DOCUMENT RESUME

ED 205 386 SE 035 435

| | |
|---|---|
| TITLE | Energy, Natural Resources, and the Environment in the Eighties. |
| INSTITUTION | President's Commission for a National Agenda for the Eighties, Washington, D.C. |
| SPONS AGENCY | Department of Energy, Washington, D.C. |
| PUB DATE | 80 |
| NOTE | 67p. |
| AVAILABLE FROM | Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 (Stock No. 041-001-00218-9, $3.75). |
| EDRS PRICE | MF01/PC03 Plus Postage. |
| DESCRIPTORS | Conservation (Environment); *Energy; *Energy Conservation; *Environment; Federal Government; Futures (of Society); Long Range Planning; *Natural Resources; Opinions; *Public Policy |
| IDENTIFIERS | *Environmental Protection |

ABSTRACT

Presented are the findings of a national panel which investigated the present situation and future policy options regarding energy and the environment. Three sections comprise the report: (1) a chapter dealing with energy supply, consumption, pricing and policy; (2) an analysis of environmental issues such as land use, toxic substances, cost-benefit analysis, and government regulation; and (3) a set of criteria against which future directions of society may be judged. Emphasized is the importance of achieving far higher levels of energy efficiency--better ways of using the raw energy resources now consumed. Also stressed is the need to shape a "conserver society" that values conservation, relies primarily upon renewable resources, and recycles much of its material. (Author/WB)

★ ★ ★ ★ ★

PRESIDENT'S COMMISSION
FOR A NATIONAL AGENDA FOR THE EIGHTIES

REPORT OF THE PANEL ON
ENERGY, NATURAL RESOURCES, AND THE ENVIRONMENT



# Energy, Natural Resources, and the Environment in the Eighties

Washington : 1980

2

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

This document was prepared by the Panel on Energy, Natural Resources, and the Environment, one of nine Panels of the President's Commission for a National Agenda for the Eighties. The report represents the views of a majority of members of the Panel on each point considered. Not every member of the Panel agrees with or supports every view or recommendation in the report. This report was prepared by members of the Panel without involvement by members of the Commission who were not members of the Panel. This project was supported by the U.S. Department of Energy, under provisions of Executive Order 12168, dated October 24, 1979. Points of view or opinions expressed in this volume are those of the Panel on Energy, Natural Resources, and the Environment, and do not necessarily represent the official position of the Department.

**Library of Congress Cataloging in Publication Data**

United States. President's Commission for a National Agenda for the Eighties. Panel on Energy, Natural Resources, and the Environment
Energy, natural resources, and the environment in the eighties.

1. Energy policy—United States. 2. Power resources—United States. 3. Environmental policy—United States.
I. Title.
HD9502.U52P35 1981 333.79'0973 81-649
AACR2

# Foreword

As America enters the eighties, our nation faces a world greatly changed from that of even a decade ago. Vast forces are in action at home and abroad that promise to change the lives of all Americans. Some of these forces—such as revolutionary developments in science and technology—hold out hope for longer life, labor-saving mechanisms, exploration of the universe, and other benefits for all peoples. Other forces—such as the growing demand for strategic raw materials under the control of supplier cartels—raise serious problems for all nations. At home, we face serious and unresolved issues in the social and economic structure of American society.

On October 24, 1979, President Jimmy Carter established the President's Commission for a National Agenda for the Eighties. His purpose was to provide the President-elect and the new Congress with the views of 45 Americans drawn from diverse backgrounds outside of government. The group is bipartisan, representing business and labor, science and the humanities, arts and communication. Members of the Commission are experts in many fields, but possess no special expertise in predicting the future. Rather, we have done our best to uncover the dynamics of American society and world affairs that we believe will determine events in the eighties. This report of the Commission, *A National Agenda for the Eighties*, sets forth our views.

The analytical work of the Commission was accomplished by 9 Panels, each consisting of 5 to 11 Commissioners with appropriate staff. The Panels probed into major subject areas designated by the President in the Executive Order that created the Commission, as well as other areas that the Commission itself determined should be on the agenda. This approach gave Panel members an opportunity to gain considerable familiarity with complex subject matters, and provided the full Commission with a wide range of information not otherwise attainable in the 13 months available for this study.

The Panels are responsible for their own reports, and the views contained in any Panel report do not necessarily reflect the views of any branch of government or of the Commission as a whole.

William J. McGill
Chairman

La Jolla, California
December 31, 1980

# Preface

Our conclusions are simple, stark, and painful. There are no "magic barrels." There is no easy technical or resource fix; neither synfuels, nor new finds, nor solar energy. For the next decade we will have to make do with what we have, and our main hope is to increase energy efficiency; for that is the meaning of conservation.

We say this mindful of the belief that all that is necessary is to "get the government off our backs," to relax regulations, to release the market price of oil and natural gas, and new supplies will come gushing into the market.

We do not think this will be so. There is economic logic to the release of price controls—if phased out so that consumer and industrial markets are not disrupted. And this is being done. The price of a product should reflect its full economic—and in the case of oil, its full political—cost; otherwise there are serious disruptions in the patterns of use. But that is a different matter from saying that the release of prices will easily stimulate large new supplies. In the case of natural gas, some wells that have been kept out of production will come into the market as prices allow producers to pay the marginal costs of production. But that is a far cry, especially in the case of domestic oil, from saying that large new gushers or new fields will come forth to keep us warm in the winter and cool in the summer. The evidence we have seen does not warrant such a claim.*

We say all this to emphasize the continuing seriousness of the problem. We paid dearly in the 1970s for the cycles of hysteria and cynicism, when momentary shortages and momentary gluts created alarm and then apathy. The energy problem is not primarily one of shortages; it is one

* It is said that the release of federal lands, held largely for scenic or environmental reasons, would allow large new supplies to come on the market. That too may be a deception. For one thing, such an argument ignores the large spoliations of the environment—and in the case of land the environment is also the economy. It ignores the large social costs—in expanding communities, new infrastructures, demands on limited water supplies—that such new production might entail. And if these costs are not reflected in the market price, we are fooling ourselves as to what we would be obtaining.

of a stable source of supply and a stable set of costs. Without those two factors there can be no long-range investment by any corporation or municipality in the country. And without that stability and investment our economic growth, which is necessary to meet our rising needs, is imperiled.

How then, should we think about energy? We emphasize three points:

- ☐ Different timeframes dictate different priorities. There are the next 5 to 10 years, when the focus must be on energy efficiency. And there are the next 10 to 20 years, when we have to develop diverse sources of energy supply.
- ☐ Energy efficiency, or conservation, is not the simplified stunt of turning out an unneeded light. It means a sustained effort in all fields, from automobile usage to home insulation, to be more efficient, and therefore to save energy and money, in the use of fuels. More than that, it has to be an effort to allocate the diverse kinds of energy more rationally, in accordance with end-product use and with the different geography of the country. Thus, it is clear that we have and will continue to have an automobile economy; cars and trucks are the dominant mode of transportation in the country. For this reason, transportation should have priority in the use of liquid fuels. Natural gas should be devoted chiefly to residential and commercial space heating and to industrial specialty use. And electric generation and industrial process heat should be provided by coal, as well as by existing nuclear and some hydropower facilities.
- ☐ Given the rapid changes in the nature of technology and resource adaptability, it would be unwise in the long run to concentrate on a single field, such as synfuels, to provide new sources of supply in place of a dwindling or insecure long-term oil supply. We have to emphasize experiments and alternatives in the light of market use and costs.

There is little that is dramatic in any of these reviews and proposals. We have sought to avoid ideological simplicities or utopian fancies. A complex problem has to be understood in its complexities.

This report has been accepted by all the members of the Panel, although individuals inevitably differ as to the exact weight that should be given to one or another proposal or conclusion. Yet all agree upon the central assessment.

The work of the Panel has been possible only because of the quality of its staff, in particular that of

C. Richard Corrigan, who has carried the major burden of reviewing the material on energy and making the conflicting evidence intelligible to the Panel. We have been fortunate because Mr. Corrigan, a trained analyst and reporter, has covered the energy field for several years for *National Journal*. He has learned to discount the forecasts made so confidently in previous years, to understand and weigh the partisan claims of special-interest groups. We owe him a large vote of thanks.

Mr. R. William Potter, a young lawyer, carried the burden for a time of preparing the material on the environment, but had to leave before the conclusion of the report; we thank him for his contribution. The Panel also appreciates the help of Robert Hamrin and William E. Jordan, who contributed to the environment section, and the work of the Commission's administrative staff, especially Lourie A. Russell-Kawecki and Debra K. Amick.

Commissioner Thomas C. Jorling has brought a special point of view to the environmental questions, a view gained from his experience in government; some of his probing, philosophical questions are printed as a separate statement.

Daniel Bell

Daniel Bell
Panel Chairperson

Cambridge, Massachusetts
December 31, 1980

# Energy
NATURAL RESOURCES, AND THE
# Environment

**Chairperson**
Daniel Bell
*Professor of Sociology*
*Harvard University*

Philip Handler
*President, National Academy of Sciences*

Thomas C. Jorling
*Professor of Environmental Science, Williams College*

Theodore R. Marmor
*Professor of Political Science and Public Health, Yale University*

Michael McCloskey
*Executive Director, Sierra Club*

Edmund D. Pellegrino
*President, The Catholic University of America*

Henry B. Schacht
*Chairman, Cummins Engine Company*

**Senior Professional Staff**
C. Richard Corrigan

TABLE OF
# Contents

# Introduction

It is the conclusion of this Panel that U.S. energy policy for the 1980s should be directed, as the first order of business, toward achieving far higher levels of energy efficiency.

The nation will need substantially more output from its resources in order to maintain economic growth. The Panel believes that greater energy efficiency—that is, better ways of using the raw energy resources now consumed—offers the most significant opportunities for meeting the rising demand for energy. The conservation of energy through old and new techniques and technologies ought to be regarded as an alternative source of supply, especially in meeting the demand for liquid fuel. Conservation simply represents the cheapest, quickest, surest, and least risky way to restrain the nation's requirements for energy in general, and for imported oil in particular, in the 1980s.

Not the least of conservation's attractions is the lessening of a multitude of environmental impacts and threats, as compared to those to be expected from virtually all other energy sources. There are also advantages to national security that can be obtained through energy conservation.

Strictly on economic grounds, energy conservation deserves the highest priority in national energy policy through the 1980s. The assignment of top priority to energy conservation makes necessary a true commitment to this objective by the federal government. This would mean that the executive branch and Congress, having already made the decision that many billions of dollars in public funds should be funneled into the energy sector, would support energy-saving initiatives with a much larger share of federal resources than has been allocated so far. Energy-producing ventures, such as synthetic fuels projects, would be accorded a considerably smaller share than is now contemplated.

In other words, this Panel contends that if public funds are to be invested in the energy sector, they should go where they are likely to elicit the greatest and most immediate return—that is, mainly into energy conservation. They should not be disbursed to the most costly, and least promising, energy production technologies. To a great extent, the Panel expects the nation to achieve higher energy efficiency in many sectors and markets without additional Federal subsidies or directives. Indeed, there is evidence that energy efficiency already is improving at a pace that is not widely recognized. It is this trend that the Panel seeks to encourage.

The Panel does not claim that improvements in energy efficiency will represent the sole solution to the nation's energy predicament, which has been developing for many years and will take many years to resolve.

There is a very real possibility, for example, that this nation will be confronted with interruptions in deliveries of oil from abroad during the 1980s. Voluntary conservation measures obviously would not be sufficient to cope with sudden shortages of any magnitude. Government-enforced rationing, as well as the use of oil from a well-stocked Strategic Petroleum Reserve, would be necessary to deal with such an emergency.

There is also the very likely prospect that world oil prices will continue to rise, and there is no guarantee that any energy policy would avoid further economic shocks such as those already sustained. But reductions in U.S. requirements for imported oil, which higher levels of energy efficiency certainly could achieve, would mitigate the adverse effects of supply interruptions or price hikes and lengthen the odds against such occurrences.

Expectations of an early end to the nation's energy predicament through a surge of new supplies from any single domestic source or combination of sources—nuclear power, oil, natural gas, coal, solar energy in all its forms, or synthetic fuels—have been overblown and unwarranted. It is because this Panel sees no early solution on the supply side that it looks to improvements in energy efficiency as the most pragmatic short-term response. At the same time, research and development programs should be accelerated to assess the potential of alternative energy sources, especially renewable resources.

The Panel approaches the cluster of energy issues with some measure of humility. Over the past decade, there have been countless attempts to craft a national energy program; doubtless there will be more such undertakings during the 1980s. Those engaged in these exercises have found that energy forecasting is a most inexact science. Very few analysts have anticipated the actual course of events in the production, consumption, control, and pricing of energy. Because the future is open to definition, the situation demands that proposals be offered or considered by all who have a stake in what happens next—in other words, by all Americans.

