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A PLAN FOR ENERGY INDEPENDENCE

By Carroll L. Wilson

I BELIEVE the United States is facing a national energy emergency. It arises from our extravagant and wasteful use of energy and from a shift in the sources of fuels. Per capita consumption is three times that of Western Europe, and we may ask ourselves whether our greater use enriches the quality of life by any such margin. Our cars are twice as heavy and use twice as much fuel as European cars which run about the same mileage each year, and the ratio is getting worse because of the sharp drop in fuel economy on recent models of American cars, owing to emission controls and air conditioners. We keep our houses and buildings too hot and use large amounts of fuel in air-conditioning everything. We have not given a thought to fuel conservation and efficiency since the days of rationing in World War II—an era which only 30 percent (those over 45) of the population can remember. These are some of the reasons why with six percent of the world's population the United States uses 33 percent of the world's energy—and why Europe and Japan are unlikely to be sympathetic to our plight as we ask them to share with us their traditional supply sources in the Middle East.

The costs and perils of dependence upon Middle East nations around the Persian Gulf were eloquently stated by James Akins of the State Department in the last issue of this journal.[1] His analysis of the expected scale of payments to Middle East countries and the inability of the largest producer, Saudi Arabia, to absorb or use a significant fraction of these payments for internal purposes underscores the perils of open-ended dependence upon these nations for our oil. The most critical aspects of the national energy emergency are the shift to such dependence and the enormous foreign-exchange drain it must progressively entail

[1] "The Oil Crisis: This Time the Wolf Is Here," *Foreign Affairs*, April 1973.

by the late 1970s alone. Recent "symbolic" interruptions by some Middle East countries, in protest against U.S. policy toward Israel, may be one hint of what the future holds; the continued hard bargaining on price is another. Although we will have to live through a period of substantial reliance on Middle East oil, it is hardly an acceptable national policy to leave the emerging situation in this highly unsatisfactory state. There are simply too many cumulative problems and dangers involved.

The question, of course, is what *could* we do about it. The time has come to propose solutions. I propose a strategy to overcome this emergency, a program of action to implement such a strategy, the machinery needed for implementation, and an assessment of the global and environmental consequences of the adoption and execution of such a program by the United States. Obviously, the number of variables is immense and only by gross simplification can one define a strategy and program; there should be alternative strategies and plans. But this may be a place to begin.

II

The objectives of my proposal are to achieve, by 1985: first, the independence of the United States from critical reliance on imports of energy in any form—defining critical reliance as anything more than ten percent of our needs; second, energy costs below some target level, in dollars per million British Thermal Units (BTU), which is a common energy pricing unit for all fuels. I suggest as a goal keeping energy costs for premium fuels such as gas or oil below $1.00 per million BTU. This is equivalent to oil at $6.00 per barrel, roughly twice present prices, or to gas at $1.00 per thousand cubic feet, twice present wellhead prices on new contracts. The current cost of coal is very low in relation to its heat content, and the proposed ceiling gives great latitude for its use.

To see how we might reach these goals, let us start by examining the components of energy supply in the United States—past, present and future. Current projections make three key assumptions—that total energy consumption will continue to grow at the rate of 4.5 percent a year that has prevailed in the past decade, that the present pattern of use of particular energy sources will continue, and that nuclear power will be rapidly developed. As we shall see, all three of these assumptions can be challenged. If

they were the case, however, the currently projected picture (seen in relation to present and past) would look as follows:

TABLE I

U.S. ENERGY SOURCES AT STATED PERIODS

	Actual 1960–63	*Actual 1970–73*	*Projected 1980–83*	*Projected 1985*
Oil	44%	44%	44%	47%
Natural Gas	29%	33%	28%	20%
Coal	23%	18%	17%	17%
Hydro/Geothermal	4%	4%	5%	6%
Nuclear	.5%	1%	6%	10%

As the table shows, the crux of the problem is that oil has had to assume a large and slowly increasing share of the total. Natural gas appears to have reached its peak and will decline as a proportion of total supply even if higher prices produce increased exploration and discovery. Hydro sources can at most hold their place.

