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A SURVEY OF FUTURES STUDIES IN THE GOVERNMENT OF CANADA PHASE II

report

rapport

A SURVEY OF FUTURES STUDIES IN THE GOVERNMENT OF CANADA PHASE II

Secretariat for Futures Studies
Technology Assessment Division
Ministry of State for Science and Technology

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A SURVEY OF FUTURES STUDIES IN THE GOVERNMENT OF CANADA

PHASE II

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THE BASIC OBJECTIVES

.To identify, in specific terms, the Federal Government's need for futures studies;

.To determine the extent to which these needs are presently being met by futures work and long-range analysis in the government; and,

.To devise a strategy for improving futures work and long-range analysis in the government so as to better fulfill these stated needs.

THE BACKGROUND

The Survey reviews and evaluates futures studies in the Federal Government as a follow-up to the Lamontagne Survey of 1975 - Phase I. This was published by the Special Committee of the Senate on Science Policy as Issue No. 13 in June 1977. Phase I was designed to be a quantitative analysis of futures work in government and to yield some basic data about budgets, personnel, projects, and publications. It sketched out the major contours of the field in government and tracked the preliminary directions which it was taking. Phase II, on the other hand, is designed to be a qualitative assessment of futures work in government, using both the information generated by Phase I, and new material collected specifically for this purpose.

THE PROCEDURE

The introduction reviews the general state of futures studies in the Federal Government, utilizing as a base the previous publication of MOSST, "The Lamontagne Survey of Futures Studies: An Analysis and Summary".

In the second section, the twelve departments selected for review were judged to conduct the most promising futures work in the Federal Government. The period covered, for the purpose of this review section, is from January 1976 to March of 1977.

In the third section, the prime futures efforts in three departments, namely the Department of Communications, the Department of National Defence, and Transport Canada are evaluated using a methodology developed by the Futures Secretariat. This evaluation covers the period 1972-1977.

Observations regarding the state of futures studies in the Federal Government are provided in the final section.

Appendix I contains a brief summary and comparison of nine world models. These models represent a serious attempt to relate essential economic and social variables on a global basis. Appendix II outlines in brief the significant long-term models which have been developed to investigate, from various perspectives, the future of the Canadian economy. Appendix III consists of two important efforts in the Canadian Government to explore alternative environmental trends and prospects for Canadian society in the future. Appendix IV summarizes the Futures Program of the Institute for Research on Public Policy.

The review of futures work in the Federal Government (Section II) synthesizes information gained through interviews conducted by the officers of the Technology Assessment Division. The methodology is based upon work being developed on the production and use of futures research in government. The overviews of Canadian economic models (Appendix II) and environmental designs for Canada's future (Appendix III) were distilled from material supplied to the Secretariat by the relevant federal agencies.

THE CONCLUSIONS

The report established the following key points with respect to the first objective outlined above:

- The primary needs for futures work in the government are those of general projection, early warning, policy development, strategic planning, goal and value definition, and resource planning (page 52-3)

- In the case of policy development, the special needs are those of addressing policy issues of special importance to the future; assessment of future implications of present policies and programs; identification of preferred future conditions and situations (i.e., policy targets); identification of alternative policy options; extrapolation of consequences and implications of feasible policy options; and, identification of comprehensive, long-term policy objectives. (page 52)

In determining the extent to which the stated needs were being met, the report was encouraging in its balance of success against perceived deficiencies. It noted the capacity of the government for realizing as yet largely unfulfilled potential. In particular,

- .The overall success of departments in structuring and developing futures studies in a way which will satisfy their requirements is less than it could, or should, be - particularly in light of the considerable resources committed for futures work in the Federal Government.

- .Several of the governmental needs in this field are quite adequately met by many departments. Most notable are the general projection and the early warning functions (page 52) which the futures work reviewed can be seen to perform well.

- .Four departments - Department of Communications, Department of National Defence, Department of Energy, Mines and Resources, and Transport Canada - have planned and developed their work so that it effectively fulfills their requirements and, to a considerable extent, those of the government as a whole.

- .The contribution of futures work to government policy and planning in most departments has not been realized as yet. Most noticeably, deficiencies occur in the clear identification of long-term objectives, the relationships between these objectives, and the exploration of alternative policy options for achieving these objectives.

THE RECOMMENDATIONS

There are two main aspects involved in designing ways to improve departmental futures work and long-range analysis so as to better fulfill requirements of the government. One is identifying those aspects of present futures work which most significantly need to be improved and which require special attention. The other is determining how to organizationally bring this about. On the first, the report advances the following recommendations:

- .Departments should conduct futures work and long-range analysis in such a way as to ensure that it is applicable and useful to governmental policy and program planning.

- Futures work can only be useful in the consideration of those problems and objectives which are uniquely long-range in character. Consequently, a special effort should be made to determine, in advance of the research, which of the problems confronting the government are especially important for the future and which could be profitably investigated.

- It is important that long-term objectives be identified and interrelated so as to highlight conflicts which bear upon shorter-range goals and interests of the government.

- An effort should be made to establish priorities among long-term problems of concern to the government.

- Alternative policy options for achieving long-term objectives should be identified and then evaluated by tracing through the implications of each option. Additionally, an effort should be made to examine the effects of the most promising policy options in the light of alternative developments in the national and international environments.

- Alternative plans and strategies should be established on the basis of this review of policy options open to the government.

With respect to how these recommendations could be organizationally brought about, three main points emerged from the report.

- It is imperative that senior management be kept involved <u>on an on-going basis</u> throughout the process of planning and developing futures work in government. This underlines the need for regular feedback to, and direction from, senior management where the departmental futures or planning group is concerned.

- Continuing evaluation is a vital process to ensure that the best directions and opportunities for futures work and long-range analysis are explored. The Secretariat for Futures Studies is useful in keeping the field moving in the Federal Government, especially where it both develops and catalyzes innovations, and ensures the continuous exploitation of the potential of futures studies.

.It is important that results of futures work and long-range analysis be widely distributed. This will encourage the achnowledgment of divergent views in the work of the department concerned. It will also help to ensure that parties who stand to be affected by the analysis will be well informed about that analysis. The Secretariat can perform an equally significant role in this dissemination process.

A SURVEY OF FUTURES STUDIES IN THE GOVERNMENT OF CANADA

PHASE II

I INTRODUCTION

A number of recent events and concerns have focussed attention on futures research work conducted in the Canadian government. Examples are the Lamontagne Senate hearings on Scinece Policy and the GAMMA report on the conserver society. There has been a growing concern with the domestic long-term energy picture and other resource problems such as those looked at by the Club of Rome. Canada has also participated in various internationally-sponsored projects, such as the Habitat Conference and the OECD Interfutures project. These address long-term social and economic issues with worldwide implications. While it is generally held within government circles that longer-term studies and planning activities can be of great benefit to public decision-making, there is also a concern to ensure that futures work in the federal government be both relevant and reliable.

Futures studies focus specifically on identifying and clarifying social, economic and technological trends, changes and needs. "Good" futures studies should strengthen the ability of decision-makers to recognize and choose from many complex alternatives those carrying with them the most beneficial long-term effects on society. One can differentiate between forecasting, long-range planning and futures studies. While in practice they may be woven

together, they each have specific characteristics described in "The Lamontagne Survey of Futures Studies: An Analysis and Summary".

Futures studies have been classified into four broad types, essentially:

1. The projective approach (trend extrapolation, envelope curves, multi-variable correlation models, mathematical models, stochastic models, input-output matrices, etc.);

2. Prospective research (scenarios, Delphi studies, morphological analyses, cross-impact matrices, simulations of future options, etc.);

3. Decisional research (cost/benefit analysis, relevance trees, network theory, decision and control steps, social assessment of technology, etc.); and,

4. Planning instruments (formulation of objectives, value analysis, conflict-analysis, optimization techniques, PPBS, sensitivity analysis, game and simulation models).

Futures research has by no means been limited to these principal approaches. Futures research has included approaches from pure imagination to a normative type of approach.

Futures study is now a concern to most organizations in both the public and the private sectors. Major corporations, university faculties and government policy units all engage in forecasting work

of one sort or another. In Canada, the initiatives taken in 1975 by the Senate Special Committee on Science Policy served to dramatize the importance of long-range planning activities to decision-makers in government and industry. Already there exist several national organizations with a definite futures orientation.

First is the Institute for Research on Public Policy, which was established to do research and analysis designed to improve the bases for informed choices and decisions by the Canadian public and its leaders on questions of public policy. This institute is dedicated to providing basic research and analysis on public policy questions as a service to the various regions and various governments of the people of Canada. At the request of the Government of Canada, the institute initiated a program in trend analysis and forecasting with a view to anticipating far-reaching changes in Canadian society.

Subsequently, a Secretariat for Futures Studies was established in the Technology Assessment Division of the Ministry of State for Science and Technology. The terms of reference for the Secretariat were stated in a letter (January 27, 1976) from the Honourable C.M. Drury, then Minister of Science and Technology, to Senator Maurice Lamontagne:

1) to be aware of all futures studies in the federal government, and to provide assistance and advice as requested, by summarizing, cataloguing and identifying the scope of futures programs and activities;

2) to provide secretarial services to the Interdepart-

mental Committee on Futures Research by scheduling and arranging meetings, by taking and distributing the minutes, and by performing other duties requested by the Committee; and,

3) to be the central point for general information purposes for persons and organizations outside the government.

From the fall of 1975 to the spring of 1976, the Senate Special Committee on Science Policy under the chairmanship of Senator Lamontagne initiated and completed a survey of futures studies in Canada.

A quantitative analysis and summary of the results of this survey was performed by the Secretariat for Futures Studies in the fall of 1976.[1] In terms of expenditures, this analysis and summary showed that the federal emphasis was first on Resource Conservation and second on the Human Environment. The private sector was primarily interested in the Economy and secondarily in Resource Conservation. In 1975-76, the most recent fiscal year for which data was available, federal expenditures on futures research exceeded $3.7 million. The Lamontagne survey did not cover the provinical governments or the universities.

[1] "The Lamontagne Survey of Futures Studies: An Analysis and Summary", MOSST, report published in 1976.

What are Futures Studies?

Futures studies have been defined as "studies that focus specifically on identifying and clarifying possible social, economic and technological trends, changes and needs, thereby strengthening the ability of decision-makers to recognize and choose among complex alternatives those which have a long-term beneficial impact on society".[2]

An important reason for the present concern with futures studies arises from the rapid rate of change in the world, caused basically by technological change, economic considerations, prevailing values, and private interests. In general, government find it very difficult to look ahead in its legislation and to adjust policies in the light of external change. The Canadian parliamentary system, with its usual electoral cycle of four years, encourages an almost exclusive preoccupation with immediate issues, on the part of both governments and oppositions. This mattered little in earlier days of slower change. Today, with the increasing importance of forces external to a nation and beyond its control, such as monetary difficulties, contagious inflation, scarcity and high costs of raw materials, fundamental transformations of the situation can only be discerned over longer periods, say 5 to 7 years. The immediate issues on which a government was elected and which were the concern to the electorate can quickly become quite marginal in relation to the longer-term developments.

Of course, governments have for many years attempted to project and to forecast. Medium-term forecasts, for example, cover

[2]"The Lamontagne Survey of Futures Studies: An Analysis and Summary", MOSST, report published in 1976.

economic development and growth, employment and demography, agricultural production, etc. Such forecasts are, however, almost always strictly sectoral and do not take into account cross-impacts between sectors. National plans have up to now been mainly economic and have taken only marginal notice of social or technological development.

Concern with the environment, the consequence of population increase and urban growth, recognition that economic growth is not an end in itself but the means to provide for social development, are factors of major importance in modern society. These, and many other factors, are suggesting more and more the need for a new type of integrated planning which will require the development of reliable social indicators and the use of forecasting and assessment of future trends.

These considerations suggest that futures studies cannot be developed and used in isolation, at least as far as their influence on policy-making and the public acceptance of change are concerned. They are to be seen as part of the approach to the problem of the management of complexity. Important elements of this complexity include:

- The fact that world population is increasing very quickly and will double in just over fifty years.

- The increase in the scale of world activity and hence the demand for raw materials, energy, products and services, arising from both population increase and faster economic growth.

- The rapid rate of technological change arising from scientific discovery.

- The interdependence of industrialized nations.

- Expectations within the third world.

Futures Studies and Science and Technology

The time factor is particularly important in science and technology. The time scales of the world of science are widely different from those of the world of politics. Research and development are inherently long-term processes. It takes more than thirty years from the development of a basic concept in the minds of scientists until its generalized application in the fabrication of new products or processes or new types of institutions. Of course, there are innumerable smaller innovations which can be accomplished much more quickly. In general, therefore, the research-development-production chain is very long and, "for fusion, for example, it may be much longer than political exigencies will permit".[3] Even when no novel features are involved, the process is slow. For example, a quarter of a century elapsed between the first experimental pile going critical and the first CANDU nuclear power station going into service.

These circumstances indicate the need to give special attention to futures studies in science and technology, and to relate

[3] Alvin Weinberg Nuclear News No. 14 1971

such work to the political and economic process. It is a partnership of a new kind between science and policy.[4] From this point of view, it is clear that technological forecasting should be developed in MOSST in close cooperation with other federal departments and with international organizations.

The events and trends which followed the petroleum crisis have given a new impetus to longer-term thinking and planning in Canadian companies. Several large firms, such as Bell Northern and CIL, have units devoted to futures studies, generally working close to the president or the managing director. In many cases, the director of research and development is responsible for these units, which is an important move since it brings research planning much closer to overall corporate strategy than is normally the case.

Finally, there is a need for two distinctive types of institutions. The first type consists of essentially policy-oriented units close to the decision-makers which generate, stimulate and select the necessary information of a prospective nature and ensure that it is taken into account in decision-making. The second consists of research institutes which develop new techniques, refine existing ones, and explore particular trends. The futures-oriented policy units would stimulate research and have it contracted out to the futures research bodies.

[4] Jean-Jacques Salomon Science and Politics MIT Press 1974.

II REVIEW OF FUTURES WORK IN THE FEDERAL GOVERNMENT

Scope of the Review

This review of futures studies in the federal government is a follow-up to the Lamontagne survey. The twelve departments selected were judged to conduct the most promising futures work in the federal government. It was decided that an order of 10 to 15 departments would be a representative sample. For practical reasons only twelve departments were surveyed. The review addressed the following topics:

1. What futures studies are being performed?
2. Who performs these activities?
3. To whom do they report the result of their studies and analyses?
4. What impact have these activities on policy decisions?

Information was also obtained on other aspects of the planning and analysis systems of the departments and agencies reviewed.

The information was gathered between March and July of 1977. The study is based on interviews with responsible officers in eleven departments and agencies. The survey of the futures activities in the Department of Finance is based on the information supplied by the officials to the Senate Special Committee on Science Policy on March 19, 1977.

Many documents were furnished by the departments and agencies as products of their futures activities. Although these documents were reviewed, this study only assessed the technical merit of the reports

of three departments. The futures efforts in these three departments, namely, the Department of Communications, the Department of National Defence, and Transport Canada are evaluated in Section III. This evaluation covers all futures work in these departments conducted over the last five years.

The following departments and agencies were reviewed:

1. Canadian International Development Agency
2. Communications
3. Energy, Mines and Resources
4. External Affairs
5. Finance
6. Industry, Trade and Commerce
7. International Development Research Centre
8. National Defence
9. National Research Council
10. Regional Economic Expansion
11. Transport Canada
12. Treasury Board Secretariat

The three departments selected have been given the opportunity to comment upon the evaluation of their futures effort and to supply additional information where necessary. The replies have been incorporated into the text in each corresponding section. (See page 63, 69, 74 for DOC, DND, and TC respectively.)

CANADIAN INTERNATIONAL DEVELOPMENT AGENCY

Responsible Officer: L.A. Dorais,
Vice-president, Policy Branch

Dates of Interviews: May 18, 1977
May 24, 1977

Persons Interviewed: Charles Jeanneret, Chief,
Prospective Group,
Policy Branch.

Domingo Donida, Director
Policy Analysis Division,
Policy Branch.

The Policy Branch is responsible for the coordination of the policies and the programs of CIDA in order to formulate global policies and to ensure comprehensive planning and program evaluation. It stresses the importance of prospective thinking on international development. The Prospective Group and the Policy Analysis Division are two centers of long-term research in this Branch.

I. PROSPECTIVE GROUP

A. Resources

The Prospective Group, headed by Charles Jeanneret, has a complement of 3 persons (2 professionals and 1 support). Its objective is threefold:

i) to develop a conceptual framework for prospective analysis and promotion of awareness for long-term thinking in CIDA as it relates to international development;

ii) to look at future international cooperation;

iii) to develop concrete policy alternatives for Canadian international cooperation.

B. Futures Studies

Many of the initiatives of the Prospective Group have been directed towards the integration of prospective analysis into the internal planning process in CIDA. They provided in 1974 a background paper for the 1975-1980 CIDA strategy (the basis of planning CIDA), and then a critique of its first year of implementation in July 1976. They also set up with the Advanced Concepts Center at DFE, a series of interdepartmental workshops on prospective analysis; one workshop was held in 1975 ("Prospective on Environment and Development: ASIA: Pacific Rim") and two others in 1976 ("Eco-Development, National Development and International Cooperation Policies" and "The International Development Problématique"); a fourth one should be held this fall on the relationships between Canada and the Third World.

The Group has tried to develop links with prospective analysis projects in Europe, Africa and South America. In Canada, the Group has contacts with IRPP, ECC, PAG (External), and IDRC* They tried to set up a "Prospective Institute" in January 1976, but without success. Moreover, Mr. Jeanneret is associated with the U.N. University (Tokyo) Project (Human

* IRPP: Institute for Research on Public Policy; ECC: Economic Council of Canada; PAG: Policy Analysis Group, External Affairs; IDRC: International Development Research Centre.

and Social Development Division) on goals, processes and indicators of development. He is also active with the futures studies program of the Inter-University Centre of post-graduate studies at Dubrovnik, Yugoslavia.

Finally, the Group is involved in a prospective analysis project with the Sahel Section of the Bilateral Programs Branch.

II. POLICY ANALYSIS DIVISION

The Policy Analysis Division is mainly involved in task forces with the Bilateral Policy Advisory Group (BPAG), Bilateral Programs Branch. These task forces, established by the President's Committee (President and Vice-presidents), deal with long-term policy issues relating to aid and development. The priority areas are as follows:

1) Concentration on the poorest;
2) Transfer mechanisms;
3) Local cost financing;
4) Sectoral papers;
5) Typology of development;
6) Country program reviews.

One of them, "Typology of development", is being done with the assistance of university consultants (Carleton). Another one, "Sectoral papers", is an update of the "Sectoral Guide" published in 1975.

The Division is helping the Multilateral Programs Branch in its program review and the Non-Governmental Organization

Division (Special Programs Branch) in the organization of its work plan. The Division is also performing an educative function through in-house seminars. Two will be held this year (one in English, one in French) for the planning officers of the Bilateral Programs Branch, with the help of external resources. The theme will be development theories. No joint formal endeavour, however, exists between the Policy Analysis Division and the Prospective Group.

DEPARTMENT OF COMMUNICATIONS

Responsible Officer: D. Parkhill
ADM (Research)

Dates of Interviews: June 27, 28, 1977

Persons Interviewed: J. Halina, Director-General,
Research Policy and Planning

Dr. J. Chapman
ADM (Space Program)

The organization for futures studies in DOC is considerably different from that of other departments. There is no single position or group established to conduct and oversee futures studies for DOC. This is, in part, a reflection of the fact that the department does not conduct futures studies per se. Instead, several groups investigate a number of research subjects and policy areas which might be seen to come under the general umbrella of futures studies. These subjects and areas include requirement needs, priorities research, systems and technological forecasting studies, resources planning and impact analyses. The identification of the need for futures studies originates usually at higher levels in the organization at the time the priorities are discussed.

A. Futures Studies

The time-horizon for most DOC futures-oriented efforts is 10-15 years. DOC experience can be divided, for analytic convenience, into two sections: futures efforts directed at the overall policy structure of communications in Canada, and

those zeroing in on specific resource and hardware issues. It was indicated that the most important potential contribution futures studies could make to DOC was in the former area, though at the same time, this was probably the most difficult area to address.

Dr. Joe Halina has been largely responsible for initiatives in the first area (overall policy structure). Two discussion papers have been produced -- "Perspective 1985", published in February 1975, and "Threats and Opportunities in the Development of Canadian Public Telecommunications in the Next Decade", published in April 1977. These papers comprise DOC's systematic attempt to examine the department's entire "constituency"; ascertain "its dynamics" and the long-term directions in which it is heading; and to explore the R&D priorities in Canadian public telecommunications development. The purpose of these efforts is to facilitate the regulatory and catalytic roles that government may be called on to play in communications in the coming decade. The details of "Perspective 1985", i.e. assumptions, scope, methodology, are described in DOC's response to the Lamontagne survey. The basic conclusion of the study was that a major dichotomy between Canadian rural and urban sectors in communications has begun to emerge and will likely persist into the next decade. The lack of development and remoteness of the rural telecommunications sector were projected to intensify into the 1980's. The quality of service to be provided to the rural sector at economically feasible rates would be vastly inferior to that available in the urban sector --

assuming continuity in existing financial and institutional arrangements. Exploration of technical, commercial, and operational alternatives was indicated so as to reduce investments needed under existing arrangements. The urban telecommunications sector was projected to continue its exhaustion of communications "space" which would restrict expansion of services and lead to or create over-investment and inter-carrier conflict. Greater rationalization of the telecommunications industry, certainly before 1990, was indicated.

B. Conclusion

This futures-oriented effort was instrumental in effecting a rearrangement of departmental priorities, particularly where the development of the regional telecommunications sector was concerned. The next set of major concerns to the department which are already beginning to materialize as concrete problems are the following: 1) the influence of the U.S. in telecommunications; 2) the projected "shake-down" in the Canadian commercial broadcasting industry (including the appearance of PAY-TV on the scene); and 3) the increased domination by Japanese and American corporations of the subscriber terminal sector. These concerns are thoroughly investigated in the "Threats and Opportunities" paper.

ENERGY, MINES AND RESOURCES

Responsible Officer: Gordon McNabb, Deputy Minister, Energy, Mines and Resources.

Date of Interviews: April 4, 1977

Persons Interviewed: James E. Gander, Director-General, Energy Review Group.

F.W. Belaire, Study Coordinator, Energy Review Group.

R.F.S. Robertson, Technology Advisor, Energy Review Group.

