RECORD OF SOCIETY OF ACTUARIES
1976 VOL. 2 NO. 2

Vol. 2, No. 2 May, 1976

RECORD

ALTERNATIVE ENERGY FUTURES FOR NORTH AMERICA

An Address by
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North America, before the European invasion of the continent, was richly endowed with potential energy resources: Great forests, an intricate network of rivers, vast coal beds, abundant oil and gas fields, generous deposits of uranium, tar sands and oil shale, a large proportion of arable land. In no other continent was there such a fertile potential for the rapid development of an industrial society.

Most immigrants to what are now Canada and the United States came from Europe and the British Isles. They came with knowhow and ambition, seeking economic opportunity. They dug, blasted, sawed, and built their way across the land. They and their descendants created the world's most advanced industrial society, a society in which per capita energy consumption is six times the world average.

Today, we are aware of some energy problems in North America. We are running out of oil and gas. More than three-quarters of our energy comes in these two forms. To replace declining domestic production, we are importing oil and are starting to import natural gas in liquid form. The United States, once the world's greatest producer and exporter of oil, now imports almost as much oil as it produces. The transport system, utterly dependent upon petroleum, has become the Achilles heel of our society. Not only do we have no strategic reserves of oil with which we might hope to withstand an interdiction of our foreign supply, but we have no alternative fuels readily available. Furthermore, our cities, where 80 percent of our people live, have no reserves of food to fall back on if the transport system should fail. While oil is available from other continents, we must pay for it. We used to be able to pay for imported raw materials with manufactured products and the exchange was generally favorable to us. That pattern is changing. The sharply increased cost of imported oil cannot be paid for by increased exports of manufactured goods, for the rest of the world now produces many of the goods it consumes and much of the world has a limited capacity to buy goods. There is, however, a high demand for food in the world, some countries that are able to pay for it, and few countries with a food surplus. Accordingly, we find that in recent years we have been paying for imported oil largely with exports of food, while those industrialized countries, such as the United Kingdom and France, that do not have food to export find their currency inflating and their levels of living descending because their manufactured goods will no longer pay for the energy and raw materials they import. We are extraordinarily fortunate in having food for export and in being able, if we have the will, both to increase our food surplus and to decrease our energy consumption without dire consequences to our life style.

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The present waning of North American reserves of oil and natural gas will be followed in 20 to 40 years by decreasing world production of these most valuable resources. Then the basic fuels for industrial society will be coal and uranium, and for the rest of the world agricultural refuse and dung. We have had an enormous natural subsidy from oil, natural gas, and coal, because we needed to use only 20 percent or so of the energy in them to get them into usable forms and, in direct heating, we lost only 20 to 25 percent more; thus our net profit was as high as 65 percent of the energy originally in the fossil fuel. In making electricity, the energy profit is much less but still considerable; about 25 percent of the energy in coal ends up as profit in electricity at the point of use.

The alternatives to oil, gas, and coal are less profitable. Uranium, because of the heavy energy investment in enrichment and in reactor construction, and because of thermodynamic losses in the power plants, nets us only 15 percent profit or less with present technology. If we make substitute crude oil or methyl alcohol from coal, refine that to gasoline, and burn it in the internal-combustion engines of trucks and cars, we will capture less than 5 percent of the original energy to do the work of moving vehicles. At the present time, we do not know how to make an energy profit out of solar electricity, although we can make a good profit from solar heating. Of course, as long as we can make any energy profit, we'll do it. But the significance of low-profit energy systems is that they are much more expensive than the high-profit systems we have been using. We are beginning to see this in the rapidly escalating capital cost estimates for developing a new barrel of oil production capacity--in the North Sea, in the Alberta tar sands, in the oil shales of Colorado. To deliver the same amount of useful heat and work, a low-profit system may require many times the capital investment of the high-profit system it replaces.

Capital is not money. We can print money, but not capital. Capital consists of physical plant, inventory, knowledge, and debt (other people's obligations to work for us or to deliver goods to us). Capital represents profit from the past exploitation of energy resources and of those resources that either increase the efficiency of energy use, as iron and copper, or that can be traded for true capital, as gold and diamonds. Capital can be accumulated from agricultural energy profits, but no nation ever got rich from agriculture, nor from fishing, nor from forestry. The wealth of nations has come out of the ground. Spain's wealth came from the silver and gold mines of the Americas; Great Britain's, from its own coal, iron, and tin as well as copper from South America and oil from the Persian Gulf; North America's, from our own coal, iron, copper, nickel, oil, and natural gas. This wealth has been high-grade. The remaining resources are leaner, in more hostile environments, or in more recalcitrant form. From now on, the energy profits will be less from energy-resource exploitation and this in itself will make other resources more costly.

