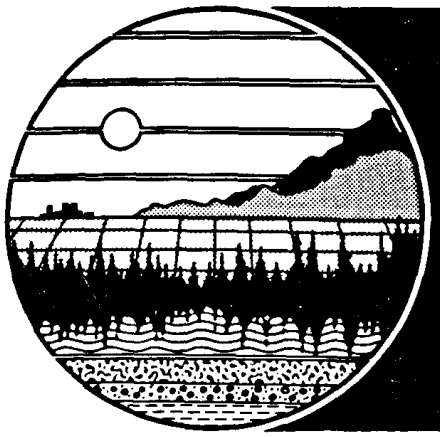

LANDS DIRECTORATE

DIRECTION GÉNÉRALE DES TERRES

ANALYSIS OF THE UNITED STATES EXPERIENCE IN MODIFYING LAND USE TO CONSERVE ENERGY

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ANALYSIS OF THE UNITED STATES EXPERIENCE IN MODIFYING LAND USE TO CONSERVE ENERGY

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EXECUTIVE SUMMARY

As the price and unreliability of energy supply increases, so too do the disadvantages of its inefficient use. Since it is cheaper and less environmentally disruptive to save energy than to produce it, many Canadians have begun to recognize that conservation must play a major role in any energy policy designed to achieve self-sufficiency.

Every urban form represents an attempt to attain varied human goals. These can only be met at the expense of energy consumption. Differing settlement patterns and city infrastructures greatly affect energy use through their influence on the length and number of journeys to work, shop and recreate. Building location, height, orientation and relationships to topography and vegetation also affect heating and cooling requirements.

The impact of these and other related variables on energy consumption can be mitigated by comprehensive planning. It follows, therefore, that those who control where, when and how urban settlements will develop have a major impact on energy consumption, often for decades if not for centuries to come. Much of this power, in Canada, rests with the provinces which have delegated a considerable portion of it to the municipalities. This situation mirrors that in the United States. Here the states typically have delegated planning authority to the municipalities, while frequently retaining the ultimate power to make major development decisions. Energy shortages have been more severe in the United States than in Canada. As a result, probably there has been more interest in that country in energy conservation through land use planning. This report analyzes that experience, with a view to determining its relevance to the Canadian scene.

Modelling indicates that efficient land use can result in a reduction of at least 20 percent in the energy demands

of new development. To achieve such a conservation target there are more than 30 energy efficient land use strategies that can be adopted at the local level. A survey of 160 United States settlements demonstrated that these are being accepted with increasing frequency. Several communities including Lincoln, Nebraska and Davis, California have made firm commitments to them, through a comprehensive plan which emphasizes energy conservation as a major goal. In such settlements, per capita energy consumption is beginning to fall significantly.

To determine how land related energy innovations are diffusing in the United States, an indepth survey of two communities, Portland, Oregon and Lincoln, Nebraska was undertaken by the present authors. Questionnaires and interviews were used to determine how decision making had occurred, what obstacles had been overcome and which groups had actively supported and opposed the adoption of energy efficient land use planning. In both Portland and Lincoln, energy conservation became a strategic issue during a period of shortage. Crisis placed this issue firmly on the political agenda. Strong leadership from the mayor and a majority of council ensured that effective action was taken. In both settlements the state supported the move towards energy efficient comprehensive planning, as did the majority of the public. Debate has been intense and the greatest support has come from environmentalists, newspapers and the heads of local government agencies. Opposition has stemmed mainly from developers, realtors, industrial and union leaders and the Chamber of Commerce. Such interest groups have played these roles nationwide and might be expected to take similar positions in Canada.

It is concluded that energy efficient land use planning should be promoted in Canada and a series of recommendations are made to facilitate this. If adopted, these strategies will allow the federal government to act as a catalyst,

permitting a significant reduction in energy demand from new developments on a countrywide basis. A first step is the organization of a national conference to discuss the issue with planners and other government officials.

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ACKNOWLEDGEMENTS

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Present and potential energy constraints emphasize the need to reorganize the spatial framework of urban areas. There is a parallel need for a rational decision making process that compares the benefits and liabilities of alternative actions to achieve a balance between energy needs and energy availability.

— Dutt and Costa (1977)

ENERGY AND URBAN FORM

To plan is to design the future. Cities are physical expressions of societal objectives and their forms have major implications for human equality, happiness, fulfilment and work. The search for an optimum urban structure, which will permit society to achieve its current goals, is the major function of town planning. This quest is limited by two main constraints, the nature of prevailing human values and available technology.

The dominant value system in any society determines what is seen as desirable. These views promote particular city forms which, in turn, influence the operation of the social system. For example, a planned urban centre which separates high and low income housing areas and incorporates a stock exchange and industrial estates is a model for a class society with production based on capital. Similarly, arcologies, cities to be housed in a single megastructure, are seen by their creator Paolo Soleri as the physical expression of ecological principles, and are to be built to provide an environment capable of solving many of mankind's social and spiritual problems (Tod and Wheeler, 1978). Every urban form, therefore, represents an attempt to achieve varied human goals and reflects the ranking of these objectives in the society involved.

How these targets are pursued is influenced greatly by the resource base and the technology which are available to the community. Where construction materials are limited to clay or wood, the urban form does not normally include high-rises. Such vertical expansion is facilitated by the use of steel or concrete, while extensive lateral growth requires efficient transportation systems, such as those based on the automobile. Knowledge, resources and technology, therefore, control what is possible.

Since the nature of the existing city structure reflects both social values and technology, it follows that dramatic changes in either are likely to result in the need for new urban forms. For more than a decade, the dominant paradigm in North American society, that which accepts growth as inevitable and desirable for its own sake, has been under attack (Sewell and Foster, 1971). A variety of alternatives including value systems which place greater emphasis on environmental stability and resource conservation have been gaining support (Sewell and Foster, 1976). This social turmoil has been reflected in a series of new planning concepts, or wider adoption of older innovations which, in their turn, have given rise to changes in the urban form. Examples include the use of green belts and agricultural land reserves to control city size, the setting of height restrictions for buildings and, in rarer instances, the conscious decision to prevent or retard further urban population growth. A major unifying factor, linking competing alternative paradigms, has been a commonly held belief in the inefficiency of current resource use and the need to achieve more with less. As a result, there has been growing support for the implementation of strategies designed to ensure greater efficiency in the use of energy. Such conservation strategies differ in radicalism and in the immediacy of their returns. Some minor changes in individual behaviour, for example the lowering of thermostats, can be attained with relatively little effort or sacrifice. At a somewhat higher level of expenditure and commitment are minor structural or life style changes, such as the use of double glazing, insulation and more efficient equipment. Beyond this, major structural and social change can provide large scale energy savings. These include the use of passive solar buildings, the utilization of waste heat from power plants and recycling of refuse. With even more commitment to conservation, greater energy efficiency might be accomplished by designing patterns of land use in such a

way as to achieve economic and social goals with the minimum expenditure of energy.

Because of the dramatic and largely unexpected nature of the 1973 oil crisis, conservation strategies with a short pay-back period have been emphasized by Canadian federal and provincial governments. For example, a public information and awareness program was quickly launched through the media and various publications of the Office of Energy Conservation of Energy, Mines and Resources, Canada (Energy, Mines and Resources, Canada, 1977). This was followed by the promotion of minor structural alterations to residences, through the Canadian Home Insulation Program, which initially offered participants up to $350 towards the costs of the purchase and installation of insulation. In addition, the federal government has developed an appliance energy labelling program and has increased its support of research into energy conservation in buildings. More recently, energy efficient structural change is being promoted by the development of a draft "Canadian Code for Energy Conservation in New Buildings," the introduction of Low Energy Building Design Awards, and the purchase of solar heating equipment for installation in federal buildings (Gillespie, 4 July 1978).

Interest is now growing in Canada in the fourth level of commitment to conservation, the use of planning to improve the energy efficiency of settlements. This trend has been illustrated by the federal government's organization of a Habitat and Energy Seminar in Ottawa in October 1977, the sponsorship of research into such topics as municipal energy profiles for Ottawa and Quebec City, and the preparation of a municipal energy conservation manual. A number of provincial initiatives are also in hand. The government of Ontario, for instance, has begun a study of energy saving through better subdivision design, while the Bureau of Municipal Research in the same province has completed an analysis of opportunities for municipalities to promote more efficient

land use. The foregoing studies will contribute towards the development of a framework for identifying strategies for achieving higher levels of conservation. Because so little work has been done so far on these matters in Canada, however, the present research effort is heavily focussed upon potential rather than achievement, and on the collection of data on existing land uses and present energy consumption rather than on experience with innovative energy conservation strategies.

Before major changes in federal and provincial policies can be made confidently, there are still many topics requiring additional study and clarification. As Chibuk (1977) has suggested:

> ... There is a need to examine such issues as: how far should the public sector go in effecting changes in urban form; what would implementing the extrapolated general directions mean for the quality of life; what financial and institutional problems have to be addressed and what would these impacts be; how would the urban development process itself have to change in order to accommodate the designed strategies; and what planning mechanism would be most efficiently employed to attain the general directions?

Answers to some of these questions can best be sought through analysis of experience elsewhere, notably in the United States. This is because many of the strategies that need to be considered for application in Canada have been applied there with varying degrees of success. Whilst institutional differences exist, there are nevertheless numerous similarities in the physical, economic, social and technological environments and in the energy problems to be faced. Moreover, there exists considerable literature on various aspects of energy conservation and planning in the United States. For these reasons, experience in the United States has considerable relevance to the Canadian scene and it is with achievements to the south that the remainder of this report is concerned.

The authors of this study have identified a multiplicity of strategies that urban planners in the United States are using to improve the energy efficiency of the towns and

cities for which they have a professional responsibility. These strategies rest on *three* basic principles. The first of these is the need to reduce the distance between residence, workplace and services, so minimizing the energy demands associated with travel. The second of these is the necessity to increase population densities in certain locations. Thirdly, planners must seek to make more effective use of the energy related aspects of the physical environment to reduce space heating and cooling demands. A variety of strategies being introduced in the United States with increasing frequency to achieve these three goals will now be described in detail.

Although the winter of 1973 was comparatively mild, the oil embargo forced Americans to face cold reality. Realizing that the years of feasting upon cheap energy were over, citizens across the country rallied to slogans of energy conservation.

— Harwood (1977)

ENERGY EFFICIENT LAND USE STRATEGIES

Land Use, Transportation and Energy Consumption

There are four distinct ways in which the energy demands of transportation within cities can be reduced by the implementation of innovative land use. Certain policies, for example, may encourage the more frequent use of energy efficient forms of transport, such as public transit or bicycles. Strategies can also seek to increase passenger loads in vehicles that normally operate at less than optimum capacity. In addition, land use policies may be implemented which reduce the average length of trips and minimize the number of unnecessary excursions (Erley, Mosena and Gil, 1979).

In both the United States and Canada, dependence on the energy inefficient automobile is overwhelming. In the former country, for example, a survey conducted by the Federal Highway Administration (1973a), for the period 1969-70, indicated that 96 percent of all trips made by individuals over the age of 5 were by automobile. The journey to work accounted for 36 percent of such excursions and for 42 percent of vehicle miles travelled in the United States (Federal Highway Administration, 1972). There is clearly considerable potential for reducing energy demand by lessening dependence upon the privately owned automobile.

Even if the dominant mode of transportation cannot be changed, alterations in its use can result in large scale energy conservation. To illustrate, a survey carried out by the Federal Highway Administration (1973b) demonstrated that three out of every four cars used for the journey to work carried only their drivers. It has been estimated that if more effective carpooling could be encouraged in the United States and commuter occupancy rates raised to 1.6 individuals per automobile, 440,000 barrels of oil a day would be saved

by 1980 (Stuntz and Hirst, n.d.).

There can be little doubt that the greatest potential energy savings can be achieved by encouraging the use of public transportation. Cars with cold engines are energy inefficient, yet the average length of 60 percent of all automobile use in the United States is for travel distances of less than 5 miles. In contrast, even the most conservative estimates admit that buses are at least twice as energy efficient as automobiles (Stuntz and Hirst, n.d.). This figure is considerably higher during rush hours. The American Public Transit Association (1976), for example, demonstrated that a bus carrying 75 customers averaged 307 passenger miles per gallon, while the average automobile, with a load of 1.4 individuals, travelled only 19 passenger miles on the same quantity of fuel. Trolleys and subways are thought to be more efficient than buses when the entire working day is considered (Stuntz and Hirst, n.d.). Naturally, bicycling or walking are even more desirable from an energy conservation viewpoint. Such forms of transportation become more feasible where residences and workplace are not widely separated.

It should not be imagined that all public transit systems are necessarily energy efficient. Lave (1977) has shown, for example, that a typical modern rail transit system, BART of San Francisco, has caused a net waste of energy. This surprising conclusion results from the enormous quantities of energy invested in building the system. Lave (1978) has also recently analyzed three newly proposed mini-rail transit systems, those for Cleveland, Los Angeles and St. Paul. Using the projected patronage of these systems, forecast by the planners involved, Lave found that all three will use more operating energy than the transportation modes they replace. This is because passengers tend to be attracted not out of automobiles but out of buses. In addition, the rail systems appear to generate many new trips which would otherwise not have been taken. The net result may be energy

inefficiency.

Hannon (1977), however, has tried to refute Lave's arguments about BART's energy inefficiency by pointing out it is currently operating far below capacity, unlike the freeway lanes used in comparison. He also argues that highway construction is 62 percent more energy intensive than rail mass transit per dollar invested. Despite all the arguments over specific systems, mass transit is inherently more efficient in moving people than automobiles, provided there are sufficient levels of demand. Bernard and La Belle (1978) have illustrated this point with data from northeastern Illinois' six county region (Tables 1 and 2). Even with some relatively low load factors for certain transit modes, particularly suburban bus, the energy consumed per passenger mile is about one-third that for the automobile.

When a city grows in population and size, average trip distance lengthens. The World Bank (1976) has postulated that, for a given population density, trip distance increases roughly in proportion to the square root of the radius of the city. For example, if a city grows in population from one to two, four, and then eight million people, with a constant density, average trip distance may be expected to increase from its initial level by roughly 20, 40, and 65 percent respectively. Similarly, decreasing population density tends to increase the average trip distance. If two cities have the same two million population, one with a density of 12,000 per square mile and the other 6,000, the average trip distance in the latter is likely to be 20 percent longer (World Bank, 1977).

Energy analysis has shown that land use policies most likely to reduce transportation energy demand have several distinctive characteristics; they encourage contiguous development and moderately high densities, they mix employment and residential opportunities and ensure service by effective public transportation (Harwood, 1977). If moderately high

TABLE 1: MODAL TRANSPORTATION CHARACTERISTICS FOR NORTHEASTERN ILLINOIS REGION

Mode of Travel	Average Vehicle or Coach Occupancy	Average Vehicle Efficiency[a]
Typical U.S. Auto	1.45	13.5 mpg (5.7 km/l)
CTA Bus[a]	16.8	3.6 mpg (1.5 km/l)
Suburban Bus	6[b]	3.9 mpg (1.7 km/l)
CTA Rapid Transit	20.2	4.7 kWh/VM[c] (2.9 kWh/VK)
Commuter Rail Diesel	46	0.83 gal/CM[d] (1.95 l/CK)
Electric	62.9	11.6 kWh/CM[c] (7.2 kWh/CK)

[a]CTA: Chicago Transit Authority; CM: Coach Mile; VM: Vehicle Mile; VK: Vehicle Kilometer.

[b]Estimate.

[c]As delivered to vehicle; assumed 30% power plant and transmission efficiency.

[d]Includes coach standby power.

Source: Bernard and La Belle (1977).

density residential development is impossible in the urban core, employment should be distributed throughout the entire region, not concentrated in one central business district. Land development strategies should also be designed to distribute civic, religious, medical, educational, shopping, entertainment and recreational facilities within residential districts, thereby reducing travel distance to these service areas. It appears preferable to develop small clusters of such

TABLE 2: COMPARISON OF MODES OF TRANSPORTATION FOR NORTHEASTERN ILLINOIS REGION

Mode of Travel	Direct Energy Consumed		Annual Passenger Travel 10^8
	Per PM (PK)[a]	Per Yr 10^8	
Typical U.S. Auto	6390 Btu (998 Kcal)	178 Btu (45 Kcal)	279 mi (449 km)
Total Transit	2400 Btu[b] (375 Kcal)	9.12 Btu (2.3 Kcal)	38 mi (61.2 km)
Transit Share of Regional Total	4.9%		12.0%

[a]PM: Passenger Mile; PK: Passenger Kilometer.

[b]Average for all transit modes weighted by mileage.

Source: Bernard and La Belle (1977).

facilities in many localities so that several errands can be accomplished with one short journey. These service clusters and associated higher density residential development can facilitate the design and use of energy efficient public transportation. Certain activities, such as dry cleaners and grocery stores should be dispersed at the neighbourhood level. This diffusion of services permits rapid access by bicycle or on foot. It should be noted that regardless of trip origins and destinations, moderately high density contiguous development, clustered around transit stations, remains essential if large energy savings in transportation are to be achieved. Even where such growth is not possible, linear expansion along transportation corridors, or polynucleated development connected to the urban centre by effective public transportation is more energy efficient than low density, non-contiguous sprawl (Roberts, 1975). It

should be noted that higher density growth also provides a milieu in which district heating, based on the use of waste heat from factories or power plants, becomes increasingly more practical.

There are, of course, a variety of economic and legal strategies other than those of land use planning which could be used to ensure more efficient transportation patterns. Severe limitations on city parking, or on single occupant automobile use, or significant increases in the federal gasoline sales tax would induce carpooling and transit patronage. However, there is strong public and government opposition to such schemes and land use planning to halt sprawl and simultaneously induce urban redevelopment would speed the process of energy conservation with considerably less negative reaction (Sagner, 1978).

Romános (1978) has argued that rapidly increasing energy costs will, in themselves, lead to the evolution of a more energy efficient metropolitan structure. Utility analysis of the residential location decision of households and the energy conservation efforts of companies has shown the probable form this reorganization would be likely to take. A multinucleated urban system with a number of strong urban nuclei playing the role of employment centres for the suburban residential areas surrounding them could be expected. Lower density development could be anticipated between these centres. Naturally, however, such efficient development can be achieved more rapidly and with less social inequity through the use of municipal legislation which provides incentives for energy conserving land use.

Zoning for higher density development, particularly in close proximity to proposed or existing transportation networks or service centres

Traditionally, zoning and subdivision regulations are adopted by municipalities to ensure that community design

enhances the welfare, safety and health of inhabitants. Zoning regulations therefore tend to stress measures which reduce congestion, minimize losses from natural hazards and provide for adequate light and air. They are also adopted to facilitate the provision of public services, such as water supply, sewerage, schools and parks (Harwood, 1977). The end product of attempts to meet such goals has often been the adoption of rigid lot size and height and use restrictions which together reduce density and encourage the inefficient use of energy.

Significant energy savings can be achieved by changes in density which are not extreme. Enormous highrises are not required; indeed residential buildings of fifty storeys or more generally have been found to be energy inefficient. In contrast, conservation is possible for even lowrise and small apartment buildings. Size is not the only significant criterion; location is also important. An isolated highrise building will not permit the use of public transit and will probably encourage greater reliance on the automobile (New York Regional Plan Association, 1976). Yet, if residential density is doubled from 5 to 10 dwellings per acre, within one mile of a downtown centre of 10 million square feet, per capita public transit use will rise greatly. It is estimated that such a density increase will result in 17 times as many transit trips as would a similar development 10 miles from the city centre. It is therefore very important that construction of multifamily structures and development of smaller lots be encouraged as close as possible to the urban core.

As Harwood (1977) has pointed out, by examining their comprehensive land use plans, localities can identify areas where denser development can result in energy savings from space heating and cooling and from greater use of public transport. Other neighbourhoods may be identified where even if single family housing is desirable, smaller lot sizes can reduce urban sprawl. Once this step of identification has

been taken, existing ordinances can be modified to achieve higher densities. Typically, five types of changes may be required: zoning for multifamily dwellings, reduction of height and lot size restrictions, the modification of floor-to-area ratios and permitting conversion of large single family units to apartments.

Simple changes in the text of zoning ordinances or zoning maps can be made which permit multifamily housing in areas where it had previously been prohibited. Normally developers will be quick to take advantage of such stimulants to higher densities. However, communities can promote multi-family housing by ensuring that property assessments reflect permitted densities. Oregon, for example, has amended its tax laws to oblige assessors to value land in accordance with existing comprehensive plan and zoning restrictions.

Density can also be increased by amending height restrictions and so allowing more energy efficient lowrises and garden apartments to be constructed. To avoid congestion, multistorey buildings may be restricted to major roads and transportation corridors and new commercial nodes. In such locations, integrated land use and transportation planning can result in more widespread use of conveniently placed public transit systems. Such an approach has been taken by Montgomery County, Maryland which is creating transit station development zones. These include high density, multistorey buildings within easy walking distance of public transportation.

Large standard lot sizes encourage low density urban growth. Once established, such rigid lots, to be used for single family dwellings, discourage transportation energy conservation and result in the inefficient provision of all forms of public and private services. If energy is to be saved, it is important that such stringent lot restrictions in rapidly developing districts be modified to permit higher density, compact growth. Even in some areas of smaller lot

size, accompanying requirements, such as those that govern the minimum size of front, side and back yards, can be barriers to energy conservation. These regulations are often virtually irrelevant since they do not guarantee either privacy or a view. If they were abolished many such areas could be used for multifamily dwellings. Often in large urban areas there are hundreds, if not thousands, of substandard lots on which, because of inadequate frontage or peculiarities of shape, residential construction is prohibited. In Portland, Oregon, for example, some 5,300 such substandard lots have been identified. In perhaps the majority of cases, innovations in design, coupled with an easing of rigid lot restrictions, could allow residential infilling and increases in density. It is estimated, for example, that this is possible on as many as 3,500 of Portland's substandard lots.

Although most communities in North America regulate density through the use of height, setback and yard requirements, some use a floor-to-area ratio regulation. For example, a ratio of 1.0 or 100 percent means a single storey building can cover the entire lot or a four storey structure one-quarter of it. Such an approach allows greater density to be accommodated more easily because of its flexibility.

Typically, the conversion of large, single family dwellings to multifamily units is resisted at the local level. Yet such conversions, the renting of rooms, or the alteration of basements into suites or even the provision of several apartments or co-operative dwelling space can provide higher density development close to the urban core. Where such flexibility in use is not permitted, space and energy are wasted and illegal conversions frequently occur. There are many ways of overcoming this problem, the right to convert can be granted to all owners, provided certain health and safety standards are met, or special permits can be used to control density increases. Such conversions are often a far more publicly acceptable method of promoting higher

densities than the construction of highrises.

Reducing travel frequency and distance through mixed use zoning

A traditional aim of most planning has been to segregate distinct types of land use. By implication this separation forces people to leave their residential zone to work, shop and play, causing large and often unnecessary transportation energy demands. There is a growing realization that such segregation is not necessarily beneficial (Erley, Mosena and Gil, 1979). In developed urban areas, special permit systems, liberal definition of the term "accessory use" and variances have been used to permit some mixing of land uses, usually on a limited scale and often restricted to services such as small retail shops, churches, groceries and day care centres. Mixed use of land therefore is not a novel concept. What is relatively new, however, is deliberate zoning for a variety of integrated uses. Mixed use zoning, as an energy conservation strategy, is usually taken to include three distinct types of development. Firstly, it permits a combination of different types and values of residential structures, so that all classes can find housing close to their source of employment. Secondly, mixed use zoning is also often taken to include the combination of multiple uses (residential, commercial and perhaps even industrial) in the same building. A typical structure will have ground floor shopping, several storeys of offices and upper level residential use. Finally, mixed use zones also normally include a variety of structures that have distinctly different purposes, such as residential, commercial and industrial.

The typical urban zoning procedure often separates individuals from their source of employment and necessitates long and energy inefficient journeys to work. This problem may be particularly acute for low or moderate income families whose choice of residence is strictly limited. One way of attempting to overcome this problem is to eliminate zoning

restrictions that prohibit multifamily housing in communities. Another approach is to mandate a mixed percentage of low or moderate cost family housing in all new mixed use zones. This second approach has been implemented in Montgomery County, Maryland. It was also attempted in Fairfield County, Virginia but was declared invalid and struck as being outside the scope of the enabling legislation (Harwood, 1977).

Expanding upon an established tradition, multiple use buildings are also becoming increasingly popular in the United States. They are efficient from an energy perspective because they can significantly reduce transportation requirements. Examples of such buildings include the Olympic Tower in New York City, the Prudential Center in Boston, Los Angeles' Century City and the Penn Center in Philadelphia. Typically these structures combine stores, offices and apartments. Changes in zoning provisions are usually required to permit such large new centres, although land use integration can be achieved on a smaller scale by a liberal interpretation of the term "accessory use." One way of ensuring approval of multiple use buildings is to modify the local zoning ordinance to permit specified commercial and residential combinations. This step has been taken by a number of United States cities including Chicago, Little Rock, Baltimore, San Francisco, Washington D.C. and White Plains, New York (Williams, 1975). Even the federal government has passed legislation encouraging the General Services Administration to integrate commercial offices, shops and restaurants in public buildings (Public Buildings Cooperative Use Act of 1976). In addition, the multiple use of structures can be encouraged on a smaller scale by permitting home occupations. Such use of residences by doctors, dentists, typists, lawyers and dressmakers can be controlled by special permit if required.

One of the most active attempts to encourage the construction of a variety of buildings with distinctly different

purposes in mixed use zones has been undertaken by Montgomery County, Maryland. Zoning ordinances established a series of mixed use zones, one of which, the transit station-residential zone, is designed to encourage the development of multifamily housing for all economic groups within easy walking distance of commuter services and public transportation. Such a zone permits a variety of residential uses including room rentals, churches, libraries, museums, rest homes and various commercial services such as laundries and doctors' offices. Restaurants, hotels and grocery stores may be permitted by special permit. Even greater flexibility of use is permitted in transit station-mixed zones. Despite such integration of land use, Montgomery County maintains control by requiring the submission of a development plan which must prove that changes to mixed use zones are likely to be more efficient and desirable than existing standard methods of growth. Site plans are also required and are often used to promote energy efficiency.

Providing utility lines, transportation, sewer and water facilities adequate to accommodate higher densities in energy efficient locations

New roads, sewerlines, hospitals, airports, municipal offices and civic centres have a great impact on transportation energy consumption. Such facilities promote additional growth and should therefore be located in areas where they do not generate unnecessary additional traffic. Harwood (1977) has identified six basic principles that should be followed to maximize efficiency.

He argues that, as far as possible, such new public facilities should be located in developed areas, not on the urban fringe, where they will almost certainly encourage premature growth. Water and sewer lines should only be extended to areas *outside* designated growth regions when land *within* such centres is fully developed. Open space zoning

can be used to prevent unwanted growth along sewer and water systems linking an urban centre and a new growth centre.

A second basic principle guiding the construction of such service facilities is that they should be large enough to accommodate the required development density. For example, if an area is zoned for small highrises, the supporting infrastructure of sewers, roads and utilities lines must be capable of facilitating such development. Thirdly, major travel inducing services should be located along adequate traffic arteries, to prevent congestion and to facilitate the use of public transit. Clustering of public services, for example, locating a swimming pool, library and museum in close proximity allows them to be a single destination point on a public transit system. It therefore permits one trip to accomplish several objectives. Such groupings can be placed in mixed use zones to encourage higher density development. Capital facilities can be used as a means of encouraging private developers to undertake energy efficient projects. As an example, the addition and renovation of services in downtown areas can stimulate the movement of population back into the inner cities, so increasing density and reducing travel.

Such use of public facilities to stage development in accordance with capital facilities extensions has been undertaken in Ramapo, New York (Stollman, 1975). By amending its zoning ordinance, Ramapo prohibited residential development without permit. Such permits are issued only when it can be shown that the site to be developed is served by adequate fire stations, roads, parks, schools, sewers and drainage facilities. A points system is used to determine whether the availability of services is adequate. In addition, the town's capital facilities and service program designates where public facilities will be provided for the next 18 years. If developers do not wish to wait they can build such services themselves to qualify for a permit. To prevent

developers from leapfrogging to more distant areas, outside the jurisdiction of the locality imposing stringent development controls, regional co-ordination is necessary. This can be achieved by having a state or provincial agency which reviews proposals for capital facilities' expansion beyond municipal boundaries. Oregon established three regional boundary commissions in 1969 to play this role. They have jurisdiction over counties surrounding the three major urban areas in the state. Such regional boundary commissions can also make sure that no premature annexation is allowed, so preventing low density sprawl.

Open space zoning

Open space zoning is a further strategy which can be used to discourage premature growth in areas widely separated from employment and shopping centres. Like other growth management regulations it is best applied within a comprehensive regional plan and should complement capital facilities expansion programs. Various types of open space zoning are being used in the United States to improve the efficient use of energy. These include large lot, agricultural and environmental zoning.

In large lot zoning, a minimum lot size of perhaps ten acres is set. This results in very low density growth. However, because of the relatively small number of residences involved, total energy demand is slight. Although large lot zoning is not an optimum strategy from an energy efficiency viewpoint, it is often familiar to local officials and therefore relatively easy to implement.

Various types of agricultural zoning also are used in the United States to prevent urban sprawl. Exclusive agricultural zoning prohibits the construction of all buildings unrelated to farm use, while other less restrictive forms permit occasional residential building. In Sacramento County, California, for example, minimum two acre lots are required

in the agricultural-residential area. Similar size restrictions are in force in Pinellas County, Florida (Gleeson et al., 1975). Sensitive area and environmental zoning is also often used to prevent development on high risk sites such as floodplains, shorelands and landslide prone areas or on important wildlife habitats. Such zoning can be used to prevent energy inefficient development through the preservation of open space.

Land pooling, land banking and the transfer of development rights

One of the major obstacles to the more efficient development of urban fringe areas is often the multiplicity of landowners involved and the small sizes of their lots. This problem can be overcome by the use of land pooling, a technique for the compulsory but *temporary* consolidation of private landholdings so that they can be planned, serviced and subdivided as a whole. The costs incurred are then recovered from the increase in land values. In this manner, energy efficient development can be promoted by local governments at no cost either to themselves or to the landowners involved. While the authors of this report are unaware of the use of this approach in the United States, it is being applied in Perth, Western Australia with considerable success (Archer, 1978). Similarly, the pooling of privately owned lands for urban development is a common practice in South Korea, Japan and Taiwan (Doebele, 1976; Sah, 1972). In these countries efficient development is prohibited without such a practice by the existence of numerous small and irregular shaped farms.

Land banking is a more commonly applied approach to consolidating urban fringe land. In contrast, this involves *permanent* government acquisition and disposal of undeveloped land on sufficient scale to control future growth patterns. Land can be acquired on the open market or by expropriation. It may then either be withheld from developers, so encourag-

ing greater density growth in more central locations, or released in a manner that provides energy efficient, orderly development. There are small scale advanced acquisition programs in perhaps one-third of all cities in the U.S.A. with populations of over 50,000. These, however, have typically been used to promote particular land uses, such as industrial parks or low income housing, rather than to control development on a large scale. Exceptions have occurred. Puerto Rico created a land bank in 1964 to stabilize land supply and to control the direction of growth (Fishman, 1975). Its success has been limited. In contrast, Stockholm, Sweden began land banking in 1904 and now owns 70 percent of land outside the central city. This ownership has allowed the construction of 18 new communities near subway systems designed to facilitate energy efficient transportation links with the capital (Kraus, 1975).

The transfer of development rights is a relatively recent innovation being used to promote higher densities in central locations and to prevent premature fringe growth. Under a transfer of development rights plan, the right to alter the natural landscape by building is transferable from one parcel of land to another. A lot or parcel to which the rights have been shifted can then be developed at higher density than would otherwise have been permitted under the zoning ordinance, prior to the transfer of development rights. Such rights are usually sold or can be moved by their owner to other sites acquired elsewhere. Such movement of rights is not permitted to occur at random but is governed by a comprehensive plan for orderly growth which has established desirable high and low density development districts. Such a transfer of development rights plan is currently in operation in Chesterfield Township in New Jersey, Southampton Township in New York, Buckingham Township, Pennsylvania and Collier County, Florida (Harwood, 1977). The major advantage of such a system is that it does not provide certain landowners with

windfall profits at the expense of others who have had their rights to development wiped out.