There remains, of course, the question whether present geothermal sources can be expanded to a greater degree and whether new "miracle" sources of energy can be found from solar energy, nuclear fusion, hydrogen broken down by nuclear methods, or any other. In all of these there is hope if we look ahead on a 30-year projection—and in the most promising areas there is justification for much greater research and development effort. But if one puts together the theoretical possibilities and the best available sense of what it would take to develop any of these "miracle" sources to major production levels, the honest judgment at this stage must be that they will contribute nothing by 1985 nor be substantially operative before roughly the year 2000, if then. And we simply cannot wait that long.

Rather, then, we have to look to our present sources of energy within the 1985 time frame. Obviously, we must have the maximum possible expansion of domestic oil and natural gas production, but the increases cannot be large in relation to total need. In addition, we should establish synthetic oil industries based on shale and on coal, building some large-scale plants to demonstrate feasibility and costs and to test features that minimize environmental impact. Such developments might yield a few million barrels per day, and we might require refineries to mix such oil with regular crude oil for a fraction of their feedstocks—even if initial prices of synthetic crude oil exceeded the $6.00 per bar-

rel ceiling target for 1985 energy costs.

Looking at all the technological possibilities, however, it is my conclusion that the best sources of energy that can be greatly expanded in this time frame, at reasonable cost and with an impact on resources and on the environment that we can bear, are nuclear fission and the production of gas from coal through gasification—a process which produces from coal a clean, all-purpose and readily transportable gaseous fuel. For this purpose, some of the necessary technology now exists, but some still requires additional development. Gasification itself has been demonstrated, and technologies are already in use that produce low-BTU gas. However, the technological obstacles to producing gas of pipeline quality from coal are still formidable; a massive crash program of parallel pilot and demonstration plants for the four or five processes that now appear possible should permit construction to start in two to three years on production plants that make use of whichever process or processes then look best.

This selection of technological possibilities is the first element in the proposed strategy. The second—at least equally important and urgent—is a program effectively to reduce the rate of growth in our energy consumption. Actually to lower our consumption substantially is not, I believe, acceptable without far too drastic changes in our whole society. But I believe it is feasible, and should be our target, to achieve and maintain a rate of growth in our energy consumption of three percent per year, rather than the present 4.5 percent. In arithmetic terms, instead of our energy consumption in 1985 being 70 percent greater than it is now, it would be "only" 43 percent greater—a large and critical difference without which no action program can, I believe, do the job.

This is still a drastic target. To achieve it requires a recognition and acceptance that we are in a national emergency. Since shortages are upon us, we will have to begin to practice conservation not because of price but because of shortages. Although the first guidelines for voluntary "sharing of shortages equitably" have been issued by the government, we have no rationing machinery except to give priority to domestic heating and to drop other loads if not enough energy is available. There are not even the rudiments of machinery for rationing fuel. The only serious study of an emergency program has been made by the Office of Emergency Preparedness, which has produced two very useful studies indicating measures that could be taken if the will existed

to diminish significantly our energy demands, thereby reducing our dependence upon imported oil. Yet, before the year is out, shortages of gasoline and heating oil in many parts of the country will make it clear that a national emergency exists and that appropriate steps must be taken.

Some of the necessary measures will involve presently extravagant uses and waste, and some an increase in efficiency. Here it is striking to note how little scientific and technical effort now goes into this latter question; a very modest improvement in our present low fuel efficiency may turn out, over time, to be in itself sufficient to bring us close to the three percent growth rate. But in the meantime we must surely cut back painfully.

III

On the whole we do very well in dealing with national emergencies. Many examples come to mind from World War II when we created the machinery; gave it the necessary authority; provided the money; mobilized the parts of the society, public and private, which were needed to overcome the emergency or meet it; energized the program by a system of contracts; and achieved the target results.

A notable example was our action in dealing with the abrupt cessation of the natural rubber supply. We carried out a crash program to set up a synthetic rubber industry, quickly creating the necessary machinery, authority and money. The results were dramatically successful. Another example was the decision to produce an atomic bomb in time to be usable in World War II. The decision was taken at a time when there were four or five possible routes to securing fissionable material from uranium and only some clues as to how to make a weapon from fissionable material. Special machinery was set up with the needed authority, with superb leadership and organizing capability, and within the tradition of mobilizing the private sector by contract. The Manhattan District then conducted that remarkable program of carrying forward simultaneously four different approaches to producing fissionable material and two simultaneous approaches to making a weapon, while building everything from cities to railroads to huge and completely novel factories, all in the space of less than three years. It worked.