No one is truly qualified to pose as an expert on energy, if the broad reach of energy-related topics is taken into account; but no one can be excused or excluded from joining the debates, either. The issues involve much more than geology, or economics, or engineering, or any other single field of inquiry, and really present questions about which values the nation prizes and which risks it is willing to take. In the end, the public will be setting its own energy policies by the actions taken in the marketplace, in the conduct of personal and community and business life, and in the political arena.

## The Environment

It may be that no other domestic policy challenge of recent times has been addressed as forcefully and quickly, and with such notable progress, as has the task of halting the degradation of America's environment.

In the 1970s the United States entered into a long-term commitment to restore and protect the quality of the environment. The signing of the National Environmental Policy Act (January 1, 1970) signaled the start of a decade of legislative and administrative initiatives at all levels of government. At the federal level alone, some 20 major environmental laws were enacted during the decade. The control of pollution and the preservation of natural resources became major items of public business.

This commitment to environmental quality was manifested by the adoption of national air and water quality standards, by the investment of federal funds in the construction of sewage treatment plants on a massive scale, and by the establishment of two federal agencies, the Council on Environmental Quality in the Executive Office of the President and the Environmental Protection Agency, to monitor developments and to enforce standards.

Significant results have in fact been achieved. The air is indeed cleaner: data on ambient air quality in most major metropolitan areas indicate that levels of pollution have been reduced through the enforcement of emissions standards on stationary and mobile sources. And the water is purer: measurements of water quality show continuing declines in pollution levels as a result of restrictions on industrial discharges and improved treatment of municipal wastes. The benefits accruing from these programs include a healthier environment as well as a more pleasant one.

This is not to say that pollution has been brought under control, or that the environmental objectives that have been set will soon be reached. In the changing economic conditions of the 1980s, the nation will be facing complex questions about the costs of attaining further reductions in pollution and of minimizing hazards to human health, while confronting mounting pressures on the domestic and global environment.

The context in which environmental issues are dealt with today differs from that of the early 1970s. As the 1970s began, Americans seemed to believe that the environment could be cleansed rather quickly. The 1980s are likely to be characterized by a greater appreciation of the magnitude of this task. After roughly a decade's experience with the Clean Air Act, the Federal Water Pollution Control Act, and other environmental laws, it has become apparent that controlling pollution is neither simple nor cheap, and that the pursuit of environmental objectives may result in clashes with other national goals.

As these control efforts continue, controversies inevitably will emerge over how high a priority should be attached to a cleaner envirnment, or how quickly (and at what cost) a specific environmental standard should be attained. The U.S. economy suffers from high inflation and stagnant economic conditions, and it might be expected that the public interest in environmental goals would slacken. But there has been no indication that support for pollution control programs has faded. Public opinion surveys consistently indicate strong backing for government efforts to protect the environment, even as the costs of compliance have risen. There is, however, a wider recognition that these policies may have a marked effect, positive or negative, on efforts to achieve various other national objectives.

At what point might trade-offs between environmental goals and other national priorities be necessary? That will depend on essentially political judgments, to be made when the relative values of national objectives come into conflict. There is no rule by which the value of environmental quality can be assessed.

The costs of controlling pollution represent government-mandated corrections to the traditional workings of the marketplace. In the past, polluters used common resources—air, water, and land—as free receptacles for their wastes. The degradation of these resources reduced their value to the public, although an accounting of these losses had not appeared in the nation's economic indices.

In the 1970s the United States began to require polluters to internalize the costs associated with the abuse of these resources. Now those responsible for pollution are being held accountable for preventing, minimizing, or repairing the damage. The costs of control are added to the prices paid by consumers for the goods and services produced with these resources.

As the cost of compliance with environmental standards rises, users will tend to curtail their most resource-intensive processes and to raise the prices of their most resource-intensive goods and services, leading to reduced production, lower demand, and less pollution. In some instances, users will be unable to recover their additional expenses because of market conditions; if they cannot otherwise adapt their operations to offset the extra costs, the effect will be to curtail or halt the use of that resource.

Environmental standards are not always incorporated smoothly into the workings of the economy. They can have disruptive effects on employers, employees, and communities, and federal assistance may be necessary to help relocate or retrain workers who lose their jobs as a result of federal environmental standards. When an environmental standard appears to threaten the economic viability of an industrial facility—to cite the most extreme, and relatively rare, instance of conflict—society then is faced with the question of whether the standard is worth enforcing.

There can be no fixed rules for settling such questions. In light of the expressed national interest in protecting and improving environmental quality, the political process seems to have put the burden of proof on those who seek a weakening or postponement of environmental standards. In circumstances that present a clear threat to public health, the enforcement of environmental standards must take primacy. The safeguarding of natural resources has become a continuing responsibility of the public and private sectors, and should not be regarded as easily expendable.

The nation's commitment to a cleaner environment is not absolute, but it has been given a high priority. Only in some few instances should action be deferred because of serious and irreconcilable conflicts with other objectives. That is the legacy of the first environmental decade.

The environmental objectives that were set in the 1970s are likely to remain goals for the 1980s; however, the methods used to attain them might be changed. The environmental regulatory system is a new one, and some variations in approach may be warranted to make the system work more effectively and with less discord. More significantly, future gains in energy efficiency resulting from rising energy prices can be expected to limit the pollution that would have occurred had energy consumption followed its previous high growth rate. The moderation in demand for raw energy resources may prove to be the most effective means of protecting environmental quality, because so many environmental problems are associated with the production, the transmission, and the consumption of energy.

Chapter 1

# THE Energy Predicament

This Panel begins its assessment of the energy situation with a sense that the dimensions and character of the problem have not been well defined. As the nation moves into the 1980s, an appreciation of the long-term nature of the energy crisis is in order.

There has been widespread doubt, reflected in public opinion surveys, whether the nation really faces a crisis and, if so, what the nature of the trouble is, what caused it, and how it should be handled. In the absence of a common understanding of the problem, it is not surprising that corrective actions have been difficult to find.

The Panel wishes to emphasize that there are several timeframes involved in effecting a massive transition in U.S. energy systems. The present predicament arose from a complex combination of events and circumstances, including the fact that this country's known reserves of crude oil are running dry. The problem should not be regarded as something that can be cured with any magic formula within the next 10 years.

It could be said that the United States brought its predicament upon itself by failing to husband its immense natural resources more wisely, by failing to prepare sooner for a transition from a petroleum-based economy, and by failing to anticipate the impact of its massive intrusion into the world oil market. The United States can, however, if time and circumstances allow, accommodate itself to the closing of the era of cheap energy.

## Consumption Patterns

In evaluating the present energy situation, it is useful to break down national consumption figures by principal sectors and regions to show how much energy, and what kinds of energy, are being used for which purposes.

Aggregate figures show that total U.S. energy demand increased sporadically during the 1970s before leveling off in 1979. Demand in 1979 totaled about 79 quads (quadrillions of British thermal units).* A closer look at the

* A British thermal unit (Btu) is the amount of heat needed to raise the temperature of one pound of water by one degree Fahrenheit.

numbers reveals that virtually all of the growth in energy demand during the 1970s occurred within two categories—in the generation of electric power, and in the transportation sector.

The transportation sector is a special case, because it operates almost exclusively on oil. Private automobiles account for about 55 percent of consumption within this sector; trucks, 24 percent; planes, 8 percent; railroads, 4 percent; and buses, less than 1 percent, with other forms of transportation (pipelines, ships, etc.) making up the balance.[1]

The private automobile almost surely will remain the principal means of transportation through the 1980s and beyond, although other vehicles offer far more energy-efficient methods of transportation. Past government policies—including the issuance of government-insured mortgages that spurred the great postwar growth of suburbia, and the construction of the interstate highway system with the proceeds of motor fuel taxes—virtually guarantee that the car will continue to dominate the nation's transportation system through the end of this century.

Moreover, gasoline consumption is highest in the fastest-growing regions of the nation, in the Sun Belt states that are not well suited to fixed mass-transit systems. Two states, California and Texas, account for 18 percent of U.S. gasoline consumption; New York State uses about half as much gasoline as California.[2] About one-third of all gasoline, according to government estimates, is used for commuting to and from work. Three-fourths of that fuel is used by workers who live 10 miles or more from their jobs. More than half the nation's jobs now are located on the fringes of major urban areas rather than inside central cities, where mass-transit systems are concentrated.[3]

The other three end-use sectors, in statistical portraits of U.S. energy use, are residential, commercial, and industrial. These three sectors showed very little change during the 1970s in total energy consumption, except for their increased use of electric power. In addition, these sectors actually consumed much less electric energy than is attributed to them; approximately two-thirds of the raw energy that goes into the generation of electric power from fossil fuels is lost in conversion and transmission, and is never delivered in the form of electric power. Thus, the nation is really using less energy than is commonly recognized. This loss of delivered energy is one drawback to be considered in energy policies that are designed to stress heavier reliance on electric power.

In the industrial sector, which is the No. 1 user of energy, consumption is concentrated within two regions and a small number of manufacturing operations. According to one government survey, nearly half the energy used by the U.S. industrial sector in the mid-1970s was consumed in two of the nation's nine census regions—the West South Central area (Arkansas, Louisiana, Oklahoma, and Texas) and the East North Central industrial belt (Illinois, Indiana, Michigan, Ohio, and Wisconsin). In 1974, industries in these two regions used a total of 9.9 quads, half the 20.1 quads used by the industrial sector nationwide.[4]

On a nationwide basis, according to the same survey, the chemical industry accounted for one-fourth of total industrial energy use, or 5.2 quads; the primary metals group (steel, aluminum, and others), 4.8 quads; petroleum refining, 3.1 quads; and the paper industry, 2.2 quads.[5]

These figures illustrate the importance of oil to the U.S. economy and in the U.S. energy mix, especially in transportation and in certain oil-based industries such as petrochemicals and refining.

## Supply Patterns

The roots of the U.S. energy predicament may be said to lie in the shrinking domestic base of conventional crude oil, the nation's primary energy source. Oil production began falling at the start of the 1970s, and despite a short surge in output when oil from Alaska's North Slope began flowing, the slump appears to be irreversible.

Most government, industry, and academic studies agree that conventional crude oil production is on a downhill course. Recent projections by the Central Intelligence Agency, the Department of Energy, the General Accounting Office, the Congressional Budget Office, Resources for the Future, Exxon and Shell, to cite several of these disparate sources, indicate that there is very little hope for a resurgence.

U.S. oil production reached a peak of 11.3 million barrels a day in 1970. (One million barrels of oil a day equals roughly 2 quads a year.) Output dropped to a low of 8.1 million barrels a day in 1976, and then, by the first few months of 1980, had climbed back up to 8.7 million barrels a day. The rebound was due to the 1977 start-up of production on Alaska's North Slope, with Alaskan oil in 1980 flowing at a rate of 1.6 million barrels a day. Without this contribution, U.S. production would have been only 7.1 million barrels a day.[6]

The record-setting reserve at Prudhoe Bay was discovered in the late 1960s; nothing approaching the magnitude of that 10-billion-barrel bonanza has been reported in this country since, despite the enormous increase in the value of oil and sharp acceleration of drilling activity. U.S. proven reserves of crude oil have dwindled over the past 10 years. At the end of 1979 the oil industry listed such reserves at 26.5 billion barrels, representing only about 8 years' supply at the current rate of production.[7]

Demand for oil continued to rise sharply in the early 1970s, resulting in the abandonment of the Mandatory Oil Import Quota program in spring 1973. The percentage of imported oil in the nation's total oil supply rose sharply, nearly reaching the halfway point by the late 1970s; domestic output simply could not satisfy consumer demand. The entry of the United States as a major buyer in the world oil trade allowed the member nations of the Organization of Petroleum Exporting Countries (OPEC) to raise their prices and collect the profits associated with a sellers' market. U.S. importers were competing with European and Japanese buyers, among others, for access to limited supplies.

*Dependence on Imports*

This nation's mounting reliance on imported oil, especially from the volatile Middle East, also subjected the United States to the hazard of interruptions in supplies through political or military action. The oil embargo of 1973-1974 and the curtailment of Iranian production in 1979 caused serious economic shocks to the United States and demonstrated the risks involved in such reliance on Middle East oil.

**Energy Pricing Policies: The 1970s**

During the 1970s the U.S. government sought to assemble a set of national energy policies that would respond to the oil embargo and the escalation of world oil prices. The government manifestly was unprepared to deal with the challenge. In the succeeding years, the going was slow, the debates were bitter, and the energy situation in many respects got worse.

A full review of the energy policy pronouncements and laws of the 1970s is beyond the scope of this report. But one point to be made is that there has been an underlying divergence of opinion between the government and the governed on a crucial matter of energy economics—that is, on the question of whether energy is underpriced or overpriced.

