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July 1976

Population, Technology and Resources

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Even on the edge of an abyss, we have to take our problems one by one, so that even the ordinary person will realize that something has to be done now – things like controlling poisonous atomic waste, expanding the world's food supply, persuading people to regulate the size of their families.

Arnold Toynbee, *Loyalty in America*

July 1976
The Honourable C. M. Drury, PC, MP,
Minister of State for Science and Technology,
House of Commons,
Ottawa, Ontario.

Dear Minister Drury:
In accordance with Sections 11 and 13 of the Science Council of Canada Act, I take pleasure in forwarding to you the Council's Report No. 25, *Population, Technology and Resources.*

The Report draws attention to the way a rapidly growing population would exacerbate the stresses caused by existing patterns of production and consumption. It notes the probability of greatly increased pressures on Canada's urban areas, transportation systems, and related social and political institutions. Uncertainty about the extent of non-renewable – especially energy – resources is noted, and the potentially adverse effects of climatic fluctuation on Canada's renewable resource base are considered. The Report urges moderation of rising rates of consumption of energy and other non-renewable resources, therefore; and more efficient consumption of renewable resources, especially food, is advocated.

But even if these measures are adopted, meeting Canada's domestic and import requirements will place great strains on the ecological *status quo*, on Canadian resources, and on the resource industries. Canada's flexibility and capacity to solve domestic problems and assist in solving world problems – through trade or aid – would be seriously diminished if population continues to increase at a rapid rate.

The Science Council recommends moderate growth of the population, which would accommodate the desire of Canadians to reunite families, provide havens for refugees, and balance the country's requirements for labour and skills. Canada cannot, through immigration policies, contribute materially to the solution of problems of exploding populations in other parts of the world. Such problems can be better treated with economic and technical assistance from the developed world rather than by large scale migration. The Report stresses flexibility, however, and a five-yearly review of immigration policy is therefore recommended.

Realistic immigration policies and moderated resource consumption will not necessarily prevent Canadians from having to rely, to an increasing extent, on large, capital-intensive, energy-intensive technologies. The likelihood of such reliance is of concern to the Council. Also, the Council recognizes that some of the policies recommended in the Report (e.g., those relating to land use) could lead to an increased amount of centralized planning and decision making, which necessarily implies some danger of adverse social and political impacts.

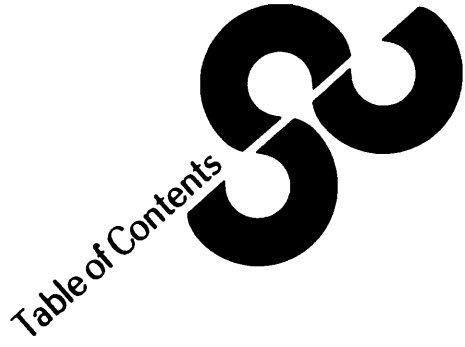
The Council has established a parallel study of the concept of a "Conserver Society", which, among other things, will deal with aspects of centralization. This study is expected to lead to recommendations on improved consumption, production, institutional, and social patterns –

designed to preserve the individual freedoms and economic and social well-being that Canadians currently enjoy.

Canadians need to make choices. This Report is designed to contribute to an informed public opinion through the stimulation of public debate.

Yours sincerely,

Josef Kates,
Chairman,
Science Council of Canada.



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Prologue

This report is addressed to the public – especially to those with the time and inclination to think about long range problems – in order to point out that Canadians must now discard some hitherto popular mythology about Canada: namely, that its agricultural potential is more or less infinite, and that its resources and land area will always support a virtually open-door immigration policy.

The Science Council addressed those issues related to the question of population size which have a scientific or technological component. These include issues concerning:

- the studies of demographers on future population size and age;
- energy resources;
- food and agricultural production;
- the design of cities and the impact of planning on city life;
- work patterns.

We would like people to understand that Canada is not now well prepared for the impact of its predictable population expansion to the year 2000, even with very limited immigration, because we have not yet solved our short-range energy problems and have hardly begun the planning and research required to ensure a continuing supply of energy in the long range future.

Prime agricultural land with good climate, which is very scarce in Canada, is as yet unprotected except in British Columbia. We have not yet taken seriously the problem of ensuring our own future food supply, much less protecting our position as an important exporter of food. We are only beginning to take a systematic and planned approach to the management of our natural resources, including ensuring that they are used frugally and that they are processed as far as possible within Canada before export. There are unresolved urban and transportation problems, so that stresses following the major urban growth during the last twenty-five years have not been absorbed. We are not adequately prepared to deal with the problems of an aging population. We have not yet thought through Canada's role in an overcrowded and hungry world and are just beginning to talk about a conserver society that would reduce Canada's consumption of food, energy and resources and make possible a larger contribution to underdeveloped countries.

The main themes of the report are embodied in the following *view*, glimpsed as it were through a chink in an opened door. It reveals a future Canada that some of us would like to see, and one that need not lie beyond our grasp. A compromise rather than an ideal, it was distilled from the material in the following pages and represents our country 25 years hence.

> *Canada is a country in which population growth has been slowed considerably, both because of the continuation of low fertility rates and through appropriate complementary immigration policies, reviewed every 5 years. At the end of the century our population has only reached about 29 million.*

Major metropolitan areas have grown in numbers, but not in size. Cities are more densely settled, with considerable savings in energy, raw materials and transportation costs. Through skilful urban design, city dwellers feel less crowded than they did in the 1970s.

The population is distributed across the country in much the same long thin strip. Large growth centres in the north and mid-north have not appeared but there has been a steady growth of population in that region in response to economic opportunities. There has been a continuation of the century-long westward shift in the centre of gravity of the population, but it is possible that a slight eastward shift is about to occur.

Near the cities much prime farmland has been put back into agricultural use and is helping to produce the food that is one of Canada's major exports. Farming is still heavily mechanized, but great progress has been made in reducing energy demands and avoiding ecologically unsound practices. There have been significant changes in the average Canadian's diet; we still overeat, and eat far more meat than is necessary – but grain-fed beef is an occasional luxury. Food prices have risen sharply, and the surplus that maintains Canada as one of the three remaining food exporting countries is usually a key item in our international balance of payments. It usually is, we say, for the price we ask is not always the world price, because priority is still being given to those in acute need.

Canada still exports manufactured goods, but resources, together with the scientific and technological skills associated with their development, are becoming more important. Resources are exported in more processed forms than was once the case, and command higher prices. This is the only way Canada exports energy. Supplying the large amounts of energy needed for this processing, for extracting low-grade ores, and for recycling materials has become the country's largest single industry. Only by keeping population growth low, while at the same time implementing conservation measures on all fronts, has it been possible to meet the demand.

Canada's imports largely complement its capital intensive structure. It provides a market for labour intensive goods, produced worldwide.

Canada is well down the road from a consumption-oriented society to one in which conserving resources is a national objective. The need for some private possessions has diminished as the supply of public services has increased substantially. Concurrently, GNP *has been relegated to its former role as a technical economic indicator, rather than as the nation's raison d'être, and its rate of growth has declined. However, because population growth has been cur-*

tailed, the quality of life has improved for most people. Finally, we are learning to solve problems other than by further growth.

There is plenty of work to be done, and very little involuntary unemployment. During the 1980s when growth of the labour force began to slow down while development increased, it seemed that Canada would need to attract huge numbers of immigrants. However, working conditions were improved, and means were found to reverse the labour growth decline through the participation in the work force of more women, young and retired people, and we were able to meet these labour needs from Canadian sources. The leisure revolution turned out to be an illusion; leisure hours are no more numerous than they were in the 1970s. We simply know how to use them better, and more attention is paid to recreational facilities – which are becoming accessible to larger and larger numbers of people.

Most manpower economists' projections proved inaccurate. Rather than each year's additions to the labour force being destined solely for service occupations, it has turned out that we need unexpectedly large numbers of skilled professionals and tradespeople in the food and other resource sectors. For a brief period, the universities and colleges were unprepared for the sudden demand for agronomists, hydrologists, geochemists, and engineers of all kinds. There were also brief shortages of skilled tradespeople such as pipe fitters and sheet metal workers.

There are good numbers of well-educated and committed young people, but the population is generally older, although healthy. The emphasis on preventive health care, rather than on treating sickness, is beginning to pay off. There is an increasing proportion of seventy- and eighty-year-olds, who, because of flexible retirement policies and other measures, actively contribute to the community, rather than depend on institutional care.

The population continues to grow, but slowly, and will stabilize within a generation. At the beginning of the twenty-first century, the pessimism and foreboding of the 1970s looks old-fashioned, and Canadians feel that the future looks manageable.

This is a view – but a realizable one. It depends on three crucial factors. First, we must adopt and maintain a slower population growth than Canada knew in the last quarter century; a population of 29 rather than 35 million in the year 2001 would increase our options substantially. Second, we need to have available the skills and knowledge to implement all the technologies on which our preferred future depends. Finally, there has to be an informed public consensus to proceed in this direction. The decision has to be made.

I. Introduction

How large a population should Canada have twenty-five years from now? Or fifty years from now? What proportion of population growth should come from immigration? What proportion from natural increase? Should we be selective about immigration? How? Is there an "ideal" age structure for this country? How should the population distribute itself across the country?

These are all questions to which there are no scientific answers. Science can help define the range of possibilities, but in the final analysis the answers depend on our image of Canada as a nation, on the sum total of our individual and collective aspirations.

Population and technology have worked hand in hand since the very first settlements. By making it possible to open up and inhabit new territories, technology permitted rapid population growth, while at the same time it improved the standard of living.

Canada, as a comparatively young country, inherited a considerable technological endowment, and added to it. Almost from the start, our economy has been highly technological: the railroad, air travel, and the mechanization of agriculture made it possible for the population to grow and spread at remarkable speed, without unduly adverse effects. Partly as a result of the intensity with which we use technology, we are today one of the world's most energy-dependent nations. Although current population growth rates are low and massive population settlement has come to an end, technology is being used to help maintain the viability of the current size and distribution of our population. We cannot now abandon it.

Technology, we are now beginning to realize, has a second function: helping us to change the future, to redirect long-established trends. Technology has played a major role in past social revolutions, although its influence was rarely appreciated at the time. Now, as we begin to realize the environmental consequences of continuing on our present course, we begin to see the need to use technology *consciously* to change direction. With the realization that trends are not destiny, it becomes apparent that we will have to "invent" the future.

Therein lies the difficulty: choosing between several alternative futures, each needing a different mixture of technologies. It is not so much a question of choosing the most attractive technology: the real question is, what kind of future Canada do we want?

One major problem is that in the last few decades technology has become enormously more complex, more costly, and much of it so large-scale that it takes years to plan – and even longer to put into operation. This is a problem particularly in Canada, which is one of the most capital-intensive, technology-dependent countries in the world. Changing our main thrust in the use of technology is not an overnight task. We have on the drawing boards for the next decade a dozen or so projects of unparalleled scope and magnitude, some of them intended to slake insatiable demands – to fulfill prophecies which perhaps ought not to be fulfilled.

In this report we are not concerned solely with numbers of people, but also with how these people behave: what they consume, what they waste. And we are not so much concerned with the use of technology

to continue long-established trends as with how to make it possible for people to live saner lives in harmony with the biosphere.

This report has focussed on Canadian population issues but we have not ignored population pressures in the rest of the world. Throughout this discussion, the world population problem remains as an invisible presence: while meeting our own national aspirations as best we can, we must constantly make sure not to worsen an already perilous world situation.

Under the shadow of the bomb, two dangerous world trends continue: the poor nations are rapidly expanding their numbers at almost constant standards of living, and the rich are even more rapidly increasing their standards of living at only slow rates of population increase. The rich are getting richer and the poor more numerous.

Quite apart from the evident risks of violence inherent in such a growing disparity and apart from everyone's distaste for the disparity itself, there lies the second danger of resource depletion, and hence of famine and deprivation on a giant scale.

Demand is evidently a function of two factors: numbers, and the per capita resource consumption underlying standards of living. Increases in either augment total demand, and because the rich have been increasing their demands even more rapidly than have the poor, a growth moratorium in relation to exploding living standards is just as urgent as one in regard to exploding populations. The question is not of numbers alone.[1]

It follows from this that one of Canada's principal international contributions would be to live frugally and avoid waste. This is consonant with the views of those who see true solutions to population and resource problems being found within national borders, and not internationally through trade, since there appears to be no authority with sufficient power to effect solutions to these problems on a worldwide basis. In the last few decades there has been, according to Jay Forrester, "a tendency to shift responsibilities upward, from the village to the state to the nation, and from the nation to various international bodies – and even as we do, the problems become more intractable and the social institutions more ineffective."[2]

We see Canada in the longer term becoming a conserver society using food, energy and resources frugally and using transportation and communications technology to permit a very wide choice of lifestyle, often in smaller communities.

We are convinced, however, that exclusive emphasis on a "soft-technology" future would be misplaced at the present time; for purely national solutions to international problems, while they must be initiated now, are still a long way from fruition.

The 1974 U.N. World Food Conference concluded that a solution to the food problems of developing countries had to be sought in programs of overall rural development having as general aims increased food production and higher rural standards of living. The forms of international assistance stated to be most important to effective integrated rural development were technical and financial, not shipments of goods. However, it will be a very long time before many developing countries

effect the fundamental reforms necessary to become more self-reliant. In the meantime, they will have to depend on assistance in bulk form; on food itself, on fertilizers, on machinery. Grain stocks will have to be set up as security against famine.

In considering Canada's global responsibilities, the Science Council has looked at the country's spectrum of options in regard to recommended levels of population and of immigration. As for immigration, neither end of the spectrum is credible: neither a completely closed nor a wide-open door seems reasonable. In no way of course could Canada ever solve the world problem of overpopulation. Even if we maximized immigration and allowed our population to soar to 100 million people over the next 25 years, we would absorb only one year's world population growth, at current fertility rates.

Canada's world role might then be found more in exporting food and other valuable commodities than in encouraging immigration. If Canadians are to feel justified in maintaining our present lifestyle, we will probably find it impossible to restrict access to our resources, and above all, our renewable resources, in the face of rising world demand. Keeping our own numbers low might be the condition for us to significantly contribute resources to the world at reasonable prices, for Canadians consume resources at rates many times the world's per capita average. Increasing our own numbers could sharply decrease our exports. We should strike a balance, maintaining an invigorating human inflow into Canada and recognizing it as a country with a limited but important contribution to make to the rest of mankind.

It may seem incongruous that the second largest country in the world should seek to limit its numbers. Yet extent of territory is not a dominant factor when so much of it is desert and rock, swept by winter's wind. What we do have cannot be thought of as ours alone, and, as our per capita needs are necessarily great (due to climate and distances), we should as good stewards limit our growth. This argument probably holds, quite apart from the considerable magnitude of our present prodigality. When that prodigality is taken into account, and as long as it is not corrected, the need to control our numbers seems of greatest urgency.