Another example of how we can mobilize resources against an explicit target was the space program. In 1960, for reasons then

considered sufficient, we decided that we should put a man on the moon before the end of the decade. To accomplish this, we created a special agency with great authority and lots of money and manned it with extraordinarily capable leadership. The fantastically complex and difficult scientific, technical and logistical problems were overcome, and, indeed, we put the first man on the moon in July 1969.

These are a few examples of how we have acted successfully when we have accepted the existence of a national emergency and taken the necessary actions (through Congress and the President) to provide the authority, the money, the machinery and the leadership to meet and overcome it. It is our national style to be most effective in tackling concrete programs, or working toward specified goals. Sometimes that approach is not appropriate as, for example, in solving the problem of cancer; in this case, however, it is the right one.

What might be the action program aimed at 1985—the Decade Program if you will—if we accepted the existence of a national energy emergency and then took the necessary steps to cope with it through meeting the specific targets suggested?

The first element in any such program must concern the use of oil. To limit our oil imports to ten percent of energy requirements by 1985—using now the target three percent annual growth rate to estimate total 1985 energy consumption—would mean that we would be importing no more than five million barrels of oil per day at that time (compared to the roughly 15 million barrels now projected).[2] In the total energy picture shown in Table I, oil (domestic and imported) would have to drop markedly from its projected 47 percent to a proportion of roughly 30 percent in 1985.

This at once suggests the first component of the action program. Thirty percent is roughly the proportion of our energy that now goes to transportation, especially automotive uses—for which, of course, oil is uniquely suited. It will take work to keep our transportation uses down to this proportion, for they are now expanding faster than total energy consumption and this tendency

[2] Oil would not, of course, be the only energy source imported. As we know, substantial possibilities exist for the importation of natural gas from Canada and of liquefied gas from Algeria, the Soviet Union and perhaps other sources. Without judging the wisdom of expanding any of these sources, their proportion of total energy is not likely to add much to the ten percent of total energy represented, for this program, by imported oil. We would still be within reasonable overall margins of import dependence.

will be accentuated by lowered efficiency due to tighter emission controls—not to mention the current sales rate of a million passenger cars a month! But if the proportion can be kept down—actually slightly reduced—then it can and should be met from oil, and oil should be withdrawn from other energy uses such as heating. This is a harsh measure but an indispensable one—the keystone of the whole program in fact.

The next component of the action program concerns nuclear power—currently providing one percent of our total energy, and projected in Table I to provide ten percent by 1985. In this respect, Table I reflects technological possibilities with proven techniques, but it does *not* reflect current political realities, nor, in my judgment, the true difficulty of meeting valid safety and environmental objections to the kind of major expansion it would take to achieve the projected figure.

Like others who have followed closely the development of nuclear fission as an energy source for more than 25 years now, I originally and for some time believed that it could, without undue difficulty, become the most important source of energy we have, especially for electricity. But problems have mounted, and delays, restrictions and technical uncertainties have dogged nearly every one of the many steps needed to bring a new nuclear plant into full operation, thus drastically slowing down the nuclear input to our energy system. The determined opposition of states and localities and citizen action groups, plus rising caution by the Atomic Energy Commission, has stretched out to ten years the interval between application for a plant permit and bringing the plant "on line" at an economic power level.

In part, the political forces at work reflect an exaggeration of the problems, or at least a failure to weigh fully the inevitable trade-offs between energy supply and other factors. But these politically reflected concerns do have a substantial basis, both as to safety and as to unnecessary and unacceptable environmental consequences. Only if we deal with these factors can nuclear fission play the role I believe it must play in our total energy picture by 1985.