The past three Administrations have based their recommendations at least in part on the proposition, often unstated, that energy has been too cheap, and that consumers ought to pay the true price of fuel and power—that is, a price related to the energy-equivalent value of a barrel of imported oil. The public's reading of the energy problem, it seems safe to say, has been exactly the reverse: energy prices have risen too high. Government officials have never presented a strong case directly to the public on the counterproductive effects of price controls, and policies designed to push prices even higher thus appeared to be ill-advised and harmful.

Economic theories dictate that energy be priced at its replacement cost, that is, the going rate for the next available unit of supply. If prices are held below this replacement level, consumers will not receive the proper signals in the marketplace, and will consume more energy than they or the nation as a whole can afford. Energy producers, meanwhile, will be disinclined to meet demand if they cannot receive what they regard as the real value of their products in the marketplace because of price controls.

In practice, these theories can result in rapid, across-the-board price increases throughout the economy as domestic energy prices rise to world prices. If price controls during the 1970s held domestic oil at an artificially low level, it is also true that the OPEC cartel abruptly lifted prices to an artificially high level in relation to the true cost of getting oil from existing fields. OPEC prices have been based instead on an assessment of the real value of this finite resource in an oil-dependent world.

In the United States, two recessions, soaring inflation, a sharp drop in the dollar's value, and a large increase in the U.S. trade deficit have been attributed to the consequences of OPEC's actions. Even with price controls holding down the prices of domestic fuels, energy prices rose precipitously in relation to the prices of other goods and services. The Consumer Price Index, starting at a base of 100 in 1967, increased to 217.4 at the end of 1979; the energy component of that index, also starting at 100 in 1967, reached 275.9. The Producer Price Index, a measure of wholesale prices, rose from 100 to 236.3 over the same period; its energy component jumped to 408.1.

It is clear that higher prices have undermined economic growth outside the energy-producing sector. The Council of Economic Advisers has attempted to quantify the "net oil drag"—that is, the increased transfer of wealth from oil consumers to foreign and domestic producers, minus the funds that oil producers are expected to put back into the U.S. economy. According to the Council, the net oil drag increased by $53 billion in 1979 and was expected to increase by an additional $24 billion in 1980. (That was on the basis of 1979 year-end oil prices, which have since gone up still higher.) By the end of 1980, the net oil drag was expected to have increased over a 2-year span by an amount equal to 3 percent of the nation's gross national product (GNP).[10]

By insisting on lifting price controls on domestic oil slowly, Congress has allowed U.S. consumers to avoid paying the full current rate for energy supplies, and U.S. reliance on imported oil probably increased as a result. But it could also be argued that Congress bought time for the nation to adapt itself to the new era of high-priced energy, and that the economy benefited temporarily from this gradual education in energy economics. All domestic crude oil will be decontrolled by October 1981, and new natural gas will be exempt from controls by 1985, according to current schedules.

If U.S. production of crude oil continues to decline, as is expected, large amounts of energy from other sources will be required simply to maintain the present energy supply. Suppose, for example, that U.S. production of crude oil drops by 1 million barrels a day by the close of this decade. This is not a worst-case estimate; it is a conservative projection based on available data. To replace the amount of energy contained in 1 million barrels a day, which is the yearly equivalent of approximately 2 quads, the following would be needed:

## Policy Options for the 1980s

- ☐ Construction of up to 100 new nuclear power reactors of 1,000 megawatts each (more reactors than are presently in service); or
- ☐ Mining roughly 400 million extra tons of coal each year, representing an increase of one-half the current production rate; or
- ☐ Operation of 20 synthetic fuel plants, each capable of producing 50,000 barrels a day of fuel from coal or shale; or
- ☐ Delivery of an extra 2 trillion cubic feet a year of natural gas, or more than one-tenth of the current production level of this fuel.

Little of this energy could be substituted directly for oil. These figures illustrate the massive demands that would be placed on other resources merely to maintain the current level of U.S. energy production. A wait-and-see policy will not suffice. Nor will longer-term policies, although necessary to help effect a transition to renewable resources, be of much help between 1980 and 1990.

Assuming this forecast of a drop of 1 million barrels a day in U.S. oil production during the 1980s, the following options are available for consideration: additional reliance on imported oil; all-out production of conventional fuels; quick transition to renewable resources; or a stronger commitment to energy conservation.

### *More Imports*

Since the 1950s, the U.S. government has spoken of the national security advantages of self-sufficiency in energy production. Clearly, the United States cannot allow itself to become overly dependent on imported oil, which is expensive and unreliable. Such reliance makes this nation vulnerable to political blackmail and economic warfare, and heightens the risk of military confrontation in a worldwide scramble for access to oil supplies. Yet this is, in practice, the policy the United States has been following since the domestic production of oil began to drop. During the 1970s, annual imports rose by as much as 250 percent over the 1970 volume.[11]

The United States can continue to meet its energy requirements by bidding for more oil on the world market. This course need not be as reckless as it sounds. While buying more oil abroad, the nation could seek to diversify the sources of the oil, and at the same time commit itself to buying oil for the Strategic Petroleum Reserve as insurance against interruptions in deliveries.

One troubling aspect of this policy is that there might not be enough oil for sale around the world to meet the needs of the United States and other nations. Much will depend, of course, on decisions reached by oil-exporting countries as to the speed with which they will tap their reserves. Much will depend, too, on the success of exploratory drilling in frontier regions, which might add considerably to total production capacities.

Non-OPEC nations outside the Communist sphere can now produce a little more than half as much oil as the OPEC nations, whose total production capacity is estimated at 32.6 million barrels a day. This represents a non-OPEC production increase of one-third since 1976.[12] The OPEC cartel still dominates the market, but other suppliers are weakening its control.

Whether the non-OPEC nations will continue to boost production during the 1980s is an open question. Some observers expect that non-OPEC output will rise as high as 30 million to 40 million barrels a day by 1990, and expect a worldwide oil glut. Others are not so sanguine. One specialist suggests that total world oil production, including OPEC and non-OPEC oil, will peak during the 1990s. Oil-producing nations could not be expected to raise their production rates in the meantime if oil's value is likely to keep rising. Exxon expects that, even with a substantial rise in non-OPEC production, total world output will level off by the year 2000.[13]

It should be kept in mind that non-OPEC oil is not any cheaper than OPEC oil; indeed, North Sea oil is priced at a premium. And it is doubtful that any oil-producing nation would deliberately lower world prices by flooding the market.

Another factor to be considered is that the developing nations of the world will need an ever larger share of whatever oil may be available. The United States, which rapidly became the world's leading oil importer during the 1970s, may antagonize both developed and developing nations by bidding for additional supplies and thus provoking further increases in oil prices.

The oil-importing nations, including the United States, damage one another by bidding for oil amid fears of a shortage. The 1979 Iranian production cutback led to a doubling of world oil prices, although world oil production actually was higher than in 1978, because of panic buying by companies, governments, and individuals.[14] Increased reliance on imported oil by the United States might lead to worse consequences in the next real or perceived emergency.

Even at current import levels, the United States is not prepared to cope with a major interruption in supplies. Emergency conditions might require the imposition of a rationing program, which the government does not yet seem in a position to conduct. The United States should also develop, in concert with other oil-importing nations, a workable and equitable oil-sharing arrangement for possible emergency use.

This Panel cannot guess at how much oil remains to be found in the world, or how much of it eventually will be brought to market, or at what price, in both economic and political terms. Because the uncertainties are so great and the risks so high, the Panel concludes that a national policy—whether explicit or implicit—of relying on additional purchases of imported oil to meet future U.S. energy demand cannot be pursued. However, this does not mean that the U.S. government, and U.S.-based oil firms, should not help expand worldwide production capabilities, or seek access to some of the new supplies that may become available. Among the opportunities to be pursued are further development of petroleum reserves in this hemisphere, notably in Mexico, Canada, and Venezuela.

The United States should not abandon efforts to buy oil for the Strategic Petroleum Reserve, which currently contains less than 100 million barrels, about two weeks' supply of imported oil. The Panel recommends that the next Administration exercise every effort to obtain more oil for the Reserve, unless market conditions are such that purchases would have clear and immediate adverse effects on world supplies and prices.

Drawing oil from the Strategic Reserve could only lessen the immediate effects of a severe shortage, however; the existence of a fully stocked reserve would not provide sufficient insurance for this nation to look abroad for extra energy as a long-term policy.

*More Conventional Fuels.*

The next option to consider is a stepped-up effort to increase production from other conventional domestic resources.

Few would quarrel with the objective of increasing the percentage of domestic resources in the U.S. energy supply mix. The relevant questions are how much energy, and what kinds of energy, the United States will require; what contributions can reasonably be expected from conventional nonrenewable resources toward meeting this demand; and what economic and environmental costs would be incurred in trying to increase present rates of production. Certainly the idea of quickly reaching national self-sufficiency, as outlined by President Nixon in his "Project Independence" speech in 1973, has since been widely dismissed as unrealistic.

**Oil.** The Panel assumes that production of crude oil will drop by at least 1 million barrels a day during the 1980s. Higher recovery rates from some reserves and new discoveries in frontier areas at best may partly offset a steady decline in output from producing fields. The United States cannot count on oil that has not yet been found inside its borders to maintain its current production level.

**Natural Gas.** As is the case with oil, proven reserves of natural gas declined during the 1970s despite rising prices and a resurgence in drilling activity. According to the American Gas Association, proven reserves at the end of 1979 totaled 195 trillion cubic feet, representing only a 10-year supply at the current production rate.[15] There are recent indications that newly tapped reserves may stabilize the gas supply. Some of the new production comes from small pockets of gas that previously were not considered worth developing. In the Appalachian area, for example, a small-scale boom has improved local supplies.

It is also possible that sizable new supplies can be extracted from very deep reservoirs, from once-impenetrable formations, and from geopressurized brine. Still, there are no guarantees of adequate long-term supplies. Gas producers have been offered special incentives to develop new supplies under the current regulatory framework, but there is no assurance that recoverable resources will expand appreciably.

One project that deserves special mention is the proposed Alaska Highway gas transportation system, which would provide the biggest addition to national supplies of any energy supply project now pending. This pipeline network would carry more than 2 billion cubic feet of gas a day from Alaska's North Slope to markets in the Midwest and on the West Coast, tapping a reserve estimated at 26 trillion cubic feet. Its construction is expected to cost more than $20 billion, a record expense for a commercial venture.[16]

The Panel recommends that Congress reach an expedited decision whether, and how, development of this pipeline system should take place. The lead times involved in construction already guarantee that North Slope gas cannot be brought to markets until late in the 1980s, and the question of how the project will be paid for, if it is to be built, should be settled quickly.

**Coal.** U.S. coal reserves are more than adequate to meet the nation's energy requirements under any conceivable circumstances, in terms of Btus. But the direct use of coal can take care of only a small portion of total U.S. demand, because so much of the economy now is geared to run specifically on oil.

At present, approximately three-fourths of U.S. coal production is used in electric generating plants; most of the rest is used in industrial boilers or is exported. Coal was virtually driven out of the residential and commercial sectors years ago by oil and natural gas, and by diesel fuel from the transportation sector. In recent years, use of coal within the industrial sector has dropped, from 4.4 quads in 1973 to 3.6 quads in 1979. Because the largest potential U.S. customers for coal over the next several years are electric utilities and certain industrial users, there are obvious limits to the likely expansion of coal sales in domestic markets.

The Powerplant and Industrial Fuel Use Act of 1978 requires that new electric-generating plants be powered by coal or nuclear energy rather than by oil or natural gas. This gives coal a clear government-sanctioned advantage over its two major competitors. Large industrial boilers also are covered by this law, so that coal ought to capture new orders in this market. Utility and industrial boilers already in service that are deemed capable of burning coal also are affected. Otherwise, however, there is not much domestic market territory for coal to penetrate, without new technologies to process coal into synthetic oil or gas, or to make possible the direct conversion of coal to electricity at competitive prices. The utility and industrial markets, as big as they are, are small in relation to the total U.S. energy picture and in their short-term capability to use more coal. The oil that is used in the generation of electricity, for example, amounted to 1.4 million barrels a day in 1979, almost 3 quads—a substantial figure, but still only about one-twelfth of all oil consumption.[17] Coal now is the prime source of fuel for generating electricity. In addition, the lead time for construction of a coal-fired power plant is about 10 years, meaning that coal's domestic potential for the 1980s already has been fairly well defined.