A. Futures Studies

In "An Energy Strategy for Canada: Policies for Self-Reliance", published in the summer of 1975, the Canadian Government specified a number of energy targets to 1990. These targets were set out against a dynamic background of changing energy supplies and demands, and of policy decisions made since 1973. Future energy scenarios were presented for the period 1976-1990. Within that fifteen-year period, the report did not envisage any significant displacement of oil and natural gas as the dominant energy resources. However, the study did recognize the need to begin now to examine carefully the possible energy alternatives over a longer transitional period than the next fifteen years. It noted that "What is necessary is to begin now to plan so that such a transition can take place in as smooth and orderly a manner as possible. These longer-range issues will be addressed in a paper to be published later that will deal with 'Alternative Energy Futures Beyond 1990'".

B. Long-Term Energy Objectives

For the period beyond 1990, Canada should strive for sustainable-self-reliance (SSR) in energy. This would require that a sufficiently large part of Canada's future energy needs be met from domestic sources so that in the event of disruptions of international supplies, the necessary adjustments could be made to permit the economy and society to function more or less normally.

Conditions of energy self-reliance are continually changing; they are always in a state of transition. Self-reliance, therefore, requires a dynamic, flexible and resilient approach -- one that can accommodate continual change and unexpected shocks. Self-reliance is sustainable because of that resilience to accommodate changes in energy demand, supply and in attendant economic and social conditions. That accommodation is made easier because the changes, the opportunities and the constraints are foreseen far enough in advance to ease the adjustment process in a flexible way.

Traditional resources such as oil, natural gas and coal are likely to be supplemented by emerging sources of energy such as nuclear power and oil from the oil sands. Major new factors can be expected to gain increasing prominence -- for example, greater use of renewable resources and far greater efforts to conserve energy and to use it more efficiently. The combination of possibilities are numerous, and each carries widespread implications for the future of Canadian society. The

combinations are not equally to be preferred. Each brings with it a host of technological requirements and requirements for changing inputs of many other kinds. By one means or another priorities and preferences will be established among them. Among the key questions, therefore, are the following:

1. Can sustainable self-reliance in energy be achieved? If so, when?
2. What various accommodations of supply and use yield the most probable and the preferred conditions of sustainable self-reliance?
3. What constraints stand in the way of achieving sustainable self-reliance by each of the identified combinations?
4. What are the economic, political, institutional and societal implications of the various possibilities?

C. Resources

The long-term energy assessment will deal with many topics within the energy sector or in areas substantially affected by the changing situation. The topics will be considered in terms of key questions and issues. These, in turn, involve perceptions of fundamental change in the energy sector, the economy and society.

The basic structure of the long-term assessment consists of the ten areas of focus listed below.

1. Economic & Social Setting
2. Energy Supply

3. Energy Demand & Conservation (The demand projections were made on seven scenarios including one defined as "conserver society" -- in all studies growth rates were between 1.3% to 2.6% per year (very low)).
4. Environmental Concerns
5. Technology and R&D
6. Provincial & Regional Priorities
7. Finance, Ownership & Control
8. Policies, Institutions and Regulations
9. International Aspects
10. Statistical Assembly and Systems

Each area of focus will be assessed by a task force, and considered in a matrix form to identify important cross-links among them. Each task force, when examining its own area of interest, will ensure that account is taken of the cross-links that are relevant to its work.

Liaisons have been established with other federal departments, provincial energy departments, industry, energy consultants, universities, public interest groups, experts in other countries and in international agencies.

D. Conclusion

No meaningful outline can be provided at this time of the size and format of the final report and its supporting documents. The report will be a public document. Systematic

follow-up is envisaged to receive assessments by technical experts, parliamentary groups and the interested public. A report on that follow-up, or some other subsequent report might then be in order.

EXTERNAL AFFAIRS

Responsible Officer: K. Goldschlag,
Assistant Undersecretary of State
for External Affairs.

Date of Interview: April 12, 1977

Person Interviewed: Chris Davis, Policy Analyst,
Policy Analysis Group.

Futures studies, and any other related forward planning or research at External Affairs, naturally emanate from a need to meet certain stated objectives. Some of these objectives are: the presentation of a National identity, i.e. presentation of Canada as a "distinctive bilingual, multicultural nation", and preservation of the federal authority for the origin of the conduct of External Affairs (responsibility of the Federal/Provincial Co-ordination Division.

A. Futures Studies

Work has been conducted in the following areas:

1. The future potential of Latin America -- completed by the Policy Analysis Group (PAG);
2. Future instabilities in southern Africa (PAG and area group);
3. Futures of the international system (developing countries vis-à-vis developed countries) in terms of possible future demands upon Canada;
4. The future of Japan as related to Canada (PAG and area group);
5. Trade depending study with an emphasis on centralization.

The results of these studies were sent on to the Research Committee composed of the Directors General of PAG and Directors of various branches of the Department. The Policy Analysis Group acted as a Secretariat to the Research Committee. These results were then channelled into policy decisions by the Research Committee.

Other futures-related questions with which the Department of External Affairs has dealt have been:

(a) What would be the international consequences of a North American superstate (i.e., Canada plus U.S.)?

(b) What steps must be taken in order to preserve sovereignty, independence, and a distinctive personality (especially in view of a giant neighbour -- U.S.)?

(c) What economic steps must be taken to ensure political independence?

(d) How can external policy be made to reflect the diversity and the multicultural aspects of Canada?

(e) What regions are potentially unstable; for instance, the Russia-China border, South Africa, Middle East, Latin America, S.E. Asia, etc.

(f) What is the future of Aid and Trade flows?

B. Resources

The Policy Analysis Group is responsible for research contracts which must be approved by the Research Committee and, in some circumstances, by the Interdepartmental Committee on

External Relations (ICER). The Policy Analysis Group consists of three officers, R. Hathaway, C. Davis, and J. Roy (but is allocated six man-years) and a part-time academic in residence, P. Arnopoulos of the University of Montreal.

DEPARTMENT OF FINANCE

Responsible Officer: Edmund Clark, Director,
Long-Range and Structural Analysis Division.

Update information supplied by the
Department of Finance.

A. Resources

Last December, the resources of the Long-Range Planning Branch were folded into the Economic Analysis, Fiscal Policy and Capital Markets Branch, and a new division was created called "Long-Range and Structural Analysis Division". This integration of the previously separate branches within the Department of Finance should improve the coordination of the activities within that department, and ensure that longer-term and structural considerations are more fully taken into account in economic policy work, which would fall under the mandate of the Department of Finance.

B. Futures Studies

The new division is now developing and implementing a long-range work program. A new set of medium and long-range macro-economic projections is being prepared with particular attention devoted to examining the sensitivity of the projections to alternative assumptions. A particular effort is being made also to ensure that the material is accessible to, and usable by, other departments. The first stages of the work program and the

interdepartmental discussion of it, has already taken place. This new division in the Department of Finance is also working to strengthen further the ability of the Department of Finance to do macro-economic analysis. A section devoted to assessing current and future structural problems has been established in the division.

Growth in Canadian GNE (Gross National Expenditure) and GNE per capita to 1995. The methodology used in this project is based on the identity relationship that real GNE is the product of employment and real output per employee. Within this framework the problem of forecasting the growth of GNE becomes the problem of forecasting the growth of GNE per employee (aggregate productivity). A great deal of attention has beed devoted to the demographic factors which underlie employment growth and thus the growth of real income. Projections are given of the population growth rates to 1995 and of the impact of the growth on either real GNE or real GNE per capita. Growth of "participation rates" have been examined with particular attention to relationship between demographic changes and changes in participation rates. It should be noted that the growth of cyclically-adjusted GNE was forecasted to 1995 and not the actual GNE.

The main conclusions of the study are as follows:

a. Sharp decline in rates of labour force growth

- Primary cause is sharp decline in rates of population growth. This conclusion is not very

sensitive to likely range of variation of population growth rates.

- Plateauing of participation rates contributes to the easing of labour force growth.

b. No major change in rates of growth of GNE/employee is expected.

c. Potential GNE growth rates decline significantly through to period ending in 1995.

d. Potential GNE/capita growth rates decline significantly through to period ending in 1995.

C. Conclusion

Initial work in the Department of Finance has consisted of the analysis of the effect of different demographic assumptions on gross national expenditure growth and examination of the likely performance of participation rates over the next 20 years. An integral feature of this activity in Finance will be the continuation of ongoing consultations with other federal departments in order to foster a more cooperative approach to medium and long-term forecasting within the federal government.

INDUSTRY, TRADE AND COMMERCE

Responsible Officer: F. Chambers, ADM,
Policy Planning.

Date of Interviews: May 10, 1977.

Persons Interviewed: Ted Roseman,
Economist, Policy Analysis.

Bruno Goulet,
Economist, Macro-Economic Analysis.

A. Resources

The main focus of futures research at ITC had been in the Office of Science and Technology but since the death of Brian Tucker that emphasis has been eliminated at OST. The main focus of futures-related research at ITC has now shifted to the office of "Policy Planning". This consists of the Economic Analysis Branch under Don Allen, and the Policy Analysis Branch under Gordon Ritchie.

B. Futures Studies

In these branches, such futures-related work as a long-term industrial sector strategy, and an analysis of industrial incentives with their medium and long-term impacts, are being formulated. It is also here that the Canadian Explor Model has been developed as a long run structural and trade simulation model. This is a major futures effort involving approximately four man-years. On the industry side of ITC, emphasis is being given to planning large "turn key" projects with a long planning period,

such as railroads, subways, airports, irrigation and power projects, in international markets.

The Canadian Explor Model (CEM)

Explor is an input/output model with coefficient projections for 68 sectors which are analysed by ITC line branches for their reasonableness. The main thrust of the model has been towards international trade and project analysis such as the analysis of tariff cuts in the current Multilateral Trade Negotiations and energy project proposals. Other ongoing projects include an examination of the future Canadian industrial structure for the OECD working group on future industrial structures and the sectoral specification of long-range scenarios from other sources, most notably the Department of Finance.

A detailed description of the CEM is provided in Appendix II.

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE

Responsible Officer: R. Zagorin, Director, Programs.

Date of Interview: April 26, 1977

Person Interviewed: M.S. Rao, Associate Director (Economics), Social Science and Human Resources Program.

A. Futures Studies

The IDRC does not conduct futures studies in-house but has funded futures work in several countries. The most significant work in this area was the Latin American world model developed by the "Fundacion Bariloche", in Argentina.

This model was developed as the result of the Club of Rome meeting in Rio de Janeiro in 1970. The authors develop their model from an approach entirely different from all other global models.

To them the results of the Limits to Growth and other doomsday prophecies are irrelevant since 2/3 of the world population already live in desperate conditions. These problems are not caused by any scarcity of resources but by the limitations of mans' current, social, economic and political systems.

With these basic premises in mind they develop a normative model of the world economic development process. The a priori assumptions are the following:

1) The LDCs* cannot retrace the steps of the developed countries. This would lead to a replication of their mistakes with regard to excess consumption and misplaced goals.

* Less Developed Countries

2) The widely predicted world catastrophe is already here. Worry about the levels of pollution and crowding in advanced industrial economies and the resulting prescriptions for zero world economic growth are irrelevant when 2/3 of the world need economic development to lead "meaningful lives".

3) The advanced industrial economies should slow their rates of growth and assist the LDCs to close the income gap between them.

To accomplish the development of the poor regions of the world, the Bariloche authors made a radical departure from other model builders and propose a total reordering of international and intranational politics, social institutions, and economic relations. The present alternatives, capitalism, or centrally planned socialism, fail to meet the basic requirements for management of rational growth. The future society should - and does within their mathematical model - conform to the following description:

(i) egalitarian society with regard to basic needs;

(ii) no profit motive - social needs determine production;

(iii) no property rights - neither private nor state.

The basic needs are defined as absolute per capita amounts of the following:

(i) 3000 calories/day;

(ii) 100 grammes protein/day;

(iii) 98 per cent of 6-18 year old children receive 12 years of education;

(iv) One house per family (four small rooms).

These four factors are combined in a small sub-model that predicts life expectancy at birth. This criterion is chosen as the best single proxy for general living conditions.

The mathematical model allocates capital and labour resources to five sectors of the economy to maximise the life expectancy number for each region. In this respect the Bariloche model is quite different from the others reviewed in this chapter, being the only one to employ an explicit maximisation routine to force the optimal allocation of resources.

The five sectors of each regional economy are:

1. Agriculture and Nutrition
2. Education
3. Housing
4. Capital Goods
5. Other Consumer Goods.

The output of the first three sectors are the basic needs. Section four provides capital investment goods while sector five represents the non-essential consuming activities.

The world is broken up into four regions. The largest includes all of the developed countries: OECD, Eastern Europe, USSR, other Europe, and Israel. The second region is Latin America, the third Africa,and the fourth Asia.

The running of the model is an exercise in optimal control applications. The control variables are the fractions of total labour and capital going to each sector. The objective function is the value of the life expectancy at birth for each period. Additional restrictions ensure a smooth transition of the level of production of each industry between periods.

Necessary to the implementation of social optimisation envisioned by the Bariloche team is the complete restructuring of the world system of economic relations. In addition to the internal changes concerning property rights and the profit motive, the external links of each country must undergo significant shifts. International specialisation in production and the accompanying trade flows among the four regions is periodically ruled out. The structure of the model thus ensures that each region is autarchic with regard to links with other regions, with completely mobile allocation of resources and goods within the region.

Due to the importance of world models in developing the methodologies for futures studies, a comparative evaluation of nine global models has been included as Appendix I.

B. Other Related Activities

Other related activities in this area includes the creation of the International Food Policy Research Institute (IFPRI). As IFPRI focuses on food grain, its activity is of great interest to Canada, the second largest wheat exporter in the world. The IFPRI has published three reports on international trade, nutrition, and food deficit countries. An update and a 5-year extension of the 10-year projections made for food deficit countries is presently in print.

DEPARTMENT OF NATIONAL DEFENCE

Responsible Officer: Pat Black,
ADM (Policy).

Date of Interviews: June 23, 1977

Persons Interviewed: F. Walden, Director,
Socio-Economic Strategic Planning,
Policy Planning Branch.

B. Thillaye, Director,
Strategic Policy Planning,
Policy Planning Branch.

A. Resources

There are four branches within the Department which are responsible for conducting futures studies:

1. the Policy Planning Branch of the Policy Group, which reports to senior management through the Assistant Deputy Minister (Policy);
2. the Operational Research and Analysis Establishment, which is responsive to tasking from all parts of the Department and is placed administratively under the Assistant Deputy Minister (Policy);
3. the Plans Branch of the Defence Research Board, which advises the Minister of National Defence on all matters relating to defence science and technology; and
4. the Intelligence and Security Division, which reports through the Vice-Chief of the Defence Staff.

The Policy Planning Branch within the Policy Group conducts the most significant work in the area of futures studies. This Branch consists of essentially two sections, the Strategic Assessment Team, and the Planning Guidance Team. The former Team carries out or sponsors futures studies; it consists of seven policy analysts, three at director level, whose background includes expertise in political science, military affairs, international relations, economics, sociology, science and technology. The Planning Guidance Team attempts to apply and integrate the results of the futures studies into the policy planning process; it consists of three senior policy analysts, with a similar range of expertise.

B. Futures Studies

Work was completed in 1976 on the first phase of PROJECT 2000, in which an attempt was made to forecast the occurrence of conditions and developments which could result in serious instability in the international system over the next ten years. Attention has been concentrated in this initial assessment (STRESS 1985) on conditions and developments which could lead to the use, or the threat of use, of military force in those areas of the world which are relevant to the security and strategic interests of Canada. More specifically, the analysis has sought to:

a. assess the potential for occurrence of significant international conflict and instability;

b. identify the conditions which could cause or precede this conflict and instability;

c. estimate, where possible, the probability of occurrence of disturbances of sufficient magnitude to upset the international system;

d. visualize the nature and form of these disturbances; and,

e. consider the implications of these developments for Canadian security and strategic interests in general, and for Canadian defence planning in particular.

STRESS 1985 was completed in August of 1976 and distributed within and outside the Department as the official long-range strategic planning document. In general the document was very well received by the senior officials of other departments.

The Policy Planning Branch is also participating extensively in NATO's prime long-range program-planning into the 1980's. Both the Policy Planning Branch and the Plans Group of the Defence Research Board are actively involved in the NATO AGARD (Advisory Group for Aerospace Research and Development) study, a comprehensive attempt to project and direct the development of aerospace technology in the west for the balance of the 20th century.

• Further to this, the DND Policy Planning Branch will be involved in the east-west overview to the year 2000, a type of futures international meta-study, the idea of which was

approved at the recent Western Summit in London, England. Details are not forthcoming at this point, because the basic parameters of the study, i.e., scope, fundamental assumptions, participants, have yet to be finalized.

NATIONAL RESEARCH COUNCIL

Responsible Officer: W.A. Cumming,
Vice-president, Administration.

Date of Interview: July 5, 1977

Person Interviewed: W.H.C. Simmonds, Industrial Liaison,
Industrial Programs Office.

In general, the situation concerning futures studies has not materially changed since that reported in the NRC reply of December, 1975.

NRC continues to perceive the need for forward-looking studies in relation to its research programs. The organization and management of such studies continue as previously described.

A. Futures Studies

In regard to specific futures studies, a report entitled 'Canadian Opportunities in Space' by Dr. P.A. Forsyth was presented to Council in 1976. It deals with the nature of research in space to be done and the resources required (Report of the President of NRC, 1976-77, p. 46).

NRC is participating in the Government's Panel on Energy Research and Development under the Department of Energy, Mines and Resources and in the work of the Energy Review Group through the NRC Energy Project Coordinator, Dr. E.P. Cockshutt. NRC has primary responsibility in the field of non-renewable energy and in fusion research (Report of the President 1976-77, p. 50, 52, 54).

In 1976, an ad hoc task force set up by the Research Branch, Department of Agriculture, and the Division of Biological Sciences, NRC, reported its study on 'Food Research 2000', which outlines requirements for food research from now till that time.

In 1977 an ad hoc task force comprising members from Agriculture, Environment, Health & Welfare, MRC and NRC, reported its findings on the immediate and future situation in the training of toxicologists and the needs for contract work and research in this field in Canada. A rapid increase in Canadian capabilities is becoming necessary as the result of changes in U.S. regulations regarding the release and use of potentially toxic substances and in the number and kind of such substances being found in the Canadian environment.

AGARD, the Advisory Group on Aerospace Research and Development, has carried out the first phase of AGARD Project 2000 at the request of the Military Committee of NATO. Phase II is currently under consideration. Mr. Frank Thurston, Director, National Aeronautical Establishment, is the current chairman of the National Delegates Board of AGARD; Mr. W.H.C. Simmonds, NRC, is the Canadian member on the Steering Committee for this project.

Mr. Simmonds was also invited to participate in the National Science Foundation's 'Project: Knowledge 2000' in 1976, and in the current study by the Office of Planning and Development, Quebec City, in their study, Quebec 1995. He also acted as a consultant for Professor Erwin Laszlo's report to the Club of

Rome 'Goals for Mankind', and is the NRC representative on the Interdepartmental Committee on Futures Research.

B. Resources

Contract for a study on the feasibility of solar heating in Canada placed with Professor Hollands of the Department of Mechanical Engineering, University of Waterloo, through the Waterloo Research Institute, 1975 - Nov. 1977, $61,000 total.

Contract by the Division of Building Research, NRC, and the Nova Scotia Power Corporation (50:50) for a feasibility study on the possibilities for district heating in the City of Halifax, placed with Shawinigan Engineering, completed January 1977, $100,000 total.

C. Futures Methodologies

In regard to futures methodologies, the need to differentiate between know-how, and know-why type questions has been made clearer, and a method of determining the potential direction of social change has been devised.

A book entitled 'Futures Research: New Directions' is being co-edited by W.H.C. Simmonds and will be published by Addison-Wesley Publishing Inc. in the spring of 1978.

D. Conclusion

The above indicates that NRC futures studies are normally made in the area of possible future directions for

research. Such studies are conducted internally or by contract and in cooperation with departments, etc., with responsibilities in the same or related areas as required.

DEPARTMENT OF REGIONAL ECONOMIC EXPANSION

Responsible Officer: Mark R. Daniels, ADM,
Planning and Coordination.

Date of Interviews: April 29, 1977

Persons Interviewed: Mark J. Daniel, Analyst,
Economic Development Analysis Division,
Analysis & Liaison Branch.

D.G. Tate, Director,
Program Evaluation Division.

A. Futures Studies

In the summer of 1976, the Economic Development Analysis Division at DREE set up the "Regional Future Project". The aim of the project was to build a simple, flexible and highly manageable model that could produce sufficiently meaningful regional long-term projections of main demographic and economic aggregates. In short, the model generates output from demographic variables at the national level, whereas at the regional level, it generates population from economic variables. A status report produced in July included projections up to the year 2001. In September, an update was made to incorporate the Conference Board in Canada's regional projections (the time horizon is still the same). The project has necessitated only half of a man-year since its inception.

The interesting feature of the model is that it is directly made for decision-makers. Only a few variables are interacting. The model is easily usable even directly by the

regional offices. So far, the Atlantic and Quebec offices have used the model. Also, some scenarios were tried at the headquarters in Ottawa.

Another project, called "Regional Trends", has been connected with the "Regional Futures" project.

The Program Evaluation Division is involved in the evaluation of projects that DREE could eventually support. Usually, a long-term perspective is adopted for those evaluations that try to compare costs and benefits of projects examined. For example, a 25-year horizon was necessary in the evaluation of a steel mill project for Eastern Canada. It could take as long as ten years to put the plant into production and 15 more years to reach full profitability. In the case of the forest industry, a longer time horizon was used since trees need from 30 to 40 years to reach maturity.

Sectoral analysis is mainly used for the evaluations. Topics such as the social discount rate, the social opportunity cost of labour and foreign exchange and investment problems have also been researched.

TRANSPORT CANADA

Responsible Officer: Nick Mulder,
ADM, Strategic Planning.

Date of Interview: June 30, 1977

Person Interviewed: Richard Clark, Study Director,
"The Future of the Automobile in Canada".

A. Futures Studies

The part of Transport Canada which is most closely involved in futures research is the Strategic Planning Group headed by Nick Mulder. Of the work ongoing in Mulder's group clearly the most impressive futures effort is the special study on the future role of the automobile in Canada headed by Richard Clark. The objectives of this study are:

1. To identify and assess present and future influences on the role of the automobile in Canada.
2. To identify and assess problems of national significance pertaining to the automobile.
3. To identify and assess possible future roles for the automobile.
4. To formulate and stimulate action on short, medium and long-term strategies towards the automobile.