On safety, a real uncertainty now exists concerning possible accidents which could have disastrous consequences—especially the failure of liquid cooling systems resulting in a meltdown of the highly radioactive core and release of the gaseous fraction of these radioactive products into the atmosphere. A year of hear-

ings by the AEC has not persuaded the critics that current reactor plans are safe against such accidents, and the problem exists as well in the liquid-metal-cooled breeder reactor designs.

As I see it, the only way to meet these objections and so resolve the current impasse is to put all new plants underground. This is an entirely practicable course of action. Studies indicate that placing nuclear power plants underground would add only a small fraction to their cost. The extensive know-how of the mining industry plus that of the underground gas storage industry could be applied in placing such plants in suitable geological formations 500 or more feet underground near load centers. So located, with suitable locks in the elevator shafts to contain and hold back any pressure of radioactive gas in the event of an accident or a meltdown, these plants could meet the requirements for nuclear safety. Placed in a suitably impermeable geological formation, a meltdown, even if it buried itself below the underground chamber level, would not leak radioactive products into underground water or into the atmosphere.

The second big nuclear production problem today is primarily environmental; it concerns the effects of the water discharge from large reactors in heating up streams and larger bodies of water, thus altering the ecology in many harmful ways. Here Europe has pointed the way to the answer—large cooling towers, built on the surface to recycle and cool the hot water discharges with very low net water heating.

Finally, there are problems in the safety and security of handling and transporting plutonium, and in the perpetual storage of radioactive wastes. In these areas, risks cannot be totally eliminated, but they can and should be sharply reduced to an acceptable level by determined action—as we enter an era of massive production, transport and handling of plutonium, which is one of the most toxic substances known.

All in all, the measures required to permit expansion of nuclear-fission plants will not be cheap or easy. But if the necessary steps are taken, nuclear-fission plants should be able to provide roughly ten percent of our total 1985 energy needs at tolerable levels of risk and bearable costs. And experience in this next decade should tell us much about the degree to which we can hope to expand, by the end of the century, our use of nuclear fission, especially through the breeder reactor; in the 1985 time frame, the breeder is not likely to make a significant contribution.

If roughly ten percent is the best we can hope to get from nuclear sources by 1985—the figure used in our original Table I —it follows that there remains a very large shortfall from the proposed reduction in overall oil use. Even if we now assume that total consumption would be less than assumed in Table I, the proportion to be made up is on the order of 15 percent. Indeed, on my own best guess about the amount of domestic natural gas we shall be able to find by 1985, I should think that natural gas (even with some imports) should not be counted on for more than 15 percent of the total, and perhaps as little as ten percent; perhaps new gas reserves will be found on a large scale, but at the moment much expert opinion doubts this. We would do well to plan prudently on a figure not exceeding ten percent, or a total shortfall of roughly 25 percent of the total to be made up from sources other than oil or gas.

Inevitably, we are drawn to coal—and to greatly expanded coal production and gasification as the third central element in an action program. To whatever extent possible, coal as a solid fuel should be expanded in its own right, especially in electric power plants—using processes to remove the sulfur from stack gas such as the Japanese now employ. But for every reason —adaptability, transportability and environmental consequences —gas from coal is particularly important.

Available options for processing coal include conversion to low-BTU gas, high-BTU pipeline-quality gas, oil or various combinations. Technical, economic and time criteria should guide the choices made. But the great advantages of pipeline-quality gas for most uses justify major emphasis on this choice. A massive crash program is needed to move present process options forward. Current estimates indicate that the cost of capital investment in new gasification plants should be on the order of $20,000 per ton of daily coal feed to process coal into pipeline-quality gas.

Any program to increase coal mining must face up fully to the problem of environmental impact. The necessary coal must come overwhelmingly from surface mines, predominantly west of the Mississippi. In the past, such strip mining has rightly acquired a bad reputation. Fortunately, a large part of the coal reserves in the West are located on public lands. Therefore, the federal government is in a position to set the conditions for mining operations. I believe it essential that such conditions

include provision for restoring the land after the coal is extracted, putting solid waste from the mining process back underground and creating a land surface that must be at least as stable, fertile and valuable as the original. An allowance of $2,000 per acre for such purposes may be a fair approximation of what it would take, and this cost would have to be considered a basic cost of production. Underground mines must control pollution and use several practices which might increase costs up to a dollar per ton. Similarly, coal gasification plants can and must incorporate controls to avoid air and water pollution. Altogether, while the mere existence of the plants means that the countryside can never be quite the same in the future, the problem of environmental impact can at least be reduced to bearable proportions in view of the stakes involved.