While the drawstring tightens on nature's bag of resources, the world's human population continues to increase absurdly. The shrubs of Sahara borderlands are pulled up for firewood, tropical forests are leveled for the ephemeral promise of new food production, the limited food resources of the seas are overharvested, and desperate attempts are made by overpopulated countries to trade copper, aluminum, phosphate, oil, or human labor for food, fertilizer, and industrialization.

The world may be a spaceship, but it is a ship in which the first class is

sharply separated from the steerage, separated largely on the basis of per-capita energy use. Energy resources never were randomly distributed throughout the world, but show a striking preference for the northern temperate zone. Industrial society developed in that zone and grew to dominate the entire earth, so that resources were drawn away from the other parts of the world toward the high-energy countries. The exportation of public-health technology to the low-energy countries allowed an explosive growth of population in them and virtually guaranteed that they would drop farther behind in material levels of living. Low-energy countries without natural resources, of which the most important are energy resources, have no capital. Without capital, they cannot industrialize. Even with capital, they cannot industrialize if the population grows faster than the production of useful heat and work in the economy.

I intend now to sketch three possible energy futures for North America, exclusive of Mexico. These futures do not have to be coincident with the futures of the world. In fact, I do not see how the world could share in either of the first two. Only in the last of the three, which you likely will find least desirable, could we find ourselves essentially in the same economic and cultural boat with most of the other humans on board planet Earth.

These three alternative futures are:

(1) a high-energy, unstable future

(2) a moderate-energy, almost-stable future

(3) a low-energy, stable future

The high-energy, unstable future

Nothing known to science or engineering precludes the development of an energy system that would produce as much or more useful energy per capita than we now consume in North America at a slowly increasing cost in work, materials, and ecological impact for a long time, even after our oil and natural gas run out.

Heating and cooling for comfort can be accomplished through the manipulation of solar heat, aided by refuse fuels and waste heat from powerplants. To power machines, vehicles, industrial furnaces, and electrolytic processes, some combination of fuel and electricity on a large scale will be required. Coal in North America can supply fuels of various kinds perhaps for several hundred years. High-conversion fission power, through the breeder and CANDU reactors, is both technically and economically feasible. The probable base for a continued high-energy economy in North America is a combination of nuclear electricity and coal-derived fluid fuels. In addition, we have the potentially vast resources of the tar sands and oil shales to augment the supply of fluid fuels. Finally, there are the uncertain potentials of fusion and solar power.

Insofar as this future is supported by nonrenewable resources, it will be limited in time. But, since this time limit could easily be several hundred years, why do I suggest this future will be an unstable one?

The main reasons are (1) the inherent economic instability of the high-energy

growth state, (2) the rising danger of social disruption in a world that is one part rich and three or four parts poor, and (3) the potential effects of social insanity in a society more and more susceptible to the malevolent or irrational acts of small groups.

Let us take these briefly in order. High-energy society is based on perpetual growth in the production of goods and services. But perpetual growth in production demands perpetual growth in consumption, and that is not possible.

Man is not an unlimited sink for goods. In recent years, the automobile, aircraft, and construction industries in North America built more cars, planes, and living units than were needed, and the rate of growth of our population has been diminishing. Instead of facing these facts, these industries prefer to blame the Arabs (for raising energy prices), the government (for not subsidizing sufficiently the demand for their unneeded products), and inflation (for making people cost-conscious).

Neither is man an unlimited sink for services. As the service sector of a high-energy society grows, the subsidy it demands from primary industry (which in reality comes entirely from energy-resource profits) becomes more and more burdensome, and it thereby prices itself out of the mass market. Health-care services in our society illustrate the point.

Nor is the environment an unlimited sink for the waste products of economic growth. Environmental changes that threaten large numbers of the human population can be foreseen, albeit somewhat dimly; however, such unfavorable alterations of our physical habitat, e.g., climatic change due to increased carbon dioxide in the atmosphere, seem rather distant when contrasted with the imminence of unfavorable alterations of our social habitat because of the probable amplification of the boom-and-bust cycle inherent in growth-state economies. Since 1940 we have tried to convince ourselves that we have learned how to control that boom-and-bust cycle. Yet we must not ignore the possibility that these unprecedented 30 years of sustained economic growth were made possible, not by perceptive economic and social management, but by incredibly cheap oil. Someday soon we must face the fact that any high-energy nation can produce more goods and services than its people can consume. We try to conceal from ourselves that fact by putting large portions of our productive output into preparation for warfare, into "adventures in national pride" such as the Apollo program, and into increasingly expensive welfare systems, and by increasing employment in government. We pursue the twin chimeras of "full employment" and "production efficiency" long after it should have become painfully obvious that both are disastrous strategic objectives, and that optimal unemployment and consumption efficiency are more rational objectives. Recessions are certain to recur. After each, the same production will be achieved with fewer workers. There will be more pressure to bring the unemployed into the comforted ranks of government employees, to expand welfare programs, and to subsidize unneeded industries as well as travel, housing, health care, and insurance. Such support of nonproductive activity is possible without a lowering of living "standards" only as long as sufficient new capital or profit from energy resource use enters the economy. As the real costs of energy and other resources rise, this profit will decrease. As the emphasis continues on exploitation of resources to expand production, needed or not, the real costs of resources will rise faster than if emphasis were to be on conservation and efficiency of consumption. When the profit from energy use falls below that required to sustain the existing level, true inflation (not just escalation of prices but a lowering of buying

