to which we have adapted.

It has been pointed out by anthropologists that a baby born today is really next of kin to the child born to the nomadic tribesman or cave dweller at the outset of our civilization 10,000 years ago when man first started tilling the soil. The difference is in the access to information and knowledge of the modern child. Knowledge is really information organized in a logical manner. From this point of view "information" is the foundation upon which all human activity is based.

The spectacular technological achievements of the 20th century are largely based on the increased ability to handle information due to improved telecommunications and the computer. The development of the modern computer and information processing is very closely tied to advances in the telecommunications art. Thus, the invention of the transistor by Bell Laboratories in 1948 should rank as one of the most important milestones in human history.

We have arrived at a juncture of human history where the limits to technological progress have been moving rapidly outwards, and future applications of electronics is more likely to be guided by our ability to conceptualize new services and systems than be limited by technological constraints.

There are many aspects to the "information society." The possession of information and the ability to process it is not enough. As a society we need to define our system of values and at least adopt some basic goals for future policy. The institutional structure of our society will greatly influence future developments. In particular, future progress in communications and the information services in Canada will depend on the legislative and regulatory framework established by governments.

[illegible]

I would like to stress here that the views put forward by me in the following discussion of Canadian communications and information processing are my own and not necessarily those of the company for which I work, Bell Canada, although I would sincerely hope that a majority of workers in the vineyard would share most of these views.

After this somewhat philosophical and wide-ranging introduction to my topic I will now turn to a more specific discussion of ways and means of achieving a more rational and efficient development of communications and information services in Canada, dealing not only with the technological and systemic considerations relating to infrastructure for these activities but also discussing some aspects of the broadcasting industry.

The Key to the Conserver Society

It should be emphasized here that efficient and rational communications and information handling systems are the key to an efficient conserver society. Modern telecommunications systems are very frugal in their use of energy and becoming more so; the rapid flow of information allows business and institutions to operate more efficiently, and conserve energy and in many cases communications is a substitute for travel. Increasingly, the success or failure of business depends on a firm's ability to generate its own information and make use of it, receive and utilize technological and marketing information from outside sources, and maintain a management information system which assists its management to make the right decisions and react quickly to opportunities and changed circumstances.

In today's Canada more than 50% of the working population is engaged in the handling of information in one form or another. These information based service functions are increasingly reliant on the services of telecommunications carriers for interaction between their various components. Broadcast services have similarly revolutionized access to mass entertainment, information, cultural, current affairs and news programming to such an extent that the average Canadian spends 30 hours per week watching television alone - mostly programs of foreign origin, but some excellent Canadian programs are also being produced. The future direction for the Canadian broadcasting system continues to be a major policy problem.

Canadian public telecommunications carrier systems are well developed and rank among the very best in the world providing a wide range of services at low cost. They are world leaders in the development of sophisticated new data transmission services and are supported by a strong R & D capability and manufacturing industry closely affiliated with the major carriers.

The technical facilities of the broadcasting industry are also well developed. More than 50% of Canadian homes are now connected to cable television systems offering access to a great many television stations.

The technological [illegible] towards [illegible] integration of all telecommun[illegible] [illegible]

The Present Industry Structure

Historically a duopoly of intercity telecommunications carrier services provided by the TransCanada Telephone system and CNCP Telecommunications has developed in Canada. In addition, the Canadian Radio-television and Telecommunications Commission, and its predecessors, have maintained a policy that broadcasters should own their transmitters and has also insisted that cable television operators own a substantial portion of their distribution system, in particular head-end equipment, cable amplifiers and household drop cables.

In spite of these policies the separation of the various telecommunications systems is far from complete. Thus CNCP operates an inter-city transmission network but leases local distribution loops from the telephone companies in most instances. They are now applying for full interconnection to the switched local telephone network for their data and private voice services. This would enable them to use their competitors' network when it suited them and compete for any data and private line voice services offered by the telephone companies.

Similarly, the broadcasters obtain their networking facilities from the telecommunications carriers. As radio and television transmitters are in a sense terminal devices emitting broadcast signals for which no charge is made to the public, it matters little who owns such transmitters, at least from a carrier point of view.

The cable operators ride piggy-back on the right-of-way and the pole and conduit structure of the telephone companies and the hydro-electric companies which constitute a resource of far greater value than the CATV investment in their own distribution facilities. During the past year, Saskatchewan and Manitoba have obtained the right to provide almost all of the distribution network for cable television through their provincially owned telephone systems.

The evolution of technology is now, however, driving us towards greater integration of telecommunications plant, including those broadcasting functions which provide the medium for delivering the message as opposed to the programming function.

It has in the past been easier to achieve economies of scale in the long distance network because of its joint use characteristics. The development of high capacity microwave radio systems and the introduction of Direct Distance Dialing have been major advances. In Canada telephone companies with the explicit support of regulatory commissions have always set rates for long distance telephone services high enough to provide substantial support for the maintenance of low local subscriber rates.

Technology has now given us the means for achieving greater economies in the local distribution plant. We now have the technology for rationalizing the local distribution system and achieving increased joint use characteristics. A number of [illegible] telecommunications services can be provided over a common network at reasonab[illegible] [illegible] in a socially beneficial way, but in order to accomplish this new governme[illegible] [illegible]atory [illegible]

Canada is a world leader in providing public data transmission services to the data processing industry. The digital Dataroute system and the Datapac data package service of the TCTS companies and the Infoswitch service of CNCP Telecommunications provide largely equivalent services but it is doubtful if such duplication makes sense.

New Technology

A major transformation of the Canadian telecommunications carrier network is well under way. The main feature of the new network is that eventually most or all messages – voice, data and video – will be transmitted and switched in the form of pulses. This is ideal for data and computer communications but also offers improved voice and video transmission. A fibre optical local distribution network will be able to carry all local services such as telephony, data, information retrieval services, cable television, electronic meter reading, etc.

In the intercity network digital microwave radio systems are being built and will be supplemented by improved satellite communications systems and in some instances by long distance fibre optical transmission cables.

Up to the present time most telecommunications systems have employed analogue transmission. In an analogue system the electric signal carried by the system is varied strictly in proportion to the amplitude of the input signal which may be voice, video or data. The parameter varied may be amplitude, phase or frequency. Many such signals are combined into a multi-plexed signal for transmission over inter-city radio and cable systems. To avoid excess noise and distortion all circuit elements in such analogue systems must be strictly linear and need to be tuned accurately.

In a digital system the amplitude of the signal to be transmitted is sampled at frequent, regular intervals and each sample is then encoded and transmitted as a series of pulses. To illustrate: A voice signal is sampled 8,000 times per second. The amplitude of each sample may be encoded by an 8-bit code which permits 256 discrete levels of the sample to be encoded (i.e. 2^8 levels). This results in a pulsed signal of 64,000 bits/second.

These pulses are extremely short and many such pulse trains can be interleaved to produce a time-multiplexed signal for transmission over long distances. At the receiving end these signals are then decoded and provides an analogue output signal if the original signal was in analogue form. Data signals are of course in digital form.

The great advantage of digital systems is their superior transmission quality and ease of maintenance. As pulse signals in a binary system are always of two discrete amplitudes, "0" or "1", all that is required of amplifiers along the route is that they can identify without fail each incoming pulse as a "O" or "1" and retransmit an identical fresh pulse down the line. No finely turned circuits are required, which would be impossible anyway when transmission systems are built up with large scale integrated [illegible] circuit chips containing thousands of transistors [illegible]

Signalling also needs to be provided to instruct switching machines how to route each signal, provide ringing and busy signals, etc.

The new generation of digital switching systems will result in a new network architecture. Digital switching offices can be very large, up to 200,000 subscribers per office, and by placing some of the switching function in remote switching units (RSUs) connected to the central office it will be possible to serve quite large areas economically from a single central office. Installation of such large digital switching offices will commence in 1980 in Canada while some smaller officers are now in the process of installation. For a prolonged period analogue and digital networks will interface through analogue/digital converters but for best economy and performance an all-digital network is required.

Fig. 1 shows the principle of a broadband local network using a digital switcher and fibre optical distribution cable. A fibre optical loop system is being constructed by Bell Canada for demonstration and testing in Yorkville, Toronto, and other tests of fibre optical trunks are taking place in Montreal and Manitoba.

The technology of fibre optics is in rapid development. Experimental systems are being tested in several countries. The cost of very pure low-loss fibres is coming down rapidly. The light-emitting diodes (LEDs) and solid state Lasers used as transmitters in these systems and the photodetectors used for reception use very little power and at the present time permit as many as three television programs to be transmitted over a single fibre optical strand the thickness of a human hair. The Japanese HI-OVIS system is of special interest as it is expected to demonstrate many of the concepts of "the wired city."

Already fibre optical distribution can be shown to be economically feasible for an urban distribution plant for telephone, data and cable television but would not be economical for CATV alone.

Another extremely important development is that of the US space shuttle. Not only will the space shuttle reduce the cost of placing satellites in orbit by a factor of three, but it will also soon become possible to build larger communications satellites, refuel them in orbit and even take them back to earth for maintenance. This could make the use of high-powered satellites for direct broadcasting to home television receivers quite attractive.

Computers are undergoing a similar transformation. In the last few years the cost of hardware has come down drastically. Several generations of mini-computers and micro-processors have succeeded each other within the span of the last five years. New Very Large Scale Integrated (VLSI) circuits containing thousands of transistor circuits per tiny chip, and new data memories offering data storage at a hundredth of a cent or less per bit have revolutionized the industry. It is really useless to quote specific figures as they become very quickly outdated.

Distributed data processing whereby an organization may replace or supplement [illegible] large mainframe computer by several interacting smaller computers located at [illegible] sites. [illegible]

The development of new protocols and standards for data communications over the public carrier system is of major benefit to data processing organizations and will facilitate the future introduction of new services. New more simple computer languages, such as COBOL, will also make it easier to use computers for persons with less specialized computer training.

Economies of Scale and Scope

Economies of scale are very pronounced in the long distance network but much less so in the local telephone network. In the local network individual access must be available to all users of the switched network, and this limits the economies obtainable through joint use of facilities.

In economics literature the situation where it is cheaper to provide two or more types of services via one organization and/or by the same facilities than to supply them separately, is referred to as "economies of scope." The main opportunity for achieving economies of scope in the local network is to provide many services over the same facilities. The use of fibre optical loop plant in the local network will extend the capability of the local network to carry all kinds of wideband and narrow-band communications over the same plant.

Economies of scope are not mainly dependent on having all local services use the same transmission cables. Some economies are achieved by permitting the cable television companies to use the right-of-way and support structures of the local telephone and hydro companies. Optimum economies of scope would result from telephone companies providing local loop facilities for all services using combined drop wires avoiding any duplication of mainteance and installation crews, technical management, and vehicle and workshop facilities. Such administrative services as billing and the taking of orders for CATV service could also be provided by the telephone companies as just another item on the local telephone bill or another service provided by the telephone business offices.

It is unfortunate that past events have prevented the telephone companies from providing complete technical distribution facilities for CATV. Subscribers have borne the burden of maintaining duplicate administrations. Hopefully the new agreements between the federal government, Saskatchewan and Manitoba on CATV facility provisioning will be followed by a general policy removing present bars to provisioning of complete CATV facilities by telephone companies.

While fibre optical plant offers tremendous promise for increasing the capability and flexibility of the local network to provide a wider range of telecommunic-ations services, it should be realized that local plant integration can also be implemented using existing copper technology providing substantial savings in the avoidance of duplicate administrative and technical services.

Social Factors

Much [illegible]

more than 50% of Canada's workforce now is engaged in the handling of information in one form or another, most of these jobs are dependent on healthy primary and secondary manufacturing industries. Thus, I was recently told by an official of Northern Telecom that between 60 and 70% of the cost of developing a new telephone switching system is in the creation of software and other information.

It is also evident that in the future we must learn to achieve greater efficiency in industry and governmental administration but hopefully without sacrificing essential social security services. It has been said (by Drucker, I believe) that it is more important to do the right things than to do things right. It is less a question of working harder than of concentrating our efforts in certain industrial sectors, such as telecommunications or electric power generation to mention just two such sectors, where we can hope to maintain an advanced technological capability and be competitive in a world market. This can mainly be achieved through encouragement of R & D activities and improved management of information. The knowledge industries will need to grow and a sophisticated capability in electronics, including telecommunications, automation, data processing and system analysis will become increasingly important as these fields of expertise are basic to a modern industrial society.

Sophisticated telecommunications and data processing system can be both a centralizing and a decentralizing force. It is reported that in some multi-national corporations improved management information systems, providing the central headquarters with up-to-date information on the operation of branch plants and subsidiaries, have led to increased centralization of decision making. On the other hand, information can flow both ways making it possible for personnel at remote company locations to make decisions at the local level utilizing information drawn from the company's central computer files.

In Canada a business organization or government department no longer needs to centralize various related office functions under one roof but can operate efficiently in several locations using data communications and other telecommunications links to tie the various functions together. The decentralization of some federal government activities illustrates this trend. There is reason to think that a further decentralization of federal government departments and agencies may provide a partial answer to offset the effect of regional disparity without any loss in efficiency. This is particularly true for administrative activities which do not require constant interaction with other government departments on policy matters.