B. Resources

The task force, headed by R. Clark, comprises three full-time professionals, two full-time research assistants, numerous persons from the departments of EMR, Environment, ITC, MSUA, Finance, other branches and administrations of Transport Canada, and twenty-six individuals as consultants. The task force reports regularly to a special Transport Canada steering committee established to oversee the direction and status of the study. The following departments participate in a technical coordinating committee: EMR, Environment, ITC, Urban Affairs, Consumer and Corporate Affairs, and Finance. Other contributors to the study include: automobile manufacturers, the Ministry of Transportation and Communications of Ontario, several municipal governments, Bell Canada, and DOC along with other federal departments. Outside contracting to provide professionally reliable and specialized expertise is important to this infrastructure. Consultation with relevant provincial government departments is ongoing.

C. Futures Methodologies

The most important analytic tool for the study is the scenario technique. This is used:

1. to explore the reasonable range of possible future conditions for the automobile in Canada up to the year 2000;
2. to illustrate and examine the interaction of the automobile with all significantly affected aspects of society; and

3. to provide the basis on which strategies for affecting the role of the automobile in Canada can be formulated.

The fundamental assumptions in each of the basic scenarios are extremely comprehensive. The main ones are social, economic, technological and energy.

Five basic scenarios were developed and some of the most important assumptions in each case are specified below. The time horizon is 25 years although actions and recommendations are being formulated more for the period of up to 15 years.

1. "Paralysis" - economic stagnation and continuing inflation; international economic growth slow; urban growth slow; national energy sources development delayed; imports and costs of energy increase sharply; political instability.

2. "Muddling Through" - economic growth - 4%; unemployment down; moderate energy conservation; moderate improvements in fuel economy; auto technology; auto sales moderately up.

3. "1985 - The Turning Point" - major energy crisis leads to economic slump (15% - 25% unemployment) and strong federal role to

manage recovery; sharp drop in number of autos on road, survival/salvaging technologies for autos.

4. "Energy Conserving Society" - oil imports to nil by 2000 after increase to 40% in 1985; high priority - energy conservation and transition; steady economic growth and low unemployment.

5. "California" - renewed economic growth, decline in inflation, energy situation strong; requirement for urban development increases sharply, auto technology and sales re-vitalized.

D. Conclusion

The scenarios have generated substantial interest within and outside the federal government. For example, the Department of Finance is using information derived from the scenarios as inputs into its own long-range efforts. Several provinces and municipalities are now using the scenarios as the basis on which to re-evaluate existing programs, policies and future plans. The expected completion of the auto study is February 1978.

TREASURY BOARD SECRETARIAT

Responsible Officer: R.H.J. Bower, Director,
Effectiveness Evaluation Division.

Date of Interviews: April 1, 1977

Persons Interviewed: D. Woodward, Head,
Futures Research and Forecasting.

M. Moffat,
Effectiveness Evaluation Division.

H. Duff, Policy Analyst,
Effectiveness Evaluation Division.

A. Resources

The Treasury Board Secretariat, until recently, had two centres interested in futures studies: one in the Planning Branch, the other in the Personnel Policy Branch. Of these two the Personnel Policy Branch was by far the most active.

B. Futures Studies

Futures research in the Personnel Policy Branch was conducted by D. Woodward of the Planning and Coordination Division. Reports produced include: "A Futures Report to Aid Long-Term Strategic Planning in the Personnel Policy Branch"; "Personnel Management in the 1980's"; "The Quality of Working Life Concept and Implications for Personnel Policy"; and "Towards the Future". These reports and other related material provided the management of the branch with an excellent introduction to futures research along with many insights as to its application to personnel management.

While the Planning Branch does not have a unit devoted to futures research, it is interested in this area for a number of reasons: (a) many branch studies have long-term implications; (b) the branch has a responsibility for overseeing government planning generally, including futures research; and (c) most members of the branch have a professional interest in long-term studies.

Studies conducted in the Planning Branch tend to be very specific, concentrating on the year-to-year operations of government programs. They are present-oriented but are often geared to problems that are structural by nature. They therefore have strong future implications. Examples of such projects are: negative income tax; social security design; guaranteed annual income; and various tax credit systems.

C. Conclusion

Interest in futures as a part of government planning has always been present in the Planning Branch but has been strenghthened with the formation of a small secretariat for the Coordinating Committee on Evaluation and Planning (CCEP). This group has been closely associated with MOSST in the latter's survey of futures studies activities in the government. It's main interest is in rationalizing the government's long-term planning procedures.

III THE EVALUATION OF FUTURES STUDIES IN THE FEDERAL GOVERNMENT

The Purpose and Utility of Futures Studies in the Government

The utility of futures work, conducted within the federal government, must be assessed in terms of:

1. its Relevance to the government;
2. its Reliability; and
3. its Utilization by the government.

The relevance of futures work represents the potential usefulness which this kind of work could have for the government.

The reliability of futures work in the government denotes the quality of the production and presentation of that work, as well as the quality of the product itself, as assessed against research criteria.

The utilization of futures work represents the actual use to which futures work is put in the government.

1. Relevance Criteria

Six desirable functions for futures work in the federal government are developed. These constitute the first set of evaluative criteria gauging the relevance of particular futures studies to the government. To the extent that futures studies satisfy these criteria, they will be capable of performing desirable functions.

Each function outlined below comprises:

- an explanation of that function
- a list of the key ways in which that function can be performed.

1.1 General Projection Function

Futures studies which attempt to project trends under different conditions, particularly in terms of continuity and change, are performing this first function.

- Projection of the present situation into the future.
- Projection of specific problems, issues, concerns.
- Delineation of alternative situations/scenarios in the future.

1.2 Early Warning Function

Futures studies which attempt to anticipate imminent or possible problems, crises, and other "abnormal" conditions which may materialize in the future are performing this function.

- Anticipation of imminent and distant crises, problems, and other potentially disruptive factors.
- Identification of major potential threats and challenges to the international and national environments.

1.3 Role in Policy Development

Futures studies which attempt to improve government policy, by ensuring that consecutive stages of the policy-formulation process are extended into the future, are performing this role.

- Addressing policy issues of special importance to the future.
- Assessment of future implications of present policies and programs.
- Identification of preferred future conditions/and situations.
- Identification of alternative policy options.

- Extrapolation of consequences/and implications of selected policy options.
- Identification of comprehensive, long-term policy objectives.

1.4 Role in Strategic Planning

Futures studies which attempt to develop general strategies, taking into account promising opportunities and choices for government action, are performing this role.

- Development of contingency options and plans.
- Identifying present and potential opportunities for government policy initiatives.
- Development of overall comprehensive strategic planning framework for the future.

1.5 Role in Goal and Value Definition

Futures studies attempting to examine goals and values in the future, perform this role.

- Future relevance and suitability of present goals and values.
- Identification of new, goals and values for the future.
- Projection of individual, national, and societal needs.
- Anticipation of public expectations.

1.6 Role in Resource Planning

Futures studies which attempt to project the need for, and availability of, specific resources, are performing this role.

- Extrapolation of actual resources, assets and programs.
- Extrapolation of potential resources.
- Conceptualization of plans for developing specific technologies for eventual use in the future.

2. Reliability Criteria

The second set of evaluative criteria gauge the reliability of futures work in the federal government. The criteria consist of general research standards which are especially important for futures work and a set of specific controls unique to futures work. To the extent that futures work in the federal government satisfy these criteria, they can be judged reliable. The more reliability criteria a futures product meets, the greater its overall reliability will be, and the greater the level of confidence that can be placed on that product.

2.1 General Research Standards

- Existing futures research applied to the same subject area, or using an identical or similar approach, is acknowledged and reviewed for its implications for the general field and for this futures product.
- Limitations of futures studies are acknowledged in general terms -- i.e., the vulnerability of causality theory for forecasting the future -- and in more specific terms, where limitations present special difficulties for this particular piece of futures work.
- Explicit identification of basic assumptions underlying the approach.
- Complete articulation and explanation of a research design (usually consisting of a conceptual framework, specific research strategy, methodology and techniques).

- Comparison of research design with existing similar research plans and strategies, especially if applied to same subject area, to establish linkages and symmetries between them, and to illuminate main difficulties.
- The specific technical assumptions and limitations of the research design are explicated.
- Operationalization of complete research design to ensure replicability and facilitate verification of research process.
- Identification and explanation of sources for data.
- Tests for ensuring validity of data.
- Stages of data and variable analysis outlined and explained particularly where complicated quantitative analysis is used.
- Logical consistency in inferences drawn from analysis phase, particularly statistical analysis, i.e. validation of original propositions, hypothesis; formulation of new propositions.
- Brief summary of the major limitations and qualifications to the exercise.
- Implications and need for further work in this area or in larger subject area are clearly identified. Particular phases of the analysis could be isolated.

2.2 Specific Controls for Futures Work

- Definition of key futures terms, especially those unique to the study.
- Distinction between normative and indicative modes of futures work and specifications of use of one or both modes at specific stages of the research design.

- Distinction between possible and probable futures, and in the case of the latter, statistical methods outlined and calculations supplied.
- Specification of type of futures approach used, i.e. qualitative, quantitative, or a combination of both. Clear acknowledgement of the limitations of the selected approach.
- Specification of type of futures methodology used, particularly the exact analytic technique used. Particular limitations and estimates as to the reliability of a technique, based on track records in selected subject areas, are noted.
- Specification of time horizons or research design; rationalization of these horizons and elaboration of their implications for the design and the techniques used.
- Application of qualifiers and conditions to enhance the accuracy of the predictions and forecasts made in the analysis stage.

3. Utilization Criteria

The third set of evaluative criteria estimates the actual use of futures work by the federal government. To the extent that the utilization criteria are met by individual departments, the futures work can be said to be effectively utilized. It is important to note that neither relevance nor reliability are sufficient conditions for the utilization of futures work in the federal government. Accordingly, it is imperative to identify what sorts of futures work are being utilized by government, what parts of the government are utilizing them, for what reasons they are being utilized, and in what ways they are actually incorporated into departmental planning activities.

The Evaluation Exercise:
Application of Evaluative Criteria to Departmental Futures Efforts

1. Communications

2. National Defence

3. Transport

DEPARTMENT OF COMMUNICATIONS

A. RELEVANCE CRITERIA

1. General Projection Function

Projections of the future general communication environment in the 15-25 year time frame (i.e. up to 2000) have been the subject of a number of documents, initiated at the outset of the department. A large-scale study on computer communications (Branching Out) looked at mid-term futures in computer applications and services and their impacts on communications. A study of public telecommunications in terms of inter-regional traffic expectations correlated public carriers, facilities planning, and traffic engineering forecasts, with household and economic activity projections. The two documents "Perspectives 1985" and "Threats and Opportunities in the Development of Canadian Public Telecommunications in the Next Decade" represent a comprehensive effort to ascertain the dynamics and long-term directions of the field.

2. Early Warning Function

Identification of imminent problems in the public telecommunications field has been attempted in many of the items outlined above. Identification of the emerging dichotomy between rural and urban Canadian communications sectors is of prime concern to DOC. Other examples of this function are listed below:

(1) The projection of over-investment and inter-carrier conflict potentially arising from the development of the urban sector.

(2) The extending influence of the U.S. in Canadian telecommunications.

(3) The projected "shake-down" in the Canadian commercial broadcasting industry, and;

(4) Increased domination of the subscriber terminal sector by Japanese and American corporations.

Particular effort has also been devoted to the potential crisis that could emerge if those industries controlling Canadian telecommunications distribution systems were also allowed to produce or manage the content handled within those systems.

3. Role in Policy Development

DOC identified, several years ago, some of the basic policy options open to the government, traced through their long-term consequences, weighing overall advantages/and disadvantages, and subsequently recommended the preferred policy option. For example, one major policy option was to induce competition in the Canadian telecommunications sector -- as in the U.S.A. -- and to encourage free enterprise to act as the basis for provision of public services. Projected consequences of this option over the 10-15 year time frame indicated that a monopolistic situation headed by a corporation such as IBM could easily have developed, and a

highly non-preferred situation was thus clarified. Other options, including opting for non-private, publicly-accessible line systems were fully investigated, and subsequently this policy option was recommended for adoption. DOC has also gone a long way in developing comprehensive long-term policy objectives for Canadian telecommunications, i.e. (1) development and promotion of quality of service for rural telecommunications sector comparable to that in the urban sector at economically feasible rates; (2) provision of good-quality services for the North; (3) the separation between "content and container" or "message and medium" as a socio-cultural imperative; (4) the rationalization of delivery facilities as a techno-economic imperative; (5) and the rehabilitation and rationalization of the terminal sector with subscriber facilities as a service imperative.

4. Role in Strategic Planning

Development of contingency plans for use in situations which may actually emerge in the future communications environment, has not been neglected but neither has it been pronounced. DOC identified important initiatives for the government in the telecommunications sector. These are done explicitly in the aspects of messages (content and programming), of delivery, and of terminal facilities and services in the telecommunications field. None of this work has developed, or has been accepted, to the point that comprehensive strategic planning is possible for DOC.

5. Role in Goal and Value Definition

Considerable thought, has been directed at the first order questions -- (1) What is the role of communications in society? (2) What could it be? (3) What should it be? (4) What are desirable, realizable goals for communications in Canadian society? The following second order questions have also been examined: (1) Is Society a captive of its communications infrastructure to the extent that it is inhibited in adapting to changing realities? (2) Is approximately 40-50% of our GNP poured into all forms of communication too much? (3) What are the long-term effects of this trend? (4) What are the present and future opportunity costs of this trend?

Although this extensive scrutinization of goals is not officially-designated policy investigation, it does focus sharply on the very rationale of DOC and the whole future Canadian telecommunications sector.

6. Role in Resource Planning

Projecting the effects of new technologies into the future, such as satellite communications, is an important feature of DOC's futures effort. Another aspect of this role, involving the conceptualization of plans for developing new technologies, was realized through the Anik satellite program which has already effected "desired" futures for Canada's North. Such a program went as far as generating new demands and expectations, but also resulted in cultural stresses.

B. RELIABILITY CRITERIA

While the work is supported in places with the use of a number of futures techniques such as statistical extrapolations, an explicit research design is not fully developed. This in itself by no means disqualifies DOC's effort from being reliable, but it does limit the replicability of the effort, and in particular, inhibits the verification of the more general conclusions inferred from the analysis. The articulation of a research design would enhance the clarity of the analytic process used. The argumentation involved in the "Threats and Opportunity" document is commendably stimulating, and reflects considerable imagination and perspicacity on the part of the author. However, the argumentation could be more tightly structured so as to yield sharper conclusions. Further, much more effort could be devoted to systematically identifying the specific implications of the analysis for the particular policies and objectives of the government in Communications. Areas in the communications field which require more extensive futures research should also be highlighted. DOC should be credited with pointing out the limitations inherent in futures work, or more precisely, inherent in approaching the future of the communications sector in Canada.

C. UTILIZATION CRITERIA

Efforts to examine the interface of futures studies with departmental planning has been very limited. This has not, surprisingly, precluded DOC from coming up with a process that is suited to its needs and that ensures that policy documents are "futures sensitized". But it does mean that careful examinations of

the design of futures studies and their interface with the policy framework has not been conducted. Thus the ultimate goal of ensuring that futures studies be conducted so as to maximize their contribution to departmental planning is still eluding DOC.

D. DEPARTMENT'S COMMENTS ON THE EVALUATION

The Department viewed the assessment to be quite satisfactory. In addition, the Department felt that it would be useful to highlight some basic research projects "which addressed themselves to concrete issues individually and, collectively, to the framing of departmental orientations and policies". The following are among the most noteworthy.

1. "Medium-term economic forecasting for which DOC has developed and is using a number of complementary models. While the models are complex, being used for a variety of analytical and forecasting work, certain individual modules have become work-a-day tools in dealing with regulatory issues in the Telecommunications Economics Branch of the Department.

2. The Information Economy having been abruptly discovered to account for something of the order of 40 to 50% of our overall economy, is looming up as the Department's number one futures research challenge. The research program is just starting and might be of interest to many departments, given the pervasiveness of information and communications in every activity.

3. The Domestic Long Distance Communication Network Study is one of the Department's earliest case histories in futures research and is now fully documented.

4. Project Quist was an experiment in applying and learning the limitations of one of the most sophisticated forecasting methodologies -- that of dynamic programming. While the Department did not exploit the technique further, it learned that the feasibility and possibility of quantifying essential inputs can make or unmake models.

5. Data Terminal Technology exploited familiar methodologies in an area of exceedingly rapid change in this decade.

6. Spectrum policy. This project is of special interest in that it related to a sector in which vested interests are complex, powerful and very sensitive to government and regulatory concepts about the future. Its method was correspondingly conservative -- that of interactive consultation with a complex cross section of the entire community."

NATIONAL DEFENCE

A. RELEVANCE CRITERIA

1. General Projection Function

This is done at two levels:

(1) projecting the development of the overall international system in its political, economic, scientific-technological and military spheres.

(2) forecasting continuities and changes in the international security sub-system, identifying implications of these more precise trends for international instability and conflict.

Linkages between developments in the domestic situations and the international environment are carefully investigated. Macro-issues, of special importance to the direction of the international system, are isolated, analysed, and incorporated into the general and specific projections. "PROJECT 2000" -- and -- "STRESS 1985" -- investigate the development of the international system by resolving the system into its key components.

(1) the geographical dimension.

(2) macro-issues (e.g. arms trade, nuclear proliferation, development of the seas).

These two documents focus the inquiry on the conditions likely to precede and produce international instability, and ultimately, conflict. These sets of conditions are inter-related and progressively telescoped to provide an assessment of the ways (areas and times) by which the international system will be most

susceptible to disruption. The implications of this for Canadian security are then calculated. Exploration of potential new technologies and their impact on the political and military spheres is also a strong asset of DND's futures efforts.

2. Early Warning Function

Anticipation of international crises, in more than the narrowly-defined military sense, is a prime objective of the STRESS 1985 effort. Projecting tension levels in the future international system, gauging critical interaction paths (as in the case of future super power competition, especially in the nuclear and conventional arms race) and monitoring developments in specifically-isolated conflict zones in the world are three facets to this task. Interpolation of events which may radically affect international stability over a very short period of time is also conducted by DND; hypothesizing the acquisition of nuclear weapons by terrorists and aggresive military regimes, and then calculating the likely effects on regional and international stability is a good example.

3. Role in Policy Development

- Identification of consequences of present policies and programs.

  i.e. identification of appropriateness of present policies regarding sovereignty protection, NATO, NORAD and peacekeeping for future situations. Assessment of projected capabilities (force levels, weapons levels) against projected future requirements.

- Identification of significant policy-manipulable variables.

  e.g. controlling supply of nuclear resources to 3rd world countries; controlling aspects of the international arms trade.

- Identification of preferred future conditions/situations.

  e.g. nuclear arms control, balanced force reductions in Europe, chemical and bacteriological weapons (CBW) disarmament/arms control, support of regional power centres conducive to stability in international conflict-zones, e.g. Iran in the Middle East.

- Selection for negation, avoidance, or restriction purposes, of non-preferred situations capable of policy manipulation or influence.

  e.g. denial of excessive potentially destabilizing preponderance of Soviet military strength in European theatre.

- Identification of alternative policy options.

  e.g. possible exclusive reliance on U.S. for necessary military capabilities.

- Extrapolation of consequences/implications of selected policy options.

  e.g. garrison-state situation plausible as result of policy option identified above.

- Specification of comprehensive long-term policy objectives.

  e.g. promotion of international stability -- and derivative -- avoidance of unilateral military actions destabilizing to international security and Western effort in that regard.

4. Role in Strategic Planning

DND has developed selected strategies for achievement of projected future policy objectives.

e.g. Strategy of negotiation -- MBFR, CCD, UN negotiations

Strategy of peacekeeping -- UN Peacekeeping Primarily

Strategy of military contributions -- NATO Commitments Primarily

These strategies have been integrated, on a preliminary basis, into a comprehensive strategic planning framework.

5. Role in Goal and Value Definition

Some work has been conducted into the continued importance of national security to societies and Canada, large military infrastructures will remain necessary for the foreseeable future (up to 2000) if this goal is to be adequately met. An assessment of DND's futures effort in this regard is particularly difficult as their very raison d'être is premised upon the existence and achievement of one goal -- national security. Consequently, this goal is expected to be the parameter, not the object, of analysis in DND.

6. Role in Resource Planning

This has been performed effectively in the following areas:

- Projection of present capabilities, i.e. present weapons systems, into future, e.g. life-span, future obsolescence.

- Projection of mobilizable potential for new resources and capabilities in the future especially in terms of new technologies that can be incorporated as weapons systems.

B. RELIABILITY CRITERIA

The futures products of the Policy Planning Group merit special mention. "STRESS 1985" and "PROJECT 2000" are strongest in the introductory and design phases. Considerable effort has been expended in developing a long-range framework for analysis and planning that draws upon the best theory in the field of futures research and international affairs. Limitations of futures research have been examined extensively in position papers that make up PROJECT 2000. The most promising opportunities for futures work in the areas of international relations and Canadian security have been explored. The design of PROJECT 2000 which is reflected in its policy derivative -- STRESS 1985 -- has been fully explicated. Its objectives, assumptions, time parameters, and methodology have all been clearly identified and these are being reviewed regularly. While the Policy Planning Branch's futures effort is also strong in the analysis and assessment phases, more extensive empirical analysis needs to be conducted and its linkage to the more generalized propositions requires clearer identification. Further, specification and rationalization of confidence-levels would enhance the reliability of the projections for the development of the international system. The concluding phase of this futures work is exemplary, especially where the implications of the forecasts for the policies and objectives of the department are explained.

C. UTILIZATION CRITERIA

A careful examination has been undertaken of the interface between futures studies and departmental planning efforts, and the alternative institutional options for integrating the two have been thoroughly explored. Building the futures studies interface into successive stages of policy, strategic and capability planning and ensuring that the department's futures efforts are policy sensitive in terms of their objectives and frames of reference have both been instrumental in assuring the relevance and importance of futures studies to DND.

D. DEPARTMENT'S COMMENTS ON THE EVALUATION

The general approach of the review and evaluation provides the kind of guidance to thinking about futures studies in government which up to now has not been available. Perhaps the most useful function of the Survey is to inform each department of the nature of futures studies in other departments, and of the part these studies play in the overall planning and decision process. The Survey provides the Strategic Assessment Team with an even wider range of personal and professional contacts across the federal government departments, and so will enable each member of the Team to call upon resources in the areas of expertise and experience relevant to his part of the Strategic Assessment.

