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Energy approaches for a liveable planet

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"No other large animal has ever lived on earth in such numbers as the present population of human beings. No other animal has adapted itself to such a wide variety of climatic and geographic conditions, and no other animal has used earth's resources so extravagantly. The very skills which make possible this narrow, technical success, in which man-kind overspreads the earth and busies himself in wide-ranging activities, these skills, I repeat, make man also the most dangerous of animals. The greatest danger arises from the heavy demands that human beings make upon the environment. All other animals together have a less disruptive effect upon the environment than man.

There is yet another danger stemming directly from the ability of human beings to survive and adapt. People are, in fact, capable of living under conditions which give rise to destructive frustrations, hostility and cruelty. Thus, the remarkable capacity for survival and adaptation enables human life to continue even when it becomes degrading. People crowd together in human settlements which have no sense of community, in which mutually satisfying human relationships have largely ceased to exist, and in which even the notion of beauty has been lost. In other words, man reverts to living like one of the lower animals without having the benefits of natural adaptation to a specific environment.

The problem of human settlements in the final years of the Twentieth Century - which is central to this conference - is obvious. Will the human adventure

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culminate, perhaps terminate, in nothing more than an aimless swelling of population and the building up of habitations in which the sense of fellowship, of human community, is less than in the caves of our distant ancestors? Surely we have reached a point in history where our wisdom must take over and direct our technology towards something more than mere survival in a world degraded by activity for activity's sake. We must, therefore, see the problem of human settlements as a problem of choice and of common will rather than as a merely technical question.

When I emphasize choice before technology, I am saying that we have some real options at this point in history and that we can do something other than develop more techniques for building and operating huge cities.

Consideration of the problems of human settlements has concentrated upon the development and organization of huge cities because our thinking - and our planning - are typically dominated by the analysis of past and current trends and geared to growth. These trends show that we are now experiencing the most dramatic change in the distribution of population that has ever taken place - the shift from a predominantly rural to a predominantly urban way of life. It is anticipated that by the year 2000, perhaps three-and-one-half billion people will be dwelling in urban areas. Typical planning procedures indicate that we address ourselves to the task of creating liveable cities. A broader view of the immediate future, a view based upon the importance of choice, indicates that we should now consider how other patterns of settlement could meet the needs of the people now flocking towards the cities. Obviously, planning for choice involves deeper levels of questioning - questions about the social and economic influences which draw people towards cities; questions also about the conditions which enable people not only to survive but to live with a sense of self-worth and mutual respect.

I do not suggest that we can disregard the current trends, for it is quite clear that no effort of planning and development could suddenly halt the rush to the cities. However, if we do not immediately begin to think and plan in terms of alternative choices, the only force that will ever halt worldwide urbanization will be the collapse of the cities themselves, a collapse already happening in certain cities.

Whatever patterns of settlement develop by the year 2000, those settlements and

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the range of human activities occurring within them will be dependent upon diverse and vast supplies of energy. The technology which makes a massive human population possible and the technology which enables a wide range of settlement patterns, is a technology which produces and uses huge amounts of energy. People live under extremes of climate and enjoy such a prodigious range of activities - even the activity of gathering for a worldwide conference such as Habitat - because people make use of energy in such vast and various ways. As Chairman of Canada's new national energy corporation, Petro-Canada, I am concerned with present problems of energy supply and I am even more concerned with the future demand for energy. In considering the energy needs of the future, I once more affirm that we cannot afford to plan on the basis of past and current trends. If we assume that a decent standard of life for the world's people inevitably requires increasing per capita consumption of energy, we are most likely to be planning for an energy-starved world or an ecological disaster - or perhaps both.

Though Petro-Canada is charged with developing new sources of fossil fuels for Canadian use, we are also concerned with the management and utilization of energy. Rather than merely finding new energy, we hope also to contribute to its wiser use. In the light of this concept of the energy stewardship, I will attempt to discuss the role of energy and conservation in the development of human settlements.