Building up our reliance on coal would involve capital costs for mining production as well as for the gasification plants. In 1970 U.S. coal production was about 500 million tons and accounted for roughly 20 percent of our energy needs. To meet 50 percent of total energy needs in 1985 (at the three percent intervening growth rate) would require a production level of two billion tons per year—a quadrupling of the 1970 level and an average growth rate for the next 12 years of 12 percent per year. Investment needed to produce this basic production increase can be roughly estimated at $10 per ton, or $15 billion. If two-thirds of the increase, or one billion tons, went to gasification, the plant investment would be approximately $60 billion, and there would be a major additional investment in gas pipelines. Finally, for the one-third of increased coal output burned directly in power plants (to replace present oil and natural gas supplies), a substantial railway transport investment would be required, as well as costs of conversion to coal where feasible, and desulfurization of stack gases.

Obviously, such a buildup of coal production and coal gasification is a truly major undertaking, difficult from a technical standpoint and costly and complicated in terms of the mix of private and public effort involved. It is a big job, but no bigger than the Manhattan or Apollo projects—in fact substantially less in proportion to the scale of the American economy in the 1970s and 1980s.

One crucial question remains—the adequacy of reserves. Before embarking on a course designed to make coal our principal

source of energy by 1985 and thereafter, we need to assess the scale of our coal reserves and how long they might last. While I have stated my proposal purely in terms of 1985, it is obvious that we would not wish to mount an effort on this scale and then change course quickly thereafter; on the contrary, it is my own belief that we should plan tentatively at this stage to meet not just 50 percent but as much as 75 percent of our energy needs from coal by the year 2000. It is now forecast that natural gas reserves will be gone before 2000 and that global oil reserves will be declining fast (even with less U.S. consumption than now forecast). Thus, coal and nuclear power *could* be our overwhelming energy sources by that time, with coal by then being converted on a large scale to oil for transportation needs. Oil from shale might also have become a substantial source; present reserves of oil shale are such that we could produce five million barrels of oil a day for more than 300 years before such reserves were exhausted. We need not be quite this futuristic for concrete planning—but we do need to assess reserves on the basis of large assumptions, to be sure of what we are doing in the 1985 time frame.

Happily, the coal reserve picture is reassuring even if all this comes true. The current Bureau of Mines estimate (1970) of U.S. coal reserves is 1,600 billion tons. If coal use now moves up steadily to 50 percent of total energy by 1985 and to 75 percent by 2000 (again allowing for a small but steady annual increase in energy use), then total consumption in the entire period from 1974 to 2000 would be on the order of 70 billion tons, or four and one-half percent of known reserves. Exhaustion of reserves would be roughly 100 years away in 2000, even if the use continued to increase at a steady rate.[8]

In sum, coal reserves are ample to meet the projected needs through the balance of this century and to leave us with supplies to last another century. Through the use of coal on this scale, coupled with the restriction of oil supplies to transportation uses and the regaining of our momentum on nuclear power, we could meet the strategic goals stated at the outset: minimal dependence on overseas supplies and reasonable rises in energy costs—to

[8] The actual calculation here is that 17 billion tons of coal would be consumed between now and 1985 and 50 billion in the next 15 years. The latter figure assumes that growth in total energy needs (in terms of BTU content of fuels) would have been reduced to two percent per year, versus the three percent target of the Decade Program and the present 4.5 percent.

levels not over two or three times present rates. This is the best action program now available. It would get us through this period and buy crucial time for whatever innovations may develop, while allowing us to continue with expanded coal use if such innovations do not appear on a large scale.

IV

I have outlined this "Decade Program" first in order to define the key elements in our effort between now and 1985. These key elements are essential, they take time to bring about, and we must get started on them at once.