Some people favour substantial increases in Canada's population. Reasons advanced include the economies of scale of a larger national market, the need for larger cities to provide for social and cultural diversity, the advantages of a larger population in maintaining national sovereignty and paying for national defence. No attempt has been made to counter these arguments explicitly. They have not been ignored but it is felt that the arguments advanced in favour of the lower rate of population growth deal adequately with them.

The Council has also very seriously considered the question of the preservation of French language and culture, and can state that the immigration target which we recommend is compatible with efforts now being made to maintain the linguistic balance in this country.

In setting immigration policy, the country will naturally be influenced by humanitarian considerations. We will insist that families be reunited, that political asylum be offered and that small ethnic groups

be able to maintain, or even increase their numbers. In making our recommendations for permissible levels of immigration, provision has been made for these demands. At any rate, the numbers involved are not large (save, perhaps, for those rare catastrophic events which leave great numbers of helpless people; in such cases we will do our part).

Canada has been and continues to be greatly enriched by its immigrants. They have brought with them talent, culture, and energy. They have been law-abiding and self reliant and, at least initially, contribute to the work force in higher proportions than do average Canadians.[3]

A comprehensive report on population, technology and resources would touch on every aspect of human existence. We have chosen, instead, a highly selective approach, singling out those issues which are likely to loom large between now and the end of the century, on which decisions are needed soon, and to which science and technology can make a significant contribution.

This report is wider in scope and deals with more complex issues than any previous Science Council report. From the start it was obvious that we would have to use a different method of enquiry: there are few "experts" (other than in a narrow technical sense) in this field, and on many topics we considered that the viewpoint of any well-informed citizen was just as valuable as any expert pronouncement.

The method that was finally adopted involved dividing the subject into "areas of concern"; urban problems, land use questions, implications of changes in the age structure, and so on. This division was functional: our intention was mainly to reduce a mammoth subject to manageable proportions. Thus, environmental concerns are not discussed under a single subtopic but are raised under each of the headings chosen.

For several of these topics we assembled a source-book: a compilation of the best available data and viewpoints, demographic, economic and scientific. These were required background reading for a series of two-day working parties, at which specially commissioned papers were presented and debated until the underlying issues began to emerge. Participants in the working parties were drawn from a wide range of disciplines and diverse background experience. Many of their conclusions – frequently equally diverse – are summarized in a series of *Perceptions* volumes, published concurrently with this report.[4]

These volumes also represent detailed consultation with scores of people from many walks of life. From the range of informed viewpoints generated through this process, the Science Council has drawn its own conclusions, expressed in this report.

We had other motives for choosing this particularly lengthy process. The questions with which we began this report are good, stark questions – but they cannot be answered without considering in detail a host of other closely related questions. Inevitably, individual value judgements enter into this process: the *Perceptions* volumes show how our particular set of values influenced our conclusions, and where our findings are more or less objective.

These are uncertain years, and decision making is more painful than ever. Our areas of ignorance seem to have grown, rather than shrunk. We are very much aware of the costs of setting off in a new direction, only to retreat, ingloriously, a few years later.

In this report, we seek to argue that the costs of doing nothing, of not deciding, are far greater. For refusing to decide is also to decide, and what we do over the next decade sets Canada on the course it will follow, more or less inexorably, until the turn of the century.

There *are* grounds for competent decision making, and many of these decisions are long overdue. The question that most concerns us is: Will these decisions be made in time?

The reader is invited to reflect upon reading the following pages whether two roads forward are not indicated by this report. One, the way of temperance, is that we must learn to tread softly upon the earth; the other, which is complementary to the first, is that we collectively accept as a national challenge the provision of resources to a world in need. Canadians, who have long lived in the shadows of others should not underestimate what they can do. For its part, the Science Council intends to try reconnoitring both these roads. Our Conserver Society study is under way, and our attempt to determine Canada's international responsibilities for food is about to begin.

II. The Range of Population Options

The great virtue of demography is that it gives us some insight into the more or less certain future. Except in cataclysmic times, people do not suddenly disappear; they are born, grow old at the same rate, and die in fairly predictable numbers. The ratio of the sexes stays within narrow limits, and the changing distribution of human settlements is a relatively long-term process. Except for minor perturbations, life patterns remain remarkably stable; people have always left home, formed attachments, and moved into homes of their own. Demographic data and projections give us a kind of periscope through which we can glimpse the start of the next century.

Caution must be exercised however in attempting to predict our demographic future. In the 1940s, Canadian demographers predicted that our population would stabilize about 1970 with 16 million people. This was based on the low fertility and immigration rates of the 1930s. While the number of couples having children was in agreement with the projection, the number and timing of births, and higher levels of immigration after World War II upset this prediction. The same type of mistake could be made today unless successful efforts are made to influence public choices on the desirable future population of Canada.

Future population size and composition have both inexorable and adaptive elements. The present population of Canada is approximately 23 million. Even though current fertility rates are below the long-term replacement level, if immigration were reduced to equal emigration immediately, population size would nevertheless increase to 26 million by the year 2001. (See Figure II.1.) This is because of the demographic momentum built into the Canadian age structure by the disproportionately large group of young people compared to old people (the result of the "baby boom").[1]

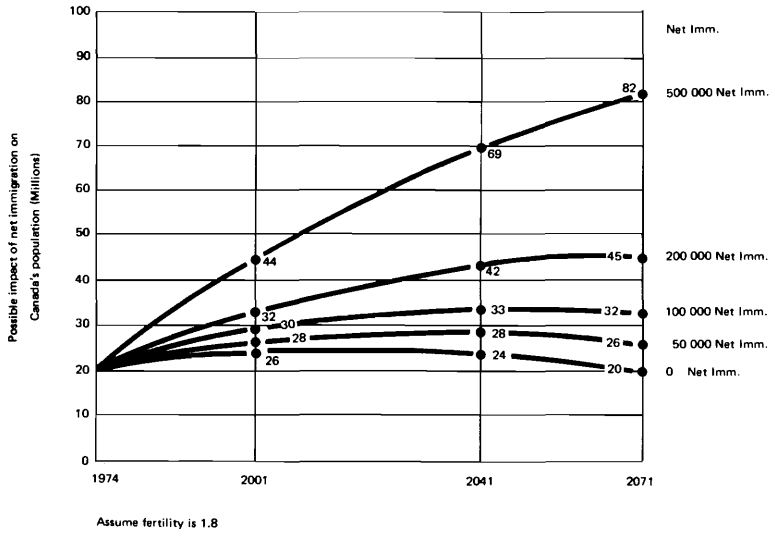
Fertility could drop below current rates, but demographers feel this is highly improbable. However, if fertility were to revert to 2.4 children per woman (i.e., to the levels of the late 1960s) population would increase to 30 million with zero net immigration (immigration equal to emigration).[2] This is a range of possible population increase over which society as a whole has not yet chosen to exert direct influence. It illustrates how individual decisions on family size critically affect population futures.

Immigration levels, on the other hand, can be directly influenced to achieve demographic objectives over both the short and long term. Assuming present fertility rates do not change, the lower and upper limits over the next 25 years might range between 0 and 250 000 net immigration. These would result in populations of 26 and 35 million respectively – an increase of from 3 to 12 million over the remainder of the century.

Narrowing this range, and allowing for small variations in fertility and net immigration (from 1.8 fertility and 50 000 net immigration to 2.13 (long-term replacement) fertility and 100 000 net immigration) would result in a 2001 population ranging from 28 to 32 million – increases of 5–9 million. (See Figure II.2.) This range of uncertainty is more "manageable."

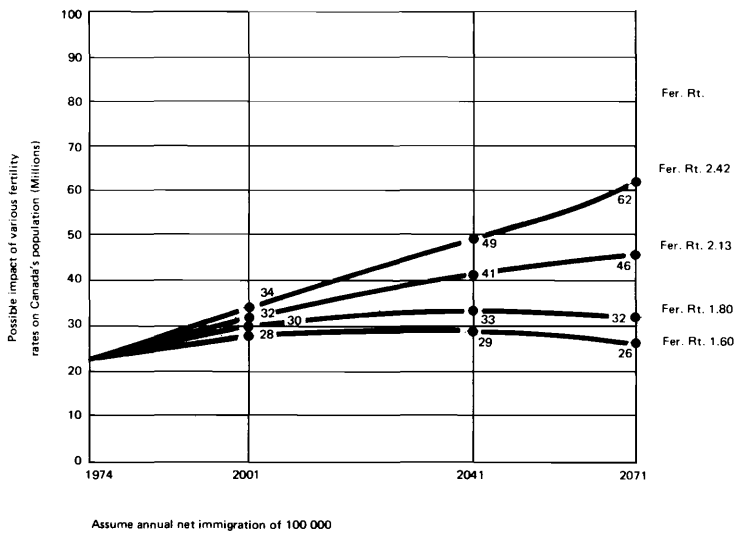
A population increase of 10 million or more (with higher levels

Figure II. 1 – Possible Impact of Net Immigration on Canada's Population (in millons)



Source: Minutes of Proceedings and Evidence of the Special Joint Committee of the Senate and of the House of Commons on Immigration Policy, 24 September 1975. Taken from Demographic Policy Secretariat, Department of Manpower and Immigration.

Figure II. 2 – Possible Impact of Various Fertility Rates on Canada's Population (in millions)



Source: Minutes of Proceedings and Evidence of the Special Joint Committee of the Senate and of the House of Commons on Immigration Policy, 24 September 1975. Taken from Demographic Policy Secretariat, Department of Manpower and Immigration.

of fertility and/or net immigration) is not beyond the realm of possibility in the 1971–2001 period. Increases of this magnitude have been accommodated in the past. In fact, Canada's population increased by 10 million in the previous 30 year period, 1941–1971.

The impact of population growth is complicated by the unevenness of growth rates in provinces and metropolitan areas. On the basis of provincial population growth trends exhibited from 1972 to 1975, it is apparent that significant shifts were beginning to occur in the patterns traditional up to that time. Prince Edward Island, Nova Scotia, and New Brunswick had positive net migration during this period, most notably from internal migrants.[3] If this trend continues these three provinces will contain 7.3 per cent of total Canadian population in 2001, rather than the 5.7 per cent that had been projected from 1968–71 migration patterns.[4]

Ontario's share of interprovincial migrants has declined so that it may only contain 37.1 per cent of the 2001 Canadian population rather than 41 per cent, as recently projected. Saskatchewan, in 1974–75, experienced a net inflow from other provinces, and for the first time in seven years experienced an absolute increase in its population. Projections made on 1968–71 migration patterns for Saskatchewan indicated its share of Canadian population might fall from 4.3 per cent in 1971 to 2 per cent in 2001. This has now been raised to 3 per cent, and should Saskatchewan continue to have a net population increase it may match or pass its 1971 share.

Several independent projections of the population of Canada's 22 census metropolitan areas anticipate growth of at least 50 per cent; in fact, at least six of these metropolitan areas are expected to double their populations in the period 1971–2001. The three largest metropolitan areas, Montreal, Toronto and Vancouver, are expected to comprise almost one-third of Canada's population in the year 2001. Their combined future population is estimated at slightly above 9 million, compared with almost 6.5 million in 1971.[5] These are conservative estimates: already, population is spilling over these cities' designated census boundaries.

These trends do not have to continue. But it is none too soon to question the possibility of other development patterns, and to ask what role technology can play in bringing about alternative patterns of settlement and life style.

On the other hand, we should recognize that some demographic trends are virtually unalterable. The progressive aging of Canada's population, for example, is assured unless we decide to promote a massive and continuing influx of young immigrants.

There are certain other population options which have not been considered in this report because of a lack of information about their likely impact on society. The availability of a virtually perfect system of family planning (instead of the present collection of imperfect techniques) might cause a further drop in fertility rates, but is more likely to lower abortion rates. The ability to influence the sex of unborn children might lead to fluctuations in the sex ratio, but is more likely to lead to lower family sizes as parents achieve desired sexes of children.

What little research there is indicates that neither development is likely to produce radical departures from current social norms and preferences, but will allow greater freedom of choice in planning family size.

Two notes of caution. The foregoing projections (and other projections introduced in later chapters) were not produced by the Science Council. They are the best we could find from the range of projections produced by various agencies and individuals. However sophisticated the means by which they were produced, they are all essentially extrapolations of trends, and make no allowance for discontinuities or sudden changes in policies or behaviour. It is important always to bear in mind that *projections are not predictions*; they simply indicate the most likely future *if* we continue on our present course. They show us a hypothetical future from which – to a greater or lesser extent – we may decide to depart.

The other warning concerns our time horizon. To make this report as practical as possible, we have concentrated our attention on the next twenty-five years, to the period between now and the end of the century. The year 2001 is a convenient milestone for planning purposes, but it is not the end of the world. For example, even at current below-replacement fertility rates and zero net immigration, our population would only stabilize in another 40 years.

- **Canada should adopt a long term population policy, designed to achieve slow and orderly growth while admitting a degree of flexibility.**
- **A process of continuing review of desired immigration levels should occur and a full policy review be undertaken at least once every five years.**

III. The Changing Age Structure

Throughout history, most societies have been demographically young. It was only with the advent of medical technology over the last hundred years that any substantial proportion of a population survived into their 60s and 70s. The "mature" countries of western Europe are actually a comparatively recent phenomenon.

Like other "new world" countries, Canada has retained a youthful age structure over the years. The relative youth of its immigrants, the prodigious fertility rates (an average of four to five children per woman around the turn of the century, for example), and more recently the post-war "baby boom" have all combined to keep this country one of the youngest of all developed nations.

This situation is about to change. In future years, there will be significant alterations in the Canadian age structure as two demographic phenomena continue to exert their influence. One is the continuation of a long-term "aging" effect. By United Nations' standards, a country is "old" when 8 per cent of its population is aged 65 or more. Canada joined this category in 1971, and it is anticipated that the actual number of elderly people will double by the end of the century from 1.7 to 3.4 million. At the very end of the age scale, the number of Canadians 80 years of age or older will increase by 130 per cent over the same period. This "aging" effect results from a progressive – although erratic – long-term decline in fertility, combined with a gradual reduction in deaths at earlier ages (so that more people survive to elderly status).

The phrase "an aging society" may conjure up a picture of a society in which the existence of large numbers of aged and infirm people is prolonged, at great cost, by an ever-decreasing proportion of workers. Canada is unlikely ever to find itself in this position. While it is true that the proportion of aged people will increase steadily in future years, the proportion of total dependents in society (including children and students as well as old people) will decline until at least the turn of the century. It will increase slightly over the following decades, but will remain below today's levels even in the year 2031.

The other demographic effect now at work is the post-war "baby boom" – a phenomenon more strongly pronounced in Canada than in any other country. This "bulge" is now roughly between 15 and 25 years of age. Its main impact on our educational systems has only a few years to run; thereafter, it will perturb in turn those social institutions catering to progressively older age groups – housing, employment, and medical services, for example. Without adequate planning, the repercussions may be no less profound than the "boom-and-bust" effect recently observed in the educational system.