Other strategies capable of generating moderate or small energy savings

There are at least eight other strategies that can be applied by municipalities which may result in small, but not insignificant, energy savings. These include the creation of neighbourhood parks and requiring developers to dedicate conveniently located land for recreational use. Similarly, the designers of large planned unit growth can be obliged to locate service centres so they are easily accessible to the maximum number of residents. The construction of bicycle and pedestrian paths should also be encouraged. In 1971, for example, Oregon enacted a bicycle and footpath law which requires that 1 percent of the state highway funds that are awarded to a city or county must be used to establish footpaths and bicycle trails. The California Bikeways Act also encourages such development. In warmer climates, an attempt may be made to shade roads with vegetation to encourage pedestrian use and the number of through streets reduced to discourage automobile traffic. The use of the bicycle as a means of transport is being promoted by every level of government in the United States. On November 24, 1975 Congress approved an appropriation of $6 million to provide funds for "bikeway projects of national interest and [for promotion of] bicycling as a safe and viable alternative mode of transportation for commuter and/or recreational use in urban or urbanized areas." Individual projects were to be funded on an 80 percent federal and 20 percent state or local matching basis. The response was overwhelming: 495 individual projects were proposed by 50 states, the District of Columbia and Puerto Rico. These involved almost 4,000 miles of bike paths and facilities with an estimated cost of $141 million. Because of the project's limited budget, only 41 were selected for funding by the Federal Highway Administration

(Wheeler, 1977).

Cluster zoning relaxes yard, setback and lot size requirements thereby allowing buildings to be grouped. Such an approach can greatly reduce the road lengths required and lower the need for energy in both construction and use. The Urban Land Institute (1961), for example, has shown that a development tract with 94 one-acre plots requires some 6,000 feet of road if development is clustered, while rectilinear growth necessitates 12,000 feet and curvilinear development needs 11,600 feet. In addition to efficiencies in transportation, clustering also permits maximum use of the energy saving features of the natural environment, such as passive solar heating and shade from vegetation.

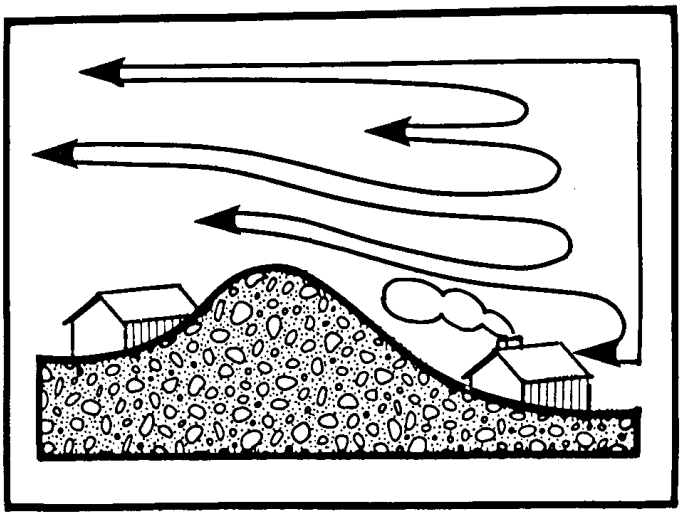
Space Heating and Cooling Efficiency and Land Use Regulation

Energy can also be conserved by applying land use regulations which increase the thermal efficiency of new construction. Two legislative thrusts are required to achieve this goal. Multifamily structures must be promoted and maximum use must be made of the energy conserving attributes of the physical environment.

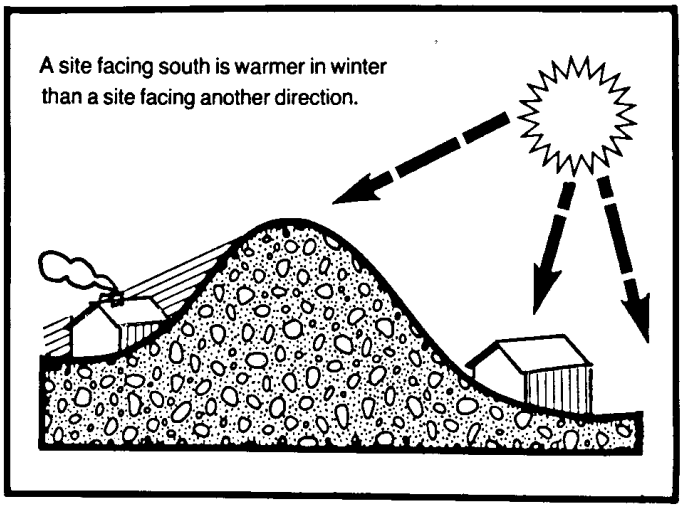
Multifamily structures have fewer surfaces exposed to the vagaries of the weather than do single family residences. As a result, a smaller volume of cool air infiltrates and less heat is lost by conduction. It has been demonstrated that about 30 percent less energy per square foot is required for temperature control in medium sized multifamily dwellings than in detached homes. In addition, such apartments often provide less per capita floor space and, in consequence, may use up to 60 percent less energy for space heating and cooling on a per unit basis (Keyes and Peterson, 1976). This generalization is not true, however, for buildings over 50 storeys in height which require large quantities of energy for heating and cooling common space such as hallways and for the operation of services such as elevators.

One of the early pioneers in the use of the energy conserving properties of the landscape, Victor Olgyay (1963) discussed the topic at length in *Design with Climate: Bioclimatic Approach to Architectural Regionalism.* He demonstrated that considerable energy savings could be achieved by utilizing topography, prevailing wind direction and vegetation (Figure 1). For example, in cold climates, hills should be used as buffers against harsh winds and buildings should be placed on lower slopes. In some warmer zones they should be located on summits so they can gain the maximum benefit from cooling breezes. In temperate regions, building should be encouraged on slopes facing in a southeasterly direction where they will receive maximum winter sunlight. In hot, arid zones, where residents require the benefits of cooling breezes, sites with an east-southeast exposure near the base of hills will permit maximum use of cool air flows and afternoon shade (Keplinger, 1978). Table 3, derived from an AIA Research Corporation report produced for the U.S. Department of Housing and Urban Development in 1976, summarizes the factors which must be considered if maximum use is to be made of the energy attributes of the environment.

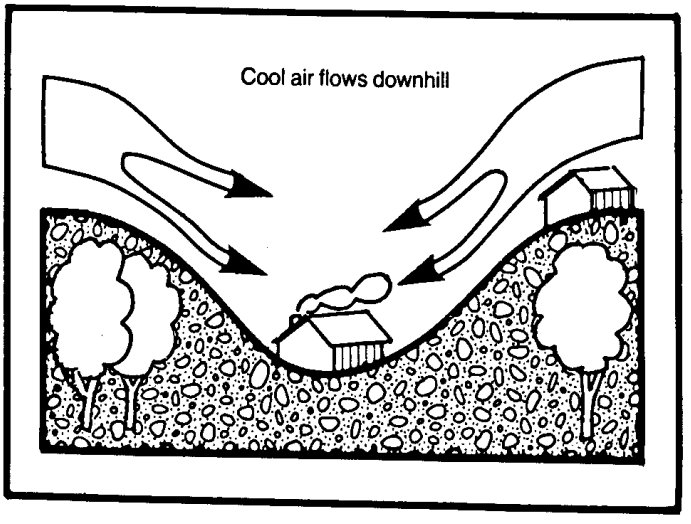
The actual arrangement of buildings on the ground is also significant since they mutually influence airflow. Arranging buildings in rows provides protection from strong winds in harsh climates. This is particularly beneficial if they are aligned in the direction of the prevailing wind. In contrast, staggered building arrangement in warm climes permits the beneficial effects of cool breezes to have maximum impact (Olgyay, 1963). To illustrate, in Princeton, New Jersey townhouses in the windward side of the city require 5 percent more natural gas than similar structures on the more sheltered leeward side. Those townhouses at the end of the row, with one exposed wall, were found to need 10 percent more gas (Socolow, 1975)(Figure 2).



TOPOGRAPHIC SITING FOR PROTECTION FROM THE WIND



SITE ORIENTATION FOR MAXIMUM SOLAR HEAT



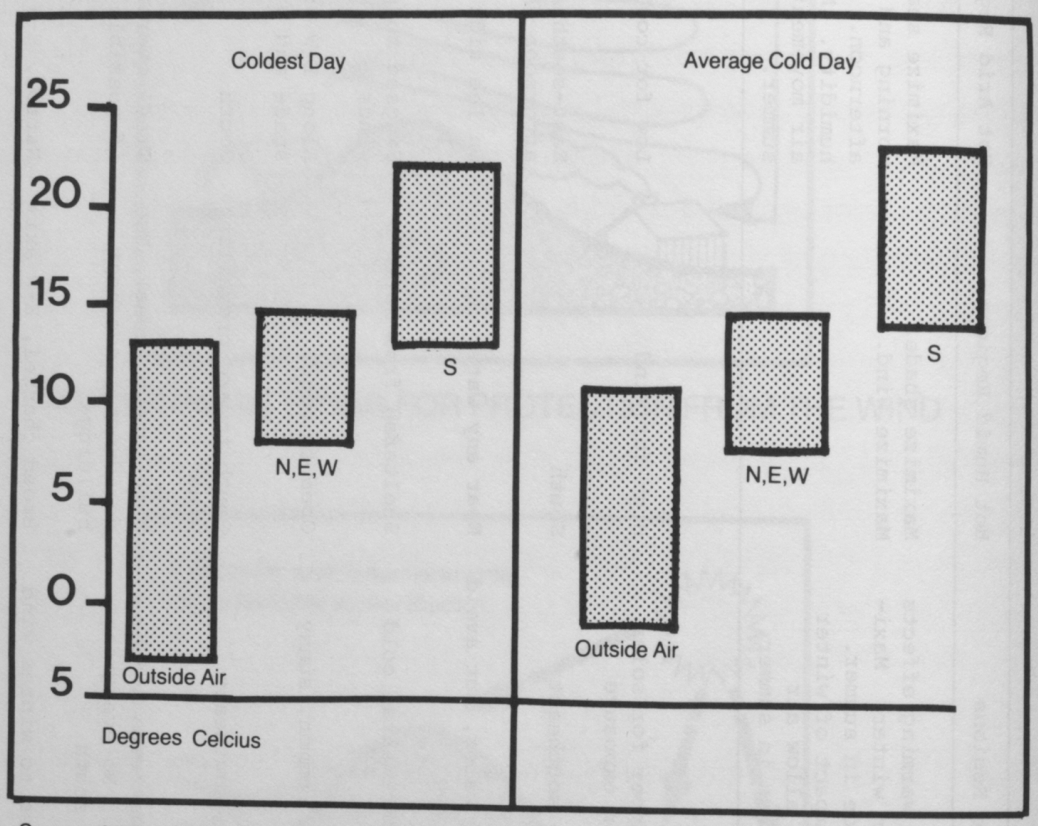
COOL AIR DRAINAGE AND COLD POCKETS

Figure 1: The use of Topography to Save Energy
(Source: Erley, Mosena, Gil . 1979)

TABLE 3 : SITE DESIGN AND ORIENTATION

	Cool Regions	Temperate Regions	Hot Humid Regions	Hot Arid Regions
Objectives:	Maximize warming effects of solar radiation. Reduce impact of winter wind. Avoid local climatic cold pockets.	Maximize warming effects of sun in winter. Maximize shade in summer. Reduce impact of winter wind but allow air circulation in summer.	Maximize shade. Maximize wind.	Maximize shade late morning and all afternoon. Maximize humidity. Maximize air movement in summer.
Adaptations:				
Position on slope	Low for wind shelter	Middle-upper for solar radiation exposure	High for wind	Low for cool air flow
Orientation on slope	South to southeast	South to southeast	South	East-southeast for afternoon shade
Relation to water	Near large body of water	Close to water, but avoid coastal fog	Near any water	On lee side of water
Preferred winds	Sheltered from north and west	Avoid continental cold winds	Sheltered from north	Exposed to prevailing winds
Clustering	Around sun pockets	Around a common, sunny terrace	Open to wind	Along E-W axis, for shade and wind
Building orientation	Southeast	South to southeast	South toward prevailing wind	South
Tree forms	Deciduous trees near building. Evergreens for windbreaks	Deciduous trees nearby on west. No evergreens near on south	High canopy trees. Use deciduous trees near building	Trees overhanging roof if possible
Road orientation	Crosswise to winter wind	Crosswise to winter wind	Broad channel, E-W axis	Narrow, E-W axis
Materials coloration	Medium to dark	Medium	Light, especially for roof	Light on exposed surfaces, dark to avoid reflection

SOURCE: AIA Research Corporation (1976).



Source: Adapted from A Strategy for Energy Conservation, City of Davis, California

Figure 2: Winter Temperature Ranges of Unheated Apartments Facing Different Directions.

The use of landscaping is also important. Land use policy should encourage the saving or planting of deciduous trees which shade homes in summer and allow solar rays to warm their interiors in the winter. Evergreens can also be used to protect dwellings against cold winds, while hedges and trees can be positioned to deflect breezes onto buildings in warmer climates.

Strategies to promote the construction of multiunit structures

Many of the strategies to promote the construction of lowrise and small highrise family housing have already been discussed since they are also pertinent to energy efficient transportation systems. These include reducing lot and height restrictions, allowing conversion of single family homes and increasing building floor-to-area ratios. In addition, two other approaches should also be mentioned. For example, legislation can be passed which permits, or indeed requires, planned unit developments or projects over a specified size to include fixed percentages of lowrise and small highrise buildings. In addition, density bonuses, a type of incentive zoning that allows developers to build at a higher density than normally permitted if they include certain amenities or special features in their designs, can be used to promote multifamily structures. Such bonus systems can be either voluntary or mandatory. They become even more valuable if the amenities to which they are tied are also energy efficient. For instance, a density bonus can be granted to a development located close to a public transit station, or which has multiple use of buildings or is oriented to make the maximum use of passive solar heating. To illustrate, Lakewood, Colorado and Fairfax County, Virginia have required large developments to include a fixed percentage of low and moderate income residences. In exchange, developers are given a density bonus (Harwood, 1977). In Eugene, Oregon such incentives have also been given to developers

who dedicate land for bicycle paths.

Such high density living would perhaps reach its maximum in North America if the single urban structures, arcologies designed by Paolo Soleri, are ever completed. One, a 25-storey, three dimensional city called Arcosanti, is currently under construction 70 miles north of Phoenix, Arizona (Hughes, 1978). This is expected to utilize passive solar heating and cooling, greenhouses for food production and waste recycling techniques. The arcological city faces south and is being build to support a population of 5,000.

Strategies designed to take maximum advantage of the physical environment

Some municipalities are beginning to implement legislation designed to increase the thermal efficiency of buildings through the effective use of the natural environment. Such strategies include zoning for flexible yard and setback standards that allow both energy efficient orientation of the structure and optimal building shape. Legislation is usually designed to encourage cluster zoning. In certain cases special permits are issued to allow the most beneficial building orientation to be used. This approach has been applied in Buchanan, New York (Williams, 1975).

In Vermont, state permits are required for all major developments. The Vermont Public Service Board and the Agency of Environmental Conservation designed a checklist of site planning objectives to decide if a permit should be issued. This includes numerous items which are designed to ensure minimum heat loss from buildings. For example, the agency examines the proposed design to see if buildings will face southeast to southwest, are located midway up slopes, and are sheltered by trees and shrubs. In all, 27 aspects of the physical environment and the development are checked to ensure maximum energy conservation. Such a site review naturally examines different aspects of the milieu in warmer climatic zones, but the checklist could easily be modified

to permit this (Figure 3).

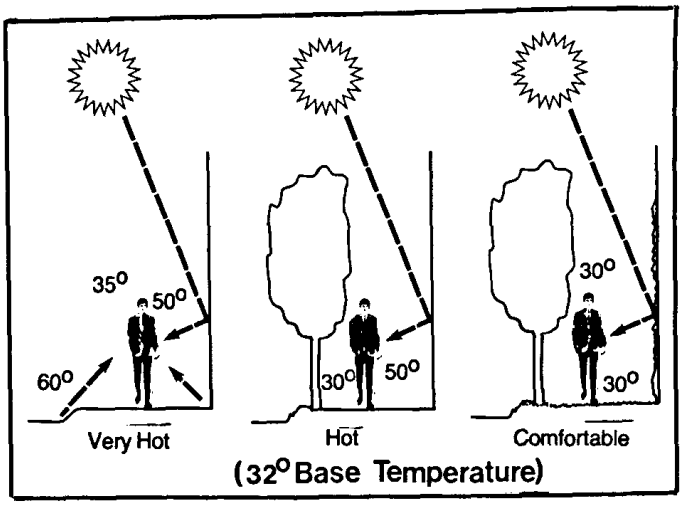
In Davis, California a comprehensive study has been carried out to promote local energy conservation. One of the more innovative suggestions involved examining the various ordinances that provided obstacles to the utilization of solar energy in neighbourhood design and proposing revisions of each. The investigation has ranged from minor problems such as the placement of fences to major issues including street design. Three dimensional envelope zoning is proposed in an effort to assure shadow free solar collector locations and unobstructed windows. Such an approach could be used to encourage passive solar heating on a larger scale. Indeed, Keplinger (1978) has suggested that ordinances and covenants may soon be passed in the United States to control the flow of cool or warm air through cities in the same way that water movement is now commonly regulated.

Thermal efficiency can also be improved by requiring roads and lots to be laid out to permit optimal building design and orientation. In addition, natural vegetation must be preserved and new trees and shrubs planted where they will shelter buildings from extremes of temperature. In Fairfax County, Virginia, for example, no developer can clear five or more acres of land without a tree removal permit. In this way shade and buffer trees can be preserved.

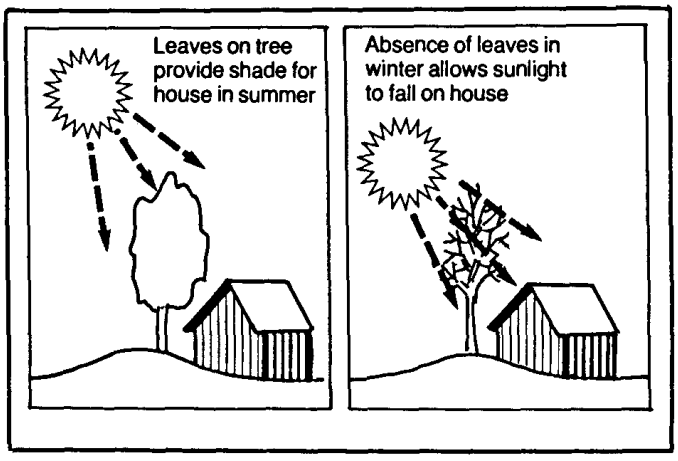
Minor energy savings in construction can also be achieved by preserving the environment as far as possible. By way of illustration, street width requirements can be reduced, these are often excessive in residential areas for the traffic they bear. Similarly, site plan reviews can stress reduction of street length and curbs and gutters unless other constraints require the use of more extensive systems.

Underground storage and construction

In September of 1977, Rockstore 77, an international conference on underground storage facilities, was held in



Source: Adapted from Planning for Energy Conservation, City of Davis, California 1976



Source: Erley, Mosena & Gill, 1979

Figure 3: Effects of Vegetation on Air Temperature.

Stockholm. It was attended by over 1,000 delegates (McCreath and Mitchell, 1978). At this meeting and elsewhere the energy implications of underground building have been shown to be enormous. Bligh (1975) reported that cold storage facilities operated by Space Center Inc. above ground in St. Paul, Minnesota use approximately ten times as much energy as similar company facilities 15 meters below ground in the limestone caverns beneath Kansas City. The reported energy savings for facilities such as schools, warehouses and offices, that operate at normal temperatures of approximately 20°C, range from 20 to 90 percent. In general, the harsher the climate, the greater the underground energy savings. Underground building would therefore be particularly efficient in Canada.

The Brunson Instrument Company of Kansas City, a manufacturer of high precision equipment, has operated both above and below ground facilities. By moving underground, annual operating costs were cut from $70,000 per year to $3,200, largely due to a reduction of energy demand from 590 kW to 222 kW for heating and from 2,470 kW to 201 kW for air conditioning. Greatly reduced energy requirements have also been reported from high temperature underground silos for molasses and heated residual oil storage in Norway (Larsen and Meinsingset, 1977).

An underground home market is beginning to develop in the United States. In Granite City, Illinois, for example, subterranean residences are claimed to have achieved between 60 and 75 percent reduction in heating and cooling energy requirements (Davis, 1978). Ecology Houses, designed by architect John Barnard, have been built completely below ground in Massachusetts, Oregon, Georgia, Kansas and Missouri (Craig, 1978). Major energy savings are claimed for these structures.

While underground housing may not be as practical as high density development, it does offer an energy efficient

alternative to highrise living. As yet, few communities have been faced with a demand for large scale underground construction of this type. Nevertheless, it is apparent that, from an energy efficient viewpoint, building codes and land use regulations which prohibit or limit it should be eased whenever possible. As far as the authors are aware, only one community in the United States has addressed this problem; Lawrence/Douglas County, Maryland has revised its zoning ordinance to accommodate underground housing. Here such structures have been given a definition distinct from basements so that subterranean dwellings have the same status as above ground housing (Erley, 1979).

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Research on the energy demands of alternative land use patterns have proliferated over the past two years. Although such studies merely whet our appetities for more empirical data, researchers agree that land development patterns clearly affect the amount of energy we consume, particularly for transportation and for space heating and cooling.

— Harwood (1977)

POLICIES TO PROMOTE ENERGY CONSERVING LAND USE

Changes in Planning Related Legislation

The most effective way to implement energy efficient land use strategies is through comprehensive planning. To have maximum impact, this must be co-ordinated at every level of government and should ensure that energy conservation is injected into all relevant agency decisions. Naturally, comprehensive land use planning seeks to satisfy other goals besides energy efficiency but, articulating this objective makes certain that it will be given due weight in the decision making process.

Several United States governmental bodies have made significant progress in this direction. In some cases all that has been involved has been an amendment to the state, regional or local general comprehensive planning acts so that they oblige the agencies to consider the energy implications of their land use decisions. It is relatively easy to add energy conservation to the list of goals sought. Such an approach has been taken in Eugene, Oregon and Albuquerque-Bernalillo County, New Mexico. Existing land use legislation has also been amended to encourage the adoption of energy efficiency in Vermont and Florida; states which have gained control over local projects with large potential energy impacts. Similarly, regional planning councils may be set up to promote energy efficient land use. One notable example is the Minneapolis/St. Paul Metropolitan Council, which has the authority to develop "metro system plans" dealing with open space, transportation, airports and sewers in the Twin Cities. Any local government comprehensive plan that is inconsistent with regional aims can be vetoed by the council. An alternative approach is for the state to expressly formulate a series of goals but to require local municipalities to develop their own comprehensive land use plans. These, of course,

must conform to the statewide goals and are reviewed to ensure that they are in fact compatible. In 1973, Oregon began to implement such a strategy and established a Land Conservation and Development Commission to set goals and review all local plans. Energy conservation was one of the statewide goals adopted and must now be demonstrated in all local comprehensive plans. The success of this approach is described in detail elsewhere in this report with special reference to Portland.

In 1969 the National Environmental Policy Act was passed in the United States. Since that date a large number of state, county and local statutes have been introduced which are modelled on the federal act. Of the 25 states that have adopted such environmental impact legislation, 9 explicitly require analysis of the energy demands of the project in question. In both California and New York states the impact statement must analyze measures to conserve energy. In California, for example, the environmental impact statement must contain mitigation measures proposed "to minimize the impact, including but not limited to measures to reduce wasteful, inefficient, and unnecessary consumption of energy." Various guidelines to developers have stressed encouraging mass transit, orientation of structures to minimize heating and cooling requirements and the construction of bicycle lanes (Harwood, 1977). Similarly, energy impact statements are required by the South Florida Regional Planning Council. Such assessments of proposed developments have already begun to promote the more widespread use of energy efficient land use strategies in Florida.

Planned Unit Developments are characterized by a single integrated plan for an entire project. In 1973 six states had enabling legislation for such Planned Unit Developments and six others had approved similar techniques. Such an approach to planning has enormous potential for energy conservation and can result in the integration of virtually all

the strategies discussed to date into a single project. Planned Unit Developments can combine residential, commercial, institutional, light industrial and recreational land uses to produce virtually self-sufficient communities. Orientation, shape and density of buildings can also be planned to give maximum energy efficiency. Although Planned Unit Developments vary in size from new towns such as Twin Rivers, New Jersey which covers 714 acres and is to accommodate a population of 10,000 in less than 5 acres, very few have yet been planned with energy conservation as a major goal. Nevertheless, the potential for efficiency in such developments is extremely high.

Cost of Energy Efficient Land Use

As Keyes (1976) has pointed out, in judging the suitability of any policy, relative efficacy is only one consideration. Cost, acceptance or general feasibility are the others. As yet there is no methodology available to fully quantify the monetary effects of applying land use controls to create an energy efficient urban form. Naturally, limiting the supply of land for certain purposes affects land prices, which in their turn must be reflected in the costs of urban goods and services. In contrast, energy conservation will reduce these costs in other ways, notably through savings in transportation and heating and cooling. As yet, little more than such general assertions can be made.

There are, of course, other costs associated with promoting energy efficient land use. Higher densities may cause losses of privacy or perhaps greater noise pollution and stress. Increased public involvement in land use through the enforcement of stringent regulations is likely to be seen by many as a further unwarranted infringement on the right to private land ownership. It should be pointed out that single purpose planning can only achieve single purpose objectives. This is not enough, since the rational development and

management of cities involves complex trade-offs against multiple objectives. An energy efficient city, for example, may be highly susceptible to fire or crime. The assessment of any of these strategies to increase energy efficiency, therefore, requires a careful analysis of all its probable secondary impacts so that a package of options can be selected which permits progress towards not one but several goals.

A strategy for innovation is, in a sense, an exercise in "planning the unplannable." Innovation cannot be commanded; it must be encouraged and coaxed.

— M. Shanks, *The Innovators: The Economics of Technology* (1967)

ESTIMATED ENERGY SAVINGS

The major links between land use patterns and the consumption of energy are derived from two intermediate relationships. The first involves building types and occupancy and the second, travel behaviour (Keyes, 1976). The innovations previously discussed assume that where population densities are high and industrial and commercial activities small and integrated, there is a considerable potential for energy saving through more efficient space heating and cooling. Similarly, where sources of employment and commercial centres are located close to residential districts, it is believed that energy consumed in travelling to work and to shop will be greatly reduced. This should be especially true when high density development is restricted to transportation corridors, allowing individuals or goods to move by energy efficient modes, such as rapid transit.

Although beneficial relationships between certain types of land use patterns and energy consumption may appear self-evident, more quantitative assessments of savings must be made if policies resulting in major changes in the urban form are to be justified. In order to document actual savings from certain types of innovative land use patterns, relatively detailed descriptions of both energy consumption and spatial variations in urban form must be obtained from several cities. These urban areas must also display distinct differences in infrastructure to facilitate meaningful comparisons of energy use.

Despite considerable interest in this relationship, researchers in the United States have found great difficulty in obtaining disaggregated data on energy use in cities, or even descriptions of the urban form which do not rest virtually exclusively on population densities and density gradients (Keyes, 1976). Some attempts have been made, however, to study the relationships between energy consumption and

existing urban structure. In addition, models have been developed which attempt to predict how alternative land use patterns may influence future energy demands.

Probably the most detailed examination of the relationship between present energy use and urban form, yet undertaken in the United States, was conducted for the New York City region (Regional Plan Association Inc. and Resources for the Future, 1974). In this study, energy use in each of the area's 31 counties was estimated for both economic sector and fuel type. Urban form was, however, only represented in the analysis by gross population density and the extent of the region's transit network. The results of this survey were inconclusive, possibly because of such data limitations. For example, in the New York metropolitan area which includes 9 of the 31 counties, population densities are highest and the transit service the most extensive. As might be expected, the average energy used for transportation by a resident of New York proper is less than half that required by the typical American (Darmstadter, 1975). Nevertheless, despite higher population densities, the average per capita residential energy consumption in the New York area is 15 percent greater than elsewhere in the United States. This may be the result of a combination of the effects of cooler climate and higher incomes but its cause remains problematic. In summary, when the New York region as a whole was analyzed, the data appeared to support the hypothesized transportation energy/spatial structure relationships postulated earlier. In contrast, probably because of the crude measures of urban form, the evidence for the anticipated residential energy/spatial structure relationship was found to be inconclusive (Keyes, 1976).

There is also voluminous literature on travel behaviour in U.S. urban areas (Stowers and Kanwit, 1966; Deutschman and Jaschik, 1968). Keyes has attempted to summarize the findings of these and other studies and has concluded that four major

relationships can be substantiated. Firstly, as population density increases within a United States urban area, the number of non-pedestrian trips decreases. Secondly, as both population and employment density increase, the percentage of journeys undertaken by automobile decreases. Thirdly, as distance from the central business district increases, so too does the speed of traffic. Finally, average metropolitan trip length has not been shown to vary consistently with average population density, although some differences between central city and suburban lengths have been noted. To summarize, although some research findings lend support to the hypothesized relationship between transportation energy use and certain types of urban structure, the data are not as yet conclusive. It must also be pointed out that household characteristics such as family size, income and age are probably more important than the density of the neighbourhood or distance from the central business district in determining how, when and where particular individuals travel (Stowers and Kanwit, 1966).

Several models have been developed recently that enable estimates to be made of the future heating and cooling loads of various structures. These predict building energy demands from such factors as design and orientation, construction techniques and materials (including insulation) and the type of heating and cooling systems used. These models are relevant to the present study because attempts to increase population density give added momentum to the adoption of certain types of structures, particularly highrises. A study of this type was conducted by Anderson (1973) in conjunction with Tokmanhekin and Harvey (1974) for the Baltimore, Maryland/Washington D.C. area. This established a general trend towards reduced energy loads with greater density. Such savings resulted from both inherent thermal efficiency gains in highrise buildings and the smaller size of associated multifamily units. On the basis of floor area, single

family detached homes require 20-30 percent more energy than do similar sized units in highrise structures. A further examination of this topic by the Arthur D. Little organization (1974) which also incorporated regional climatic differences, estimated a heating and cooling load differential between such residential structures of about 65 percent for a given area, averaged for all regions of the United States. Although energy consumption patterns for different building types vary across the United States, it is apparent that any land use policy which promotes greater population densities through the use of highrise development will be a step towards energy efficiency.

On a more theoretical level there have been several attempts to establish the transport related energy demands of various urban forms. These have attempted to estimate either the total travel that will occur in a particular urban area, and hence permit energy needs to be calculated, or they simulate the energy used for travel directly.

One such study was carried out for the Seattle, Washington area by Schneider and Beck (1973). These authors developed a methodology for searching through a very large number of possible spatial arrangements of residences, jobs and transportation networks. Using certain relatively unsophisticated assumptions about travel behaviour, based chiefly on a gravity model, they were able to select spatial arrangements which minimized total travel time.

This approach has also been used by Edwards and Schofer (1975) to analyze the energy requirements of 37 possible combinations of spatial structure and transportation networks for Sioux Falls, South Dakota. The results indicated that the energy consumption levels of the least and most efficient hypothetical cities varied by a factor of about 10. In those test cities where only shape and the optimum distribution of land use were considered, this variable alone accounted for differences of a factor of 2, linear cities appearing to

consume the least energy and concentric ring cities the most. In a similar manner, the energy implication of five alternative growth scenarios have been studied for the Washington, D.C. area by Roberts (1975). These possibilities, broadly representative of different city forms, are listed below:

A. DENSE CENTER

This scenario assumes that all added households and employment will be concentrated in the metropolitan center, with somewhat higher density residential development.

B. TRANSIT-ORIENTED

The emphasis in this scenario is on the planned METRO system, with all new households and employment located in areas where planned stops on the rapid rail system are located. Densities are moderately higher.

C. WEDGES AND CORRIDORS

The prevailing plan for development in the metropolitan Washington area calls for emphasis on radial transportation routes from the metropolitan center, and development of those corridors; wedges of open land without development would be reserved between corridors. This alternative reflects that plan.

D. BELTWAY-ORIENTED

Since much of the recent growth in metropolitan Washington has been focused on the Capital Beltway, a circumurban expressway that rings the metropolitan center, this alternative extrapolates that trend. All added households and employment are concentrated in vacant areas adjacent to the Beltway.

E. SPRAWL

In this scenario, the increment of households is assumed to locate beyond the Beltway in low density, largely single-family units; employment on the other hand is concentrated in the metropolitan center (office uses) or around the Beltway (retail uses).

In each case about 50 percent of the present base is expected to be added by 1992, that is 500,000 new households and 750,000 additional sources of employment. The energy implications of future travel were examined using a model calibrated to account for present transport behaviour in the area. The results obtained indicate that, considering automobile consumption alone, the sprawl pattern would be about twice as energy demanding as that of the dense centre and transit oriented options by 1992. Considerable differences

would also occur in residential energy demand (Table 4).