Business organizations will likely in the future only maintain a small downtown head-office for senior staff while locating most of the headquarters departments in suburban locations where space costs less and employees have an opportunity for living closer to their place of work. These departments would have access to central computers and data banks or would have their own computers and data banks as part of a distributed computer system.

City planning is likely to be strongly influenced by such decentralization of business organizations which may have important implications for transportation and [illegible] to a [illegible] population in the inner city core.

of advertising and exposure to other lifestyles. On the other hand, the public is much better informed about national and international affairs than ever before. While any efforts by governments and regulatory agencies to censor information should be avoided there is a need to provide a greater variety of quality programs, less advertising and a more balanced fare of imported programs from many different countries.

Industrial Considerations

The Canadian electronics industry as a whole has not fared well in recent years as evidence by the Sector Profile of The Canadian Electronics Industry recently prepared by the Department of Industry, Trade and Commerce. The one bright spot is the Telecommunications sub-sector. As ITC puts it: "Given its size and existing strength, the future of Canada's telecommunications industry lies with Northern Telecom to a large extent but other smaller companies also contribute strongly to this country's overall capability in this field." ITC and also the Science Council and the Department of Communications have often pointed to the mutually supportive cooperation between Northern Telecom, Bell Northern Research and Bell Canada as an example to be emulated in other Canadian industry. It is somewhat ironic that the Restrictive Trade Practices Commission has launched a major attach in order to break up this corporate relationship. In my view, the RTPC action represents a kind of Canadian death wish in a world where all developed countries maintain high, and often impenetrable, invisible trade barriers to protect their domestic telecommunications equipment manufacturers.

Northern Telecom's success in world markets is based on advanced technology. You cannot rest on such laurels but must keep constantly one step ahead of your competitors. This company is a world leader in the introduction of digital switching technology. The next major step forward is likely to be the technology for fully integrated telecommunications carrier systems. The Japanese in particular are making rapid progress in this field. It should be obvious that if Canadian governments persist in maintaining the existing institutional separation between telephone companies and cable television companies this will greatly reduce our status as a world leader in the telecommunications carrier field and will eventually harm the Canadian telecommunications industry. We now have a chance to develop a world lead in integrated network development thereby strengthening both the Canadian infrastructure and our competitive position.

The CATV industry is mainly supplied by foreign manufacturers. Because of the fragmented nature of this market, co-axial cable and most of the hardware for this industry are not being manufactured in Canada.

The Canadian computer industry has made considerable progress in recent years. Although not strong by international standards, it may be expected that the greater use of smaller computers and the ready availability of such building blocks as circuit chips and memory circuits from international suppliers will enhance the importance of software and open up opportunities for Canadian manufacturers of many speical purpose computers. Major international computer manufacturers have also increased their Canadian operations. Our greatest opportunity in this [illegible] should, however, be the [illegible]

There are some notable successes in Canadian electronics such as the strong position of CAE Electronics in the flight simulator field, the advanced railway train control designs of Glenayre Electronics, and many other examples to show that there is no lack of inventive genius in Canada but a strong need to encourage such information based industries.

Telecommunications Carriers – The Problem of Duopoly

The main function of a public telecommunications carrier is to provide a common network for hire for the carriage of telecommunications traffice for all users of the network without discrimination. The public telecommunications carrier is a public utility, subject to public regulation of the rates charged to the public, and does not control or influence the content of any messaged carried over its network. For maximum usefulness a public telecommunications carrier network must be ubiquitous, i.e., it must provide individual users access to all other users of telecommunications services, and must provide reliable service of high quality at reasonable cost.

In Canada only the telephone system is a complete national telecommunications carrier system providing both local and long distance services over its network. This network provides fully integrated telecommunications services over its long distance facilities for voice, data and video and also in its local network except for household CATV distribution. However, the telephone companies with their strong technological and operating capability and their associated R & D establishments and manufacturing industry which have made them world leaders in the telecommunications carrier field, are effectively barred from applying their skill and resources in the cable television distribution field.

The Trans-Canada Telephone System is an association of the major telephone companies in each province and Telesat has recently become a member of the TCTS. It coordinates the planning of national systems and services, administrates the division of revenue for U.S.-Canada toll trafic between member companies, and is responsible for network control. TCTS itself does not own any network facilities as these are provided by the member companies.

CNCP Telecommunications is an unincorporated cooperative organization of the telecommunications divisions of the two major railways. They jointly operate their trans-continental microwave network which links major Canadian cities. CN also operates telephone services in the Yukon, the Western Arctic and in parts of Newfoundland. separate from the CNCP Telecommunications arrangement. The CNCP Telecommunications system is not a complete network as it lacks local distribution loops in most places. In most cases loops for connecting CNCPT customers to their microwave network are leased from the local telephone companies. This does not entail system interconnection between CNCPT and the TCTS companies as these loops are provided exclusively to CNCPT as private loops and are not connected to the switched telephone network.

The economies of the CNCPT microwave system are much lower than for the [illegible]

The Railways' Interconnection Case

The railways in a current case before the CRTC are now attempting to gain access to Bell Canada's switched network for their data and voice services. If they succeed in this case, they would then try to gain access to the switched network of other telephone companies. The CNCPT would under this plan use the switched telephone network to offer competitive services to those of the telephone companies and for drawing more inter-city traffic to the CNCPT microwave system. CNCPT would expect to offer similar duplicate data services, including credit check services, electronic fund transfer systems, etc. on a national basis. So called "private line" voice service would according to CNCPT include the provision of telephone service between all telephones of a company contracting for such service, using the local switched telephone network together with CNCPT's inter-city microwave network to connect the various parties together, thus bypassing the TCTS long distance network.

It is an illusion to think that competition from CNCPT is holding down rates for TCTS long distance services. On the contrary, the siphoning off of some traffic to the CNCPT system reduces both the operating economies and the long distance revenues of the TCTS companies and thereby necessitates higher rates.

The current system interconnection case raises some very important policy questions. All telephone companies and most of the provices oppose the railway application on the grounds that system interconnection would lead to increased "cream skimming" by CNCPT on the major inter-city routes, thereby reducing the economies of scale of the TCTS companies, reducing their long distance revenues and necessitating higher rates for local service. It is further questioned whether Canada will be well served by having two national data networks, duplicate investments in digital data services, and forcing business organizations and institutions to subscribe to both the TCTS and the CNCPT data services to gain access to all their customers.

Proponents of competition generally argue that competition is of such benefit that it is worthwhile to sacrifice some efficiency and allow some duplication of investment in facilities to achieve such competition. In the case of inter-city telecommunications such efficiencies are so pronounced that CNCPT can only maintain a viable operation so long as TCTS long distance services are priced fairly high to provide support for low local and rural subscriber services. The averaging of rates for telephone service between high cost and lost cost areas and the policy of regulatory commissions of keeping rates for local services low at the expense of somewhat higher long distance rates is well established in Canada.

Economists may argue whether rates for local and long distance service should be set to more closely reflect actual costs of service provision, however, because the existing rate system is based on "value of service" pricing it will be very difficult to change. Under the value of service concept local telephone rates are based on the number of telephones in a base rate area and not on the actual cost of service provision. i.e. if a subscriber can reach 5,000 other subscribers without [illegible] long distance charges he [illegible] less per month than if he could reach [illegible]
[illegible]

Possible Solutions to the Problem of TCTS and CNCPT Duopoly

A more fruitful solution would result from a recognition that there are advantages of both monopoly and competition in the provision of telecommunications services. We do not maintain different highway systems for trucks and cars. In the early days of telephony there were competing telephone companies in many cities. This was the time of "double price or half service", but it was soon recognized that telephone service was a natural monopoly. Some services, such as long distance transmission and switching, can be most economically provided by a single network. It is also more practical and more economical to have only one public data transmission network using a standardized protocol for various data services. While the main "communications pipe" can most efficiently be provided by a single supplier, this does not necessarily preclude competition betweeen various suppliers of communications services using a common network.

However, in view of the current interconnection case before the CRTC, this would not be an opportune time to elaborate on specific solutions to achieve national network integration.

Broadcasting

Broadcasting in Canada comes under exclusive federal jurisdiction, although several provinces have challenged this. Exclusive federal jurisdiction over communications using the radio frequency spectrum was established by a Privy Council decision in 1932, the Radio Reference Case. Then in 1965 the British Columbia Court of Appeal ruled in the Victoria Cablevision Case that cable television systems come under exclusive federal jurisdiction. The Supreme Court of Canada reaffirmed the exclusive federal jurisdiction in cable television in 1977. The Broadcasting Act makes no mention of hardware in its definition of an undertaking. The Privy Council in the Radio Reference Case defined an undertaking as follows:

> "Undertaking is not a physical thing, but is an arrangement under which of course physical things are used."

Thus federal jurisdiction over broadcasting does not depend on ownership of hardware used by broadcast receiving undertakings (B.R.U.s), i.e. cable television undertakings. The recent federal/provincial agreements with Manitoba and Saskatchewan giving the telephone companies in these provinces the right to provide more of the physical facilities for cable television indicate increased flexibility by the federal government in these matters. The Minister of Communications has indicated her willingness to discuss delegation of powers in telecommunications matters to the provinces but has also stessed the important role of the federal government in this sector to assure a complete telecommunications systems for the entire country. (Statement on 14th December, 1977).

Broadcasting policy has always been controversial in Canada. Broad objectives for Canadian broadcasting are embodied in the Broadcasting Act. [illegible] in achieving a rationalization of the telecommunications distribution function.

The telephone companies have consistently maintained the need for a separation of the medium and the message in broadcasting. It does not matter much who owns the transmitters for radio and television broadcasting since these are essentially terminal devices, usually obtaining a substantial portion of their feed via the networking facilities provided by the telecommunications carriers and making no charges to the public for their service. The B.R.U.s are in an entirely different position. They do charge their subscribers for their services which to date have been mainly geared at providing a distribution system for television signals received at a head-end or via microwave from distant locations. They do not pay for the use of these television signals and the share of the revenues of the CATV industry devoted to local programming has to date been minuscule. Thus, to date federal regulation of B.R.U.s has resulted in a degree of duplication in the local telecommunications network in the provision of the physical facilities for local telecommunications services while the true broadcast originating function of these local cablecasting systems has been largely undeveloped.

Cable Television Distribution

Cable television services are more fully developed in Canada than in any other country because of the attractiveness of U.S. television to most Canadians and also because of the generous regulatory treatment accorded the CATV industry by its regulatory commission.

More than 50% of Canadian homes now have access to cable television. In Vancouver 95% of all homes now receive CATV service and Toronto has reached more than 80% CATV penetration.

Increasingly most Canadians will receive their television and radio programs via cable and direct television broadcasting will become less important.

It is likely that in the future most CATV systems will receive their programs via satellites rather than from head-ends and terrestrial microwave feeds. Newer satellites using frequencies in the 12 to 14 GigaHertz range, or higher frequencies still, are not affected by ambient man-made noise occurring at lower frequencies, and signals from such satellites can be received on relatively small antennas located in urban areas. As the satellite beam pattern covers a large ground area, and each satellite may have several directed antennas, two satellites could cover all of Canada. There will of course also be overlapping coverage by US and Canadian satellites in large areas. The satellite is almost ideal for multi-point television and radio networking for CATV and broadcast systems. In Canada where we have 5 1/2 time zones, it may be necessary to repeat some transmissions to make certain programs available at convenient times, and there will also be a need for real time transmission of news in several time zones.

Direct transmission to home satellite receivers may not be desirable at this [illegible] This would require very powerful satellites [illegible] small, inexpensive antennas [illegible] home [illegible] the signals. [illegible]

If satellites are to be used for network distribution, all programs will need to be transmitted to the satellites from one or more program centres equipped with high quality transmitters. There will be no further need for direct pick-up of TV channels via head-ends. Various program studios can of course be connected to these program centres via special studio channels. Many of the foreign programs could also be received via US and Intelsat satellites at such program centres.

This is not a far-out scenario. Satellites suitable for such networking of television channels are being procured by Telesat, and low cost satellite receive-only stations are available today.

This is the time to rethink and replan the Canadian broadcasting system. The time has come to separate the medium and the message in broadcasting.

Programming is the heart of broadcasting and "the rest is house-keeping", as Fowler put it in his report on broadcasting. Canadian broadcasting organizations should in my view concentrate all their funds and resources on program origination and get out of the distribution function.

A Possible Scenario for the Canadian Broadcasting System

The first step would be for governments, broadcasters and telecommunications carriers to accept the basic concept of separation of the programming and distribution functions in broadcasting and work together to establish a new system based on this concept.

The feasibility of this concept rests on the creation of an efficient multi-user network, using mainly satellites to feed all television program channels from main programming centres to all local distribution systems for cable television. Small multi-channel rebroadcast transmitters might also be included in the distribution system to serve areas with scattered population. The local cable television distribution systems would be fully integrated with the local telephone network for maximum efficiency and minimum costs as discussed earlier in this paper. The cost per viewer of operating the multi-user network would be quite low as the cost would be distributed among many receiving points and millions of viewers. Presumably 24-channel satellites would be used for this purpose.