power) will add its effect to physical saturation of markets and there will occur a recession or depression. The amplitude of such economic perturbation will tend to increase.

High-energy, growth-oriented society will become even more capital-voracious and its productive systems even more beyond the economic grasp of most present low-energy countries. In a world that remains largely poor but partly rich, the rich will feel compelled to maintain large, mobile, expensive military forces, not just to threaten each other in the increasingly fierce struggle for raw materials, for food, and for environmental sinks, but also to keep the much greater numbers of the poor in the steerage section of this spaceship. There is a rising danger of effective terrorism and blackmail directed at the rich or high-energy countries. It should not be necessary to cite recent kidnappings, hijackings, and bombings to show that this wave already is upon us. When plutonium becomes available to the poor, as it surely will, the prospect of blackmail on a hitherto unimaginable scale becomes real.

Social disruption by terrorism is not limited to the international arena. Our society is increasingly susceptible to blackmail and injury by small groups of people; a large city can be paralyzed by a strike of bridgetenders, garbage collectors, or subway motormen; the entire nation is thrown into a corrosive tizzy by a few aircraft hijackers. As our energy and communication systems become more concentrated and centrally controlled, it becomes easier for small groups either to wreak havoc or take over; and, as we attempt to cope with such hazards by installing elaborate safeguard systems, we move step-by-step toward a police state and a garrison society.

The high-energy growth-oriented state will press beyond the capacity of society to consume goods, of human beings to put up with one another, and of the environment to absorb wastes without lethal adjustment. High social instability is the expectable result.

The moderate-energy, almost-stable future

The Benedictines introduced technology into their 15,000 monasteries in order to increase the time they could have for what they called "rewarding work" (what we call "productive leisure"), not to achieve a surplus of goods. Europeans outside the monastery walls who learned from the monks that system, regularity, and technology could increase production decided to take their surplus in goods rather than in leisure and, thereby, contributed substantially to the emergence of our growth-oriented industrial society.

If now it should happen that, because of sharply-rising costs of both energy and materials, we find ourselves forced into a pattern of conservation that impels attention to efficiency of consumption, there might develop an almost steady-state society with a high component of leisure at a level of consumption of energy perhaps half of that in North America today. The output of useful heat and work would be only modestly less, the level of living would be unimpaired, but there would be some substantial changes in life-style.

In the approach to the steady or stable future, emphasis on efficient use of energy will bring great changes in the structure of cities and transport systems. Urban sprawl will be checked and may recede as cities once more become bedrooms and playgrounds as well as workshops. Cities will become three-dimensional by development of the urban underground for transport, storage, and

manufacturing. Audiovisual communication will replace many business trips and conferences, because the transport of words and images consumes much less energy than does the transport of bodies. The necessity for speed, a glutton of energy, will be questioned. The fact that it takes 40 times as much energy to cross the Atlantic in an airplane as it does on a ship will have made vacation flights to Europe rare. But vacations in such a world--where only the people needed are actually at work--could be much longer than at present, making the speed of vacation travel unimportant.

There will be a great deal of unemployment by our present definition, for that will be a major social goal, although services that use little energy will be encouraged. The ingenuity of man, now devoted primarily to using up resources, will be extended to its utmost in devising ways of using leisure so that satisfaction and happiness result rather than boredom and rebellion. Education will be more important than it is today, for it will be devoted to enriching lives rather than pocketbooks, and to cultural transmission designed to assure social stability.

Occupational mobility will be small, and social mobility will not be available to many who have been able to move upward in the growth state where social status has been linked with economic power. It is not reasonable to expect that many will be content with leisure alone, even when leisure has become the socially-correct expression of a nation's energy surplus. This society will need to rediscover the social benefits of physical exertion, of ceremony and ritual, and of social climbing unrelated to accumulation of economic power. The average age of the high-leisure population will be substantially greater than in the growth state; generation gaps should disappear and age no longer will exclude one from full participation in society; indeed, age may become again respected instead of shunned.

This future is quite possible physically, but it will require a revolution in human thought and a return to the Benedictine goal. A society that has been taught to regard idleness as sinful cannot be counted upon to rebuild itself on the basis of the goodness of leisure. Furthermore, a steady-state society threatens vested interests, aspirations of material advancement, and the econoreligious basis of the growth state.