Roberts concluded that:

> ... the attributes of an energy-efficient land use pattern seem to include the following: development at somewhat higher densities, with clustering techniques as well as use of natural amenities on the site to reduce heating, cooling, and lighting loads; contiguous development with no leapfrogging; orientation to public transportation and reduced, more efficient use of the automobile; use of certain technical options that require some reorganization of present land use patterns in order to be implemented; and general relationships among land uses that will result in less travel, less material requirements, and less land and structural area per dwelling unit.

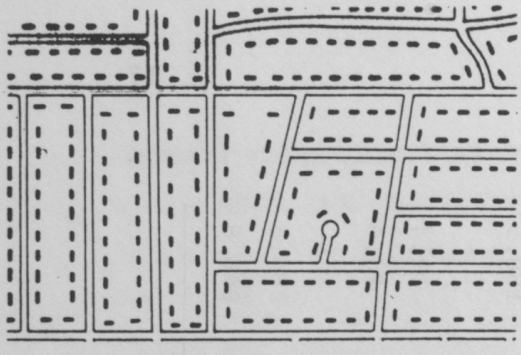
In 1974 the United States Real Estate Research Corporation published estimates of the economic, environmental, psychic and other personal and community costs associated with alternative patterns of residential land developed. This study, entitled *The Costs of Sprawl*, focussed upon six development forms which ranged from the traditional "unplanned" single family subdivision to high density "new communities" (Figure 4). In each case 10,000 dwelling units were involved in the analysis. Data were drawn largely from an examination of the experience of actual municipalities and the costs that they had incurred in undertaking various types of residential growth.

It was concluded that planned development of all densities was far less costly to create and operate than sprawl. Some of the advantages of high density planned growth included lower air and water pollution levels, less water use and cheapter utility and road service. Most pertinent to this study were the conclusions drawn about the probable energy demands of the six alternative residential development forms. These estimates ranged from an annual low of 2,274 billion Btu's for 10,000 high density planned units to a peak of 4,060 billion Btu's for a similar number of residences that could be characterized as low density sprawl. Planned, combination and sprawl mixed and low density planned residential developments had estimated yearly energy requirements

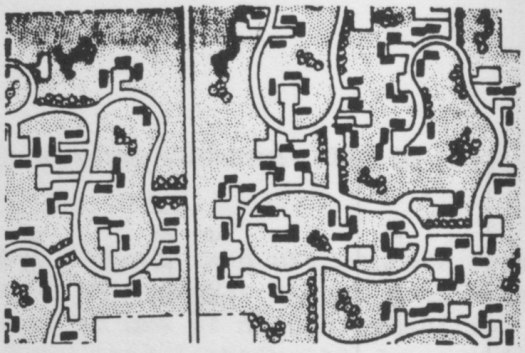
TABLE 4 : ENERGY CONSUMPTION BY ALTERNATIVE DEVELOPMENT SCENARIOS (in 10^{12} Btu/Yr) IN 1992

	Base	A Dense Center	B Transit Oriented	C Wedges and Corridors	D Beltway-Oriented	E Sprawl
CONSUMPTION BY SECTOR						
Residential	265.3					
Increment		91.0	95.8	109.9	112.4	122.6
Total, Forecast Year		356.3	361.1	375.2	377.7	387.9
Commercial/Industrial Institutional	176.6					
Increment		78.9	78.9	78.9	78.9	78.9
Total, Forecast Year		255.5	255.5	255.5	255.5	255.5
Transportation, Automobile	117.9					
Increment		35.1	33.1	59.5	52.2	70.6
Total, Forecast Year		153.0	151.0	177.4	170.1	188.5
Transportation, METRO	2.5					
Increment		12.4	12.4	12.4	12.4	12.4
Total, Forecast Year		14.9	14.9	14.9	14.9	14.9
TOTAL	562.3					
Increment		217.4	220.2	260.7	255.9	284.5
Total, Forecast Year		779.7	782.5	823.0	818.2	846.8

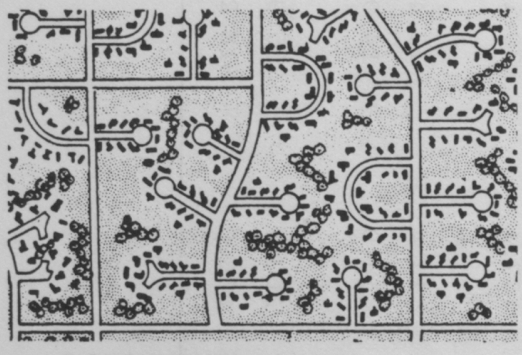
SOURCE: Roberts (1975).



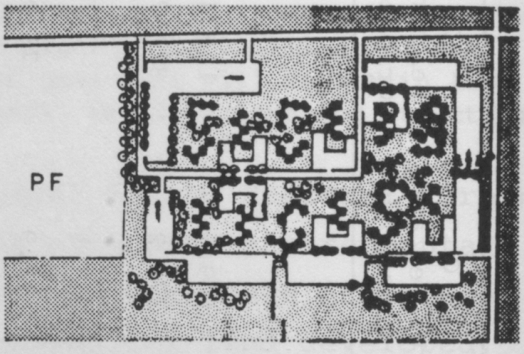
A. SINGLE FAMILY
CONVENTIONAL 100 ACRES



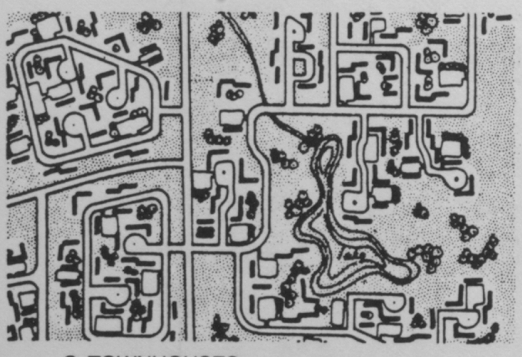
D. WALK-UP APARTMENTS
100 ACRES



B. SINGLE FAMILY
CLUSTERED 100 ACRES



E. HIGH RISE APARTMENTS
100 ACRES



C. TOWNHOUSES
CLUSTERED 100 ACRES

0 500 FEET

F. HOUSING MIX
(20% EACH A-E) 100 ACRES

0 500 FEET

NEIGHBORHOOD PROTOTYPES - LEGEND

PF — PUBLIC FACILITIES

R — RECREATION

V — VACANT LAND

PUBLIC AND SEMI-PUBLIC OPEN SPACE

UNDEVELOPED LAND

SINGLE FAMILY CONVENTIONAL

SINGLE FAMILY CLUSTERED

TOWNHOUSES CLUSTERED

WALK-UP APARTMENTS

HIGH RISE APARTMENTS

Figure 4: Representative Development patterns
(Source: Real Estate Research Corporation, 1974)

of 2,822; 3,019; 3,281 and 3,735 billion Btu's respectively. The study therefore illustrated that United States local communities could reduce their energy requirements of new residential developments by as much as 44 percent by encouraging high density planned development and prohibiting low density residential sprawl (Real Estate Research Corporation, 1974).

Elsewhere in this volume the efforts of the City of Portland, Oregon to conserve energy are discussed in detail. It is important to note here, however, that one of the chief objectives of the Portland Energy Conservation Management Demonstration Project was to develop a methodology to predict potential energy savings from changes in the urban form. The methodology developed was designed to be applicable to other United States cities although energy savings would differ with climate and building codes (Bureau of Planning, Portland, 1977). Savings from over 85 conservation programs were calculated and 42 were used in assembling a comprehensive energy plan. Portland is therefore one of the few cities to attempt to quantify potential energy savings from the application of particular land use strategies. For example, it has been estimated that by promoting the construction of townhouses and apartments near transit stations, Portland could save 6.2 percent of its regional 1995 projected energy demand for transportation, and a further 6.2 percent of that expected for residential use. Similarly, encouraging more neighbourhood grocery stores could reduce 1995 transportation requirements for energy by 1.4 percent, while the promotion of bicycle paths might cut it by a further 0.3 percent (Table 5). The model used to produce these estimates appears to have potential Canadian applications.

There has been at least one attempt in the United States to expand consideration of the relationship between energy consumption and city form to include the urban hinterland and the demands placed on it by city dwellers. This step has

TABLE 5 : TRANSPORTATION AND LAND USE CONSERVATION CHOICES, CITY OF PORTLAND, OREGON

Implementation Program	Maximum 1995 Energy Savings Billions (10^9) Btu's Per Year	Maximum % Savings of Regional 1995 Projected Demand	
		Transport	Residential
A. RESIDENTIAL LAND USE AND TRANSPORTATION			
Townhouses and apartments along transit streets	11,015	6.0	7.6
Townhouses and apartments near employment centres	8,379	5.4	5.7
Townhouses and apartments near shopping centres	9,417	5.3	6.7
Townhouses and apartments near transit stations	9,419	6.2	6.2
Zoning change to allow apartments in large homes	986	1.2	1.3
"Infill" housing on vacant single parcels	256	0.2	N.E.
Require two-storey construction in dwellings greater than 1,100 sq. ft. (handicapped persons excepted)	881	N.E.	0.4
B. COMMERCIAL/INDUSTRIAL LAND USE AND TRANSPORTATION			
Neighbourhood grocery stores	1,203	1.4	---
Limited expansion of strip retail development	165	0.2	---
Allow home occupations (office type)	145	0.1	N.E.
Reuse of waste heat	1,736	---	2.5

continued

Table 5 continued

Implementation Program	Maximum 1995 Energy Savings Billions (10^9) Btu's Per Year	Maximum % Savings of Regional 1995 Projected Demand	
		Transport	Residential
C. PUBLIC LAND USE AND TRANSPORTATION			
Build exclusive bicycle paths	272	0.3	---
Lower speed limits within SMSA to 45 MPH	347	0.4	---
Improve traffic flow	397	0.4	---
Car/van pool incentives	3,402	6.1	---

SOURCE: Policy Analysis Section, Bureau of Planning, City of Portland, Oregon (1977).

been taken because significant energy efficiencies can be achieved by servicing cities with local produce. Any such move towards self-sufficiency naturally will be reflected in suburban and rural land use patterns. Using the Metropolitan Landscape Planning Model (METLAND), developed at the University of Massachusetts, Braiterman, Fabos and Foster (1976) studied this problem for Franklin County, Massachusetts. They concluded that a hypothetical community with a population of 10,000 would require 340,000 gallons of milk, 351 tons of apples, 365 million gallons of drinking water and 42,500 tons of sand and gravel annually. If these were produced locally, as opposed to imported from competing but distant sources, large energy savings were possible. For example, for the four commodities studies, 98.5 billion Btu's could be saved by using local produce (Table 6). This would be sufficient energy to heat 500 homes on an annual basis in Massachusetts.

TABLE 6 : ANNUAL ENERGY SAVED WHEN A COMMUNITY OF 10,000 CHOOSES BEST OVER MIDDLE AND WORST SCENARIOS

Commodity	Best Compared to Middle Scenario	Best Compared to Worst Scenario
MILK	(New York v. Massachusetts) 53×10^6 Btu = 379 gal. diesel fuel	(New York v. Wisconsin) $9,876 \times 10^6$ Btu = 70,557 gal. diesel fuel
APPLES	(Massachusetts v. Virginia) 63×10^6 Btu = 450 gal. diesel fuel	(Massachusetts v. Washington) $42,764 \times 10^6$ Btu = 305,457 gal. diesel fuel
WATER	(Local Ground Supply v. 15-mile Ground Supply) $2,748 \times 10^6$ Btu = energy to generate 249,000 kWh electricity	(Local Ground Supply v. 30-mile Surface Supply) $7,626 \times 10^6$ Btu = energy to generate 700,000 kWh electricity
SAND & GRAVEL	(Local Mine v. 15-Mile Mine) $1,785 \times 10^6$ Btu = 12,750 gal. diesel fuel	(Massachusetts Mine v. Michigan Mine) $38,250 \times 10^6$ Btu = 273,214 gal. diesel fuel
COMBINED FOUR RESOURCES	$4,649 \times 10^6$ Btu = 33,207 gal. diesel fuel, enough to operate machinery to grow 2,400 acres of corn or heat (space and water) 24 homes all year	$98,518 \times 10^6$ Btu = 703,864 gal. diesel fuel, enough to operate machinery to grow 51,400 acres of corn or heat (space and water) 500 homes all year

SOURCE: Braiterman, Fabos and Foster (1978).

It is a major step to move from single city or regional models to an examination of energy savings from land use innovations on a national scale. Nevertheless, Keyes summarized the available literature in 1976 and attempted to separate what was theoretically possible from what was realistically viable. He concluded that land use innovations might result in a 20 percent reduction in energy use through the promotion of higher densities in new development. Similarly, he predicted that altered travel habits induced by

land use changes could save a similar percentage.

Using these approximations, Keyes then estimated that if higher density and more efficient transportation networks were promoted throughout the United States, they could result in an annual saving of approximately 0.9 quadrillion Btu's by 1985. This figure does not include energy reductions that could be achieved by encouraging the greater use of local produce in urban areas.

Keyes characterized this potential energy conservation as "significant but not dramatic." This assessment appears realistic when such potential savings are compared with those that might be achieved by other conservation techniques. For example, a mandatory 20 mpg standard for all United States automobiles could save 1.9 quadrillion Btu's, while more rigorous thermal efficiency standards for new buildings could also save a further 1.0 quadrillion Btu's. Such conservation strategies are clearly interrelated. To illustrate, mandatory thermal efficiency standards would have a greater effect on energy consumption in single family dwellings. As a result, energy savings through increases in population density would be reduced. Similarly, as automobiles become more efficient, energy savings from the integration of higher density development and transportation corridors will be less significant.

In summary, studies in the United States have demonstrated that there is considerable potential to save energy through changes in urban form. Regional differences can be expected in the impact of particular strategies, however, because of variations in climate, socio-economic factors and the rate of adoption of other conservation practices in construction and transportation. While it is difficult to extrapolate the United States experience into Canada, perhaps the potential 20 percent reduction in conventional energy consumption levels in new developments through the use of land use innovations can be used as a starting point for

debate. That is, it should be possible to sustain growth in Canadian cities with only 80 percent of the traditional increased energy demand.

Cities express the best and worst of man's achievements, the best of his efforts to create order and beauty and the worst of his activities in producing human misery and environmental destruction.

— Newman (1975)

UNDERSTANDING DECISION MAKING

Introduction

Planning and policy making by local governments are likely to play key roles in the future search for solutions to the emerging energy crisis. While federal, state, and provincial governments may determine to a large extent the magnitude and mix of available energy sources, and may control pricing policies, detailed implementation of many of the use related strategies is likely to be left to local initiatives. This appears to be especially so with schemes to improve the efficiency of energy consumption. In both Canada and the United States local governments effectively control the use of land within their jurisdiction, and they generally provide the infrastructure of roads and other public facilities. Hence, to the extent that they can and do alter the mix of land uses, and change the nature of the road network, they exert a powerful influence over the use of energy. Whether and how far they will deliberately promote energy efficient land use depends a good deal on the extent to which energy conservation becomes a key issue on their political agenda, and how far local governments are willing to introduce new and possibly radical strategies in dealing with this issue.

Any federal Canadian attempt to improve the likelihood of energy efficient land use strategies being adopted requires an understanding of the municipal decision making process on the one hand, and the theory of diffusion of innovations on the other. These two factors are closely interrelated, and both are influenced considerably by the perceptions and attitudes of those who are involved at various stages of the decision making process.

The options considered by a local government seeking a solution to a given problem will be conditioned not only by the existing means of dealing with it but also by the avail-

ability of new alternatives. A city, for example, may be trying to deal with a problem of traffic congestion in the downtown area. Conventional solutions, such as the widening of streets or construction of highrise or underground parking lots limit the flexibility of action. In contrast, innovations such as parking on the periphery of the town and the introduction of subsidized, low priced bus or metro transportation within the city, or rezoning so as to reduce the distance to be travelled between home and workplace would increase the range of possible choice.

By the same token, the adoption of a given innovation will be conditioned by the decision making process. Not only will acceptance depend upon the perceptions of the decision makers as to its applicability, but also their attitudes as to its desirability, given their views about the way in which their own situation would be improved or impaired.

Various authors have sought to shed light on how decisions are actually made in the public sector, including local governments. A number of conceptual frameworks have been proposed and applied, notably in the fields of resources management and urban affairs. At the same time, a body of theory has begun to emerge on the diffusion of innovations, and on the role of perceptions and attitudes in decision making. It is impossible to understand why some cities eagerly adopt energy efficient land use strategies while others maintain traditional planning practices, without an appreciation of this body of social science theory.

Decision Making Analysis

The desire to improve decision making in the resources management and urban development fields has focussed attention upon two major questions:

(a) How *good* was a decision in a particular instance? Here the interest is in how far a given objective was attained, such as the maximization of profits or the

provision of services at the lowest possible cost.

(b) What influences were brought to bear in arriving at the decision? In this case the attention shifts from the appraisal of the outcome per se to an explanation of the way in which it was arrived at.

Two different kinds of theories have been developed in the attempt to answer the two preceding questions: normative (prescriptive) and behavioural (descriptive). In both instances it is assumed that decision making proceeds through a series of steps or phases, beginning with the identification of goals to be achieved or problems to be solved, and continuing through the evaluation of alternative solutions, the choice of a strategy, its implementation and hindsight review. Figure 5 presents a representation of such a process. The two sets of theories, however, differ in the objective of the underlying approach and the assumptions made about motivations and rationality.

The normative approach

The basic assumptions in the normative approach are that there is something to maximize (such as profit or satisfaction) or minimize (such as pain or suffering) and that decision makers actively pursue such goals. It is further assumed that they have complete knowledge and that rationality prevails throughout the process. The purpose of normative analysis, therefore, is to determine how good the actual outcome was compared with what could have been attained if all the assumptions of the normative approach had prevailed (Bauer and Gergen, 1968). One might ask, for example, did the decision result in the cheapest means of providing electric power? Did it result in the best use being made of a given area of forest land or a fisheries resource? Did it lead to a more efficient means of moving people from one part of a city to another? These are important questions, especially when there is severe competition among users of a

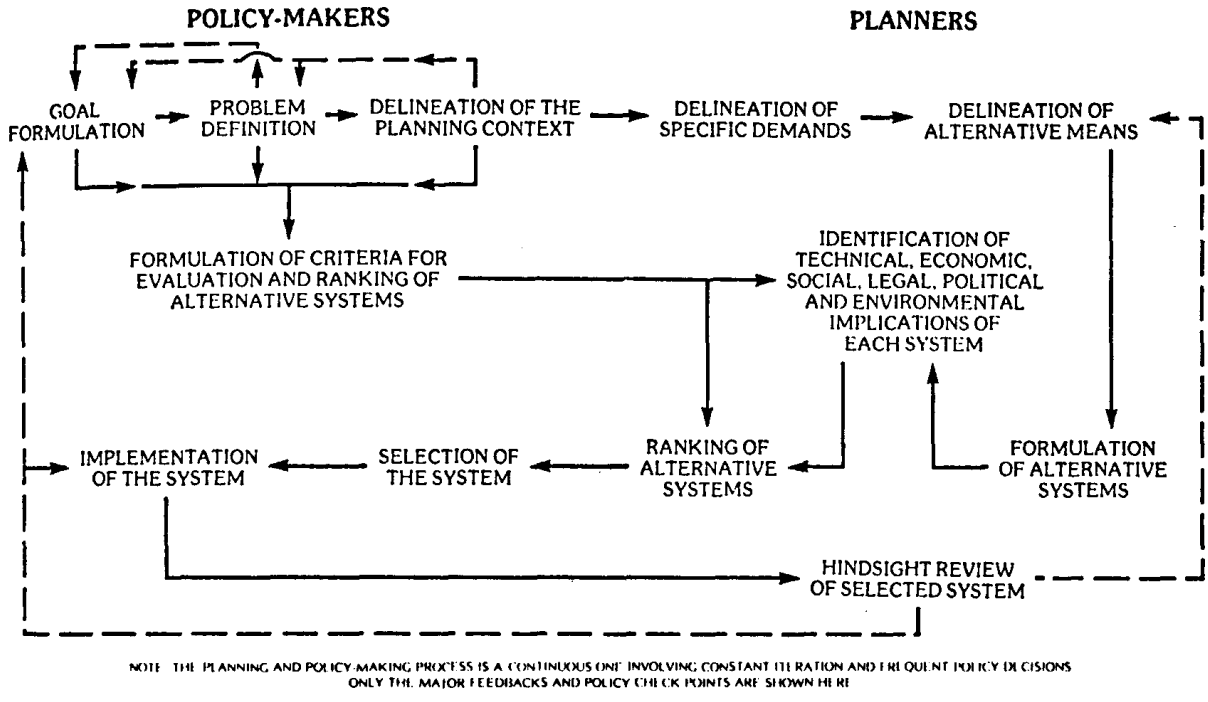


Figure 5: Schematic Representation of the Planning and Policy Making Process.

given resource or where there are many calls on the capital resources of a decision making body.

The normative approach has been widely used in the analysis of policy decisions, particularly in the fields of resources management, transportation, and the provision of various public goods. In some instances it has been formalized into concrete procedures for evaluation, as in the case of benefit-cost analysis or cost-effectiveness analysis (Sewell et al., 1961; Rivlin, 1972). Among its specific applications have been the analysis of water resources policies (Krutilla and Eckstein, 1957; Krutilla, 1967; Davis, 1968; Hirschleifer et al., 1960), environmental policies (Dewees et al., 1975; Kneese and Schultze, 1975; Mills, 1978), transportation projects (Frost, 1971; Peters, 1973), energy development schemes (Cicchetti, 1972), and agricultural adjustment policies (Buckley and Tihanyi, 1967).

The behavioural approach

In contrast to the emphasis of the normative approach on *performance*, the behavioural approach is more concerned in the *way* in which the decision was made. The product is indeed of interest, but equally so is the process and the influences that were brought to bear. The focus, therefore, is on the actors in the decision making process and the ways in which they try to influence choices. Also of concern are the roles of the media and various institutional constraints, such as past precedent, laws, policies and administrative structures and procedures (Figure 6).

Because it is concerned with process as well as outcome, the behavioural approach is especially helpful in analyzing policies concerned with resources and environmental management, and urban development. Typically, decisions in these connections involve conflict resolution and so it is important to know who was involved, the goals they perceived, and the strategies they employed in pursuing these ends. Know-

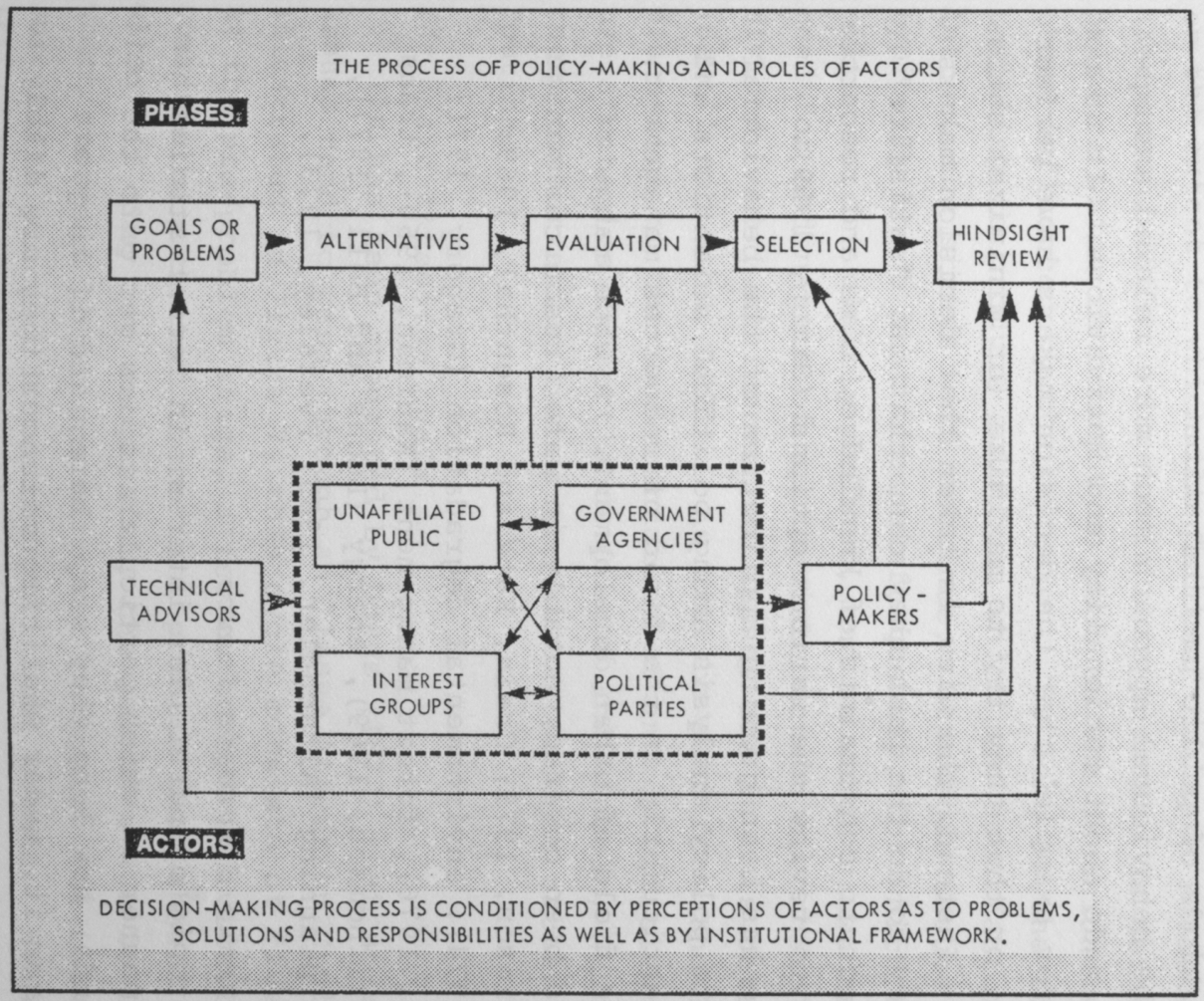


Figure 6: The Process of Policy Making.

ledge of such factors may reveal needed alterations in policies and institutions. Behavioural analyses may indicate, for example, what factors tend to inhibit consideration of the full range of alternatives, such as energy efficient land use strategies, or the advantages and disadvantages of different kinds of public participation.

In the behavioural approach much more relaxed assumptions are made about rationality and motivations. It is not assumed, for example, that the decision makers have perfect knowledge, or that they try to maximize (or minimize) satisfactions. Instead, the view is taken that decision makers somehow try to do the best they can, that is, "satisfice" with respect to constraints of knowledge, time and resources available to review the various options (Simon, 1959).

There has been growing application of the behavioural approach to policy analysis among political scientists and others, particularly in the field of resources management, and in the field of urban development. A wide range of topics has been covered, notably in water resources management (Swainson, 1979; Crain, Katz and Rosenthal, 1969; Carter, 1974), environmental degradation (Gregory, 1971; O'Riordan, 1976), forest management (Kaufman, 1960), transportation (Thomson, 1969), energy (Lucas and Bell, 1977), and urban planning (Altschuler, 1965; Eversley, 1973).

Routine versus Strategic Issues

One topic of particular interest in recent studies has been the manner in which particular topics get onto the political agenda, how long they stay there, and if they are removed from it, under what circumstances they are likely to return. Some items are constantly on the agenda. These may be described as "routine" issues. At the local level of government these concern the line functions of basic services (such as police, fire services and garbage collection) and the provision of infrastructure (such as roads, sewers, or

water supply). Generally these issues arouse little debate, and for the most part discussion focusses upon the magnitude and timing of increased investment in these services.

In contrast, there are "strategic" issues which appear on the agenda for a short while and then disappear, depending on the extent to which the "stress" has been relieved (Kasperson, 1969). Stress in this instance is defined as the pressure which is brought to bear on the decision makers by those influenced by the decision. So long as the former are unwilling to produce solutions which are satisfactory to the latter, the stress will continue. Strategic issues are typically those that occur infrequently, for which responsibility is not clearly defined, and in which views as to the need for and nature of appropriate action are sharply divided. Many environmental issues are in this category (Sewell and Wood, 1971). As will be seen from the later discussion of the implementation of energy efficient land use strategies in Portland, Oregon and Lincoln, Nebraska, these conservation issues are also strategic rather than routine.

The Issue Attention Cycle

It has been suggested by Downs (1972) that strategic issues tend to pass through an "Issue Attention Cycle." As illustrated in Figure 7, this cycle consists of five stages. At the pre-problem stage, a few concerned individuals try to convince others that there is a problem that should be dealt with. If they are successful, the second stage follows in which those in positions of power recognize the issue and succeed in placing it on the political agenda. Eventually, the decision makers realize that attention to the issue will require modifications in existing policies, often involving capital expenditures, or threats to major sources of political support. They have to weigh the costs of deferred action against those of immediate action. With certain kinds of

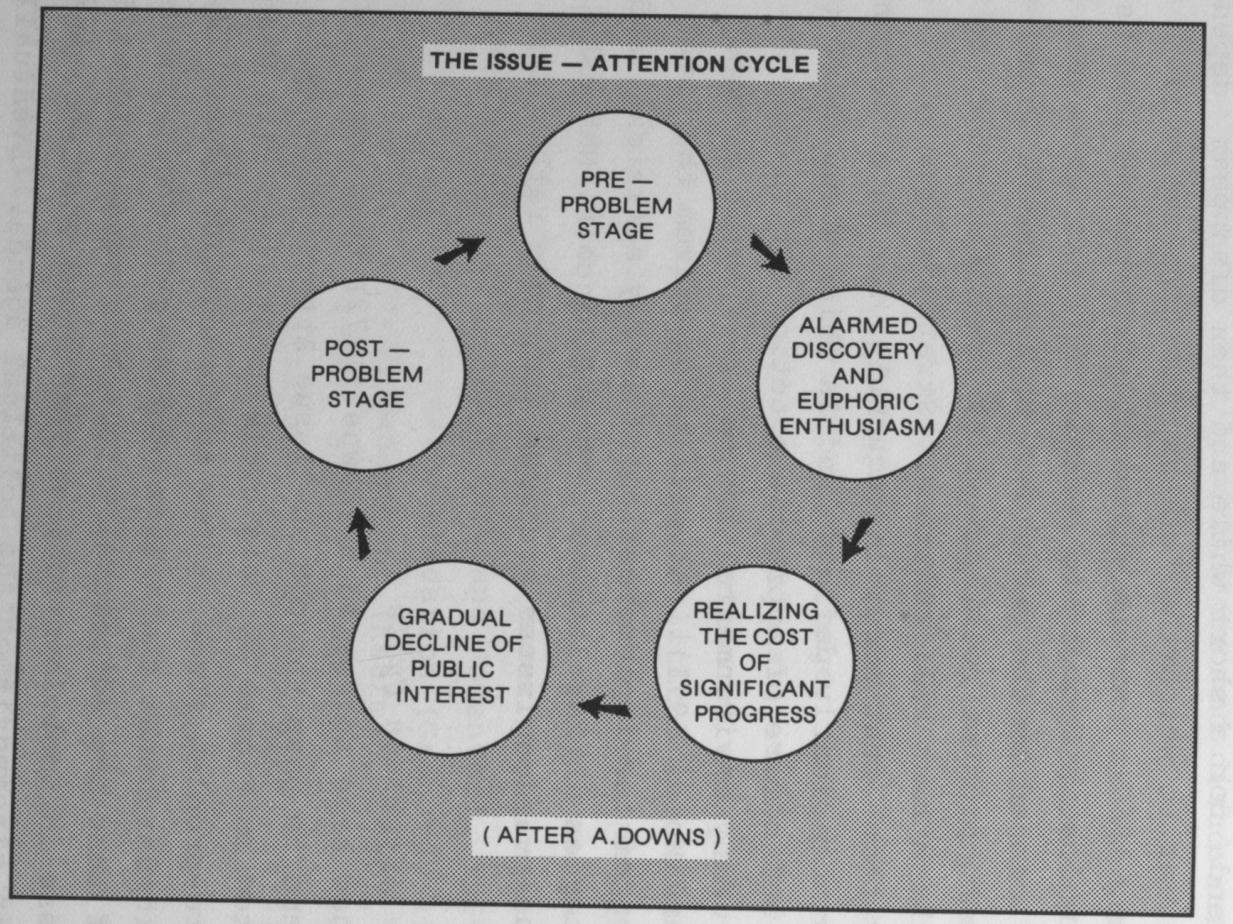


Figure 7: The Issue Attention Cycle.

issues, notably those involving the environment, other problems may suddenly supersede them in perceived importance. Employment and national security are typical examples. A post-problem stage may eventually be reached where an issue stays until a crisis or a shift in social values places it on the political agenda again. An objective analysis of the environmental movement, for example, would suggest that in Canada, there is now an overall declining interest in environmental issues in the face of concerns about mounting costs of amelioration and unemployment, and fears about shortfalls in energy supply. At the same time, however, concern about particular environmental issues remains high, notably those relating to nuclear power and oil spills (Sewell and Swainson, 1979).