Two additional complications must be taken into account. The increase in numbers of elderly people will not be uniform over the next fifty years. The below-average birth-rate during the depression years will produce a slowing of the general trend in the 1990s. This is, in effect, a breathing space before the "baby boom" reaches its mid-60s, during the second decade of the next century. Immediately thereafter the size of the elderly population will begin to increase with remarkable rapidity.

The second complication is that the baby boom may be followed by a succession of smaller population waves, spaced about 25 years apart, as the numerous baby boom children themselves have children. The size and shape of these waves will obviously be affected by prevailing fertility rates and by changing attitudes toward the timing, spacing and number of births.

There have been significant regional deviations from these general observations. If existing fertility trends coupled with 1968–71 migration had continued, Saskatchewan would have a significantly more elderly population than the country as a whole – with about 20 percent of its population over 65 by the year 2001. However, if the 1972–75 migration pattern takes hold, about 15 per cent of Saskatchewan's population will be over 65 by 2001.

Moderate variation in immigration levels will not influence these long-term trends to any great extent (although almost one-half of current immigrants are in the 20–34 age group, thereby somewhat amplifying the "bulge" effect). Mostly these trends are domestic in origin.

In summary: over the next few generations we must make provision for a relatively *smaller* school-age population, a *larger* and progressively *older* potential labour force, and an ever-larger *elderly* population – bearing in mind that these changes will not occur in a smooth, linear fashion. The magnitude and sporadic nature of these changes offer a considerable challenge to the adaptability of our institutions.

In considering these specific challenges, it is convenient to divide them into short-to-medium term and long term. In the first group we place issues such as education, housing, employment, and transportation. The most outstanding long-term issue is the provision of healthcare facilities.

Education

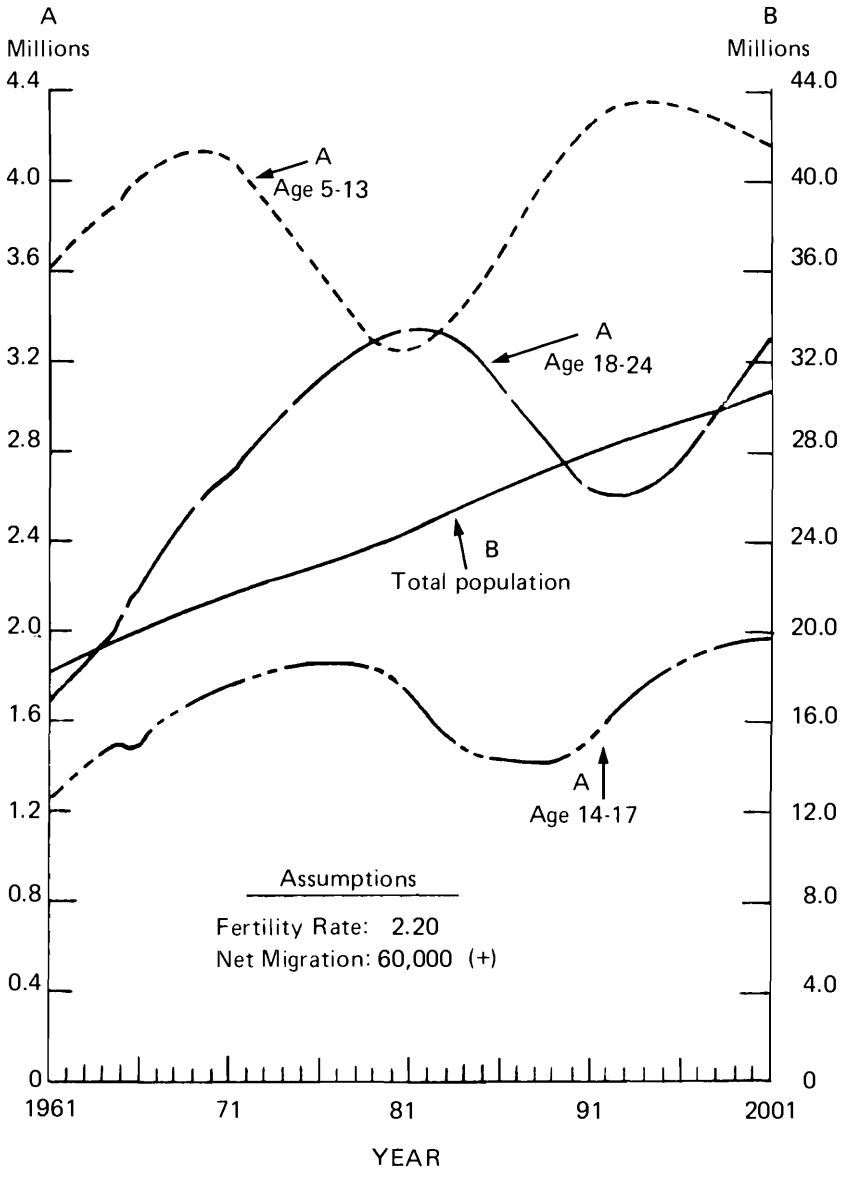
Although substantial provincial variations exist – and may be expected to persist – for Canada as a whole, large-scale changes in "education-prone" age groups are in progress. For convenience we consider trends in three age groups: 5 to 13, 14 to 17, and 18 to 24 (See Figure III. 1).[1]

The size of the 5 to 13 age group reached its peak in 1971, and is now declining. By 1981, it will have decreased 20 per cent or more. By the mid-1990s, it will have grown again, possibly surpassing the 1971 peak. Thereafter, it will again decline. (Should fertility levels remain at their current low levels, however, the upward cycles will be less pronounced, and the downturns steeper. This qualification applies also to the other age groups).

The size of the 14 to 17 age group will reach its peak in 1976, then decline about 25 per cent over the next 12 years. Projections then indicate an increase of 40 per cent (or rather less if fertility remains low) in little more than a decade.

The university-age population, the 18 to 24 age group, is still growing, but will peak around 1982. A 22 per cent decline is expected between 1982 and 1992, followed by a gradual increase (to approximately 1982 levels) by the end of the century.

Figure III. 1 – Population of Cohorts Approximately Relevant to School Enrolment, Canada, 1961 – 2001



Source: Z. Zsigmond, "Patterns of Demographic Change Affecting Education, 1961 – 2001", Paper presented to the Conference on Financing Education, the Canadian Teachers' Federation, 16–19 February 1975, p. 12.

Enrolment patterns may be expected to follow these rollercoaster population trends fairly accurately. With continued public scrutiny of educational expenditures, it seems indisputable that means must be found to plan physical facilities and software so as to cushion the impact of these future fluctuations. New patterns of adult education could, however, influence predictions.

A further serious problem is the danger of stagnation in the universities, because of aging faculties and declining numbers of students.[2]

Labour Force

For many years the annual rate of growth of Canada's labour force has been greater than that of almost any other developed nation. Much of this increase was due to the influx of immigrants: during the early 1950s, for instance, immigrants provided almost two-thirds of Canada's labour force growth. For the next 5 years, it is almost certain that the labour force will continue to grow at 250 000 or more per year. However, the difference is that immigration will be a relatively minor component of this increase: at a net migration level of 100 000 per year, its contribution would be about 20 per cent. The major influence will be the coming-of-age of the baby boom.

By 1985 the bulk of the baby boom will have been absorbed into the labour force, and the choice of immigration levels will once again exert a marked influence on the annual rate of growth. With a "low" net migration level of 60 000 per year, for example, total annual additions to the labour force would average 150 000 for the decade 1985–1995.

One conclusion that can be drawn is that the next five to ten years will be unusual in terms of the long-term perspective. The domestic population will account for the bulk of the growth in labour force, and it may be more difficult to find suitable employment for these new entrants than it was in the case of immigrants selected partly for their particular skills. Canada has historically relied heavily on immigration to meet specific employment needs; we are about to face the challenge of using our domestic supply in an optimal manner.

There is another challenge: employment of a special kind has to be created, so that Canada does not become committed to special labour intensive industries which cannot be sustained when the rate of increase in the labour force falls to a more-or-less permanent lower level.

In Canada, immigration policy has been tied to the nation's economic objectives. However, neither increased nor reduced immigration levels should be used to tide us over short-term economic developments, such as demographically-induced fluctuations in the growth of the labour force. Immigration is a long-term investment in people, not just a means of fine-tuning the nation's economy.

Housing

The baby boom cohort is now at the age of family formation. This factor is primarily responsible for the upsurge in housing demand since the mid-1960s. Initially, young people took to apartments. Now, as the leading edge of the demographic bulge moves into their mid to late 20s, demand is shifting toward single family homes.

Canada now faces the same abrupt increase in the demand for housing as it once faced for schools, and this demand will not decline until the end of this decade. The Central Mortgage and Housing Corporation estimates new household formation in the five-year period 1971–76 at 934 000 (compared with 870 000 in the decade 1961–1971)[3] and a similar rate of increase is projected for 1976–81. In the following decade, household formation will decline sharply. Adding to these stresses, the demand for single-family homes has been far stronger than was anticipated.

In response to these pressures, Canada has been shortsighted. Housing is being provided – although somewhat short of the demand – but it is often inflexible in design, and in locations likely to precipitate future transportation crises. This is not necessarily the fault of the designer or urban planner. It is the result of conflicting jurisdictions, a fragmented building industry, and a number of other serious regulatory, institutional and economic impediments. In short, our response to an acute short-term pressure may well jeopardize the possibility of rational planning for long-term needs.

Transportation

Satisfying the immediate housing needs of Canada's baby boom is, then, well under way. Consequently, the principal development patterns of our major metropolitan areas will be almost completely established by the mid-1980s, barring significant increases in immigration levels.

Examination of trends to date and projections based on patterns of household income distribution reveal a general trend resulting basically from the rapid increase in numbers of new families. About one-half of new housing will be accommodated within existing urban areas, mainly in multiple family units. The remainder are projected to be built beyond existing urban limits, in scattered developments or on individual lots; these will be low density areas with high automobile ownership. It will be impossible to supply these areas with rapid transit service unless densities become very high, and, even then, not at an early date: ten years is a commonly-accepted implementation schedule for rapid transit. Unless intermediate transit solutions can be found for these areas, an automobile-oriented pattern will develop which will be extremely difficult to change. This is the immediate transportation dilemma arising from our changing age structure: locking one-half of all new housing into automobile-dependent transportation.[4]

There is a longer-term aspect of transportation policy concerned with usage and accessibility. Currently, the major demographic variables used in transportation planning are employment and household location; age structure is not an explicit factor. Stated simply, most transportation is planned for working people. Little attention has been paid to the *latent* demand for transportation – the trips that would be made if adequate transportation were available. Latent demand, which is important now anyway, will become far more important in a society with rapidly increasing numbers of elderly people.[5]

Health Care

A continued increase in the demand for medical facilities will occur in the years ahead. Careful planning is needed to prevent costs escalating to unsupportable levels. In the process we will need to re-examine our priorities, and to question the relative value of different modes of medical care, both in institutions and in the home.

Most of the following discussion deals with the special health care problems of the over-65 group. One exception should be noted. By the turn of the century, the bulk of the baby boom will be middle-aged and approaching a period when they will be prone to acute illness. Medcial planning must prepare for this eventuality.

For the over-65 population, we face a different set of problems. Over three-quarters of this group are afflicted with some form of chronic illness.[6] Accordingly, although they now form only 8 per cent of the population, they account for 35 per cent of all patient days in hospital. By the year 2001, it is projected that slightly less than 12 per cent of the population will account for 46 per cent of all patient days in hospital.[7] Even in the short term the problem is formidable: if present patterns continue, between 1970 and 1984 the increase in hospital beds to accommodate elderly people has been estimated to be 14 000, with a cost around $550 million.[8]

There is nothing more certain than that an increasing proportion of medical work will be concerned with the care of elderly people. It is time to begin to ensure that we have adequate numbers of suitably trained health care workers. In the process, educational and training programs, and guidance into fields of specialization, will need to be modified considerably.

Similar examples can be cited showing rapidly escalating costs in every field of endeavour involving elderly people. In almost every case the reasons are the same. In Canada, we have chosen to devote most of our resources to the treatment of acute illness, and have neglected to develop well-structured preventive and care programs. There has been an overwhelming emphasis on institutional settings. Especially with the aged, most of our health-care programs are designed to remove the individual from the community, rather than to assist him or her with supportive in-home services.

Changing direction is no easy task. But we have been misguided, and in the long run it may be better if we immediately set about encouraging better home care services, the adoption of a systems approach to health care, and the integration of all levels of services.

Other countries have gone through their own aging process, and survived. Canada has special problems. Few other countries have had so high an influx of immigrants, and few have so pronounced a demographic bulge. These circumstances mean that our aging will produce unusually profound structural changes in society. As with an aging individual, society has two options: we can ignore the problem, treating old age as a series of temporary difficulties, or we can accept it as a natural process, and plan to enjoy it as best we can.

- **Chosen immigration levels should be in line with Canada's overall demographic objectives, and not be set solely to tide the country over short-term economic developments.**
- **Society must prepare for the meaningful and active participation of a considerably larger proportion of elderly people. This will require not only better access to goods and services but also opportunities for useful part-time employment.**
- **Adequate numbers of trained people must be provided to give good health care to the increasing number of elderly people. Policies must be adopted which will foster alternatives to custodial, institutional care, such as in-home and community services.**

IV. Work

One can tell a great deal about a country by examining how its inhabitants spend their time: how much they work, at what occupations, and how they occupy their free time. Not only do these patterns determine the economic life of a country, they determine whether its people achieve a sense of fulfilment.

The structure of Canada's economy and pattern of employment is unique. We are second only to the United States in the proportion of the work force engaged in providing services, yet the Canadian economy has a larger resource extraction base and a smaller manufacturing sector than most other developed countries. Despite valiant efforts to achieve a more "balanced" economy, it seems almost certain that we will retain this structure for many years to come: it is no easy task to change the occupations of 10 million people, nor to alter long-established world trading patterns.

To some extent, this structure accounts for Canada's consistently high rates of immigration. Resource-based employment usually means dirty or menial jobs, and we have always had to fill a high proportion of these jobs with either immigrants or former farm workers. This is true, too, of the task of "developing" the country: whether building railways or constructing office blocks, we have always relied on a continuing infusion of immigrants – even over the last decade, when the coming-of-age of the baby boom produced remarkably fast growth in our domestic labour force.

Our historic dependence on immigrants has implications for the kinds of work Canadians will be asked to perform in the next decade or two. For demographic reasons, the domestic supply of new workers will drop markedly around 1985 – at the very time when many of the current generation of miners and resource workers will be approaching retirement. At that time, too, we expect present and planned energy and mineral producing activity to reach an all-time high: we will need tens of thousands of skilled and semi-skilled workers at the very time that the domestic supply begins to diminish.