Coal exports have risen since the most recent oil price increases, because U.S. coal now can be burned in industrial and utility boilers in Europe and Japan at a competitive cost. If a brisk export business can be sustained, overseas sales of U.S. coal would help to offset the economic drag of purchasing imported oil. One recent study claimed that the United States could dominate a fast-growing world coal market, just as Saudi Arabia has been the most decisive participant in world oil trade.[18]

However, there are still many factors militating against a strong expansion in U.S. coal production. These include the safety and environmental hazards associated with the mining and burning of coal, the lack of adequate transport systems to move more coal into U.S. markets or to export terminals, and the threat of long-term changes in climate as a result of carbon dioxide emissions.

**Nuclear Power.** It is now apparent that nuclear power will not deliver nearly as much energy before 1990 as was once expected, and that its future role in the nation's supply mix is likely to be quite limited. A drastic reduction in projections for new nuclear plants has taken place, with electric utilities canceling or deferring orders for new reactors. The causes include rising construction costs, slowing demand for electric power, and new regulatory requirements that were imposed after the 1979 accident at the Three Mile Island power plant.

Nuclear power plants were providing about 10 percent of the nation's electricity in mid-1980, with 74 reactors listed in operation. There were 176 units in operation, under construction, or on order. In 1975, the total of operating and planned units was 236.[19]

Such factors as the widespread fears about reactor safety, the continuing absence of an acceptable system for long-term disposal of nuclear waste, and doubts about the adequacy of U.S. uranium reserves to support a major expansion of light-water reactor operations, led the Panel to conclude that the nuclear option cannot be expected to provide any more energy than is already scheduled, for the foreseeable future.

**Synthetic Fuels.** Production of synthetic fuels on a commercial scale has not yet begun in the United States; apparently, these fuels do not yet represent a sound investment to private industry. The per-barrel-equivalent cost of extracting oil from shale, or oil or gas from coal, will certainly be far higher than the actual cost of producing conventional crude oil. Evidently this cost is expected to be even higher than the inflated price at which oil sells today.

Much of the research, development, and demonstration work in oil shale processing, coal liquefaction, and coal gasification has been sponsored wholly or in part by the federal government, with marginal results. No company or combination of companies has yet been willing to plunge into construction of synthetic fuel projects at its own risk. This hesitation of the private sector stems in part from the possibility that world oil prices might fall by the time production of synthetic fuels could commence.

The federal government has offered additional inducements to the private sector to engage in synthetic fuels production. The Energy Security Act of 1980 authorizes subsidies of up to $88 billion in the form of federal loans, loan guarantees, price supports, and direct investments in commercial-scale projects as part of a long-range development effort. This legislation sets a national goal of producing the equivalent of at least 500,000 barrels of oil a day in synthetic fuels by 1987, and 2 million barrels a day by 1992.

There are two attractive qualities to oil-rich shale. First, as is the case with coal, there is a great deal of it in the United States. Second, if the technologies work as hoped, shale will provide a liquid fuel that could readily augment supplies of conventional crude oil. Synthetic oil from coal, or synthetic gas from coal, likewise might provide welcome additions to the nation's energy supply. Because the nation's most pressing energy problem over the next decade is likely to be a deficiency in oil production, the synthetic fuels option has obvious appeal.

However, this Panel believes that the executive branch and Congress, by proposing vast subsidies for synthetic fuel development, have erred by allocating public funds on a basis of expense rather than opportunity. If these projects really require federal aid on such a massive scale, this simply confirms that they are still regarded as too costly to compete on their own. By using taxpayers' dollars to launch a synthetic fuels industry, the government may be committing itself prematurely to the least economic way of resolving the energy problem. At best, this is a choice whose full costs cannot yet be estimated. These costs include the direct costs of federal and private capital, the indirect costs of the energy that will be expended in the operation of a synthetic fuels industry, and the opportunity costs of the higher benefits that might be realized by using that money and energy elsewhere.

The Panel recognizes that federal assistance might be needed to test the commercial viability of synthetic fuels, even should cost estimates indicate that these fuels would be competitive in today's markets. Therefore, the Panel believes that subsidies should be provided, but on a limited basis. To encourage private industry to develop these technologies, the government should offer a financial "safety net" rather than direct aid. For example, the government could pledge to purchase synthetic fuels from a producer at a fixed price, equivalent to the prevailing world oil price, in the event that world oil prices later drop. In this way the government would be involved only as a buyer of last resort, and would not participate directly in energy investments.

Any sizable development of synthetic fuels will require the resolution of serious environmental issues. These include the reclamation of mined lands, disposal of waste materials, allocation of water rights, possible contamination of ground and surface waters, and control of potentially hazardous emissions. The growth of a synthetic-fuels industry also will create socioeconomic problems in the Western states where development will be centered. The sudden appearance of construction boom towns in lightly populated areas will require additional public services for temporary residents.

Government support for research, development, and demonstration projects should proceed in assessing the most promising ways to extract liquid and gaseous fuels from coal and shale. The best policy approach for the 1980s is to evaluate the potential of synthetic fuels as energy sources for the 1990s and beyond, but not to expect or demand quick results from such projects.

*Transition to Renewables*

Renewable fuels comprise solar energy, in its various forms; biomass energy from wood, crops, and waste; geothermal energy; wind, wave, and ocean thermal energy, and hydroelectric power.

Hydroelectric power has demonstrated a continuing capacity for growth. In fact, because of recent reductions in nuclear power output, hydroelectric power has regained its position as the No. 4 source of electricity (behind coal, natural gas, and oil). More importantly, applications for licenses for new hydroelectric power units, many at existing damsites where energy has not been captured before, are being filed with federal authorities in record numbers. These projects, if completed, would provide total electric power equal to the output of at least 16 new, 1,000-megawatt nuclear reactors.[20]

Except for hydroelectric power, however, renewable energy sources cannot provide much additional energy within the next 10 years. Several new methods of using renewable sources appear to be highly promising; advanced wind-powered turbines and the direct conversion of sunlight to electric power with photovoltaic cells are two examples. Efforts are also under way, with mixed results, to use municipal, agricultural, and industrial wastes as sources of heat and fuel. And the application of passive solar designs in the siting and construction of buildings holds high potential for reducing future energy requirements.

But at present rates of market penetration, new energy production systems based on solar power or other renewable resources will not make a noticeable impact on national energy supplies in the remaining years of the 1980s. The use of active solar power systems is concentrated in marginal services, such as the heating of swimming pools. Some renewable resource technologies—for example, the use of ocean thermal power systems, or the generation of electricity from solar collector stations—still appear too costly to merit commercial development. And serious questions have been raised about the use of crops for production of alcohol-based fuels, because of the energy required to process these fuels and because of the large tracts of farmland that would be needed for large-scale production.

Thus, some renewable resources systems will probably provide substantial contributions in the future; others may never come into the marketplace. An agenda for the 1980s should include further research, development, and demonstration projects designed to examine the potential advantages and drawbacks of these systems. However, the United States should not expect an early end to its energy predicament from a sudden infusion of fuel and power from renewable resources.

## The Case for Conservation

In its massive study of the nation's energy prospects, the Committee on Nuclear and Alternative Energy Systems of the National Academy of Sciences said:

> [A]s energy prices rise, the nation will face important losses in economic growth if we do not significantly increase the economy's energy efficiency. Reducing the growth of energy demand should be accorded the highest priority in national energy policy. In the very near future, substantial savings can be made by relatively simple changes in the ways we manage energy use, and by making investments of retrofits of existing capital stock and consumer durables to render them more energy efficient. The most substantial conservation opportunities, however, will be fully achievable only over the course of two or more decades, as the existing capital stock and consumer durables are replaced.[21]

*Energy Future,* the report of the Harvard Business School Energy Project, described conservation as "no less an energy alternative than oil, gas, coal or nuclear. Indeed, in the near term, conservation could do more than any of the conventional sources to help the country deal with the energy problem."[22]

In speaking of energy conservation, this Panel is not advocating any form of rationing or forced curtailment in the availability of energy. Nor is the Panel endorsing conservation as inherently superior on moral grounds, or as a part of a "no-growth" doctrine. Conservation is regarded instead as a prerequisite to economic growth. As the Ford Foundation report, *Energy: The Next Twenty Years,* put it:

> We mean by conservation those energy-saving investments, operating decisions, and changes in the goods and services that we buy and use that save

money over the life of energy-consuming products. Money can be saved by substituting intelligence, prudence, maintenance, better equipment, or different equipment for purchased energy; the substitution should be made up to the point where the cost of not using the energy is equal to the cost of the energy saved.[23]

Support for energy conservation has also been forthcoming from the energy industry. For example, the Edison Electric Institute, speaking for the nation's private electric utilities, said in a recent study that ". . . vigorous 'productive conservation' measures—that is, the cost-effective substitution of capital, labor and materials for energy—will be essential."[24]

Speaking in favor of higher energy efficiency is one thing; demonstrating that improvements in fact can be achieved at reasonable cost is another. There is evidence that the economy already is adapting to rising energy prices with energy-saving steps; and not at a loss in real economic growth, but as a way of maintaining it. Government statistics show a continuing drop in the amount of energy used in relation to growth in the GNP.

The energy/GNP ratio describes the relationship between energy use and the economy by showing the thousands of Btus used per dollar of GNP (in constant 1972 dollars). In 1970 this index stood at 62.4. The figure declined steadily thereafter until it reached 54.6 in 1979, the lowest figure for any year since 1947. The first-quarter 1980 figure, expressed as an annual average, was 53.0. While real GNP was increasing at an average yearly rate of 2.65 percent from 1973 through 1979, energy consumption rose at a much slower rate of 0.88 percent a year.[25]

Rising energy prices have been instrumental in restraining U.S. economic growth, in causing the recessions of 1974-1975 and 1980, and in raising the overall rate of inflation. Nevertheless, real economic growth was achieved during most of the 1970s with a substantial reduction in the amount of energy consumed per dollar of GNP. These numbers demonstrate that gross energy consumption can be separated from real economic growth, and need not increase at the same pace.

*Demand Forecasts*

Recent projections of energy supply and demand show that the United States probably will require much less energy than had earlier been supposed, in part because of conservation measures.

Shell Oil Co., for example, recently predicted that U.S. energy demand growth will average about 1.2 percent annually during the 1980s, compared with a yearly growth rate of about 1.8 percent in the late 1970s. This reduction in forecasted demand is accounted for in part by expected gains in energy efficiency. Shell said that it expected U.S. energy demand by 1990 to be about 84 quads, rather than the 98 quads the company had predicted earlier.[26]

Exxon has projected energy demand to grow at a rate of less than 1 percent a year through 1990, and of 1.6 percent a year in the 1990s. By the year 2000, Exxon said, energy consumption per unit of GNP will be 30 percent below what would have been expected if previous energy/GNP ratios were maintained. And the Edison Electric Institute expects that energy growth rates between 1980 and 2000 will range between zero and almost 3 percent annually, depending on economic growth rates. The Institute said further that the growth rate in electricity would be higher than that for total energy, but still lower than in the past, with electricity's growth rate projected at between 2 percent and 5.1 percent a year.[27]

These reduced projections of future growth in energy demand result in a continually lower target for U.S. energy supplies in the year 2000. Until the late 1970s, it was widely predicted that the nation would require approximately 150 quads or more annually by the year 2000. In a 1979 study, Resources for the Future found that projections from various sources were falling, and that "a distinct clustering in the range of 115 to 130 quads for the year 2000 emerges." The doubling of world oil prices during 1979 has caused further cuts in projected demand, with energy requirements for the year 2000 now being estimated at approximately 100 quads. Some forecasters claim that energy consumption might stay at present levels (78.8 quads in 1979), or even drop below current consumption.[28]

## *Net Energy*

A major factor to be considered in assessing future energy production levels is that much of the new raw energy being extracted will never be delivered to consumers; it will be lost in conversion and transmission. Substantial amounts of energy also will be needed to produce the additional supplies.

For example, the Carter Administration's national energy plan portrayed a scenario in which total energy supplies would rise from 78 quads in 1977 to 92 quads in 1985 and to 119 quads in the year 2000. These figures were not discounted for conversion losses that were projected to increase from 16 quads in 1977 to 22 quads in 1985 and to 35 quads in 2000.[29] Thus, although supplies would increase by 41 quads from 1977 to 2000, 19 quads of this extra energy, or nearly half, would never be put to use.

Exxon has predicted that U.S. demand for energy will increase from 0.8 percent per year from 1980 through 1990 to

> . . . an indicated rise to 1.6 percent per year in the 1990s . . . this latter rate includes the significant effect of a rapid acceleration in synthetic fuels manufacture. Excluding the energy consumed in synfuels manufacture, the growth rate would be 1.2 percent per year, 1990 to 2000.[10]

These numbers indicate that one-fourth of the projected growth in energy demand during the 1990s would result from the need for energy to process synthetic fuels.