The Elitist versus the Pluralistic Viewpoint

A critical consideration in the analysis of the items composing the political agenda is the view that is taken of the power structure, whether it is "elitist" or "pluralistic." In the case of the former, it is believed that decision making in local communities is largely in the hands of a small group of individuals. Generally, these are drawn from the better educated, economically well established part of the community. They are relied upon to identify what the urgent issues are and to propose which action should be taken. This perspective underlies much of the work undertaken on community decision making, particularly by sociologists. The approach in policy analysis, therefore, is to sample local opinion as to who the leaders are. This, it is believed, will reveal where the political power lies. Research then focusses upon the perceptions and behaviour of these leaders.

In contrast is the pluralist approach, which sees political power in local communities as residing in pressure groups which vie for attention. Although only a small minority is actively and continuously involved in politics, it is

believed that the "silent majority" in the end determines the outcome, reacting to positions taken by various pressure groups. In the pluralist view, power is fractionated and fleeting. It is issue based, passing from one set of hands to another as issues change. Because power is diffused in this way, it is usually necessary for those requiring support for action on a given issue to canvass a wide spectrum of pressure groups and leaders in the community. Vote trading is a common strategy, as is the formation of coalitions.

The pluralist view also assumes that the political system is penetrable; that is, it is not a closed one, managed by a small elite which determines which questions shall be given attention and which questions shall be rejected or ignored. Theoretically, therefore, almost any issue might get onto the agenda. The fact is, however, that many issues never do appear on the latter. The reasons for this are diverse. In some instances it may be because other issues competing for attention are viewed consistently as being more important and meriting more urgent attention. In others, it may be because political leaders work hard to ensure that particular matters do not come up for discussion, fearing that if they did so they might have to voice opposition and possibly adopt an unpopular position.

An Alternative Formulation

A number of observers have criticized the elitist/pluralist dichotomy as failing to present a realistic view of the political system. They note that the latter is usually open to influence of some sort, but that it is not completely open: some voices are heard more clearly than others. They suggest that a "political climate" usually develops in which the kinds of issues that will be recognized and dealt with are defined. This climate is seen as varying from community to community, reflecting differences in economic interests, traditions, and other factors. It also

changes over time.

In reality the political agenda emerges from the interaction of several groups of actors, as illustrated in Figure 6. In some instances the elected representatives may exert the dominant influence, in others the bureaucracy may play a key role, and in yet others individual pressure groups or coalitions thereof may be the determining factor. A basic purpose of the behavioural approach is to determine which are the most critical influences in a given instance.

A number of case studies undertaken in North America and Europe have helped shed light on the way in which environmental concerns get onto the political agenda and, once there, the kinds of strategies that tend to be adopted to deal with them. While the range of issues studied has been wide, investigations concerned with air pollution (Hagevik, 1970; Crenson, 1971; Downing and Brady, 1978), and water pollution (Woodrow, 1974) have been the most numerous, and have brought forward several important insights.

Most of the studies take the view that pollution control is a bargaining process, involving in part negotiations between the government and the polluters (Holden, 1970; Frankel, 1974), and in part rivalries between two or more levels of government or among several agencies at a given level of government (Schatzow, 1977). Typically, it seems, it takes a long time for a pollution issue to get onto a political agenda. Usually it requires a major crisis (such as the outbreak of a water borne disease or a massive fish kill) to trigger action. Faced with costs of introducing corrective measures, polluters are highly resistant to suggestions for environmental improvement. Often possessing considerable power through provision of employment, they are able to persuade elected officials and the bureaucracy to delay action and to impose minimal standards. Environmental interest groups may be thoroughly convinced that such delays are counter to the public interest, but unless they have

concrete proof in the instance at issue, they are powerless to persuade decision makers that a change in policy and its implementation needs to be made. This is especially so where issues of employment, inflation, or national defence loom large--either because they are in fact important or because powerful leaders say they are.

Crenson (1971), in one of the most penetrating analyses undertaken so far, examined the lack of action to deal with air pollution in the United States in the 1950s and 1960s, despite the fact that there had been several hundred deaths which could be directly attributed to mounting concentrations of particulate matter in the atmosphere. The findings of his study suggest that issues like air pollution and probably energy efficient land use planning tend to get onto a political agenda only when the "political climate" is amenable to them, and particularly when there are not a number of other strong issues which correlate negatively with action on air pollution, such as high regional unemployment. The results also indicate that some issues are "linked" so that when one is discussed then it is likely that others of a similar type will also be brought up. Crenson describes this tendency as an "ecology of issues." Experience in the United States with air pollution seems to have followed the classical pattern with respect to the development of policy on strategic issues. That is, there has been a tendency on the part of elected officials to wait for a signal from a crisis. The latter often not only indicates that action is needed but also provides the opportunity to introduce a change in approach without large scale opposition.

Even when such a strategic issue does get onto the political agenda, action is typically hesitant and conventional rather than innovative. Thus there will usually be an attempt to deal with air pollution by increasing the scope and coverage of regulations, rather than the provision of incentives to curb pollution. Initially, at least, short

term measures are tried as opposed to major strategies which will lead to a longer term solution.

Crenson (1971) in the United States and L. Foster (1975) in the United Kingdom have shown that action on particular issues may vary considerably from one region to another. Thus, although there was broad acceptance of the need to improve air quality in England and Wales following the disastrous smogs in London in 1953 and 1954, action varied considerably. In some areas such as London, major measures were introduced to cut down the use of smoke producing fuel. In other regions, such as the Midlands and the North where the problem was very severe, for various economic and social reasons, local authorities were slow in taking action (Wall, 1973).

Diffusion of Innovations

An additional source of explanation for the kinds of strategies that are selected to deal with environmental issues, and the pace at which they are adopted, may be found in theories of diffusion of innovation. Based on concepts drawn particularly from sociology and psychology, these theories purport to explain why certain ideas or technologies tend to be adopted while others are rejected, and why some spread rapidly while others experience a very long period of gestation. The basic notion underlying the various theories is that any innovation poses a threat to the existing way of doing things, and hence it must prove conclusively to those who might adopt it that it represents a cheaper, more efficient or otherwise more advantageous alternative. This is, of course, true of energy efficient land use planning. Those innovations which pose the least threat to the present way of life or existing institutions, and which are perceived to be as clearly advantageous, meet the least resistance. The hula hoop or the transistor radio fall into that category. In contrast, innovations which might result in a loss of

employment or power and prestige, particularly for key influentials in a community, are likely to meet with stout resistance. This is true of most kinds of automation, and those innovations which threaten to alter existing social relationships or social values. Thus, automation in the post office, the introduction of the typewriter and the swimsuit took several decades to accomplish.

Theoretically, the process of innovation passes through a series of phases beginning with invention or discovery and continuing through successive steps during which more and more of the potential adopters decide to join those who accepted it in the initial stage (Foster and Sewell, 1977). Research on a wide variety of innovations suggests that there are three main phases, each composed of a number of stages. These are illustrated in Figure 8. At each stage, various groups of actors play an important role in influencing the pace of adoption. As might be expected with certain kinds of innovation, the government may be a key influential in determining the rate of acceptance, either by offering inducements or by erecting barriers, such as the introduction of regulations. By providing grants to researchers, initiating demonstration programs, or buying part of the initial output, for example, a government could play a positive role in fostering early adoption. In such an instance, the curve of adoption would tend to be shifted to the left, or B in Figures 9 and 10. Where an innovation meets with strong resistance, the curve tends to be pushed to the right, as in C in Figures 9 and 10.

Some innovations bring benefits directly to particular individuals whereas others are shared. An illustration of the former is a new type of cooking facility, such as a microwave oven. An example of the latter is an improved rapid transit system or the provision of access to a beach or park. In both instances there are individual gains but in the latter case a consensus, at least among elected

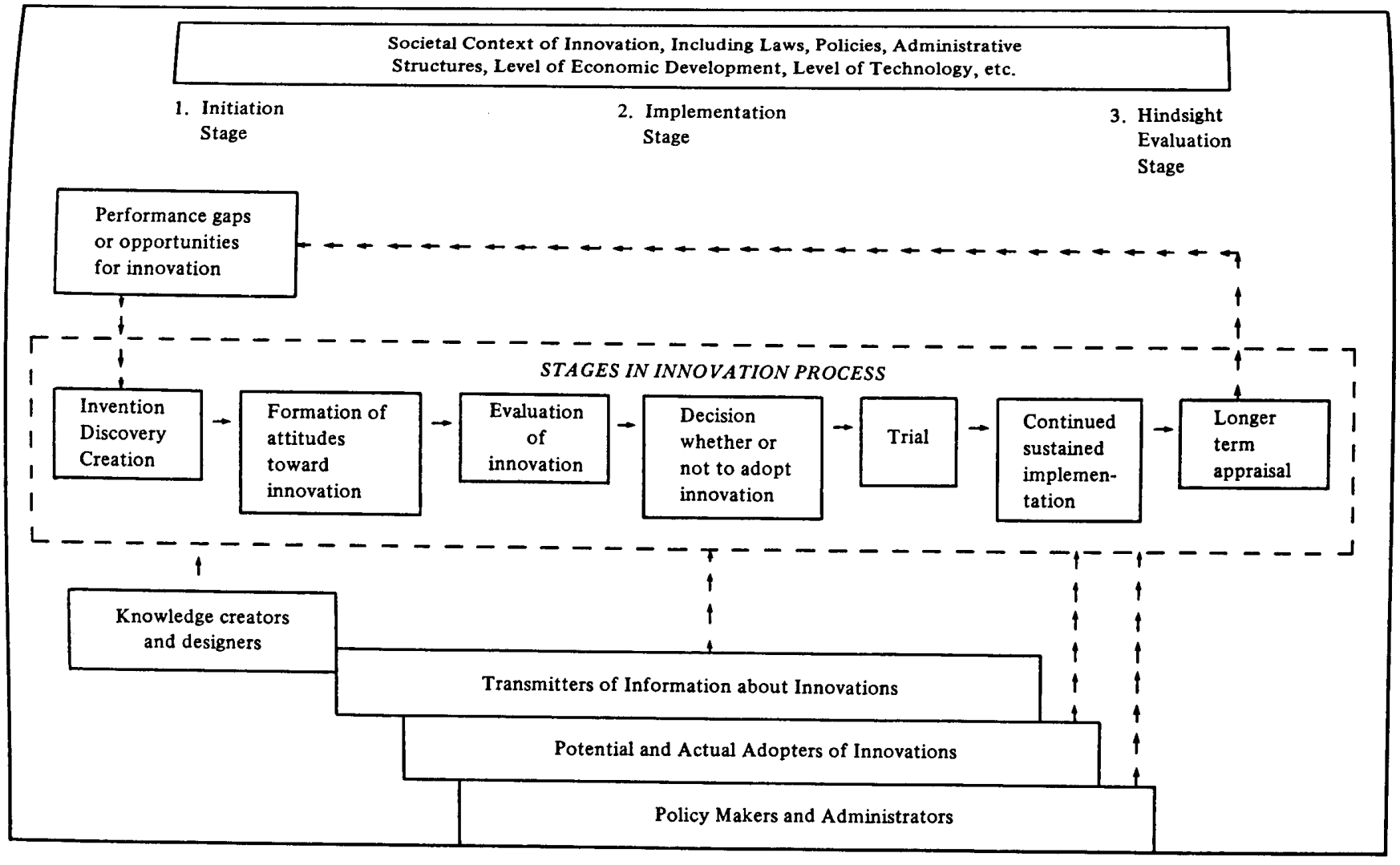


Figure 8: Schematic Representation of the Innovation Process (Note: Only the major links and feedback loops are shown).

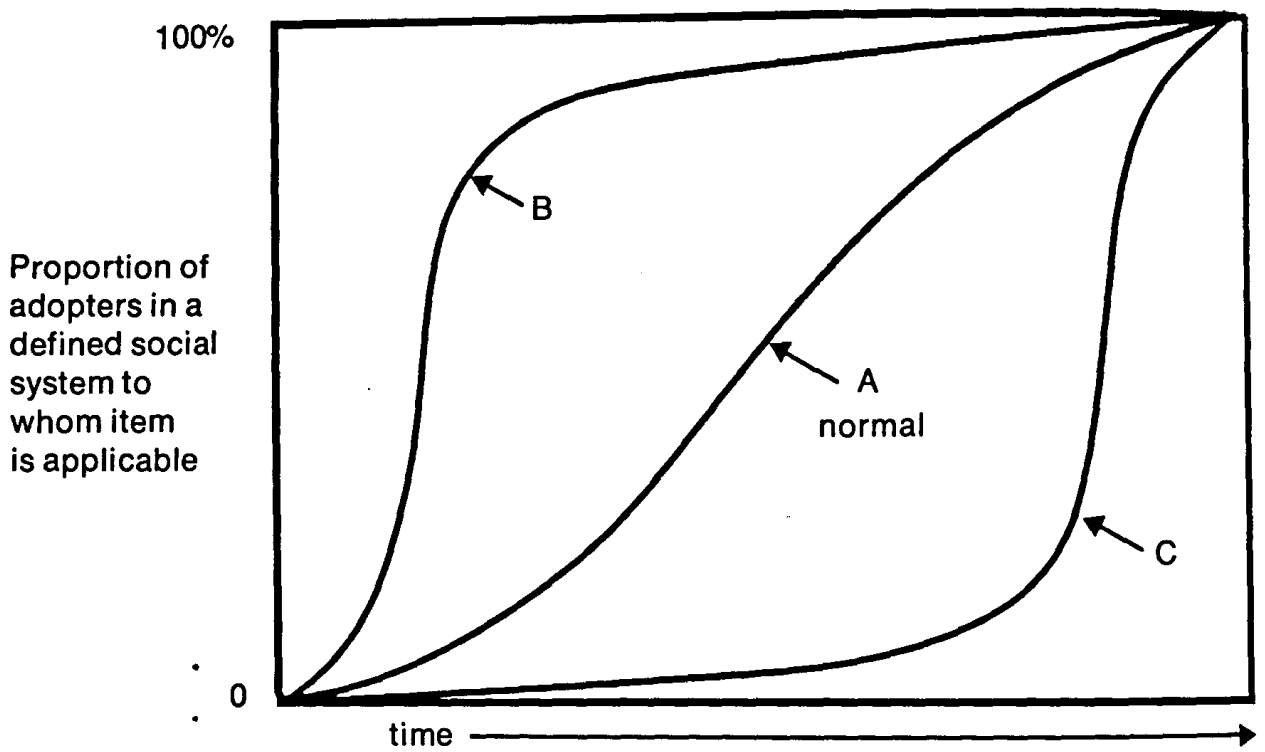


Figure 9: Cumulative Diffusion Curves.

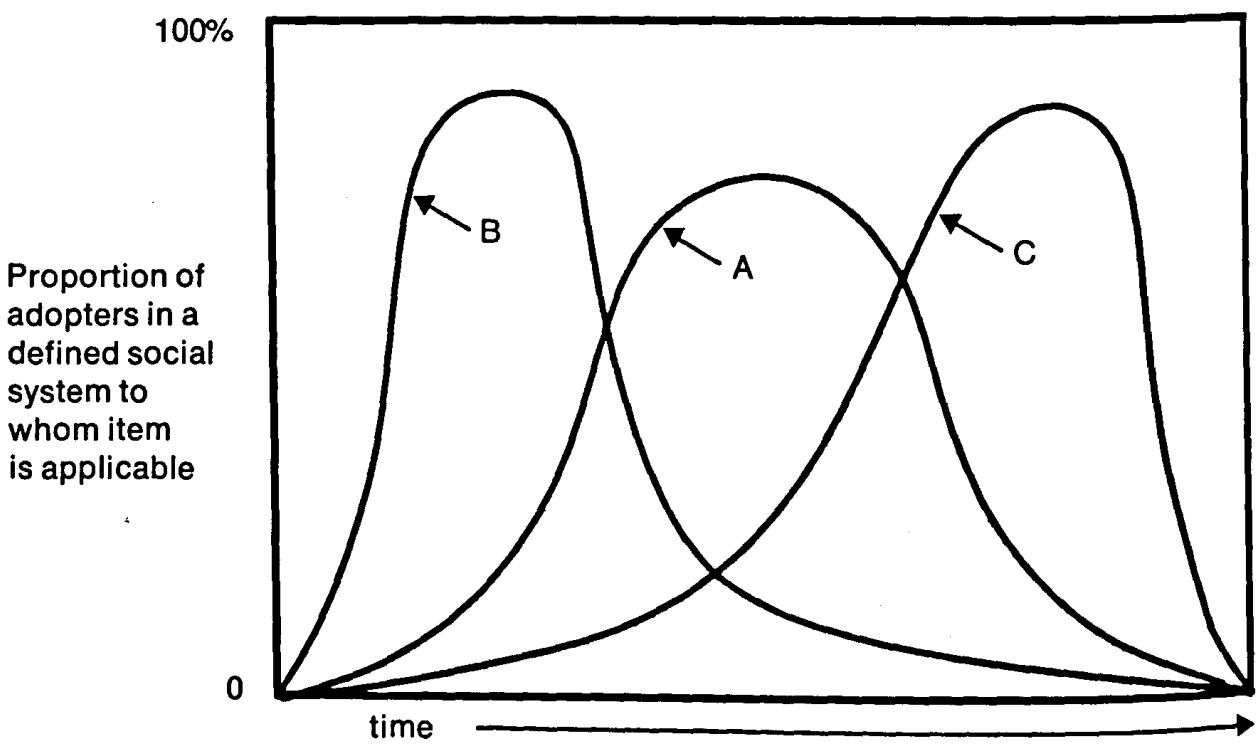


Figure 10: Incremental Diffusion Curves.

officials, is required if the innovation is to be instituted. In reaching a decision they will need to weigh the competing claims of the various actors for the allocation of the public purse, and the costs of harming or ignoring some of the groups by favouring others. Innovations in the energy field fall both into the category which brings individual benefits and that which brings collective ones. An energy conserving engine is an example of the first, while development of a land use pattern that promotes rapid transit is an illustration of the latter.

Research on the diffusion of innovations is still relatively undeveloped. Beginning with an interest in the spread of technologies in agricultural areas (Rogers, 1962), its focus has gradually moved to the urban scene. Here the emphasis has shifted from technology towards ideas and policies. A number of major research projects have been undertaken in the United States and Sweden, to model the diffusion process, aiming to identify the factors which condition the rate of adoption. Even though much has been learned there remain several unanswered questions, such as the extent to which diffusion patterns are contagious or hierarchical in form, or whether economic factors are more critical than social interaction considerations as prime determinants. Beyond this, there are certain areas of diffusion that have been little studied to date, notably those concerning the adoption of innovations in energy utilization and conservation. There are, however, a few exceptions, such as work on the adoption of electric utility systems by Wood (1971) and studies of the acceptance of solar home heating technology by Foster and Sewell (1977a).

Despite these latter deficiencies, however, it is possible to apply some of the concepts and conclusions developed in other studies of the diffusion of innovations to the analysis of land use strategies for improving energy conservation. Such studies include those focussing upon the

adoption of innovations which convey personal benefits (such as the introduction of cablevision, transistor radios, or microwave ovens) and those which bring collective benefits (such as urban renewal, public housing, fluoridation, or automated data processing by municipal governments). Working papers on these matters have appeared recently as part of the output of a research project on the diffusion of innovation at the Ohio State University.

In summary, the theories of decision making and the diffusion of innovations described in this chapter may be helpful in any attempt to understand the nature and pace of adoption of energy efficient land use planning in the United States and elsewhere. To this end, various concepts derived from the theories were incorporated into a research strategy which is now described in detail.

... the development and management of urban areas involves difficult trade-offs among multiple objectives.

— Keyes (1976)

ENERGY CONSERVING LAND USE PLANNING IN THE UNITED STATES: AN OVERVIEW

Innovation is the process by which society evolves. Advancement through change includes the creation, diffusion and adoption of new or improved mores, processes, systems, products or services. It occurs in the belief that a perceived "performance gap" between the desired and the presently achieved can be reduced or removed by change (Foster and Sewell, 1977a). Typically, this process begins slowly, accelerates as its benefits become more widely appreciated and decelerates once more as an effective alternative is discovered. In the early stages of the process, the experience of innovators is extremely valuable information since it can be widely disseminated and used to persuade the less adventurous to adopt. For this reason the authors designed a brief questionnaire (Appendix 1) to gain an overview of the experiences of municipalities in the United States with energy conserving land use regulations. A literature search identified 80 communities which had adopted or seriously considered applying energy efficient land use strategies. A control group of 80 settlements, not known to have been involved with such innovations was also developed (Figure 11). The mayors of both groups were sent copies of the questionnaire and a letter explaining the nature of the survey. The questionnaire sought information which would help to determine how closely the adoption of energy efficient land use strategies had followed the pattern that could be predicted from the previously described body of social science theory. Drawing upon the concepts already described it was hypothesized that the nature and pace of action to improve efficiency depended upon:

(1) The type of economy of the community. Communities vary considerably in their economic structure and hence in their demands for energy. An important question, therefore,

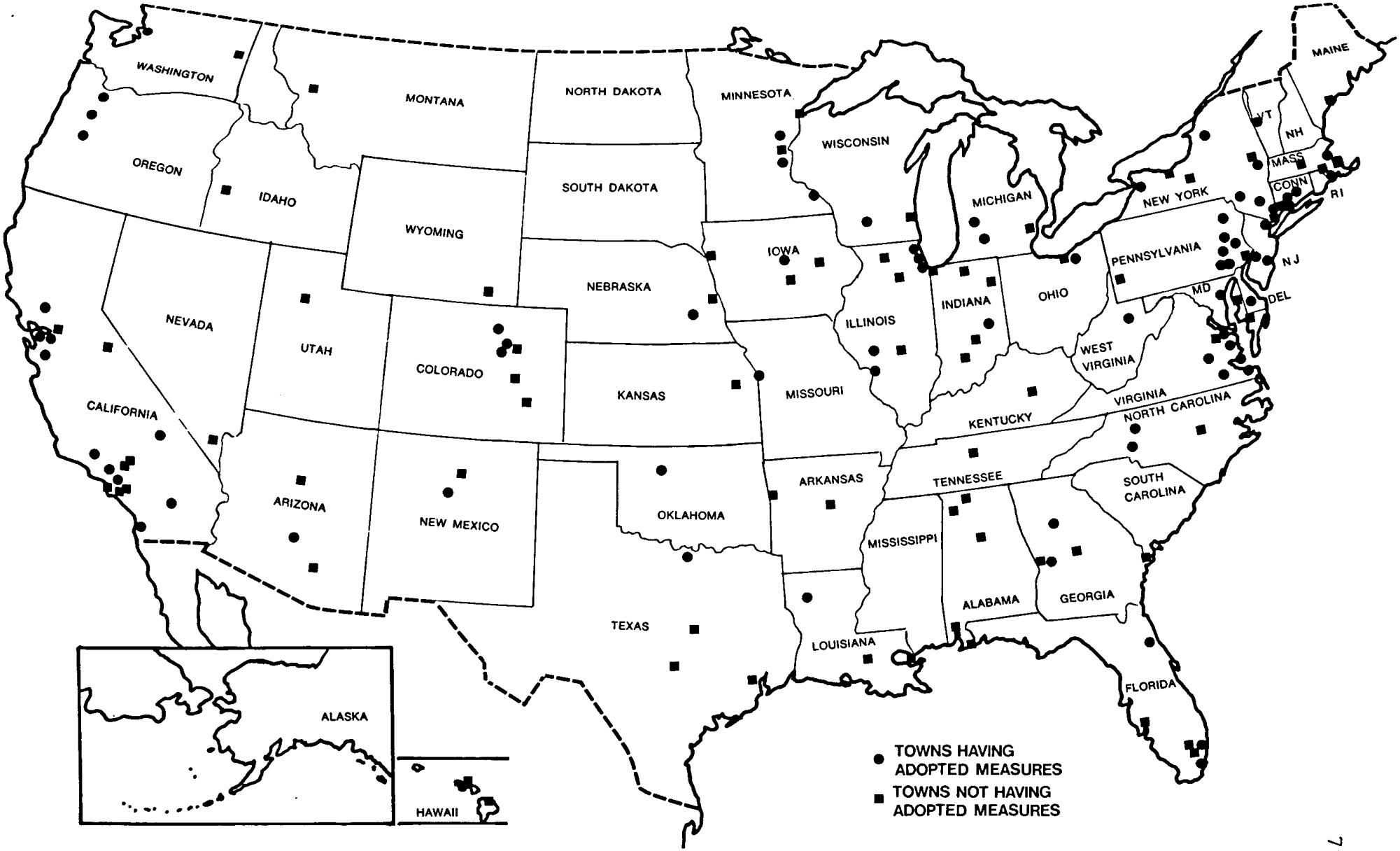


Figure 11: Overview of Energy Efficient Land Use Location of Settlement Surveys.

is whether those towns which consume large quantities of energy, and especially where the price is high, are among the leaders in the adoption of conservation measures.

(2) Competing issues on the political agenda. Studies of environmental issues in North America and elsewhere have shown that they tend to appear on the political agenda only when a serious crisis has occurred, and only then when certain other competing issues such as unemployment or racial conflicts are not perceived as serious. In this study it was important to identify, therefore, which issues have been perceived as important in the past five years in the community.

(3) Innovativeness in the community. Communities vary a good deal in the extent to which they actively encourage the adoption of new approaches to problems. Some are constantly leaders in this connection: most are followers and a goodly number are consistent laggards. To shed light on this dimension the mayors receiving the questionnaire were asked to specify the dates on which certain types of legislation were passed, and when funding was provided with respect to a list of policies concerned with local government functions, such as the construction of industrial parks, provision of low cost housing, or promotion of the use of public transportation. Some of these policies concerned items which would benefit a single group directly (such as the provision of industrial parks or public housing) whereas others would benefit the community at large (such as the protection and renovation of heritage buildings or provision of public transportation).

The matter was probed further with respect to energy conservation by asking the mayors to identify which kinds of strategies had been introduced to foster improved efficiency in this regard. Through the latter information it was hoped also to determine if there is a hierarchy of adoption of strategies, such that the ones involving the least commitment

are adopted first whereas those requiring radical change or major allocations of finance are deferred.

(4) Obstacles to adoption of land use regulations as a means of fostering energy conservation. Perceptions of support or opposition are often key determinants in political behaviour. To illuminate this aspect with respect to the introduction of land use regulations to stimulate energy conservation, a series of questions was posed to identify which groups within the community had supported or opposed policies relating to energy efficient land use. An attempt was also made to determine the barriers to implementation that were perceived by members of a community trying to emphasize energy conservation in its land use planning.

American Planning Association Survey

While the questionnaires were being distributed, it came to the attention of the authors that the American Planning Association was also collecting information on the adoption rates of energy efficient land use strategies. This survey was being undertaken for the United States Department of Energy and administered by the Argonne National Laboratory in Chicago. Its aim was to determine which communities in the United States had actually enacted ordinances, incentives, or policies that were directly related to energy conservation through land use. Each institutional subscriber to the Association, a total of 1,300 municipalities and other governmental agencies, was sent a questionnaire which listed 30 potential innovations and sought information on which had been adopted. They were also asked about the groups involved in adoption and its impact on energy consumption. Additional information was also sought through publications of the American Planning Association, which have a readership of some 20,000 planners (Mosena, 1979; Erley, 1979). Although this information has not yet been published, the American Planning Association provided the authors with a

short summary of its results (Erley, 1979). This information, together with that obtained from 51 completed questionnaires, or some 32 percent of the sample, which were returned to the authors, allows an overview to be provided of the factors influencing the rate of diffusion of energy efficient land use strategies in the United States. In addition, several United States communities sent copies of their energy plans or related fact sheets.

Questionnaire Results

Energy conservation as an issue

A wide variety of issues were listed by respondents in answer to the question "What do you personally think have been the six most important problems faced by your city since 1974?" The most commonly expressed concern was over the diminishing effectiveness of the tax base to support municipal services. This problem was identified by over 70 percent of those answering. Also seen as being of key significance were the local implications of too rapid urban growth. The cost and availability of energy and the inefficiency and inadequacy of existing transportation systems vied for third and fourth positions respectively, in terms of their frequency of mention. Other commonly identified problems were downtown redevelopment, the lack of housing for the poor, waste disposal, crime and pollution. It is clear, therefore, that United States' cities are having difficulty responding both to routine issues, such as the provision of housing and waste disposal and to strategic issues including energy shortages.

It is interesting to compare this ranking of problems with that of Canadian planners. In 1977, the authors interviewed planners or sent questionnaires to over 200 Canadian municipalities (Sewell and Foster, 1977). Although some of the 65 respondents were provincial or federal planners, the majority were active at the municipal level. They named

national unity as the chief issue, followed in order of significance by energy prices and policy, inflation, unemployment, pollution and conservation. Although the questions posed were not identical, the Canadian planners being encouraged to answer on a nationwide basis, it is apparent that in both countries energy availability and price has become a major issue. For this reason it has repeatedly appeared on the political agenda at all levels of government since 1973.

Diffusion of conservation as a strategy for dealing with energy shortages

Concern over energy availability has been translated into action in every one of the United States municipalities from which questionnaires were returned. Each settlement has adopted at least 3 of the 15 general energy conserving strategies identified in the authors' questionnaire, while 87 percent had implemented at least 5, and some 18 percent 10 or more. Campaigns to reduce energy use in municipal buildings have been the most popular strategy to date. It would appear that this addresses two issues seen as significant by municipalities; high operating costs and uncertain energy availability.

At least one energy conserving land use strategy has been adopted in 88 percent of the responding municipalities. The most popular has been the provision of bicycle paths. Other commonly adopted strategies have been cluster, high density and mixed use zoning which have been implemented in 60 percent, 56 percent, and 55 percent of the municipalities respectively.

Table 7, based on the authors' questionnaire responses, lists all 15 potential energy conservation strategies for which information was solicited in order of their frequency of adoption. This table might be taken as a scale indicative of the ease or otherwise of diffusion of such innovations. For example, those innovations that require little financial

TABLE 7: ENERGY CONSERVING STRATEGY ADOPTION IN DESCENDING ORDER OF ADOPTION

Energy Conserving Strategy	Date of First Adoption*										
	pre-1970	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Campaign to reduce energy use in municipal buildings	0	0	0	0	5	6	2	4	10	6	8
Public statements by mayor in favour of energy conservation	0	0	0	1	9	3	1	2	3	5	8
Provision of bicycle paths	4	1	1	3	5	2	4	5	6	1	0
Cluster zoning	5	1	2	5	1	3	2	2	0	3	1
Promotion of car pools	0	0	0	1	4	7	2	2	4	2	6
Publication and wide distribution of literature to encourage public energy conservation	1	0	0	0	1	6	3	3	2	6	6
Mixed use zoning	9	1	1	2	0	1	3	2	2	2	1
Higher density zoning	12	0	0	3	2	0	1	1	2	2	2
Recycling of bottles, cans and paper	1	1	4	2	3	2	1	0	3	1	1
Setting of energy efficient standards for new developments	0	0	0	0	0	0	1	1	1	10	6
Adoption and publication of municipal energy plan	0	0	0	0	1	2	0	2	0	3	6
Redesigning the municipal land use plan to increase energy conservation	0	0	0	0	1	0	0	2	2	4	3
The use of energy analysis in the planning of roads, sewer lines and other public facilities	0	0	1	1	0	2	0	3	2	1	0
Requirement of impact statement from developers	0	0	0	1	1	1	1	2	2	0	1
Construction of a district heating system	7	0	0	0	0	0	1	0	0	0	0
TOTALS	39	4	9	19	32	35	22	31	39	46	49

*Many respondents did not provide specific dates of adoption.

investment or are in no way coercive and, therefore, are unlikely to be strongly resisted by any pressure groups have been the most frequently adopted. Included in this group are drives to reduce energy consumption in government buildings, public statements by the mayor in favour of wiser energy use and the provision of bicycle paths. Innovations which may meet some opposition, but which are adaptations of familiar strategies, such as zoning changes to permit cluster development, higher densities or mixed land use and recycling appear to occupy a middle position in terms of ease of adoption. Other land use related energy conserving techniques which involve either probable vocal opposition or represent a major commitment to change, have been implemented far less frequently. Examples include redesigning the existing municipal land use plan, using energy analysis in the provision of services or requiring energy impact statements from developers.