This, simply put, is the dilemma. For reasons more or less unconnected with our own population growth rate, Canada will need to develop substantially more resources in the years ahead. (The main impetus is supplying the growing world population with raw materials while maintaining our economic well-being.) If, to retain a recognizably Canadian way of life, we decide to limit population growth, we will be forced to turn to work we have always shunned in the past.

Even given moderately low levels of net immigration (less, for example, than the average of the past decade) the annual rate of growth of the labour force is expected to continue at high levels, about 250 000 per year, until 1980. This growth is primarily of domestic origin: the baby boom entering the work force. Thereafter, the rate of growth will decline fairly sharply: by 1986, for example, annual labour force additions will drop to 150 000 – assuming that net immigration is maintained at 60 000 per year.

As a consequence, a major difficulty will emerge gradually over the next 15 years. Current surveys show that Canadians increasingly gain work satisfaction from its challenging nature: a feeling of "success"

can be more important than financial considerations. "Opportunities for promotion" is the single greatest unfulfilled aspiration for workers at all age levels. In 10 to 15 years' time, however, opportunities for promotion are likely to be far rarer than they are today. Reflecting the age structure, the occupational "pyramid" is more likely to be diamond-shaped, with middle-aged workers predominating. Young workers will be in relatively short supply (unless renewed immigration fills this gap) yet their chances of promotion may be quite poor.

With vertical mobility effectively restricted, other criteria for satisfaction will need to develop. Lateral mobility is one answer. This may appear first in the scientific professions, where there is already a good deal of movement from field to field.

Another likely development is fulfillment through self-definition of work, combined with an increasing democratization of working arrangements, both in manufacturing industry and in the provision of services (the destination of most additions to the labour force).

Self-definition of work is by no means incompatible with social productivity. It is now becoming recognized that the demand for "private" goods and services (i.e., those products that we buy as individuals) ultimately tends toward saturation, and demand then shifts to "public" goods and services (such as transportation, public recreation, and health care) that can only be purchased by the community as a whole. Projects such as Opportunities for Youth and Local Initiatives Programs can be seen as experiments both in self-definition of work and in the identification of new kinds of public services.

This shift in the concept of "work", while abetted by demographic forces, is a rational part of the move from a consumer-oriented society to a conserving society. In the process, we may lose a measure of material affluence – but gain in the quality of our lives.

We do not believe that Canadians have become lazy, or that they have rejected the concept of "work" in any substantial numbers. Indeed, surveys indicate that, for the great majority, meaningful work is an indispensible means of helping them structure their lives. This is fortunate, for there is a great deal of work to be done over the next decade or two. It can be done – and by a slowly growing population – if we find ways of removing certain psychological barriers. Most people do not need to be motivated to work. What does need to be done is to reduce all the demotivating influences: perceived pointlessness, authoritarian management, rigid hierarchical structures, and so on.

Two other possible developments must be taken into account. Both are instances of over-response to demographic phenomena. First, as the labour force ages, it may turn out that business, government and academic institutions will increasingly be dominated by older persons. There is a consequent danger that as a nation we will tend more and more to resist change and innovation.

Conversely, as the domestic labour force continues to grow at high rates over the next ten years, pressures will likely develop to retire senior members of the labour force at progressively earlier ages. Our response to these pressures must be tempered by the realization that the influx of domestic entrants to the labour force will begin to decline

around 1985. In the long run, early retirement may not prove economically wise; it is, in addition, a conspicuous waste of human resources.

Developing and adding value to Canada's resources over the next quarter-century is a monumental undertaking. However, the domestic labour force, supplemented by only moderate levels of immigration, will be sufficient to meet the challenge.

- **All Canadians should have some work and some leisure. This could mean increased labour participation rates, later retirement, and more of the working year being devoted to leisure and self improvement. The exclusive seasons in life for learning, earning and repose can be changed.**
- **Much imaginative new thought should be given in Canada to the sociology of work – a neglected field.**
- **Our society's "traditionally unpopular jobs" should be transformed to become more attractive. Canadians should themselves prepare to fill those that remain, and not count on immigrants to do so.**

V. Urban Policy

Three-quarters of Canada's population is "urban."[1] But, more significantly, 55 per cent of the population are metropolitan dwellers, living in continuous built-up areas with populations of 100 000 and more.[2] If existing trends continue, almost *all* of our population increase over the next 40 years is expected to occur in these metropolitan areas. Most experts believe that by the end of this century, 90 per cent of all Canadians will be living in urban areas – and that metropolitan areas will grow rapidly at least until 1985.[3] In the year 2001, over 32 per cent of our population is expected to be living in Montreal, Toronto and Vancouver: these urban regions will have increased their combined population by at least 3 million.[4] "Second level" cities, with populations between 400 000 and 1 million (Calgary, Edmonton, Hamilton, Ottawa-Hull, Quebec and Winnipeg), are expected to grow proportionately even more rapidly, with several of them doubling in size within 30 years.

These differential growth rates imply an acceleration in the westward displacement of the urban centre of gravity. Generally, the relative share of urban population is expected to increase in British Columbia and the Prairie Provinces, to remain stable in Ontario, and to decline in Quebec and the Atlantic provinces.[5]

As a picture of our urban future, this has many unwished-for implications. To list only a few:

1. Those cities and regions for which below-average growth is projected will have even slower growth in the working-age population. Ultimately, this may mean that a relatively small number of workers will be asked to support relatively larger numbers of school-age and retired persons.

2. In the rapidly-growing cities, where there are many young people forming households, there will be a disproportionately higher demand for housing. In Vancouver, for example, housing needs are expected to have risen 58 per cent in the ten-year period 1971–1981 – Calgary's likely increase during the same period is 66 per cent.

3. If many of these homes are the single-family, detached dwellings which most home-buyers still seem to demand despite high land costs (which have had some influence lately in raising densities), hundreds of square miles of land will need to be found for housing alone. Streets, commercial and industrial areas, hospitals and schools will require still more land. The cost of the resulting urban sprawl may be very high.

4. If, as seems disturbingly likely, housing in the rapid-growth cities is built to be serviced mainly by private automobiles, these cities may soon lose the lower total-cost option of following the public-transit development path chosen by Montreal, Toronto and Vancouver.

These projections are based on an assumption of 100 000 net immigrants annually and the 1966–71 internal migration pattern.[6] A lower rate, 50 000 per year, for example, improves the picture only slightly: the main determinants of this massive urban change are domestic population growth, the coming-of-age of our baby boom, and internal migration. Further, for demographic reasons, between now and 1985 we will have built 90 per cent of all new housing units required to the end of the century – thereby establishing the form and shape of our

cities for many years to come.

Canadian census data do not go beyond 1971, but researchers at the Department of Manpower and Immigration have estimated that in 1972 and 1973, Canadian non-metropolitan areas grew faster than metropolitan areas. Though metropolitan areas continue to grow as a result of natural increase and immigration, several cities are no longer attracting as many rural migrants as in the past. Rural-to-urban migration has traditionally constituted the major portion of internal migration in Canada. According to a recent Department report, however, migrants from rural farm areas now tend to move to rural non-farm areas, sometimes near an urban centre.[7]

Historically, our cities have grown mainly through specialization of occupation, and through economies of scale. Specialization remains a valid means of organization, but the economy of scale argument might be breaking down with the metropolitan sizes projected for Canada. At some point, the environmental and social costs begin to outweigh the purely economic benefits.[8] We need to develop technologies that will permit smaller viable economic units, thus broadening options for industrial location.

On the other hand, there is little doubt that our metropolitan areas could accommodate far higher population densities than they do today, especially in suburban regions. For many reasons – the preservation of irreplaceable agricultural land, the greater economic, environmental and natural resource costs of sprawl[9] – metropolitan areas should have higher densities of population concentrated in urban areas, along corridors or sub-centres, and any future population growth should be accommodated mainly in these locations. With proper design, we can achieve higher densities with less crowding, and have rural amenities close to the city dweller. But to accomplish this, we will need political and economic innovations, such as in planning and by altering the basis for assessing municipal taxes.

There is an argument for new growth centres,[10] as existing city boundaries are unlikely to be able to accommodate total projected population growth. But they should be few, and fairly large: and should have the diversity of occupation and autonomy of existing metropolitan areas. The case for "new towns" appears to be considerably weaker. They have had only limited success elsewhere; they tend to be monolithic and uniform and can compete with larger cities only by providing land more lavishly. They should not be located on good agricultural or recreational land.

Although increasing the density of existing metropolitan areas is both economically and technologically feasible, there is a danger of environmental degradation, and consequent psychological and social stresses.[11] Social innovations (for example, extremely flexible working hours) could be beneficial, but we have no way of knowing to what degree these innovations would strain social institutions. Furthermore, careful attention must be given to the long-term health consequences of the increased levels of pollution which denser urban populations could entail.

It is inevitable that some low-density communities will continue

to grow, especially in outlying suburbs. But they should not be permitted on or near prime agricultural land. Residents in these communities pose a very difficult transportation problem. When they work in neighbouring cities, they usually commute to work by private automobile and contribute to the congestion of the cities. There is no foreseeable transportation technology that will provide public transport for them at a reasonable cost. They must, therefore, be encouraged to find local work or drive to commuter train or bus services as they become available.

Much attention is paid to our transportation system and little or no thought is given to simply reducing the need for urban travel. Living near enough to one's job in order to walk to work would be possible if living and working areas were intermingled more than they now are. In this manner, the approximately 28 per cent of the nation's energy budget devoted to transportation could be significantly reduced,[12] and urban congestion ameliorated.

Care should be taken in any large urban centre to ensure diversity of land use, in order that people will mingle – living and working together. Our present suburbs were not so designed. Not only is specialization uniform and drab, but it leads to specialization elsewhere in the city, with downtown areas becoming the exclusive domain of office buildings and parking lots. Even if mass transit partially replaces cars, it should not be thoughtlessly oriented to serving the downtown core, but could also help disperse people throughout the city.[13]

Land use planning in Canada was originally done by individual municipalities. It is now becoming regional and provincial and no doubt the day will come when provinces will plan within an agreed "national plan," even embracing a "national urban policy" that will have a powerful influence on population distribution.

There are powerful constraints on good urban planning. Much urban land is privately held and ownership confers considerable power on a large number of individuals and corporations. These owners know that the value of a holding is determined by its location, i.e., by its relation to the sum total of urban activities. This value is strongly affected by any and all measures of public planning, not only by regulatory measures such as zoning, but also by the location of public works such as roads, utilities, schools and parks. Every planning decision inevitably shifts some site value from one piece of property to another. There is, then, a necessary contradiction between the private ownership of land and public planning.[14]

The substantial fiscal dependence of municipalities on the real estate tax can be another constraint. Commercial and private proposals, promising high tax yields, tend to be adopted over public amenities, which yield little or nothing. The beautification of Ottawa, so ably orchestrated by the National Capital Commission, was carried out with the help of vast and exceptional federal spending, and thus constitutes an example which other municipalities cannot emulate.

Furthermore, economic growth and other economic issues can play far too dominant a role in decision making – as when unique heritage buildings are wrecked to make way for commerce. Despite its obvious shortcomings, we persist in the myth that the "market place" is always

the best means of determining our priorities. (On the other hand, social issues must not be emphasized irresponsibly, so that the community lives beyond its means. Housing, for example, can be ruined by unrealistic rent control.)

These, and other problems, are barriers to developing and implementing programs aimed at improving urban life. They are barriers to using available, appropriate technology. Instead of confronting these issues, we continue with ever more sophisticated forms of analysis, until there is every danger of intellectual and volitional paralysis.

Looking around at our cities today, we find much to be proud of. They have a polygot vitality, they are relatively crime-free, and the transportation system works most of the time. Physically, they are in much better shape than their American counterparts. In none of them has the inner core deteriorated beyond repair. They are livable cities. We have done some things right – and had a little luck. From now on, we will need prudence.

- **Urban areas can and should absorb further population growth without taking up much more land. This can be done with good design without increasing the sensation of crowding and without undue risk of higher pollution.**
- **Growth of low density urban communities onto good agricultural land should be stopped.**

VI. Agricultural Land Use

In Canada, we are singularly well endowed with land; although we often treat it merely as a commodity, we still recognize that land is, fundamentally, a national treasure.

Land has many uses – for settlement, agriculture, forestry, recreation, wildlife – always potentially in conflict with one another. Despite Canada's substantial land area, as the population grows, serious conflicts arise between the use of land for agricultural purposes and its use for other development, especially development to accommodate our expanding urban areas.

There is less land suitable for agriculture in Canada than is generally realized. Figure VI. 1 shows that 13 per cent of our land area is suitable for some kind of agricultural production; but we see in Figure VI. 2 that considerably less than half of this is capable of sustained production of common field crops.

Figure VI. 3 shows the composition by use of the 170 million acres now in farms. Over and beyond this amount is land in reserve amounting to 55–60 million acres suitable for field crops and 60–65 million acres suitable for forage production. Much of the latter is presently under forest in climatically marginal areas and will take considerable capital investment to develop for food production.[1]

Only 19 per cent or 55 million acres of total agricultural land is prime farmland, suitable for a wide range of crops. It has the highest productivity and almost all of it is currently in use.[2]

Much of our best soils are in the Western Prairies. Since climate is also important for productivity, however, the southern lands of our Eastern Provinces are seen to be more important agriculturally in the national context than areas alone would indicate (see Appendix B).