Access to the multi-user national network system would need to be controlled by the CRTC, and a Programming Authority responsible for the job of providing programming for the network, i.e. the administration and coordination of programming for the multi-user network. Such a Programming Authority might be a joint operation of the various broadcasting corporations. The CBC would be assigned several channels for English and French programs, and the major independents such as CTC, Global and TVA (French) would also be assigned national channels. Canadian educational television could be given increased regional or national distribution, and to the extent that the Provinces obtain the right to originate television programs beyond the somewhat limiting constraints imposed on ETV, such programs could add diversity to the [illegible] broadcasting scene.

has a good international reputation - much better than at home - and the Programming Authority might be charged with responsibility for negotiating agreements with foreign broadcasting organizations for exchange of programming or for purchase of the right to use in Canada of foreign network programs.

A very intriguing thought would be for the Programming Authority to provide a number of "packaged" channels which would carry a mixture of Canadian news, current affairs and entertainment programs together with a number of foreign programs but without foreign advertising. Nobody would need to be denied access to their favourite U.S. or other network programs but it would be possible to impose Canadian content requirement on each such "packaged" channel - in part the exposure to Canadian programming could be increased by running Canadian programs on different channels at different times.

The proposed Programming Authority might also contract with Canadian independent programming organizations to supply additional programs. The National Film Board might possibly be joined with the CBC, or, if it remains independent, direct its main effort at supplying programs for television. Canadian film studios could be given a great boost by such contract work for the Programming Authority.

The existing CATV operators might be encouraged to become programming organizations. There is a strong need for more and better community programming. It would thus be possible to license many of the present CATV operators as what we might call "originating cable-casters." An originating cable-caster would be a broadcaster who originates his own programs, has the right to sell local advertising and the right of access to one channel on the local cable distribution system. He would, however, not own or operate a broadcast transmitter.

At least during a transitional period there would be a continued need to maintain over-the-air transmission of television programs but such transmitters could gradully be phased out or replaced by a minimal direct broadcasting service provided by small, unattended multi-channel transmitters fed from the national network system and providing such basic two or three channel service which was deemed to be essential on social grounds.

It is encouraging that the federal Minister of Communications in her opening statement at the Federal-Provincial Conference of Communications Ministers, at Charlottetown, March 29-30, 1978, showed a clear appreciation of the potential for change due to new telecommunications technology. She remarked that:

> "It is quite evident, for example, that we must, as a nation, face the threats and potential advances in communications technology. The impact of the next generation of communications satellites, for example, is bound to influence the future development of cable television. Developments in computer/communications, switching techniques, and distribution hardware may bring the long promised "Wired city" into existence sooner than had been anticipated."

New Communications Services

Some are impatient at the delay in introducing the many new services which have been promised by futurists and planners for the "wired city." It should be realized, however, that even if many such services are technically feasible today, the timing of their introduction depends on a good many factors such as market demand, the achievement of local network integration, organization and the investment of a considerable amount of funds years in advance of any positive return on such investments. Nevertheless, substantial progress is being made. Thus word-processing typewriters, some with the capability to transmit finished letters over the telecommunications network to other machines, or to file correspondence in office data files at the touch of a key, are being introduced. The "Office of the future" is well on its way to revolutionize the business scene. Newspapers and publishing companies are introducing electronic word processors, electronic editing and page layouts, electronic type-setting and replacing the traditional newspaper morgue by data banks.

While electronic fund transfer systems may still be some years away, a great deal of experience is being gained from various experimental systems, mostly in the U.S. and all banks are automating a great many of their internal processes.

It would take too much time for me to review these many developments. I would like to mention, however, that the View-Data information retrieval system developed by the British Post Office is of very speical interest to Canada. Studies of an equivalent "Teleview" system for use in Canada are in progress. The concept is excellent but it will require very substantial investment in information packages, hardware and marketing before any return on investment can be expected.

For a further discussion of the many intriguing developments in this field, I will refer you to an excellent presentation by A.R. Megarry, Vice-President, Corporate Development, the Torstar Corporation Ltd., to the Science Council of Canada on the topic of "The Information Society", February 9th, 1978.

We cannot foretell with any accuracy when various new services will be introduced or whether they will succeed or fail in the market place. What is certain is that more and more services of increasing sophistication, and invariably in digital form, are being introduced. Major emphasis therefore has to be placed on developing a public telecommunications system equal to the task of accommodating any such new service. The Canadian telephone network is going digital, and full integration of the local network can give us a network which will be both economical and of sufficient flexibility to accommodate any new services that will be introduced.

We now have an opportunity of creating in Canada the world's first fully integrated modern telecommunications network. If Canadian governments have the foresight and the courage to unshackle the telecommunications carrier industry and reorganize the broadcasting industry, we can go very far. This could, indeed, give Canada a well-deserved leadership position in the telecommunications field which would benefit the economy and the functioning of Canadian society as a whole.

The Time Frame

I have been asked by GAMMA to indicate what might be accomplished in a 5-year and a 15-year time frame respectively. Here are my views on what might constitute an attainable time schedule:

First Five Years

Prepare new government policies and any legislation required to achieve full separation of the medium and the message in broadcasting. Undertake federal-provincial coordination in this respect. Eliminate duopoly in national telecommunications services as discussed earlier. Achieve integration of local telecommunications distribution network by telephone company operation of cable television systems using existing copper technology but gradually introducing fibre optical distribution systems. Organize and plan the multi-user network for networking of television programs and establish a national Programming Authority as discussed earlier. Launch the new satellites and start the replacement of existing head-ends for CATV by satellite receive-only stations. Encourage the rapid introduction of digital technology in the telecommunications network by appropriate policy such as giving telecommunications carriers the same tax advantages as manufacturing and processing industries, and other measures encouraging investment. Last, but very important, bring the full resources of the Canadian R & D establishment, in particular Bell-Northern Research, to bear on designing the most modern and versatile telecommunications network at a price we can afford.

Fifteen Year Time Frame

Following the rather rapid schedule of organizational change and upheaval of the first five years, the next ten years should be a time of implementation and steady growth. During these years the long distance network would become fully digital, and digital switching would have been established in all areas where businesses, industries and government were large users of digital communications facilities. It would, however, take an additional ten or fifteen years before the entire network was in digital form. Optical fibre distribution systems would become established in all new service areas and would gradually replace copper plant as it wore out or needed further capacity. The reorganized broadcasting system would become fully operational at a fairly early date as the new satellites become available and satellite receive-only stations replace the existing CATV head-ends. All the technology is there.

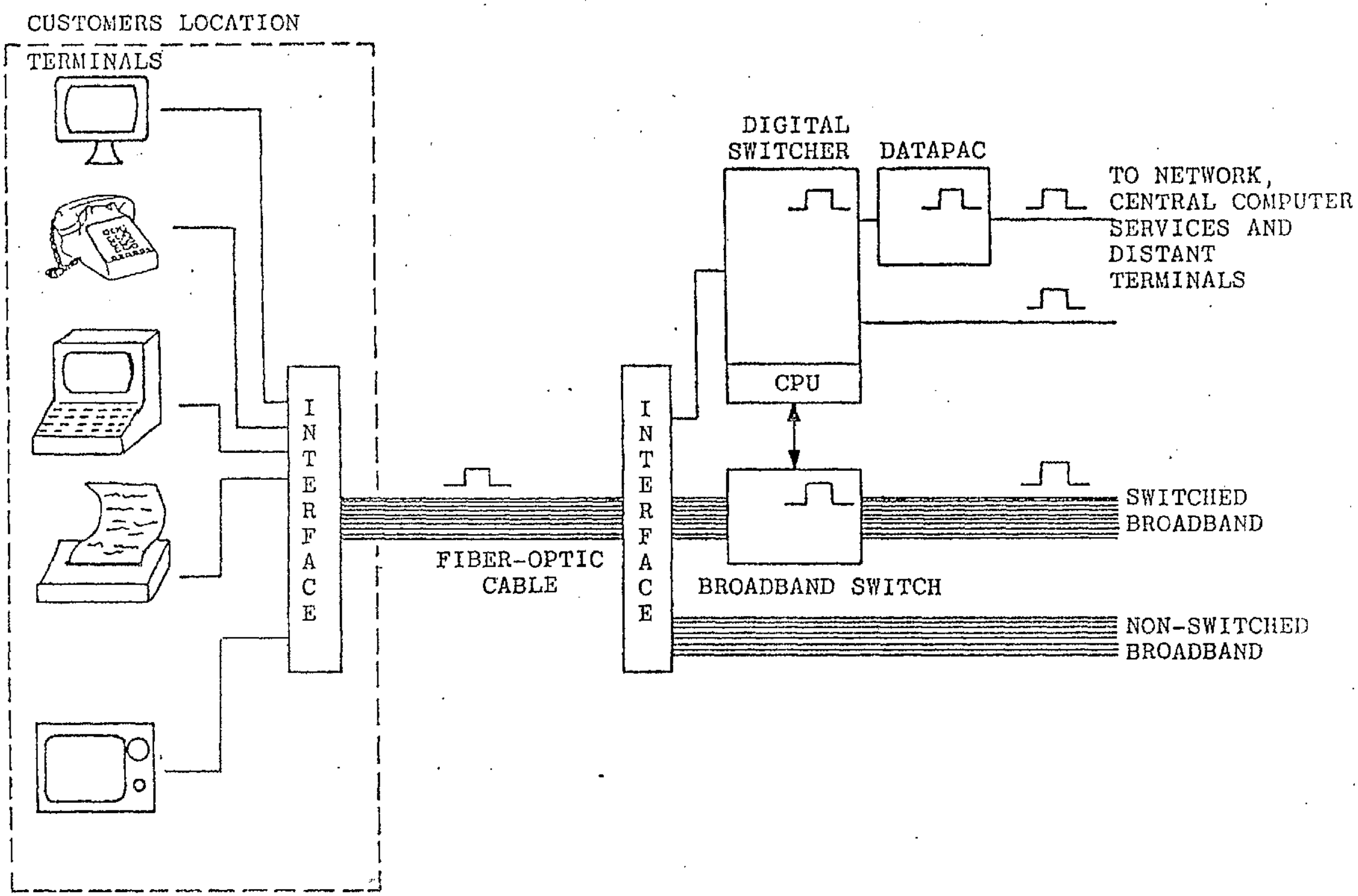
It may perhaps be considered foolhardy to make such an estimate as I have just done. Have I forgotten that nothing can be accomplished before the jurisdictional tug-of-war between the Provinces and the Federal Government is settled? To the public and the telecommunications industry jurisdiction is not the real issue, but rather whether good services are available at reasonable prices or whether regulation is good or bad. I have simply assumed that it is possible for action to be taken on [illegible] rationalization of the Canadian telecommunications system without making federal [illegible] I believe [illegible]

I understand that the federal Secretary of State Department is undertaking a new study on broadcasting. May I suggest that this would be a good opportunity for undertaking an in-depth study of the future broadcasting system and the possible solutions discussed in this paper.

At this point, I find myself resisting a strong urge to go on to discuss a number of very important issues such as Pay-TV, rationalization of the railway system through better use of electronics and modern system engineering concepts, and many other topics. In a short paper such as this, it is, however, not possible to deal with more than a few basic ideas, but I think that the issues discussed in this paper are of such central concern that they require serious consideration and decisions by governments now.

Let me say in closing that we have in Canada both the resources and the skills required for providing Canadians with the best and most economical telecommunications system in the world. Only governments working in cooperation with industry can create the conditions necessary for removing existing barriers to a full integration of the telecommunications network and services. Advanced telecommunications and information services and associated industries are vital to Canada's future as an industrial society and as a nation. We have done well in the past in developing our telecommunications and information services but are now ready to take a very important step forward.

INTEGRATION OF VOICE, DATA AND VIDEO (BROADBAND) SERVICES



POTENTIAL FOR INDUSTRIAL DEVELOPMENT IN THE CONSERVER SOCIETY -- INSTITUTIONAL IMPLICATIONS

Michel Chevalier*
Professor
Université de Montréal and York University

Abstract

In this paper a basic comparison is drawn between the end use perspective of development and the production perspective. The former tends to optimize the collective end use of goods and services and the latter optimizes the production of goods. The substitution of the end use for production perspective with its associated social impacts such as a more self regulated lifestyle is considered.

Comparison of end use management and industrial strategies are made with Denmark, China and Japan. Social limits to growth are also discussed as outlined by Hirsh, as well as the economic impacts anticipated by the U.N. study, "The Future of the World Economy".

The concluding sections of the paper deal with end use activity and management in Canada and specifically Montreal. The comparison is made between MIU (Maximum Individual Use) and OIU (Optimum Individual Use) as applied to the examples of electric power, urban transit, housing and food marketing. Finally, the author considers how certain end use patterns could be implemented.

1. Incentive for the Conserver Society

The favouring of business development initiatives which are compatible with the Conserver Society** is timely in the present Canadian context of slow economic growth in general, and a declining secondary industry sector in particular.

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* Jean-Marc Choukroun contributed to some of the arguments in this essay.

** Hereinafter CS or Conserver Society.

The usual incentives for changing development patterns in Canada are pressing and immediate. They include objectives of import substitution and export, as well as stimulation of employment and control of inflation. A primary focus for such objectives is in the secondary industry sector and its negative trade balance of eleven billion dollars, and still rising.

The new incentives of the Conserver Society, including the growing constraints of energy and material scarcity, call for fundamental -- albeit progressive -- changes in modes of production and consumption in Canada. These imply changes in lifestyle, particularly in major Canadian cities, which are prototypes of the system of urban centres in the more highly industrialized countries -- a system which generates and paces the escalating excesses of the World's consumer society pattern. And the consumer society pattern is increasingly seen as a root of social turbulence and disparity between and within nations, as well as of spreading environmental degradation.