Although the results of the American Planning Association survey are not identical, they demonstrate a similar scale of adoption (Table 8). Some of the differences must obviously stem from the fact that in the latter case, information was also solicited on provisions for site design and orientation for energy conservation. In fact, this strategy was found to be the most common type of regulation reported. Questions were also asked on street width reductions which were found to have been accepted by four communities.

In summary, both surveys indicated a largely piecemeal approach to the implementation of energy-conserving land use regulations. Erley (1979), for example, concluded from the American Planning Association's survey that:

> ... none of the communities have really taken a comprehensive approach to making their land development regulations more energy-efficient. Davis is the only exception as far as I can tell. What we do have here is a wide range of types of regulations. The only kind that is missing is for facilitating integrated community energy systems. (The regulations for alternative techniques deal exclusively with solar energy systems.)

TABLE 8: RESULTS OF THE AMERICAN PLANNING ASSOCIATION'S ENERGY EFFICIENCY LAND USE STRATEGY ADOPTION SURVEY

	Street Orientation and Site Design	Plan Amendment or Element	Underground Housing	Bike and Footpath Incentives	Landscaping Requirements	Reduced Street Widths	Incentives for Inefficient Land Use Patterns (Incl. use of mass transit)
Sacramento Cty. CA	x Site design standards	x					
Baltimore MD	x Subdivision regulations				x Subdivision regulations		
Windsor CT				x Design standards in zoning ordinance		x May be reduced by plan commission	x Transfer of development rights
Port Arthur TX	x Subdivision regulations					x Subdivision regulations	
Kings Cty. WA	x Zero lot line	x					
Ada Cty.				x Bike safety			
Corcoran CA				x Informal incentives to provide paths			
Porter IN						x Reduced within reconstructed streets	
Madison WI					x Parking lot requirements		
Pima Cty. AZ					x		
Lawrence/Douglas Cty. MD			x Underground housing is recognized in zoning ordinance	x Plan amendment for path network			x Resolution
Honolulu HA		x					
Long Beach CA				x Subdivision incentives			x
Metro Dade Cty. FL	x Zoning ordinance						
Modesto CA	x Local interpretation of state regulations						
Davis CA	x	x		x	x	x	

SOURCE: Erley (1979)

While the authors would agree in part with this general sentiment on the basis of their own survey, it appears rather pessimistic. There appear to be at least 13 communities in the United States that have adopted or are in the process of implementing a more comprehensive approach to energy conservation through land use planning. The settlements are Boston, Massachusetts; Pensacola and Tampa, Florida; San Bernardino, Davis and Indio, California; Lincoln, Nebraska; Hammond, Indiana; Lexington, Kentucky; Boulder, Colorado; Cheyenne, Wyoming; Portland, Oregon and Washington, D.C. The authors make no claim that this list is complete, indeed it only includes communities responding directly to their own questionnaire. While it is difficult to draw precise conclusions from the spatial distribution of settlements adopting energy efficient land use, it certainly appears to be favoured by heavy industry. In addition, adoption is particularly high in certain states, such as California and Oregon. Such innovation also seems most prevalent in communities with a population range of between 15,000 and 150,000. There also seems to be some correlation between the adoption of energy conserving land use strategies and the growth of the solar energy industry in the United States. The distribution of the latter has been outlined by a previous survey undertaken by the authors (Foster and Sewell, 1977b).

Planning strategies to conserve energy are relatively new to the United States (Table 7). With the exception of district heating facilities, often built in the 1930s or earlier, and mixed use and higher density zoning the adoption of most of these strategies has occurred since 1970. In this period over 85 percent of all such diffusion of these innovations has taken place. It is apparent from the replies to the authors' questionnaire that the most popular period for implementing energy conserving strategies has been 1978 and-1979. Nevertheless it is clear from the analysis that energy conservation has been a recurring issue at the municipal level

every year since 1972. It is fast moving from the position of a strategic issue to becoming a routine problem. In consequence, a variety of energy related agencies are being set up in municipal government to deal with it. Personnel from many of these agencies, such as the Indiana Energy Office and the City of Boston Energy Office, answered the questionnaire on behalf of the mayor. Since the number of conservation strategies being adopted is increasing, it is apparent that energy conservation in the United States is still in the third, most active phase of the Down's issue attention cycle (Figure 7). It is in this stage that there is most possibility that innovations will be adopted to solve the problem.

Consumption patterns

The impact of energy conservation strategies at the municipal level is being reflected in per capita energy consumption. Twenty-nine percent of those communities polled by the authors reported a per capita annual decrease in energy use since 1974. The largest such annual decline in the use of energy, 5 percent, was recorded by Davis, California. Other communities with particularly significant reductions included Flagstaff, Arizona; Madison, Wisconsin, and Indio, California. Each of these municipalities reported that they had adopted three or more energy conserving land use measures. In contrast, 71 percent of the communities admitted to an increase in per capita energy consumption in the past five years. In the most extreme case, Allentown, Pennsylvania, this has been 6 percent annually. The mode for the entire sample showed an increase of some 2 percent annually. This figure cannot be considered typical for the United States as a whole since the sample was stratified, therefore emphasizing those communities which were thought to have undertaken land use related energy conservation programs.

It was also apparent from the answers to this query that many United States communities are monitoring their energy consumption. Very few respondents indicated that they were

merely guessing, the majority being able to give precise answers to queries on per capita energy consumption. For instance, La Grange, Georgia reported an annual per capita increase in gas consumption of 2.577 percent and for residential electricity of 1.703 percent. Similarly, detailed information was available for Lincoln, Nebraska and San Diego, California. This growing concern with conservation is also apparent from the number of detailed energy related reports sent to the authors. Several communities such as La Grange, Georgia and Sioux City, Iowa sent the authors copies of detailed community energy surveys and plans to reduce consumption as far ahead as the year 2020 (James Wright Associates, 1977, and Sioux City, City Plan and Zoning Commission, 1978).

Support and opposition

The pace of innovation depends not only on the general societal disposition towards change, but also on the objectives and characteristics of special interest groups who can influence adoption. Such associations typically support innovation when they perceive that it will result in additional financial or social gain, and oppose it when loss to them is anticipated as a consequence of the adoption. In the latter case, special interest groups will erect or strive to preserve obstacles to change; economic, social and legal barriers, with which innovation is challenged and prevented.

If the diffusion of energy efficient land use is to be promoted in Canada, it is essential that potential advocates and critics be identified and strategies adopted that garner the greatest support. Crenson (1971) identified 17 pressure groups that typically seek to influence municipal decision making in the United States. Despite the obvious validity of the observation made by the respondent from Boise, Idaho that "land use planning to increase energy conservation is not one issue, but covers a broad spectrum of policy issues

some of which any one organization would support and some of which it would not," general experience with such special interest groups is significant. This is widely based since 88 percent of the communities responding to the questionnaire had implemented at least one energy related land use strategy. Table 9 ranks the 17 pressure groups in order of the support that they have given or would be expected to give in the communities polled.

TABLE 9 : UNITED STATES SPECIAL INTEREST GROUPS LISTED IN DECREASING ORDER OF THEIR SUPPORT FOR ENERGY EFFICIENT LAND USE

- Environmental groups
- Newspapers
- Heads of local government agencies
- Democratic Party
- Radio and television stations
- Neighbourhood improvement groups
- City and county employees
- Church leaders
- Ethnic groups
- Chamber of Commerce
- Bankers and executives of financial institutions
- Bar Association
- Republican Party
- Labour unions
- Other businessmen
- Industrial leaders
- Retail merchants

It can be seen that the greatest backing has come from environmental groups, newspapers, heads of local government agencies, the Democratic Party and neighbourhood improvement groups. The strongest opposition to such conservation strategies has been provided by retail merchants, industrial leaders, other businessmen, the Republican Party and the Chamber of Commerce. Bankers and executives of financial institutions, together with bar associations and labour unions have also been relatively lacking in support.

It is clear from the questionnaire returns that there

are other interest groups that may also seek to influence rates of adoption of energy efficient land use strategies. The respondent for the District of Columbia, for example, considered that "on a case-by-case basis opposition might be encountered from ... developers, historic preservationists, low-income tenant or neighborhood organizations threatened with displacement and upper and middle income neighborhoods threatened with increased density." Another respondent added utilities to the list of special interest groups and indicated that they had been particularly supportive of energy efficient land use policies in his own community. There is general agreement, however, that the *most influential pressure groups* with regard to this particular issue, regardless of their stance, have been newspapers, environmentalists, heads of local government agencies and neighbourhood improvement groups. Also seen as wielding significant power are Chambers of Commerce and bankers (Table 10).

Some light is also thrown on the role of pressure groups in supporting energy conserving land use regulations by the American Planning Association's survey. This organization reports that in Windsor, Connecticut and Kings County, Wisconsin citizen and neighbourhood groups were active in the adoption process. In Kings County, for example, the energy element that was adopted was based on a report by a citizens' advisory group (Erley, 1979). In Port Arthur, Texas a developer and the local utility were involved in drafting site orientation regulations to aid in the construction of passive solar buildings. Their interest and support apparently played a major role in ensuring site orientation regulations were passed by both the local planning commission and the city council. In Sacramento, California the chief advocates of energy efficient land use were members of an energy council. This consisted of utility representatives, citizens, local government officials, business people and public interest group members. This council initiated work on site design

TABLE 10: MOST INFLUENTIAL GROUPS IN THE DEBATE OVER ENERGY EFFICIENT LAND USE LISTED IN ORDER OF DECREASING IMPACT

1.	Newspapers
2.	Heads of local government agencies
3.	Environmental groups
4.	Radio and television stations
5.	Industrial leaders
5.	Chamber of Commerce
7.	Neighbourhood improvement groups
7.	City and county employees
7.	Democratic Party

standards, hired a consultant to prepare them, held hearings and then forwarded them to the County Board for passage (Erley, 1979).

Barriers to diffusion

In designing a strategy to promote diffusion, it is imperative to obtain an overview of any perceived negative characteristics of either the innovation or its milieu since these tend to reduce or preclude adoption. In an attempt to discover such barriers to the acceptance of energy efficient land use strategies, each community included in the survey was provided with a list of nine possible obstacles to diffusion. These barriers had been identified by the authors during the literature search. Respondents were also encouraged to mention any other problems not listed. The following number system was to be used in responses to rate the significance of the issue:

0 Not a problem
1 A minor problem
2 A moderate problem
3 A major problem but solvable
4 A major problem but not readily solvable

While these numbers are definitely *not* additive, they can be used as such, provided the limitations of this approach are fully appreciated. For example, two respondents ranking opposition from groups and organizations within the community as a moderate problem had the same impact on the mean rating as two respondents, one ranking this issue as not a problem and the other as a major problem but not readily solvable. Clearly, this approach has drawbacks but is more satisfactory than verbal description that presents little prospect of quantification. It has previously been used to assess the significance of barriers to the diffusion of solar home heating in Canada (Foster and Sewell, 1977a).

Table 11 shows a ranking of the 9 potential barriers based on this point system. The major barriers to the adoption of energy conserving land use strategies are perceived

TABLE 11: BARRIERS TO THE ADOPTION OF ENERGY EFFICIENT LAND USE IN THE UNITED STATES, LISTED IN DECREASING ORDER OF SIGNIFICANCE

1. The rigidity of the existing municipal infrastructure, such as roads, sewers, and other utilities.
2. Lack of interest in the community.
3. Energy conservation not seen as an urgent problem.
4. Lack of federal and state incentives.
5. Opposition from groups and organizations within the community.
6. Conflict with other municipal objectives.
7. Division of professional opinion over the advisability of such a step.
8. Lack of jurisdiction over this issue.
9. Planning staff unfamiliar with the approach

as the rigidity of the existing municipal infrastructure, lack of interest in the community and the fact that energy conservation is still not seen as a significant issue at the local level. Of least significance are unfamiliarity with the approach by planning staff and lack of municipal jurisdiction over the land use conservation issue.

Several other barriers, not listed in the questionnaire, were mentioned by respondents as being at least moderate problems. A respondent from Boise, Idaho, for example, wrote, "innovation, new procedures, and the development of new criteria for review of projects costs time and money and represents the equivalent of capital investment in government. This is in short supply." Another community representative from Minnesota perceived lack of commitment from federal government agencies to emphasize energy conservation in their own projects as a major problem, while the mayor of a Wyoming urban centre identified "general opposition to any land use planning" as a significant barrier. Lack of technical expertise within city government was also cited as an obstacle to the diffusion of energy conserving land use strategies by one respondent.

In summary, because of the barriers involved the diffusion of energy conserving land use strategies has been relatively slow in the United States. Certain communities, such as Davis, California; Lincoln, Nebraska; Portland, Oregon, and Cheyenne Wyoming, however, have made dramatic progress with their adoption. It is on two of these cities that the remainder of the report focusses, since it is here that experience has been greatest and is, in consequence, most valuable.

Those selected for indepth review are Portland, Oregon and Lincoln, Nebraska, which because of their size and location are particularly relevant to the Canadian situation. Since the emphasis in this study is on how municipalities

were encouraged to adopt energy efficient land use strategies rather than on the quality of this step, the descriptions which follow are based upon the behavioural rather than the normative model of decision making.

The great cities of the world are most significant because they provide the settings where the new ideas of the period are tested first.

— Meier (1970)

PORTLAND OREGON: A CASE STUDY OF AN INNOVATIVE COMMUNITY

Federal Assistance

In 1974, the United States Department of Housing and Urban Development (HUD) began attempting to improve the calibre of local government decision making through its Capacity-Building Demonstration Program. This was designed to test and evaluate approaches for strengthening the capabilities of local officials to fulfil their overall responsibilities for development, resource allocation and management (Bureau of Planning, City of Portland, 1977). Although this program is now over, HUD's Office of Policy Development and Research has continued to pursue the objective of improved local government by supporting other similarly focussed demonstration projects. Three of these have specifically set out to test a variety of approaches to municipal energy conservation management.

With federal financial assistance, the Massachusetts Department of Community Affairs aided small cities in the state through a program of training, technical assistance and information dissemination. This involved the testing and implementation of conservation methods in municipal buildings operation, vehicle fleet management and street lighting. Similarly supported, Anaheim in conjunction with nine other California Innovation Group cities, set out to survey existing energy conservation practices and to develop a model energy conservation plan and energy audit procedure. The third demonstration program, again funded by the United States Department of Housing and Urban Development, began in Portland, Oregon in 1975. In this city, a comprehensive energy conservation plan was produced to assess the potential energy savings of alternative programs, changes were also recommended in municipal codes and ordinances and capital budgeting procedures. All three energy conservation manage-

ment programs are now complete with the results published. In the case of Portland, 11 volumes are available under the general title *Energy Conservation Choices for the City of Portland, Oregon* (1977).

One obvious objective of the Portland Energy Conservation Demonstration Project was to reduce energy consumption in the area studied. However, the primary aim was to provide a model which would permit other local officials to develop comparable conservation plans in far shorter time and with much less effort. Such guidance, of course, is designed to remove some of the barriers facing the adoption of energy efficient land use strategies in the United States. It should be stressed that the federal government saw all three municipal conservation projects as demonstrations. That is, they were designed so that the methodology developed, the findings, and the general background information could be easily transferable to other local governments throughout the nation. In this sense, selected state and city agencies co-operated with federal officials to play the role of transmitters in the diffusion process (Foster and Sewell, 1977a).

Since the publication in 1977 of the 11 volumes which outline *Energy Conservation Choices for the City of Portland, Oregon,* a comprehensive plan has been developed and an energy policy adopted in the community. Both incorporate a variety of the energy efficient land use strategies that are the focus of this report. This process of implementation is not yet complete and is taking place against a background of opposition and support. Portland therefore provides an ideal social laboratory to study both the advantages and disadvantages of federal intervention in the municipal energy conservation scene. Its successes and failures have implications at both the local and national levels and can provide valuable insights into the diffusion process for Canadian policy designers.

Portland: Geographical Setting

The Portland Energy Conservation Demonstration Project did not focus exclusively on the City of Portland but also included consideration of the surrounding counties of Multnomah, Washington, Clackamas and Clark. These five jurisdictions together form a unit known as the Standard Metropolitan Statistical Area (SMSA). This was used for energy analysis for two basic reasons. Firstly, almost all data were more readily available for the Statistical Area than for the City of Portland alone. Secondly, the impact of conservation choices will be felt far more widely than merely the region's urban core.

The City of Portland is located at the confluence of the Willamette and Columbia rivers. It reached a maximum population of 379,000 in 1975, a figure which has since declined to 365,000. Nevertheless, it continues to dominate the economy of the Standard Metropolitan Statistical Area. This larger region, including Portland, has a total current population of approximately 1,075,000, a figure expected to rise to 1,600,000 by the year 2000 (Portland Bureau of Planning, 1977).

The City of Portland covers a relatively restricted area and has developed in traditional North American grid pattern form. It is noted for its small block size and compact neighbourhood structure. Residential development makes up the largest single land use category, while streets, waterways, and railroads comprise the second major land use classification. Commercial and retail areas are located in the Central Business District, the Lloyd's Center area less than one mile to the east, and the John's Landing district about three miles south of the city centre, as well as along all major arterial streets. Industrial development is concentrated along the Willamette River, the northwest portion of the city, and the Rivergate Industrial Area at the confluence of the Columbia and Willamette rivers. The potential

for further development is restricted because of topography and by substandard lot sizes. Some vacant industrial land is, however, available in parcels of 20 acres or more; the majority of these are located in the Rivergate Industrial Area. Any substantial growth of all land use segments will inevitably depend upon annexation.

Portland has developed using traditional transportation modes. The automobile has dominated since 1950 and it is predicted that its usage will continue to increase into the next decade. Public transit has shifted from a streetcar and bus network to a combined metropolitan system based upon bus patronage. This is operated by the Tri-County Metropolitan Transportation District (Tri-Met), a state appointed agency. Tri-Met is responsible for all existing public transportation as well as for developing new modes of transit. The City of Portland and Tri-Met are now finalizing plans for building a light-rail system, serving suburban Gresham and downtown Portland. Transit ridership has increased over 70 percent since 1970, although it still represents a minor portion of all types of trips. During the next five years, the region will spend over $500 million on transportation projects. Of this total amount, 60 percent will support the completion of Interstate 205 (Oregon Department of Transportation, 1978).

Urbanization is taking place rapidly within the Portland Standard Metropolitan Statistical Area (SMSA). This process is occurring in areas with few or no municipal services, and where the automobile is a necessity, since there is insufficient population density to promote effective public transportation. In 1970, for example, 572,000 private automobiles and pickup trucks were registered in the SMSA. By 1974, this figure had increased by 13 percent to 645,000 vehicles, while the population had grown by only 6.3 percent (Bureau of Planning, City of Portland, 1977). Despite this growth, vacant land within the City of Portland, where services are available, remains under-utilized. This is the result of

large lot minimum footage requirements in the present city building code.

Metropolitan Portland has a diverse economic base which primarily rests upon forestry, agriculture, shipping, health services, and electronics. The single most significant employment sector is the electronics industry with Tektronix Incorporated the largest employer, having a work force of 19,000. Portland's second largest employment group is health services, including the University of Oregon Medical Center. The region is a major processor and transshipment centre for forestry and agricultural products and also a very significant lumber and paper centre. The Port of Portland is the second largest grain handler on the west coast of the United States and is increasing its share of the growing container shipping industry. This diversified economic base has provided a stable economic environment and, as a result, Portland has not experienced large fluctuations in the business cycle (Wellington, 1979). Traditionally the Portland SMSA has had an abundant, cheap supply of energy in the form of oil, natural gas and electricity. The largest single source was electricity generated by hydro-electric, thermal and nuclear plants. For this reason energy consumption in the Portland area, and indeed in Oregon as a whole, has continued to rise in a manner similar to the national United States average (Table 12). In terms of electric power the Pacific Northwest region still has a substantial price advantage over other parts of the United States. Further, the Portland SMSA enjoys an advantageous position within this already attractive pricing region. However, this is not true for natural gas costs where the Pacific Northwest region is less well off. Much of the supply is derived from British Columbia, through the Westcoast Transmission Company pipelines, which have been experiencing supply difficulties. In addition, the Canadian federal government has been committed to removing any undervaluation of natural gas relative to crude oil. As a result,

TABLE 12: HISTORICAL AND PROJECTED ENERGY CONSUMPTION BY SOURCE OF ENERGY, STATE OF OREGON (10^{12} Btu)

	1960		1965		1971		1990	
Hydroelectric	133.8	30.3%	167.8	31.5%	353.3	43.1%	360.0	22.8%
Oil	208.8	47.4	241.8	45.4	303.9	37.1	639.5	40.5
Gas	33.2	7.5	62.6	11.8	110.5	13.5	127.9	8.1
Wood	56.4	12.8	52.2	9.8	48.1	5.9	42.6	2.7
Nuclear	--	--	--	--	--	--	409.0	25.9
Coal	8.7	2.0	7.7	1.5	3.8	0.4	--	--
TOTAL	440.9	100.0	532.1	100.0	819.6	100.0	1,579.0	100.0

Source: City of Portland, Policy Analysis Section, Bureau of Planning (1977).

the cost of natural gas in the Portland area has been rising rapidly and seems likely to continue to do so. In consequence, only the New England region incurs higher unit prices for natural gas. This position is altering with the import of higher priced Mexican gas into other areas of the United States. The situation is worse for fuel oil, where the Pacific Northwest is even more severely disadvantaged. This area is subject to the highest costs of any United States region for this commodity. Due to the absence of refineries in the region capable of handling high sulphur crude, this situation is not expected to change even with the increased availability of Alaskan oil (Bureau of Planning, City of Portland, 1977).

Energy and the Political Agenda

Experience has shown that major changes in municipal policies are most likely to occur as the result of stress. Such pressure is experienced by decision makers after events have demonstrated that traditional problem solving approaches are no longer adequate (Kasperson, 1969; Sewell and Wood, 1971). Change is the response to the resulting crisis. This model appears to hold true for the acceptance of the need for energy conservation by the City of Portland. During the fall and winter of 1972, precipitation over the Columbia River basin was 20 percent below normal, adversely affecting the area's generation of hydro-electricity. As a result, by mid-1973 Portland was experiencing power shortages and some brownouts. This electricity shortage helped to focus attention on a long term problem for the Portland area--that electrical supply sources were not keeping pace with demand growth. Most hydro-electric potential had been developed and, in consequence, new supplies would have to come from thermal plants. Inevitably this electricity would be more expensive and its higher cost would have adverse impacts on consumers, industry and government.

The impact of the OPEC oil embargo was also felt in Portland at the same time as the Pacific Northwest hydro-electricity shortage. This event and subsequent higher oil prices forced the United States as a whole to confront its vulnerability to future supply disruption and the probability of continually escalating energy costs. These two events communicated an unmistakable message to decision makers in Portland. They could expect supply decreases and cost increases and should be prepared to adopt policies to mitigate them. Energy supply had dramatically become a "strategic" issue in 1973.

Although it was perhaps inevitable that such shortfalls would place energy firmly on the political agenda, it was not inevitable that they would lead to the selection of Portland as a national model to demonstrate the viability of large scale energy conservation. Indeed, many cities in the United States have less secure supplies, faster growing populations and greater potential for future disaster stemming from major energy shortages. How then was Portland selected by the federal government to demonstrate the value of energy conservation to the nation?

The Decision to Conserve

Oregon has a well founded reputation as an innovative state with a long history of progressive environmental legislation. State action to preserve the milieu began in the period 1911 to 1912. At that time, the state assumed control of the entire Oregon coastline. This legislation was aimed at preserving the natural beauty of the coastal environment, as well as preserving the public's access to it. From this beginning, other statutes followed which controlled forestry and fishing resources, as well as the establishment of a state park system. By 1970, environmental protection was an accepted thrust of public law in Oregon. After this date additional legislation was added to promote conservation and

recycling and in 1973 the legislature passed the nation's first "Bottle Bill," requiring a deposit on drink containers (Stacy, 1978).

Also in 1973, a statewide concern over the preservation of agricultural land generated a new legislative proposal. At first this was to focus on developing an agricultural land use policy. Due to the political influence of Governor Tom McCall, the legislation took a broader view of state land use policy issues. The resulting legislative package became known as Senate Bill 100 and established a system of 19 statewide planning goals which must now be followed by citizens and by all levels of government. This law required all municipalities to produce comprehensive plans. The State Land Conservation and Development Commission (LCDC) is responsible for reviewing all such local comprehensive plans and ensuring that they meet the 19 goals.

Three of these mandatory goals are of particular significance to Portland's energy problems. Goal One develops a system of citizen involvement which assures the "... opportunity for citizens to be involved in all phases of the planning process." This involvement brings the citizen into the process at its inception and establishes a forum for public debate and plan acceptance. Goal Two establishes a "... land use planning process and policy framework as a basis for all decisions and actions and actions related to use of land to assure an adequate factual base for such decisions and actions." Goal Thirteen is the last related goal. It establishes that "Land and uses developed on the land shall be managed and controlled so as *to maximize the conservation of all forms of energy, based upon sound economic principles*" (italics added). These goals are not guidelines, but regulatory requirements that mandate city and county action. By July 1980, all units of local government in Oregon are required to submit, to the state Land Conservation and Development Commission, comprehensive plans which conform to

these goals as well as a description of procedures for implementing them (Oregon Land Conservation and Development Commission, n.d.).

It can be seen, therefore, that because of this state legislation, the City of Portland was obliged to develop a comprehensive land use plan which maximized the conservation of energy. While this is the case, it still does not fully explain the use of the city as a national conservation model. This role appears to have been largely due to the leadership efforts of one man, former Portland Mayor Neil Goldschmidt who is universally credited with bringing the city into the forefront of energy conservation.

Soon after the end of the OPEC embargo, Mayor Goldschmidt began to play a role in the national debate over energy policy. He testified before a working committee from the Region X Office of the Federal Energy Administration on Project Independence. At this meeting he emphasized the need for a United States energy policy which stressed conservation, rather than increased supply. His testimony sought to develop principles around which national policy could be constructed. Possibly as a result of this leadership role, Goldschmidt was invited by the National League of Cities to take part in an energy policy discussion at their convention in Houston, Texas. Again he stressed the role of energy conservation and was subsequently invited to a special meeting of mayors held by Frank Zarb, then administrator of the Federal Energy Administration, to discuss this topic. As an outgrowth of his participation in the United States energy debate, Goldschmidt prepared a formal 24-page statement on national policy, attempting to provide a framework for a comprehensive approach. This document led to a recognition that additional information was required and more details needed about the implications of conservation alternatives before communities could be encouraged to implement multifaceted conservation programs.

In August 1974, Mayor Goldschmidt proposed to the United

States Department of Housing and Urban Development that the City of Portland be used as a model to demonstrate how a community could identify and assess alternative strategies for energy conservation. The mayor actively lobbied for this concept in Washington and was rewarded with the selection of Portland as the site for the implementation of the federal government's major urban energy conservation demonstration project. The resulting study was specifically designed so that the findings of the energy analysis and energy conservation alternatives could be made transferable to other municipalities throughout the United States (Bureau of Planning, Portland, 1977).

In summary, it can be argued that by providing leadership in the debate over energy conservation at the municipal level, Mayor Goldschmidt became one of the leading national spokesmen for such policies. In addition, the state of Oregon was also characterized by strong leadership. Former Governor Tom McCall was a central proponent of environmental management. He vigorously supported Senate Bill 100 and led a successful campaign for its adoption. In consequence, the United States federal government was aware that the Portland Energy Conservation Demonstration Project would have outstanding political support at both the municipal and state levels. The passage of Senate Bill 100, which mandated a comprehensive plan for Portland, also made it extremely likely that many of the conservation strategies examined would be implemented. It is felt by many of those directly involved that the selection of the City of Portland, to demonstrate nationally the feasibility of large scale community energy conservation, rested on these political considerations.

The Portland Energy Conservation Demonstration Project

The goal of the Portland Energy Conservation Demonstration Project was to provide local decision makers with a

series of conservation choices which would become the basis for public debate and eventual municipal action. The results of these analyses were published in 11 volumes which together describe their costs, benefits and the social and environmental impacts of their implementation (City of Portland, 1977). Since 12 of the strategies which were identified were land use related, the Portland Energy Conservation Project is clearly relevant to the present study (Table 5).

Such conservation strategies and their impacts were established using a 10-step methodology, which for the sake of brevity and convenience is presented in the same manner below:

(1) Estimates were made of the 1975 and projected 1995 populations in the Portland Standard Metropolitan Statistical Area. Types of residences and commercial and industrial premises were also estimated and forecasted.

(2) Estimates were then made of the related energy requirements for commercial and industrial facilities and their related employment, several types of housing and the travel of residents and other transportation requirements.

(3) Total 1975 and projected 1995 energy use was determined by integrating the data from steps (1) and (2). Energy requirements were estimated for each category and subcategory of major use. It was calculated, for example, for single family and multifamily existing and new construction and for eight industrial types characteristic of the Portland economy.

(4) Having established the energy data base for the area, potential conservation strategies were identified by literature review. This process was widened to include telephone interviews and meetings with experts from government agencies, consulting companies and other municipalities. Eighteen such contacts were made and

a summary of experience elsewhere was prepared.

(5) Energy savings that could be achieved by applying the most progressive conservation strategies identified in step (4) were calculated for prototypical homes, commercial premises, industries and for various government activities and travel patterns. In some cases computer models were available to assist with these calculations.

(6) Maximum potential energy savings for major users were calculated by multiplying the conservation in each prototypical unit, determined in step (5), by the number of users who would be expected to take these actions, assuming an acceptance pattern established in step (8).

(7) Implementation programs were identified to encourage adoption of energy conservation; these involved either public education, financial incentives or mandatory requirements.

(8) To estimate the percentage of major users who would adopt strategies under specific conditions, a workshop was held which was attended by 80 representatives from industry, business and the utilities. These provided estimates of the impact of implementation programs on the rate of adoption of conservation strategies. Replacement rates of buildings, appliances and equipment were also used to estimate rates of potential adoption.

(9) Potential total energy savings in 1995 were established by multiplying the percentage of major users adopting conservation actions established in step (8) by the maximum potential energy savings from the program, determined by step (6).

(10) Certain assumptions were thus made about regional population growth, per capita gross national product, lifestyle patterns and energy prices to allow actual estimates to be made of energy consumption in the Portland area in 1995, with and without the adoption of various conservation strategies.

Simultaneously with the development of the plan, consultants from the Natural Resources Law Institute developed selected model code provisions which, if implemented by local government, would allow such energy reductions to be achieved.

The Portland Energy Conservation Demonstration Project was completed in June 1977. Its HUD contract price was $224,305. This expense represented 10.5 man-years of project staff time, hardware necessary for data retrieval, 2,000 documents and an overhead rate of 5 percent for administration. Much of the work was in fact completed by private consultants. Those involved estimate that using the Portland experience, other cities of the same size could repeat the study in between 6 to 9 months for some $100,000-$150,000 (Policy Analysis Section, Bureau of Planning, Portland, 1977).

In summary, the project examined 85 energy conservation strategies and identified 42 as being applicable to Portland. The co-operation of federal, state and local government is required to implement this entire package but, if this were achieved, anticipated energy demand in the Portland region could be reduced by 35 percent in 1995.