Aggregate land use statistics for the last decade show no appreciable decline in farmland, which is misleading. In point of fact, present urban growth is encroaching on key farmland, that with the best soils and climate. Land in Southern Ontario and in the Saint Lawrence Lowlands is in greatest jeopardy. It has been estimated that *half* of the farmland lost to urban expansion is coming from the best *one-twentieth* of our farmland.[3] The farmland which nominally might be considered to replace this loss is almost invariably in regions with poorer soil and a less favourable climate. And as Norman Pearson pointed out: "given the need to increase production every decade for the foreseeable future, it is better to do it on the best land, for the limits and hazards on the poorer land can slow the process enormously."[4]

In Southern Ontario, in the 15 years prior to 1966, farmers sold considerable quantities of rough unimproved land, but only small amounts of improved land – even adjacent to the urban arc encircling western Lake Ontario. Around 1966, a change occurred: sales of improved farmland began, at rates six times faster than in the preceding period. Between 1966 and 1971 a million acres or almost one-tenth of the improved farmland in Southern Ontario was lost to agriculture.[5]

Very little of this loss can be accounted for in terms of conversion to direct urban uses; one estimate is that less than 5 per cent of the farmland fallen idle between 1951 and 1971 has been developed for urban use.[6] Rather, it seems that most of this land is being held in

Figure VI. 1 – Canadian Land (2293 million acres)

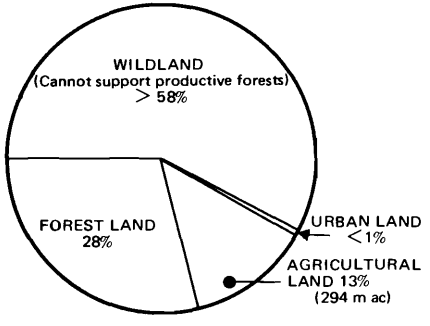


Figure VI. 2 – Land Designated as Having Agricultural Potential (294 million acres)

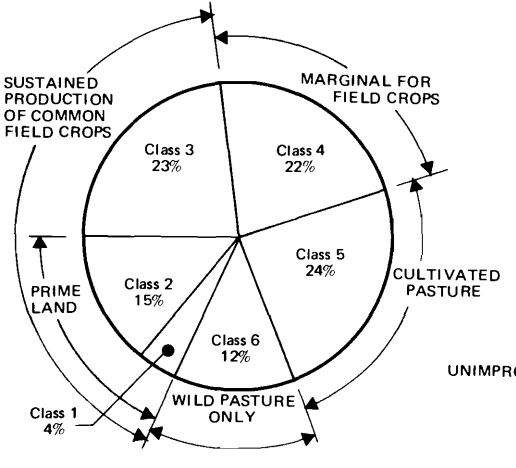
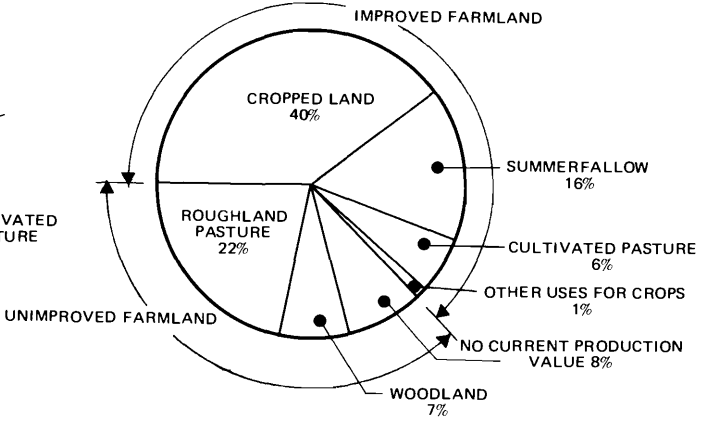


Figure VI. 3 – Land Now in Farms (170 million acres)



reserve for future urban expansion over the next two decades. In the meantime, it falls under the urban "shadow", and is no longer used for agricultural production.

This phenomenon – food-producing land falling out of production years in advance of its development at the periphery of the expanding city – is seen most clearly in Southern Ontario, but has also been noticeable around Montreal and Vancouver. Interestingly enough, for more populous cities the developed area per capita is less than for smaller cities, but the extent of the urban shadow is greater.

Decision makers have begun to realize the implications of this profligate retirement of prime agricultural land, and it is possible that ultimately some of it may be returned to food production. Even so, rural policy is still considered subordinate to urban policy, and many experts believe we have only one decade in which to redress the balance.[7] Current agricultural practice concentrates, by default, on utilization of marginal land. We have identified a number of issues which exacerbate the problem of loss of the best agricultural land, and make more urgent its prompt resolution.

1. The best agricultural land cannot, in agricultural use, command prices comparable to those it would have in almost any urban-related use. Accordingly, the market mechanism cannot be counted on to protect this land from development. Further, the very limited success that municipal zoning has had in countering market forces over the years shows the relative weakness of local organizations left to their own devices.

2. Certain specialized agricultural land, for which replacement areas are almost non-existent, continues to be lost. The situation is not particularly pressing with land for vegetable and hard fruit production; however, it is quite likely – given present trends – that Canada will soon lose most of its capability for growing soft fruits.

3. In recent decades the weather has been unusually favourable for North American agriculture. It is now generally agreed that it will soon become less favourable, due to increased variation in weather patterns.[8] As a consequence, uncertainty in the choice of crops will increase and yields are likely to decline, thus placing greater dependency on prime land in the warmest areas of the country.[9]

4. Urban air pollution – particularly from ozone, sulphur dioxide and peroxyacetyl nitrate (PAN) – jeopardizes productivity on prime agricultural land. Beyond certain minimum levels of pollutant, the decline in productivity is rapid.[10, 11]

5. If, as seems likely, industrial and other demands for oil and petrochemical products increasingly compete with agricultural demand, energy prices will rise even further, and marginal land will become even more marginal economically.

6. Although agricultural technology will continue to improve, it is unlikely that the year-to-year productivity increases of the last century can continue at the same rate.[12]

7. It now seems to be agreed that as the demand for food increases the world faces short-falls in food supply unprecedented in modern times. Canada is one of the world's few remaining net exporters of

food, and its farmland is an increasingly vital global resource.

To recapitulate: increasingly over the last decade, prime agricultural land has been lost to food production, and replaced by marginal land. Two related causes can be identified:

– The outward expansion of cities. Lack of any clear-cut direction in urban and regional policy has produced extensive "rurban fringes": non-urban non-agricultural areas in which the land has become a non-productive, speculative, urban commodity.

– Sale of farms. As city boundaries encroach on farmland, the more expensive the land becomes, and the more intensively it must be farmed to produce adequate returns. Intensive farming leads to conflicts with increasing numbers of non-farming neighbours, concerned mainly with urban-style amenities, for which the farmer must help foot the bill. Economic and social pressures ultimately force the sale of farmland to developers.

The Canadian public and politicians are beginning to appreciate the limits of our agricultural land. The "Man and Resources" conference and various provincial land use forums have helped spread this message. The passage of provincial legislation in recent years is also encouraging. In British Columbia, legislation to protect agricultural land has been implemented and seems likely to succeed. On Prince Edward Island, suitable levels of maintenance might yet be required from owners. In Ontario, however, the erosion of farmland continues, despite that province's sophisticated land use planning legislation.

We can only conclude that strong measures are called for:

1. Recognition that the designation of our best agricultural land *as* agricultural is urgent. This implies, in Canada, bold initiatives at the provincial level in planning and implementation, inseparable from political risk.

2. *Rural land use planning* should have as high a priority as *urban land use planning*. Rather than endlessly debating conflicting uses for urban land, there is a need to consider the basic conflict between urban and rural uses, and among mutually incompatible rural uses. Obviously, most planners' basic perspective needs to change. They must become aware of rural land use issues and understand rural social patterns. They need a far better appreciation of the food-producing landscape and its limitations.

3. Recognition that future growth of metropolitan areas must often be accommodated by in-filling within existing boundaries. Sprawl is not a necessary evil: it is unnecessary, and entails considerable economic, environmental, and social costs. We also need to consider whether our standards for lots, housing units and residential road widths are not overly generous; most European countries make do with far less. The adoption of a *site value tax*, in which land, and not man-made improvements, is taxed, should release land for in-filling in cities.

4. The often disruptive influence of the growing numbers of rural non-farming residents in the farming communities lying beyond the urban fringe should be scrutinized. Admittedly, many people like living in a rural environment and it seems only sensible to continue making some provision for housing non-farmers there, especially since they can

act as very efficient buffers against the subdivider. The true social cost of this influence needs assessment.

5. Within metropolitan areas, planning for ecologically, economically, and socially balanced activities is essential. By means of initiatives in urban agriculture, in urban forestry and through imaginative planning generally, recreational open spaces might be expanded considerably, thereby enhancing the city-dwellers' immediate environment, while reducing his or her dependence on the surrounding countryside. In the words of Paolo Soleri, "the creation of truly lovable cities is the only lasting solution for land conservation."[13]

The preservation of farmland does not, by itself, guarantee its use for food production – but it is a necessary first step. Unless economic incentives to the farmer are substantially increased, continued growth in food production is by no means assured. For the farmer near a city, this will almost certainly require selective subsidy even if food prices rise substantially. The current generation of farmers will soon retire, and their descendants are increasingly choosing non-farming activities with higher economic returns. People with the will and ability to become successful farmers are increasingly frustrated by the escalating costs of capital, land, equipment and livestock.

Recently, our attitude to land has been undergoing change.[14] Belief that it was limitless probably allowed Canadians to undervalue it and to think of it only as a commodity. Although a commodity it will and probably should remain, we have begun to consider it more and more as a resource as well, and a resource is a precious thing that belongs in some manner to all. It is not for any one of us to use and abuse. Apart from the *rights* of ownership – some of which might be privileges – there are *obligations*, and of these singularly little is being heard. Obligations to one's own community, and to other people beyond, make of land ownership a stewardship.

- **The elaboration of local, regional and provincial policies and mechanisms for land use planning and control and the synthesis of these into a national policy is an urgent necessity.**
- **Our best agricultural land, in terms of soil and climate, must be designated for agricultural purposes only. This is the responsibility of the provincial governments, and it should be done immediately in Ontario and probably also in Quebec. The British Columbia precedent should be studied and the issue of adequate compensation must be resolved.**
- **In order to have land farmed and not just saved for farming, and in order to improve rural life generally, agricultural land planning should have as high a priority as urban land planning. Suitable levels of maintenance should be required of land owners.**

VII. Food Supplies

The most important issue in Canadian agriculture is whether it will meet the great needs of the future. It does meet present domestic needs, for although we now import many foods that we cannot produce ourselves, such as citrus fruits, out-of-season vegetables, nuts, exotic fruits and beverages, we also import other foods, especially meat, milk and eggs which we do produce domestically (and export). But we are self sufficient in many commodities and consistently maintain a favourable trade balance in agricultural produce (almost $1 billion in 1974).[1] Our principal export is grain, and enough of it, a sustainable 15 million metric tons annually, to feed either 15 million people at Canadian standards or approximately 75 million people at the standards of Third World countries such as India.[2] Our net imports, then, are luxury items whereas we export very significant amounts of protein in the form of wheat, other cereal grains and oilseeds.

There is much malnutrition and starvation in the world, and while diets improved for much of humanity from 1950 to the early 1970s the situation has since worsened because of soaring world food prices and a precipitous decline in food aid. Cereal import requirements for poor countries could rise steeply over present levels.

There is a growing world dependence on North America to make up for food production shortfalls in the rest of the world. The number of net food exporting countries has diminished drastically and no important new ones have emerged in the last quarter century.[3] Now only the United States (1973 grain exports: 70 million metric tons), Canada (18 million metric tons) and Australia (7 million metric tons), are the major suppliers.[4] Canada is prominent in world agriculture trade even though its share of world production is small. It should remain an important food exporting nation, for not only will others continue to depend on us, but food exports should prove of major benefit to our balance of payments.

Canadians are among the most affluent people in the world with regard to diet. Despite this abundance of food, particularly protein foods, recent studies by Nutrition Canada have indicated that Canadians are sometimes ill-nourished and suffer from deficiencies of vitamins and minerals which may contribute to health problems.[5] We eat too much meat and not enough fruit and vegetables. Were our eating habits brought more into line with nutritional guidelines, current research suggests that additional Canadians could be supported by our agricultural system, or more food could be exported.

Maintaining our present relative level of exports and assuring the needs of our own population will not be easy. We will only succeed by slowing population growth, increasing our production and cutting down on waste – in consumption and in production.

There are extensive lands classed as arable which have not yet been developed for farming. Some 55–60 million acres above the 170 million acres now in farms are unused potential cropland; however, this is marginal land for the most part and would require a great deal of money and energy before it could become productive. It would also never yield as much as the better classes of land now farmed. A further 60–65 million acres, now unused, are suitable for forage production.[6]

The rate at which marginal land could be put into production is probably relatively slow: one million acres per year are proposed as reasonable. Due to its poor inherent productivity, the contribution of marginal land to total output of food supply would be only half the per cent increase of the land itself. Within the land now in farms, proposed methods for increasing the land in production include extending irrigation (up to 0.5 million acres), developing roughland pasture (10 million acres) and reducing summerfallow (by 12 million acres).[7]

Greater promise for increased production on existing farms is found through better management and the full use of present technology. Vastly increased outputs should not be looked for from more intensive fertilizer use, however, for much of our agricultural land in the Prairies is dry, and on dry land diminishing returns from fertilizer use set in quickly, and diminishing economic returns even more quickly.[8]

There are also many powerful constraints:

– Advances in agricultural research are now harder to achieve. Yield increases in both plant and animal productivity are becoming progressively more difficult, perhaps as biological limits are being approached. (None the less, there are still many promising avenues for progress and research funds should not be cut.)

– Additional resources such as fresh water, fertilizers and energy are made available with increasing difficulty, either because of cost or environmental concern but rarely because of absolute scarcity, with the exception of phosphates.

– The climate is changing – unfavourably for agriculture.
(See p. 46.)

– A capital shortage is possible (see Chapter IX). Agriculture is becoming ever more capital intensive.

– Some lands with satisfactory soil can be inappropriate for agriculture – such as steep slopes planted in corn, or stream banks trampled by cattle. Soil erosion is, or can become, a problem on many Canadian farms.[9]

After assessing these constraints, evaluating our marginal lands for production, and our management methods and use of technology compared to what they could be, it seems that agricultural productivity in Canada could be doubled over present levels. Agriculture Canada writes: "A doubling of output from actual and potential agricultural land is possible if all technical information could be used without regard to market fluctuations and supply limitations."[10]

The uncertainties of the market are probably the most important constraints acting against increased production. Production quotas now keep down yields to avoid oversupply and to maintain price levels; wildly fluctuating prices in some commodities require farmers to remain flexible and prudent. Only the guarantees that could be provided by a major national agricultural program could lead to a rapid increase in output. From 1950 to 1969, the rate of increase was 1.9 per cent per annum.[11] With proper economic incentives that rate could be increased to 2–3 per cent per annum. Thus, a doubling could not occur overnight: the year 2000 might be the very soonest.

Very significant gains can also be achieved through waste reduc-

tion, and in a shorter time frame as well. We waste mainly productive land (as we have seen), grain and energy.

Canada has been most profligate in the grain fed its farm animals, particularly in finishing beef for market. This is food fit for human consumption and yet the amount used as feed over the past years has been roughly equivalent to the amount of grain we export.[12] Canada is not alone in turning food into feed, of course, and international shortages of grain are sometimes caused this way. Feeding cattle grain shrinks the available food supply drastically. Beef, in particular, is inefficient: from 10 to 16 pounds of grain are necessary to produce one pound of meat.[13] However, meat production from range-fed animals is not wasteful: ruminants are "protein factories" and produce protein from non-protein. According to the Food Prices Review Board, there exists enough potential forage in the country to meet current beef requirements.