The low-energy, stable future

There is no reason to expect the transition from a low-energy society to a high-energy society to be irreversible. If the energy support of a high-energy society fails, it must again become a low-energy society.

The sequence of changes is predictable. First, the uses of energy which are not vital to the industrial economy will be eliminated: pleasure driving, boating, flying, and snowmobiling; air-conditioning and frost-free refrigerators; large lighted advertisements. At the same time, there will be sharply increased and unremitting emphasis on energy efficiency: buildings will be well-insulated, windows will become smaller or be eliminated; many human activities will be transferred underground; bodies will be warmed more by clothing and less by heating the surrounding air. The service sector of the economy will shrink, except for police and applied research.

The second phase will be marked by the partial dismantling of the industrial plant. Energy-intensive processes will be discontinued as will the manufacture of unneeded objects and the provision of unneeded services. Solar heat-

ing and design cooling will be widely used; methyl alcohol--from cellulose, algae, and coal--may be the most common fuel.

The third and most drastic phase of retrogression will reduce the industrial plant to a skin-and-bones system concentrating on the efficient production of fertilizers, pesticides, textiles, cheap construction materials, and cereal-based foods. Meat animals, except for those that can feed on land that will not grow crops for man or on refuse, will have disappeared; the main high-protein foods will be soybean products and fishmeal, with high-lysine corn also important. Most workers will be back on the farm. Because social security in the present sense will be economically impossible, all able-bodied oldsters will be at work, many of them in the fields. Incidentally, they may live and love longer than they do now. The system of higher education, except for technical and certain professional schools (for doctors, not lawyers), will also have been dismantled and the lower schools will be reoriented toward agriculture and crafts training. High school probably will no longer be obligatory. There will be no unemployment and it will be socially unacceptable for a woman to have more than two living children. The food-production capacity of the land probably will not be taxed to support the resident population, since it could support a population of more than one billion on a vegetarian diet; however, an exportable surplus will be required to pay for imports of energy, fertilizer, and certain strategic metals.

Conclusion

Which of these scenarios is the most probable?

In the short term, the first, because it continues what we are doing now and because a combination of foreign oil, nuclear power, and coal offers us the necessary resource base. Foreign oil will be available because we will have surplus food-producing capacity for 50 years or more and the rest of the world will not. In the longer term, perhaps a combination of the second and third scenarios. Because of our fixation on the growth economy, we may deplete our resources well beyond the point at which the steady state could offer a reasonably high standard of living, so that forced stability will find North Americans improving their bodies in the fields more than their minds in symposia.

Now, let me ask you, "Do you fear any of these possible futures?" If so, why? Is it because you have too much of yourself invested in things as they are? Is it because you believe our present society is the best of all possible worlds? Are you a victim of pleonexia, the desire for more and more, or simply a communicant of the Church of Christ Economist, of whose founding by Adam Smith in 1776 we are celebrating the bicentennial this year? Is your paycheck a true measure of your worth to society or your own sense of achievement? What constitutes poverty, a low income or a meagre soul? Is it not possible that St. Benedict was more right than Henry Ford? These questions are relevant when examining one's own position in relation to an uncertain future.

We used to regard the future with confidence because we thought we could shape it as we wished. Man was given dominion over the earth, reads one verse of Genesis. Now we seem to fear the future because we have lost confidence in our master-building art and are faced with some of our own failures and with the troubling thought that the laws of physics may limit the attainment of the desires of man. Although we should be concerned, why should we

fear the future? We are creatures of adversity, with a long history of successful struggle and progress against astounding odds. We have shown only an inability to cope with material affluence, which appears to be a temporary condition of the human race. Why should we fear scarcity, since scarcity is the natural, historic, dominating element in our society and in our own nature? Why should we fear the necessity for improving our social organization in order to share limited space and scarce resources, since social organization is what lifted us out of the lesser ranks of the animal world and gave us our gods? The future is as exciting a challenge today as it was a hundred years ago. If we fear it, we fear only ourselves.

The so-called energy crisis of two years ago is gone. We will have others like it, perhaps as soon as this fall or winter. But the long-term crisis facing us is different. It does not consist of temporary shortages or embargoes. It consists of the need to adopt a frame of mind and an institutional structure that will allow us to prepare for the worst, while working for the best; to accept physical and social limitations on the use of energy and other resources, while attempting to continue to enlarge the energy resource base; to see the necessity for ultimately coming to terms with nature on the most favorable basis then available, both for ourselves and our descendants; to understand the social changes that will be required; and to live confidently with uncertainty.

(Note: Dr. Cook's views are stated at greater length in his book, Man, Energy, Society, published by W. H. Freeman & Co., San Francisco.)