From the viewpoint of this study, one of the major innovations of the Portland conservation demonstration was the development of an energy zone map (Figure 12). This divided the city into five zones based on the relative efficiency of energy use in each. The object of this map was to guide capital improvements into energy efficient locations. The zones and the criteria used in defining them are described in Table 13. It was established, for example, that if most new development occurs in Zone 2 rather than Zone 4, Portland will use 7 percent less transportation and 1 percent less residential energy. Similarly, it was shown that an average family occupying a townhouse, apartment or a single family home in Zone 1 would use approximately 35 percent less energy than it would require when living in the same type of residence in Zone 5. These savings reflect differences in

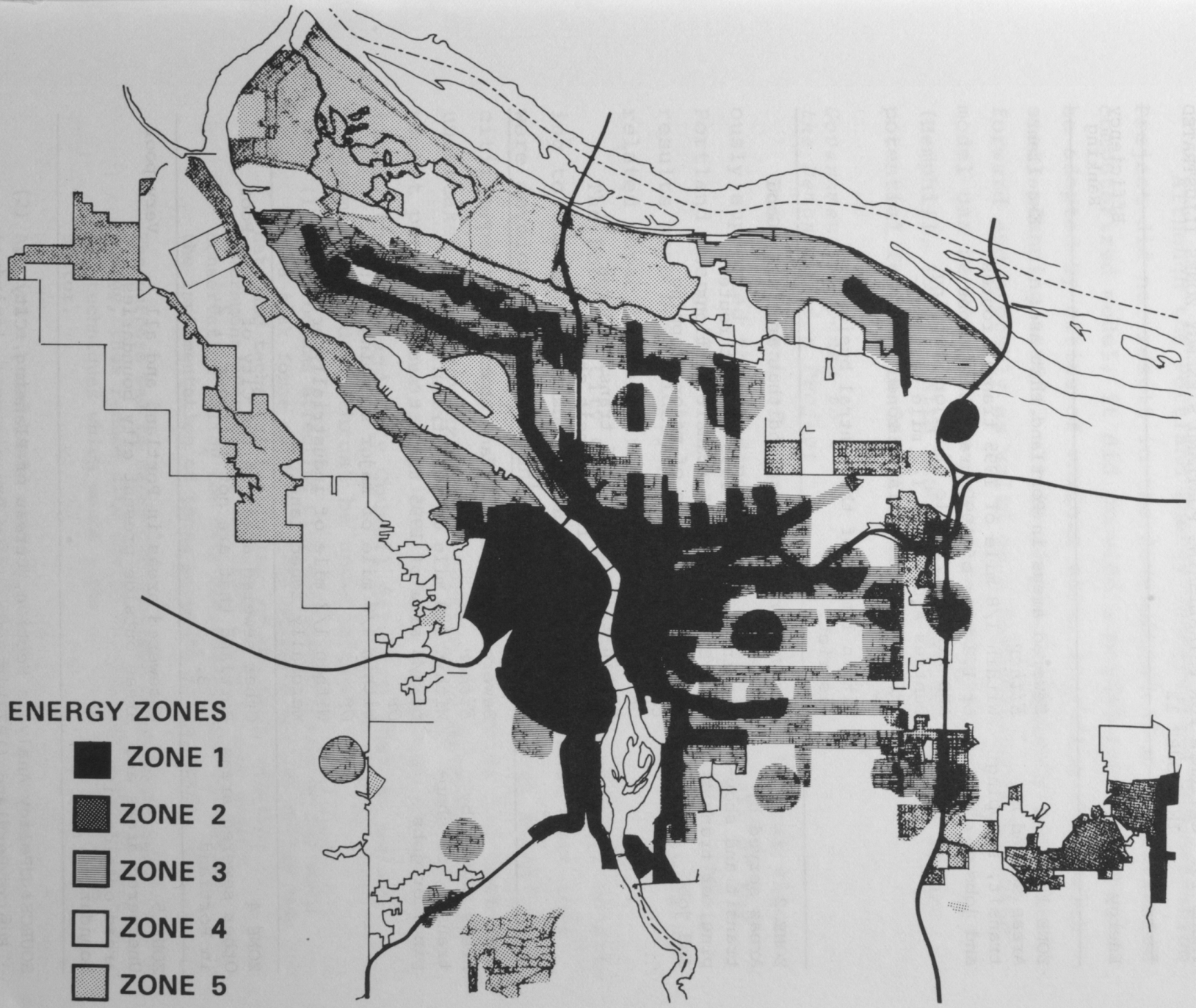


Figure 12: Portland Energy Zones.
(Source: Policy Analysis Section, Bureau of Planning, Portland, 1977).

TABLE 13: CRITERIA FOR ESTABLISHING PORTLAND'S ENERGY ZONES ILLUSTRATED IN FIGURE 12

Energy Zone		Efficiency Ranking
ZONE 1 Areas served by transit, shopping and jobs	Sewered areas in Portland that are: *Either* Within 1/8 mile of 1995 transit routes or 1.3 mile of 1995 transit stations AND within 1/3 mile of major shopping centres AND within 1/2 mile of industrially or commercially zoned land. *Or* Within 1 mile of the central business district.	Excellent
ZONE 2 Areas served by transit and shopping, or transit and job	Sewered areas in Portland that are: *Either* Within 1/8 mile in 1995 transit routes or 1/3 mile of 1995 transit stations AND within 1/3 mile of major shopping centres. *Or* Within 1/8 mile of 1995 transit routes or 1/3 mile of 1995 transit stations AND within 1/2 mile of industrially or commercially zoned land	Good
ZONE 3 Areas served by transit, or shopping, or jobs	Sewered areas in Portland that are: *Either* Within 1/8 mile of 1995 transit routes or 1/3 mile of 1995 transit stations. *Or* Within 1/3 mile of major shopping centres. *Or* Within 1/2 mile of industrially or commercially zoned land.	Fair
ZONE 4 Other sewered areas in Portland	Other sewered areas in the City of Portland that are not in zones 1, 2 or 3.	Poor
ZONE 5 Unsewered areas and areas outside city boundaries	Unsewered areas in Portland and all areas outside present city boundaries.	Very poor

SOURCE: Policy Analysis Section, Bureau of Planning, City of Portland (1977).

travel behaviour.

Although the Portland Energy Conservation Demonstration Project did not result in the development of a sophisticated computerized model, it did provide a methodology that could be adopted by cities of various size, including those with small planning staffs. It is simple, relatively straightforward and probably as valid as a forecasting or planning model can be without the use of econometric modelling (Hemphill, 1979). With minor modifications it has clear potential for use in Canadian cities.

Government Response to the Demonstration Project

The Department of Housing and Urban Development vigorously supported the findings produced by the staff of the Portland Energy Conservation Demonstration Project. Their results have been widely publicized, together with those of related capacity building projects.

The Portland City Council was less enthusiastic, objecting to the conservation estimates on the grounds that they were developed by staff and consultants, without significant citizen participation. The only outside review had been undertaken by energy experts, checking the methodology and market penetration assumptions. As a result of these objections, the Portland City Council directed that an energy program with a dual thrust be undertaken:

(1) The programs affecting City government should be reviewed by a task force of City Bureau Managers to: (a) verify the data and technical feasibility of the study relating to government operations; (b) draft a preliminary energy conservation policy for City government; and (c) monitor the implementation of those programs and policies.

The purpose was to carry out programs which could save energy, thus reduce city energy expenditures, and to test the techniques which would later be asked of the private sector.

(2) Appoint a broad based citizen's group to: (a) review the technical, economic and political feasibility of the various

> programs (by "political" I mean the acceptability of the programs by those agencies and firms which would be required to carry them out); and (b) develop for Council adoption an Energy Conservation Policy which would provide a framework from which to hang the various program options, justify the need for conservation action at the local level and to provide policy guidance to this or any future City Council. (Hemphill, 1979)

During the two years in which the citizens' group was developing a proposed energy policy for Portland, the City Energy Management Task Force prepared a wide range of conservation documents. The three most significant amongst these were *Energy Conservation Policy for City Government*, *Municipal Building Energy Audit* and *Municipal Control of Utility Rates*. One result of these activities has been that the Portland City Council has adopted a policy that 0.5 percent of the General Fund and all applicable Special Funds (such as those for water supply and street lighting) be set aside to implement conservation recommendations. This policy stays in effect until it is no longer cost-effective to make the necessary investments.

Mayor Neil Goldschmidt appointed 15 citizens to serve on the Energy Policy Steering Committee and 60 others to take part in a series of six technical advisory task forces. The purpose of the task forces was to review the feasibility of the conservation strategies outlined in the publications of the Portland Energy Conservation Demonstration Project and to report to the Steering Committee. The Steering Committee provided basic information, background research and advice to the citizens. The citizens involved volunteered over 3,500 hours of work in the 15 months required to complete their tasks. Presentations were heard from a wide variety of authorities in building and construction, finance and economics, law, energy technology and other related areas, together with members of the public (Hemphill, 1979). Eventually the Energy Policy Steering Committee developed a *Proposed Energy Conservation Policy for Portland*. In an effort to demon-

strate that they had a wide political base of support the Steering Committee held nearly 40 meetings with citizens and special interest groups to discuss it. Over 1,500 people participated in the review process. They included members of such groups as the Chamber of Commerce and the Northwest Industrial District Association and renewable energy lobbyists promoting recycling, solar power and less established technologies. Their comments and testimony were recorded and transmitted to Portland City Council. As a result of these meetings, the *Proposed Energy Conservation Policy for Portland* was revised by the Steering Committee.

On August 1, 1979 this modified document passed first and second readings by City Council. Voting was 4 to 1 in favour. It was adopted on August 15, 1979 as Ordinance 148251. At the same meeting Ordinance 148252 was also passed, instructing city bureaus, offices, commissions and employees to begin implementation of the energy conservation policy.

From the point of view of this study, the most significant portions of the policy are those dealing with land use and transportation. For example, the former is controlled by policy number 3:

> The City shall develop land use policies which take advantage of density and location to reduce the need to travel, increase access to transit, and permit building configurations which increase the efficiency of space heating in residences.

Specific objectives of this policy include developing land use patterns to reduce the journey to work, promoting intensive commercial, residential and retail growth near transit stations and increasing the economic feasibility of close-in housing.

Policy number 5 is that:

> The consumption of nonrenewable fuels for transportation shall be reduced through actions which increase the efficiency of the transportation system operating within the City. These actions will encourage individuals to choose the method of travel which is the most fuel-efficient for the purpose of the trip; promote the energy-efficient movement of goods; and provide incentives for the use of fuel-efficient vehicles.

Policy objectives include the development of a network of safe, direct bicycle routes throughout the city.

Portland's Proposed Comprehensive Plan

Energy efficient land use planning strategies have been promoted by the staff of the Portland Energy Conservation Demonstration Project and incorporated into the city's official energy conservation policy. However, if they are going to significantly increase conservation it is essential that they are incorporated into Portland's comprehensive plan. This is being developed to meet the city's obligations under Senate Bill 100 which requires Portland to produce a comprehensive plan. This document must meet the 19 goals, including that of energy conservation, outlined in the state legislation.

In January 1979, a discussion draft of Portland's proposed comprehensive plan was released for public scrutiny. This compact collection of goals and policies and an accompanying land use map were the result of a year of public workshops and intensive activity by the city's Bureau of Planning. The cost of plan production to that point was estimated at almost $1 million (Sistrom, 1979). This draft was for discussion purposes only. Its major energy efficient features included the creation of centres and corridors of commercial activity and high density apartment and row housing along most of Portland's larger streets. The draft plan envisaged a population increase of some 70,000 over 20 years and attempted to locate most of it in such locations. Perhaps in an effort to counteract adverse reactions to such higher densities, the plan attempted to reinforce the city's most common housing pattern--medium density single family homes--by down-zoning in many neighbourhoods. The draft plan also sought to increase employment by encouraging light industrial growth and more land was zoned for this purpose. Mass transit was also to be encouraged, especially by the

higher densities in development centres and along corridors. The energy efficiency of such a system and the better air quality associated with it were pointed out. The plan also attempted to maintain Portland's leadership role in the metropolitan area by encouraging population and industry to move into the urban core.

Even the development of the draft comprehensive plan had involved considerable public participation as called for under Senate Bill 100. This had been achieved by holding a series of planning workshops where interested citizens were offered three concisely worded alternatives for Portland's future growth. These had been developed by juggling housing density, commercial and industrial development and transportation in different ways. One alternative called for no change in existing zoning and land use patterns. The second sought a larger portion of the region's population for the city by encouraging high density rental apartments and commercial developments along major streets and at neighbourhood centres. The third alternative also accommodated a substantial jump in the city's population, but would have dispersed it around the city by rezoning numerous single family residential areas to allow other, more innovative kinds of housing such as duplexes and townhouses and by using small land parcels. It also put a strong emphasis on encouraging employment, especially in the industrial sector. The draft comprehensive plan can be seen as a hybrid compromise between these three prototypes.

As might have been expected, it rested on several policies that had been accepted previously by the city; particularly the Arterial Street Classification Policy which had been adopted in 1977. This developed the concept of centres and corridors. Centres are areas of existing commercial activity and some higher density housing and apartments. Under the draft plan these were to be reinforced by zoning revisions. Corridors are major streets, designated

as such under the Arterial Street Classification Policy. The plan attempted to change their emphasis from automobile oriented use to mass transit. Commercial outlets along such corridors would have to be transit supportive. Uses dependent upon car traffic, such as drive-in banks and fast food outlets, were to be discouraged.

Facing the corridor streets were to be developed a row of apartments. Farther back, extending off the street for approximately two blocks on either side, a strip of primarily owner-occupied (though high density) housing was to be encouraged. The predominant zone along the proposed corridors called for a new type of housing, row and townhouses, which was expected to act as a buffer between high density corridors and the tradtional single family dwelling neighbourhoods. The plan also permitted small rental units in single family houses, termed "Add-a-Rental."

In addition to the energy conserving centre-and-corridors strategy, the draft comprehensive plan contained 14 general goals and supporting policies, revisions of the city's 20-year old zoning ordinance and a detailed land use plan map which designated permitted use to every parcel of land in Portland. Many of the 14 policies were in fact merely restatements of accepted policy. For example, the plan's housing policy was the same as that adopted by the City Council in March 1978.

The draft plan had several important omissions, which also had energy conserving implications. The most significant of these was its failure to identify an urban-services boundary. The City of Portland is obliged by Senate Bill 100 to propose a limit outside its present boundaries, beyond which it will not provide city financed services, such as police and fire protection, water and sewers. This boundary was not defined by the draft plan and yet can clearly be a very significant energy conservation measure. Another incomplete section of the plan dealt with energy policy which was still being drafted at the time of its release.

The draft comprehensive plan for the city clearly incorporated many of the energy conserving land use strategies evaluated by the Portland Energy Conservation Demonstration Project. These represented major change for many of the city's residents and resulted in considerable opposition to the adoption of the plan. This unrest is discussed in detail elsewhere in this report. Such reactions were aired in a variety of forums, including over 100 public meetings held by the Portland Planning Commission, to assess public reaction to the draft. These occupied the first six months of 1979, during which over 13,000 copies of the plan were distributed to interested individuals and organizations. As a result of feedback, the Planning Commission revised its initial document and reissued it in September 1979 as a Proposed Comprehensive Plan. This is currently the subject of public hearings and debate and will be modified once again before it is presented as a formal recommendation to the City Council.

The Proposed Comprehensive Plan which is currently being debated in Portland shows the signs of considerable compromise. As the result of public criticism there has been "detailed tailoring" of the goals, zoning revisions and land use map. Fundamental goals appear to remain more or less intact, although over 60 percent of specific requests for modification were granted. Amongst the alterations are reworking of the draft plan's row house zones, revisions of the centres and corridors strategy, and building size limits on the Add-a-Rental proposal to allow rental units in single family dwellings. Also added were a new high density apartment zone for buildings outside downtown, and a major rewriting of the commercial zone definitions. These changes are the result of public pressure. Neighbourhood groups, for example, bitterly opposed the row house concept and the emphasis on development corridors. The Proposed Comprehensive Plan retreats a little from this concept by breaking up several corridors into clusters of commercial activity

surrounded by high density housing, terming these development nodes.

The public debate continues and the plan is likely to undergo further modification before it is submitted as a formal recommendation to City Council by early 1980. At this point, the City Council itself will hold its own public hearings before adoption. The comprehensive plan must then be accepted at both the regional and state levels. The final acceptance of Portland's comprehensive plan rests with the State Land Conservation and Development Commission, set up by Senate Bill 100. It is by no means certain therefore that, even if the comprehensive plan is adopted by Portland's City Council, it will be acceptable to higher levels of government.

Another actor in the comprehensive plan debate is the Metropolitan Service District. This is a body with regional responsibilities which co-ordinates land use, transportation, sewers and other services in the Greater Portland area. The Metropolitan Service District Council is a relatively new organization. In January 1979, it absorbed the Columbia Region Association of Governments (CRAG) in an expansion of regional powers. The former body has also been active in the energy field and had published progress reports on regional energy analysis (Weinstein, 1977a, 1977b). These were largely devoted to providing an energy use data base but also included consideration of the relationships between energy use and density in the area. Such reports were clearly supportive of more energy efficient land use and other forms of conservation. It was the Columbia Region Association of Governors which first determined the location of the Greater Portland urban growth boundary which is now supported by the Metropolitan Service District Council. This line is to separate areas which are permitted to develop from areas which are not. It will effectively set a limit to urban sprawl at least until the end of the twentieth century. The initial proposal made by the Metropolitan Service District

was for an area of 234,994 acres. This included the City of Portland and parts of Multnomah, Washington and Clackamas counties. It appeared in July 1979 that the state would reject this proposed limit to Greater Portland's urban growth as being excessive. Since this date, the Land Conservation and Development Commission's staff and planners representing the Metropolitan Service District have reached a compromise and an area of 232,000 acres appears likely to be accepted within the urban growth boundary. Nevertheless, this may be challenged in the courts by an active environmental group, the 1000 Friends of Oregon, which considers it includes 29,000 acres which should remain undeveloped (Alesko, 1979).

Other Government Agencies

One further governmental actor in the energy conservation and land use controversy in the Portland area should be identified. Public transit for the Portland metropolitan area, based on bus ridership, is operated by the Tri-County Metropolitan Transportation District (Tri-Met). This is a state appointed agency. Improvement in public transit is considered a major step in conserving energy and promoting efficient land use patterns. Transit policy, therefore, attempts to increase ridership and decrease the region's dependence on the automobile. This is accomplished by subsidized fares, route selection, and co-ordinating land use developments with local units of government.

As a result, this agency has been actively lobbying for higher density land use patterns suitable for effective public transit. Its influence may have been reflected in Portland's draft comprehensive plan which so heavily emphasized development centres and corridors.

Portland: A Summary of Government Activity

Portland is currently undergoing a major social upheaval as it attempts to move towards greater energy efficiency.

The city has analyzed a wide variety of energy alternatives, adopted an energy policy and is now involved in applying these innovations through a new comprehensive land use plan. As might be expected, opinions have polarized and the fight for or against energy conservation through land use planning is being waged in public hearings, the media, government agencies and in the courts. Numerous groups of both persuasions are extremely active and employ diverse strategies with a varying degree of success. Slowly compromises are evolving from the debate.

There are few, if any Canadian cities that can claim to have achieved as much in the application of energy efficient land use strategies. As a result, a great deal is to be learned from the Portland experience which will be relevant if such strategies are to be applied widely in Canada. For this reason, emphasis is now turned to the diverse reactions to these government proposals to increase energy efficiency through land use change in the Portland area.

The Actors

A variety of different groups which are actively striving to influence energy policy in the Portland area, were identified through interviews, the application of questionnaires and a literature review. The questionnaire was administered to respondents using a two-step procedure. After the initial appointment was set up, the questionnaire was left to be completed by the interviewee. Emphasis was placed on gathering the opinions of local politicians, planners and leaders of special interest groups that had been particularly concerned with the issue (Table 14). Interviews were conducted during a return visit to collect the completed questionnaires. Where permitted, this was taped for future reference. In addition, the Land Conservation and Development Commission supplied some 400 newspaper clippings which summarized press coverage of the energy conservation and land use issue for

TABLE 14: INDIVIDUALS IN THE PORTLAND AREA WHO COMPLETED QUESTIONNAIRES AND ALLOWED A TAPED ENERGY AND LAND USE RELATED INTERVIEW

Lynn Bonner, Policy Assistant to Mayor McCready

Charles Davenport, Vice-President, Pacific Power and Light

* Hilary Heignerader, Environmental Scientists, Portland General Electric

* Marion Hemphill, Energy Advisor, City of Portland

* Clifford Hudsick, Head, Planning and Research, Port of Portland

* Patti Jacobson, Director, Office of Neighborhood Association, City of Portland

* Robert Keesee, Chief Economist, Georgia-Pacific Corporation and Chairperson of Chamber of Commerce Energy Committee

Phil Keisling, Reporter, *Willamette Week*

* Linda Macpherson, Field Representative, Land Conservation and Development Commission

* Jim McKillip, Executive Assistant to Charles Jordon, City Commissioner, City of Portland

* Dan Mosee, Multnomah County Commissioner

* Anthony Reser, Assistant to Mildred Schwab, City Commissioner, City of Portland

* Robert Stacey, Staff Attorney, 1000 Friends of Oregon

* Christine Tobkin, Executive Secretary, Long Range Planning Section, City of Portland

* Tracy Watson, Chief Planner, Long Range Planning Section, City of Portland

** Taped Meeting of the Portland Chamber of Commerce Energy Committee

*** Steven Fisher, Regional Planning Co-ordinator, Tri-Met

* Includes taped interview.

*** Questionnaire not returned, but interview taped.

TABLE 15: PORTLAND AREA SPECIAL INTEREST GROUPS LISTED IN DECREASING ORDER OF THEIR SUPPORT FOR ENERGY EFFICIENT LAND USE

1.	Environmental groups
2.	Newspapers
3.	Democratic Party
4.	Heads of local government agencies
5.	City and county employees
6.	Radio and television stations
7.	Republican Party
8.	Bar association
8.	Labour unions
8.	Neighbourhood improvement groups
8.	Bankers and executives of financial institutions
8.	Church leaders
13.	Ethnic groups
14.	Industrial leaders
14.	Retail merchants
16.	Chamber of Commerce
17.	Other businessmen

the entire state. These were analyzed for content. From this information the influence of special interest groups was identified and the techniques they have used to affect energy and land use policies were determined.

Table 15 lists supporters and opponents for energy efficient land use in Portland. It is based upon responses to the questionnaire and shows considerable correlation with the national experience summarized in Table 9. Specifically in Portland, as elsewhere, the greatest supporters of this group of innovations appear to be environmental groups, newspapers, the Democratic Party, heads of local government agencies and city and county employees. The bulk of the

opposition nationally and in Portland stems from industrial leaders, retail merchants, the Chamber of Commerce and other businessmen.

When asked to name individuals or groups who have actively lobbied for or against land use energy conservation, the respondents collectively listed 18 individuals and 19 interest groups. In order of frequency of mention, former mayor Neil Goldschmidt and former governor Tom McCall were most commonly cited as active supporters. Their roles have already been described. The most widely recognized organizations lobbying for this group of innovations were the 1000 Friends of Oregon, the Oregon Environmental Council, Portland General Electric and other utilities and the City Club of Portland. Others cited by respondents included the Metropolitan Service District, the Oregon Solar Power League, the Oregon Homebuilders Association and Skidmore, Owings and Merrill, a consulting company active in the Portland Energy Conservation Demonstration Project.

Respondents were either far less willing or far less able to identify specific opponents to land use and energy conservation planning. Only 4 individuals and 8 organizations were identified. The specific names are not important here. It is sufficient to say that those cited were either occupying government positions or active in land development. The most prominently listed organizations attempting to obstruct efficient land use were seen to be the Washington County Landowners Association, and the Portland Chamber of Commerce. Other organizations mentioned as opponents were the Oregon Real Estate Association, the labour unions, certain major timber companies and aluminum processors. It is of interest to note that two organizations, the Oregon Homebuilders Association and Portland's Neighborhood Associations, were listed as both supporters and opponents of energy efficient land use. Their role in the debate is relatively ambiguous.

While it would not be realistic in a report of this size to describe the origins and operation of all the organizations involved in the struggle to promote or prevent energy efficient land use in Portland, for illustrative purposes the authors have selected the five which they consider most influential and will now describe their roles in detail.

1000 Friends of Oregon

The 1000 Friends of Oregon is essentially an environmental organization with a unique history and record of success that is hard to match elsewhere in North America. It provides the most enthusiastic support for land use related conservation. Former governor Tom McCall, who serves as the chairman of its advisory board, played a key role in the founding of the organization.

1000 Friends of Oregon was established in early 1975 to help ensure that the goals of Senate Bill 100 would be met throughout the state. Since that date, it has led the fight to prevent repeal of Oregon's land use laws and has provided attorneys at no cost to anyone wishing to obtain an appellate court ruling in favour of more stringent environmental protection (Richmond, 1979). The 1000 Friends of Oregon has a nine member staff, which includes several attorneys, and is currently engaged in 60 to 70 statewide proceedings involving land use law. The organization is based in Portland and is funded by private donation and public subscription. It has, for example, received grants totalling some $185,000 from the Ford Foundation and the Northwest Area Foundation in the past three years. In addition, membership fees are $100 annually and a drive is currently attempting to add 500 new individuals to the organization (Swire, 1979).

The 1000 Friends of Oregon is unique in that it is the only public interest law firm in the United States devoted to supporting a single law, Senate Bill 100. To do this is has applied a wide variety of tactics. It has been a strong

supporter of the urban growth boundary concept, for example, which it sees as being at the heart of Oregon's land use program. In this area it has worked through court appeals, the hearings of the Land Conservation and Development Commission, testimony to local governments and recommendations to the U.S. Environmental Protection Agency (which finances sewer construction) to ensure stringent limits are placed on urban sprawl. For example, 1000 Friends' attorneys won a major ruling from the Oregon Supreme Court that, prior to the adoption of their boundaries, cities must apply the sprawl control standards of the Land Conservation and Developement Commission's goals to all land use decisions to avoid committing land at the fringe to urban uses. As the result of a 1000 Friends memorandum showing projects would serve areas not needed for future urban growth, the U.S. Environmental Protection Agency halted four sewer projects, including two involving $17 million and 22 miles of shoreline in Lincoln County.

1000 Friends of Oregon is also fighting, with great success, to preserve farmland, promote higher density housing and protect the coast and historic buildings and wildlife habitat (1000 Friends of Oregon, 1979). In addition to the use of various legal tactics, it has a powerful public lobby which it alerts through progress reports and newletters. This lobby writes to legislators and to the press to promote 1000 Friends' goals.

Among the state's planners the 1000 Friends of Oregon is both admired and feared. The following newspaper quotation sums up the dilemma of the professional planner:

> Still reeling from the attacks of East Multnomah County residents who believe proposed housing densities are too high, Multnomah County planners now are faced with a counterattack from 1000 Friends of Oregon, saying they are too low. (Carman, 1979)

It is generally believed that the urban growth boundary prepared by the Portland Metropolitan Service District will be challenged in the courts by the 1000 Friends of Oregon.

This organization has already successfully appealed the Columbia Region Association of Governments' original boundary before the Land Conservation and Development Commission, arguing that it included four times the area required for new growth. The Land Conservation and Development Commission agreed and ruled that the boundary was invalid and required revision to comply with the goals of Senate Bill 100. The Columbia Region Association of Governors has since been absorbed into the Metropolitan Service District. However, this new body still supports urban growth boundaries for the area which the 1000 Friends of Oregon considers are excessive.

There is also a belief by some planners that Portland's comprehensive land use plan will also be challenged in the courts by 1000 Friends of Oregon on the grounds that too many compromises have been made to satisfy opponents of certain aspects of energy efficient land use. Given the almost perfect record of 1000 Friends' attorneys, this prospect is not found reassuring. So far only 30 of the state's 277 local jurisdictions have comprehensive plans acknowledged by the Land Conservation and Development Commission. Many of those pending appear certain to be opposed by 1000 Friends of Oregon and Portland's is likely to be no exception.

Washington County Landowners Association

The greatest opponents of the 1000 Friends of Oregon are the owners of land, particularly those in the Washington County Landowners Association. Its president, J. Allison, recently suggested the 1000 Friends should change their name to "Friends of the Rich, the Powerful and the Big Developers." Similar views have been expressed by individual landowners in letters to Oregon newspapers. One of them wrote recently:

> Your editorial written in praise of the 1000 Friends of Oregon must have been done by someone who does not own property under the Land Control and Deprivation Conspiracy. Neither I nor other rural land owners are praising them, you may be sure. What they have caused to be done to all of us is cruel and heartless. They have deprived us of our assets that were expected to carry many

> of us through our old age, without being dependent on anyone. (Booth, 1979)

The Washington County Landowners Association has a membership of some 650. One of its major objectives appears to be protecting the equity of its members. Zoning and other land use measures can, and do, drastically alter land values in Oregon. Naturally those who are adversely affected attempt to protect their interests.

Recently the 1000 Friends of Oregon demanded that Washington County apply Land Conservation and Development Commission goals 3 and 4 to the issuance of building permits. This would probably result in the denial of building permits to some property owners. Allison, the President of Washington County Landowners Association, wrote to the 1000 Friends of Oregon stating:

> These sanctions against Washington County, which the so-called Friends of Oregon have sold to the LCDC bureaucracy, are designed to deny building permits to an unknown number of owners of land in the county.
>
> These owners, in good faith, have purchased parcels of land in the county for the express purpose of building a home. The parcels were created in compliance with the state laws, in harmony with the county comprehensive plan and zoning code and in an area selected by the professional planners for small part-time farms. To deny these people a permit to build a home on their land is a gross injustice which we will not tolerate.

Allison wrote further that:

> It is evident to me the actions being pushed by the Friends clearly demonstrate that they are opposed to any new homes being built outside of the shrunken urban growth area where the price of land is already out of sight. Only the rich will be able to afford a home of their own. Under the Friends' concept of land-use planning, nearly everyone else will have to live in a highrise slum with a concrete front and back yard. (Allison, 1979)

Landowner associations, including that of Washington County, have lobbied the Land Conservation and Development Commission, presented briefs at public hearings, sent letters to numerous newspapers and sought to undermine support for Senate Bill 100. These efforts have culminated in three attempts in nine years to repeal statewide land use planning laws.

In 1970, Ballot Measure No. 11 voted on changes in the old Senate Bill 10 (predecessor to Senate Bill 100) to restrict counties' planning commissions power over rural property. This was defeated by an overall vote of 342,503 to 272,342. It passed in 14 Oregon counties.

On November 2, 1976 a measure to repeal land use planning co-ordination statutes was defeated by a vote of 536,502 to 402,608. The issue carried in 16 Oregon counties. On November 7, 1978 voters defeated Ballot Measure No. 10 that would have meant major reduction in the powers of the Land Conservation and Development Commission. This passed in only five counties and was beaten by a vote of 515,138 to 334,523. In summary, the landowners' battle to defeat comprehensive land use planning in Oregon is not succeeding.

Other tactics are now being employed. In July, 1979 the president of the Washington County Landowners Association filed a preliminary petition with the Secretary of State to add a new section to the Bill of Rights of the Oregon Constitution. Relative to the proposed initiative, Allison said:

> When a state bureaucrat, endorsed for the job by Governor Atiyeh, has the power to order county officials to deny a building permit to the owner of a lawfully created lot of record, it is time we added to our Bill of Rights.
>
> Hundreds of people have purchased land in Washington County for the express purpose of building a home on their land. These parcels were lawfully created in accordance with state law, the county comprehensive land use plan and the local zoning code. No Salem bureaucrat, with or without the endorsement of Governor Atiyeh, should have the power to deny a home building permit to these citizens.
>
> A copy of the initiative follows.
>
> AN ACT
>
> The Constitution of the State of Oregon is amended by creating a new Section (No. 40) to be added to ARTICLE __--BILL OF RIGHTS to read:
>
> Section 40. If at the time a person acquires a lawfully created parcel of land the right to establish a single family dwelling is a permitted use on such parcel, that use shall not be denied such person as the result of zoning, rezoning, by the adoption or amendment of a comprehensive land use plan or by changing the text of a zoning code.

The fight against comprehensive land use planning is not merely restricted to the landowners associations. Realtors have also actively attempted to repeal Senate Bill 100. In addition, 18 local governments, including counties, cities, public ports, and soil and water conservation districts have brought a lawsuit seeking to dissolve the state Land Conservation and Development Commission. Their suit contended that the commission was unconstitutional because it makes rules that only the legislature has the authority to pass. The fight is being led by Curry County that budgeted $100,000 for the suit. In August 1979, it was rejected by a Marion County Circuit Court on the grounds that land use goals are administrative rules that can only be reviewed by the Court of Appeals. Columbia County is also an active participant in the suit (Kristof, 1979).

Opponents of comprehensive planning are also attempting to take advantage of a 1977 state law that guarantees tax relief to property owners whose land depreciates because of changes in zoning. When many comprehensive plans are accepted, it is possible that county assessors will be bombarded with requests for reductions in property taxes. In Polk County this process has just begun (Lamers, 1979).

In summary, much of the fight against land use planning on a statewide basis is coming from landowners and their associations whose property values are declining because they are no longer eligible for residential or commercial use. Property owners who feel their rights have been violated can now turn to a new organization called Mad Oregon Property Owners Incorporated. Headquartered in Willamina, it was recently founded by Dr. S.S. Herr, a semi-retired doctor.

Despite the repeated voter support for Senate Bill 100 there are still many propsective members for this organization in Oregon, as the following excerpt from a letter to the editor of the *Eugene Register-Guard* illustrates:

> Wake up America. I hope you haven't slept too long. You were warned a long time ago that the Russians would bury us. Well, they have already got us in the hole, and if we don't get in and fight against this LCDC and this land-use planning, and let the people who own their property and pay the taxes do as they wish with what they have worked hard for all these years, all you are going to need next is to have the dirt thrown in on you and fill the hole. (Saunders, 1979).

Within the City of Portland itself, two organizations appear to be acting as leaders in the fight for and against energy efficient land use. Major support is being provided by the City Club of Portland, while opposition is being organized by the Portland Chamber of Commerce. The roles and strategies of these two special interest groups will now be examined in more detail. Neighbourhood associations are also very active but appear to be playing an intermediate role.