Agricultural operations can be wasteful of energy. A reform of the feedlot method of meat production could itself be a considerable economy measure. Animals are often overfed in this manner and their manure is largely going to waste, sometimes causing water pollution. Manure can be used as a plant nutrient, as a fuel (methane production) and, in a limited way, as an animal feed. When use is made of such "waste" for fertilizer, one can "close the loop" on a mixed farm, thus producing a stable ecosystem in which a high percentage of organic matter is recycled internally.[14]

Only when these changes are put into effect will we be doubly assured – of meeting our own food needs to the end of the century, and of remaining a major food exporting nation.

- **Research to intensify production on current farmland, conserve scarce resources and develop environmentally appropriate techniques is essential.**
- **Food fit for human consumption should not be fed to animals; every effort should be made to find alternative markets.**
- **The country should plan to intensify food production and make provision for its appropriate storage and transportation.**

VIII. Energy

Adequate energy supplies and a satisfactory living environment for Canada's future population should be continuing national goals of overriding importance.

Traditionally, Canada has been among the most energy-intensive countries in the world. There are many reasons why this is so. The hostile climate is an important if not dominant factor: a great deal of energy is essential to keep warm and to survive our long winters. Also, Canada is a vast country with the extremities of its densely inhabited southern portion further apart than Moscow and London. There is a very high energy demand for transportation. Over recent decades, energy has been plentiful and inexpensive, thus favouring the development of energy-intensive activities. Industry uses more than one-third of our energy today. The demands of the primary sector especially will grow rapidly as high-grade mineral resources are exhausted, oil and gas exploration continues to move northwards and offshore, and as additional energy is needed to develop other marginal resources.

Moreover, we are locked into an especially energy-dependent lifestyle: private automobiles, air travel, large single-family houses, energy wasteful commercial developments. Unlike countries employing low-energy technology or even medium levels of energy consumption (as in many parts of Europe) Canada is engaged in technologies crucially dependent on a continuing large supply of energy.

Indeed, it is hardly overstating the situation to point out that we need energy as badly as fish need water: a severe energy shortage would just as surely endanger our survival in a hostile climate.

Energy Demand

Two factors influence future energy demand: rates of change in per capita consumption and rates of population growth.

In the period 1960 to 1973, the compound rate of increase of per capita energy consumption was 3.5 per cent per annum, equivalent to a doubling every 20 years. We can and must take immediate steps to reduce this rate of growth. But we must be realistic, and recognize that stabilizing energy use per capita could take a long time. In this analysis we have assumed that per capita consumption will stabilize before the end of the next century. This stabilization, however, will probably occur at levels considerably higher than today's. Basically, the role of energy in satisfying human wants over the next generation will not be greatly different than it has been in the recent past. (Appendix C contains a discussion of projected energy demand by sector.)

Regional economic expansion, northern and offshore development and elimination of poverty in an equitable society, should ultimately increase the present consumption per capita by at least 40 per cent. In addition, we will need to expend energy in order to generate and transport more energy.

Without the impacts of greatly increased prices, a vigorous conservation program, and the introduction of much more efficient technologies, stabilization at some 1 000 million BTU/capita-year is likely. If such measures were taken, stabilization at a level of 550 million BTU/capita-year could be expected. Although there are problems in our

ability to reduce increases in per capita energy consumption below certain critical levels, we appear to have greater control over the rate at which the population increases.

To illustrate this point: if Canada's population were frozen at its current level, successful conservation measures adopted and impacts of increased prices fully felt, total energy consumption would most likely increase by 50 per cent by the year 2001. If population were to reach 29 million by 2001 – an increase of 26.1 per cent – energy consumption would almost double. The trend from 1958 to 1973 was characterized by a doubling time of 13 years, reflecting a rate of increase of over 5 per cent per annum. A reasonable prediction of energy consumption would take the form:

Year	Unit Consumption (BTU/capita-year)	Population (millions)	Total Requirements (1 Quad = BTU x 10^{15})
1975	280 000 000	23	6.42
1990	370 000 000	26.5	9.81
2001	416 000 000	29	12.06

Since our analysis takes population factors explicitly into account, we can formulate energy requirements for an additional million people as follows:

Year	1975	1990	2001
Energy Requirement: (Quads)	0.28	0.37	0.42

The projections for total energy demand are decidedly conservative for two reasons. First, they reflect a moderate population increase, based on a fertility rate of 1.95 and a net annual immigration of 50 000. Second, they assume an annual growth in per capita demand averaging only 2.6 per cent between now and the year 2001. More specifically, the compound rates of growth decrease successively as follows:

Period:	1958 – 1973	1975 – 1990	1990 – 2001
Per Cent	5.3	2.9	2.1
Doubling time (in years)	13.2	24	34

For this scenario to be achieved, real increases must occur in Canadian energy prices, with considerably greater savings and efficiency in the use of energy. The energy conservation story and the need for technological efficiency must be told as clearly and forcefully as possible to all Canadians. The need for this cannot be over-stated. Nor is it likely that this low growth in energy demand would be possible in the event of resumption of rapid growth in the Canadian economy. In short, our postulated growth in energy demand is considerably below historical levels, and will not occur except through deliberate political intervention.

Energy Supply

In Canada, the sources of supply of energy in increasing order of importance, during the present decade, have been, as pointed out in Report No. 23:

1. Biomass	1%	4. Natural Gas	19%
2. Nuclear	1%	5. Hydroelectricity	24%
3. Coal	10%	6. Petroleum	44%

Additional sources of energy are expected to help supply Canada's future needs. They are likely to be 1) direct solar heating and cooling, 2) geothermal energy and 3) wind power.

Wood and other biomass forms could contribute several per cent of total energy requirements. A serious conflict could, however, arise between these and the need for agricultural land, not to mention other needs for capital.

In the short and mid-term, nuclear power will probably be the only source of energy other than fossil fuels to make a major contribution. By the year 2001, electric energy, as an end-use form, is expected to be the backbone of our economy. Nuclear energy, which should account for about 25 per cent of the total, will be the mainstay of electric power production, especially in the most energy dependent province, Ontario.

Supplying Canada with adequate electric power by the end of this century will be an almost herculean task – particularly in view of capital, manpower and energy requirements. Yet the consequences of falling short of the mid-term goal by more than 20 per cent are serious indeed. Nuclear fission, which is expected to supply a substantial proportion of future electrical energy needs, should not be looked upon as a desirable solution in the very long term because of problems in managing radioactive waste.

Among the alternatives, nuclear and coal sources offer the only major possibilities for meeting energy requirements during the next few decades. Coal could be provided by 1990 at more than 100 million short tons per year, approximately four times today's output. We have enough coal to supply our total future energy requirements for many years, although there are at present serious environmental, economic and technological obstacles to its accelerated development.

Without effective exploration, efficient recovery and control of end-use, we will likely encounter serious shortages of natural gas. Critical domestic demand could remain unsatisfied in the 1980s should additional development and investment in established producing areas not materialize and exploration in frontier areas not be vigorously pursued. By the mid-1980s or perhaps even earlier, an extremely serious situation could develop. Natural gas is not a renewable or inexhaustable resource, and there must eventually be a transition to new forms of energy (e.g., hydrogen technology). For it to be timely, this transition must be planned now.

Though the estimated potential of undeveloped hydro sites is considerable – somewhere in the range of 2 or 3 times the existing capacity – further supplies will be costly because of difficult sites and their distance from consumers. In fact the true total costs could be prohibitive due to undesirable environmental and social impacts and the competition for use of land. In short, a serious problem might arise because of the huge investment that electric power development might require. Nevertheless, the present electricity supply (some 210 billions of kilowatt hours per year) could increase by 90 per cent by 1990.

Petroleum and petroleum products maintain the dominant role within Canada's energy supply spectrum. Our known reserves of oil and gas, however, have recently been found to be more limited than they were thought to be 5 years ago. The magnitude of our hydrocarbon reserves, especially crude oil, and particularly in frontier exploration, continues to disappoint the experts. The timing of the first oil deliveries from the Mackenzie Delta and East Coast offshore areas remains uncertain. Moreover, views on the role of the Athabasca oil sands are progressively more pessimistic with respect to economic viability, net energy recovery and the rate at which a high level of production can be achieved.

The Canadian oil deficiency picture (see Appendix D) for the period ending in 2001 is represented as follows:

	Years		
	1975	1990	2001
Deficiency (thousands of bbls/day)	116	310 910*	–1 250 750*

*Deficiency without availability of low certainty oil supply from frontier areas.

The oil situation, from a balance of trade point of view, will become extremely critical. By 1990, assuming an international price of $20 per barrel and low continuous supply from frontier areas, the deficit could amount to $2.25 billion. Should the low certainty supply not materialize, the deficit will be even higher: $6 billion. The problem is exacerbated by the relative lack of satisfactory energy substitutes for oil.

Canadian crude oil consumption is estimated to increase by an average of 1.4 per cent annually from 1975–90, and 1.9 per cent from 1990–2001. The low projected rate of increase in the period 1975–1990 reflects the impact of both the recession and initial conservation measures.

Looking at additional sources of energy for the future we find that solar energy for heating and cooling may barely attain a fraction of 1 per cent by 2001 although, under ideal conditions, it could almost attain its full potential of nearly 10 per cent by 2050. Because of institutional and other constraints, the process of introducing this technology on a large scale might be extremely long. It should be speeded up.

Geothermal energy potential, as viewed from present regional perspectives, may ultimately contribute a few per cent of total energy supply. Wind power may eventually add another 1 per cent, probably on a regional basis. In general, such exotic forms of energy have serious practical limitations that rule them out as significant contributors (less than 15–20 per cent) in the long term.

Keeping in mind that the total energy requirement for each additional million people in 1990 will be 0.37 Quads (3.9×10^5 terajoules/year), and assuming that one barrel of oil will cost $20, it follows that the cost of importing energy in 1990 will amount to $1.3 billion for every additional million people. In terms of oil supply, the necessary

imports per additional million people will amount to 180 000 barrels per day. This rate exceeds by far the current oil production of very large pools in Alberta, and equals the rate of production of the series of pools referred to as the "Golden Trend." As for bituminous coal, the energy requirement for an additional million people exceeds the current production in Canada. Likewise, for natural gas, the additional energy requirement would equal the current domestic demand in Alberta and would be higher than the expected supply from British Columbia in 1990. The additional electrical energy requirements for a million people represent the output of over 13 000 installed megawatts, whether six and one-half power stations of the original Pickering type (4 x 500 MW reactors), 4.65 stations of the Bruce type (4 x 750 MW reactors) or 3.3 contemporary plants (4 x 1000 MW reactors). Very approximately, the 13 000 megawatts will cost some 13 billion constant (1976) dollars.

Conservation

We have assumed that effective conservation measures will be implemented because conservation provides the greatest short and medium-term leverage in combatting possible shortages. Conservation will, at least initially, be a great deal less expensive than providing new energy. Two areas in particular present prime opportunities for energy saving: automotive fuel consumption and space heating.

Quite apart from lower speed limits, which if required by all Canadian provinces would save gasoline in noticeable quantities, fuel could be economized most significantly by paring down the weight of cars. The average car today weighs 4 000 pounds. Changing body structure, by means thoroughly understood at the present time, could effect a weight reduction per car of about 600 pounds. A further 400 pounds could also be removed with relative ease. Just by changing the weight of cars, and carrying out small modifications by means of existing technology, gasoline consumption could be maintained at current levels for some 15 years, even assuming a 3 per cent growth in the number of cars on the road every year.

A desirable target for 1985 would be to double today's average mileage of 17.5 miles per gallon. Recourse must be made to technology to find solutions to the problems inherent in the trade-off between more efficient burning of gas and protection of the environment. Moreover, the present ineffective tax on car weight could, for example, be considerably increased and made to apply not just to a very small number of units, as is the case now, but to all cars considered inefficient by reason of weight.

Residential and commercial building codes should undergo change so that standards for thermal insulation would be raised. If such standards were made to apply to existing structures (including retrofitting of the million or so houses which are badly insulated or not insulated at all), energy consumption in the mid-term future could actually drop. Such retrofitting, which would be an expensive conservation program, is still calculated by experts to be profitable.

Conclusions

Energy is the ultimate resource. Given sufficient energy, we can obtain supplies of all the other resources. Even if zero population growth becomes a reality in the foreseeable future, Canada's energy requirements will probably continue to increase. The raising of living standards and the need for further industrial development will put increasing strains on the country's energy resources. In the past, projections and analysis of energy needs have been based upon present trends. The experience of the last few years suggests that we can no longer assume the continuation of present trends. Exact energy requirements in the future are not clearly definable but we do know for certain that these requirements will severely strain our economic and technological capabilities.

In the future, more energy will be used as electricity. However, nuclear energy might be utilized only gradually between now and the year 2001, given the tremendous financial and security problems which could inhibit its development. While there is guarded optimism on engineering, there is considerable concern that the necessary facilities might not be completed on time. Supplies of essential materials could act as constraints unless a system of priorities is instituted. Skilled labour and competent technicians are in short supply. The provision of capital may be associated with conditions that are unacceptable to the Canadian population.

Clearly, the most critical source of energy for the next 25 years will be fossil fuels. The former highly optimistic views of Canada's "limitless" resources now sound hollow. Recent investigations have revealed that even short-term supply data are alarming. The whole picture appears to be darkening. In view of the special functions of petroleum (e.g., chemical feedstocks, transportation and agriculture), any uncertainty in the supply of crude oil is critical. Among other things, we know that our limited non-renewable resources cannot be maintained at present price levels – scarcity will intervene and prices will rise. Likewise, the impact of any novel technology is uncertain. Experts have expressed pessimism in this regard. A critical energy supply situation is now developing despite reduced oil and gas exports.

Although new potential fossil fuel sources in Canada's frontier areas presently appear to be abundant, we have grave reservations about Canada's capacity to meet the huge economic and environmental costs involved in getting supplies to southern markets. Even if sufficient capital is available, ecology could be the ultimate constraint.

By 1990, there will be a drastic change in the net oil supply situation of today. There will be an enormous gap between supply and demand. Thus, by the year 2001 we may be dependent for energy on politically unstable foreign supplies. We need to conserve our own available supply. It should be treated as a critical and strategic national resource to be used only when needed.