There are no major errors in the Survey concerning Futures Studies in National Defence, but a few points which could be clarified. While it is true that the early phase of the work

was given the title "Project 2000", this was largely for convenience in referring to a framework being developed for the Strategic Assessment. This title, Project 2000, is no longer being used, particularly since it might cause some confusion with other futures studies of the same name. The same observation applies to "STRESS 1985". The present title, "A Strategic Assessment For The Next Ten to Fifteen Years", describes the work more appropriately, and the aim is to produce an annual up-date of the Strategic Assessment. In this way the Strategic Assessment will be the initial phase of the continuing planning cycle, providing the basic reference for the planning process.

Finally, and most importantly, in terms of futures studies in the federal government, the Strategic Assessment Team has developed a wide range of cooperative support in other parts of the department, in other government departments and agencies, and in universities and research institutes. It would be useful if in the future work of MOSST, these links could be made more explicit. The value of knowing such networks in various fields of study, foreign policy, economics, resources, demography and so on, is obvious.

TRANSPORT CANADA

A. RELEVANCE CRITERIA

1. General Projection Function

The major work of the Transportation Development Agency in Montreal,(1) "Alternative Environments for Canadian Transportation, 1980 - 2000", attempted to outline the future transportation environment for Canada and present several basic situations which could alternatively characterize this environment. The Auto Study, which is clearly TC's largest and most important futures effort at the present time, projects the future environment which will influence the role of the automobile and identifies the alternative possible future roles for the automobile. The scenario technique is used in the Auto Study, in terms of this projection function, to explore the reasonable range of possible future conditions for the automobile in Canada up to the year 2000, and to illustrate and examine the interactions of the automobile with all significantly affected aspects of society.

2. Early Warning Function

The Auto Study alerts Transport Canada to possible critical future situations regarding the automobile in Canada. Gasoline consumption, potentially critical points in the economy, implications for other travel modes, and levels of environmental damage are good examples. TDA appears to have addressed future problems in terms of long-range national requirements for transportation.

(1) now renamed Transport Canada Research and Development Centre

3. Role in Policy Development

Policy-salient issues are being addressed by TC's futures effort. This is evidenced in the Auto Study which postulates that the future of the automobile is key to the future energy and economic situations, and vice versa. Effects of transportation on the general economy and environment in the future have been investigated by TDA. In the Auto Study, parameters of each of the basic 5 scenarios, represent individual or combined policy options, e.g. postulated energy conservation for several of the scenarios. Limited work has been done on the development of preferred futures; more accurately, possibilities for desirable conditions have been explored in the general field of transportation. The development of broad, long-term policy objectives, as an additional part of this policy function of futures studies, has been attempted but not within the context of a specifically-constructed and analysed future environment.

4. Role in Strategic Planning

The development of selected strategies is another key function of the Auto Study, though Clark's group has yet to fully concentrate on this phase. In the general field where strategic planning maps out the course and effects of government policy in the transportation field for the future, the requirement exists to take into account, and manage through policy, the inter-relationships between the various travel modes/sectors over time. It does not appear, however, that the futures effort of TC had been developed to the point where it permits the formulation of a strategic framework for the future within which transportation

policy for the different sectors and their interrelationships can be articulated.

5. Role in Goal and Value Definition

TDA's considerable effort to look at the value of transportation to society in the future and the relationship of transportation goals to society's priorities now and in the future is commendable. The "Mobility and Quality of Life" study title is itself an indication of the comprehensiveness and "objective detachment" characterizing this approach. The study focusses on such aspects as efficiency, accessibility, and equity of transportation and balances these against the costs to society of this important sector (limited resources, capital, environmental damage, etc.).

6. Role in Resource Planning

Regarded in terms of a futures context and in terms of a general planning framework, the resource function has not been strongly developed by TC. In specific sectors, as with aviation facilities requirements in relation to future supply/and demand conditions, this function is performed well. This is certainly evidenced in terms of projecting possible effects of resources outside the government where particular technologies are concerned (i.e. auto technologies).

B. RELIABILITY CRITERIA

The shortcomings of Transport Canada's Futures effort are few and do not substantially impair the reliability of the product. The limitations of scenario construction should be more explicitly

acknowledged and examined. Examination of other futures work in the area of transportation could be attempted to help place this particular study in perspective. However, it is easier to credit the Auto Study for having clearly outlined assumptions underlying the exercise. The design and analysis phases are exceptionally strong -- virtually all of the specific reliability criteria are satisfied. The reliability of the Auto Study could be enhanced by the specification of confidence levels for projected developments affecting, and affected by, the future of auto transport. While the Auto Study is not yet completed, it would seem at this point that it will easily meet the standards suggested for the concluding phase of futures research. Special emphasis should be placed on the Auto Study's carefully structured time program for conducting and completing specific phases of the research exercise. From this point of view, the Auto Study is exemplary and could well be used as a model for similar futures research designs in the government.

C. UTILIZATION CRITERIA

It is not clear that TC has focussed with any perseverence on the interface between futures studies and their departmental planning efforts. What is clear is that a number of elements within their organization are performing futures studies quite well in their own respective areas, but the interrelationship between these and the ongoing examination of the overall transportation environment of the future is,at the very least,underdeveloped. Re-organization of the areas involved in or related to TC's futures efforts has not resulted in a more carefully-planned interface and integration of futures studies and departmental planning.

D. DEPARTMENT'S COMMENTS ON THE EVALUATION

1. The evaluation is generally very fair and almost too complimentary. It should be stressed that the evaluation was done during the summer of 1977, and progress has been made since then.

2. The evaluation highlights the strengths and merits of the current study on the Role of the Automobile.

3. It also stresses the current weaknesses within the Department that "TC has (not) focussed with any perseverence on the interface between futures studies and their departmental planning efforts (p. 73)", and that "...TC's futures efforts have not resulted in a more carefully planned interface and integration of futures studies and departmental planning (p. 73)".

4. These critical points are not new or unknown to planners in the Department; indeed, within the Strategic Planning Group in Transport Canada, those "weaknesses" are in a sense intentional. Our experience in futures research within the Department and elsewhere has shown that good futures research is most effective when it is:

   a. undertaken by a group close to the decision-makers;
   b. implemented in an incremental way over an extended period of time;
   c. carried out initially on one or two high potential and relevant policy areas; and

d. based on good results from (c), applied more generally to other policy and research activities as resources and success permit.

5. With that in mind (and following the completion of the TDA's futures paper referred to on p. 70 - a broad-based treatment to get decision-makers to think "futuristically" within the Department), it was decided late in 1976 and early 1977 to apply futures research to two major policy areas: (a) the Role of the Automobile Study referred to in this report (it will be completed in February 1978); and (b) the Southern Ontario Multimodal Passenger Study (a Study aimed largely, but not exclusively, at deciding whether or not Pickering Airport should be built; to be completed in April 1978). By limiting scarce resources and time to those two highly relevant policy issues, the planners in Transport Canada can show decision-makers that futures research is key to policy planning and can clarify, not obfuscate, policy options and choices. If successful in those two areas, it is the intention (as a matter of fact, that work is currently being initiated) to apply the results of that futures work to other policy areas and to incorporate, for example, the scenarios work of the Role of the Automobile Study, into a planning process aimed at producing a "national transportation framework". Work on that "framework" will be both the porcess and the document that will lead to "a more carefully planned interface and integration of futures studies and departmental planning (p. 73)".

6. In summary, therefore, the evaluation by MOSST of futures research activities in Transport Canada is generally very fair and accurate as of the summer of 1977. It misses the point, however, that "inadequacies" in futures research in the department are largely "planned", based on the view of the current regime of transport planners that it is better initially to concentrate on a few highly relevant topics than to scatter scarce resources and support for futures research over a wide front. It remains to be seen (late 1978 or early 1979) whether Transport Canada will be successful in moving from a couple of specific projects to integrating the results of that work to other planning areas in an integrated way.

IV GENERAL OBSERVATIONS REGARDING THE STATE OF FUTURES STUDIES IN THE FEDERAL GOVERNMENT

1. There are still many competing definitions for research conducted on the subject of the future, although the term futures studies is most widely used in the general field, as well as in the federal government (i.e. as opposed to futuristics, futurology, futuribles, etc.). Futures research is used with nearly as much currency, and interchangeably with futures studies (FS).

2. A large variety of methods and techniques are being used in the government. Reliability of each is a function of many factors. The particular subject-area to which they are applied, the technical skill with which they are employed, the accuracy and completeness of the data introduced are prime factors, but by no means exhaustive.

3. Methods of quantitative and qualitative analysis are both useful and necessary for FS. Each is of limited value when used on its own. In many instances not only are they mutually reinforcing when combined, but a synergistic effect can also be generated where complementarity is strong. Examples: Delphi technique and trend extrapolation; scenario construction and trend extrapolation.

4. FS is not discipline- or technique- bound. Both the multidisciplinary and interdisciplinary characteristics of the field are some of its most potent assets. The development of new techniques is virtually limitless, but the reliability of these varies considerably.

5. FS is applicable to many levels of analysis. Global, international, national, regional, and sub-regional (e.g. individuals) levels may all be examined productively.

6. FS is sufficiently adaptable to make both macro and micro analysis possible and useful. A good example of futures macro-analysis in the federal government is DND's "PROJECT 2000" which projects the overall international system into the future. At the other end of the spectrum, Transport Canada's "Future of the Auto" Study isolates one component (the auto) from a particular environment (the domestic, transportation environment). This latter kind of futures micro-analysis, of course, incorporates several features of the larger future world environment (such as world energy supplies) but these are the parameters and not the object of the analysis: Futures macro-analysis is subject to the same strictures as all high-level generalized investigations while futures micro-analysis presupposes precise, complete data, and its focus greatly limits its utility and demand.

7. Many functions have been suggested for FS in the federal government context.* These range from providing an early-warning function to decision makers of imminent problems and crises (a minimal function) to providing a framework for constructing all medium-to long-term planning (a maximal function).

8. While FS is not considered (as yet) an academic discipline, it is clear that a certain kind of expertise is relevant and necessary to the field. Additionally, the need exists for professionalism or professional guidelines so that the claims for the field, its concepts and techniques are not exaggerated.

9. The 10-25 year time-span appears to be the part of the future which can be focussed on most effectively by the federal government and which may be best suited to the government's interests and capacity for action. This time period is usually described as the medium-to long-term future (i.e. Medium: 5-10 years; Long: 10-25 years; Very Long: 25 + Years).

10. Specific techniques of FS, while highly useful and reliable when applied to given subject areas, are as equally unreliable very often in other areas. For example, gaming could be profitably used as one of several futures techniques in DND's work, since dyadic interaction is central to potential international conflict. The same technique would have very limited and questionable use in Transport Canada's DOC's futures efforts.

* See Pages (52 - 53)

11. FS should not be used in excess of its potential. The prediction of specific events and the projection of highly complex patterns of interaction between selected variables are examples of extremely difficult, unreliable exercises with questionable utility. Attempts at predicting the precise development of an economic crisis at a specific time in the future (i.e. a given year) is both unnecessary and unreliable. Intervening factors and events, which may result in an outcome radically different from that predicted, cannot be adequately accounted for in advance. Discounting them completely may render the forecasting exercise excessively unrealistic. It is sufficient to outline the general nature of such a potential crisis and the time span during which an economy may experience this event.

12. FS is both useful and necessary to departmental planning frameworks, and at the very least, to sensitize departmental planners to longer-range, comprehensive concerns.

13. FS in the federal government has been responsive to major policy issues affecting society. Indeed, FS has been largely responsible for clarifying and identifying candidates for social issues. The environment, and supply/demand distribution of natural resources are two cases in point.

14. Not every problem or program has a long-range character and analysis should only be made if there is a need. Such a need should be the result of a careful decision that the problem or program has implications for the future and that long-range analysis would be useful in addressing the problem area.

15. FS can and should be integrated into the decision/planning process at senior management levels without being in a highly jargonized, technical form. The value of FS can be retained in this manner; resistance to adapting even technical specialized FS in this way will undermine the credibility of FS as an important vehicle in long-range planning.

16. FS efforts in the federal government can be enhanced through interdepartmental consultation, with the Interdepartmental Committee on Futures Research (ICFR) acting as a principal vehicle for this activity.

17. The Secretariat for Futures Studies (SFS), is essential to keep the field moving in the federal government, especially where it both develops and catalyzes innovations in the field, and ensures the continuous exploitation of the potential for futures studies in the government.

18. Ongoing self-evaluation is a vital process to ensure that best directions and opportunities in FS are explored, particularly since government can assume the initiative for translation of FS into policy decisions and plans.

19. It is particularly important for the Futures Secretariat to be kept informed of developments in the futures field outside of government. The work of Canadian, other national, and international organizations involved in futures work is integral to the success of FS in particular policy areas of governmental concern. It is evident, this far, that there is no one source of FS expertise outside of the federal government which can provide reliable advice on FS to all of the futures groups in departments. This is due primarily to:

1) the scope of the work of a particular futures entity (i.e. university, private institute) is not sufficiently comprehensive to cover the information needs of the federal government futures groups as a whole and/or
2) the perceived reliability of the product or service of the futures organization is sufficiently unclear or questionable to deter excessive reliance on this work and to encourage recourse to alternative futures information and research from outside the government.

APPENDIX I

WORLD MODELS:

A BRIEF SUMMARY AND COMPARISON

1. INTRODUCTION

The presentation, in 1972, under the auspices of the Club of Rome, of the Meadows' Limits to Growth model was a major event. Whatever may be thought of the model's structure and consequences, this research has created enormous interest in prospective analysis at the world level. Since then, a continuous flow of world models has appeared, emphasising different aspects of the world problematique.

But the interest of world models goes beyond this impact on public opinion, because they are a conscious and serious attempt to represent, at world level, essential relations between economic and social variables, and to detect, beyond the scenarios, the policy issues with which the decision makers are confronted.

2. DESCRIPTION

Nine models are reviewed in this chapter. They are:

1. "The Future of the World Economy", United Nations, 1976. "A Study of the Impact of Prospective Economic Issues and Policies on the International Development Strategy".
   This report and the model behind it were prepared by a research team led by Anne P. Carter, Wasilly Leontief, and Peter Petri. The stated purpose of this team was to investigate the links among economic growth, resource availability, and pollution and

abatement issues. The basis of this model is an input-output representation of the world economy. For the remainder of this chapter, the model will be referred to as the "UN-10" model.

2. The "Strategy for Survival" model of Mesarovic and Pestel.

   This is a large scale model of the world developed under the auspices of the Club of Rome by Mihajlo Mesarovic of Case Western University in the United States and Eduard Pestel of the Technical University of Hanover, West Germany. The theoretical basis for this global multi-sector model is "Multilevel Hierarchial Systems Theory" developed by M. Mesarovic. We will refer to this as the "M-P" model.

3. The "Latin American Model"*of Foundation Bariloche.

   This model was developed at the Fundacion Bariloche in Buenos Aires, Argentina, under the direction of Amilcar O. Herrera and was financed by a grant from the International Development Research Centre, Ottawa, Canada. Of all the global models reviewed here, this is the only one with a normative outlook. Sophisticated community welfare maximisation is the basis for the computer model.

4. The "SARU World Model" of the Department of the Environment in the United Kingdom.

   This model is presently being developed by the Systems

* Discussed on Page 31.

Analysis Research Unit of the Department of the Environment in the United Kingdom. It is, at present, a highly aggregated model in terms of regional representation and categories of manufacturing. Primary emphasis is given to agriculture.

5. The "SIMLINK model" of the World Bank.
   This is the only model reviewed in this survey which is concerned solely with the evolution of the less developed countries. The purpose of this exercise was to analyse the prospects for growth and development of LDCs under alternative assumptions about growth and inflation in the developed world.
6. The "MOIRA" model of Professor Linneman at the Free University of Amsterdam.
   This model deals with international relations in agriculture and was designed to explain the development of food production and consumption in relation to population growth, non-agricultural economic development, and the prices of inputs to agricultural production.
7. The "Project LINK" led by Dr. Lawrence Klein at the University of Pennsylvania.
   The LINK project is an attempt to combine national short-term macroeconomic models in a consistent way through trade flows.

8. The "Limits to Growth" model.

   This is the original world model sponsored by the Club of Rome. It is a highly aggregated long range model of difference equations describing the evolution of many key indicators. Dennis and Donella Meadows, currently at Dartmouth College in the United States, are the leaders of the team.

9. The "MOISE" model.

   This model was developed at GEPI (Groupe d'Etudes Prospectives Internationales) in France to study the major linkages between nations of the industrial West.

3. GENERAL OBSERVATIONS

- No single model of the 9 is clearly superior to all of the others.
- The value of a given world model is a function of its coincidence with the user's perception of the world economy, its concentration on the sectors of interest to the user, and its analytic capacity to thoroughly simulate the operation of the sectors selected.
- The 9 models were all conceived and constructed to meet different objectives.
- The value of each of the world models must be assessed in terms of the objectives of each model and the relative merits of the models depend critically upon the type of investigation to be carried out.

4. COMPARATIVE STRUCTURE

- Most of the models are constructed around a central core of the macro economic sector. The single exception is the Limits to Growth model.
- The models differ widely in the representation of industrial structure. Some have no representation of production of separate manufacturing and service goods (Bariloche, SIMLINK, MOIRA, Limits to Growth). Some break down gross production but do not use the disaggregated production levels any further (M-P model, LINK). A third group describe individual industry value and determine gross production as their sum (UN, SARU, MOISE).
- Several of the models treat food production and consumption with special emphasis (MOIRA - detailed treatment of total food demand; SARU - complete representation of agricultural activity, with specification of behavioural relationships between investment, land improvement, and consumption).
- The models are very different in the isolation and degree of specificity of energy and mineral resources. None of them are entirely satisfactory for comprehensively representing this sector. Only five of the models separately model production and consumption of energy and mineral resources. Even the most energy-

detailed model, the UN one, deals with only three primary sources (oil, coal, gas). Complete implications for global energy consumption then cannot be calculated even from the UN model.

- Only three models attempt to treat population as endogenous (M-P, Bariloche, Limits to Growth). None are very sophisticated and the population variable/ sub-model is highly sensitive to exogenously-specified values for pollution, quality of life (Limits to Growth) or to changes in sub-models outputs -- food (M-P, Bariloche) and health services, education and housing (Bariloche).
- It is very difficult to systematically incorporate environment in a world model. Only the UN and Limits to Growth models have pollution and pollution-abatement sectors.
- The representation of trade is a key aspect of world models. There is a huge distance between Limits to Growth and Bariloche, at one extreme, and SIMLINK and LINK at the other, in terms of their capacity to explain trade flows between regions, balances of payments and external debt. Two models actually exclude trade; the Limits to Growth model depicts the world as a single monolithic system, thus precluding sub-systematic interaction between the four sub-systems constructed for the world as such interaction would contradict its global strategy for optimizing basic human needs.

On the other hand, the SIMLINK model, designed to study the effects of developed country import demands on developing country growth, structures trade activity by commodity and by country. With similar detail the LINK model specifies a sophisticated trade linkage between the component national macro models of developed countries and estimates bilateral trade flows in terms of relative prices, trade barriers and national demand.

5. COMPARATIVE RESULTS

- The outputs (projections) of five of the world models -- Bariloche, UN, M-P, Limits to Growth, and SARU are compared to illustrate major points of convergence and divergence between them. These 5 models were selected as they were considered to be the most general in terms of the range of variables projected.
- Projections for only four broad indicators are shown for each model -- population; gross regional product and GNP; food supply; and energy supply.
- The year 2000 is used as the standard base year for comparison of the projections.
- The review presents results, where possible, for four general regions -- Western industrialized regions, Latin America, Asia, and Africa.

- Regarding population, from 1970 to 2000 the difference between the maximum projection (UN -- 6.399×10^9 persons) and the minimum projection (M-P -- 5.835×10^9 persons) is only 10%. Immediately beyond 2000, the projections diverge strongly, with the Bariloche model projecting a constant growth rate while the M-P and Limits to Growth models project a rapid decline in the population growth rate.
- Regarding gross regional product and GNP, the basic assumption for all the models that regulates the growth in production is the rate of technical change. All three of the M-P, UN, and Bariloche models are relatively pessimistic about Asia and Africa. Projections for the world vary from $10.699 \times 10^{12}$$ (1972 US dollars) in the Bariloche model through $10.945 \times 10^{12}$$ in the M-P model, and $11.732 \times 10^{12}$$ in the SARU model to $14.518 \times 10^{12}$$ in the UN model. The models' projections as to the percentage of production that will be located in the "Third World" by the year 2000 vary from 19% in the M-P model to 30% in the UN model.
- Regarding food, the Bariloche, SARU, and Limits to Growth models derive very optimistic results for world food production in the year 2000. The M-P results are very pessimistic with respect to food, particularly in the case of Asia and Africa. All of the models project

serious food shortages for Asia shorthly after 2000, with less severe shortages for Africa. Primary determinants of the food situation are population projections, exogenous crop yields, and the availability of cultivable land.

Regarding energy, the energy projections are difficult to compare and depend on the envisioned technological possibilities. The projections range from the extreme pessimism of the Limits to Growth model which projects serious shortfalls in energy resources to the opposite optimism of the M-P model which projects a tremendous expansion of the nuclear industry, especially in the West, by 2000.

SUMMARY OF CHARACTERISTICS OF WORLD MODELS

ACTIVITY / MODEL	MACRO + GROWTH	STRUCTURE OF OUTPUT	AGRICULTURE	ENVIRONMENT AND POLLUTION
UN-10	Planning model no investment behavior	Very detailed 1-0 system 48 sectors	Some detail	Detailed pollution + pollution abatement
M-P	Simple one sector growth model	1 sector	Very simple	Small stand alone
BARILOCHE	Optimal growth	5 sectors	Very simple	None
SARU	Detailed neoclassical investment behavior	9 sectors	Very detailed production + demand curves	None
SIMLINK	Simple LDC exported growth models	2 sectors	Good detail of LDC agriculture exports	None
MOIRA	None	None	Great detail of food demand	None
LINK	Detailed short-run demand determined	Varies with country generally aggressive	None	None
LIMITS TO GROWTH	Only general indicators	None	Simple but with land use and quality indicators	Pollution + quality of life sector with feedbacks
MOISE	Very detailed for West Europe + North America	12 sectors	2 sectors very aggregated	None

ACTIVITY / MODEL	ENERGY AND MINERAL RESOURCES	POPULATION	TRADE
UN-10	Very detailed mineral sectors + energy requirements	Exogenous UN estimates	Detailed non-market trade flows
M-P	5 energy products 2 consumption categories no mineral sectors	Endogenous hypothetical relationships	Very simple
BARILOCHE	None	Similar to M-P	Excluded by assumption
SARU	1 energy 1 mineral sector	Exogenous UN estimates	Complex market-oriented bilateral flows
SIMLINK	Several mineral commodity markets	None	Detailed LDC and OECD trade
MOIRA	None	Exogenous UN estimates	Simple food trade determination
LINK	None	None	Very complex market-oriented capital market and trade bilateral flows
LIMITS TO GROWTH	Reserve and usage indicators for energy + minerals	Endogenous highly aggregated	None
MOISE	1-0 framework 1 energy and 1 mineral sector	None	Detailed accounting + price framework

APPENDIX II

LONG TERM ECONOMIC MODELS FOR CANADA

A. CANDIDE - CANADIAN DISAGGREGATED INTERDEPARTMENTAL ECONOMETRIC MODEL ECONOMIC COUNCIL OF CANADA

LONG-RANGE SIMULATIONS WITH CANDIDE

1. ITS DEVELOPMENT

This effort of the Council consists of several simulations performed with the CANDIDE Model to the year 2000. A number of problems of current interest such as energy investment, foreign trade and demographic trends require a longer time horizon than had previously been used in work with CANDIDE. The model's (CANDIDE) consistent macroeconomic framework has been judged by the Council to be a useful tool to explore these problems on a longer-term basis.