The traditional incentives are immediate. The new incentives are not generally perceived as immediate, but are nonetheless just as pressing. A complementarity between the two kinds of incentive lies in the application of existing and new Conserver Society "socio-technologies" * Their application serves both as a basis for large scale economic development on one hand, and a basis for optimal energy and materials use on the other. The industrialized countries which are the first to turn this complementarity into broad economic policy and industrial development programs will get the most benefit from it. They will move toward activating existing and new technologies applied to their home markets, and then to export markets as a significant stimulus to their secondary industry sectors.

That is the general theme of the argument. The focus is on public policy and programs, including individual initiative as an essential element of public action.

The incentives to modify Canada toward Conserver Society patterns are found in existing Canadian conditions, always of course in a world context. The critical incentive I have selected to illustrate the argument is that of the recent precipitous decline in secondary industry in this country. It is first of all a preoccupation of the exponents of traditional economic development based on increasing material and energy use -- the antithesis of everything the Conserver Society stands for. But it can be turned to CS purposes, and can lead to direct incentives. From traditional incentive then, what kinds of direct CS incentive can be identified and activated, and how can this be done -- that is the institutional question raised here.

I propose to clarify this question by setting out a working assumption, by considering it in a Canadian and a world context, and by applying it to three time frames -- from the present over the next five years, in the medium term of five to ten years from now, and finally for the subsequent open-ended period ahead.

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* The development and application of technology must always be defined operationally as being in a social context. Socio-technology is a variant of the "socio-technical" concept, which integrates man's technical intervention in his material environment with his pattern of social intervention in the human community. It is a rich field of social investigation pioneered by F. E. Emery and Eric Trist over the past [illegible] London, [illegible]

2. A Working Assumption

The working assumption makes a distinction between what I call the production perspective and the end-use perspective in the management of human affairs. Both of these perspectives operate in some pattern of priority of one over the other. Sometimes end-use sets the pattern, but more often it is production that calls the tune.

I argue that the production perspective stimulates the consumption society, and that the end-use perspective leads towards a Conserver Society. Further, the production perspective tends to enjoy a priority over the end-use perspective in almost every aspect of Canadian activity today. Production is the measure of most indices of national development and progress, including the collective outputs of business and government as well as the inputs to the individual end-user, the consumer. This is the case for national, regional and sectoral product indices, and in corporate balance sheets. And it is evident in consumption indices of living standards. These are primarily based on aggregates of produce use by consuming individuals and households, as distinct from optimal profiles of consumption. The aggregating pattern of scale and growth rate of production then, is the primary measure of development — not the end-use pattern of satisfaction and well-being. Perhaps a key reason for our reliance on production as the main measure of progress and success is that it can more easily be calculated, when compared to the more incalculable nature of end-use satisfaction and well-being.

In any event, development tends to be assessed in terms of production. And production stimulates the consumer society — a society which consumes as a function of production. The alternative to work toward is the Conserver Society, a society where production is a function of end use. In other words, we should be seeking a rebalancing of the two perspectives so that end-use patterns shape the equilibrium between demand and supply more than do production patterns.

To the extent that production shapes end-use, there is a tendency toward a regulated system of social organization — regulated in the generic sense. And to the extent that end-use shapes production, there is a tendency toward a self-regulating social system.* Of course, both these tendencies are always present in Canada. The interesting question is which tendency of social organization — the regulated or the self-regulating — predominates in various Canadian settings. The question is interesting because it reflects many of the burning issues of the day in this country — for example, the growth of government generally, the federal-provincial balance of power, the standardizing and centralizing effects of big national and multi-national companies, the impact of "modernization" on native peoples, the apparently increasing importance of many sectors of Canadian industry to compete at home and abroad, regional disparity in Canada, and last but not least the escalating realization and expectation of material life styles by Canadian individuals and households — apparently not directly correlated with satisfaction and well-being.

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* For example, F.E. Emery, Futures We [illegible], Stenfert-Kroese, [illegible], 1977, pp. [illegible] [illegible]

As we shall see, self-regulation does not necessarily mean "small" and regulated does not necessarily mean "big". Small may or may not be beautiful, and big may or may not be bad. The people in a metropolis or a small community may be either regulated or self-regulating: or in a big or small organization. The notion of regulation suggests a pattern of relationships rather than scale.

To recapitulate: The working assumption makes a distinction between the production and end-use perspectives. To the extent that the production perspective predominates, as is largely the case in Canada today, the consumer society holds sway. To the extent that the end-use perspective predominates, the Conserver Society is in the ascendancy. The working assumption further specifies that a self-regulating mode of social organization is compatible with development in the end-use perspective, and a regulated mode of social organization is comptaible with development in the production perspective. The first form of development, that of end-use by self-regulation is the one that will lead toward compatability with the environment, that is toward the Conserver Society.

TECNICAL

SOCIAL		End-Use	Production
	Self-regulating mode of social organization	Conserver Society Development A	D ~~Consumer Society Breakdown~~
	Regulated mode of Social organization	~~Conserver Society Breakdown~~ B	C Consumer Society Development

Figure (1)

I invite the reader to consider figure (1) for a moment. It illustrates four possible conditions in a context of socio-technical interaction. I have been discussing A and C. A stresses social development, C technical development. Both the Conserver Society (A) and the consumer society (C) then, represent processes of development. A dysfunctional Conserver Society process (B) leads inevitably to social breakdown. Notwithstanding the hopes and projections of some more militant Conserver Society exponents, a regulated mode of social organizations cannot in the long run achieve their purpose. Similarly, a [illegible]functional consumer society process (D) leads inevitably to breakdown as [illegible]. The development of a [illegible] must in practice be based [illegible]

That is essentially what happens now, and its ineffectiveness in achieving environmental equilibrium in becoming increasingly clear.

A breakdown in the development of a Conserver Society (B) would appear to the extent that its management was centrally controlled or regulated. Experience suggests that such forced regimentation or deprivation leads to an unstable society over time. The more militant Conserver Society exponents would do well to ponder this point.

Turning to the consumer society, its continued development (C) must -- paradoxically -- be based on the management of production as the stimulus and regulator of end-use. This point of view is a predominant one in marketing philosophy and practice -- the invention and design of new products and services to catch the attention and loyalty of the consumer.

A breakdown or decline in the process of development of the consumer society (D) tends to appear to the extent that production becomes fragemented and comes more under decentralized regulation. The vast expansion of consumption (and of course production) in this century could not have been achieved without a corresponding sweeping integration of national and multi-national production facilities. Inexorably, this meant decline and destruction for localized producers and markets, and shrinking trade restraints. Any reversal of this trend will lead toward consumer society decline. And that is an ever-present and now rising preoccupation in international trade circles (not to mention inter-provincial trade in Canada).

I will from here on focus primarily on conditions A and C, the functional or developmental conditions of the Conserver and consumer society patterns. And I will seek the predominance of A -- the end-use perspective coupled with the self-regulating mode of social organization.

3. Canadian Context for End-Use Management

In Canada, there is fast-increasing alarm about the soft short term outlook for many sectors of primary industry: About the continued precipitous decline of secondary industry: About the continued pressures for growth in the tertiary and quartenary sectors --services, finance, government, the "knowledge" industry, etc. We are turning more and more to the primary sector to bail us out of our eleven billion dollar plus trade deficit in secondary industry: And paradoxically, we are borrowing massively abroad to do so, notably for energy and its transmission. Moreover, the primary sector is also in large measure called on to pay the shot for our still escalating demands in the tertiary and quartenary sectors. We are making some efforts to control these last two, but we are still playing longingly with such costly practices as fully-indexed pensions and exotic new banking and credit facilities, for example -- caricatures of how to fuel and nurture the consumer society. In all this increasingly frantic juggling to keep existing patterns of production and consumption growing onward and upward, the aspect on which I [illegible] to focus is that of secondary industry. Just to dream for a moment, if we [illegible] somehow able to bring the secondary industry trade deficit back down to the [illegible] the mid-sixties, unemployment [illegible]

[illegible]

perhaps lower, the economic motivations for political division would not be so critical, our reliance on the soft and spotty demands for export of our primary resources would be less, and so on. It seems to be a timely focus on which to build my argument. And as I noted earlier, my argument begins with traditional issues and incentives like these.

Perhaps Canadian leaders and technocrats took too literally the "ideal type" society defined by Daniel Bell in the mid-sixties -- the post-industrial society. By his definition "In descriptive terms, there are three components: in the economic sector, it is a shift from manufacturing to services; in technology, it is the centrality of the new science-based industries; in sociological terms, it is the rise of new technical elites and the advent of a new principle of stratification." * He goes on to predict "a changeover from a goods-producing society to an information or knowledge society." All that may be valid in some respects, although Bell apparently took little account of the technical constraints of the material environment. But now, today, in Canada, his "ideal type" society which we have pursued assiduously over the past decade and more, is not the answer. We have pursued it consciously because it was the in-style, and unconsciously because it was easy and attractive to drift into. And now we find ourselves in a situation which we, of all countries, have no excuse to be in except as a reflexion of our own inability to read the signs. Business, labour and government, not to mention the new post-industrial swarm of academic and technocratic elites in the private and public bureaucracies, have more often than not chosen the wrong problems and chased the wrong solutions.

We forgot about bread-and-butter manufacturing, and leapt into services with abandon. We tinkered expensively (albeit with relatively little effect in world terms) with the "new science-based industries." And we encouraged without reserve the rise of the new technical elites. During all this time progressively, inexorably, visibly, we were losing vast amounts of ground in secondary industry — with not a whine, or even a whimper. Why is there so little excuse for such a slide in comparative terms with other OECD countries? There is little excuse because we have perhaps a higher combination of per capita natural resources and advanced socio-technical heritage than any country in the world. With our share of the World's human and material resources, our recent record of performance in comparison to almost any other country is not one to be proud of. Seen in that light, the motivation for us to do better is quite compelling - even within the standard of incentives of extending the consumer society. And secondary industry is an area full of opportunity. I will discuss later how these incentives can be reoriented toward the Conserver Society.

There are various ways by which one can identify kinds of secondary industry. Daniel Bell makes the distinction between industry based on older, simpler technologies, and that based on "new, science-based technologies." I don't pursue that distinction here, although it is a valid one for some purposes. I will simply suggest that the appropriate technology is the one to apply in any instance, with the proviso that one should only apply evolved, complex, or new technology if it does the job better - that is from the point of view of the end-user, the impact on his whole consumption profile, and its set of opportunity costs and benefits. The question is <u>how</u> to apply it.

A key distinction in describing secondary industry which is useful for the present argument is the one between <u>product systems</u> and <u>product items</u>. Product systems are products based on a number of related technologies and/or components.

Product items are individual products which have an end-use directly with the consumer, or end-use as a component of product systems. The distinction is one which highlights the recent (since the early fifties) stunning expansion in Denmark's secondary industry sector. And I propose to use Denmark as an illustration of the art of the possible for injecting new life into Canadian secondary industry.

There are practical limitations to such a comparative exercise, of course, and we Canadians have been subject to much preaching of that order over the years. Why can't we organize ourselves like the Japanese or the Germans: Why can't we be innovative like the Swedes: Why don't we develop a pattern of entrepreneurial initiative and openness like our great neighbour to the south? Canada's level of domestic ownership of business, R & D expenditure and output stability in labour relations, employment, rise in productivity, and other related measures, is way down on the comparative performance scales of OECD countries: And so on. There is, of course, some validity to all these comparisons but often they are overdrawn. In spite of such words of caution, however, Denmark is an interesting prototype for my argument - not that we should do just like the Danes have over the past quarter century, but to illustrate that a reorientation of the order I wish to suggest is quite possible. Denmark did it, within the lifetime of most of us. But of course we are different, we live in different times and circumstances, with different constraints and opportunities. We can learn from them, but we can't copy them. We have to design our own thing.

Denmark imports 93% of its energy. It has scarcely any primary resource base except agriculture (and some fisheries). Thirty years ago, three quarters of its exports were primary or first-level processed agricultural products. And the rest was largely secondary industry products (with some invisibles). In the intervening period of about a generation, the proportion has been just about reversed. Now, some three quarters of exports are from secondary industry, and one quarter are primary (essentially agricultural). It is true that this transformation has contributed to major problems in Denmark's international debt position, but nevertheless Danes own some 88% of their industrial capacity. West Germany is next door, about as much an elephant to Denmark as the U.S.A. is to Canada. There are, of course, partly countervailing neighbouring forces of a multiple nature like Denmark's relations with the Scandinavian countries and with the other countries of Europe to help her in comparison to Canada.

In any event, had not this Danish transformation taken place, the country would have been in a state of economic subservience, of very high domestic unemployment and high migration, and of a comparatively low rather than high "first world" standard of living. Many factors contributed to this quarter century of secondary industry growth and innovation. Here, I will only consider two quite basic ones, which might be significant for Canada. First, Denmark reactivated and reinforced its tradition of product designs. Furniture springs to mind, but there are of course many other examples -- as the statistics show. And second, Denmark built on its existing pattern of small industry and entreprenuership. In the design process, it focused more on product items than on product systems; that is to say, it tended to concentrate on individual products for direct end-use by the consumer, and on [illegible] components for integration in the product systems being produced in other [illegible] positive spin-offs was reinforcement of domestic control of industry. A factor which was not as central to the Danish transformation as one might suppose, was the domestic technological R & D output. As component suppliers, the Danes could integrate their design capability with the complex technological and institutional product systems of others.