- **A concerted and greatly strengthened national effort should be made to conserve energy through higher energy prices (more nearly reflecting true costs), greater technical efficiencies and a major program to reduce demand, but this should not be enforced to the point of preventing desirable economic growth.**
- **A new prompt and intensified effort should be made to quantify our energy resources in the light of the considerable present supply uncertainties.**
- **Prudence should be exercised in the planning and especially scheduling of huge energy delivery systems, because of their very high cost, environmental effects, long construction times and their impacts on human and material resources. There is an urgent need to satisfy public doubts about the safety of nuclear power plants.**
- **Studies should be initiated to evaluate new energy resources: solar, geothermal and wind. Demonstration projects should be funded to test out their economic viability and to estimate the possible extent of their future use.**

IX. Capital Needs — Can We Afford the Future?

Estimates of Canada's capital needs in the next decade have increased from about $500 billion (current) in the spring of 1974 to about $700 billion last summer to even higher figures now. The Economic Council of Canada has emphasized the difficulties we will experience in obtaining capital in the future: "Capital needs for the period from 1975 to 1985", the Council argues, "will total between $800 billion and $860 billion (current dollars), depending on the extent of the development of natural resources and the external environment."[1]

While foreign sources accounted for some 16 per cent of total savings in 1975, which is considerably more than they have averaged in the past decades, they are estimated by the Economic Council to remain high at least until 1985, when they should be in the range of 10 to 17 per cent of savings. Given that the Economic Council has projected investment to rise from 23 per cent of GNP in 1975 to approximately 27 per cent by 1981, and given that investment comes from and must equal savings, it follows that importation of foreign savings could reach well over 4 per cent of GNP in 1981, a huge figure. There has been a precedent however: in the very high investment years of 1956–67 (27 per cent of GNP), similar exceptionally large foreign imports were found (4.2 per cent of GNP).

It is not at all certain though that such high sums can be secured from international money markets. The Americans, for example, are now faced with an investment need at least as proportionately demanding as ours (much of their urban infrastructure is in worse state) and, given their greater absolute demand for funds, might themselves absorb a very large part of the total savings internationally available. Some recent political events have also cast a shadow over the Canadian investment climate. Furthermore, there is internal resistance to massive capital imports in the form of equity: the passage of the Foreign Investment Review Act testifies that Canadians will not welcome all foreign investment uncritically.

Even with a fall in the growth rate of our economy from an average of 5 to 5.5 per cent during the 1960s and 1970s to approximately 4 per cent during the 1980s, the additional and major share of investment that will have to be provided from domestic sources will be very considerable and will represent a big effort even for Canada, where the savings rate is exceptionally high – between 21 and 23 per cent of GNP. Were this historic level only to be maintained and not exceeded, it would still mean that corporate, government and personal sources of savings will have to resist the pressures now being brought to bear on them (quite apart from the influence of anti-inflation programs):

– In the business sector, part of corporate savings comes from profits in the form of retained earnings, and yet a strong current of Canadian thought – as exemplified by the "corporate rip-off" political theme – seems inimical to corporate profits, all the more so when they are high.

– The other source of business savings, capital consumption allowances, will only retain its share of total savings if disproportionate sums do not have to be put aside to replace obsolescent equipment with sophisticated new plant, and if fast write-offs are not discouraged.

– In the government sector, there can be a bias in favour of programs which stimulate current consumption as opposed to investment.

– The problem in the personal sector is providing sufficient incentives to save in a time of inflation when savings are habitually ravaged.

The question could be asked why, if capital is to be scarce, should we not admit sufficient immigrants to provide the high labour force growth that is also conducive to high rates of economic growth? There should be no shortage of potential immigrants.

In any industrial structure, capital intensity and labour intensity tend somewhat to be mutually exclusive; and there are those who believe that our comparative international advantage lies in resource and energy development, which is highly and increasingly capital (and not labour) intensive. While real, this ability of capital to offset labour in contributing to economic growth must not be exaggerated. To some degree, a capital-labour complementarity obtains in certain industries, in that greater capital investment is accompanied by greater employment opportunities. Nevertheless, Canada's economy is *inherently* capital intensive for reasons which include:[2]

– our geographically dictated emphasis on transportation and communications;

– the present importance, just mentioned, of primary resource industries;

– the large seasonal climatic variations which make inevitable the handling of large seasonal peak loads (as in heating and transportation);

– the limited size of the markets to which we have access, for in them capital tends to be used relatively inefficiently (short production runs, etc.).

The Science Council has therefore concluded that Canada is likely to need a great deal of capital in the decade ahead, and that this capital will be hard to raise. This, however, we must strive to do. We will need to increase our savings and reduce the current level of our consumption of goods and services – in government and the private sector. Canadians should recognize that we live in a capital-intensive society and that we should no longer rely on immigration to regulate the economy.

- **Canada's rate of domestic savings must be maintained at a very high level.**
- **We should attempt to fund our investment needs as independently of foreign sources of savings as possible.**
- **In accepting foreign investment into Canada, relatively little should be admitted in the form of equity.**

Epilogue

Canada is more fortunate than most countries in the degree of flexibility available to it; in its ability to adjust to change. At this time, because of its resources of minerals, food, land and energy, and because of its small population, it is still in a position to exercise major policy choices.

However, although Canada is relatively rich in resources, it is a comforting and popular myth that these resources are virtually unlimited. All serious opinion now points to their finiteness, particularly in the energy sector.

In addition to energy, it is becoming clear that pressures both on arable land and for food production may impose severe limitations on future policy options. This is due to a variety of factors, including climatic variability, continued urban sprawl, and limitations in technology and capital.

A further limitation relates to the expectations of Canadians themselves. While it is becoming evident that Canadians may be prepared to forego a lifestyle based on conspicuous consumption, it is nevertheless realistic to assume that they are only prepared to espouse goals which would imply a standard of living not substantially lower than current levels, including the right of all to work, a secure environment, and opportunities for recreation and creative living.

In view of these limitations, and having reviewed our policy options, this report concludes that Canada has a need to control population growth at a conservative level and to organize more effectively our utilization of energy, land and manpower.

We believe that the greatest contribution Canada can make in the international context is to moderate its own population growth, in order to strengthen its position as a net exporter of food and food related products, services and technologies, at prices as reasonable as possible. By exporting food, other goods and technology, we believe that Canada can contribute to the alleviation of the world population problem more effectively than by permitting uncontrolled immigration. Even with the most generous immigration policy, Canada could only hope to accommodate such a small fraction of the over-population of other countries as to be insignificant.

We are today in possession of most of the technology that will influence the direction of our lives over the next 25 years. However, decisions concerning the use of these technologies must be implemented almost immediately if we are to shape the course of events and the position of Canadians in the year 2000.

We have to create the economic climate necessary to utilize these technologies for maximum food production. This implies that instead of responding to short-term market demand, we must evolve a comprehensive incentive program designed to encourage the Canadian food producer to increase output to keep pace with rising demand. Not only would such a policy serve to fulfill our international obligations, it would also contribute in a major way to the maintenance of our national balance of payments over the next two critical decades.

We must also be prepared to plan urban development as well as social services in the light of predictable changes in our population

structure. Immediate priority should be given to changes (as in manpower training) required in the provision of health care for the elderly.

There is obviously no one indisputable and simple answer to the complex questions that arise in planning the Canadian future. Canadians are fortunate in having choices at all. We must, however, exercise these options now if we are to avoid a situation in which we have to accept a severe curtailment not only of our standard of living, but also of our personal and national sovereignty.

General Recommendations

The principal recommendation of this report is that Canadian population growth should be slow. The country should adopt a long term population policy to achieve this slow growth. An initial target of 28–30 million for the year 2000 seems reasonable, assuming that the fertility rates remain between 1.8 and 2.1. An annual net immigration (immigration minus emigration) of about 50 000 per annum would achieve this goal. However, since we are not yet certain why fertility has dropped and have no sure way of controlling it, immigration programs should be reviewed at least every five years to be sure that the chosen goal is achieved.

The reasons that have led the Council to recommend slow population growth include the following:

- Canada as a whole, and especially the industrial heartland of Ontario and Quebec, face quite severe difficulties in meeting their short-term energy requirements, especially oil and gas, and will probably have trouble meeting their energy needs for many years to come.
- The population around cities, especially Toronto and Hamilton, is spreading onto the very small amount of good agricultural land in a suitable climate that is available in Canada. Reversing this trend will require careful land use planning and rigid control of agricultural land, plus economic incentives for farmers, to ensure that land that is protected for agriculture is actually used for growing food.
- Metropolitan centres can and should absorb further population through in-building without extending their boundaries, in order to minimize the occupation of good agricultural land, and transportation and other costs.
- Even with effective land use control, Canada will have to use food more carefully if it is to maintain its position as a major food exporter.

Appendices

Appendix A – Perceptions Volumes

1. Science Council of Canada, Perceptions 1, *Population Growth and Urban Problems,* by Frank Kelly, Information Canada, November 1975.
2. Science Council of Canada, Perceptions 2, *Implications of the Changing Age Structure of the Canadian Population,* by Lewis Auerbach and Andrea Gerber, July 1976.
3. Science Council of Canada, Perceptions 3, *Population and the Preservation of Agricultural Land,* forthcoming.
4. Science Council of Canada, Perceptions 4, *Food Production in the Canadian Environment,* forthcoming.

Appendix B – A National Rating System for Agricultural Land

Canada's potential agricultural land has been surveyed and classified by the Canada Land Inventory (CLI). Class groupings have been made province by province and range from Class 1 to Class 6. The first three classes are considered capable of sustained production of common cultivated crops, the fourth is marginal for sustained arable culture, the fifth is for permanent hay and pasture and the sixth for wild pasture only.* Productivity under good management can be significantly higher in Class 1 than Class 4 – approximately twice as high.†

Land in CLI Capability Classes (million acres)‡

All Canada	1	2	3	4	5	6
294	12	43	68	64	70	37

When comparing land on a national scale the CLI classification does not sufficiently allow for the influence of climate. An Agroclimatic Resource Index § was established in 1975 at the request of the Science Council to evaluate climate as a resource for agriculture. The Index is a function of the yearly frost-free period with adjustments in the Prairies and British Columbia for inadequate moisture and in coastal areas for decreased degree days in the growing season. This index was combined with the land classification system to develop an overall rating which allows land in one part of Canada to be compared directly with land in another part in terms of agricultural productivity. When the various provinces were compared by means of this rating, there were surprises. Although Saskatchewan currently has four times as much farmland as Ontario, the agricultural land resource base of Saskatchewan was found to be only twice that of Ontario when soil differences were taken into account. When climatic differences were also considered, the Council calculated that Saskatchewan had a productive potential only slightly more (about 26 per cent of Canada's total agricultural potential) than Ontario (with some 22 per cent).

*Environment Canada Lands Directorate, *Canada Land Inventory Report 2*, Ottawa, 1972.

†D. Hoffman, "Utilizing Ontario's Land Resources", *Notes on Agriculture*, January 1975, vol. 11(1), pp. 12 – 14.

‡Alex McKeague, "Inventory of Canada's Land Resource", *Agrologist*, September 1975, vol. 4(4), pp. 10 – 13.

§G. D. V. Williams, Agrometeorology Service, Chemistry and Biology Research Institute, Research Branch, Agriculture Canada, December 1975.

Appendix C – Projected Energy Demand by Sectors

The sectors in which energy is consumed are expected to increase their demands at different rates, some of them showing a clear dependence on population growth.

In the *residential* sector, the increasing spaciousness, size and standards of comfort in some homes tend to be counterbalanced by a transition toward apartment units and by a greater efficiency in using energy. Increases in energy consumption are determined largely by population-related increases in the number of households.

Demand in the *commercial* sector is also correlated closely with population and especially number of households. Mainly as a result of rapid growth in service industries, commercial sector energy use doubled between 1960 and 1970; however, recent growth rates have been more modest.

The Household-Commercial or Residential-Commercial sectors are usually combined because of data limitation. In the period 1960–1970 the size of household decreased from 4 to 3.6 persons. The numbers of households, however, increased in the same period from some 4 500 000 to approximately 5 800 000. The rate of household formation will probably increase into the 1980s; however, in the very long run both size and number of households should decrease. A possible scenario indicating a reduced relative energy requirement for the combined residential-commercial sector is in Table C.1.

Table C. 1 – Size and Number of Households

Year	1975	1990	2001
Size of household	3.4	3.1	3.1
Households (*000*'s)	6 703	8 413	9 508

Changing lifestyles may mean more single-person households and explain the decrease in the average household size. Alternatively, a trend toward a communal lifestyle might develop, but this would only reinforce the trend toward relatively lower energy requirements.

The *transportation* sector, which represents about 15 per cent of the gross national product, is dominated by automobiles; energy consumption is predominantly in the form of petroleum products. Canada's transportation systems will probably expand selectively and become more integrated and complex. However, there is considerable room for improvements in technological efficiency, users' attitudes and management. Based on this assumption, transportation demand is expected to remain in an almost constant ratio to total energy demand. The substantial energy losses occurring during the transportation of energy are distributed proportionately to energy end-uses in the sectors.

The *industrial* section draws upon all forms of energy (e.g., coal, oil, petroleum products, gas and electric power). The rate of growth in energy demand for this section depends primarily on the level of economic activity (e.g., as measured by the GNP) and increases in per capita personal income. In the period 1975–2001 the average growth rates of GNP and real disposable income per capita are expected to be 3.5 and 3.0 per cent respectively. Table C.2 summarizes our findings.

Table C. 2 – Summary of Findings on Energy Consumption

Sector	1975		1990			2001			
	Share of Total (%)	Energy (Quads)	Share of Total (%)	Energy (Quads)	Average Annual Growth 1975–1990 (%)	Share of Total (%)	Energy (Quads)	Average Annual Growth 1975–2001 (%)	Average Annual Growth 1990–2001 (%)
Residential/Commercial	35	2.25	31	3.04	2.3	29	3.50	2.1	1.4
Industrial	38	2.44	41	4.02	4.3	42	5.06	4.1	2.4
Transportation	27	1.73	28	2.75	3.9	29	3.50	3.9	2.5
Total	*100*	*6.42*	*100*	*9.81*	*3.5*	*100*	*12.06*	*3.4*	*2.1*

Appendix D – Projected Oil Supply and Demand

Supply (000's bbls/day)	1975	1990	2001
Conventional Oil	1 439	500	300
New Oil in Established Areas	0	175	200
Oil Sands open pit	44	365	1 050
in-situ	0	100	200
Low Certainty Supply	0	600	2 000
Pentanes Plus	151	75	65
Total Supply	*1 634*	*1 815*	*3 815*
Total Consumption	1 750	2 127	2 565
Deficiency	116	310	–1 250
		910*	750*

*Deficiency without availability of low certainty oil supply from frontier areas.

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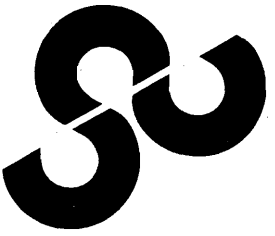
Science Council
of Canada
Report No. 25

July 1976



Population, Technology and Resources

SUMMARY

Policies for the use of science and technology are essential to the formulation of a national population policy. Such a policy must be based on a careful examination of the interrelationships of population, technology and resources. The United States National Academy of Sciences has also used this approach in its 1975 report of the Committee on Population and Food.

Population, Technology and Resources has addressed the range of resource questions in addition to identifying some of the scientific and technological constraints on population growth in Canada.

As a result of this review, the Science Council of Canada draws attention to the very considerable uncertainties bearing upon the extent and upon the realization of our resource potential and is conscious of the pressures likely to develop in respect of them. As a consequence, we feel that flexibility is mandatory and that we must strive to develop and maintain a wide variety of policy options. Within this context, we recommend a reasonable but limited population growth for Canada, and suggest that immigration levels should be reviewed on a five yearly basis.