I shall emphasize the use of energy for improvement of urban settlements because it is in the big cities of the world that the settlement problem is most severe. The greatest challenge to planning humane, habitable cities for the future arises in the developing countries which are now experiencing the most furious rates of urban growth. With their limited resources, they are little able to cope with the pressure of the urban explosion and, under such conditions, urban problems threaten to become eco-disasters. Recognizing the enormity of this threat and considering that the urban crisis is worldwide, we must also recognize that the planning and marshalling of resources to meet the problem must be worldwide. The organization of human settlements in the next decades will, therefore, require co-ordinated action involving international agencies and programs, national governments, local governments and individual commitment. Though I speak from the point of view of a national corporation and with special reference to energy, I wish to give special emphasis to the importance of planning, in both national and international contexts, and also to planning procedures which recognize the importance of the individual. Our concern with the global scope of settlement

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problems should never blind us to the fact that the final test of any solution to the crisis in human settlements must be measured against effects upon the lives of individuals.

Taking a more limited point of view within the planning framework I have just suggested, it is obvious that urban problems are bound up with the use of energy. The energy needs of vast cities are most evident in the delivery systems that are required as the population multiplies. Urban populations require great quantities of water, food and fuel. Apart from the quantity of energy in the fuel itself, the delivery of these life-sustaining commodities requires a continuou use of energy. Even the physical components of the delivery systems - the steel for pipes, the cement for roads, the copper for wire - are produced through energy-intensive processes. The collecting and processing of a city's waste requires another energy-intensive system - though we sometimes choose a short-sighted saving of energy and, wantonly pollute rivers and lakes instead. Of cours the building of the city itself, particularly the larger buildings, requires much energy. Better urban planning and more efficient processes can save energy, but monster cities must still be gluttonous users of energy.

If we are to make better use of energy in human settlements we must definitely break with past and current trends. Our experience in the recent past has made up wasteful, rather than wise, in the use of energy. In the last fifteen years, world use of energy has approximately doubled. Although energy use has recently increased most rapidly in the less wealthy areas of the world, in Africa and Asia, total consumption in these regions is still only a fraction of what it is in North America. North America now uses about five times as much energy as is consumed in all of Asia, and per capita consumption, is about 24 times higher.[1] It has been estimated that, in 1975, people in the United States WASTED more fossil fuel than was used by two-thirds of the world's population.[2]

The modern pattern has been that no matter how extravagant the style of life, people have sought, and usually have found, the energy to support it. The jet plane makes it possible for executives and middle echelon managers to attend hundreds of meetings a year scattered across continents, or even across oceans, without serious question as to their utility. In northern climates, living and commercial areas have been completely enclosed and heated to shirt-sleeve temperatures in the midst of snow and blizzards. Indeed, in a country such as

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Canada, we have not troubled to implement a distinctive architecture for those of our settlements which are sub-arctic, although our more thoughtful architects have produced appropriate designs. We have preferred increasing use of energy to innovative design or higher initial building costs. This pattern of styling our lives as we wish through the prodigal use of energy is a luxury of wealthy nations, and it is contrary to the pattern of planning and development needed to cope with the expected world urban growth.

We must break from this pattern of rapid expansion in the use of energy and we must stress the conservation and re-allocation of energy. The figures for world energy use previously cited show that the major breakthrough can be made in the rich countries. A 5 percent per capita reduction in European energy consumption would save as much energy as a 54 percent reduction in Africa. Though important energy savings can most readily be made in rich countries, it is still vital for the poorest countries to stress conservation and efficiency of use. From an economic point of view, poorer countries cannot afford to import expensive energy, such as that derived from fossil fuels. Also, the energy saved in one part of the world cannot always be re-allocated elsewhere. Reducing consumption of hydro-electric energy in Scandinavia does not make the saved energy available in another region. Every country, therefore, is vitally concerned with the more efficient use of energy. Even the most modest savings possible in less wealthy nations will be important for their development and their ability to meet the growing needs of their population.

This emphasis on conservation of energy, which is consistent with my view of Petro-Canada as a national energy corporation rests on two convictions. First, as I have already suggested, human life is uniquely dependent upon energy, and there are many people, probably the majority of mankind, whose lives are seriously restricted by lack of energy. Even the most basic improvement in living conditions which are now below minimal standards of human decency will require increased use of energy. Population growth will further increase the demand for energy. Second, I think it would be most imprudent to expect any technological breakthrough which will quickly meet our demand for energy. There will be progress and our technology will yield new ways of making energy available for human use, but that progress is likely to be steady rather than spectacular. If we are thus faced with new needs for energy and if it is vain to hope for sudden technological deliverance from energy shortages, we must remember that

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conservation is the least expensive source of energy. Every unit of energy saved, every increase in energy use which is avoided or postponed, represents an important saving in economic, as well as in environmental terms. Postponing some increases in energy use while meeting other new demands for energy means that energy for luxuries can no longer take precedence over energy for the necessities of life.