The purpose of this work was to make the Economic Council of Canada aware of the problems that would arise in using CANDIDE as a tool in long-run analysis. More specifically, it was not the Council's intention to undertake a systematic study of a particular problem but to investigate the feasibility of doing so. This was done by developing a reference solution and examining a few alternatives to it that would occur in studies concerned with demography, energy and the public sector.

2. A BRIEF OVERVIEW

The study of long-run economic problems is greatly assisted if production, incomes and expenditures are analyzed

within a consistent and simultaneous framework. Although a partial analysis may capture the direct effects of a sequence of policy decisions upon the various sectors of the economy, they miss important interactions between them. Furthermore, partial studies seldom consider such basic constraints upon economic performance as, for example, the balance of payments.

Because of the great interest in problems of this type, the Council decided to extend CANDIDE's exogenous data set to the year 2000 so as to enable the simulation of the Canadian economy over this period. The simulations were designed to find out if a systematic study of long-run issues was possible with CANDIDE.

A reference solution which satisfied specific criteria was developed and then alternative simulations were made by simply substituting alternative scenarios into the reference exogenous data set. The requirements for the reference solution were the following: both current account and government balances should not exceed $\pm$ 2 per cent of nominal GNPC; the unemployment rate should be, on average, 6.0 $\pm$ .5 percent; the difference between the long-term interest rate and the rate of inflation should not exceed the historical average and the vacancy rate should be, on average, 4 per cent. Certain exogenous variables, constant adjustments and, in a few cases, parameter values, were used to produce a reference solution which satisfied these few criteria. The alternative simulations are pure variations about the reference solution.

Several exogenous data sets concerning particular areas of economic activity are first developed. From the set of Statistics Canada population projections, two demographic scenarios were chosen that exhibit medium and slow rates of population growth. Although both resulting populations are, by historical standards, "middle-aged", the high population scenario is the larger and younger of the set.

Two foreign scenarios were developed. In the first scenario export volume whose rate of growth is moderate compared to the dramatic growth in the 1960s, is combined with foreign inflation which, while termed low, is higher than that incurred in the sample period. This commodity price scenario embodies a price "boomlet" in the later 1970s. In the second scenario, foreign prices of a higher overall rate of growth are paired with lower export volume.

Similarly, two energy scenarios were developed. Inputs from the moderate price energy scenario reflect assumptions of a rate of inflation in crude oil similar to the anticipated world rate of inflation. The investment requirements, with emphasis on nuclear development, are massive by historical standards. The higher price energy scenario is based on assumptions of more concentrated development of fossil fuels with lower overall investment expenditures.

The projection of government exogenous variables generally maintains a continuation of the present policies. This strategy produces simulations that may be used for alternative government scenarios at a later date.

From the several possible combinations available, four simulations were run, and then two further "adjusted" solutions were devised. A simulation combining the low demographic scenario with a strong foreign environment, lower commodity prices and the moderate energy scenario has been used as the reference solution.

A brief overview of the behaviour of some of the major indicators of economic activity to the year 2000 is highlighted by graphic comparisons with the historical experience since 1926. A detailed discussion of the major sectors of the economy is provided, concentrating on the reference solution. This section includes discussion of areas such as labour supply, investment, foreign trade, wages and prices, productivity and labour demand, and the personal and government sectors.

A comparison of three of the simulations follows, attempting to identify the dominant factors that influenced the particular outcomes. The high demographic solution is discussed with reference to low demographic: the larger population assumption results in increased unemployment. In the second comparison, the implications of assuming a lower volume of foreign trade, combined with higher commodity and energy prices, are analyzed. A terms of trade advantage somewhat softens the impact of reduced foreign demand and domestic spending.

One of the major conclusions of this work is that the use of CANDIDE in longer-term studies is viable, within certain limitations.

3. THE STRUCTURE: Exogenous Scenarios

For the demographic sector, two Statistics Canada projections are used, denoted H and L. They may be distinguished by the differences in two characteristics: average family size, 2.4 in H and 1.8 in L; annual rate of net immigration, 100,000 in H and 60,000 in L. The H population is the larger and the younger of the two: by 2000, its population is 31.8 million as compared to 28.2 million in L. However, it is not until the late 1980s, when the higher birth rate in H leads to more rapid increases in the proportion of the population that is of working age, that the Council expects, on a per capita basis, higher potential output growth in H.

The international price of crude oil is the key variable in the development of the two energy scenarios, HP and MP. In MP, it increases at an annual rate of 4.5 per cent, while in HP, it increases by 5 per cent per annum until 1985 and then decreases to 4.5 per cent. The domestic wellhead price achieves equality with the foreign price by 1978 in HP, and by 1981 in MP. In addition, both the domestic and the export price of natural gas is determined by the price of crude oil.

The prices for fossil fuels influence the growth of energy demand and, as a consequence, determine the rates of investment in electric utilities, pipelines and tar sand plants. The lower prices in MP restrict the development of

frontier sources of fossil fuels with the result that, after 1985, energy demand must be met by a substantial increase in the number of hydro electric and nuclear power plants. In contrast, the higher price in HP is associated with lower energy consumption, greater development of fossil fuel sources and a lower volume of energy-related investment in the 1990s.

Pipeline and tar sand investment is concentrated in the 1980-85 period. There is, in both scenarios, a bunching of pipeline completions in the 1986-88 period.

In CANDIDE, 85 per cent of the volume of exports of goods and services are determined by the importing regions' level of output and the foreign to domestic price relative. As Canada is assumed to be a price taker in most international markets, the projection of foreign prices includes both export and import prices. Two foreign scenarios have been constructed: the S scenario combines "high" export volumes with the "low" foreign prices; and the W scenario which pairs low export volumes whth high foreign prices.

The average rate of foreign inflation over the simulation period is 4.8 per cent per annum in S and 4.0 per cent in W. Excluding 1973-75, these inflation rates are almost double the post Korean War experience. Commodity cartel formation is assumed to continue to be an important feature of the simulation period. Information from various published sources has been used to arrive at foreign activity levels. For example, US GNP growth rates were derived from projections

made by the Wharton Econometric Forecasting Unit at the University of Pennsylvania. In general, GNP growth rates are projected for the industrialized countries that are lower than those obtained in the 1960s; this is due to higher energy prices and lower rates of population growth. By 2000, exports have increased their share of GNP from 24 per cent in 1975 to 33.5 per cent in the S scenario and 30 per cent in W scenario.

In the government sector, exogenous tax rates and contribution and benefit rates were projected in accordance with current legislation. Real exogenous expenditures in this and the "other" sector were increased by 3 per cent per annum. Nominal items in both sectors were increased at 7 per cent per annum. The exchange rate was fixed at 1.02 $ Canadian per US dollar.

The number of possible combinations of these exogenous variables was reduced to four when each energy scenario was combined with a different foreign scenario: HP was combined with W, and MP with S.

The reference solution uses the lower population scenario, L, the higher volume, lower price foreign scenario, S, and the medium price energy scenario, MP.

4. THE RESULTS: Reference Solution

The relevant features of the reference solution are noted before proceeding to a description of the alternative

during the 1960s. Furthermore, during the simulation period, growth is slower in this sector than it is in the primary and secondary sectors of the economy. Thus the share in output held by the service sector declines over the simulation period. Increases in labour productivity occur primarily in the primary and secondary sectors: these averaged, during the 1990s, 4.1 and 2.7 per cent per annum, respectively. In contrast, productivity increased by only 1 per cent per annum in the tertiary sector. Given the result for productivity increase (1.9 per cent per annum), real GNP in the reference solution is growing at the capacity rate of approximately 3 per cent per annum.

Productivity increases in the primary and secondary industrial sector are such that there is relatively little increase in the demand for labour from these two sectors over the simulation period. Most of the employment increase stems from the service sector. The sudden rise in unemployment of 1.4 points in 1986 is due to the completion of pipeline construction.

It is interesting to observe that the rate of inflation in domestic prices tends to converge to the rate of foreign inflation. In the 1990s the CPI increases at 4.7 per cent per annum which corresponds to the 4.3 per cent rate of foreign inflation for this period.

The exchange rate is assumed to be fixed throughout the simulation period. The balance of payments in the reference solution, although negative throughout the period, stays within

solutions. The reference solution is composed of three parts: 1977-85, a period of rapid expansion in the energy sector; 1986-88, a transition period when pipeline construction is finished; and 1989-2000, a period with reduced population growth and capacity growth in real output. The growth rate in real GNE is 4.2 per cent per annum in the first period and 3 per cent per annum during the 1990s. Both these rates are lower than the 5.2 per cent growth employed during the 1960s; this is a consequence of slower growth in the labour force.

Labour force growth is attributed to increases in the aggregate participation rate and the source population. In the 1990s the 1.08 per cent increase in the labour force is due to a .13 per cent change in the participation and .95 increase in the source population. The average participation rate, for all workers, increases from .59 in 1975 to .615 in 2000. Thus although the participation rate is an important contributor to labour force it is far from being dominant.

The growth in potential output is decomposed into the growth of the labour force and increases in productivity. Increases in productivity (GNE/Employment) averaged 2.64 per cent per annum during 1976-85 and 1.90 over the 1986-2000 period. The latter rate is close to the 1955-75 average. The distribution of final demand determines industrial output shares which, in turn, affect aggregate productivity. In these solutions, the composition of final demand is such that output growth in the service sector is slower than it was

-"The Electronic Briefcase: Text Processing and the Office of the Future". Four types of text processing equipment are considered in relation to four typical applications - a large newspaper, multinational corporation, a small law firm, and a one-man consulting practice.

-"Nodule Shock: Impacts of Seabed Mining on Canadian Nickel Mining". This study assesses the potential impacts to the Canadian nickel industry resulting from the deep seabed mining of polymetallic nodules. As early as 1982, Canada's dominance as a nickel exporter may be further eroded by this new source in the world market. Stemming from international political decisions, the interplay among timing, volume and demand will determine the level of impact resulting from seabed mining.

The second project -- the study of "Social Impacts of Alternative Energy Sources in Canada" focusses on the energy situation Canada will face during the period from the present until the year 2000 and the period from the turn of the century until 2025. The objective of the work is to determine how lifestyles, social trends, political and economic variables and the environment will be affected by energy supply changes. Basically, the study examines the supplies of alternative fuels presently available to the Canadian market and then develops realistic projections of the potential fuel

the criterion set for it (± 2 per cent of nominal GNP). This solution represents an economy which becomes more open to international trade. The share of exports in real GNP rises from 24 per cent in 1975 to 33 per cent in 2000 while imports increase their share from 30 per cent to 34 per cent. There is a substantial increase in the share of industrial materials in exports in the 1990s, and this, together with the energy-related investment, biases output growth towards the primary and secondary industrial sectors. Although the balance of payments is negative throughout the simulation period the Council points out that this has been the post war experience as well.

Although energy-related investments are substantial, the share of total real private investment in real GNP does not exceed levels attained in the past. The average share of nominal investment in nominal GNP is equal to the historical average. These solutions appear to say that the energy investment does not burden the economy. The Council declines to say if room has been made for these investments by the process of substitution since they have not made a systematic study of this problem. Residential construction is down in the reference solution; this is consistent with the low population growth scenario.

The share of personal income that is provided by wages rises from .69 in 1970 to .77 in 2000. This increase is at the expense of unincorporated income, the share of

transfer income being almost constant at .13. What is surprising is that personal taxes and contributions increase their share of the disposition of personal income from 19 per cent in 1975 to 32 per cent in 2000. This means that disposable income declines as a proportion to GNP. The average savings rate declines from 10 per cent of disposable income in 1975 to 8 per cent in 2000. A relatively constant average personal savings rate, together with an increasing average personal tax rate, means that consumption declines in both real and nominal terms with respect to GNP.

Although government expenditures are approximately 15 per cent of real GNP, there is a conservative increase in government's share of revenue and expenditure in nominal GNP. The rising average personal income tax rate provides the major source of income. Direct taxes bring in 41 per cent of total government revenue in 1975 and 58 per cent in 2000. Indirect taxes fall in importance from 36 per cent in 1975 to 20 per cent in 2000. The government balance is within the $\pm$ 2 per cent of nominal GNP criterion, but is negative from 1986 onward.

5. THE RESULTS: Alternative Solutions

An examination of some of the alternative simulations reveals some important properties of the exogenous assumptions and the reference solution. Increasing the rate of growth of the population produces an economy that has higher

unemployment and lower per capita income. Export volume and foreign prices are fixed in this experiment so that, if per capita income is to be maintained, domestic production must increase and imports decrease. In this solution, the increasing labour force produces a rise in unemployment which causes wages to fall by more than prices. Because of the fixed foreign price assumption, domestic prices are sticky and this leads to a reduction in the real wage which outweighs the employment increases due to import substitution and population-related increases in demand. Thus, relative to the reference solution, incomes do not increase and consumer expenditure stagnates. The Council points out that if the higher population scenario had been used in the reference solution, of course, different results would have occurred. These results have caused the Council to re-examine its approach to the study of demographic problems with CANDIDE.

Substitution of the alternative foreign trade and energy scenarios into the reference exogenous data produces a solution with interesting properties. In comparison to the reference solution, consumer expenditure is higher until the very end of the solution period: this is despite lower autonomous foreign demand. This behaviour is attributed to the higher commodity prices and improved terms of trade in comparison to the reference solution.

6. THE RESULTS: Summary

In summary, the reference solution portrays an economy which, in the 1990s, grows at the potential rate and becomes progressively more open to international trade. Despite a decline in the share taken by consumption, total demand is maintained at potential levels by increases in exports and, to a certain extent, in investment. This means that domestic output is more oriented toward the highly productive primary and secondary industrial sectors than has been the recent experience. The average rate of increase in productivity is about equal to the historical average. The economic picture so portrayed would be significantly changed if there should be, as a result of further study, changes to the Council's formulation of personal direct taxation, foreign prices, foreign demand, immigration or investment.

B. CEM - CANADIAN EXPLOR MODEL INDUSTRY, TRADE AND COMMERCE

1. ITS DEVELOPMENT

The first version of the Canadian Explor Model was developed between 1975 and early 1976 within the International Trade Analysis Division (ITA) of the Department of Industry, Trade and Commerce. The CEM project was initiated by Industry, Trade and Commerce based on the results of the Department's sponsorship of Phase 1 of the Battelle Institute's Explor Multi-trade 85 Project.

That sponsorship brought to the Department a generalized model applied to ten countries which then became the base for the CEM project. Since that time, in co-operation with the Structural Analysis Division of Statistics Canada, a new data base was developed for the CEM with a base forecast of technological co-efficients every five years to 2000; new blocks of methodology were developed within ITA or applied from the Statistics Canada Long Term Simulation Model; and the whole CEM was re-estimated.

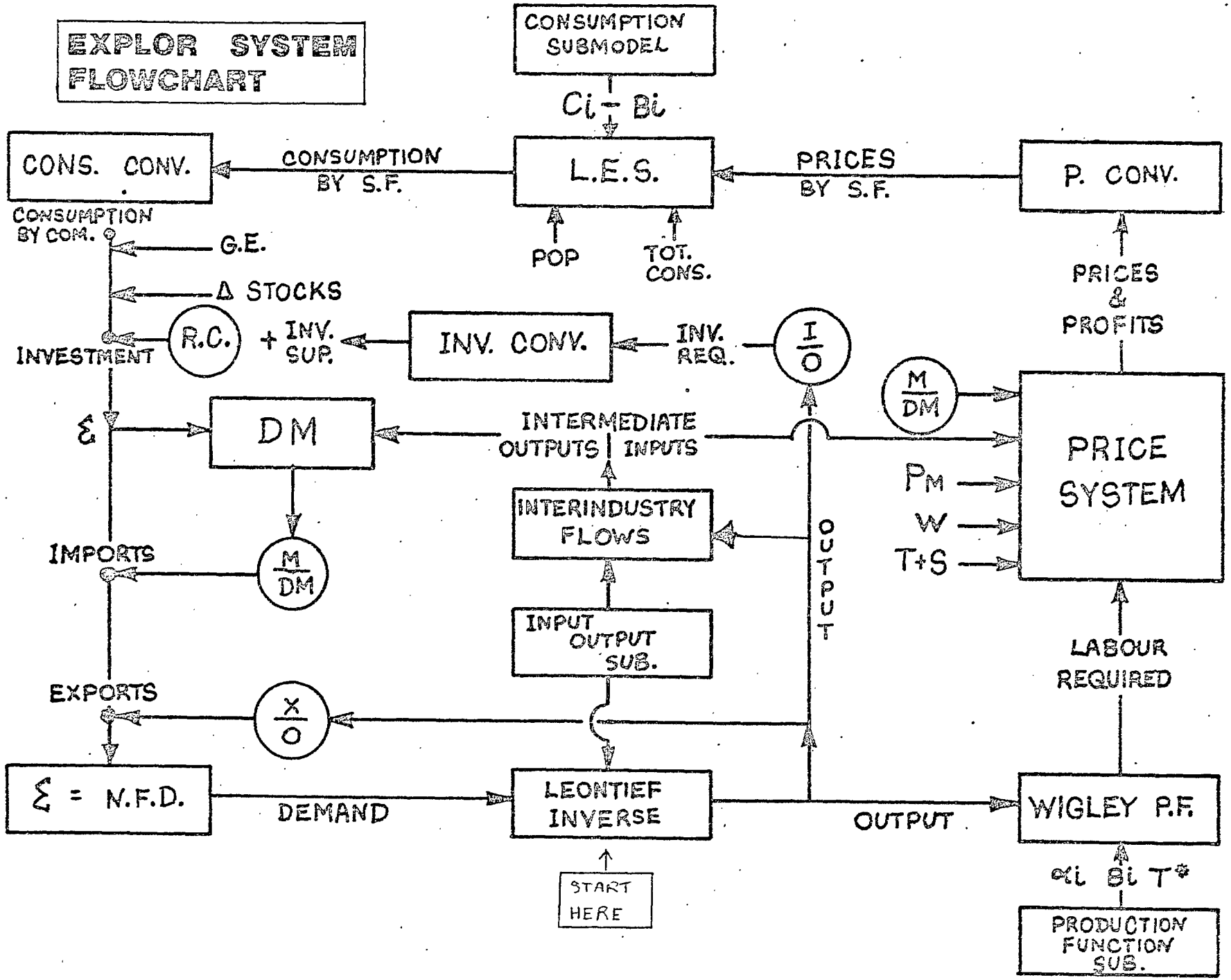
Following the initial macro economic testing of the model in the spring of 1977 various improvements in data, methodology and the simulation capabilities of the model were incorporated while the first set of trend technological forecasts to 2000 were adjusted and validated in co-operation with the Industry Sector Branches of I.T.&C. This has resulted in the present version of the model (CEM 1) maintained within the Macro Economic Structural Analysis Division of Industry, Trade and Commerce.

2. ITS GENESIS : THE BASIC EXPLOR MODEL

The basic Explor Model is the result of a research program started in 1962 at the Battelle Research Centre in Geneva. Its development and application have been managed by a project team under G. McNeil and more recently A. Gabus of Battelle Geneva, with contributions most notably from R. Stone and K.J. Wigley of Cambridge University.

In previous research phases, the Explor system was applied exclusively to European countries under primarily corporate sponsorship, which coupled with the influence of the Cambridge "Program for Growth", to a great extent explains the model's flavour and data requirements. In prior phases, the model has been concerned with estimating sets of equilibrium values required to clear the national markets given a set of exogenous final demands. Factor input requirements were then calculated for the equilibrium solution.

The system presented on the accompanying flowchart is that of Phase 1 of the Explor 85 Multitrade Research Program. This program to date has extended the Explor methodology, brought the Battelle Northwest Laboratories in the U.S. into the program jointly with Battelle Geneva, and extended the sponsorship and model application to the U.S., Canada and Japan, from its European base. The European application of the model covers Spain, France, Germany, Italy, Belgium-Luxembourg, United Kingdom and the Netherlands.


EXPLOR SYSTEM FLOWCHART
CONSUMPTION SUBMODEL
Ci — Bi
CONS. CONV.
CONSUMPTION BY S.F.
L.E.S.
PRICES BY S.F.
P. CONV.
CONSUMPTION BY COM.
G.E.
Δ STOCKS
POP
TOT. CONS.
PRICES & PROFITS
INVESTMENT
R.C.
+ INV. SUP.
INV. CONV.
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Σ
DM
INTERMEDIATE OUTPUTS | INPUTS
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INTERINDUSTRY FLOWS
OUTPUT
IMPORTS
M/DM
INPUT OUTPUT SUB.
LABOUR REQUIRED
EXPORTS
X/O
Σ = N.F.D.
DEMAND
LEONTIEF INVERSE
OUTPUT
WIGLEY P.F.
START HERE
αi βi T*
PRODUCTION FUNCTION SUB.

The Battelle Institute is a non-profit research organization and the results of its research are confidential for two years from completion. Thus, the Explor Phase 1 research results are only now becoming publicly available with sponsors adaptations as with the Canadian Explor Model.

An overview of the differences between the basic Explor model and CEM 1 is provided as follows. Apart from the development of a new data base and re-estimation and industrial validation of the input-output projections the main points of difference between the Batelle Explor Model (BEM) and CEM are as follows:

1) The price system of the BEM was a minimization system. Given price and profit targets, it solved for both given all parameters (other than productivity) exogenously. The CEM employs a standard cost push model with a number of inputs now endogenous.