THE RECOMMENDATIONS

- **Range of Population Options**

– Canada should adopt a long term population policy, designed to achieve slow and orderly growth while admitting a degree of flexibility.

– A process of continuing review of desired immigration levels should occur and a full policy review be undertaken once every five years.

- **Changing Age Structure**

– Chosen immigration levels should be in line with Canada's overall demographic objectives, and not be set solely to tide the country over short-term economic developments.

– Society must prepare for the meaningful and active participation of a considerably larger proportion of elderly people. This will require not only better access to goods and services but also opportunities for useful part-time employment.

– Adequate numbers of trained people must be provided to give good health care to the increasing number of elderly people. Policies must be adopted which will foster alternatives to custodial, institutional care – such as in-home and community services.

- **Work**

– All Canadians should have some work and some leisure. This could mean increased labour participation rates, later retirement, and more of the working year being devoted to leisure and self improvement. The exclusive seasons in life for learning, earning and repose can be changed.

– Much imaginative new thought should be given in Canada to the sociology of work – a neglected field.

– Our society's "traditionally unpopular jobs" should be transformed to become more attractive. Canadians should themselves prepare to fill those that remain, and not count on immigrants to do so.

- **Urban Policy**

– Urban areas can and should absorb further population growth without taking up much more land. Good design can decrease the sensation of crowding without undue risk of higher pollution.

– Growth of low density urban communities onto good agricultural land should be stopped.

- **Agricultural Land Use**

– The elaboration of local, regional, and provincial policies and mechanisms for land use planning and control, and the synthesis of these into a national policy is urgent.

– Our best agricultural land, in terms of soil and climate, must be designated for agricultural purposes only. This is the responsibility of the provincial governments, and it should be done immediately in Ontario and probably also in Quebec. The British Columbia precedent should be studied. The issue of adequate compensation must be resolved.

– In order to have land farmed and not just saved for farming, and in order to improve rural life generally, agricultural land planning should have as high a priority as urban land planning. Suitable levels of maintenance should be required of land owners.

- **Food Supplies**

– Research to intensify production on current farmland, conserve scarce resources and develop environmentally appropriate techniques is essential.

– Food fit for human consumption should not be fed to animals; every effort should be made to find alternative markets.

– The country should plan to intensify food production and make provision for its appropriate storage and transportation.

- **Energy**

– A concerted and greatly strengthened national effort should be made to conserve energy through higher energy prices (more nearly reflecting true costs), greater technical efficiencies, and a major program to reduce demand; but this should not be enforced to the point of preventing desirable economic growth.

– A new, prompt and intensified effort should be made to quantify our energy resources in the light of the considerable present supply uncertainties.

- Prudence should be exercised in the planning and especially the scheduling of huge energy delivery systems, because of their very high cost, environmental effects, long construction times, and their impacts on human and material resources. There is an urgent need to satisfy public doubts about the safety of nuclear power plants.

- Studies should be initiated to evaluate new energy resources: solar, geothermal, and wind. Demonstration projects should be funded to test their economic viability and to estimate the possible extent of their future use.

• **Capital Needs**

- Canada's rate of domestic savings must be maintained at a very high level.

- We should attempt to fund our investment needs as independently of foreign sources of savings as possible.

- In accepting foreign investment into Canada, relatively little should be admitted in the form of equity.

INTRODUCTION

Although the current capability of science and technology to contribute to population growth in Canada could be increased through a concerted effort in research and development, the country is not yet well prepared to cope with predictable population growth for the next 25 years – even if immigration is limited. Also, contrary to popular belief, Canadian resources, land, and energy supply are decidedly finite. These are serious constraints.

Short-range energy problems have not been solved. Planning and research for long-term supplies have hardly begun. Prime agricultural land with good climate is generally unprotected from encroachment by development. Science and technology are fundamental components of natural resource management, ensuring our own future food supply, resolving urban and transportation problems, and satisfying the needs of an ageing population. These issues require urgent attention.

This report is concerned as much with the behaviour of people as with their numbers – what they consume, what they waste, and so on. Though the aspirations of Canadians, and the way science and technology can help to achieve them, are central to the report, international population pressures have conditioned the thinking of Council. Two dangerous world trends continue: the rich are getting richer and the poor more numerous. A growth moratium on exploding material living standards is just as urgent as one on exploding populations.

Canada can help by becoming a conserving society using food, energy, and resources responsibly and frugally, and avoiding waste. Within the framework of moderation, technology can be used to permit a wide choice of lifestyle. Exclusive emphasis on a "soft technology" future could be misplaced at this time, however.

Probably the most effective long-term solutions to Third World food problems have important scientific components, including the transfer of science and technology through rural development programs to increase food production in developing countries. Meanwhile, and probably for a long time, these countries will need to import food. Grain stocks will be needed as security against famine.

Canada can never solve the world problem of over-population. An effective international role is more likely to consist of exporting food than of attracting large scale immigration: to support this policy we need to concentrate upon the intensified application of technology to food

production. This policy is particularly to be commended when there exists palpable uncertainties as to the extent of our resource base and as to our potential productivity. It is vital that we keep our options open, and minimize the pressures on our capacity.

This report treats "areas of concern" of the next 25 years for which decisions are needed and to which science and technology can contribute (e.g., urban problems, land use, changing age structure).

There is no scientific answer to the size, source, age structure, and distribution of Canada's population in the future. Science can help define the possibilities. What kind of future Canada do we want? The answers depend on our national self-image and aspirations.

THE ARGUMENT

- **Range of Population Options**

Canada's population could increase to a minimum of 26 million by 2001 due to the disproportionately large number of young people. This will happen despite fertility rates being below replacement level, even if net immigration were reduced to zero immediately. Thus the only way to effectively limit population growth and achieve our demographic objectives is to restrict immigration. However, unless many young immigrants are admitted, Canada's population will age progressively. The social and economic consequences of the changing age structure need to be considered now.

Population distribution is uneven in Canada. By 2001 almost one third of Canada's population is expected to live in Montreal, Toronto and Vancouver. Most of the overall growth will be in urban areas.

- **The Changing Age Structure**

The long-term decline in fertility and the post-war "baby boom" will significantly alter Canada's age structure. The increase in numbers of elderly persons will not be uniform over the next 50 years because of the below average birth rate during the Depression. A succession of smaller population waves, spaced about 25 years apart, may follow the baby boom. Moderate variation in immigration levels will not influence these long term trends to any great extent. We must make provisions for a relatively smaller school age population, a larger and progressively older potential labour force, and a still larger elderly population.

By 1985 the bulk of the baby boom will have been absorbed into the labour force. Thus, after 1985, immigration levels will again exert a marked influence on the rate of growth of the labour force. Canada has in the past relied heavily on immigration to meet specific employment needs. Now we must face the challenge of using our domestic labour supply in an optimal manner.

In view of the need for this optimization, neither increased nor reduced immigration levels should be used to accommodate short-term economic developments. Employment of a special kind has to be created so that Canada does not become committed to special, labour-intensive industries which cannot be sustained when the rate of increase in the labour force falls to a permanently lower level.

There has been an upsurge in housing demand since the mid 1960s because the baby boom cohort is now at the age of family formation. The demand for single family homes has been far stronger than was anticipated. Housing is being provided; but it is often inflexible in design – a technical difficulty which should and can be readily addressed – and its location could lead to future transportation crises. Our response to an acute short-term housing pressure may jeopardize rational planning for long term needs.

An automobile-oriented transportation pattern will develop. This trend will be extremely difficult to change, unless immediate transit solutions can be found for areas beyond the existing urban limits (where 50% of new housing will be built). Transportation is currently planned for working people. In a society with rapidly increasing numbers of elderly people, more attention must be paid to the latent demand for transportation and to the way technical advances or applications could satisfy this demand.

By the turn of the century, the bulk of the baby boom will be middle-aged and more and more prone to acute illness. More than 3/4 of the over-65 population are already afflicted with some form of chronic illness. An increasing proportion of medical work will be concerned with the care of elderly people.

Most of our resources have been devoted to the treatment of acute illness. We have neglected well-structured preventive and care programs. We need to encourage better home care services, the adoption of a systems approach to health care, and the integration of all levels of services.

- **Work**

Canada is second only to the U.S. in the proportion of the work force engaged in producing services, yet our resource extraction base is larger and manufacturing base smaller than most other developed countries. Substantially more resources will need to be extracted in the future, a goal that will call for significant advances in existing extraction technologies.

We have always relied on immigrants to fill a high proportion of the menial jobs of resource-based employment. Limiting population growth will force us to turn to work we have shunned in the past.

Negative factors like perceived pointlessness, authoritarian management, and rigid hierarchical structures must be removed to encourage more people to participate in the work that must be done. Another consideration is that as the labour force ages, we might tend more and more to resist change and innovation – scientific or otherwise. Then, early retirement may not prove to be economically wise; it could be interpreted as a conspicuous waste of human resources. Opportunities for useful part time employment for the elderly are needed.

- **Urban Policy**

By the end of this century, 90% of our population will be living in urban areas. Over 32% will be in Montreal, Toronto and Vancouver. Canadian cities with populations of between 400 000 and one million are expected to grow proportionately more rapidly than smaller ones. Several cities will double in population within 30 years. These differential growth rates imply an acceleration in the westward displacement of the urban centre of gravity.

There will be a disproportionately higher demand for housing in the rapidly growing cities. Urban sprawl and transportation problems will result if many of these homes are single-family detached dwellings – something most home buyers still seem to demand.

Domestic population growth, to coming-of-age of our "baby boom", and internal migration are factors influencing urban changes in Canada. By 1985, 90% of all the new housing units required to the end of the century will have been built. We will need to develop technologies which will permit smaller viable economic units, thus broadening options for locating industries.

Growth centres should be few and fairly large – with the diversity and autonomy of existing metropolitan areas.

Living and working areas should be intermingled to reduce the need for urban travel and to diversify land use so that downtown areas do not become the exclusive domain of office buildings and parking lots. Land use planning will eventually have to be done within a national plan or national urban policy. As most urban land is privately owned, there is a necessary contradiction between the idea of private ownership of land and public planning. Municipalities have a substantial fiscal dependence on real estate tax, so commercial and private proposals which promise high tax yields are often favoured over public amenities. Overall, it would be better if economic considerations could play a less decisive role in decision making on urban planning.

- **Agricultural Land Use**

Serious conflicts arise between the use of land for agricultural purposes and its use for other development. It is not generally realized that only 13% of our land area is suitable for some kind of agricultural production, and that less than half of this is capable of sustained production of common field crops. Only 19% of 55 million acres of total agricultural land is prime farm land; almost all of it is currently in production. About half the farm land losses to urban expansion have been coming from the best one-twentieth of our farmland. For example, between 1966-71 almost one-tenth of the improved farmland in Southern Ontario was lost to agricultural uses. And most of the farmland which has fallen idle since 1951 is being held in reserve for future urban expansion.

Issues Related to The Loss of Agricultural Land

Agricultural land, in agricultural use, cannot command prices comparable to those it would have in almost any urban related use. The market mechanism cannot be counted on to protect such land from development.

Irreplaceable specialized agricultural land (e.g., land for soft fruit production) continues to be lost.

Dependency on prime land in the warmest areas of the country is likely to grow because the climate could soon become less favourable to North American agriculture and western lands are most vulnerable.

Urban air pollution jeopardizes the productivity of prime agricultural land.

Marginal land will become even more economically marginal as energy prices rise.

As the world demand for food increases, Canada's farmland will become an increasingly vital global resource.

Measures to Preserve Agricultural Land

Designation of our best agricultural land *as* agricultural land is urgent.

Rural land use planning should have the same priority as urban land use planning.

Future growth of metropolitan areas must often be accommodated by in-filling within existing boundaries.

The true social cost of rural non-farming residents in farming communities lying beyond the urban fringe should be assessed.

Economic incentives to farmers must be substantially increased to ensure continued growth in food production.

Obligations of land ownership should be recognized and suitable levels of maintenance should be required of owners.

- **Food Supplies**

Canada should remain an important food exporting nation. As well as helping to meet the growing world dependence on North American grain, food exports should prove of major benefit to our balance of payments. Were our eating habits brought more into line with nutritional guidelines, more Canadians could be supported by our agricultural system, or more food could be exported.

It is generally agreed that agricultural production in Canada could be doubled over present levels. Existing farms can increase production through better management and the full use of existing technologies. However, increased fertilizer use no longer pays the dividends it once did.

Marketing uncertainties are probably the most important constraint acting against increased food production. Only the guarantees that could be provided by a major national agricultural program could lead to a rapid increase in production.

Significant gains can also be advanced through waste reduction. Food fit for human consumption should not be fed to farm animals. Ten to sixteen pounds of grain is currently required to produce one pound of beef – a highly profligate practice.

Agricultural operations can be wasteful of energy, as in feedlots. Animals are often overfed; their manure goes to waste, and sometimes causes water pollution.

- **Energy**

Canada has traditionally been one of the most energy intensive societies in the world. Our hostile climate, transportation needs, and the abundance of inexpensive energy favouring the development of energy intensive activities are among the reasons for this. And total demand will continue to grow.

The total energy requirement for each additional million people in 1990 will be 0.37 Quads. Assuming that one barrel of oil will cost $20, the cost of importing energy in 1990 will amount to $1.3 billion for every additional million people.

Our known reserves of oil and gas are less than were estimated five years ago. There must eventually be a transition to new forms of energy to substitute for gas and oil. Given sufficient energy, we can obtain adequate supplies of all other resources.

Canada's energy requirements will continue to increase *even if* zero population growth does become a reality.

The most critical source of energy for the next 25 years will be fossil fuels. Recent investigations have revealed that even short term supplies are alarmingly limited. Prices should therefore be substantially increased to ensure conservation.

- **Capital Needs – Can We Afford the Future?**

It is now estimated that we will need over $800 billion current dollars to fuel our economy in the next decade. It is doubtful if large amounts of capital will be obtainable from international money markets. So we will have to fund most of our investment needs from our own sources. This will be a difficult undertaking.

Savings must increase. The share of current consumption of goods and services in the government and private sectors must decrease.

Canada should accept itself as a capital intensive country and forego its habitual dependence on immigration to help regulate the economy.

EPILOGUE

Arable land limits, food production constraints, and energy availability may impose severe limitations on future policy options.

Canada can help alleviate the world population problem more effectively by exporting food, other goods, and technology than by permitting uncontrolled immigration.

A comprehensive incentive program to encourage the Canadian food producer to increase output should be established.

Urban development and social services should be planned for predictable changes in our population structure.

Changes are required in the provision of health care for the elderly.

Planning the Canadian future must begin now to avoid severe curtailments in our standard of living, and constraints on our personal and national sovereignty.

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