Synthetic fuels could contribute the equivalent of 4 million barrels a day to 6 million barrels a day by the year 2000, according to Exxon, or 8 quads to 12 quads per year. But the company's figures indicate that large-scale conversion of shale and coal to synthetic fuels would require the equivalent of 2 million barrels a day, leaving a net energy gain of 2 million to 4 million barrels a day.

There are, of course, energy requirements associated with all energy sources. For example, the equivalent of 5 percent of the power output of a nuclear reactor is needed for the enrichment of uranium fuel, one stage of the nuclear fuel cycle. Even solar energy technology would entail some energy losses because of the energy-intensive components used in some solar hardware.

The net energy concept deserves more attention in considering the costs and benefits of energy systems. Various energy production ventures may not deliver nearly as much energy as is claimed for them—and may cost much more than expected—once energy expenditures are included. Conservation measures, by contrast, have inherent net energy advantages.

## *Environmental Impacts and Risks*

Advances in energy conservation would contribute greatly to meeting national objectives for clean air and clean water, and in minimizing total impacts on natural resources.

A 1979 report by the Council on Environmental Quality estimated the differences in environmental impacts between two energy scenarios. One scenario presented a high-growth approach in which supplies would total 120 quads by 2000, or roughly 50 percent above the current level. The other was a low-growth approach in which supplies would be limited to 85 quads, about 10 percent higher than at present.

The high-growth scenario would result in twice as much coal production, the stripmining of nearly twice as much land, twice as many coal-fired power plants, four times as much corridor space for power lines, nearly three times as many nuclear power plants, and twice as much radioactive waste as would the low-growth scenario. The low-growth approach would lessen these environmental impacts and reduce unquantifiable risks, such as those associated with nuclear accidents and with the buildup of carbon dioxide emissions in the atmosphere.[31]

There is no clear-cut formula for measuring many of the risks inherent to different energy policies, or for comparing different kinds of risks. Preferring coal to nuclear energy, for example, implies a choice between the relatively predictable hazards associated with coal and the more remote, but potentially catastrophic, dangers of nuclear power.

In one essay on environmental impacts and risk assessment, the authors made a strong case for conservation as a way of minimizing potential hazards:

> If there is any one conclusion that can be drawn . . . it is that the present technical, theoretical and psychological understanding of our culture is inadequate to deal with the challenges posed by what we perceive as our energy needs. The full consequences of our choices will remain inaccessible until they happen, and we should not delude ourselves otherwise. This very ignorance may be the most important factor to incorporate into our decisions. Above all, it underlines the extreme importance of energy conservation.[32]

### *Regional Tensions*

Progress in energy conservation could also help to reduce tensions between energy-importing and energy-exporting regions of the United States.

Some Western states expect to collect massive revenues over the next 20 years, through royalty earnings and severance taxes on their energy resources (oil, gas, and coal). These states will be in a position to offer tax inducements, as well as assurances of adequate energy supplies, in attracting new industries and bolstering their economic bases. Although they confront problems in accommodating rapid development of their resources to meet national energy needs, their economic futures appear bright.

Most states will remain net importers of energy, and their economic prospects have been set back by rising energy prices and doubts about energy supplies. Most energy-importing states, especially those of the Midwest and Northeast, are already burdened by losses of population, employment, and tax revenues; they face additional strains because of their reliance on expensive out-of-state energy. The disparities between the energy-rich and energy-poor states may provoke divisive actions and counteractions on the state and national levels, such as efforts to reduce or redistribute future revenues of the energy-rich states, or efforts by those states to limit energy production within their borders. The Panel sees a distinct possibility that the contrasting fortunes of the energy-importing and energy-exporting states will prove to be a major national issue during this decade.

Energy conservation could not by itself resolve this issue, but could limit its potentially harmful effects. To the extent demand for out-of-state energy can be reduced by improvements in energy efficiency within the energy-importing states, their financial problems would be lessened. And for the energy-exporting states, a stabilization of demand from other states for their resources would allow them more time to cope with the effects of development.

Roger W. Sant, in arguing the merits of an energy conservation (or "energy productivity") strategy, contends that the potential benefits are much greater than is commonly recognized, and that the public would welcome a national energy policy designed to make energy services available at the least possible cost. "The single most consistent and deep-seated public perception of the energy problem is that it is one of high prices and costs," Sant says, and the costs that concern the public are the costs of actual energy services, not the raw material costs of energy resources.

Sant, distinguishing between energy in its primary forms and energy services such as heating, cooling, lighting, and mechanical motion, says that all these services can be accomplished with less primary energy than is now consumed. His least-cost energy strategy would encourage these savings, in part by stimulating greater competition throughout the energy market, including the regulated utility industry.[33]

## Opportunities for Conservation

A number of studies of the opportunities for improving energy efficiency have been made. Some of these estimates may be too optimistic about the energy that could be saved, or too conservative in their projections of the total expense involved. Certainly there is a history in energy forecasting of unwarranted optimism—the predictions that nuclear power would be too cheap to meter, or that synthetic fuels would be competitive if the price of oil ever reached $7 a barrel, come to mind.

Even with wide margins of error in the estimates, the possible savings through conservation and the possible costs of other supply measures stand in sharp contrast. The following proposals, drawn from a number of studies, illustrate the magnitude of the savings that may be obtained through conservation. The Panel believes that these proposals merit aggressive pursuit.

*The Residential Sector*

The housing sector is ripe for improvements in energy efficiency. One study found that through such measures as insulation, caulking, weather-stripping, and furnace modifications, the fuel used to heat a typical home could be reduced by 50 percent to 75 percent.[14]

The Congressional Office of Technology Assessment has found that a vigorous residential conservation program could substantially reduce the energy used to provide heat and hot water to existing houses, at a cost that would be "dirt cheap" compared to the cost of producing synthetic fuels. The Carter Administration has said that energy savings could be achieved in buildings at modest cost—at an energy-equivalent price of $10 a barrel—although the Administration has favored large subsidies for the far more expensive synthetic fuels.[15]

Several federal programs are intended to help achieve energy savings in the residential sector. Tax credits are available to homeowners who invest in energy-saving items, a low-interest loan program is being established to provide capital for the same purpose, and a federally funded program offers insulation services for the homes of people with low incomes. The government also has proposed energy-efficiency standards that would govern the construction of new buildings, but implementation of this program is now in doubt. However, these programs provide only limited incentives in comparison to the subsidies offered for energy production. For example, a 4-year total of $2.5 billion is authorized for energy-conservation loans; this is a very small amount in comparison to the $88 billion that may be made available for synthetic fuels.

This Panel is generally inclined against interfering with the workings of the marketplace by giving special advantage to private investments that should succeed or fail on their own merits. However, the Panel takes the position that additional federal subsidies to the residential sector can be justified. These programs would be designed not to guarantee profits, but to reduce the costs of meeting basic public needs; they would represent a one-time expense per dwelling, rather than a continuing commitment to an operating enterprise; and they should encourage energy-saving actions more rapidly than would be the case if they were not available. (It is assumed that many people cannot afford the initial costs of energy-saving measures although the long-term savings would be in their interest.)

Subsidies to low-income households can be justified by reasons of equity. The poor are those most hurt by rising energy prices, and least able to invest in energy-saving measures. Surveys have shown that high-income households use somewhat more energy than low-income households, and that high-income homeowners claim more and bigger tax credits for energy-saving items than do low-income homeowners. The lower the income, the fewer and cheaper are the remedies used; plastic window covers, for example, instead of storm windows. And under present programs, energy-saving investments in rental properties are not accorded the same tax breaks as are investments in owner-occupied homes. Most of the poor live in rental housing; changes in the program should be made to encourage conservation in all housing units.

Congress already has established new welfare programs that provide payments to the poor to help them meet the higher costs of power and fuel. But a continuation of this program would accomplish nothing in the way of energy conservation. The Panel believes that the national interest would be better served if some of these funds were used for a substantially improved and expanded federally subsidized insulation program for low-income housing. Such a program would benefit the recipients because their daily household energy costs would be reduced, and would benefit the nation by contributing to reductions in energy use.

Funds for such assistance could be obtained from the receipts of the windfall profits tax on domestic oil that was enacted in 1980. This tax is expected to generate more than $200 billion in federal revenues during the 1980s; a substantial portion of the proceeds could be tapped for energy conservation programs in the residential sector.

Electric utilities are instituting their own energy conservation programs by conducting home audits, arranging contracts for insulation work, and installing energy-saving equipment. These and other changes in utility operations, such as rate reforms designed to discourage high consumption, were established through initiatives at the state level and through recent federal legislation. The full impact of these changes will not be known for some time, but can be expected to aid substantially in furthering conservation.

### *The Transportation Sector*

Higher fuel efficiency performance by new automobiles and trucks represents one obvious way in which energy conservation can be advanced. There are, however, many other opportunities in this sector.

The private automobile is likely to provide most transportation during the 1980s and later years. Population shifts within the United States in fact indicate that reliance on automobiles will increase. The older cities, which have the most extensive mass transit systems, generally are the areas in which population and employment are both declining. These trends suggest that federal policy should aggressively promote the use of buses and commuter vanpools, which are relatively cheap, flexible, and energy-efficient.

A number of factors may combine to stabilize long-term gasoline demand. The price of gasoline has been going up, and presumably will continue to rise. Price increases already have helped achieve a reduction in gasoline consumption, and price controls on gasoline are scheduled to expire by October 1981.

Fuel economy standards now in effect are designed to reach a fleet average of 27.5 miles per gallon for 1985 models, approximately double the average mileage of new cars in the mid-1970s. Dramatic gains in fleet mileage standards for post-1985 models appear technologically feasible, and perhaps will be attained in part through the introduction of small cars designed specifically for use in cities. A standard of 50 miles per gallon for 1990 models, and of 80 miles per gallon for 1995 models, has been suggested by one official.[16] It is not clear whether ambitious mileage standards for future models should be set now by the government, or whether public demand alone will be sufficient to bring about additional gains in fuel efficiency.

## *The Industrial Sector*

Industry, the biggest energy-consuming sector, already has made significant strides in energy conservation. According to one authority, ". . . industrial output in goods and services rose 12 percent between 1973 and 1978, while industrial use of energy dropped by more than 10 percent. . . . This trend has accelerated in 1979."[17]

Energy-saving means that are immediately available to industry include cogeneration systems (which produce both steam and electricity), improved boilers and furnaces, variable-speed electric motors, waste-heat recuperators, and air-to-fuel ratio controls. Cogeneration is one of the best prospects for cost-effective energy conservation—it "can reduce by roughly 30 percent the amount of fuel required to separately generate the same amount of power and steam," according to the Council on Environmental Quality. Cogeneration systems could save up to 3.5 quads a year by the year 2000 (about 1.75 million barrels a day of oil equivalent). The advantages of cogeneration include lower capital investment than is needed for separate power and steam systems, possible reductions in transmission costs, lower requirements for cooling water, and shorter installation times.[18]

The 1978 Public Utility Regulatory Policies Act is intended to encourage widespread use of cogeneration systems, which were used throughout the United States until central station electric power offered cheaper energy. And other government efforts have been made to reduce industrial reliance on oil and natural gas, to increase the use of coal, and to take conservation more seriously.

This Panel cannot say whether a host of new government incentives, standards, and laws are needed at this time. Certainly the rise in raw energy prices would seem to offer incentive enough for industry to seize energy conservation opportunities wherever they might arise. Energy is used in more ways than this Panel could hope to enumerate, and any company ought to be the best judge of how and where to cut its own energy costs.

Until now, however, the full social costs of high energy consumption—including its effects on national security, on the environment, and on the general health of the economy—were not recognized by industry or by any other sector. When all these costs are taken into account, which would be the logical outcome of the long-running national debate over energy policy, energy conservation should be the first option chosen by both the private and public sectors.