I make a distinction here between product design and technology. One can use old and often simple technologies in new product design. And one can use new and perhaps over- "scienced" or -engineered technologies for old or established product design.* And of course, one can use old and simple technologies for improving established product design. Finally, there is new technology for new product design.

	Established product technology	New product technology
Established product end-uses	Design 1 1	Design 2 2
New Product end-uses	Design 3	Design 4

Figure (ii)

The point is that design is the link between production technology, and the product itself and its end-use. If design is subject to the product technology rather than to the product end-use, the production perspective is at work. This is reflected in the argument that "Canada must get into the science-based industries", electronics, aerospace, nuclear energy, petro-chemicals and their derivatives, not to mention other more exotic emerging fields. This can be positive, but it can be overplayed. Just after World War II, we concentrated on simpler things like "plastics" and "synthetic fibres". We had the technology and industrial infrastructure head start in those days, when compared to many industrial countries, but we did not have the in-depth design sense and capability to maintain our lead. We became hypnotized by the standard technological fix, and we tended to forget about what technology is for -- that is, for end-use. It is this design capacity we did not activate which the Danes have demonstrated so well (together with an entrepreneurial capacity, and particularly a small business entrepreneurial capacity).

Now, to take my argument a further step, design capacity in the national or societal sense rests largely on the lifestyles and end-use consumption patterns of the society concerned. And that is a societal strength and focus which the Danes, apparently, have in considerably greater measure than we do. There are many cultural-historical differences between us which might be the cause of their apparently much stronger indigenous design sense. The case I make here will not be furthered by an assessment of why there is a difference between the two countries. It is sufficient to say that it takes a strong and distinct indigenous way of living to maintain and nurture a societal design capability. A society must first of all be engaged in designing for its own use before it can design and produce for others — that is, compete in other countries. Technology is no more than a back-up at this level of relationship between product design and product use. Technology can support and stimulate the synergy between product design and use, but it cannot take the place of design, which is the essential link. If design capability is essential, technology is, of course, essential as well. But any lack in back-up of indigenous technology (especially in industrial countries like Denmark and Canada) can be initially made up from outside, and then integrated with the indigenous technological capability.*

The point is that Denmark did not make its extraordinarily successful leap into widespread secondary industry because of any unusual technological or scientific capability. It made the leap because it could design useful and attractive things for its own market, which were also useful in foreign markets.

Canada is not about to take the route of Denmark in developing secondary industry. But Canada has all the traditional incentives to expand its secondary industry in its own way as best it can. Here is where the traditional consumer society incentives can be recast to further the Conserver Society. Or to put it another way, here is where there can be a shift from the production to the end-use pespective.

4. A World Context for End-Use Management

I propose to focus on the world system of urban regions in this section. That is because patterns of decision, production and end-use are essentially urban and inter-urban. The centre-periphery concept put forward by Donald Schon is a useful way to consider the world urban pattern. It suggests that the pattern at the centre of any social system — say a national or the world system — tends to dictate the pattern of its more peripheral elements. And it suggests that an extension of this concept, the proliferation-of-centres model, enormously "increases the scope of the operation." So the cities of the highly industrialized countries are at the centre, pacing those more at the periphery with their more advanced "upmarket" technologies and their lifestyles.

[illegible]

We are looking at urban development as it is and might be practised anywhere in the world. And more particularly, we are focusing on urban development* as practised in North America, in cities like Montreal, Toronto, Minneapolis and Atlanta. In the world sense, cities like these can be considered as being at the "centre". They are at the centre because they represent the leading edge of urban living in their own countries, Canada and the U.S.A. And these countries are members of the club of "western" or more industrialized nations which continue to pace and shape development in general around the world, and urban development in particular. The cities of these countries enjoy about the same level or balance of "socio-technical" application of the various urban lifestyles and technologies. There are, however, some differences in pattern from city to city, and from country to country. Standards of consumption are similar, and are becoming more so. The same is true for scales of consumption.

These urbanized lifestyles of the centre, and technologies of the centre, are more or less common for the cities of the "western" industrialized world. (And the sameness of these lifestyles and technologies is even more pronounced, if one limits oneself to the U.S.A. and Canada). This class of industrialized city then, I define as representing the centre in world terms. One moves progressively toward the periphery, as one includes the cities and metropolitan regions of second world countries, and then of the more and the less industrialized countries of the third world. (The cities of the oil rich Middle East display their own characteristics of the peripheral urban condition, as indeed do the various third world cities to a greater or lesser extent depending on their own special national environments). I am not discussing quality of urban life here, but merely a hierarchy of centre-periphery influence which may induce effects of high or low quality at any level in the hierarchy.

The point is that the leading edge of development in established patterns, and of development in innovative patterns, is at present primarily concentrated in the cities of the "western" industrialized world. This has been the case since the dawn of the Industrial Revolution, when England and its urban centres started and paced the evolving pattern which spread to other countries. And the cities of these other countries tended either to grow toward the pattern of the centre, or toward the pattern of the periphery.

The pattern of the centre evolved progressively toward an equilibrium between the demands of urban populations and the capacity of national economies and technologies to support or at least to manage these demands -- utilities, housing, welfare, education, employment, health, food supply and the rest. The pattern of the periphery moved toward moderate or extreme migration of population toward urban centres, a growth which national economies and technologies were more or less unable to keep up with in terms of organized regulation or management. Evidence of this marginal condition is found in the still burgeoning numbers of urban dwellers living largely outside the modern system in such quite different cities as Calcutta, Nairobi, Djakarta, and to a lesser extent cities like Kuala Lumpur, Lima, and Sao Paolo. (Paradoxically, some premier cities of advanced urban lifestyle and technology like New York, cities "at the centre", give evidence of similar profound disequilibrium as that [illegible] third world cities at the [illegible] periphery).

There is in effect, a centre-periphery hierarchy in the urban system in world terms, as there is a centre-periphery set of relationships within each urban region.* And in many respects, the socio-technical gap or the gap in urban life-styles and technology continues to widen, within and between cities. For example, the modern enclave societies in third world cities at the extreme periphery of the world urban system enjoy a pattern of lifestyle and access to technology quite comparable to that which obtains in the most evolved western city. And it follows that the internal disparity is all the greater in the third world city. These hierarchies of disparity at both the world and local levels in the world centre periphery system highlight a set of two limits to development or growth -- technical and social. The first one, that of technical limits, is the more widely understood.

Technical Limits to Growth. I want to explore an emerging challenge faced by the world urban system, a challenge which requires a quite different and new kind of innovation, than the kind we have been accustomed to. It provides an opportunity for "reframing the problems of cities".**

It is no longer enough to plan and provide adequate housing for all, to stimulate citizen involvement and self-sufficiency, to reactivate downtown, to stimulate tertiary and quartenary high "quality" and high income business and learning institutions, to improve the quality of urban spaces and movement and so on. Cities at the centre in world or national arenas all focus efforts to "upmarket" their productive activities with higher value-added and more sophisticated products and services. These products are for export as much or more than for end-use in their own region. But other urban regions are breathing down their necks, catching up to them, outpacing them. The quarter century of urban decline and deterioration in the North-Eastern U.S. -- Philadelphia, Baltimore, New York, Providence, Buffalo, and a host of smaller urban centres is a case in point. The seeds and evidence of that decline go much farther back in time, but the widespread recognition of decline in the comparative sense of leadership and expectation dates from the early fifties. New York's threatened financial insolvency over the past few years is an extreme reflection of this sense. The threshold of a similar decline in the central Canadian cities of Montreal and Toronto is now emerging, an example which I come back to in the next section.

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*Such a two level distinction was made between a comparative set of Latin American and U.S./Canadian cities in the 1968 Inter-American Conference at Paley House, Philadelphia on Urban Poverty Leadership Styles in the Americas. It was described in a typology of dominant-subordinant relationships, which was the same both within and between urban regions of the two continents. Report by T.J. Cartwright, Michel Chevalier, Clifford Kaufman: Institut d'Urbanisme (Montréal) and Institute for Environmental Studies, (Pennsylvania), 1969.

** Donald Schon, "Framing and Reframing the Problems of Cities" in Making Cities Work. The Dynamics of Urban Innovation. D. Morley, et al, eds.. Publi[illegible]

The comparative decline, and the social and material deterioration of many urban centres in the U.S.A., in the North-East and elsewhere, is not as much front page news as it was in the nineteen sixties. It goes on, but apparently it can be managed without breakdown, at least for the present. In economic terms, this decline was reflected by a shift of growth and lean to the middle and far west, and then to the south. Turning to the world stage, U.S. high-level technology, the main motor of urban development, was still broadly ahead of that of other countries. But recent U.S. balance of payments deficits are not only caused by the new conditions in the international oil market. The urban-based industrial incursions of Japan, Germany and other mature industrial countries have been increasingly penetrating the national markets of the U.S.A. (and Canada). And other countries, further down the pecking order in industrial maturity, have also been penetrating the North American market with labour intensive products -- Korea, Taiwan, Hong Kong, and others.

Japan too, despite its present buoyant economic condition, feels these winds of change. The present strategy of the Japanese government is to readjust its manufacturing trade with its OECD trading partners by reining in some of its export initiatives, and at the same time by buying more from its partners. It is an effort to maintain some stability in its continued upmarket export drive for higher technology and value added products. At the same time Japan is under increasing "downmarket" pressure from its rapidly industrializing Asian neighbours, notably textiles in the Japanese market from Taiwan and Korea. These countries in turn are beginning to follow Japan's post-war leap into increasingly mature and upmarket innovative technologies.

China is on the verge of its own "leap forward" up the ladder of industrialization and sophisticated technology -- and this time its leap may conceivably be a stunningly successful one. So Japan is forced to move even higher on the technology upmarket ladder than its Asian competitors, again crowing and pacing the established western industrial countries. The Japanese must do this, simply to maintain their precarious leading production position, a position with scarcely any domestic energy or primary resource base. Nor can we forget massive pending inflows of human resources at the lower levels of the industrial technology ladder, from yet other countries displacing or pushing upward those already there -- other South East Asian countries, the Indian sub-continent, Latin America with Brazil and Mexico in the lead, and finally Africa. That is a part of the scenario painted by the U.N. study on the future of the world economy.* It concludes that accelerated development of the world is needed so that the countries at the periphery of the industrial-technological system can start catching up, rather than continuing to lag or fall behind as they have tended to do. To achieve this, two conditions are necessary: "First, far-reaching internal changes of a social, political, and institutional character in the developing countries, and second, significant changes in the world economic order. The study concentrates almost completely on the second condition. Moreover, as to the first condition, a primary concern for institutional change in the developing countries is perhaps the weakest point in its argument. The point is a weak one for two reasons: on one hand it does not stress the fundamental need for new institutional forms in the "developed" countries: and on the other hand it tends to underplay those third world countries already with the institutional capability to expand toward the centre [illegible] industrial and technological development. The threshold is now, and the eff[illegible] [illegible] twentieth century. This is so certainly for hundreds of millions in China and South-East Asia. The Japanese perhaps, perceive this on-coming wave more clearly than anyone else. After all, they created a similar, if smaller wave themselves as they shot in one short generation to the industrial-technological centre from a more peripheral position. Their pre-occupation now is to speed their "move upmarket, [illegible] high value, higher-technology goods." A projected shift form the bais of [illegible] electronics to industrial electronics is an example.*

What does this escalating pressure mean, pressure from the hundreds of millions of eager Asian nations expanding into high technology industrial production? What does it mean to innovation in the urban lifestyles and technology of the presently leading cities of the world, notably the North American cities?

They are at the top of a precarious pyramid based on a logic of production. The limits to growth argument suggests how precarious the pyramid is. Popularized by the Club of Rome, and subsequently reinforced by many studies including its own statement on "Reshaping the International Order",** the limits perspective has been echoed in a country with perhaps the highest combination of scale and range of material resources per capita of any country in the world -- Canada. That is the message of "Canada as a Conserver Society."*** This official report of Canada's Science Council suggests that indeed, the country's apparently vast material resources have fast-approaching limits to which Canadians must respond now. If that is the case for Canada, it is all the more so for mother other countries of the world.

Social Limits to Growth. Another statement about limits is on a different wave length from the material limits argument. It is the thesis put forward by Fred Hirsh**** that there are social limits as distinct from material or technical limits to growth. The point is that many of the things which are valued in our society are hierarchical. Hirsch calls these values or goods "positional." They become more highly valued as basic necessities are met.

Perhaps the most striking example of positional goods concern the distribution of incomes. The comparative satisfaction and dissatisfaction of higher to lower incomes escalates both ways. And it does so particularly with two common conditions stimulated by development -- wider access in any society to information as well as access to basic necessities. These two are inherent outcomes of Leontief's development scenario, of which however he does not take particular account. In recognizing social limits to growth, one quickly concludes the following: even if one denies or minimizes the Club of Rome thesis of technical or material limits to growth, there are still limits.

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* The Economist, March 18, 1978, p. 90.