2) The BEM had no forecast of labour supply, while government expenditures, residential construction and population were exogenous. CEM includes labour supply forecasts, a demographic determination of government expenditures, residential construction and some specific consumption elements. This was accomplished through an adaptation of the demographic block of the Statistics Canada Long Term Simulation Model (LTSM).

3) The trade block of the BEM consisted of trend estimates of future import shares of the domestic market (M/DM) and export shares of production (X/TO). CEM has estimated behavioural equations for both exports and imports which include both foreign and domestic activity variables.

4) The simulation properties of the model have been improved through program options allowing for the specification of institutional pricing, resource constraints, tariff and exchange rate adjustments, major industrial project investments, and endogenous income effects on consumption.

The "Explor System Flowchart" can then be compared with the CEM flowchart attached as Page 8 to this appendix.

3. ITS STRUCTURE

The choice of the Explor system as a base as well as choices among specific potential pieces of development were governed by the need to fill the gap between the detailed historical input-output models and the advanced state of econometric forecasting models. The latter while dynamic also have the properties of complexity and lack of consistent disaggregation of variables, resulting in a weak analysis of inter-industry flows and highly aggregated trade sectors.

This gap in existing Canadian models suggested the requirement for an "Economic Input-Output Model" which would allow for an integration of econometric and input-output techniques as well as the use of specific technological information as it became available. The use of input-output information in econometric modelling will receive an added impetus when the annual input-output tables from 1961 to 1971 are published for Canada, especially if this is followed by the development of annual input-output data by Statistics Canada.

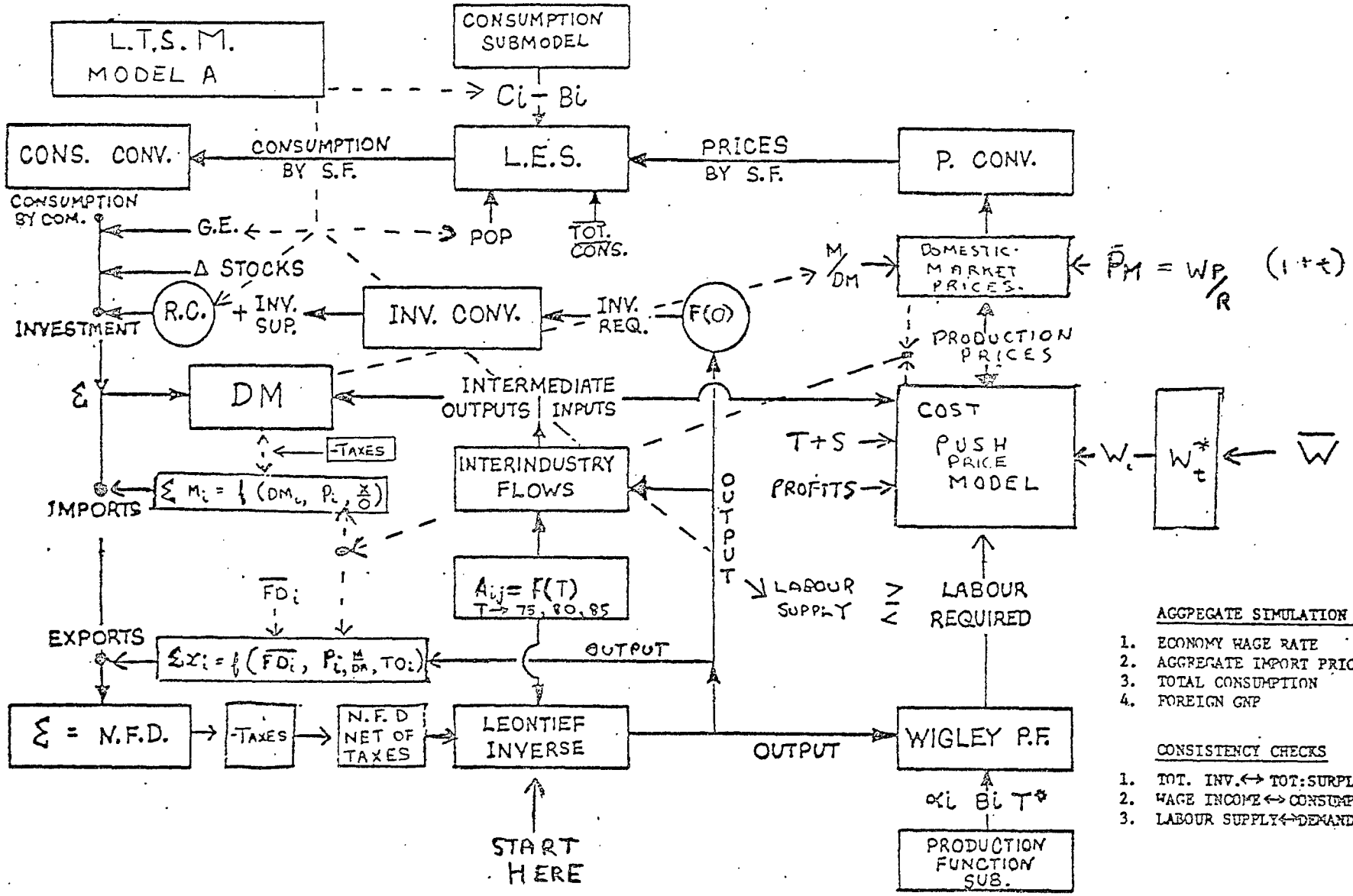
The CEM is essentially a comparative static model without the income and savings flows, policy variables and cyclical dynamics of econometric forecasting models, and is, therefore, viewed as a structural and trade simulator with "target year" solutions available in five year leaps from 1970. To operate CEM requires a scenario constructed exogenously as portrayed by the necessary demographic parameters, total consumption, total economy wage rate, foreign demand and foreign price variables.[1] Thus a consistent scenario as described above would be available to the user based on trend analysis of the output of forecasting models.

The model has as its core a 68 x 68 input-output matrix for Canada, updated to 1970 using the R.A.S. procedure, and forecasted for every five years to 2000 from there. Consumption,

1) See aggregate simulation parameters CEM flowchart.

government expenditure and investment converters have been used from the Canadian Input-Output system and these presently are fixed as 1966 co-efficients adjusted as sectoral information becomes available.

The model, given start up output values, solves iteratively for productivity, employment, domestic prices and value added, distributes total consumption, determines exports, imports and investment, adds up final demand, converts it from a consumer to producer's valuation and uses the Leontief inverse to determine equilibrium output. A simulation option is available whereby changes in employment and prices, generates alternate levels of real wage income which applied to a base relationship between real consumption and wage income generates changes in total consumption.



AGGREGATE SIMULATION PARAMETERS

1. ECONOMY WAGE RATE $\bar{W}$
2. AGGREGATE IMPORT PRICES $\bar{P}_M$
3. TOTAL CONSUMPTION $\overline{TOT_{CONS}}$
4. FOREIGN GNP $\overline{FD_i}$

CONSISTENCY CHECKS

1. TOT. INV. ↔ TOT: SURPLUS
2. WAGE INCOME ↔ CONSUMPTION
3. LABOUR SUPPLY ↔ DEMAND

C. LTSM - LONG TERM SIMULATION MODEL STATISTICS CANADA

1. ITS DEVELOPMENT

The LTSM is the first time-structured model to be developed by the Structural Analysis Division of Statistics Canada. Draft documents describing the first version of the LTSM were circulated in February 1977 to potential users in government.

The designers of the LTSM attempted to make the model operational in as short a time as possible using "existing materials". Supporting material for the LTSM stresses that model development is a continuing process. Considerable effort is now being placed on strengthening the model in several areas and on extending its capabilities. Concentration is on the development of an energy supply submodel and on improving the representation of energy demand.

The LTSM was designed and developed with the intention of complementing it with a short-term policy simulation model. The Division deliberately omitted certain features from the long-term model as it was judged that a short-term model would be better equipped to handle them. The complementarity between these two kinds of models is briefly explored in a following section on the use of the LTSM.

2. ITS NATURE

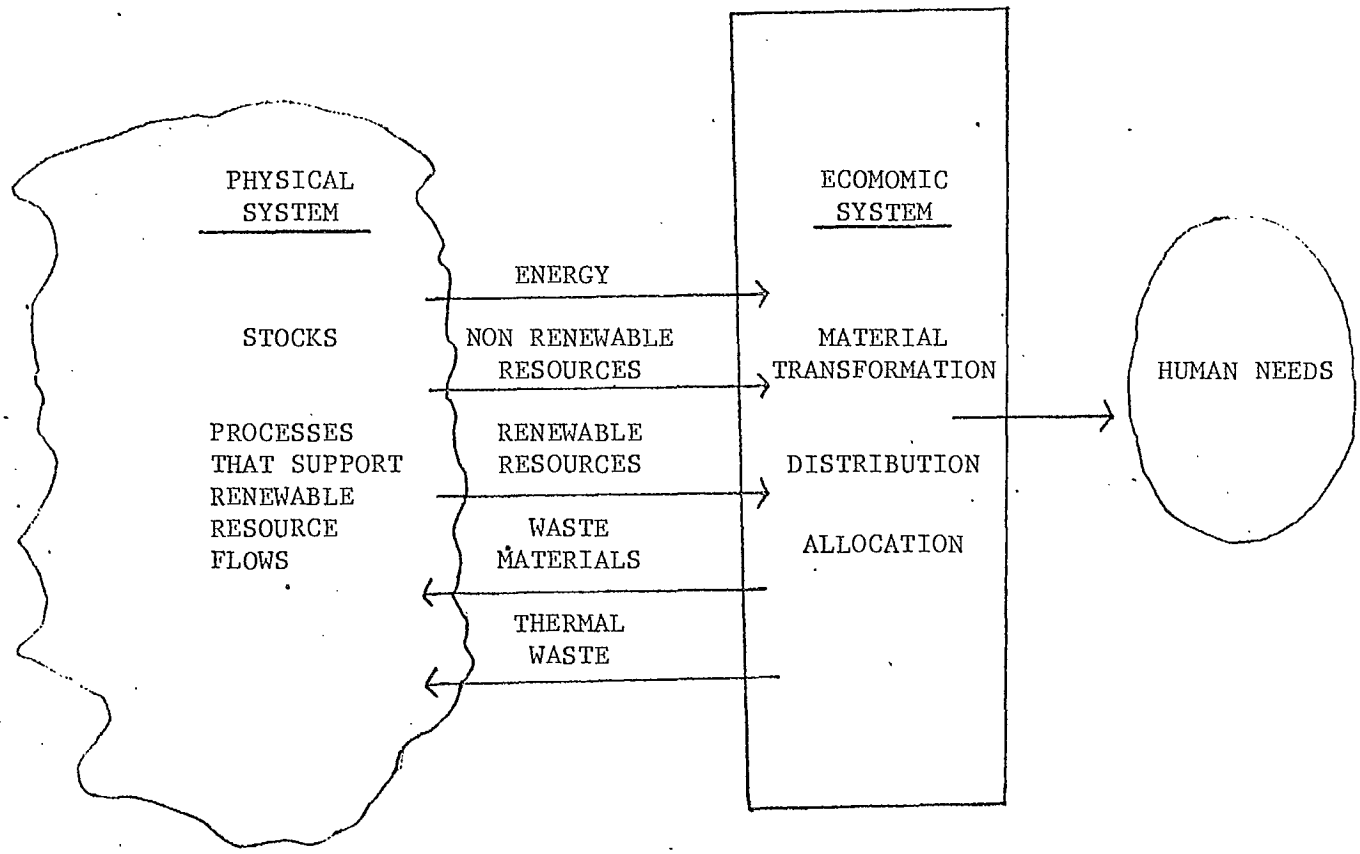
The Long Term Model is a strategic simulation model of the Canadian economy. It is intended to be a computational framework within which alternative scenarios or forecasts can be

examined from the point of view of resource availability, technological feasibility, and internal consistency. The appropriate time horizon for such strategic analyses is roughly fifty years. Thus the model is long term in the sense that its results are expected to be viable to the year 2025.

The conceptual assumptions of the LTSM can be summarized as follows. The Long Term Simulation Model is intended to represent the economic system or what is often called the economy. The economic system is defined as the interface between human needs and the physical universe. It takes the form of a set of institutions organized by man that transform the materials of the physical universe into products that are ready for human use and is the mechanism that allocates these products to meet human requirements. In order to accomplish these functions the economic system draws raw materials and energy from the physical universe. The economic system is constrained by the availability of raw materials, energy, and labour, by the ability of the physical system to accept wastes, and by physical and chemical laws that govern material transformations and the rates at which they can occur. The evolution of the economic system is determined by the interactions among economic agents and their reactions to the constraints imposed by the physical system. The structure of the system is represented in the model by means of a set of relationships and the information required to quantify them. All of this information is computer-stored and manipulated.

In the development of the Long Term Simulation Model a number of strategies were employed to simplify the structure of the system,

SYSTEM OVERVIEW



and to maximize the efficacy of the model as an analytical tool.

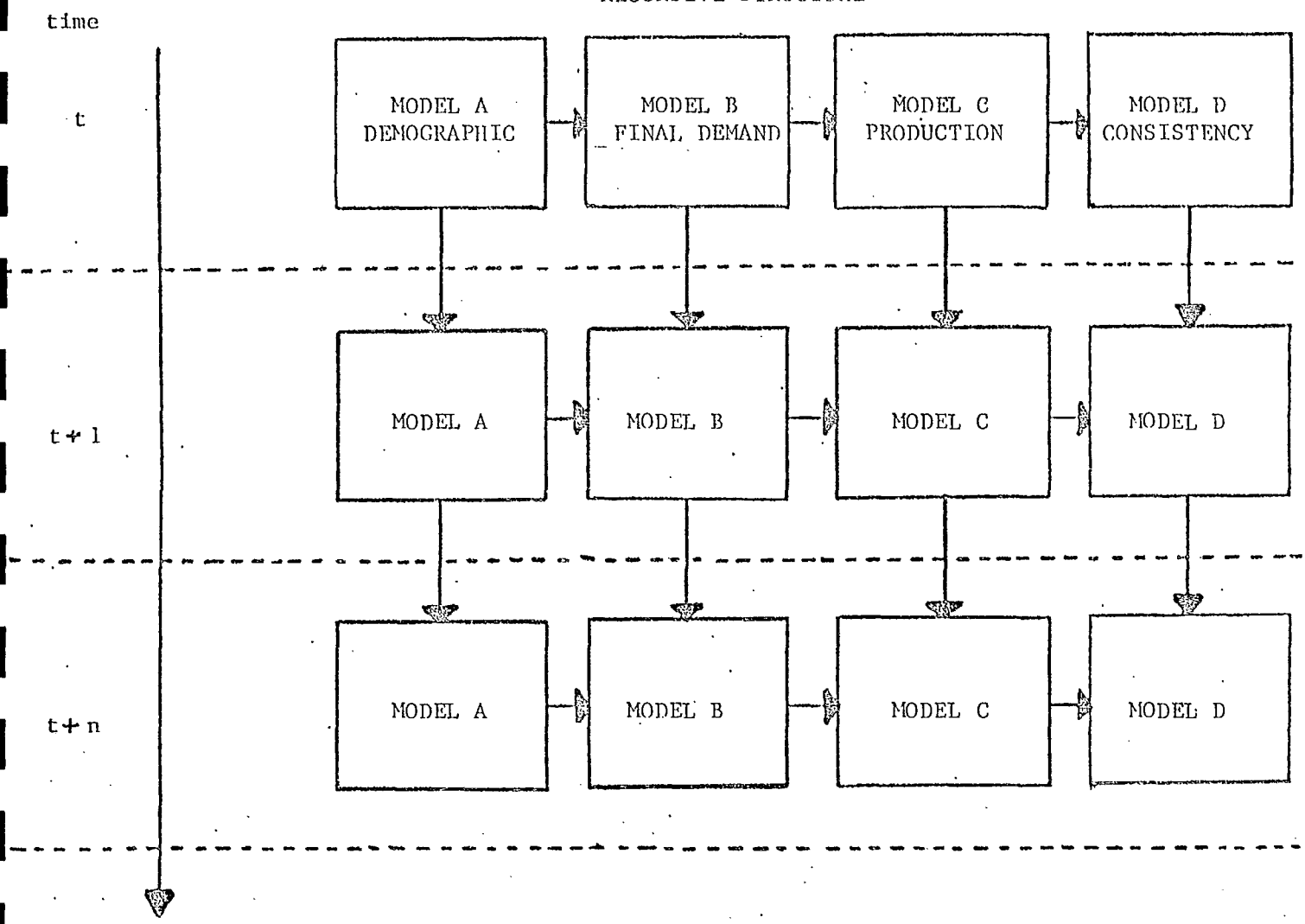
1. The time dimension was restricted to long term
2. The time structure was made recursive
3. The geographical dimension was restricted to the national boundaries of Canada
4. The model was left 'open' in the sense of requiring extensive user interaction in the definition of more subjective relationships.

3. ITS STRUCTURE

The model has four major blocks. The first is a demographic submodel which serves to calculate population, household formation and labour force. The second applies results of the demographic model as well as a series of variables and defined relationships to determine final demand. The third applies an input-output transformation to determine levels of industrial activity required to meet final demand. The fourth and final stage calculates labour, capital, energy and other resources required for the production process as well as providing an extensive reporting capability. These blocks are referred to as Models A, B, C and D respectively.

The recursive structure of the LTSM is illustrated in the accompanying diagram. There is no feedback from any block to a previously determined block. Values, once determined, are not subject to change resultant from values determined in a subsequent block. For example, demand determined in time period "t" will not automatically affect population variables such as

RECURSIVE STRUCTURE



participation rates for the current or any previous period. The obvious computational advantage to this approach is that it obviates the need for any iterative procedures to attain a model solution.

A capsule statement and structural diagram of each model in the LTSM is provided below.

Model A: Demography

Model A, the demographic submodel serves to calculate the population and household variables that are required for the formation of domestic final demand in Model B and the labour supply variables which together with the labour requirements from Model D form the labour consistency checks.

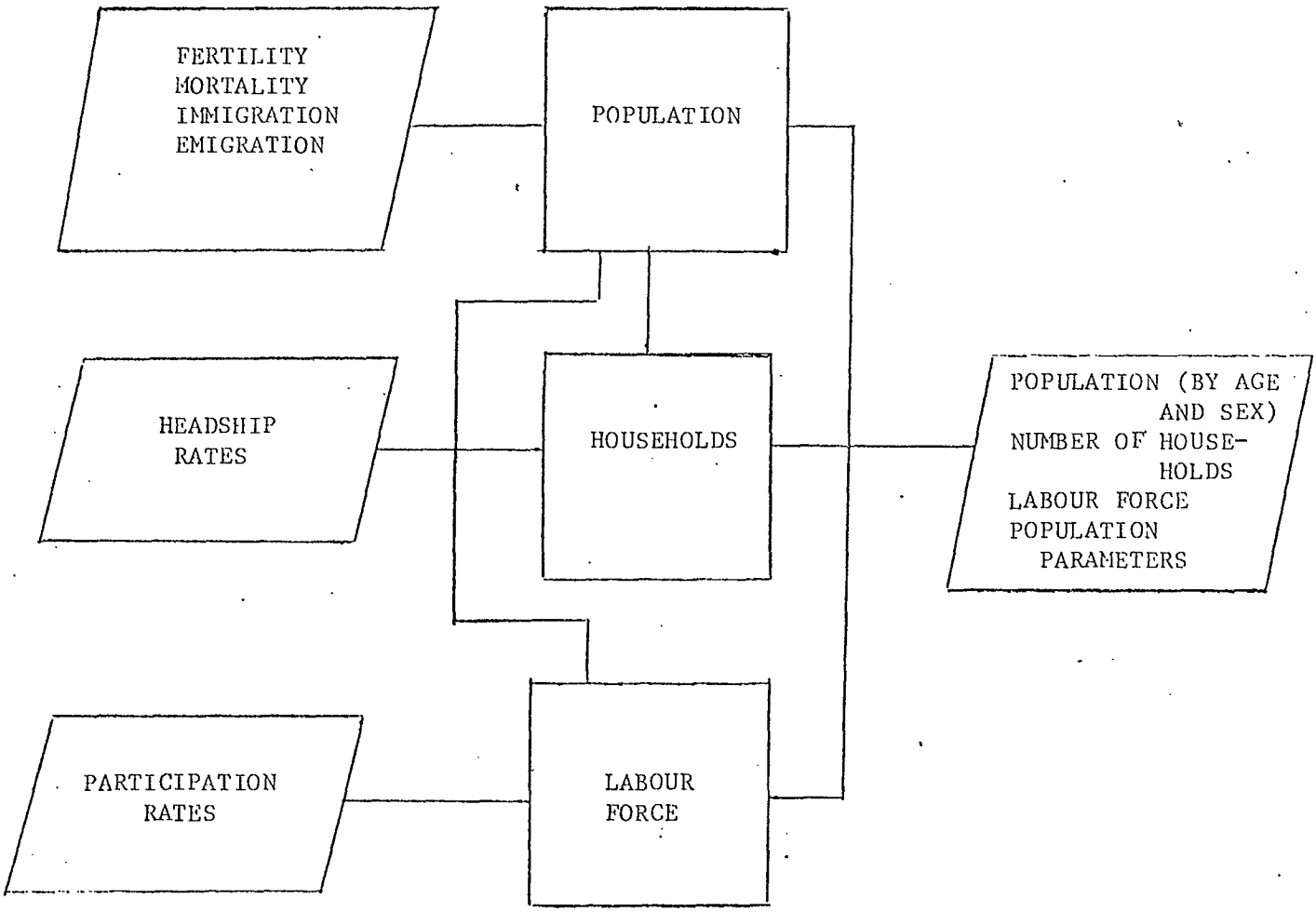
Model B: Final Demand

This submodel determines final demand for 105 Gross National Expenditure categories and distributes this over 673 goods and services distinguished in the production system. Seven major components of final demand are distinguished: consumer expenditure, government expenditure, residential construction, business investment, government investment, inventory accumulation, and exports.