City Club of Portland

The City Club of Portland is a civic organization which promotes education and research activities on issues facing the metropolitan area. In its last annual report, presented on June 1, 1979, the club's current membership was given as 1,970 (City Club of Portland *Bulletin*, 1979a). These individuals are civic and business leaders, members of professional societies and the more aware and sophisticated members of the public.

The club is engaged in two major educational thrusts, both of which have great influence in the Portland area. The first of these is a visiting speaker program which results in a discussion of relevant topics every Friday. A less formal system of afternoon meetings is also an ongoing part of its program. In 1978-79, average Friday attendance was 156. A far wider audience is reached, however, since both KOAP-FM and KBPS, two local radio stations, broadcase the club's debates. In addition, certain particularly significant meetings are televised; for example, as when the club

was used as a platform to "kick off" the 1978 campaign for the governor of Oregon. Amongst the topics discussed by the club in the period June 2, 1978 to May 25, 1979 were: "The State of the City, 1979" at which the speaker was Mayor Neil Goldschmidt and "Oregon's Land Use Program--Where Things Stand." This latter presentation was given by Henry Richmond, Executive Director of the 1000 Friends of Oregon. Public transit, electrical power's problems and prospects, the state's role in regional energy decisions and energy conservation in the Portland metropolitan area were also discussed in this period. A total of 47 meetings were held during this year in an effort to promote wider public interest in Portland's future. More recently, the region's urban growth boundary has been the topic of debate.

The City Club of Portland's second thrust is an ongoing program of long range studies. Members undertake detailed analyses of major issues which are then published and distributed to those who belong to the club and to other interested indivuals. In 1978-79 four long range studies were published, one of which on *Energy Conservation in the Portland Metropolitan Area* (1979b) is of particular concern here. In 1977, the City Club of Portland also prepared a report on *Choices for Metropolitan Portland's Mass Transit System* (1977) which had major energy implications. More recently, in June 1979, a study of the *Discussion Draft, City of Portland Comprehensive Land Use Plan* (1979c) was presented to the club membership. Its content was accepted by vote.

There can be no doubt that the City Club of Portland is very influential. Indeed, it makes no apologies for attempting to influence the political process:

> The November 1978 election was the best evidence that the City Club is carrying out its purpose of "informing its members and the public." Fifty-eight of our members produced nine majority reports and four minority reports on ballot measures. Spirited debate and good media coverage indicated the level of member and public interest in City Club positions on all measures. (City Club of Portland *Bulletin*, 1979a)

In summary, the City Club of Portland is a major lobby group that does not have a predetermined viewpoint on any issue. Its stance is developed by debate, informed presentation and research and may vary from issue to issue. Considerable effort is involved in this process, its report on energy conservation, for example, was based on interviews with 71 individuals representing a wide variety of interests and professional expertise.

As the result of these two educational programs, the City Club of Portland has come out strongly in support of both energy conservation and comprehensive land use planning. On the former, for example, its study group recommended that:

> Local governments in the Portland area should put their money where their rhetoric is on energy conservation by budgeting adequate, full-time staff to develop and implement energy conservation policies and programs....
> ... The City of Portland should adopt for inclusion in its comprehensive plan the land use energy conservation recommendations developed by the Portland Energy Policy Steering Committee. (City Club of Portland *Bulletin*, 1979b)

Similarly, the Discussion Draft of the City of Portland's Comprehensive Land Use Plan was criticized on the grounds that it did not include:

> ... a clear, positive, perhaps futuristic even idealistic statement of vision for the city--a vision on which the details of the Plan can hang and which will provide a context for discussion and debate among the city's residents over the coming weeks and months. (City Club of Portland *Bulletin*, 1979c)

The plan was also criticized for ignoring certain city policies. These viewpoints were, of course, broadcast to a large audience and widely reported in the press (Pickett, 1979).

In the Portland area the educational activities of the City Club and the legal expertise of the 1000 Friends of Oregon have together been a very significant force in promoting energy efficient land use. Within the city, two important sources of opposition appear to be developing: the Portland Chamber of Commerce and certain neighbourhood associations.

Portland Chamber of Commerce

The Portland Chamber of Commerce which represents major business interests in the city, has over 2,200 members. This organization has had a long and active involvement in the formulation of energy policy. Over the past five years the Chamber has pointed out what it considers to be the strengths and weaknesses of proposed federal and state legislation and has been heavily involved in promoting a regional electric power bill. It has made presentations to legislative bodies on specific issues, from mandatory coal conversion to electric power generation, and has also actively lobbied individual congressmen in support of its viewpoints.

Throughout this discussion the Chamber of Commerce has been concerned about national policy. It has stressed the problems caused by both balance of payment deficits and the threats to national security resulting from heavy reliance on foreign oil supplies. In an effort to solve these problems the Chamber has promoted oil price decontrol and natural gas deregulation. It has argued that these two actions would bring about a market response; higher prices would then reduce energy consumption, increase domestic output and automatically promote economic development of alternatives and conservation. The Chamber applauded the recent United States national moves towards a phased domestic oil decontrol policy and natural gas deregulation.

The Chamber of Commerce is strongly opposed to expansion of government power, seeing it as a factor which distorts the operation of the free market and creates rather than solves problems. These views have been expressed most forcibly by the Joint Energy and Economic Principles and Policies Committee, set up to make recommendations to the Portland Chamber of Commerce on the city's energy policy. This committee urged the Chamber to support efforts under Ordinance No. 148251 which it felt will result in increased economic efficiency in the city's use of energy and improve

the dissemination of cost-effective energy conservation information to consumers. It asked the Chamber to oppose a City Charter amendment requiring new city employees and existing employees who move, to reside within the city. In addition, the Joint Committee recommended that the Chamber oppose city energy policies which mandate that individuals take specific action, require that they consider particular energy resources, establish preferences and/or training programs favouring specific industries, or set up any new government agency regardless of its source of funding. In summary, the Joint Energy and Economics Principles and Policies Committee favoured a conservation policy that permitted almost complete freedom of choice, in a framework of higher priced energy. It supported this viewpoint with evidence to show that there have been dramatic declines in the rate of increase and demand for oil and natural gas, thought to be due to higher prices for these resources.

Until October 1979, the Chamber's position on energy policy had been reserved. It responded officially only after the adoption of the city's policy, taking a negative position on its implementation portion. The meeting at which this decision was taken was recorded for use in this study. During the debate, most members of the Chamber were supportive of the free market, echoing the views of the Joint Energy and Economic Principles and Policy Committee.

Many of the supporters of energy conservation through efficient land use and other related measures see the Chamber of Commerce as a group representing the vested interests of developers and businessmen, dependent upon the automobile and benefitting from urban sprawl. It can be argued, however, that many disagreements stem not from different goals but rather from the application of their means of implementation. Indeed, high energy prices may cause many of the energy efficient land use strategies, described in this volume, to be implemented. This may be true even if no government

intervention to mandate this is forthcoming (Joint Energy and Economic Principles and Policy Committee, 1979).

Neighbourhood associations

Neighbourhood associations are extremely active in Portland. Some of these date from the 1930s, when 16 neighbourhood councils were formed to fight juvenile delinquency. In the late 1950s and early 1960s, other groups such as those in Laurelhurst, Irvington and Sellwood-Moreland were formed to improve residential quality. Federal support then helped set up many more groups through the Model Cities program and Portland Action Committees Together Incorporated. Other neighbourhoods later organized to protest zoning decision, freeway plans or proposals for urban renewal. There are now 58 such associations in Portland, representing 68 neighbourhoods. For greater effect many of these are now linked in a series of coalitions on a geographical basis.

In February 1974, the Portland City Council established an Office of Neighborhood Associations to encourage such public participation (Office of Neighborhood Associations, 1979). The City of Portland continues to actively support neighbourhood associations. For example it budgeted $187,000 for this purpose in fiscal year 1976-77 (Pedersen, 1976).

City departments, such as the Bureau of Planning, are obliged to notify a neighbourhood association of any matter affecting the livability of its area. Policy matters require 30 days' notice unless it is an emergency. The budget review process and the open door policies of the mayor and several commissioners, together with the public hearing process, has meant that neighbourhood groups have had considerable power. Vigorous leadership has developed to exploit this at the local level (Pedersen, 1976).

In the fight for and against energy efficient land use in Portland the neighbourhood associations have been very active. Citizen involvement through the associations has

included holding public hearings, serving on energy related committees and dissemination of information. Although these associations have been generally supportive of energy policy development, there has been strong resistance on two points of the implementation program. Both the mandatory weatherization and proposed increases in density have been vigorously opposed in some neighbourhoods. Unlike the City Club of Portland or the Chamber of Commerce it is, therefore very difficult to label neighbourhood associations as advocates or protagonists of energy efficient land use. It is perhaps appropriate that they project an image of diversity. This can be seen from the fact that some of those planners and officials interviewed during the fieldwork for this study viewed neighbourhood associations as major advocates of energy efficient land use, while others listed them amongst its key opponents.

Portland as a Pioneering Community

Once a pioneering community has adopted an innovation it frequently becomes the centre of attraction. Media attention is focussed upon it and reports and information are distributed, in an attempt to promote similar adoption elsewhere. In this way the community acts as an influential in the diffusion process, reassuring those with doubts by its success and providing data on which to base similar adoption decisions in other cities. Naturally how this process is viewed depends upon personal reaction to the innovation involved.

Portland has acted as a pioneering community in many ways. As the site of the initial national energy conservation demonstration project, the city has been the first to develop a methodology for predicting savings from energy efficient land use policies and other conservation measures. This project has been widely publicized by the Department of Housing and Urban Development through its publications. In addition the conservation reports and other documents produced, as a

result of the ongoing conservation project, have been reported on in various Department of Energy, National League of Cities, U.S. Conference of Mayors, American Planning Association and other journals (Hemphill, 1979). As a consequence the methodology developed by the Portland Energy Conservation Demonstration Project is now being applied in over 100 United States cities (Hemphill, 1979). When such communities contact Portland's Bureau of Economic Management they receive copies of the city's energy policy, details of how to order the 11-volume report on the demonstration project and a summary letter describing the city's experience with energy conservation. The Bureau of Planning is also distributing several thousand free copies of its Proposed Comprehensive Plan which includes many energy efficient land use features.

It is clear that the United States federal government sees Portland as a model community. President Carter, for example, has sent letters recently to 600 United States mayors pointing out the merits of the city's energy policy. In this way the Portland experience is being used to encourage communities throughout the United States to adopt energy conservation strategies and to develop comprehensive land use plans to see that such policies are implemented. Obviously as this study shows, Portland's impact has now become international. This process of federal funding of selected municipal energy conservation demonstration projects and then using their successes to promote widespread adoption elsewhere has considerable merit. It should be given careful consideration by the Canadian federal government.

In summary the Portland experience demonstrates that large established urban centres, such as Vancouver or Edmonton, could become more energy efficient through the use of comprehensive planning. Such plans, however, must stress conservation as a major goal. It also shows that many of these strategies can be put into place with minimum disruption to existing institutions and with the support of a broad spectrum

of society. Leadership on the part of the mayor and the council appeared to provide the necessary stimulus, as well as the means whereby policy innovations could be introduced. It was also extremely valuable that such leadership was present at the state level.

It is clear, however, that such progress is not easily attained. The cost of producing an energy efficient comprehensive plan is relatively high and sustained opposition is likely to occur from landowners and businessmen. Although it was evident that various groups within Portland's public had an important role to play in providing information and ideas, these were often consulted too late in the process and major time consuming plan revisions had to be made as a result. Moreover, the range of techniques used to obtain inputs from the public was relatively limited. Decision makers depended largely on hearings, where views which had been given several times before were repeated. Because the process of adopting an energy efficient comprehensive plan has been so protracted in Portland, the stimulus of the 1973-74 crisis in energy supply has diminished. In addition, key supporters such as former mayor Goldschmidt have left the city and other issues, such as unemployment and inflation, have tended to increase in relative significance on the political agenda. While it seems certain that the comprehensive plan will ultimately be adopted, many of its energy conserving strategies have been diluted.

Since energy conservation through land-use planning is essentially a long-range strategy, the sooner these techniques are used, the sooner the dividends will be realized.

— Erley, Mosena and Gil (1979)

LINCOLN CITY - LANCASTER COUNTY: ONE STEP AHEAD?

Geographical Setting

Lincoln, sited in an area of gently rolling prairie, is located in the southeastern quarter of the state of Nebraska in Lancaster County. The western edge of the city of Lincoln lies in the flat valley of Salt Creek which receives several tributaries draining the site of the community. This creek in turn flows northeastward into the lower Platte. The terrain slopes upward to the west and reaches an altitude capable of causing instability in moist easterly winds. Winters are cold with a mean January average temperature of -4.7°C; however the area frequently experiences chinooks. Snowfall is about 63 centimeters unmelted in the average season. Summer temperatures are high and have exceeded 43.3°C on five occasions since 1888, while the average July temperature is 25.5°C (National Oceanic and Atmospheric Administration, 1978). Climatic conditions in Lincoln are not unlike those in several Canadian prairie cities.

Lincoln is the site of the county seat, the state capital, and the University of Nebraska. Indeed, the city of Lincoln is in the unusual position of having nearly all the urban and social functions within its political boundaries. This is because in the 1920s and 1930s the city annexed four suburban settlements, and by 1966 the last incorporated community within the urbanized area was annexed. During the same period, the State Legislature granted extraterritorial powers to Lincoln for a distance of three miles beyond its corporate limit. These powers apply primarily to zoning, land subdivision, building codes, and housing standards. Lincoln may still annex adjacent lands by a vote of its city council. In addition, the state legislature prohibited the creation of new municipalities within five miles of the city's boundaries.

In 1978 the population for the Lincoln Standard Metropolitan Statistical Area (SMSA), which encompasses all of

Lancaster County, was 355,500 while that of Lincoln was 168,000. Population estimates for the year 2000 predict a metropolitan population of 625,000, of which some 300,000 will reside within Lincoln itself (Barton-Aschman Associates, 1977). For comparison, the population of Regina, Saskatchewan is presently about 150,000, while that of Saskatoon approximates 140,000.

Lincoln's street network follows the traditional mid-western grid pattern. Although the railroad dominated early development, since 1920 the automobile has been the single most important factor in shaping the urban form. This domination, which is expected to continue, encouraged the creation of a relatively low density urban environment. Single family homes were typically placed on 50 to 100 foot frontage lots. Such residences represent the largest use of land in Lincoln, while public, state, city and county property, including the University of Nebraska, comprise the second major form of development. Commercial and retail areas are located along major arterials and concentrated within the Central Business District, while industrial development is generally restricted to its west around the railroad and along the northeast corridor with a concentration near the city's edge. Because of the relatively low lying relief, physical features have played only a minor role in constraining development.

Urbanization in Lincoln-Lancaster County is increasing. This growth is occurring chiefly in the area to the east and southeast of the Central Business District, where municipal services are sparse and the automobile is a virtual necessity. This is because there is little under-utilized land in the already built-up areas. Typically, city lot sizes range from 4,000 square feet to one acre (43,560 square feet). This is now recognized as excessive and a new zoning ordinance restricts lot size to between 4,000 and 9,000 square feet. The city has also established an urban growth boundary and is approaching its limits to the east. Development to the west of the Central

Business District is limited due to the problem of railroad relocation. Once this problem is solved, growth will be funnelled into this area.

Such directed urban growth is based on two major concepts which have been accepted by Lincoln's decision makers. The first of these is that the efficient utilization of land use resources is best achieved through concentric growth. This concentric growth design is aimed at improving the efficiency of the existing infrastructure of streets and utilities, so providing better accessibility to the city centre. Land to the south of the Central Business District has been set aside for future development. While it is not the purpose of this report to question this assumption, it is worthwhile noting that Edwards and Shofer (1975) have shown that concentric ring cities are far less energy efficient than those with a linear design. The second concept influencing development is the use of major radials to concentrate growth and increase densities for transit development. These radials will also carry the bulk of the traffic, lessening the pressure on local streets.

Transit only became a government responsibility in 1975 when the Lincoln Transportation System was established. It uses standard and mini-buses to provide service. Between 1975 and 1978, ridership declined, but has shown increases in the past year. Bus transportation is provided on established routes and specialized facilities are available for the elderly and handicapped. Transit is only provided in the urbanized area with occasional or special needs service available in rural Lancaster County. Most of the system is centred on the Central Business District and the adjacent university campus. Public transit is viewed as a limited service system. Headway time varies from 20 to 40 minutes, depending on the route and the time of day. Transit ridership is expected to increase as service is improved, but the automobile will still dominate travel patterns.

A comprehensive car/van pool program was established in 1977. The program's goal is to raise auto occupancy to 1.75 passengers by the year 2,000, thus reducing peak hour traffic congestion and the need for costly new road construction. Its aim is also to achieve higher air quality standards and conserve energy resources. By the end of 1978, over 310 car pools had been established with an auto occupancy of 2.71 passengers. The number of people involved in car pools increased from 281 to 563 between 1977 and 1978. Although important in demonstrating the usefulness of such a program, the total number of individuals involved is very small compared to the total number of employees (13,095) at firms participating in the program.

State and local government and the University of Nebraska dominate Lincoln's economy. As a result, the metropolitan area has experienced unemployment well below the national average. The rate has varied from 4.7 percent in 1975 to a present low of 2.8 percent. Wholesale and retail trade, manufacturing, services, finance, and insurance are the major employment sectors (Lincoln Chamber of Commerce, 1979).

Nebraska's utility resources are publicly owned with natural gas, electricity, and oil comprising the major sources. The Lincoln Electric System, a citizen owned company, provides electricity generated from nuclear, coal fired and hydro-electric plants. Natural gas dominates the home heating market. While a nine-member Lincoln Electric System Board is responsible for the control and management of property, facilities and personnel, the City Council retains the exclusive right to fix electricity rates and is vested with the power to adopt the annual budget. Pursuant to the laws of the State of Nebraska, the Lincoln Electric System serves the area within the city limits and its environs approximately three miles beyond. Until recently, the Lincoln Electric System also operated a "K" Street power plant which provided about 50 customers in the downtown area with steam for heating via a tunnel system. Unfortunately this service had to be discontinued because of the prohibitive cost of modifying its

operations in order to comply with the federal Environmental Protection Agency's clean air standards.

As the population increases and natural gas becomes less available, electricity is expected to become more widely utilized. It is projected that by 1985 the total peak demand placed on the Lincoln Electric System will be approximately 750 megawatts, more than twice the 1976 peak. It is estimated that $337 million will have to be invested to provide for such an increase in electricity use. Nevertheless, as the result of the adoption of a large number of conservation strategies, per capita energy demand in Lincoln has begun to fall. It is believed that over the past five years the annual decline in the use of natural gas has been 10 to 11 percent. Demand for electricity is also falling; preliminary estimates indicate an average annual decrease in the range of 2.2 percent for the fiscal years 1975 to 1979 (Boosalis, 1979).

Lincoln City-Lancaster County Comprehensive Plan

The Lincoln City-Lancaster County area is extremely significant from a conservation viewpoint. This is because it was one of the first regions in the United States to develop a comprehensive plan which stressed energy efficiency as a major goal. Some of the previously documented decline in per capita energy consumption almost certainly stems, in part, from the implementation of certain aspects of this plan and the awareness of conservation it has produced in the community.

Comprehensive planning is not a new phenomenon in Lincoln (Table 16). As early as 1921, the state of Nebraska passed legislation giving local units of government the power to undertake comprehensive planning and develop zoning ordinances. In 1922, Lincoln adopted its initial zoning ordinance. The first planning commission was established in 1948 in

TABLE 16: A CHRONOLOGY OF PLANNING IN LINCOLN CITY-LANCASTER COUNTY

1921	State enabling legislation.
1922	Zoning ordinance by Technical Advisory Corporation of New York.
1926	Zoning was being enforced.
1927	First official city-state "Capitol Environs" Committee.
1929	Three-mile zoning jurisdiction.
1930s	Parks constructed by WPA: Pioneer, Sunken Gardens, Zoo.
1937	Second "Capitol Environs" Committee.
1948	First Planning Commission: First City Park Study and Plan.
1948-50	City plan developed.
1959	Joint City-County Planning Commission.
1961	Second comprehensive plan.
1966	Second park study/metro transportation study.
1975	Lincoln Center plan.
1977	Lincoln City-Lancaster County Comprehensive Regional Plan.

Source: Barton-Aschman Associates, 1977.

conjunction with a park plan. By 1950 a city plan had been adopted and joint projects were being carried out with Lancaster County. Subsequent to the acceptance of this plan, a joint city-county planning department was established and by the end of 1959 a joint planning commission was approved. A second comprehensive plan was developed for the city and county in 1961 by Harland Bartholomew Associates. This plan updated the previous document and guided the city's growth for the next decade.

In 1970 the city and county began its update of the 1961 plan. As part of this process, it was decided that if any plan was to be successful it must have a broad base of public support. To ensure this a citizens' committee of 450 people was established to formulate a set of goals and policies

upon which the plan for the metropolitan area was to be based. Known as the Goals and Policies Committee, this eventually enlisted between 4,000 and 5,000 people to participate in developing a strong statement of objectives. Their recommendations were reviewed by both city and county governments and approved in 1973. With this as a foundation, the comprehensive plan update was written along traditional planning lines. During 1973 and 1974 when the results of the Arab oil embargo were beginning to be felt in the Lincoln area, energy suddenly became a strategic issue. Simultaneously it moved from the pre-problem stage of the issue-attention cycle to that of alarmed discovery (Figure 7). As a result, citizen attitudes about future transportation plans and energy conservation underwent considerable change. Until this crisis occurred, these two elements had received only slight attention in developing the new plan. The Goals and Policies Committee reviewed and strengthened these components, making them central to the entire planning process. After these additions, the Lincoln-Lancaster County Comprehensive Plan was recommended to the governing bodies by the City-County Planning Commission and approved on January 25, 1977.

The actual document was prepared by a consulting company, Barton-Aschman Associates Inc., of Evanston, Illinois. Their role was to integrate the goals and policies developed by public debate and the expertise of several local, state and federal committees and departments. The latter bodies included the Technical and Officials Committees for Continuing Transportation Planning in the Lincoln Metropolitan Area, the Lincoln City-Lancaster County Planning Department, the Nebraska Department of Roads and the Federal Highway Administration. The comprehensive regional plan produced by the consultants was published in January 1977 and is 242 pages in length.

A Monitoring Board was established to review and evaluate the plan. Every two years the Director of Planning, working with the Monitoring Board and the Goals and Policies Committee, is directed to establish specific targets for progress in achieving the goals of the plan. In addition, the Planning Director is to provide a written "Evaluation of Plan Achievement." This document is presented to the Goals and Policies Committee, the Planning Committee, and the city and county governments. The evaluation is used to recertify the plan as the development guide for the region, or to propose necessary amendments to bring the plan into compliance with the stated goals and policies. Finally, every five years the plan is to be reviewed in more depth to identify amendments, extensions, or modifications. This process must provide for the organized participation and involvement of citizens and public interest groups.

The comprehensive plan established a blueprint for the development of goals and policies for the city and county. The guideline dictated the need to weigh such goals and policies against cost and benefits. It states that the plan shall promote:

> The concept of stewardship and conservation regarding the utilization of exhaustible resources, including the improved efficiency of the development of land and supporting systems, and prepare for the conversion of new energy sources as technology and financial feasibility permit.

In accordance with this guideline five goals and 29 policies were developed. These are presented below in summary form:

1. to minimize energy demand through urban design and land use planning.
2. to establish a co-ordinated system of public and private transit, maximizing passenger miles travelled.
3. to demonstrate government leadership by making public facilities energy efficient.

4. to encourage the design and construction of energy efficient buildings.
5. to promote energy production and environmental quality.

These goals are used as a measure for all city and county planning activities.

To this end the comprehensive plan is used as a basis for the development of land use zoning, housing plans and programs, the identification of the location of new major streets and transportation services, selection of areas to be serviced by utilities, and open space acquisition.

Unlike Portland, Lincoln City-Lancaster County has not developed distinct land use related goals and policies. A wide range of such objectives has been agreed upon but they are an integral and stated part of the region's comprehensive plan. Of particular interest to this study are the plan's goals and policies relating to the use of energy. These are listed in Table 17. Many such goals are specifically designed to promote energy efficient land use. They include the regulation of land use, so as to provide higher density residential facilities in proximity to the Lincoln Center, and other major activity centres and encouragement of residents to live in close proximity to their place of employment. In summary, twelve of the energy goals and objectives are land use related. Such goals and policies provide a sound foundation for development in Lincoln and Lancaster County. However, to be useful they had to be incorporated directly into the area's comprehensive plan. This was achieved in 1977 when various functional subareas within the city and county were recognized and guidelines for their future growth established. Paraphrased, these guidelines included an agreement to concentrate new growth in the Lincoln urban area and in the villages throughout Lancaster County. It was also decided to protect existing rural areas from urban sprawl through planned

TABLE 17: ENERGY GOALS OF THE LINCOLN CITY-LANCASTER COUNTY COMPREHENSIVE REGIONAL PLAN

ENERGY SUB-GOAL 1: LAND USE

Regulate the use of land and encourage the use of urban design so as to minimize the demand for energy consumption and maximize the effectiveness of energy consumed.

Policies:

(1) Regulate the use of land so as to provide higher density residential facilities in proximity to the Lincoln Center and other major activity centers.

(2) Encourage the development of fewer and more intense multipurpose centers and their concentration as opposed to the scattering of such activities in order to provide opportunity to eliminate or substantially reduce auto travel.

(3) Encourage people to live in proximity to activity centers and particularly their place of employment.

(4) Emphasize the revitalization of the Lincoln Center and the rehabilitation or redevelopment of established neighborhoods near the Lincoln Center.

(5) Encourage radial or concentric growth about the Lincoln Center with new development to north, west, and south. When the objective establishing growth areas to the north, west, and south has been substantially developed, growth to the east into Stevens Creek watershed area may be pursued.

(6) Encourage land-use arrangements and densities that facilitate energy efficient public transit systems.

(7) Encourage existing and future industries to conserve energy and improve energy efficiency.

(8) Encourage site planning and designs which reduce demand for artificial heating, cooling, ventilation, and lighting.

(9) Encourage the investigation of energy conservation and improved energy efficiency possibilities of centralized heating and cooling facilities serving building complexes.

TABLE 17 continued

ENERGY SUB-GOAL 2: TRANSPORTATION

Plan, design, and manage a coordinated system of public and private transportation programs and facilities which maximize passenger and freight miles travelled per unit of energy consumed.

Policies:

(1) Provide the facilities and programs for increased utilization of public transit, car pooling, and bicycle and pedestrian systems.

(2) Reduce the need for and utilization of the private automobile.

(3) Continue to improve the effectiveness of existing and future roadways so as to minimize unnecessary energy consumption by improving circulation through engineering procedures and roadway improvements.

(4) Encourage a system of staggered work hours for major employment concentrations.

(5) Endorse efforts to develop energy efficient freight and passenger systems.

ENERGY SUB-GOAL 3: COMMUNITY FACILITIES

Exhibit governmental leadership and innovation related to the conservation and efficient utilization of energy for community facilities and services.

Policies:

(1) The location, design, and operation of community facilities such as schools, churches, libraries, recreational facilities, university facilities, and other public buildings should encourage energy conservation and efficient energy utilization by such means as multipurpose or joint uses.

(2) Public motor vehicle fleets should emphasize energy effectiveness.

(3) All public lighting systems should be designed and operated to utilize energy efficiently without sacrificing public safety.

(4) The disposal of wastes should permit the recycling of materials and the capture of energy from non-recyclable materials, including such processes as incineration and landfill gas production.

(5) Encourage the operation of all generating plants to incorporate the "total energy" concept, which utilizes energy by-products in addition to the primary power source.

TABLE 17 continued

(6) Power-generating facilities should utilize technology which is consistent with the need to conserve exhaustible resources.

(7) Increase consumer awareness and knowledge to reduce energy consumption through educational efforts and rate structure incentives based on costs.

(8) Develop methods to provide financial relief to the low-income families from increasingly costly energy resources.

ENERGY SUB-GOAL 4: BUILDING DESIGN

Encourage the design and construction of buildings and building complexes so as to effectively utilize all energy sources.

Policies:

(1) Building design and orientation should utilize natural lighting effectively and reduce the effects of exposure to extreme weather conditions, thereby reducing the need for mechanical heating, cooling, and ventilation.

(2) Building codes should stress the requirement of adequate insulation in all types of structures.

(3) Building codes should promote the use of energy conserving building materials.

(4) Landscape materials should be utilized effectively to reduce the adverse effects of weather conditions.

(5) Building codes and other regulatory measures should encourage the utilization of new and alternate energy sources in order to reduce the demand for exhaustible energy sources.

(6) Buildings should be designed and built to utilize waste heat to reduce the demand on public utilities.

(7) Buildings should be designed and built to consider energy costs for the life of the building.

ENERGY SUB-GOAL 5: ENERGY PRODUCTION AND ENVIRONMENT

Encourage energy production from all sources which promote environmental quality.

development and to locate future land uses in a manner that precisely delineated the possible physical limits of expansion of Lincoln and Lancaster County villages. The comprehensive plan was also intended to ensure that growth in the urban areas radiated in all directions from a more intensely developed downtown, and that less significant subcentres of activity should be interspersed throughout the urban area. A transportation network and community facilities were to be provided which supported and encouraged such desirable development patterns. The plan also specified eight basic types of planning subareas which included multi-purpose activity centres (Figures 13 and 14).

More specifically, the need to develop increased densities on vacant lots adjacent to the Lincoln Center, and the construction of multi-family housing in close proximity to proposed shopping centres is also stressed. The comprehensive plan also seeks to assist in revitalizing the downtown area and to emphasize the role of the Lincoln Center. Certain other multi-use centres were also supported (Barton Aschman Associates, 1977). Energy efficient transportation is promoted including the use of bicycles. To this end a regional bicycle plan was proposed including a network of separate bicycle paths envisaged for both recreational and commuter purposes.

In summary, the Lincoln City-Lancaster County comprehensive regional plan incorporated a wide variety of the energy efficient land use strategies previously described by the authors. More specifically those adopted included zoning for higher density development and close proximity to service centres and transportation networks, the prevention of sprawl through the use of an urban growth boundary, and the promotion of multiple use to reduce travel. It is clear from the survey conducted by the authors and that undertaken by the American Planning Association that the Lincoln City-Lancaster County Comprehensive Regional Plan is one of the most energy conscious planning documents yet adopted in the United States.

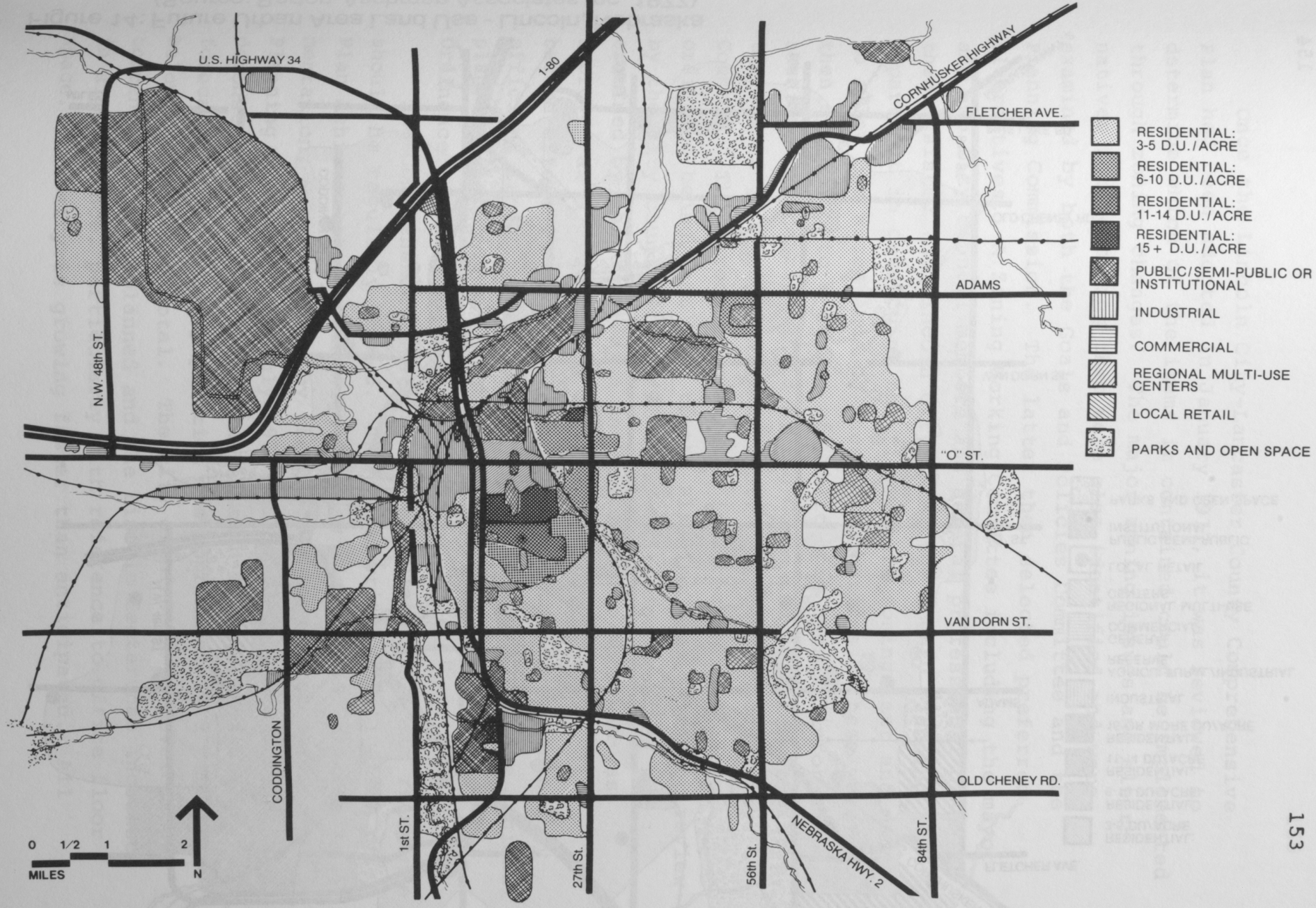


Figure 13: Existing Urban Area Land Use - Lincoln, Nebraska
(Source: Barton-Aschman Associates Inc. 1972).