Notes


1. U.S. Department of Energy, Energy Information Administration, *End Use Energy Consumption Data Base: Series 1 Tables* (Washington, D.C., 1978), p. 36.
2. U.S. Department of Transportation, *Highway Statistics 1978* (Washington, D.C., 1979), p. 5.
3. U.S. Department of Transportation, Office of the Assistant Secretary for Policy and International Affairs, *Profile of the '80's* (Washington, D.C., 1980), p. 27.
4. *End Use Energy Consumption*, p. 147.
5. Ibid.
6. U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review: November 1980* (Washington, D.C., 1980), p. 26.
7. American Petroleum Institute, *Two Energy Futures: A National Choice for the 80s* (Washington, D.C., 1980), p. 38.
8. Al Richman, "The Polls: Public Attitudes Toward the Energy Crisis," *Public Opinion* (Winter 1979), p. 576.
9. *Economic Report of the President Together with the Annual Report of the Council of Economic Advisers* (Washington, D.C., 1980), pp. 259, 268.
10. Ibid., p. 64.
11. U.S. Department of Energy, Energy Information Administration, *Annual Report to Congress 1978, Volume 2: Data* (Washington, D.C., 1978), p. 39.
12. U.S. Department of Energy, *International Energy Indicators: November 1980* (Washington, D.C., 1980), p. 10.
13. William M. Brown and Herman Kahn, "Why OPEC Is Vulnerable," *Fortune* (July 14, 1980); Earl T. Hayes, "Energy Resources Available to the United States," *Science* (January 19, 1979); Exxon Corporation, *World Energy Outlook* (New York, 1980).
14. Walter J. Levy, "Oil and the Decline of the West," *Foreign Affairs* (Summer 1980).
15. American Gas Association, *Gas Facts 1979: A Statistical Record of the Gas Utility Industry* (Rosslyn, Va., 1980), p. 5.
16. American Gas Association, *The Gas Energy Supply Outlook: 1980-2000* (Rosslyn, Va., 1980), p. 16.
17. *Monthly Energy Review*, p. 62.
18. World Coal Study, *Coal—Bridge to the Future* (Cambridge, Mass., 1980).
19. *Monthly Energy Review*, p. 69.
20. Ibid., p. 60; William J. Lanouette, "Rising Oil and Gas Prices Are Making Hydropower Look Better Every Day," *National Journal* (April 26, 1980), p. 685.
21. National Academy of Sciences, Committee on Nuclear and Alternative Energy Systems, *Energy in Transition 1985-2010* (Washington, D.C., 1979), p. 84.
22. Robert Stobaugh and Daniel Yergin, eds., *Energy Future* (New York, 1979).
23. Ford Foundation, *Energy: The Next Twenty Years* (Cambridge, Mass., 1979), p. 115.
24. Edison Electric Institute, *Economic Growth in the Future: II* (Washington, D.C., 1980), p. 3.
25. *International Energy Indicators*, p. 28.
26. Shell Oil Company, "Shell Releases Major Energy Forecast Data," News release, June 4, 1980.
27. *World Energy Outlook*, p. 8.
28. Sam H. Schurr *et al.*, *Energy in America's Future: The Choices Before Us* (Baltimore, 1979), p. 183; Eliot Marshall, "Energy Forecasts: Sinking to New Lows," *Science* (June 20, 1980).
29. Executive Office of the President, *National Energy Plan II* (Washington, D.C., 1979).
30. *World Energy Outlook*, p. 26.

31. Council on Environmental Quality, *The Good News About Energy* (Washington, D.C., 1979).
32. John Harte and Alan Jassby, "Energy Technologies and Natural Environments: The Search for Compatibility," *Annual Review of Energy* 3:101 (1978).
33. Roger W. Sant, *The Least-Cost Energy Strategy* (Pittsburgh, Pa., 1979), p. 20.
34. Marc H. Ross and Robert H. Williams, *Drilling for Oil and Gas in Our Buildings* (Princeton, N.J., 1979).
35. U.S. Congress, House of Representatives, Committee on Interstate and Foreign Commerce, Subcommittee on Energy and Power, testimony of John H. Gibbons, Director of the Office of Technology Assessment, October 18, 1979; *Special Analyses, Budget of the United States Government, Fiscal Year 1981* (Washington, D.C., 1980), p. 387.
36. U.S. Congress, Senate, Committee on Energy and Natural Resources, testimony of Charles L. Gray, Jr., April 30, 1980.
37. *Least-Cost Energy*, p. 39.
38. *Good News About Energy; Energy in America's Future*, p. 176.

Chapter 2

# THE Environmental Challenge

The environmental problems of the 1980s may prove to be more difficult, and in some cases more urgent, than those of the 1970s. The nation has begun programs to regulate the pollutants that are easiest to identify and control. The critical question now is how to anticipate the consequences of new environmental hazards, especially those of global scale. The concerns of the 1980s are likely to include the control of toxic substances, nationwide land use patterns, and the degradation of global resources.

## Toxic Substances

There is a new awareness of a set of environmental problems of unforeseen hazards that are the legacy of the chemical age. Hazardous wastes and toxic chemicals can cause cancer, genetic alteration, neurological damage, and fertility loss—the subtle, degenerative effects that come from long-term exposure to fairly low levels of certain contaminants.

Indeed, the problem of hazardous waste disposal, epitomized by the Love Canal tragedy, is the most urgent environmental challenge facing U.S. industry today. Of the more than 77 billion pounds of hazardous waste—excluding radioactive materials—generated each year, the Environmental Protection Agency (EPA) reports that a startling 90 percent is disposed of in an unsound fashion. An estimated 800 disposal sites around the nation now pose a potentially significant danger to human health as well as to the environment. Just to contain these wastes will cost an estimated $4 billion, and to clean them up completely could take a staggering $44 billion. Hundreds of new chemicals are introduced each year; the importance of monitoring these substances and ensuring their safe use and disposal cannot be overemphasized.

Another aspect of the chemical pollution problem is groundwater contamination; recent samples reveal some contamination from past chemical disposal practices. Enormous quantities of groundwater could be poisoned by the year 2000. Techniques must be developed to clean contaminated supplies and to protect noncontaminated sources. Programs to safeguard groundwater supplies from contamination and depletion should be begun in preparation for increases in demand for water.

## Land Use

Important changes in patterns of land use have occurred in this century. The nation's population now depends on the vast consolidated farms of the Midwest and the West for food, rather than on small farms adjacent to towns and cities. The changes are reflected in the loss of topsoil, wetlands, and hardwood forests in rural America, and by the scarcity of parks and recreation lands available to city residents.

Three specific land use problems facing United States today are the siting of new energy facilities, the protection of coastal zones, and the preservation of historic and cultural resources. There are a number of government programs that address these problems; recent experience suggests that these programs should be strengthened and that better coordination among the various levels and branches of government is needed. Controversies over the siting of energy facilities in coastal areas demonstrate the need for improved efforts to identify environmentally critical areas in the earliest stages of planning. Better planning and coordination at all levels of government are needed to control the effects of rapid energy development, as shown by the environmental, social, and economic problems that have characterized energy boomtowns in Alaska and the Rocky Mountain states. New regional planning mechanisms also may be required when interstate energy projects, such as coal-slurry pipelines, are under consideration.

A major land use concern is topsoil loss, caused by the conversion of prime agricultural land to urban use and by bad management practices. Soil is being washed into rivers and blown away as dust at an annual rate of more than five tons per acre; according to some calculations, the equivalent of 3 million acres per year is being lost in this manner. The amount of land under cultivation is also reduced by other factors, such as urbanization and highway construction.

Productivity gains cannot be counted on to make up for this lost land. The growth in yields has been cut to only 1 percent a year, just half the rate that prevailed in the 1950s and 1960s. After decades of intensive cultivation, the nation's farmland is showing signs of severe strain. Vast stretches of cropland have already lost much of their nutrient value, while other land has become excessively salty or densely compacted. Soil erosion and associated water quality problems may replace oil supply issues as the nation's most critical natural resource problem in the 1980s.

## The Global Challenge

One of the vivid lessons of the 1970s was that environmental problems do not respect national boundaries. The solution of many of the most serious problems will require international cooperation on an unprecedented scale.

The *Global 2000* report, the culmination of a 3-year interagency effort to study the long-term implications of present world trends in population, natural resources, and the environment, arrived at a dramatic conclusion:

> If present trends continue, the world in 2000 will be more crowded, more polluted, less stable ecologically, and more vulnerable to disruption than the world we live in now. Serious stresses involving population, resources, and environment are clearly visible ahead.[1]

Forests are disappearing at alarming rates. The *Global 2000* study found that if present trends continue, both forest cover and growing stocks of commercial wood in the less developed regions (Latin America, Africa, Asia, and Oceania) will decline by 40 percent by the year 2000. The environmental consequences of large-scale destruction of tropical forests by erosion, salinization, desertification, flooding, silting of reservoirs and streams, clogging of irrigation networks, and unfavorable changes in local climates will be severe.

Perhaps the most serious development will be an accelerating deterioration and loss of agricultural resources. This category includes soil erosion, compaction, and the loss of nutrients, steady salinization of irrigated land and of the water used for irrigation, and the loss of high-quality cropland to urban development. Air and water pollution cause crop damage and contribute to the extinction of local and wild crop strains. More frequent and severe regional water shortages can be expected, especially where there is competition for water supplies, or where forest losses are heavy and the earth can no longer absorb, store, and regulate the discharge of water.

Soils are deteriorating rapidly in the less developed countries. Desert-like conditions are spreading in drier regions, and heavy erosion is occurring in more humid areas. At present, global losses to desertification are estimated at almost 6 million hectares a year, an area about the size of Maine. Desertification includes a variety of ecological changes that destroy the cover of vegetation and fertile soil in the earth's drier regions, rendering the land useless for range or crops. Principal direct causes are overgrazing, destructive cropping practices, and the extensive use of wood for fuel.

At presently estimated rates, the world's desert areas (now some 800 million hectares) will expand by almost 20 percent in the next 20 years. There is reason to expect that the rate of desertification will accelerate, as increasing numbers of people in the world's drier regions put more pressure on the land to meet their needs for rangeland, cropland, and wood. The United Nations has identified approximately 2 billion hectares of land where the risk of desertification is high or very high. These lands at risk comprise approximately two and one-half times the area now classified as desert.[2]

Present rates of soil loss in many industrialized nations cannot be sustained without serious implications for crop production. In the United States, for example, the Soil Conservation Service has concluded that soil losses must be cut in half to sustain crop production indefinitely at present levels.

The earth's air is seriously threatened. The three global atmospheric problems that have attracted most attention in recent years are the increase of carbon dioxide retained by the atmosphere, the formation of acid rain, and the depletion of the ozone layer. There is evidence that these are occurring; what is not known is how serious the consequences will be.

The natural flow of carbon dioxide to the atmosphere is intensified by the burning of fossil fuels, the clearing of forests, and the cultivation of land. The amount of carbon dioxide in the atmosphere is increasing, probably by about 4 percent every 10 years. Carbon dioxide absorbs heat radiated from the earth's surface; if its concentration rises too high, a gradual warming of the lower atmosphere might well occur. This could lead to changes in temperature and rainfall patterns and have serious impacts on agriculture.

Present concern is centered on the plans for rapid expansion of the use of coal, in the United States and in other nations, and for the use of coal-based and shale-based synthetic fuels. Increased use of these fuels might double the carbon dioxide in the atmosphere, causing a "greenhouse" effect that could increase the average global temperature by 1.5° to 4.5° Celsius. The result might be a rapid deglaciation of West Antarctica that in turn could lead to a 5-meter rise in sea level, covering many low-lying land areas and inundating coastal cities. Precipitation patterns and growing seasons for crops would be greatly altered, disrupting world agriculture; for example, there might be persistent drought in grain belts such as the Midwestern United States. What must be remembered is that scientific proof of the warming of the earth might come when it is too late to reverse the trend.

Acid rain is recognized as the other serious global environmental problem associated with fossil fuel combustion. In the Eastern United States, the acidity of rainfall appears to have increased by an approximate factor of 50 during the past 25 years. The precise causes and effects of acid rain are not known, but some effects are quite clear. In Scandinavia, Canada, and the Northeastern part of the United States, many lakes and estuaries have suffered complete or partial losses of fish life. Such losses indicate major changes in ecological balances that are more far-reaching than the loss of recreational resources. Loss of crop productivity and forest yields because of acid rain may be widespread. Acid rain also damages steel and stone structures, as well as works of art, and many of its effects may be permanent. Acid rain is an excellent example of a problem whose solution demands international cooperation, as Canada and the United States have begun to recognize.

The ozone problem arose with the release of chlorofluorocarbons, which convert some of the ozone in the stratosphere into oxygen. Because stratospheric ozone filters out most of the ultraviolet radiation in sunlight, a decrease in its concentration will permit more ultraviolet radiation to reach the earth. This increase is expected to have adverse effects on animals, plants, and the earth's climate. A 1979 report from the National Academy of Sciences estimated that the continued production and release of chlorofluorocarbons at the 1977 rate will cause an eventual 16.5 percent depletion of stratospheric ozone; this was more than twice the depletion estimated by the same group in 1976.[3] Growth in production and use of chlorofluorocarbons is expected to occur if controls are not established by nations other than the United States.

As the *Global 2000* report concedes, the federal government still lacks consistent projections of worldwide trends in population growth, the availability of natural resources, and environmental quality. The report may understate the severity of potential problems because the relationships among these factors are not well understood. Various agencies compile their own specialized projections using different assumptions and data, and one forecast may not take account of significant developments in other areas.

It is clear that the foresight capabilities of the executive branch should be improved so that trends in resource development and environmental quality can be monitored in a timely and consistent manner. One promising means, which this Panel endorses, is to assign this data gathering and coordination function to the Council on Environmental Quality.