But as we do so we must also reckon that the required changes cannot be brought about immediately. The program needs at least the whole decade to take full effect, and in the meantime—even if we have cut our energy growth rate to three percent—we face extraordinarily serious problems. Hence, in addition to our Decade Program, we must have what might be called an "Emergency Program." This would dovetail as well as possible with the Decade Program but inevitably would not be wholly consistent with it.

Oil remains the crux of our present problem. The standstill on new refinery construction, partly for environmental and related political reasons and partly because of unattractive return on investment, may compel some rationing of gasoline this summer and of fuel oil next winter. And even if new refinery capacity existed today, an adequate supply of crude oil from abroad could not now be landed without at least one new "superport" and also large-scale new tanker construction. As for domestic oil development, the Alaska pipeline is still in abeyance, and offshore exploration is inhibited by state opposition and disputes with the federal government about royalties. Also significant is the public belief that all offshore operations are as disastrous as the Santa Barbara episode (which disregards the large-scale operations conducted in the Gulf of Mexico and the North Sea for years without major accidents).

The fact is that we cannot avoid a continuing increase, for some years to come, in our imports of oil—especially from the Middle East. In 1973 we shall be importing 3.4 million barrels a day from the Middle East and North Africa, and two million from Latin America. These figures are bound to rise—for some years well above the Decade Program goal of only five million

barrels a day of imports by 1985.

Finally, there is a basic policy question that must be faced—whether in common prudence the United States should now have a strategic reserve of crude oil or refined products to protect against interruptions. Crude stocks are currently below 20 days and refined products in the form of working inventories in the distribution system are less than 40 days—essentially minimum working levels with no strategic reserve. Such a reserve is something individual Americans have quietly urged on Europe for years, and in 1968 the members of the European Community accepted the obligation to build up oil stocks equivalent to 65 days' use. Now it has been proposed that this reserve be raised to 90 days. In the case of the United States, the targets need not be defined in terms of such periods of total oil use, but as our imports increase we should at least have a strategic reserve equal to perhaps 90 days of our imports, to cushion the shock of any interruption for political or bargaining reasons. To urge this does not indicate the slightest degree of hostility to the supplying countries; it is what businessmen all over the world prudently do in order to negotiate on a relatively even keel with suppliers.

Solving all of these emergency problems will take both resources and ingenuity. In the case of refineries, I believe inland sites must be found, and new refineries must adopt available technology which produces virtually no air or water pollution. Such refineries exist in Europe; they can be matched here, and not at excessive cost. Similarly, superports must be built with expensive safeguards—their cost would be perhaps as high as $1.5 billion to unload ten million barrels a day, with additional pipeline costs to bring the oil to inland refineries, and conceivably an investment of $15 billion for tankers adequate to haul the ten million barrels a day from the Persian Gulf. It is a daunting prospect—and underscores the vital importance of preventing our maximum import dependence from going beyond roughly the ten million figure at any time, and the importance of reducing dependence as soon as possible to our target ceiling of five million barrels. The painful fact is that some part of total refinery capacity, and as much as half of the planned superport capacity, will become obsolete or surplus as we carry out the shift to coal and the reduction in the proportion of our energy needs supplied by oil imports.[4] When a problem has been neglected as long as we

[4] It seems likely that substantial strategic reserves of crude and refined products may still be important to protect against the effects of important interruptions.

have ignored or misjudged the energy situation, the short-term requirements may not mesh with the requirements for the medium and longer term—and so it is in this case. We have to fix the roof and build a new house at the same time.

V

In short, it will take a two-fold crash program to master the situation, part directed to a transformation in our energy pattern by 1985, part directed to getting along in the meantime. The dual task involves a series of massive new efforts, some of them within the capacity of private companies, some beyond that capacity, some which will be so clearly uneconomical that private companies would be reluctant or unable to undertake them with their own funds. No one can now say just what the mix of public and private effort will be—but what seems absolutely clear is that a much larger public role will be required than now exists, partly to pull together all the strands of both parts of the program, partly to support private effort, partly to undertake those aspects that cannot be handled by private companies.