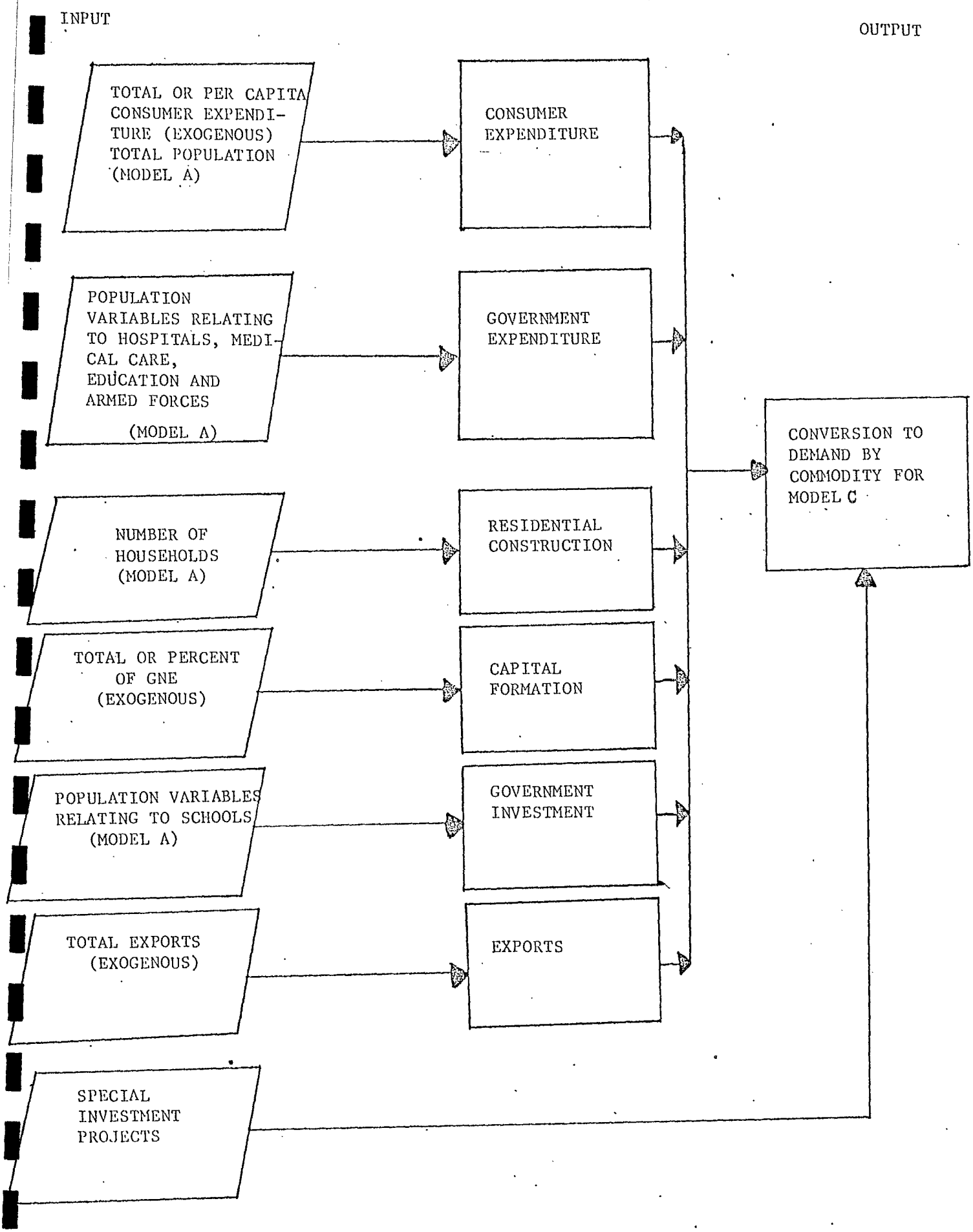
Model C: Industrial Activity

This portion of the model is designed to determine the levels of industrial activity required to meet the final

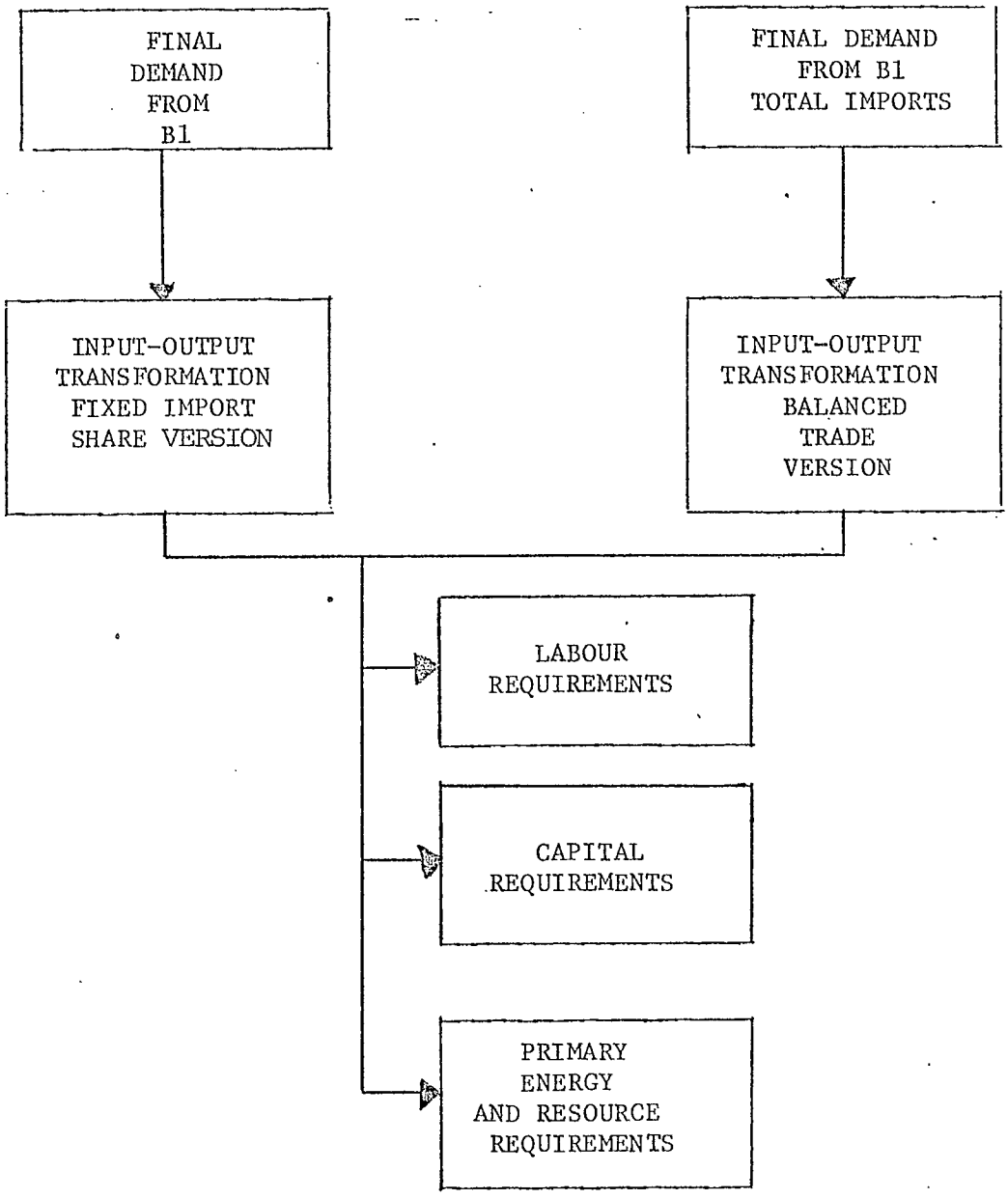
MODEL A: DEMOGRAPHIC MODEL

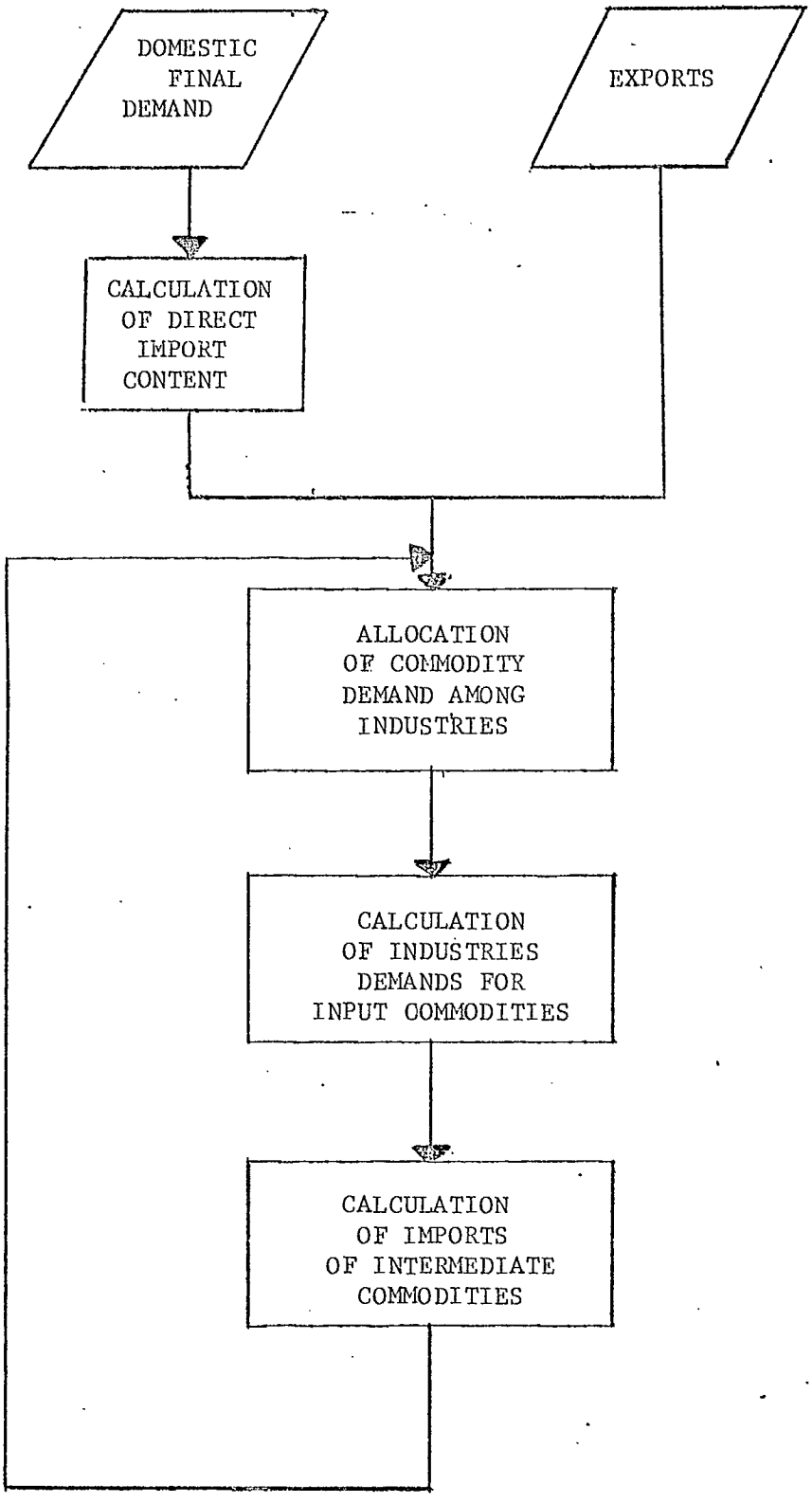


MODEL B
FINAL DEMAND DETERMINATION



MODEL C: PRODUCTION SUBMODEL




DOMESTIC FINAL DEMAND
EXPORTS
CALCULATION OF DIRECT IMPORT CONTENT
ALLOCATION OF COMMODITY DEMAND AMONG INDUSTRIES
CALCULATION OF INDUSTRIES DEMANDS FOR INPUT COMMODITIES
CALCULATION OF IMPORTS OF INTERMEDIATE COMMODITIES

demands, taking into account both interindustry flows and imports as a source of intermediate goods. This is accomplished by means of an input-output transformation. The basic assumption employed is that of a fixed technology and fixed market shares. The model is rectangular distinguishing 673 commodities and 210 industrial sectors.

Model D: Presentation of Results

This section of the model combines a generalized reporting capability with an analysis of determined industrial outputs to evaluate their impact with respect to labour, capital requirements, and the consumption of energy and non-renewable resources. Reports can be generated in time series format at a number of aggregations in both industry and commodity space. A series of fixed formats for the presentation of results, from which a user may choose any combination, have been provided. Reports relating to commodity aggregations may be applied to any vector output of the model which is produced in this space. This includes such elements as commodity output, imports, exports or any combination of the 105 categories of final demand.

4. ITS USE

The LTSM may be considered 'open' in the sense of not being fully specified. Certain relationships must be supplied by the user. In fact, model use is seen as a series of interactions between model and user.

The user initiates the sequence by presenting to the model a relatively small number of exogenous variables which constitute a macro forecast of the economy or a 'scenario'. The model then uses these variables to determine whether or not the scenario described by the user is internally consistent and feasible. The model itself does not react to apparent disequilibria or inconsistencies. Such inconsistencies are brought to the attention of the user by means of a series of consistency check reports. The user must then search for a feasible and consistent solution. This he can do in a number of ways: he can change the values of exogenous variables; he can change the relationships of the model by altering the values of internal variables; finally, he can change the model itself by choosing alternative specifications.

The relationships that are missing from the model are the reactions to apparent disequilibria. In the real world these reactions are brought about by the collective decisions of all of the economic agents. In the model system, the user of the model assumes the role of economic decision maker.

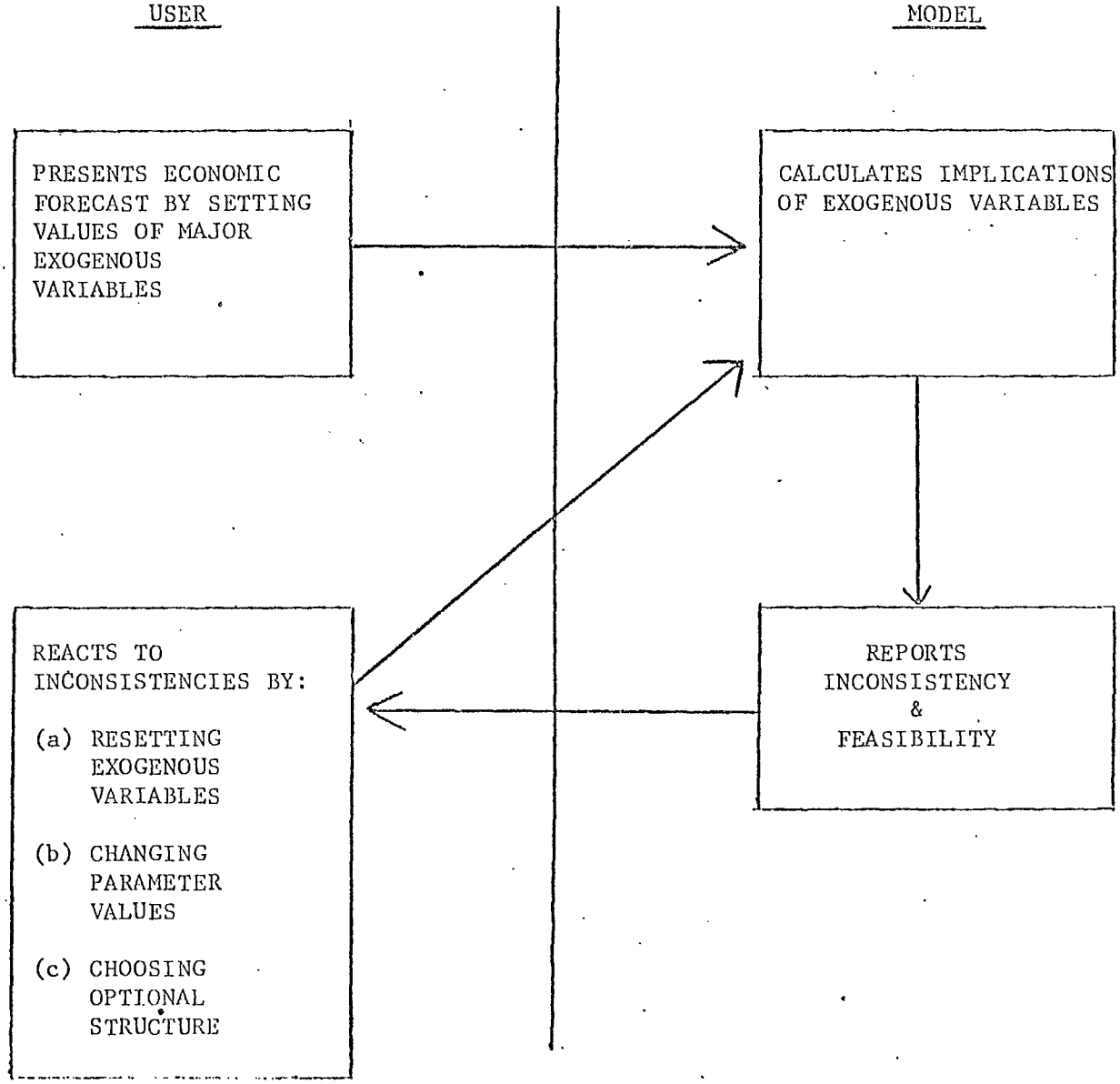
The LTSM is a computational framework within which alternative long-term evolution paths or scenarios can be developed and analysed in terms of feasibility and internal consistency. A scenario may be described in terms of a set of macro-economic variables -- each variable must be given a value for each five-year interval to the termination year which is normally 2000 or 2025. The number of variables in the set is optional: it may be as few as a dozen or as many as several

hundreds. The model assures internal consistency, for example, by making levels of consumer expenditure and certain government expenditure consistent with the projected population, by making the levels of activity compatible with the demands for goods and services, and by ensuring that the labour and capital required is consistent with levels of industrial activity. The model examines feasibility from the point of view of the availability of labour, capital, and resources.

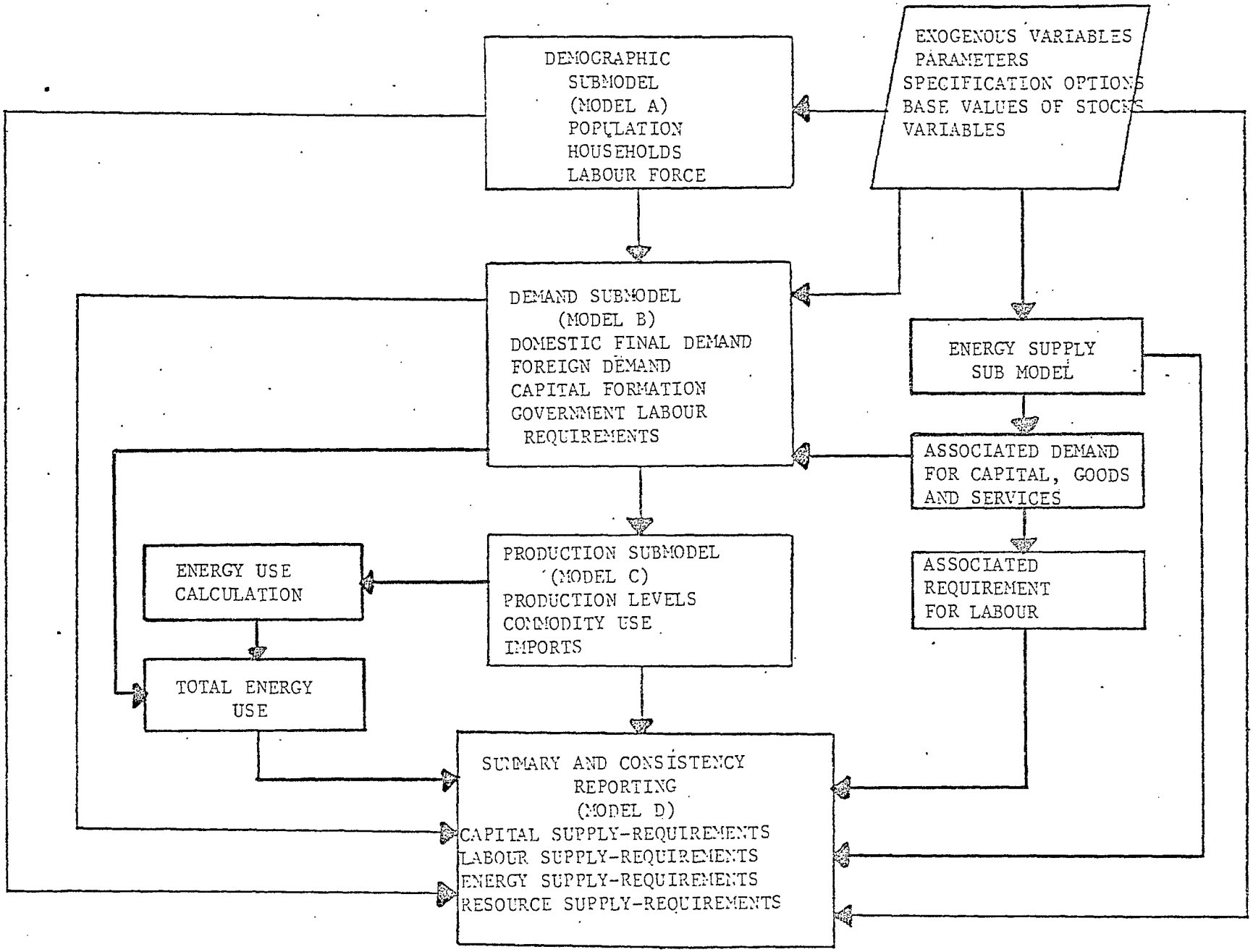
In this mode, the model may be used to distinguish feasible scenarios from non-feasible scenarios and to develop a set of feasible solutions. It is important to note that the model does not attempt to say which scenario is best; rather, it presents the alternatives from which a choice can be made.

As well, the model may be considered to be a framework within which a long-term forecast can be made. This would involve choosing from among the feasible scenarios, that scenario which is judged to be most likely. It is necessary to emphasize that the model itself does not make a forecast; it is a tool that provides a framework within which a forecast can be made.

USER MODEL INTERACTION



MODEL STRUCTURE



APPENDIX III

ENVIRONMENTAL TRENDS AND PROSPECTS FOR THE FUTURE OF CANADA

1. FOURTH-QUARTER CENTURY TRENDS IN CANADA ENVIRONMENT CANADA

(Now Department of Fisheries and Environment)

A. ITS DEVELOPMENT

The intent of Environment Canada in developing the Fourth-Quarter Century Trends (FQCT) document was to stimulate further thinking about future trends in Canada and to provide a coherent base for looking at the Department's role in the future. The draft and final versions of the document were produced by a small team within Environment Canada. The final document represents approximately 2 man-years over the calendar year 1975. The draft version of the document (September 1975) was revised and discussed with the Services and Regions of Environment Canada before the final December 1975 edition was issued. In addition, copies were sent for review to the Economic Council of Canada, National Health and Welfare Canada, Privy Council Office, Treasury Board, and Ministry of State for Urban Affairs.