**Regulations and Incentives/**

During the 1970s, environmental protection was sought mainly by the use of pollution control standards that set maximum discharge levels. This represents a command-and-control approach with compliance deadlines and a considerable degree of government scrutiny in industrial operations. Such standards are, however, only one of many possible mechanisms that can be used to achieve environmental goals. Many economists have long advocated the use of economic incentives as an attractive alternative to the existing regulatory approach.

In the past several years, EPA has examined several forms of economic incentives to help control air pollution. This approach looks toward the development of a market in air pollution emission reductions that would be overseen by government pollution control agencies.

EPA's "offset" policy was put into effect 4 years ago; its "bubble" policy was implemented in 1979. The two are closely related—both allow increased emissions of specific pollutants if these are balanced by reduced emissions of the same pollutants from other sources. Because industries are allowed considerable freedom in choosing how to reduce emissions, these policies, theoretically, can achieve environmental standards at the lowest possible cost.

Air officially acquired a market value in an EPA ruling in December 1976. Thereafter, areas that had not attained clean air standards were to allow construction or modification of pollution sources only if the new source provided for an offsetting reduction of emissions in the same area. After July 1, 1979, states were given a choice for handling industrial growth: they could impose strict emission limits on existing sources, or they could follow a case-by-case offset approach. Polluted areas that are not included in a state plan that will ensure achievement of national air quality standards by December 31, 1982 face a ban on major new sources of emissions.

The problem the offset policy addresses is not small; there are hundreds of nonattainment areas in which one or more of EPA's six ambient air quality standards are exceeded. In mid-1978, Los Angeles violated five standards; four were violated by such major cities as Philadelphia, Chicago, Cleveland, and St. Louis. Without the offset policy, economic growth in these areas would be severely restricted by current laws and regulations.

Under the offset policy, an industry or utility that wishes to build a new plant can pay the cost of installing pollution control technology at other sources of a given pollutant in that area, thus allowing an expansion in business operations without causing more pollution. An existing facility that is required to reduce its emissions, and is facing high pollution control costs, can pay for reductions at other sources instead; this saves money and achieves the same improvement in the area's air quality. The offset policy encourages the formation of a private marketplace in pollution control, as companies bargain with each other to determine how to meet their pollution control obligations at the lowest cost. Although the policy has had limited success so far, the idea of reaching environmental standards through flexible arrangements is intriguing and deserves further experimentation.

The bubble policy allows industry greater flexibility in controlling emissions of a single pollutant by placing an imaginary bubble over all or part of a plant. The firm can meet emission standards by putting extra controls on discharge points that have lower control costs, instead of on points with high control costs.

The bubble policy's effect on industrial innovation is a matter of dispute. Some argue that it encourages plant engineers to find the cheapest way of controlling pollution and so provides an incentive for industrial innovation. Others argue that the policy does not allow enough time for innovative design, because a company must still meet a compliance schedule.

It is also difficult to show in advance that the substitution of one emission source for another is equitable. It is feared that EPA will create not one or two bubbles over a plant, but many small bubbles—one over stacks, one over storage piles, one over roads, and so on. To the extent that this occurs, the bubble system will simply imitate old-fashioned stack-by-stack regulation.

### *Emission Charges*

The approach favored by many economists, and most popular in the literature on economic incentives, is the emission charge (or tax, or fee). Proponents claim that emissions taxes allow industry considerable discretion in the method chosen to deal with wastes.

With respect to economic efficiency and environmental effectiveness, emission charges are the converse of command-and-control regulations. Emission standards can be designed to satisfy an environmental objective, but there is no way of knowing whether the objective will be met in an economically efficient manner. For any given level of emission charges, the resulting reduction in pollution may be achieved at the lowest cost, but there is no guarantee that the charges will be sufficient to meet environmental standards.

A charge system involves the monitoring of emissions; the computation of taxes or fees is critically dependent on the exact measurement of levels of wastes. In most regulatory approaches, the accuracy of monitors is critical only at emission levels close to the standards. To the extent that control costs or emission levels are unknown, a charge system is less certain than is a standards approach for achieving compliance. Emission standards appear to be the only effective way to deal with those highly toxic or hazardous pollutants that must be controlled to specific minimum levels.

Experience with emission charges, both abroad and at the state level, has shown that they have not produced the expected results. Nevertheless, the Panel believes that experiments with various kinds of taxes and charges should be conducted on a limited basis to see if they might serve as supplements to the present regulatory system.

## Costs and Benefits

Increasingly, there are attempts to attack or defend environmental standards in strictly economic terms. Some critics maintain that tighter pollution controls will cause higher unemployment and consumer prices and lead to the unproductive use of capital. Others defend pollution control standards by claiming that they help to create new jobs, cause only a relatively minor, one-time increase in consumer prices, and offer the economy such benefits as lower future clean-up costs or the encouragement of innovation in industrial processes. Potential costs are likely to be exaggerated by those subject to the stricter standards, while advocates of the standards are inclined to minimize the economic burden. The actual cost of complying with a pollution control standard is an elusive figure and usually in dispute.

The Council on Environmental Quality (CEQ) has estimated the total annual costs of pollution abatement for 1978 at $26.9 billion, or about 1.3 percent of the total gross national product (GNP) of $2,127.6 billion. The CEQ figure includes operation and maintenance costs and capital expenditures for both the private and public sectors.[4]

In the private sector alone, a Department of Commerce survey of 1978 business expenditures showed that pollution abatement spending totaled $6.9 billion, or about 4.5 percent of a total industry investment of $153 billion for new plant and equipment. Higher estimates of total pollution control spending by industry were shown in a 1979 survey by McGraw-Hill Inc. The McGraw-Hill survey put total spending in 1978 at $8 billion.[5]

In a review of the Department of Commerce survey, the Congressional Research Service (CRS) noted that six industries accounted for $5.2 billion, or 76 percent of the total expenditures: electric utilities, $2.4 billion; petroleum, $1.3 billion; steel, $0.4 billion; chemicals, $0.6 billion; paper, $0.2 billion; and nonferrous metals, $0.3 billion.[6] These figures indicate that the most energy-intensive industries generate the most pollution.

Estimates of industry expenditures for pollution control, the CRS report said, do not attempt to quantify the resulting benefits:

The widespread concern about the costs of environmental regulations stems, in part, from the absence of comparable estimates of the benefits of pollution control. Benefits are more difficult to measure because they are commonly less tangible to those subject to regulation than the costs. Benefits are frequently spread among a larger population and the direct benefit to each individual may be relatively small. The aggregate benefits, however, may be substantial.[7]

The employment effects of pollution control requirements are also subject to varying interpretations. Plant closings sometimes are blamed on the additional costs of meeting pollution control standards. These closings, however, have reportedly been relatively few in number, involving an estimated 118 plants and some 22,000 jobs. It is not clear whether these plants were likely to be shut down in any case.[8]

It is estimated that pollution control expenditures now support nearly 1 million jobs throughout the private and public sectors; for example, each $1 billion spent on construction of sewage treatment plants generates about 35,000 jobs. The pollution control industry has become one of the high-growth industries in the United States, with some 600 firms manufacturing pollution control equipment.[9]

Whatever the monetary costs and benefits may be, environmental policy issues cannot be reduced to economic equations. Claims and counterclaims about economic impacts couch the issues in narrow and contrived terms, as if the critical question were whether an environmental standard can be justified by its potential return on investment. In fact, there is no objective way to measure these standards' total benefits to society and to the environment.

Economic cost/benefit analyses may be of some use in environmental policymaking, but they do not resolve fundamental issues. They may indicate which approach would be most effective in reaching a given standard at the lowest cost; they cannot, however, show whether the standard should be imposed. The balancing of costs and benefits is inherently a subjective exercise. Society makes an implicit judgment whenever a standard is imposed—or not imposed—whether that standard promises a net gain to society. Those who set the standards should seek to explain to the public as fully as possible what the likely costs and benefits will be, while emphasizing that these factors cannot be reduced to simple numerical equations.

Certainly a cleaner environment provides significant benefits to the nation in terms of reductions in mortality and morbidity rates, in medical expenses, and in lost worktime. Yet even if these benefits could be quantified and credited directly to a specific standard for a specific pollutant, they cannot be readily translated into dollars and cents and compared to the estimated cost of meeting that standard.

Moreover, the benefits attained through investments in environmental quality include many diffuse and intangible elements beyond the protection of public health, which is generally considered to be a primary objective of pollution control measures. What values can be placed on the public's enjoyment of purer air or cleaner water, or on protected wilderness? Or on preserving the long-term integrity of natural life-support systems? These are benefits that the United States seeks to gain, over and above the immediate protection of health, by spending public and private funds to control pollution and to preserve natural resources.

**Environmental Mediation**

The fact that the values involved in environmental protection cannot be quantified has contributed to the acrimonious quality of many debates over pollution control measures and costs. A half-dozen projects scattered across the United States are helping to develop solutions to difficult environmental conflicts, such as the control of pollution from a local power plant and the permissible uses of wilderness areas.

The best known, and perhaps the most ambitious, effort to develop broad environmental policy by a non-adversarial method is the National Coal Policy Project (NCPP). The Project was conceived as a way of bringing business executives and environmentalists together in an atmosphere of mutual respect to try to work out policies under which the increased use of coal could be both environmentally sound and financially worthwhile.

One year of meetings produced a two-volume study, *Where We Agree*. Among the recommendations were the consolidation of all hearings on the siting of utility plants (but no consolidation of licensing authority), with public financing of participation by environmental groups; the removal of regulatory controls on rates for coal transportation; peak-load pricing of electricity; and experimentation with emission taxes and rebates for particular pollutants. The group did not agree on other matters, such as the leasing of public land for coal mining.

The Project's work was favorably received by the press and the public, but its impact now seems less significant. Although the participants successfully developed a coordinated set of proposals, they failed to pay adequate attention to their implementation. Some progress has occurred in deregulation of the transportation sector, but very little of that was due to the NCPP report. The adoption of the other proposals appears no closer in 1980 than in 1978.

The real successes of environmental mediation have come when dealing with well-defined, relatively local conflicts. The Center for Energy Policy, a nonprofit research organization in Boston, mediated a dispute involving the conversion of the largest power plant in New England to the use of coal. The power company had initially resisted the Federal Energy Administration's order to convert its plant because of the prohibitive expense of meeting strict air pollution requirements. Working with FEA, EPA, and state and power company officials, the mediator helped to formulate a set of controls on burning coal that was both financially feasible and environmentally sound.

Other examples of successful nonadversarial dispute resolution fall in the area of land management and use, or involve the avoidance of potential conflicts. For example, a project in Delta, Colorado, helped that town prepare for and manage the changes resulting from rapid development of the area's abundant coal resources.

Most of the information on programs that use nonadversarial methods of dispute resolution is still anecdotal. Nonetheless, some tentative conclusions appear justified.

First, one impetus for using nonadversarial methods of settling conflicts lies in the shortcomings of the current decisionmaking process. Legislative, regulatory, and judicial processes overemphasize conflict and lead to distrust and hostility among groups. The legislative process, for example, discourages attempts by different interest groups to find compromise solutions; instead, they are expected to lobby tirelessly for their views.

Second, nonadversarial methods of dispute resolution will succeed only when all parties believe that they can gain by participating. In most cases, the prospect of avoiding the adversarial process is not sufficient. Mediation is most likely to succeed when all parties recognize that they are hurt by the status quo. Issues involving future conduct—the siting of a new refinery, the policy on new industrial chemicals—are the best candidates for mediation. This observation implies that the parties must have relatively equal political power, both within and outside the mediation process.*

Third, some kinds of issues are more suited to mediation than are others. The issues must be fairly well defined; otherwise it may be difficult to identify all the interested parties and to understand clearly what is at stake. Conflicts over land use appear to satisfy this criterion better than do questions of national policy, and that may help explain why mediation has had greater success in the former area.

* It may be appropriate to provide support staff for environmental groups with limited resources.

Further, mediation works best when all parties agree to pursue mediation as the exclusive means of resolving the conflict. If the dispute is under consideration in another forum at the same time as in the mediation effort—for example, in pending legislation or an agency hearing on proposed rules—parties may divide their attention between the two, attempt to play the two against each other, or ignore the mediation effort. Moreover, all participants must be able to bind their organizations.

Finally, most successful mediation processes have certain characteristics. The process of debate should be supervised by an impartial leader, someone who has no interest in the outcome and who ensures that all participants adhere to any rules for the process. In addition, so that participants can advance ideas freely, there is sometimes a requirement that no positions expressed in a mediation session be discussed publicly. Because many disputes are based on different views of the facts, often there is also a requirement that all participants share information.