** [illegible]an Tinbergen, Study Coordinator, Dutton, New York, 1976.

[illegible]

It is these social limits which are perhaps the ones recognized so negatively by the middle-class urban guerillas in such different countries as Uruguay, Germany Italy and Japan. Much of the less spectacular dissatisfaction of groups and individuals in the U.S. and Canada may have similar roots. In effect, just as competition can be a useful form of economic activity leading toward equilibrium, so can emulation lead toward disequilibrium.

In this regard the case of New York City is instructive. I noted earlier the paradox of New York's widespread conditions of urban deprivation, comparable in some respects to say, Djakarta's. But New York can still be described as the centre the core of the centre-periphery world urban system -- both in lifestyle and urban technology. And it is likely to remain so at least until the end of this century. Djakarta is rather more at the periphery. New York has been going through a middle income depopulation of some significance, and is on the threshold of a comparable exodus of lower income and welfare residents. At the same time, it is on another threshold of new reinforcement of its central role in world and national terms, as the rich from many lands make a new wave of immigration to the city. They are in a sense taking refuge from the social limits to growth, the unrest in the lands from which they came. The social disparity is there to see more than ever in New York, with the very rich and the very poor jammed cheek by jowl on Manhattan Island. The poor have perhaps the highest level of material welfare for the disadvantaged in the world. They have access to information, and basic necessities, but their condition is pitiful. And the rich are a combination of the richest and economically most powerful in the world. Mid-town Manhattan, in a very real sense the pinnacle of the world's centre-periphery system, is a caricature of social limits to growth. Few will ever make it to the pinnacle, either those who live in extreme social deprivation five minutes away north of Central Park, or those who are not socially deprived whereve they happen to be out there on the periphery around the world. Other cities, such as London and Paris also exemplify social limits on a world level. But none is perhaps as striking as New York, particularly after the recent plunge of its fortunes, and the still more recent rejuvenation of its mid-town Manhattan heart. The hierarchy of the centre-periphery world urban system and its proliferation of sub-centres is alive and well, at least for the present!

Mutually Reinforcing Socio-Technical Limits to Growth. I have referred to various national examples of technical (or material) limits to growth. Japan in particular faces a dilemma on the upmarket-seeking spiral of new technology and forms of production and is in an increasingly fragile position because it has so little primary materials or energy. Any severe dislocation in the worldwide material flows upon which it absolutely depends means breakdown of its urban material life-support system. At the other end of the scale, Canada with its vast land mass, diversified material wealth and comparatively small population, is apparently in a more stable position. Stability is relative and interdependent however. And then there are those countries, newly climbing up the ladder of industrial production and technology. For their billions of people to achieve anything like the urban lifestyle and technological life-support systems enjoyed by Japan and Canada and the OECD countries, would be to plunder the earth's material riches -- to plunder its environment beyond redemption! This may be so, although this is by no means proven. In any event, that is what the Club of Rome and other [illegible]

This position is countered by the U.N. study on "The Future of the World Economy", and its eminent project director, Wassily Leontief.[14] It takes no great stock in the technical or material limits idea (and tends to ignore social limits). He is a leader on the other side of the argument toward continued development, essentially in the established pattern of harnessing new technology and increasing investment in pollution control.

There is merit in both arguments, although the reader will have ascertained that I lean toward the first, the one which recognizes technical limits to growth. But I believe that the case for either side will not be resolved by staying within the technical frame of reference. Rather, I think it can only be resolved in a larger frame of reference. That is why I have included in this essay the social limits to growth idea, to provide a combined socio-technical framework of limits.

Even if Mr. Leontief is "right", and undoubtedly right he is in a number of important respects -- but even if he is totally so, we are still bedevilled by the problem of emulation leading inevitably to social disequilibrium. And that problem escalates as the society of men gains increasing access to the necessities of life on one hand, and to information about man's condition on the other hand. That, in spite of its strong arguments, is right where the "Future of the World Economy" leads us. On the other hand, the thrust toward continued development in the established mode is so well rooted in our institutions, that the call for restraint, for a Conserver Society, seems doomed to fail, at least in the critical quarter century ahead. This call may deflect the course of human affairs a little bit, but that course will roll on as is at least for another generation or two. We must remember the pressure for development of the billions of people who are now moving in from the periphery. And as the course of events rolls on, it may place man in an increasingly vulnerable position in his material environment.

To the extent that there is some merit to both arguments for social and technical (or physical) limits to growth, a synergy between them becomes evident. Continued technical development will breed social disparity on an even more massive scale. And where technical development falters, technical disparity will be maintained and will escalate. Each will tend to fuel the other, based on the sharpened spread of awareness generated by worldwide information and communication. Again we must not forget the billions of would-be beneficiaries of "modern" urban lifestyles and technical support systems. And as already noted, a great many of these are capable of moving aggressively in toward the centre and of participating right now in the benefits. They will, soon and in great numbers, notably in Asia.

It is a dilemma. I raised the idea of a new frame of reference to restate the two positions as to whether or not there are technical limits to growth. I added the perspective of social limits to growth, and suggested that there was a synergy between them, a combined socio-technical limits to growth. This combination apparently traps the development optimist, together with his adversary, the development pessimist, in the same dilemma. The development optimist cannot if the argument holds, escape the closing-in of social limits on an increasing world-scale, [illegible] he may demonstrate ways to push back or eliminate technical limits. And [illegible] conserver or the development pessimist [illegible] with religious fervour as he [illegible] today between the extremes of the two opposing positions, although there are many gradations and combinations of view in between.

The new frame of reference to encompass both positions and resolve the dilemma is not one of limits to growth. It is one of thresholds -- a combination of social and technical thresholds of growth.

Social-technical Thresholds of Growth. To expand on the working assumption of Section 2, the old idea of growth and development which spread from the Industrial Revolution was based more on production than on end-use. That is to say, the progressive expansion of scale of production, requiring a corresponding expansion of local to regional to national to international markets placed the end-use consumer more and more at a distance from the producer. This resulted in enormous benefits to the end-user in many respects. But it also required the producer to strive for scale and stability in his markets. The development of new technologies, which has escalated in the post-war generation, also escalated production capabilities and capacities, not to mention competition for markets between producers. Only now it is more and more one of world market firms with multiple production facilities and multiple products. And of course, it is also more a matter of competition between different products for the favour of the end-use consumer -- supposedly consumer choice. At the same time, this choice for the consumer is more and more conditioned by a marketing process backed up by the arts and the technology of communication. This in turn stimulates social limits to growth. Limits emerge because of comparative awareness of various profiles of consumtion, end-use conditioning for the purpose of market growth and maintenance, and expanding/conflicting desires for emulation. William Leiss describes the growing phenomenon of fragmentation in the consumption profiles of the end-use consumer -- the individual and the household. He also demonstrates another form of limits -- the technical limits to satisfaction of the individual consumer. We only have so much time and capacity to consume all the products that are thrust upon us, from beer to stereo sets to package vacations, to encyclopaedias!

The worldwide network of production has increasingly taken command of the very nature of end-use consumption of the individual in the affluent society. That society lives in the urban regions at the centre of the world's centre-periphery urban system, and includes the enclave societies in many of its peripheral urban regions.

I am making a case to show the predominance of the production perspective in the world's process of production and end-use consumption. That is what the upmarket striving to new technologies is all about -- in the central economies of the OECD countries, and in the economies of all the other countries strung down-market towards the periphery of the world's urbanized system.

This production perspective is aided and abetted by government, which helps to provide the interlocking technical infrastructure and institutional base -- interlocking with and reinforcing the array of things produced. For example, the technical infrastructure provides the expressways and airports, and more and bigger expressways and airports to meet the demand shaped by production and projected production capacity in autos and aerospace. And the public institutional pattern provides the taxation profiles, the income redistribution profiles, and so on, again to stimulate production and projected production capacity (e.g., lower taxes to stimulate market demand to in turn stimulate the productive economy).

The benefits of the whole operation are tremendous. Much of the end-use consumption can clearly be identified as functional, positive, "good" for the well-being and freedom of the individual. But to the extent that the production perspective (or should one say, imperative) predominates over the end-use perspective, to that extent the whole operation is out of balance. And that leads inexorably toward socio-technical limits to growth.

But we are searching for socio-technical <u>thresholds</u> of growth, through which we can pass to new and higher levels of social well-being and expression. The clue lies in shifting the predominance from production to end-use. End-use now becomes the imperative.

5. End-Use Pattern of Activity for Canada

In Section One, the point was made that complementarity between traditional incentives of the consumer society and new Conserver Society incentives should be sought, as a first step in reorientation toward the Conserver Society.

In Section Two, the distinction between production and end-use perspectives was made. The production perspective in the management of human affairs was linked to the consumer society, and the end-use perspective to the Conserver Society.

Section Three discussed the essential characteristic for any society to maintain itself — that is to maintain its social and economic identity and independence. The essential characteristic is the society's capacity to design for its own purposes, for its own end-uses. This capacity needs technical back-up, that is, the support of technology. But the first requirement is a lively indigenous design-use relationship, which must begin with a <u>social purpose,</u> and a social identity and expression. The recent striking experience of Denmark was cited, an experience which (despite Denmark's current problems) has many lessons for Canada.

In Section Four, socio-technical limits to growth on a world scale were linked with a production perspective of management and the pattern of use it generates. Socio-technical "thresholds of growth" are what we are seeking; in other words, to reverse a disequilibrium tendency to one of equilibrium -- an equilibrium of the human community with its environment. That is the nature of a Conserver Society. Socio-technical thresholds of growth, as I shall try to illustrate in a summary way for Montreal, are synonymous with an end-use perspective of management.

Montreal is chosen, to exemplify a Canadian city or urban region in the world [illegible] Winnipeg, Calgary, Edmonton [illegible]

In particular, Montreal is subject to the ubiquitous forces of socio-technical limits, which tend toward disequilibrium in the human community, often when conventional wisdom prophesizes a tendency toward equilibrium.

We are seeking equilibrium for Montreal in the national and world systems. I am trying to make the case that it can be found by favoring the end-use over the production perspective.

In the production perspective one seeks to maximize collective production of goods and services. One is concerned with their nature and quality so that they will continue to be used -- i.e. by maximizing individual use of any and all products and services in their own right. That justifies the maintenance and expansion of production. For example, medical, police, welfare, pollution control services, etc., all tend to expand in their role of management of disequilibrium, and are added without much discrimination to the score-boards of economic well-being -- the region's (or the country's) economic activity indices.

In the end-use perspective, one seeks to optimize collective end-use of goods and services. One is concerned with their nature and quality to the extent that they optimize individual use of each particular product or service within the overall profile of use of each individual (or household). This tends to cause a decrease in the use of many goods and services and consequently a decrease in the overall records of production on the regional or national score-boards. A decline in "economic growth", that is, in production, is not necessarily a bad thing, but it is almost never defined as salutary.

Both of these tendencies operate. But the production tendency predominates. The question is how to reverse the situation in Montreal, as a prototype. Two new distinctions emerge:

- The production perspective leads to a maximization of individual use of any and all products and services in their own right: Referred to hereinafter as Maximum Individual Use or MIU.

- The end-use perspective leads to an optimization of each particular product or service within the overall profile of use of each individual. Referred to hereinafter as Optimum Individual Use or OIU.

To challenge such conventional wisdom, a growing number of "insurgent" Keynesians argue that Keynes' basic thesis was one of a tendency toward disequilibrium rather than the generally applied interpretation of a tendency toward equilibrium (e.g. toward full employment of resources). See, for example, Paul Davidson "Disequilibrium Market Adjustment: Marshall Revisited", Economic Inquiry, June 1974, or A. Leyonkufvud, On Keynesian Economics and the Economics of Keynes, Oxford, New York, 1966; Stagflation and the Bastard Keynesians by John H. Hotson et al., University of Waterloo Press, 1976, is a Canadian statement of the challenge. See also Oscar Morgenstern, who states [illegible]

We can now consider some major prototypical urban activity sectors in the Montreal region, and the main interests involved in these activities. It is to clarify the question of consumer society incentives (MIU) and Conserver Society incentives (OIU).

My main illustration is urban transport, perhaps the largest single shaper of the consumer society. Goods transportation is omitted, to simplify the argument. People transportation is of two kinds: public (transit) and personal (automobile). The main interests are listed in the left hand column of figure (iii) and a preliminary assessment as to their predominant incentives recorded in one of the three other columns -- OIU, mixed, and MIU.

The assessment is no more than illustrative. It does show that the optimal individual use is favoured for transit, and the maximum individual use for automobiles. That will not surprise anyone. With a shrug of the shoulders, one is inclined to say that so be it in our free economy and society. It would take either the necessity of a grinding energy crisis or the coercion of a dictatorial regime to change things! Well, that is not necessarily so.

Considering the automobile interests first, if one were to introduce OIU incentives among them one might begin to rebalance things. For example, the annual marketing phase of "current models" in the auto industry dictates short term style criteria, medium-term obsolescence and high marketing costs. The market incentives can in principle be easily rebalanced to provide a longer term automobile life -- ten years, certainly, possibly fifteen. That displaces economic activity and jobs fromthe centre (i.e. from the world auto industry production plants) toward the periphery, that is Montreal's automobile maintenance garages. It cuts costs of energy, when one considers estimates of one-half or more of the energy used by a car during its lifetime is in the production of it -- used before it leaves the dealer showroom for the road. A ten year car maintenance package calls for a number of institutional changes -- in taxation, provision of warranties, the organization/management/financing of garage maintenance facilities in the region, the nature of automobile marketing, and so on.