Against the economics of saving energy we should set another hard fact. The costs of new energy are likely to keep increasing, and we can be particularly certain that the discovery and development costs of new oil will keep rising rather sharply. I draw special attention to oil because, for many purposes, particularly in transportation, we do not have convenient or feasible substitutes. To the extent that various energy sources are best suited to different kinds of use, a wise energy policy will stress the allocation of energy according to use. We may plan, for example, to reduce the use of fossil fuels in space heating.

The ways of conserving energy and of utilizing alternate energy sources are often quite obvious, but they are critically important if we are to have the necessary energy for the more crowded world of the year 2000. Some examples, first from large settlements and industrialized economies, and later from rural economies, will indicate the range of possibilities.

Industrial societies have often been extremely wasteful because their planning has assumed an almost endless supply of low-cost energy. The capital cost of buildings has been reduced, for example, by minimizing insulation, accepting simplified window design, and not using heat-exchangers in heating systems. Higher fuel costs have now changed the economics of such planning. With heating oil at $16 per barrel, money invested in insulating a home will earn 20 to 40 percent per year in fuel savings - compensating for the added cost in as little as three years.[3]

If some fuels are not only expensive but irreplaceable, the value of better buildings becomes incalculable.

As one example of energy saved in industrial processes, when heat from cement kilns is recaptured to preheat the limestone feedstock, the total energy requirements for the production of cement are reduced by about one-half.[4] The short-sighted energy policies which developed during times of abundance are nowhere better illustrated

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than in a contention of the United States Justice Department, in the 1930s, that paper companies should not be allowed to sell the electricity they could produce by using their process steam to generate power. Today, if all industrial steam were also used to generate electricity, the entire electrical needs of most secondary industries could be met and there would be some surplus.[5]

There are also some very encouraging examples. The State of Connecticut has embarked on a ten-year program which will use 34 percent of the State's solid waste to produce 10 percent of its electricity.[6] Sweden now utilizes about one-third of the waste heat from power plants for commercial purposes; if the United States did likewise, it could save about 5 percent of its fuel. Also, there is now a trend to the design of integrated energy systems in shopping centers and hospitals, so that energy formerly lost as waste heat is used for space-heating, for preheating water, and so on.

The possibilities for conservation of energy are enormous, from the design of automobiles to turning off unneeded lights. Any effective conservation effort will require good planning, more effective government regulations, and individual commitment. Changes in mortgage regulations could provide the incentive for the better design and insulation of buildings. Transportation systems using mini-buses and public-use automobiles can provide alternatives between the energy-wasteful reliance upon private cars and mass transit.

Again, governments can provide incentives with tax credits and licensing regulations as well as by planning city streets with public vehicles, rather than private ones, in mind. If we can get away from the idea that parking the car downtown is some kind of basic right, methods of transporting people will change. All these remedies have been possible for a decade. When will the commitment of citizens be sufficient to spur governments into action?

It is urgent to replace some uses of fossil fuels. The most obvious alternate energy source is the sun. Using present technologies, solar energy seems best suited to individual applications - space and water heating for buildings - rather than to large-scale solar installations for the generation of power. The principal limitations on the use of solar energy are that it is energy of low intensity and it is intermittent. Thus, it is not practical to design a solar heating system to carry the full heating load of a typical building as, doing so, would mean building a large system which operated much of the time at only a fraction of its capacity.

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Energy storage is also difficult, requiring comparatively large installations if solar energy is to be stored up for use at night or on the coldest days. The possibilities vary with the climatic conditions. A solar house in Albuquerque, New Mexico, was designed to use solar energy to meet from 70 to 87 percent of the load for space and water heating. In Denver, where winter temperatures may be below -30 degrees Celsius, solar energy met 26 percent of the heating needs of an early test house.[7] Solar energy systems may also be used for industrial space heating, and it has been estimated that using solar energy to preheat water will enable industries to generate three times as much steam per unit of high-grade energy - such as coal - used.