I see no alternative to new government machinery at the federal level. Accordingly, I propose a National Energy Authority (NEA) with a ten-year life and with appropriate powers to deal with the national emergency. This will mean authority to override obstacles in regard to land acquisition, siting, environmental impact, and other areas as necessary to carry out the program. This should not relieve the NEA of a very serious obligation to make environmental assessments of its proposed projects and to hold public hearings to develop the best available means to minimize the environmental consequences and risks of the actions it takes, but it would authorize the NEA to proceed with its program and not be stopped by the obstacles which stall so many things today.

Under the NEA it would be essential to create a National Energy Finance Corporation (NEFC) to provide funds for parts of the program which may not be privately financeable, including the superport, a billion-barrel strategic stock and its storage facility, sites for refineries, offshore production units, tankers, coal gasification plants, and gas, oil and coal pipelines. Large amounts of capital are going to be needed. An important obstacle today is that some of these essential investments are not attractive to private capital. In designing the NEA and the

NEFC we have many examples such as the TVA and the New York Port Authority, the Reconstruction Finance Corporation and the Export-Import Bank. There are ample precedents for the kinds of authority needed and the appropriate legislation, controls and accountability.

The NEA should be an independent agency, perhaps modelled on the original Atomic Energy Commission, in any event as resistant to political pressures as that Commission was. I propose that NEA have a ten-year life and go out of existence in 1985 except for the NEFC, which is likely to be needed beyond that time. There are several reasons for this proposal. First, the exercise of emergency powers is anomalous in our system and should be limited to as short a time as required to overcome the emergency. I believe the job will take a full ten years, but can be done in ten years if the program is geared to such a timetable. Second, when the job is done most of the programs should be carried forward by industry on a commercial basis, and necessary continuing governmental functions can be transferred to other agencies. Third, the best period in the life of any agency is the first ten years. After that the sclerosis of bureaucracy sets in and we certainly do not need any more bureaucracies. No one should seek a career in NEA—only the excitement and satisfaction of doing a critically important job and finishing it. Meeting numerical targets and being measured on performance in meeting them through frequent public reports is the kind of a challenge which should attract the kinds of people needed.

The NEA will have to undertake extensive research and development and pilot plant and demonstration operations. It should, for example, underwrite the incremental costs and use its authority to clear the way for the first two or three nuclear power plants which are built underground. It should back the construction of several demonstration units of large offshore oil production operations incorporating the maximum safeguards in technology and procedures and should use these for public education and to provide a model for the industry. NEA can work out with the AEC appropriate joint activities in regard to the underground power plants, waste disposal, plutonium shipment handling and so on.

In addition, in the Program for the Decade and beyond, conservation should be an important component; this might include the creation of a national fuel efficiency service to effect econ-

omies in the use of fuels. Currently, there is an almost complete absence of professional interest, activity, or expertise in this subject—whether in universities, engineering firms, business enterprises or the government. A major task of NEA would be to stimulate such expertise and put it to work. As a result of coping with limited fuel supplies during the next few years, we may discover economies which are not only relatively painless but which reveal to us better life-styles. Adopting such life-styles might substantially reduce per capita energy use.

In the Emergency Program of NEA, one of the first projects will be a superport. It may be sufficient for the NEA to exercise the authority to establish the superport and to supplement its financing. Clearly the NEA must work in close collaboration with the oil industry in many of the things it does. It must be shown that gas and oil pipelines can come ashore on their way inland and leave no offensive trace of their transit across the coastline. A second project is to acquire inland sites for oil storage and refineries. It should be noted that even packed closely together a billion barrels of oil storage would take 10,000 acres, or 15 square miles. Inland sites will save our finite coastline for better public uses. Another major project is the question of supplementary finance for tankers—at a time when world shipyards are solidly booked.

The NEFC will have much to do. To repeat, one problem in the financing of facilities such as the superport, tankers and perhaps the refineries is that at the end of the Decade imports are to be brought down again to only five million barrels per day. Thus, the success of the Decade Program may mean a fairly early obsolescence for part of the capacity of the superports and tankers—hence one key need for significant public financing.