B. A BRIEF OVERVIEW: Structure and Methodology

Fourth-Quarter Century Trends in Canada is an analysis of the significant interrelated factors which affect environmental management. The primary purpose of this document was to serve

as an information base and reference source from which future planning alternatives for the department may be obtained and their environmental consequences examined.

The study used a methodology which identified some of the significant factors in Canada's social, economic and environmental development, analyzed past trends and looked at future alternatives. Population and demographic growth, urbanization and economic activity are seen as dependent upon and being affected by physical/environmental resources (renewable and non-rewable) and energy.

In order to anticipate future needs in the area of environmental policy, a summary of current trends and projections in various sectors was summarized from existing information sources. To ensure flexibility, the major sectors (population, urbanization, economic activity) were viewed in terms of alternative ways the sectors could develop. The environmental implications arising from these alternatives were then examined.

The various sectors (population, resources, energy, etc.) were linked and integrated, so that broader environmental policy directions could be brought into proper focus. The conceptual framework for linking these sectors is presented in Figure 1. The key relationships and interactions highlighted by this schematic presentation are:

1. Human activities that impact on the physical environment.

   Human activity serves as a focus of dynamic sources of pressure

on environmental resources (excluding natural environmental effects and cycles) through:

(a) Size, composition, and dynamics of population; (Chapter 1)

(b) Distribution of urbanization, association urban form, and key urban infrastructures; (Chapter 2)

(c) The complex of economic activities, in terms of mass, structure, internal dynamics (relationship among sectors; multiplier and spillover effects), regional relationships, and pace of development over time (rapidity of turnover of activity, replacement and addition of economic infrastructure). (Chapter 3)

2. The resource environment, as a sustaining "pool" for human activity over time.

The resource sphere constitutes the target for human activity inasmuch as it provides:

(a) The basic life-support system -- land, water, and air;

(b) Non-energy resources (e.g., materials both renewable and non-renewable) which are used and transformed to support human activity; (Chapter 4)

(c) Energy resources (the basic support system for effecting the transformation of resources to support human activity). (Chapter 5)

3. The adjustment and management of relationships between human activities and the resource environment, by means of a number of activities that involve foresight, planning, reaction to

events, and the development and implementation of policies, strategies and tactical approaches.

C. A BRIEF OVERVIEW: Environmental Implications

Both direct and indirect implications need to be considered when examining the environmental implications arising from the interaction of the sectors. Direct environmental implications are those for which environmental policy decisions will have to be made. Indirect environmental implications are those which call for decisions to take into account environmental concerns. An example of a direct environmental implication would be increased water pollution associated with more intensive approaches to maintaining or expanding the food supply. An example of an indirect implication might be the importance of immigration as a factor in population growth, since immigration policy has a bearing on the growth and distribution of Canada's population, which in turn has environmental consequences.

The central concern of policy for resource management is the management and adjustment of interactions between human activities and resources. Given anticipated developments in the Canadian economy and society, future impacts will intensify and interactions will become more complex. Management responsibility in areas of direct environmental impacts will need to be supplemented by increased attention being given to influencing those wider areas of human activity that have profound effect on the environment. The requirement to manage the timing, scale, and type of develop-

ment lies at the heart of the balancing problem, whatever techniques are used. One has to decide whether to speed up or slow down rates of growth in various sectors; how to balance these sectoral growth rates in a comprehensive fashion. In addition, one has to make certain that one retains the option of making the system more stable over time than it would have been in the absence of policy interventions. These questions relate to supply. There is also a recognized need to influence the demand side of the equation (i.e., cutting down rate of energy consumption by conservation or other measures) to bring it more in balance with a preferred or necessary rate of development.

A general conclusion is that fourth-quarter century trends in Canada will require a greater capacity to manage crises, more and better policy at the margin, e.g., water pollution control, as well as new initiatives in comprehensive and integrated planning and management, e.g., management of the urban environment. However, the relative balance in this overall policy mix will also be affected by the ways in which trends interact.

D. IMPLICATIONS FOR ENVIRONMENTAL POLICY

While environmental legislation has had some moderate degree of success, it is nevertheless true that there has been a shift in perception in the last few years. Earlier, environmental concerns were seen solely as a constraint; today the environment is seen as one factor among others to be considered in government policy-making. Although not all segments of society are convinced

of the need for specific protective mechanisms, environmental impacts can no longer be ignored in future development of Canadian society and policy formulation.

What are the future policy implications for environmental management arising out of perceived environmental concerns? Disregarding jurisdictional questions which have not been discussed in this document, some issues emerge from the document which suggest the course of future policy development either directly or indirectly. These issues are summarized (not necessarily in terms of time spans or priority) by the Group as:

1. The overall level and structure of population growth.
2. The patterns of population distribution, regional population growth, urbanization, urban patterns, the urban environment, and environmental health.
3. The patterns of land use which optimize or maximize public expections in terms of social needs (such as recreation) and competing demands (such as urbanization versus agriculture, etc.).
4. The development and rationalization of transportation, considering such areas as: effects on population distribution, changes in social needs and impacts on them, needs for economic and resource developments, energy use and conservation, environmental quality, etc.
5. The alternative rates of economic growth as scenarios and their implications (including certain technological developments).
6. The development of renewable resources, considering the concept and limits of maximum productivity versus long-term optimum

sustainable yield (central to food, fisheries and forestry management), as well as that of substitution (species and products) and social aspects.

7. The future development of Canadian mineral resources in the light of long-term security of supply, domestic processing, environmental concerns, and export revenues.
8. The future growth and development of the energy sector, considering such aspects as a rational energy mix versus over-dependence on any single energy technology, competing energy uses, associated environmental impacts, energy conservation, etc.
9. The evaluation of the long-term effects of dynamic natural environmental patterns and cycles (such as changing climatic patterns and their effects on food production, urban needs, population distribution; "natural contaminants" in the environment, etc.), as compared to man-made impacts (such as: man-made contaminants, environmental health, effects on physical environment of such things as freons, etc.).

In addition, the direction and pace of future Canadian development will require a change in focus from sectoral environmental management to total resource management. New structures and policy instruments need to be devised so that environmental concerns are integrated in all areas of policy planning. A shift to longer term, integrated planning, as compared to crisis management or incremental approaches, will help to ensure that the

future growth of Canada preserves and enhances our life-support systems.

With a view to the future, governmental policy planning for resource management should be considered within a framework of regional environmental needs and the "boundaries" of "natural" ecosystems; and the associated jurisdictional challenges must be incorporated into the required formulae for future environmental problem solving.

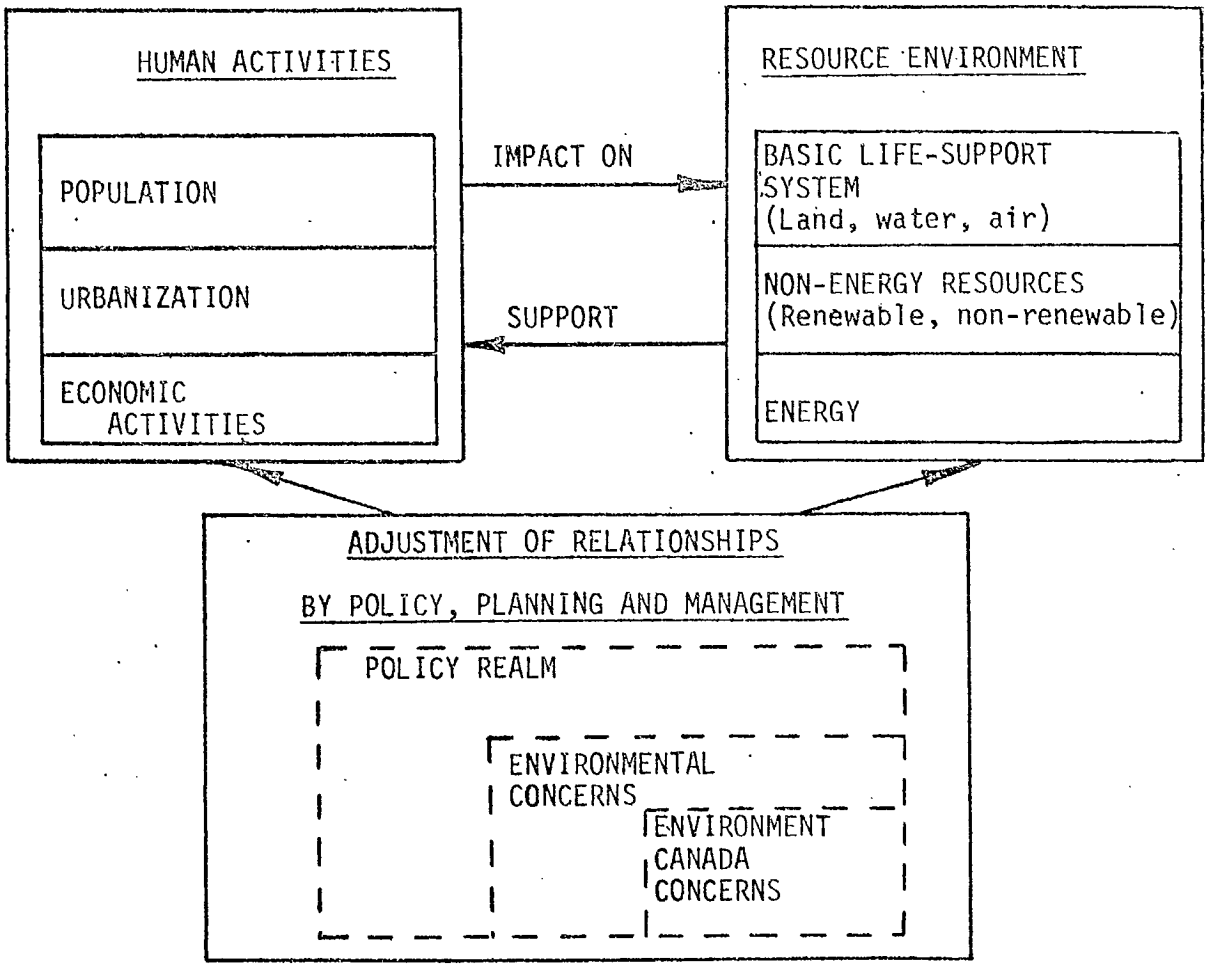


DIAGRAM OVERVIEW:

RELATIONSHIP BETWEEN HUMAN ACTIVITIES AND THE RESOURCE ENVIRONMENT

2. CANADA AS A CONSERVER SOCIETY
SCIENCE COUNCIL OF CANADA

A. ITS DEVELOPMENT

The proposal for a specific study on "The Implications of a Conserver Society" was adopted at the 42nd meeting of the Science Council in June 1973. The first formal meeting of the new Steering Committee was held in March 1975. One of its first tasks was to define more exactly what was meant by "conserver society". A provisional definition was developed:

> The concept of a Conserver Society arises from a deep concern for the future, and the realization that decisions taken today, in such areas as energy and resources, may have irreversible and possibly destructive impacts in the medium to long term.
>
> The necessity for a Conserver Society follows from our perception of the world as a finite host to humanity, and from our recognition of increasing global interdependence.
>
> A Conserver Society is on principle against waste and pollution. Therefore it is a society which
>
> - promotes economy of design of all systems, i.e., "doing more with less";
> - favours re-use 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 resiliency.

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 societal needs, both immediate and long term.

Background studies on such specific topics as renewable energy supplies, recycling, rising costs of minerals, and effects of advertising were integral to the development of the Science Council's Report. Work on the Conserver Society concept ongoing for federal and provincial agencies also contributed substantially to the Council's Report. Special note should be made of the useful study done on "The Selective Conserver Society" by the GAMMA group at the Universities of Montreal and McGill, contracted from the federal Department of Supply and Services, with the involvement of several departments and the Science Council. As part of the Science Council study, many of these activities were brought together and reviewed, with bibliographic material, in an informal journal, Conserver Society Notes/Carnets d'Epargne, distributed approximately quarterly by the Science Council to a mailing list of over 1500 interested respondents. The first issue was published in October 1975. "Notes" became an important instrument in the public dialogue initiated by the Conserver Society Committee and its staff.

A position paper, "Toward a Conserver Society - a Statement of Concern" was put out by the Committee in February 1976. It was published in Science Forum (June 1976), Québec Science (June 1976) and, in an edited version, in Canadian Consumer (June 1976), the magazine of the Consumer's Association of Canada. In March 1977 it was, in its entirety, read into the U.S. Congressional Record. The statement outlined the need for a transition to a Conserver Society and some of the characteristics of such a society in general terms. The intent of the Council's Report on the Conserver Society was to be more specific. The Report "Canada as a Conserver Society: Resource Uncertainties and the Need for New Technologies" was publicized in October of 1977.

It is important to emphasize that the Council was not attempting to set out a complete blueprint for a new society, nor to specify the exact modes of transition or how long they may take. The Report should be seen as the Council's view of some new directions related to science and technology that the conserver principles imply, and some actions in those directions that agencies at all levels -- government, business, labour, and private citizens -- can take.

B. PRESENT SITUATION AND TRENDS

The Science Council Report contends that emerging resource constraints and environmental and social boundary conditions present challenges for individuals at all levels of

Canadian society. One response to seeing an end of a cheap, easy supply of a resource is to drive to augment it. This is a normal market reaction -- find still more, no matter what the cost. To meet the challenge of scarcity, however, a second force has arisen: a questioning of the demand side of the equation. What is there about our resource transformation processes which seems to dictate such extremely rapid use of resources and energy? The Report questions the way in which our society has chosen to transform resources into commodities, and the ways Canadians have become accustomed to a way of life that involves high rates of resource use, high waste, and constantly inflating expectations. Symptoms of environmental and social stress indicate that a transition must begin toward more sustainable and selective patterns of growth.

C. CONSERVER SOCIETY CONCEPT

The characteristics of a Conserver Society were conceptually outlined in the first section above. The Science Council Report conjectures that five basic initiatives or thrusts characterize policy that will help us make a smooth transition to a Conserver Society: concern for the future, economy of design, attention to diversity and flexibility, recognition of total costs, and respect for the regenerative capacity of the biosphere. For example, many studies indicate that planning in various areas related to resources is severely limited by the short time horizons that are considered (frequently the four or so years between elections). The planning of

individuals, business and government must develop a sense of direction and lengthened perspectives to ensure that we keep options open.

The Report argues that we must strive not simply to react to crises and shortages but to attain greater flexibility and efficiency, the elimination of wasteful practices, and the re-orientation of our expectations. "Doing more with less" means aiming broadly at total social efficiency and best use of resources, keeping in mind the needs of both present and future Canadians. Thrift, saving, avoidance of waste, efficiency and appreciation of quality are likely to become important in our lives once again. Diversity in human activities, as in natural ecological systems, increases flexibility, adaptability and resiliency. It allows the decentralization of responsibility and the optimization of performance from local resources.

In a Conserver Society, the pricing mechanism would reflect not just the private cost, but as much as possible the total cost to society. This implies a conscious process of converting present-day technology in order to make it less vulnerable to energy shortages, more appropriate to local skills and circumstances, and less damaging to the human and natural environments. This conversion process will provide major new industrial development opportunities in all parts of Canada, and will generate substantial net new employment. In a number of areas, the adoption of "conserver principles" implies the creation of small businesses, or the substitution of labour for capital-intensive technology.

The Science Council Report concentrates on the scientific and technological implications of the growing need to more carefully conserve natural resources. While it is clear throughout the Report that a trend towards conservation will have wide-ranging social effects, the emphasis is nevertheless kept on developments in the technological milieu. It is assumed implicitly that social adjustments will be made in the normal way.

D. APPLICATIONS OF THE CONCEPT

The Report endeavours to illustrate the fields in which application of conserver principles must become a priority for Canada. Energy supply is becoming a primary constraint on our present pattern of growth; the difficulty and expense of bringing new sources of supply on line have made measures to conserve energy very appealing. The application of conserver principles will give us invaluable flexibility and manoeuvring space as we go through the transition away from fossil fuels.

One aim of the Conserver Society will be to achieve, over the long term, reliance on sources of energy which are in principle sustainable. This will mean a preference for renewable energy sources, such as hydro, solar, wind and vegetation, in contrast with present policies in the industrialized countries of maintaining high standards of living at the expense of non-replaceable fossil fuels.

From a conserver point of view, the Science Council maintains we would be better off to pay more attention to materials, not as throughput or flow, but as "stock", fixed in the form of buildings, roads, etc. and circulating in the form of new investment, depreciation, recycling, consumption and disposal. The ultimate goal will be a change from a system of high extraction, high flow and high disposal with recycling a minor component, to a system in which optimum use is made of a fixed and recycling stock, with new extraction necessary only for growth and "topping-up" as materials degrade from wear, tear and mixing. We are very far indeed from such a conserver society.

Another area of application indicated by the Council that will facilitate the inevitable transition to a Conserver Society is in the creation of new business and employment opportunities. A conserver approach will usher in new technologies, new opportunities for Canadian business and unprecedented challenges for the entrepreneurial spirit. The new "conserver" wave of industrialization, already underway, is based on the need for new energy sources, greater efficiency in energy use, miniaturization, process control technology, and new technologies based on ecological science. Appropriate industrial policy would foster Canadian involvement in the transition to a Conserver Society.

E. IMPLICATIONS FOR THE GOVERNMENT

There are two points revised in this report that have special technological relevance for the Canadian government. The first deals with the conservation of resources. Much attention is paid to energy conservation, and the report does give some emphasis to the conservation of materials. However, the dimensions of the economic threat due to materials scarcities are not well known. There is much less substitutability between different materials than there is between alternate energy sources. A shortage of a specific material might cripple one industry and leave another relatively untouched. While the Science Council's report does consider the problems of materials conservation and recycling, it does not look in any detail at the strategic problems associated with the disappearance of specific resources, nor does it anticipate the technological changes that will come about as a result of shortages. It also does not look at the research effort that might be needed to find substitute materials. This appears to be a problem that requires more study.

The second point raised is that of industrialisation and conservation. If one assumed that conservation is necessary and imminent, and that a whole new line of "conserver" technologies and products will have to be invented, then it follows that whoever breaks the market first could stand to do a booming business. Nations which are slow to develop conserver technologies will more likely than not have to import them. In some cases, such as solar energy technologies, the importation of

solar panels from the U.S. may result in Canada using devices which are not ideally suited to our solar regime. In such an event, Canada would lose in two ways: through a decrease in domestic industry and through the use of sub-optimal technology. The recent U.S. announcement of its intention to develop more fully the conserver option makes more urgent the need to consider the industrial implications in Canada of a Conserver Society.

F. RECOMMENDATIONS

Among urgent priorities, the Report recommends that the transportation and residential building sectors become vastly more energy efficient, and that steps be taken to stimulate the development of Canadian renewable energy technologies, to improve the ways we manage and use materials, and to promote new industries and employment opportunities compatible with the conserver approach. Further thought must be given to the very long-term management of these and other areas of activity, considering them as aspects of a system aiming at long-term sustainability.

The specific recommendations of the Science Council Report are itemized and grouped below in two categories.

1. Recommendations for Immediate Action

Transportation

-Improve fuel economy of automobiles

-Promote automobile and van pooling

-Upgrade public transit in urban areas

-Upgrade and electrify railways in high-density areas

-Improve utilization of existing systems

-Substitute electronic communications for travel

-Prepare to introduce restrictions on gasoline use

Shelter and Community

-Provide incentives to improve home insulation

-Adopt new building codes in all provinces

-Improve energy efficiency of all buildings

-Legislate sun-rights

-Give priority to energy-efficient multiple-unit housing

-Plan district heating

-Revive electrical rate structures

-Provide incentives, not impediments, to houseowners

Renewable Energy Sources

-Create institutional foci

-Increase support for Research, Development, and Demonstration (RD&D)

-Show leadership through purchasing

Materials Conservation

-Improve information base on material plans

-Support municipal resource recovery pilot projects

-Support research and development in resource recovery

-Remove impediments and provide financial stimulants to encourage recycling

-Increase public information

-Make products more durable

Industry and Employment

-Encourage and assist improvement in industrial processes

-Encourage and protect new industries based on Conserver technologies

-Train people in new skills

-Assist homeowners by lease financing

-Assist transition to new employment patterns

2. Recommendations for Investigation and Consideration

Transportation

-Study comprehensively Canada's transportation systems

-Review the need for additional airports

-Develop low-energy urban transportation

Shelter and Community

-Design total energy communities

-Design energy-efficient northern communities

-Study "retro-fit" of suburbs

-Study energy-efficient and materials-efficient urban design

-Study the costs and benefits of urbanization

Renewable Energy Resources

-Analyse total cost of energy alternatives

-Study ecological sustainability of technologies

-Develop new engines

-Develop methods of energy storage

Materials

-Consider methods of shaving down depletion of scarce resources

-Educate in conserver approaches to design

-Curb wasteful consumption

Other Questions

-Study the role of advertising and other forms of promotion in encouraging wasteful practices

-Study feasibility of total-costing of products

-Improve understanding of the extent of and manner of working of the "cost-plus" component of the economy

-Conduct studies to clarify when, and under what circumstances, increased scale ceases to bring advantage.

APPENDIX IV

FUTURES STUDIES PROGRAM

INSTITUTE FOR RESEARCH ON PUBLIC POLICY PROGRAM

The Institute has a three year contract with the Privy Council Office to establish a long-term research program in "futures studies". The mandate of the program is three-fold:

(1) to identify which aspects of Canadian society are changing most rapidly;

(2) to provide commentaries and projections on data collected and published by other agencies; and,

(3) to examine the effects of economic and technological changes on Canadian society.

The program is under the direction of David Hoffman. The research is organized along three main projects.

The first deals with the "Impacts of Technological and Economic Change on Canadian Society". Among the technical changes whose social effects will be studies are the following:

-"Industrial Investment and Canadian Economic Growth: Some Scenarios for the Eighties". This is a set of five baseline projections of alternative scenarios for investment and employment in the Canadian economy through the 1980s. Taking into account past Canadian performance, the scenario with 3.5% growth of per capita income is considered achievable.

alternatives available to Canadians within the next fifty years. Subsequently, scenarios involving different demand projections are developed, in which plausible mixes of the fuel alternatives are examined for capital costs, continuing processing costs, and social costs.

The third project is the "Report on Social Trends". The group charged with the responsibility for studying social trends in Canada will review the existing literature in this area, particularly the various publications of OECD, the Economic Council of Canada (including a number of unpublished discussion papers) as well as documents of several federal and provincial departments. After collecting trend data on a wide variety of social phenomena, the group will concentrate on certain issues such as health, lifestyle (and the relationship between lifestyle and health), the allocation of time, and access to justice.