Solar energy may also be used in less wealthy countries, but given the high capital costs of man-made solar collection systems, it is well to remember that the process of photosynthesis in plants is the fundamental means of capturing solar energy. There has recently been much work in the development of faster growing species of trees, in reforestation, and in the controlled cutting of trees for fuel. While this work is also important in the struggle against soil erosion, the cultivation of green plants as energy sources will become more important with every passing year. A time-honoured method of using the energy stored in green plants is by feeding the plants to animals and then harnessing the animals for work. Animals are not efficient energy converters however, and there are more direct methods of getting out the energy captured by green plants. Biogas digesters are an application of intermediate technology which is low-cost and suitable for small-scale applications. Methane produced from the process of bio-gasification can be burned as fuel as well as being used in engines to pump water or to generate electricity.

Studies carried out in the Gangetic Plain in India showed that the most efficient use of methane from biogasification was as a source of power for irrigation. Under the system tested in these studies, the efficiency of using biogas for irrigation derived from the increase in crop yields as more water was available. Fuel for cooking was then obtained from water hyacinths which in warm climates can produce large amounts of dry matter for fuel.[8]

Because this last example shows that options exist within energy systems which we may think of as very simple, it should remind us that all the uses of energy should be seen in the context of systems. Our energy problems cannot be solved by the

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pushing of pet projects, whether those projects are fusion reactors or solar cookers. Any alternate energy source must be examined in relation to other sources and also in relation to the range of problems in a particular region of the world. Biogasification, for example, should not be judged just as a source of energy for people in less wealthy rural regions. It can also be vital to stopping the advance of deforestation. In many countries, the forest areas are dwindling at an alarming rate because wood continues to be an inexpensive and available fuel. Biogasification also relates to another problem of our crowded world. Waste disposal can be effectively achieved, dangers from infection can be reduced, nitrogen-rich sludge is available to enrich the soil and, into the bargain, men can have clean, usable energy if human and animal wastes are processed in biogas digesters.

Biogasification may also be used in large-scale applications in wealthier countries. A $4 million methane plant is being built in Colorado to utilize animal waste from feedlots, and the Energy Policy Project of the Ford Foundation suggests that as much as 5.5 percent of United States energy needs could be recovered from crop residues, feedlot waste, and urban refuse. If 5.5 percent does not seem very impressive, note that the energy involved - approximately 4.1 quadrillion Btu's - is about 1.5 times the amount of energy available from all the natural gas produced in Canada in 1972.[9]

The possibilities of energy substitution are numerous, and I could even point to the present-day version of the wind-electric plants which were common on farms across the North American plains at the time when I was growing up in rural Manitoba. I will spare your patience, fearful that you may not have the energy to listen to all the alternatives I might be able to cite. Enough has been said to illustrate the critical point; energy is vital to the quality of life in all forms of human settlements, and in all of those settlements there are possibilities for more efficient use of energy and for utilization of alternate forms of energy. The great question remains - how can energy best be utilized in order to maintain a basic standard of life?

While I cannot explore all the ramifications of this problem, I should like to make some general observations on energy use in urban areas.

Presently, there is evidence that some of the large cities in the less wealthy countries use less energy per person than is used in the rural areas. However, I

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wish to argue that in these cities the use of energy is already too low. Life in the slums of vast cities is sub-human, the water supply for the city may be grossly inadequate and dangerously impure. Waste disposal also is so inadequate as to endanger health, and many great rivers and lakes have been sacrificed to our shortcut methods of waste disposal. (This last problem is also common in wealthy countries - witness Lake Erie and the Rhine.) The total complex of problems is more severe in the poorer countries, where the burden of disease hangs heavily on the slum dwellers and the threat of epidemics - which may become pandemics - grow with every passing year.

Only systematic planning backed by adequate technology and physical resources can deal with these massive urban dangers. The planning and the action must also cut across several levels of government - from municipal to national - and may need to be supported by international action to make the necessary resources available. However, if the treatment of the problem is systematic and comprehensive rather than piecemeal, there can be a multiplier effect. If we have the will to plan and invest in better waste disposal systems, we can, for example, gain better water by easing pollution of lakes and streams and, at the same time, gain an important source of organic material for sustaining the fertility of our soils. Some waste processing systems, as noted previously, can even produce energy. This inter-relatedness of problems of settlements, energy use, food production, and human well-being makes the future planning of human settlements one of the greatest challenges men have ever faced.