VI

In laying out this proposed program, I have indicated some specific steps to minimize its consequences for the physical environment. In some areas we should be better off in the new 1985 situation: our cars should be smaller and have reduced volumes of emissions; most fossil-fueled electric power plants would be taking sulfur out of the stack gases or burning clean non-polluting gas; new nuclear power plants would be safely underground and out of sight save for their enormous cooling towers; most important, a declining rate of energy expansion would make a

great difference to the environment all across the board, at least as compared to what we are headed for at our current rate of expansion. This would represent a sensible modification of our past craze for growth, and the environment would be the gainer in some respects.

But not in others. Up to now we have behaved as if we had the luxury to have the best of both worlds. We have not made the tough choices. Now the energy emergency makes us choose, and the choices are few. Some environmental prices must be paid: one or more oil superports off the East coast, and added refineries (however pure) inland; the Alaska pipeline with residual risks that even the safest design and procedures cannot avoid; much increased offshore oil development, and much increased coal mining largely from surface sources—which even with the best possible measures would tend for a time to deface the particular area. I do not minimize these costs, but feel them keenly as one who has been active for several years in the scientific effort in support of national and international environment measures. In each case, the trade-off has been weighed, and it seems to me that the gain outweighs the loss.

VII

What I have proposed is a national program for the United States, calculated on the basis of particular American resources and American needs. One of its major purposes is, of course, an international one, to shorten the duration of the costs, pain and strain—and of the dangers to world harmony and peace—that lie in a situation of growing American dependence on external energy sources, especially Middle East oil. But it is primarily the United States that would be hitching up its belt and putting its energy house in order, by measures that do not in themselves harm any other nation.

Is the program, however, not only national but nationalistic? Would it affect the world energy picture indirectly to the disadvantage of others, whether suppliers or consumers? Does it mean an increase in American autarky, fortifying the tendency other countries now see for the United States to take care of its own needs and let the rest of the world go hang?

The answer to all these questions is a resounding "No." This is most obvious if we look at the relations between the United States and the other major industrialized countries, which are

also the major consumers of energy. As things now stand, Western Europe and Japan are inescapably dependent, far more than the United States and far longer into both past and future, on imported oil and gas; if the United States becomes a vastly increased buyer of both, the effect can only be, at best, friction, and, at worst, price wars and preëmptive deals that would cut at the very roots of coöperation between the United States, Europe and Japan. This danger is indeed already visible, and it will take a good deal of statesmanship to avoid it as things stand now; by 1980 or 1985, on present trends, the seeds of strife could be beyond control.

Yet Japan and most of Europe have no alternative comparable to what coal can be for America. Only the United Kingdom, among the major European countries, can meet a significant part of its needs from coal and from North Sea natural gas—and the latter only at the expense of its neighbors' expectations.

Hence these countries should welcome a determined American effort to reduce dependence on the oil sources that are a "must" for them. And the same should hold true for the oil-consuming developing countries, now being badly hurt by the price rises of Middle East oil.

But does this mean that the oil-producing countries would be hurt? I think not. If Mr. Akins and others are correct, the 1980 prospect already assumes that at least two key countries (Saudi Arabia and Iran) will produce more oil, and tap a higher proportion of their predicted reserves, than they may like.[5] To prolong the life of these reserves and to space out the income of the producers can mean a net benefit to most of the producing countries. Their prices will rise in any event in the years to come, but the present prospect of runaway increases in production cannot be attractive compared to a more orderly expansion that prolongs their assets.

Indeed, I would go one step further. I believe that an American program such as I have described could be an essential ingredient in a new approach to the energy situation by the whole international community. On any rational look at the production and consumption of energy all over the world, the United States represents not only a statistical discrepancy and target for the role of villain (six percent consuming 33 percent, and getting greater), but a potential disruptive force in almost every market

[5] Akins, *loc. cit.*, p. 480.

day by day; only if this is brought under control can the United States play any responsible role in the effort that may have to be undertaken within the next decade, or at least by the end of the century—to balance and distribute world energy supplies much more fairly and reasonably than nature or men have ever done to date. For unless we do this there is scant hope for human progress and peace in the long run.

Thus, I propose a program based in the first instance on American national interest. But I deeply believe that this program could make a vast difference to international relations in the next 10 to 20 years, and serve as a step toward a more rational world use of energy for the benefit of man.