Can it be demonstrated that this would be good business for the economy of the Montreal region (and the country as a whole?) It has never really been tried, but here are some of the factors.

- lower cost to the household;
- less capital purchase from outside the region; i.e. new cars;
- more automobile "production" enterprises and jobs in the region (auto maintenance);
- incidence of both increased and decreased tax returns;
- probable net economic benefit to the region of the order of hundreds of millions of dollars per annum;

Journal of Economic Literature, 1972: and also the Social Limits to Growth thesis of Fred Hirsch, 1977, op. cit. Finally, the argument of Nicholas Georgescu-Roegen ... [illegible]

URBAN TRANSPORT (people)

INTERESTS	O.I.U	MIXED	M.I.U.
Transit Users	X		
Transport Commission	X		
Transit Vehicle Manufacturers		X	
Municipal Government (for transit)	X		
Provincial Government (for transit)		X	
Federal Government (for transit)		X	
Automobile Manufacturers			X
Autotomobile Maintenance (garages)		X	
Municipal Government (for automobiles)		X	
Provincial Government (for automobiles)			X
Federal Government (for automobiles)			X
Automobile Users		X	

Figure (iv)

- probable net economic benefit to the country in balance of payments;
- short term negative economic impact on the Canadian automobile, steel and supporting industries;
- etc.

The tendency would be for these various interests to shift from maximum individual use (MIU) toward optimal individual use (OIU). The major strategic question of course, is would automobile users accept such a fundamental change in their habits and satisfactions? More important, would they take an active position and push for such a fundamental change? I will return to that question in a moment.

Turning to the transit interests, their profile leans rather more toward OIU, than does that of the automobile interests. But they are the second place rivals of the automobile or personal urban transport system. Their users lack "street priority," notably in rush hour comparisons of per capita use of the scarce street surface commodity. In that sense, they are highly discriminated against. The real comparative costs and benefits including tax revenues and allocations for transit and automobile, are scarcely established anywhere in North America, let alone Montreal. They are not clearly known among urban transport specialists, and the public has no access to them whatever. Transit users have no idea how the pattern of automobile transportation, hand-in-hand with complementary patterns of scattered urban development, shopping and service locations and so on, discriminate against them. If they can afford a car, discrimination is relative. If they absolutely cannot, and that is the case for at least 20% of them, discrimination is harsh and absolute. With a projected proportionate rate in transportation costs by car, the absolute discrimination may encompass even more people. That describes a potential major case of socio-technical limits to growth -- increasing social disparity on one hand and increasing technical limits of energy and materials on the other.

Returning now to the question as to whether or not automobile users would support change from MIU toward OIU in the mode of automobile use: I add the companion question, would transit users push for a fairer deal with their automobile brethren if they really knew how they were being had? Both these questions can be answered in the same way.

If users were really aware of the costs and benefits in each case, there could be a substantial change in the political winds toward new profiles of taxation and regulation and their burdens and incentives. Firstly, this would lead toward rebalancing MIU toward OIU for automobile transportation in the Montreal region. And secondly, it would lead toward a joint rebalancing toward parity or even predominance for transit use over automobile use -- again a shift toward OIU from MIU.

For Montrealers to be really aware of the comparative benefits of alternative urban transportation profiles, two things are required:

[illegible] Comparative figures which show exactly what the costs and [illegible]

ii) An information program by government to disseminate these comparative figures (in this case the provincial government is perhaps the most appropriate one) although it could be done on a national level.)

An information program lightly entered into, would create immediate howls ...om some powerful interests. But how powerful are they, really? It is a good ...actical question which can be handled.

There are spin-off benefits from the decentralized automobile maintenance ...erprise which would emerge progressively in Montreal as a prototype Canadian ...entre. These are related to the essential design characteristic of any country or society with its own identity and a relative control over its own affairs. It would increase technical capabilities in Montreal:

- to modify automobiles to better respond to local conditions - cold weather, traction, etc.
- to design custom modifications to vehicles for various specialized local purposes;
- to extend such a design/production/entrepreneurial know-how to the making of other products and services. (Note the parallel Danish example);
- to increase the status of medium/small business entrepreneurship; and even more important, to increase the status of the technician and master-tradesman in relation to the professional and bureaucrat. Both of these status changes are essential to a Conserver Society in Canada.
- to develop a new OIU relationship between public and personal transport, thereby reshaping the local market for both hardware and software innovations.

Electric power is another major sector which shapes individual use. At present, power rates in Montreal tend to stimulate maximum individual use (MIU) both of power itself and of various kinds of domestic electrical equipment. Quebec Hydro is in a phase of unprecedented borrowing which will reach a critical point in 1981-82 because of increasing need for funds at that time coupled with refinancing and Quebec government demands. (Ontario Hydro and the Ontario government, the other two of the "big four" public borrowers in Canada outside the Federal Government, are on a similar course). The continued MIU stimulation of the Hydro rate structure has been recently modified somewhat. But the escalating costs of new generating facilities to assure peak load service is a classic case of maximum individual use.

Hydro is studying the advisability of marginal cost pricing, which would pass part of the additional cost of new generating facilities to users, and perhaps specifically to peak load users. In addition, an inversion of the rate pyramid so that rates per kilowatt hour would increase rather than decrease as larger amounts of electricity were used is under consideration. Such modifications ...uld be token ones, or they could reflect the real cost of electricity. The whole of acceptance. This would mean a not insignificant reshaping of domestic patterns and electrical and equipment use which in turn could provide opportunities for new secondary manufacture and services in Montreal. It could also make the provincial decision as to nuclear fission prior to the end of the century easier to make in the negative. Moreover, it would provide more flexibility for both Quebec government and Hydro financing in the critical years ahead. Finally, it would open more options for the use of electricity in industrial development and retention, an important preoccupation at this time.

The profile of interests leaning toward our two kinds of individual use for electric power looks at present something like the following:

Figure (iv)

Electric Power			
Interests	OIU	Mixed	MIU
Hydro		X	
Provincial Government		X	
Light Industry Users			X
Heavy Industry Users			X
Domestic Users			X
Hydro Bond Holders		X	
Environmentalists	X		
Electrical Equipment Manufacturers			X

Food Marketing is another major sector which shapes individual use. I am looking at it from " farm-gate" to nutrition. The long-term trend continues to be more "value-added" in food processing, packaging, and distribution; the continued development of convenience foods, and of "junk foods" for homes and restaurant outlets: the growth in size, range, food source and market, of agribusiness firms. In Montreal, as in other "western" cities, the proliferation of shopping centres has largely been triggered by the imperatives of mass food marketing by supermarket food chains. This has tended in some respects to short-circuit middle-man costs and promote savings through scale. But the supermarket system of food distribution is on the treadmill of production growth and maintenance -- that is, in its volume of sales tied to low gross profit. It does this by high mark-up (some call it value added) processed and convenience foods at shopper eye-level along its endless aisles. Fresh produce is also [illegible] able in range and abundance at a fair price in good supermarkets, but [illegible]

Farm profit has not kept pace with agribusiness, and local agriculture and market gardening is in decline in the rural areas around Montreal. Montreal depends more and more on far-away places for staples. The question of food security for the region is fast beginning to be understood -- a preoccupation which is strongly regulated in terms of minimum domestic production in many countries, notably in Sweden. The question of nutrition is also just emerging as a major concern.

Quebec province is a large milk producer. It is also one of the highest per capita consumers of soft drinks (and more lately of relatively high-cost and low-nutrition trade-mark foods from the burgeoning chain restaurants).

The Quebec government recently inaugurated a series of television commercials on nutrition and other health matters. It is a most significant step, in that it is government use of hard consumer advertising techniques to raise the knowledge of consumers about the products they buy. If, for example, this initiative were carried further toward reorienting the Montreal consumer away from the dubious merits of soft drinks toward the consumption of milk products, the dairy surplus could be eliminated and the local dairy industry could be brought back to a stable condition. Here again is an example of local design potential for local end-use (and eventual export) in the development of established and new dairy products. It needs to be attacked on two fronts:

(i) hard government consumer marketing on the nutritional merits of milk products;

(ii) new design in dairy products -- processing, packaging, marketing, delivery, returnables, and so on.

There are some efforts in both of these directions at present, but not enough to change the existing trend of decline in the dairy industry and low quality of nutrition in the Montreal region.

Concluding with the supermarket system of food distribution: it has merits and drawbacks in cost and quality of food bought by the consumer. It also is a major shaper of the pattern of urban development, through shopping centre reinforcement of scatter development and automobile dependence. There is of course another side to the coin here as well -- the more convenient access the shopping centre provides.

The basic thrust of food marketing, however, is a production one. The managers of big agribusiness (more and more internationally controlled) equate success with the maintenance and growth of volume generally, and high mark-up products in particular.

Figure (v) gives some idea of the bias toward maximum individual use (MIU) and away from optimum individual use (OIU), among food marketing interests in Montreal.

Food Marketing			
Interests	OIU	Mixed	MIU
Food Supermarkets			X
Independant Grocers		X	
Big Food Processors			X
Small, local food processors	X		
Dairy Industry		X	
Local agricultural producers		X	
Household Consumers		X	
Provincial Government		X	
Federal Government		X	
Improved Nutrition Exponents	X		
Chain Restaurants (trade-mark foods)			X

Figure (v)

Finally, <u>housing</u> is a major sector which shapes individual use. I include it here, because it is a common focus for urban transport, electric power, and food marketing. It is examined essentially in that light.

The maximum individual use tendency (MIU) evident in urban transport has contributed to a regional fragmentation of single family dwellings in isolated or semi-isolated urban tracts all around Montreal. This has created large additional costs for technical and social infrastructures (e.g. sewers and schools), and has absolutely locked many thousands of families into high local improvement taxes and one and two car ownership. Moreover, the single family dwellings — the so-called dream come true of the young Canadian family, have relatively high heating costs in a cold climate.

In the meantime, already serviced in-city areas have been drained of population. Schools are closing. Utilities are under-utilized.

The Quebec government is now trying to reverse this outward-explosion of housing neighborhoods often on prime agricultural land. The policy of government [illegible] has been [illegible] through television, and so on. This aspect is not a dysfunctional one however, except inasmuch as the physically isolated and self-contained household may be stimulated toward social isolation through say, overattachment to the T.V.

The MIU tendency in food marketing has supported the economics of suburban centres and car access from new neighborhoods, many of them otherwise isolated. That is not all dysfunctional however, except that it guarantees a long-term unavoidable high cost of movement for those occupying the new suburban housing. It will be no more than an inconvenience for middle-income households, but could be a major financial burden for many lower income households.

The MIU tendency in housing itself is focused on production targets. hard market exploitation of the middle-income suburban dream for lower income households, the interests of suburban land owner, and speculator and developer, the interests of suburban municipal governments and of local political figures at the federal and provincial levels, and the interests of Ottawa's Central Mortgage and Housing Corporation and the provincial Quebec Housing Corporation. It was in everyone's interest to produce. End-use was secondary. And the pattern of post-war housing in the Montreal regional starkly underlines all that. There is no point in my showing the interests graphically in the case of housing. It is heavily toward production, MIU, maximum individual use. In some ways, results were positive.

But there is little in design output for housing and interior furnishings, new space concepts, new neighbourhood clusters, designing housing patterns to fit in with public transport. The potential in new kinds of house furnishing is always there. Yet the local furniture industry is dieing with mass production imports from North Carolina and elsewhere. The potential for new cold weather housing is always there but scarcely exploited. Yet Montreal is perhaps the major northern city outside the Soviet Russia. The housing design impetus promised by Expo '67 never materialized.

Any effort to stimulate secondary industry in housing (and its components and interior products) must be based on the end-use perspective — optimal individual use, OIU. That is an incentive which answers both consumer and Conserver Society requirements.

The production/end-use distinction (MIU-OIU) can be applied to other major sectors of Montreal activity — for example, the communications, credit or clothing industries; the professions; the secondary steel, industrial machinery and appliance industries; the various segments of the chemical industry; and of course, the public bureaucracies of the four levels of government as they operate in Montreal.

All these sectors are comprised of large, medium and small organizations. Section 6 examines how they can be managed so that end-use will tend to predominate, rather than production as at present.

This is a management question which parallels the economic question of equilibrium-disequilibrium. Accepted equilibrium theory stipulates that the tendency is always toward full use of resources. That is in the production perspective, in that the basis of economic strategy is generally to stimulate production. The phenomena which this frame of reference does not encompass are either assumed away, or become the subject of intense debate. Stagflation and its related aspects is a current example. A burning Canadian question in April, 1978, is: Should government encourage the consumer to consume more so as to "get the economy rolling again?" That is solely a production question.

Those theoreticians and national economic managers who contest the basic tenet of equilibrium theory substitute the notion of disequilibrium. Attali* for example describes disequilibrium as a period of crisis, or fundamental readjustment which inevitably emerges from time to time, when equilibrium through production is the national strategy. The stimulation of equilibrium works for a time after readjustment. Then the accepted economic management tools of the day, at present Keynesian fine-tuning, become less and less effective, as the structure progressively loses its equilibrium. Sometimes breakdown comes with a rush, and at other times, decline and/or readjustment occurs over a protracted period of turbulence.