The effort to achieve humansettlements for the swelling world population must involve more than attempts to improve conditions in urban areas. As I argued at the beginning, we must strive to create a real choice in settlement patterns. No matter how rapidly cities are spreading and growing, there is no reason to suppose that urbanization is the final end of man. Some survival of a herd instinct, reinforced by desperate economic and social pressures, must not be allowed to shape human history in the last years of this century. Konrad Lorenz, among others, has argued that there is a great danger in crowding human beings too closely in vast settlements. He has written - "The over-crowding of many people into a small space leads ... to aggressive behavior".[10] Perhaps most in the wealthy countries we are struck by the crush of city life, the growing selfishness of harassed city people, their fear of becoming involved with others, and the massive increase of violence.

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Thus we must advance on several fronts in a concerted attack against the degradation of human life. Certainly, we must strive to create cities that are more congenial to the human spirit and more serviceable to human needs. Simultaneously, we must consider the interface between urban and rural areas, as well as the means of providing better services and more opportunities for human fulfillment in smaller and more widely dispersed settlements. If we consider the possibility of breaking up some urban concentrations, of linking limited urban centers by efficient transport systems and interspersing them with rural areas, we will be addressing several questions at once. We will be testing the energy efficiency of moving more people while reducing the distance for the transport of food. We will also be weighing the importance of providing urban dwellers with access to open country. Ultimately, our planning must take account of the extent and manner of the contact between human populations and the eco-systems upon which their lives depend.

My plea today has been for bold planning based upon the conviction that human beings can make choices which are decisive for their lives and their future development. Though I have emphasized the importance of the sources and uses of energy in creating various kinds of human settlements, I have also insisted that planning for the settlements of the future must take account of human possibilities, of the hopes of individuals, as well as the technical means at our disposal.

My great concern is that our planning processes have become too narrowly technical, too willing to accept past trends as the guide to the future, and too ready to accept what men do in response to social and economic pressures as some kind of inevitable and natural choice. Only if we have the vision and courage to see the limitations of the systems within which men live, only if we can understand that the interplay of political forces and the pressures of the market economy are the outgrowth of past human choices and not some expression of divine will, can we have the chance of resisting the course of development which now carries us toward social disintegration if not ecological disaster.

We are not just members of an urban proletariat, we are not just consumers, and we are even something better than technocrats. We are men, and we have the future in our hands. I urge that we strive to achieve a decent and humane future for ourselves and our descendants rather than just planning for what seems most

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likely. It is in this spirit of dealing with present problems in the light of a generous sense of our future possibilities that I also hope the work of Petro-Canada, as a national enterprise, may be carried on.

Yet, at the end, I must express a grave doubt. Our generation, the generation which has organized this international Conference, may not have the will to break out of the pattern of limited planning. Make no mistake, it will require an enormous effort of will to break out of old habits, the old acceptance of growth for the sake of growth, and the old emphasis on consumption as the key to happiness.

If my generation fails to meet the challenge of choosing to work effectively towards a liveable future for the people of the world, the courage and imagination that will be required of the younger generation will be tremendous. In another generation the problems will have reached such magnitude that they will require nothing short of genius and heroism in order to save man's Habitat for another hundred years."

NOTES

1. United Nations Statistical Yearbook, 1974, table 12
2. Denis Hayes. Energy: The Case for Conservation, Worldwatch Institute, Washington, 1976, p.7.
3. Hayes, p. 23.
4. Hayes, p. 33.
5. Hayes, p. 56.
6. Alan Poole, "The Potential for Energy Recovery from Organic Wastes", in The Energy Conservation Papers, Robert H. Williams, ed., Ballinger Pub. Co., Cambridge, Mass., 1975, pp. 251-254.
7. John A. Duffie, Solar Energy Thermal Processes, John Wiley, New York, 1974, pp. 298, 278.
8. Arjun Makhijani and Alan Poole, Energy and Agriculture in the Third World, Ballinger Pub. Co., Cambridge, Mass., 1975; and Kirit S. Pavikh, "India in 2001 Fuels, or 'Second India' and Energy", (mimeograph) Indian Statistical Institute, New Delhi, 1975.
9. Adapted from D.C. Ion, Availability of World Energy Resources, Graham and Trotman Ltd., United Kingdom, p. 132 and Alan Poole, "The Potential for Energy Recovery from Organic Wastes", p. 283.
10. Konrad Lorenz, Civilized Man's Eight Deadly Sins, Harcourt Brace, New York, 1974, p. 9.