Figure 14: Future Urban Area Land Use - Lincoln, Nebraska
(Source: Barton-Aschman Associates Inc. 1977).

Once the Lincoln City-Lancaster County Comprehensive Plan had been adopted in January 1977, it was reviewed to determine which of the items it contained could be implemented through zoning changes. The major zoning issues and alternatives for resolving them were also identified and were examined by both the Goals and Policies Committee and the Planning Commission. The latter then selected preferred alternatives. A Zoning Working Committee including the mayor and two city council members and several professional planners then assisted the Lincoln City-Lancaster County Planning Department in developing the first draft zoning text and maps to allow the acceptance of these alternatives. These were then subjected to a series of public open houses, information sessions and hearings held by the Goals and Policies Committee, the Planning Commission, the County Board and Lincoln City Council. This process culminated in a recommended zoning ordinance being sent back to the Planning Commission for review by the city council in April 1979. This document was re-examined by the commission and after public hearings was approved as a city zoning ordinance on May 8, 1979. It became effective on May 23, 1979. As of that date the energy efficient land use strategies, within the comprehensive regional plan, were supported by the legal authority of the Zoning Ordinance of the city of Lincoln.

The Comprehensive Region Plan stipulates that its relevance should be regularly tested. The first written "Evaluation of Plan Achievement," a hindsight review of progress in implementation, was completed by the Lincoln City-Lancaster County Planning Department in July 1979. This 43-page document demonstrated that employment was within 1 percent of that forecast, while total population was approximately 8 percent below the expected total. The city of Lincoln is developing concentrically as planned and the Lincoln Center has increased in significance, particularly with reference to office floor space. Industry is growing faster than anticipated. All

streets and roads that have been developed are in conformance with the comprehensive plan, as is the neighbourhood and district park acquisition program. Despite minor deviations from anticipated urban growth, the Lincoln City-Lancaster County Planning Department therefore recommended that the comprehensive regional plan be recertified.

The Role of the State of Nebraska

Although the citizens and decision makers of the Lincoln City-Lancaster County region have shown a willingness to develop a comprehensive plan, such action is in fact required by state mandate. Both Nebraska legislation and the Charter of the City of Lincoln provide for and require the development and maintenance of a comprehensive plan (Revised Statutes of Nebraska, 1976 Cumulative Supplement). Nebraska law, however, does not specifically demand that such planning shall be energy efficient, but does call for "the effective development and utilization of human and natural resources." With respect to the development, adoption and maintenance of the comprehensive plan the state law reads:

> The Planning Director shall be responsible for preparing the Comprehensive Plan and amendments and extensions thereto, and for submitting such plans and modifications to the...Planning Commission for its consideration and action. The Commission shall review such plans and modifications, and those which the City Council or County Board may suggest, and, after holding at least one public hearing on each proposed action, shall provide its recommendations to the City Council or County Board within reasonable period of time. The City Council shall review the recommendations of the Planning Commission and, after at least one public hearing on each proposed action, shall adopt or reject such plan as submitted, except that it may, by an affirmative vote of at least five members, adopt a plan or amendments to the proposed plan different from that recommended by the Planning Commission.
> The County Board shall review the recommendations of the Planning Commission and, after at least one public hearing on each proposed action, shall adopt or reject such plan in whole or in part and with or without modifications.

The state of Nebraska, unlike Oregon, has not insisted that municipalities develop energy efficient comprehensive plans. Nevertheless it has been promoting conservation and is

attempting to reduce state energy consumption by 44.5 trillion British thermal units in 1980 (Weber, 1977). This goal was promoted by a conservation plan which included 20 measures that the state wished to see widely adopted. Five of these -- the greater use of car pools, state standards for lighting and insulation, permission for drivers to turn right on a red light at intersections and the use of energy efficient automobiles by state agencies -- were made mandatory. Many other strategies were suggested but not made compulsory.

In summary, unlike Oregon where the state has been extremely effective in forcing municipalities to develop energy efficient land use plans, Nebraska has been supportive but not insistent with respect to conservation. Much of the drive for better energy use has come, therefore, from within the Lincoln City-Lancaster County region itself.

The Planning Process in Retrospect

The actual process of producing the Lincoln City-Lancaster County Comprehensive Plan has not been without its problems. When an update of the existing document was first discussed by council in the late 1960s, the cost involved was estimated at some $10,000. In fact, in August 1970 City Council hired the consulting firm of Leo Daly of Omaha at a cost of $71,800 to work with local government in developing goals and policies for growth. In June 1973, a timetable was prepared by Planning Director Douglas Brogden and approved by the City-County Planning Commission which showed that the updated plan would be available by September 1974. When it became obvious in April 1974 that this target was unrealistic, the Lincoln City Council approved the hiring of Barton-Aschman Associates of Evanston, Illinois to manage the updating. The original contract price was $189,000. This firm was also awarded contracts of $84,000 for a downtown revitalization study and $25,000 in payment for an urban renewal study in connection with the proposed Centrum project, a parking and retail development.

In September 1974 controversy arose over who had the final authority to accept or reject the comprehensive plan. Unlike Portland, where even the city council has no authority to do more than recommend approval of the comprehensive plan to the state, in Nebraska the final power of acceptance rested with the planning commission. This situation led to appeals by the city to the state for more input into plan preparation and for the power to grant or refuse final approval. The target for plan completion at this time was the autumn of 1975.

In the spring of 1975 criticism was levelled against the study by some city officials who claimed that the plan's population estimate of 325,000 for the year 2000 was far too high. Similarly, the plan update was delayed for a month while the State Roads Department analyzed the existing road network to see if it could handle the three alternative growth plans that were being considered. In April 1975, the state of Nebraska legislature passed a bill requiring city council and county board approval of the plan, removing this power from the planning commission. In May 1975, residents of Lincoln approved a city charter amendment giving final approval power over the plan to the council by a vote of 19,923 to 7,359. Under this amendment at least five of seven council members will now have to agree to any new comprehensive plan or changes in the existing plan. This vote had been rendered largely redundant by the earlier state action.

Also in May 1975, a dispute broke out between the city and Barton-Aschman Associates over how many meetings were required to complete the terms of reference of their contract. In July 1975, the planning commission cancelled a meeting with the consultants, claiming they had copied a law out of a text-book and that it had no relationship to realities in Lincoln. Also in July 1975, the technical committee halted transportation planning until it received answers to outstanding policy questions. Work on this element was resumed in September 1975 after tentative energy and transportation policy guidelines

had been provided by Council. As a result of these delays the autumn 1975 deadline passed and in October the contract with Barton-Aschmann expired. The consultants then stopped work on the comprehensive plan, even though the document was incomplete.

In December 1975, the city council engaged in recriminations over the delay and levelled criticism against various individuals, including Douglas Brogden the planning director. After heated debate the council set a new six month deadline for completion of the area's comprehensive plan. Closed-door negotiations were then held with Barton-Aschman Associates to encourage them to resume work on the document. A further contract was approved with the consultants in June 1976 and a new January 1, 1977 deadline was set for plan completion and an additional $7,000 was granted to pay for the work involved. City-County Planning Commission Director George Williamson stated in August of 1976 that the plan "has taken us six years, probably $400,000 and countless man-hours" to date. Williamson blamed some of the escalating costs on a "change in basic philosophy" by the city council. This in turn was thought to reflect strong public opposition to the widening of certain streets (Reeves, 1976). In November 1976, Lincoln council approved yet a further delay in the updating of the comprehensive plan and provided an additional $10,200 consulting fee. The Lancaster County Board at first refused to accept either the delay or fee increase but later changed its position. A preliminary draft of the plan was then delivered to the planning commission, meeting the January 1, 1977 deadline. This body approved the plan and submitted it to the city council and county board. Estimates of the cost of public improvements proposed by the plan ranged as high as $750 million. After public meetings and some revisions, the plan was accepted by both Lincoln and Lancaster County in January 1977.

The Actors

The methodology used in studying the evolution of energy efficient planning in the Lincoln City-Lancaster County region was comparable to that applied in Portland. The questionnaire presented in Appendix 1 was administered to 12 influential individuals who had been active in the process of comprehensive land use planning (Table 18). A follow-up interview was also conducted. The questions asked concerned the development of the area's land use policies as well as those factors which would allow for a better interpretation of the questionnaire. At times the personal interviews were wide ranging, covering actual situations or philosophical matters. Only one person, City Councilperson Joe Hampton, did not allow a taped interview. This was not a refusal, but merely a scheduling problem. Also taped was a public meeting of the Goals and Policies Committee.

In addition to these materials, over 500 energy related newspaper clippings were provided by the Journal-Star Printing Company of Lincoln. These gave comprehensive coverage of the energy debate in the region since 1968. They were analyzed to gain an overview of events and the strategies employed by opponents and supporters of energy efficient land use.

As in Portland, respondents to the questionnaire were asked to identify individuals or special interest groups that had actively lobbied for or against land use energy conservation. Collectively, they put forward the names of 17 individuals and 18 organizations: 12 of the former and 13 of the latter were seen as active proponents. In order of frequency of mention, Lincoln Mayor Helen Boosalis and Douglas E. Brogden, Director of Planning were most commonly cited as active supporters. It is widely believed that Mayor Boosalis owes her re-election to her active support of comprehensive planning. The 1979 spring primary election in Lincoln found Mayor Boosalis trailing in the opinion polls. During a public debate preceding the general election, her opponent admitted that he had not read the comprehensive plan and was unfamiliar with many of its

TABLE 18: INDIVIDUALS IN THE LINCOLN CITY-LANCASTER COUNTY AREA WHO COMPLETED QUESTIONNAIRES AND ALLOWED A TAPED ENERGY AND LAND USE RELATED INTERVIEW

Leo Beck, Vice President, Alexander and Alexander Insurance, Former Chairperson, Goals and Policies Committee.

* Helen Boosalis, Mayor, Lincoln.

Elaine Carpenter, Administrative Assistant to the Mayor.

Mike DeKalb, City Planner, Energy Advisor.

Tom Doud, Economic Development Coordinator.

John Gulick, Community Resources Specialist, Office of Neighborhood Assistance.

** Joe Hampton, City Councilperson.

Bob Jeambey, Former City Councilperson.

Dalles McGee, Planner, Neighborhood Planning Office.

Jerrold S. Olson, General Manager, Lincoln Transportation System.

V.C. Seth, Head, Short Range Planning Division.

Duane S. Vicary, Executive Vice President, Lincoln Chamger of Commerce.

Note: *Mailed questionnaire;
**No taped interview.

provisions. This single factor sparked a drive by neighbourhood groups, civic organizations, and individuals to rally behind the mayor and almost certainly provided the margin of victory for Boosalis.

This public support for energy efficient land use planning was also felt elsewhere in the political spectrum. The pre-April 1979 city council was frequently characterized by respondents as being dominated by the business community. This segment of council was removed from office because it was viewed as not supporting the goals of the comprehensive plan and of the evolving neighbourhood organizations. Those candidates for council who strongly supported the planning process, the comprehensive plan, controlled growth, and neighbourhood organizations won election. As a result, the majority of city council members now strongly support the planning process.

Respondents also pointed out the significance of certain unusual characteristics of the training and background of Lincoln's planning staff and the unusual governmental relationship that exists between the city of Lincoln and Lancaster County. Many of the planners involved, for example, have trained, not as engineers, but as specialists in urban design, landscape architecture, and architecture. They have therefore been extremely effective in promoting an energy efficient design for the urban environment and for municipal and county facilities. Lincoln and Lancaster County have a history of co-operation rather than competition. The existence of a joint planning commission and planning staff has helped to solve growth problems from a unified position. This has allowed for the establishment of a single set of urban goals and policies, growth controls, and enforcement procedures.

There is no organization in Lincoln or indeed in the state of Nebraska that compares with the 1000 Friends of Oregon. Supporters of comprehensive land use planning are usually content to operate within the political system, taking part in public

meetings and serving on the Goals and Policies Committee. This is perhaps because opposition is relatively weak and poorly co-ordinated. Certain civil organizations, such as the League of Women Voters, have been active and have supported the mayor and the planning director in their efforts to bring sound planning practices, based upon citizen participation, to Lincoln. Another supportive group has been the Junior League which has conducted workshops and public meetings to inform and educate the public about energy and land use problems. The Junior League is a women's organization composed largely of the wives of professional men. It has a membership of some 300 to 400, of which 100 might be characterized as active in programme implementation. The Junior League has been promoting planning in general, and energy conservation in particular. It is funding energy audits of Lincoln homes, the first being conducted on that of the mayor.

Neighbourhood associations have also been very supportive of the comprehensive plan. Unlike Portland, where their role has been ambivalent, neighbourhood associations have been active promoters of energy efficiency in Lincoln. Their role has been made more effective by the provision of professional expertise by the Office of Neighbourhood Assistance.

Questionnaire respondents also identified individuals and groups that they perceived as being active opponents to energy conserving land use planning. The least supportive of all organizations was thought to be the Lincoln Chamber of Commerce, which has been an active participant in the planning debate even though it joined the process later than other community groups (Table 19). The Chamber's position is characterized by a recognition of the need for good planning practices, but it supports a strong growth policy. Most Chamber members oppose mandatory policies which might raise costs and constrain the free market economy. Other organizations or groups mentioned as opponents of energy efficient land use were the Gateway Merchants, one of the major multiuse centres, home builders and

TABLE 19: LINCOLN CITY-LANCASTER COUNTY SPECIAL INTEREST GROUPS LISTED IN DECREASING ORDER OF THEIR SUPPORT FOR ENERGY EFFICIENT LAND USE

1. Environmental groups
2. Heads of local government agencies
3. Neighbourhood improvement groups
4. Newspapers
5. Ethnic groups
6. City and county employees
7. Church leaders
8. Radio and television stations
9. Democratic Party
10. Retail merchants
11. Bar Association
12. Industrial leaders
13. Bankers and executives of financial institutions
14. Other businessmen
15. Labour unions
16. Republican Party
17. Chamber of Commerce

developers, and state and city departments responsible for road construction.

Only fifty percent of the respondents would or could identify any organized opposition to energy conserving land use planning in the region, the remainder denied that it existed. It is clear from the interviews and newspaper clippings that the energy efficiency and land use debate has never reached the intensity in Lincoln that it has in Portland. Polarization of opinion is far less extreme and opposition very much more restrained. This may have been because an existing plan was being updated, rather than a novel approach being imposed for the first time.

The authors initially intended to follow the same descriptive procedure as has been used for the Portland experience.

That is, the in-depth analysis of the influence of strategies of certain key groups who have sought to accelerate or retard the adoptive process. This step was not taken because there was not the same degree of polarization. While in Lincoln there are some organizations that are more supportive of comprehensive planning than others, even the Chamber of Commerce, perceived as being least supportive, has encouraged its members to participate in the Goals and Policies Committee. The Chamber's aim has been to work within the system to ensure what it considers to be acceptable future growth for the region.

Compared with the experience in Portland, Oregon, the move towards comprehensive planning has been relatively smooth. The authors do not wish to give the impression, however, that there has been no opposition to the Lincoln City-Lancaster County Comprehensive Plan. Certain individuals have actively opposed its implementation. These have employed two basic strategies, the use of the media to criticize the plan and of the courts to challenge its legal validity.

In the former category Michael Steinman, Douglas German (1976), and R. Wekesser (1979) have been most active. These individuals have used Lincoln's newspapers as a forum to attack the plan. Steinman and German, for example, have written:

> A fantasy some are playing at is that the citizens of Lincoln have had an impact upon the drafting of the Comprehensive Plan.
>
> The commitment to citizen participation occupies a central place in the political culture of Lincoln. This is as it should be. However the fulfillment of this commitment falls far short of the expectation it creates. There can only be frustration and alienation when private citizens are misled to believe their views count.
>
> . . . . . .
>
> The draft of the Comprehensive Plan barely evidences the fact that private citizens were ever involved in the planning process.

Steinman and German continue to argue that the plan ignores fundamental commitments taken at public meetings and official hearings. Clearly they were opposed to the

implementation of the decision-making process, rather than the concept of comprehensive planning. This is not true of Wekesser (1978) who is strongly opposed to the philosophy of the plan. Using a newspaper forum entitled *Public Mind*, he attacked it under the headline "Nuts to Comprehensive Plan." In a further presentation from the same source the plan was criticized for certain land use strategies which are specifically energy conserving, particularly those that would result in high densities and downtown redevelopment.

> In my opinion, the majority of the people in Lincoln are tired of "being planned," of being told where they should live, either south, northwest or west of the downtown area in protected areas. That, somehow, farmland is sacred and must be preserved in one area outside Lincoln and totally available in other areas just to suit the whim of a few "planners." That a young couple wishing to live on a few acres outside the city noise and crime where they can raise their kids, with maybe a cow or a horse or a few chickens around, will no longer be able to afford to do so because of the day-dreaming bureaucrats' ideas of what is best for them. Only a very limited few will be able to afford 20 acres at $3,000 per acre or more.
>
> Another major flaw in the great comprehensive plan is the idea that downtown Lincoln has to be saved as a shopping center. In visiting with literally hundreds of people from within and without Lincoln, I have found very few who see the need for trying to keep downtown Lincoln as a major shopping area.

In the Portland area, opponents of comprehensive land use planning can usually count on at least the moral support of the Washington County Land Owners Association. In Lincoln, there is no such organization battling against energy efficient land use and the planning it entails. Nevertheless, certain aggrieved individuals have challenged the legality of the Lincoln City-Lancaster County Comprehensive Regional Plan in the courts. By far the most determined of these has been Newt Copple, a developer who wishes to build a $100 million shopping centre on land not zoned for this purpose. Copple filed suits against both the Lincoln City Council and the Lancaster County Board within three weeks of the final adoption

of the plan. The developer sought to have the plan declared invalid. A restraining order was also issued to prohibit the Lincoln City Council from making decisions on two potential shopping centres, one of which was that proposed by Copple, while the suit was pending.

The developer sought to have the regional comprehensive plan ruled invalid because of a possible conflict of interest on the part of one Lincoln councilman who was a partner in the competing shopping centre. It was also contended in one of the suits that the adoption of the plan was in violation of the Nebraska open meetings law. In June 1977, Copple lost his suit in Lancaster County District Court.

This developer then took the issue to the Nebraska Supreme Court. In January 1979 this body again ruled in favour of the comprehensive plan. In the following month Copple filed a brief with the Supreme Court asking them to reconsider and claiming their ruling was in error. It appears unlikely, however, that the Nebraska Supreme Court can be persuaded that the region's comprehensive plan is invalid.

The zoning regulations, which were a necessary adjunct of the comprehensive plan, were also attacked by certain individuals who felt that their rights had been violated.
A January 1979 public hearing was challenged in the district courts by businessmen who claimed the city did not post meeting notices, on or as near as possible, to each parcel of land affected by the proposed zoning changes. An attorney for Newt Copple and Sterling Flott, two developers, skating rink operator Seth Scott, and cement contractor C.V. Peterson argued the case against holding the public hearing and requested a restraining order to prevent it taking place. This was refused (Dittrick, 1979).

At the meeting many businessmen who anticipated financial loss spoke out against the zoning changes. For example, Lewis Berlowitz is quoted as suggesting that every property owner

was entitled to the highest and best possible use of his land. Newspaper reports of the meeting state that:

> "The people of Lincoln can't afford to have someone like (planning director) Doug Brodgen who is doing everything adversive to our needs," said Berlowitz, drawing one of several bursts of applause he received from the audience while addressing the council.
>
> "We made Lincoln an All-America city with the present zoning. Why the hell do we want to change it now?" he continued.

Down-zoning plans and the 20 acre requirement in areas zoned as agricultural were also subjected to vocal public criticism. This minimum was attacked for favouring the rich and was challenged by an attorney for the Lincoln Board of Realtors and the Home Builders Association of Lincoln at the first city council public hearing on Lincoln's proposed zoning code (Downard, 1979). Despite vocal opposition the zoning changes needed to implement the comprehensive plan were eventually adopted.

In summary, energy became a strategic issue on the Lincoln City-Lancaster County political agenda as a result of the OPEC oil boycott. The region was fortunate in that it was in the process of revising its comprehensive plan and its decision makers were astute enough to realize that considerable conservatgion could be achieved by energy efficient land use policies. These were designed by public debate and incorporated directly into the comprehensive plan. Despite delays in the adoption of this document it was completed in early 1977 and has been implemented for over two years. Experience has been gratifying and energy use per capita is in decline. With a few notable exceptions, public acceptance has been forthcoming and opposition relatively muted. The process is in contrast to that of Portland where the comprehensive plan has yet to be completed and where the community is extremely polarized for and against the adoption of energy efficient land use strategies.

All social and economic activities require energy in one or more of its forms, so energy policy is fundamental to social and economic policy.

— Hooker (1978)

CONCLUSIONS

Energy efficient land use strategies are being adopted with increasing frequency throughout the United States. When they are combined with other related conservation techniques they are leading to marked declines in per capita energy demand. This has occurred in such innovative settlements as Lincoln, Nebraska and Davis, California. Energy conserving land use strategies are most effective when they are adopted as an integral part of a comprehensive plan, which has the achievement of energy efficiency as a key goal.

In many settlements energy is moving from a strategic to a routine issue. Because of its permanence on the political agenda, new agencies are being set up specifically to deal with both supply and demand. Energy as an issue still occupies either the second or third stages in the Down's issue attention cycle in most United States communities. It appears likely to continue to be an active issue for many years to come as costs rise and supplies decrease.

The decision making process with regards to energy conservation is not elitist in the United States. Comprehensive plans frequently have considerable public participation in their design. However, planners and city and state officials still retain the ultimate power to make significant decisions in the adoption or rejection of energy conserving land use strategies.

While there is some variety in the roles being played, many groups are taking predictable positions in the diffusion process. Environmentalists, city officials and the media are generally supportive, while many businessmen, realtors and developers together with certain landowners and the Chamber of Commerce are not.

The authors do not wish to imply that energy efficient land use is unknown in Canada. In contrast, certain commun-

ities such as Brampton, Ontario have made major strides in this direction (Ross, 1979). Nevertheless, there are many lessons to be learned from the United States experience. These include the value of crises in stimulating major shifts in land use policy and the significance of leadership from the mayor, council and state government. The need for public involvement in the decision making process is also apparent as is the necessity of reasonable compromise. Energy efficient land use has a major role to play in Canada's future; the problem facing the federal government is that of achieving it at the minimum economic and social cost. It is believed by the authors that the recommendations given in Volume 2 of this report will assist in achieving these objectives.

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APPENDIX 1

NOTE: Questions marked by an asterisk were those included on the questionnaire mailed to the 160 United States mayors.

MUNICIPAL INNOVATIONS QUESTIONNAIRE

Date: _____

*1. Name of Respondent: _____

*2. Position: _____

*3. City and State: _____

*4. Dominant economic activities in the local economy: _____

_____

*5. What do you personally think have been the six most important problems faced by your city since 1974?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

*6. Please rank the following sources of energy in terms of their present contribution to home heating in your community. Please use 1 to 6 to indicate the most significant.

	Rank
Natural Gas	____
Oil	____
Coal	____
Hydro-electricity	____
Conventional thermal electricity	____
Nuclear generated electricity	____

*7. What kinds of information are available on energy use within your municipality? For example, are data collected on gasoline and/or heating oil use, or on electricity and natural gas consumption?

_____

_____

_____

_____

* 8. Over the past five years, please estimate trends in the ANNUAL PER CAPITA increase or decrease in energy consumption in your municipality. Indicate this by placing a cross on the appropriate position on the scale.

Percentage annual increase							Percentage annual decrease					
+6	+5	+4	+3	+2	+1	0	-1	-2	-3	-4	-5	-6

* 9. Here is a list of subjects which sometimes pose problems for cities in North America. Would you please indicate which of these has been the subject of legislation or by-laws in your own city, and the date when these were passed. Similarly, please indicate when, if ever, funding was provided to implement the legislation.

	Year legislation passed	Year funding first provided
a) Construction of an industrial park		
b) Protection and renovation of heritage buildings		
c) The use of union labour only on public construction projects		
d) The regulation of industrial and residential emissions to improve air quality		
e) The adoption of a ward system for municipal elections		
f) Provision of subsidized meals for the elderly		
g) Adoption of a land use plan designed specifically to reduce energy consumption . . .		
h) Provision of low income housing		
i) Promotion of public transportation by subsidizing fares and provision of other incentives		
j) Banning the use of insecticides in public parks		

* 10. There are many ways in which a municipality can affect energy consumption by individuals and groups within its jurisdiction. Listed below are illustrations of some of these strategies. Please indicate whether any of these have been adopted by your municipality and if so, in what year this first occurred.

	Date
1. Recycling of bottles, cans and paper	
2. Promotion of the use of car pools	
3. Higher density zoning	
4. Publication and wide distribution of literature to encourage public energy conservation	
5. Mixed use zoning	
6. Requirement of energy impact statements from developers	
7. Public statements by the mayor in favour of energy conservation	
8. Cluster zoning	
9. The provision of bicycle paths	
10. The use of energy analysis in the planning of roads, sewer lines and other public utilities	
11. Construction of a district heating system	
12. Setting energy efficient standards for new development	
13. Campaign to reduce energy use in municipal buildings	
14. Adoption and publication of a municipal energy plan	
15. Redesigning the municipal land use plan to increase energy conservation	

* 11. Listed below are 16 interest groups that might be expected to take a position on energy-related issues. Please circle the extent to which you predict, or know from experience, that each group would support or oppose the introduction of land use planning to increase energy conservation in your community. Please indicate with an asterisk (*) which 3 groups would be most influential.

		Strongly support	Support	Oppose	Strongly oppose
( )	Democratic Party	1	2	3	4
( )	Republican Party	1	2	3	4
( )	Chamber of Commerce	1	2	3	4
( )	Church Leaders	1	2	3	4
( )	Newspapers	1	2	3	4
( )	Radio & Television Stations	1	2	3	4
( )	Bar Association	1	2	3	4
( )	Labour Unions	1	2	3	4
( )	Environmental Groups	1	2	3	4
( )	Ethnic Groups	1	2	3	4
( )	Neighbourhood Improvement Groups . . .	1	2	3	4
( )	Heads of Local Government Agencies . .	1	2	3	4
( )	City & County Employees	1	2	3	4
( )	Industrial Leaders	1	2	3	4
( )	Retail Merchants	1	2	3	4
( )	Bankers & Executives of Financial Institutions	1	2	3	4
( )	Other Businessmen	1	2	3	4

12. Who inside the government is the most influential supporter of energy efficient land use in this community?

13. Which individuals or groups outside of the city government are the most influential supporters of energy efficient land use planning? What are their positions in the community?

	Name	Position in Community
1.		
2.		
3.		
4.		
5.		

14. What would you say have been their major reasons for supporting energy efficient land use planning?

	Supporters	Major Reasons
1.		
2.		
3.		
4.		
5.		

15. How did these supporters attempt to attain these objectives?

16. Who inside the government is the most influential opponent of energy efficient land use in this community?

_____

_____

_____

_____

_____

17. Which individuals or groups outside of the city government are the most influential opponents of energy efficient land use planning? What are their positions in the community?

	Name	Position in Community
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____

18. What would you say have been their major reasons for opposing energy efficient land use planning?

	Opponents	Major Reasons
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____

19. How did these opponents attempt to attain their objectives?

_____

_____

_____

_____

20. How did members of Council obtain their information about energy-efficient land use planning?

21. Were any special studies carried out?

22. When did energy-efficient land use first become a publicly debated issue in the community?

23. Who was responsible for first bringing it to the attention of the Council?

24. When was legislation passed to promote such energy conservation measures?

_____

_____

_____

25. Did energy efficient land use planning form one of a related group of social and environmental issues? If so, what other issues were debated at the same time?

1. _____

2. _____

3. _____

4. _____

26. What costs, economic or social, have been incurred as a result of adopting regulations to favour energy efficient land use?

1. _____

2. _____

3. _____

27. Has energy conservation through land use planning ever been part of a political campaign in this community? If so, in whose campaign and when?

_____

_____

_____

28. Were any new coalitions formed to support or oppose energy efficient land use planning? If so please describe the membership.

_____

_____

_____

(29) Listed below are nine criticisms often made of modern technology. For each criticism, five possible responses are also given. In each of the nine cases please check (✓) the response that is most acceptable to you personally.

1. Pollution	Pollution inevitable and worth the benefit it brings	Solve pollution with pollution technology	Inevitable result of technology; use less technology	Invent non-polluting technologies	Pollution is a symptom of capitalism, not of poor technology
2. Capital dependence	Technology will always cost money	Provide the capital; make technology cheaper	Costs of technology are always greater than its benefits; use less	Invent labour-intensive technologies	Capital is a problem only in capitalist society
3. Exploitation of resources	Nothing lasts for ever	Use resources more cleverly	Use natural not exploitable resources	Invent technologies that use only renewable resources	Wrong problem: exploitation of man by man is the real issue
4. Liability to misuse	Inevitable, and worth it	Legislate against misuse	Misuse so common and so dangerous, better not to use technology at all	Invent technologies that cannot be misused	Misuse is a socio-political problem, not a technical one
5. Incompatible with local cultures	Material advance is worth more than tradition	Make careful sociological studies before applying technology	Local cultures better off without technology	Design new technologies which are compatible	Local culture will be disrupted by revolutionary change in any case
6. Requires specialist technical élite	Undertake technical-training schemes	Improve scientific technical education at all levels	People should live without what they do not understand	Invent and use technologies that are understandable and controllable by all	Provide equal chance for everyone to become a technical specialist
7. Dependent on centralization	So what?	No problem, given good management	Decentralize by rejecting technology	Concentrate on decentralized technologies	Centralization an advantage in just social systems
8. Divorce from tradition	This is why technology is so powerful	Integrate tradition and technical know-how	Tradition matters more than technical gadgets	Evolve technologies from existing ones	Traditions stand in the way of true progress
9. Alienation	Workers are better fed and paid; what matters alienation?	More automation needed	Avoid alienation by avoiding technology	Decentralize; retain mass production only in exceptional cases	Alienation has social, not technical, causes

*31. Below is a list of possible obstacles facing any municipality wishing to emphasize energy conservation in its land use planning. Please rate each one regarding how serious a problem you believe it to be at present in your own community, using the following scale:

0 Not a problem
1 A minor problem
2 A moderate problem
3 A major problem but solvable
4 A major problem and not readily solvable

( ) __ (a) Lack of interest in the community.

( ) __ (b) Conflict with other municipal objectives.

( ) __ (c) Opposition from groups and organizations within the community.

( ) __ (d) The rigidity of the existing municipal infrastructure, such as roads, sewers, and other utilities.

( ) __ (e) Lack of jurisdiction over this issue.

( ) __ (f) Planning staff unfamiliar with the approach.

( ) __ (g) Energy conservation not seen as urgent problem.

( ) __ (h) Division of professional opinion over the advisability of such a step.

( ) __ (i) Lack of federal and state incentives.

( ) __ (j) Other (please identify):_____

_____

Of the obstacles listed above, please indicate with an asterisk (*) the one which you believe is the most important.

Please return this questionnaire to:

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