This is merely a sketch of the insurgent keynesian position, and of necessity takes no account of its more complex aspects. I include it here to illustrate the relationship I wish to draw between the pattern of activity -- what to do -- and the pattern of management, how to do it.

The various insurgent keynesian positions are at least implicitly, and sometimes explicitly, wedded to the idea of end-use predominance over production. They are focused on new ways of defining the what to do.

I now turn to the how to do it.

<u>Maximum individual use</u> can be defined as social ends governed by technical means. Social ends are essentially unconstrained. So they tend to be shaped by technical means. The production perspective is then free to maximize production and collective use. It stimulates social ends to support its growth imperative.

<u>Optimal individual use</u> can be defined as social means shaping technical ends. In other words, the individual's social means defines his overall profile of use, and in turn determines technical use from available technical ends. The end-use perspective then tends to maintain its predominance.

These two forms of individual use provide the clue for a fundamental distinction in management procedure. The distinction is of the same order as the equilibrium-disequilibrium debate in economic theory and practice. The presently accepted procedures of management are explicitly or implicitly based on the production perspective. MBO for example, is a cornerstone of management in both the public

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and private sectors, although it may not be explicitly tagged as such. The approach is a basic component of most budgeting procedures, including the now ancient and battered PPB, and shinier, newer models such as zero-base budgeting. It also is an important component of various planning processes, performance measurement techniques, and other management approaches.

First of all, MBO does not make the socio-technical distinctions. Therefore, by default, its objective focus is on the technical — unless specifically defined in [illegible] social terms. Even so, it is quickly brought down to a measurable technical surrogate. MBO can be defined as a linear process, which because it does not make the socio-technical distinction, automatically gives predominance to the production perspective.

I put forward a two-dimensional (i.e., socio-technical) process, which I call Management by Interest or MBI).* The reader, who has been very patient if he has followed the means-ends argument so far, is asked to consider figure vi). Both production and end-use procedures are graphically portrayed. And each one is a form of MBI. A sequence can be taken from each one. I use a commonly accepted four-phase management sequence.

<u>End-use</u>:

1. Goal : Social ends determine technical ends
2. Objective : Social ends determine technical means
3. Program : Social means determine technical means
4. Action : Social means determine technical ends

<u>Production</u>:

1. Goal : Technical means determine social means
2. Objective : Technical ends determine social means
3. Program : Technical ends determine social ends
4. Action : Technical means determine social ends

The reader will note that the End-use action phase corresponds to the description of optimal individual use (OIU), while the production action phase corresponds to maximum individual use (MIU).

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* See Michel Chevalier and Thomas Burns, "Rethinking the Public Management of Private Interest. A Strategy of Management by Interest", <u>Management</u> [illegible]

PRODUCTION

SOCIAL	TECHNICAL ENDS	TECHNICAL MEANS
ENDS	Collective Technical Ends – Social Ends Program 3	Individual Technical Means – Social Ends 4 Action
MEANS	2 Objective Technical Ends – Social Means Individual	1 Goal Technical Means – Social Means Collective

- Socio-Technical Limits
- Maximization
- Disequilibrium Tendency

END-USE

SOCIAL	TECHNICAL ENDS	TECHNICAL MEANS
ENDS	Collective Social Ends – Technical Ends Goal 1	Individual Social Ends – Technical Ends 2 Objective
MEANS	4 Action Social Means – Technical Ends Individual	3 Program Social Means – Technical Means Collective

- Socio-Technical Threshold
- Optimization
- Equilibrium Tendency

Figure (vi)

There is of course, much more to the MBI* construct than has been exposed here. It is included in this essay to suggest that a fundamental change of management processes is an essential first step in reorientating the kinds of situation outlined in Section 5.

The MBI. and similar management approaches, are perhaps on the verge of application in large public and private organizations over the next decade. That is because extension and refinements in established modes of planning and control are producing fewer and fewer results. Witness the call of the Auditor-General of Canada in December 1976 that Government spending was getting "out of control." This call paradoxically, came after some fifteen years of continuous application and unprecedented build-up of "modern" management techniques stimulated by the hundreds of Glassco Royal Commission recommendations. These were almost all heavily weighted toward the production perspective.** The trend continues with the recommendations of the Lambert Commission.*** Its Progress Report provides useful approaches to accounting, but much less so to accountability.

MBI-type management as a replacement for MBO-type management, does not require massive reorganization. It does require the institution of new procedures, and new forms of incentive and accountability. Perhaps, when this kind of management becomes the order of the day in the U.S.A., it will spread throughout Canada, with the aid of management marketing, packaged courses, and all the panoply of communications these entail. These last remarks apply in some respects to the private, as well as to the public sector, and they apply to the various levels of government, including the Montreal municipal and urban community governments. Suffice it to say that the Conserver Society cannot take shape by merely developing information and programs as to what should be done. The present pattern of management of our public and private organizations, based on the production perspective, cannot respond. Somewhat analogous to the required -- and emerging -- changes in economics, changes in management procedure of the nature put forward here -- toward end-use -- cannot be overlooked.

Finally, in Section 4, I suggested the urban arena as the most appropriate one to stimulate combined action initiatives of what to do and how to do it. One reason is because in the urban arena, all levels of government meet with the whole cast of organizations in the private sector. It is through a multiplicity of inter-organizational design and management initiatives in an end-use perspective in a particular geographical place that a Conserver Society begin to take shape.

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* Much of the argument here was developed in the research project "<u>Gestion publique et défi socio-écologique</u>", supported by the Ford Foundation and the Université de Montréal. Report in publication, Office of the Science Advisor, Environment Canada, Ottawa, 1978.

** A quite similar production orientation -- and effect -- obtains in government generally, at all levels.

*** <u>Progress Report</u>, Royal Commission on Financial Management and Accountability, Ottawa, November 1977.

7. Three Phases Toward a Conserver Society

One of the more recent "mainstream" studies of the short-term economic future was tabled this past January at the Joint Economic Committee of the U.S. Congress.* It suggests that the countries of the western world, and the United States in particular, are entering a "new era in economic development, with circumstances fundamentally different from those of the past." It talks about slower labour force growth, slower expansion of energy use, rising real costs of raw materials, slower growth in higher education, possible shifts in public values to place less emphasis on economic growth. The projection is really not of the order of a "new era", but it is at least a modified direction away from the production toward the end-use perspective. A similar projection is largely applicable in the Canadian situation.

That generally complacent view of the period ahead in 1980's makes it all the more difficult for Conserver Society exponents to make their case of escalating ecological danger for Man. That is why I have stressed the need for gradual insertion of new initiatives toward Conserver Society and end-use, initiatives which are complementary to established production incentives of the consumer society.** These initiatives must have demonstrable relevance to today's preoccupation.

In effect, neither Rome nor the Conserver Society in Canada can be built in a day. So I am identifying three phases or time frames through which I believe we must pass in order to move from an essentially consumer to an essentially Conserver oriented Society. Arbitrarily, I have chosen two five-year periods to effect the switch, with a third open-ended period for consolidation and maintenance. Conceivably, it could be done in that time. National transformations sometimes happen in short periods if their time has come. We have no way of knowing if the Conserver Society's time has arrived. Despite wide complacency, there may be enough turbulence, failed "solutions" and apprehension about the future to pave the way for change. I tend to doubt that possibility. Nevertheless, I will assume that the time is now: that is because a first alternative is to sit and wait for the right moment which is hard to assess beforehand. And a second alternative is to assume that the changeover can slowly evolve if we keep chipping away at it. The first alternative does not require any strategic design, being by its nature disjointed and incremental. Furthermore, the longer we wait and dither, the more the world will be passing us by, blazing trails for us to follow. So the strategy elaborated here consists of two five year phases of change from 1978, culminating in a third phase of ongoing development in the Conserver Society pattern. If nothing else, it provides a preliminary sketch of the nature of the transformation process required to achieve a Conserver Society condition in Canada. I invite the reader to look at Figure (vii) which illustrates graphically the nature of the strategy I am putting forward.

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* U.S. Long-term Economic Growth Prospects: Entering a New Era, U.S. Government Printing Office, 1978.

** An intriguing strategy in this vein has been put forward by W.H.C. Simmonds [illegible] the National Research Council [illegible] in his paper. Minimum [illegible] [illegible] Change [illegible]

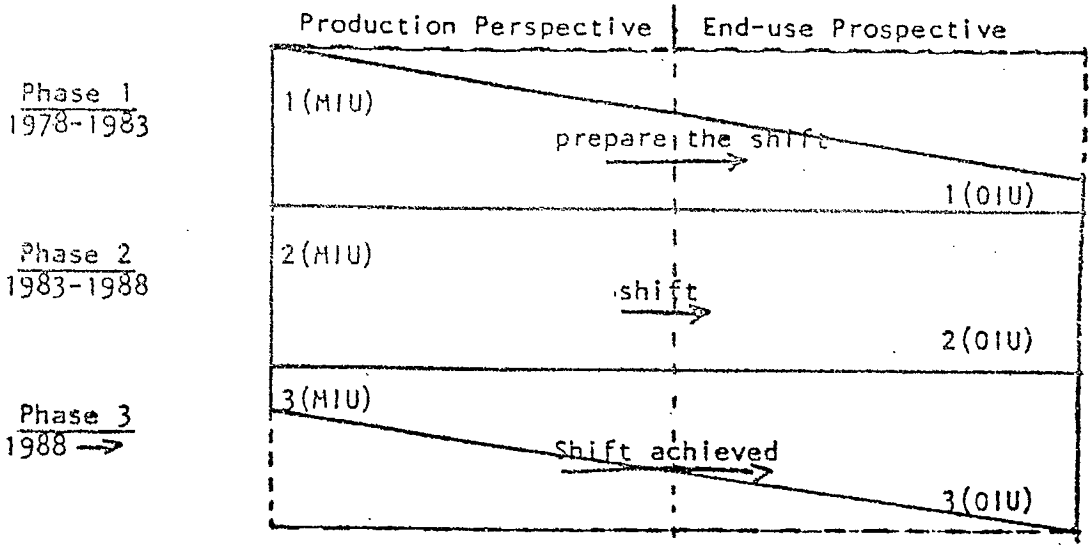

Figure (vii)

In Phase 1, the predominance of the production perspective and maximum individual use (MIU) is maintained, but preparations are made to begin the shift in Phase 2.

In Phase 2, the shift in predominance from the production to the end-use perspective is carried out -- toward optimum individual use (OIU).

In Phase 3, the shift in predominance to the end-use perspective has taken place, and development then can be maintained in the new OIU pattern, with adjustments along the way.

Examples of emerging and potential shifts are listed for each phase from among the four sectors referred to in Section Five -- urban transport, food marketing, electric power and housing.

Phase 1:

Emerging initiatives include at present:

Urban Transport

- more street priorities for buses
- smaller automobiles
- [illegible]

Food Marketing

- increasing awareness of nutritional values
- new sense of government responsibility in disseminating information about nutrition and preventive health care

Electric Power

- trend toward marginal cost pricing and inversion of rate structures.

Housing

- emerging government policy toward concentrating new development in-city.

Phase 1 is based on a dual governmental commitment: first, to provide the individual with specific true direct and indirect comparative costs and benefits of various alternative forms of maximum and optimum individual use. This is scarcely done now. It is difficult to do initially across the board, but this can be done for selected product and service uses. Second, to undertake a large-scale and continuing information program in the best tradition of advertising/marketing. The possibilities and difficulties of this approach have been reported on in detail in the GAMMA Conserver Society Project.* The information program should include references to the potentials for product and service design and expanded secondary industry initiatives in the Montreal region. This is when regional know-how in industry and the design professions should be marshalled.

Phase 2:

A shift from a primarily marketing exercise to actual initiatives:

Urban Transport

- the extension of bus rapid transit lanes.
- the design and testing of standards, regulations, tax incentives, etc. for long-term car life, a reorganization of the automobile maintenance and warranty system.
- extension of automobile maintenance trades training.

Electric Power

- gradual phasing-in of new rate structures.
- new product design and planning by secondary industry.

Housing

- [illegible]

During Phase 2, the main criterion of choice of actual initiatives should be one of regional economic and job generation.

Phase 3:

The beginnings of permanent change toward the end-use perspective -- or optimum individual use.

Urban Transport

- the beginning of a phase-in of the long-term car life package. This would require concentrated efforts from many urban regions in Canada and North America, essentially through senior governments working with the automobile industry. A prototype of this process has been underway in the U.S. and Canada over the past few years on environmental standards. The only difference is that here there would have to be much greater grass roots awareness and support. The new automobile maintenance system would begin to be activated.

Electric Power

- new rate structures could result in some reshaping of domestic use of electrical equipment, modified design of meters, appliances and heating. Regional and Canada-wide industry would have a ten year period to participate in a design and product development process to take advantage of a modified market emerging in Phase 3.

The above illustrations do no more than suggest a large-scale potential for a country like Canada -- and an urban region like Montreal -- to take advantage of the long-term pressures beginning to be exerted by world material and energy scarcity.

This would be to meet present short-term problems of unemployment and economic stagnation, as well as the longer-term Conserver Society pressures.

Some countries will take advantage of the dual incentive more than others. How might the Montreal region -- and Canada -- respond?