Although environmental mediation is still in its infancy, it appears to be a promising alternative to the current administrative decisionmaking process. It permits interested parties to develop, at lower personal and social costs, policies that are more satisfying than those generated by an adversarial process. Further public discussion, experimentation, and research are appropriate at this stage of the development of environmental mediation. The Panel recommends that the federal government become more actively involved in funding experimental mediation projects and research. It would be useful if Congress and agency officials periodically reviewed developments in this area and considered statutory and administrative requirement that would give parties an incentive to use mediation.

## A Conserver Society

The most appropriate course for the United States in the 1980s is to encourage a pattern of growth that will produce less pollution, for the ideal approach to environmental protection is to minimize pollution and waste rather than to attack emissions through regulations and control technology. To meet its economic and environmental objectives, the United States should begin shaping a "conserver society" that is built on conservation values, relies on renewable energy sources for its principal energy supplies, and recycles much of its material.

Most people today would readily equate conservation with energy conservation. A conserver society would encompass the broader concept of conserving all natural resources and raw materials. The objective would be to effect a transition from a linear economy, in which extracted resources move through production systems and are finally discarded as wastes, to a circular economy, in which a substantial proportion of output is recycled for further use.

*Recycling*

In the mid-1970s, recycled materials supplied the United States with 44 percent of its copper, 20 percent of its iron and steel, almost 50 percent of its lead, and approximately 20 percent of its paper. These relatively high rates have remained stable for more than 10 years, and recycling operations are likely to increase in the 1980s because of increasingly favorable economics. However, industries still may not engage in extensive recycling for a variety of reasons, including technical, economic, and government-imposed restraints.

Technical problems typically involve the contamination of recycled, or secondary, materials by foreign substances. Economic problems arise from the fact that secondary materials generally serve as substitutes for primary materials; when demand is high, they are used to fill gaps in supply, but they are the first to be dropped from use when demand falls. Thus, the prices of many secondary materials are more volatile than those of primary materials, which deters investment in recycling systems. Information is often lacking on how much secondary material may be available, so that optimal recycling levels cannot be determined.

There are a number of specific steps that the federal government could take to help correct these problems. First, the government could ensure that the price of a resource reflect its scarcity value, and that economic neutrality between primary and secondary materials be reached. The ending of freight rate structures that discriminate against secondary materials would be one action. A more fundamental reform would be the repeal of percentage depletion allowances on minerals. These allowances provide tax incentives for the extraction of raw materials, and thus subsidize the use of primary over secondary materials.

The government also could impose national solid waste disposal charges on the sale or transfer, at the production level, of product containers, packaging materials, and paper. This would force companies to internalize the costs of waste collection, treatment, and disposal that are now paid through general government revenues. Such charges could double the present rate of paper recycling—and packaging and paper products make up, by weight, almost 80 percent of all product wastes. The government also could review the experience of the French, Japanese, and Norwegian governments in setting up markets for recycled paper through such measures as subsidized collection and storage centers and guaranteed prices. State laws requiring deposits on cans and bottles would encourage recycling.

The recycling of urban solid wastes deserves special attention. The annual disposal cost for approximately 144 million tons of municipal solid waste is about $4 billion.[9] Although the recovery and reuse of discarded materials would significantly reduce these costs, the current recovery rate is estimated at a meager 6 percent to 7 percent. The highest technically feasible rate of recovery would provide about 40 percent of the metal, glass, plastics, fibers, and rubber needed each year in manufacturing.[10]

The United States has been recovering about 1 percent of the energy potential of its municipal solid waste; Denmark, which integrates the functions of waste disposal and energy production, recovers about 60 percent. The recoverable energy potential of this nation's municipal solid waste in 1977 was estimated at the equivalent of 400,000 barrels of oil a day.[11]

The federal government could encourage the recycling of urban solid waste through expanded planning grants to local governments to help them study resource recovery systems. Before local governments can justify the capital costs of these experimental systems, they must assess the technical, marketing, financial, legal, and organizational barriers. EPA has awarded a small number of grants; this program should be expanded. The government also should determine whether its revenue-sharing payments to local governments, which are used in part to help communities defray their waste disposal costs, have caused local governments not to adopt user fees to pay for waste management systems.

Although extensive recycling is an essential feature of a conserver society, recycling consumes energy and often causes severe pollution. The optimal level of recycling varies for different materials, depending on the energy required and on such factors as the durability of products and the availability of substitute raw materials. These variables support the view that recycling is only one element in materials conservation, and point to the importance of a systems approach to materials policy.

Along with recycling, therefore, an important objective of a conserver society would be to increase the durability of manufactured products. The marketplace itself should reward the manufacturers of durable products through increased consumer preference for long-lasting items. To help consumers assess product durability, the government could consider a number of approaches, such as the labeling of guaranteed product lifetimes or government-sponsored testing programs for major consumer products. Because automobiles impose substantial social costs in terms of resource depletion and pollution, federal standards for sustained performance should be considered.

Movement toward a conserver society in the 1980s would be fostered by the widespread adoption of a more creative approach to pollution control—that is, through the use of technologies that save resources while reducing pollution. Over the long run, this kind of technology will be much more effective and cost-efficient than are traditional end-of-the-pipe control measures. No matter how effective a pollution removal technology may be, it only contains the problem temporarily, and usually presents other problems. Control measures often create pollution generated by the suppliers of the materials and energy used in the pollution removal process. Also, the costs of pollution control, the quantities of resources consumed, and the amounts of residue produced tend to increase exponentially as environmental standards require the virtual elimination of pollutants. Reliance on control technology often can create larger problems by shifting pollution from one source to another. Resource-conserving technology makes possible the reduction of pollution without requiring the expenditure of money and resources for cleaning up. It also involves the extraction of valuable resources from waste materials.

*Resource-Conserving Technology*

Such technology is neither a panacea for environmental problems nor a substitute for pollution control. Some industries cannot change processes without disrupting or halting production; and for others the change would be too costly, or no resource-conserving technology may be available. The objective should be to use resource-conserving technology wherever and whenever it is possible and practical. Individual industries should apply their ingenuity to develop methods best suited to their requirements. Within the private sector, more innovation is needed to develop systematic approaches to production operations and pollution control. In corporate planning, the factors to be considered include plant locations, raw materials mixes, construction methods, scales of activity, process technologies, transport systems, and distribution patterns.

Much could be done by the federal government to promote the development and use of resource-conserving technology. Federal research and development programs, for example, should include evaluations of the environmental and economic advantages of new technologies. Federal environmental research and design programs should be expanded to include work on improved methods of waste reduction, separation, and disposal. Federal agencies could promote, through direct government purchases and through government-subsidized purchases, the use of environmentally safe products or products derived from the most environmentally benign processes. A thorough assessment of the prospects for achieving environmental goals with the help of technological innovation should be undertaken by the federal government. This assessment should be started quickly if the United States is to adopt the objectives of a conserver society in the 1980s.

Whether the United States can take on the characteristics of a conserver society depends ultimately on the values, attitudes, and priorities of its people.

## Notes


1. Council on Environmental Quality and U.S. Department of State, *The Global 2000 Report to the President: Entering the Twenty-first Century*, vol. 1 (Washington, D.C., 1980), p. 1.
2. Ibid., p. 32.
3. National Academy of Sciences, *Stratospheric Ozone Depletion by Halocarbons: Chemistry and Transport* (Washington, D.C., 1979).
4. Council on Environmental Quality, *Environmental Quality—1979* (Washington, D.C., 1979), p. 688.
5. Congressional Research Service, Library of Congress, "Environmental Regulations: Economic Impact," Issue Brief No. IB 79025 (Washington, D.C., 1980), p. 5.
6. Ibid.
7. Ibid., p. 9.
8. Council on Environmental Quality, *Environmental Quality-1978* (Washington, D.C., 1978), p. 432.
9. Michael McCloskey, "Have Environmentalists Really Done All Those Things?" Speech to the City Club of Portland, Oregon, March 21, 1980.
10. Environmental Protection Agency, *Journal* (Washington, D.C., September 1979).
11. Ibid.

# Additional Views of Commissioner Thomas C. Jorling

Criteria are benchmarks against which to consider future courses or directions of society, especially technological man and his activities in relation to the biosphere. The advocates of all courses of action have a special obligation to articulate what are often unstated criteria, so that choice is informed and therefore made real. Too often the assumptions underlying different courses of action are unstated. The effort to state criteria is motivated by a desire to penetrate assumptions, to give substance to the debate over the fundamental issues facing American, indeed, global society.

**A. The Character of Technology.** Technology changes the relationship of individuals to each other and to the biosphere. Technology and its systems of management can be large and complicated, thereby making individuals and communities dependent on (often alienated from) the supporting institutional structures: government (for the licensing or regulation of technology), production (to make technology available), and service (to operate, distribute, and maintain technological systems). An alternative approach to society's needs would apply this criterion so that technology would be developed in scale with individuals or communities and be serviceable by them. To the extent that this is impossible (for example, in communications or air travel) then the institutions administering such technology should be constrained by Point E below.

**B. Vulnerability (Diversity—Resiliency—Dependency).** All systems that support the lives of individuals or communities should be developed in their design and operation to avoid disruption, accidental or otherwise, rather than to achieve such avoidance by variations of the police power. Such systems should be quickly and easily repaired (that is, by commonsense ability and routinely available tools). Scale here makes an enormous difference, for the greater the population dependent on a given life-support system or service, the higher its vulnerability, and the greater is the need for forms of regimentation to protect the system. This is often done under the guise of causing people to live within predictive models, which of course are only valid if there is assurance people will behave as the models project.

**C. Freedom.** Freedom is a word subject to endless interpretation. In the present context, it means the ability to avoid coercive control of political, religious, or other views (including indirect control achieved through total dependency on a paycheck for access to life-support needs), rather than, for instance, one modern perversion which is freedom to experience sensate pleasure on demand (that is, consumer freedom).

**D. Distributive Justice.** All public policy must be developed against the recognition that all citizens have basic needs to life support; they must be able to access the resources of the biosphere to permit human fulfillment. The question, in terms of our alternative choices, is whether this can be supplied by the "pie ever increasing"—if not, it must be supplied otherwise. Here, especially, the international dimensions are crucial.

**E. Exercise of Power.** Whenever power (to hire, to fire, to relocate an employment cell, to use a biospheric resource) is exercised and when those who bear the effects of the exercise of such power personally know and are known by the exerciser of the power, then accountability should be dependent on that human interaction, with the exception of the use of public trust resources—air, water, and biota. If power is exercised without that interaction, as the Constitution wisely recognized in the federal exercise of power, there should be different and enforceable measures of accountability—including due process, norms of public interest, and the application of other criteria such as those enumerated here (A, The Character of Technology; D, Distributive Justice; G, Tightness of Matter and Energy Cycles).

**F. Assumption of Risk.** Individuals can assume risk. Societies can impose risks. Increasingly—and as a necessary function of the conventional alternatives—societies (through both public and private mechanisms) assess risk and then impose it on individuals. For example, if the release of a given chemical will cause one excess death in a given population size, the risk is imposed on society and no one knows the identity of the one who dies. Society should seek to avoid assessing and imposing risks that cannot be, in any meaningful sense, assumed by individuals ("love it or leave it" is not meaningful). Whenever such risks are imposed by society, that action must be taken through the most democratic of processes—perhaps even referenda.

**G. Tightness of Matter and Energy Cycles.** It has become routine to characterize our conventional social economic system as "linear" with regard to matter and energy: exploit, transport, use, transport, discard. This is in marked contrast to ecological patterns of cycling. No release (meaning no loss of custody) of chemicals in production and in product use should be the norm against which performance in the management of matter and energy is measured. Special burdens of justification (that is, fundamentally compelling) should be established before activities or systems that release chemicals into the environment are permitted, especially chemicals not normally found in the biosphere.

Availability of resources must drive our systems to recycle and reuse and away from the linear model. It must drive our systems (and all human communities) to design and build technology to withstand the second law of thermodynamics for the greatest time rather than, as at present, counting on it for rapid turnover (obsolescence).

**H. Time/Permanence.** We must endeavor to evaluate how any action (development of technology, development of a system of production, etc.) and logical extensions of it are likely to influence the future, that is, 20 to 50 years from now, especially against other criteria, such as vulnerability, here enumerated. For instance, the establishment of a huge centralized system for producing autos could have been predicted, with rudimentary foresight, to hold our socioeconomic system hostage for its continuation.

Any actions taken by man vary in the extent and length of time in which such action will affect the environment. Contrast the development of nuclear fission technology to the clearing of land for agricultural production. After the cessation of activity, fission byproducts can affect the environment and health for thousands of years, while only traces of agricultural activity can be detected after 40 years. Actions must be evaluated against permanence and the least impact course chosen.

**I. Second Law of Thermodynamics—Entropy.** The inexorable tendency of all material and energy to move to higher levels of disorder must be recognized in our investment in (choice of) life-supporting techniques and systems. Whenever a system is developed there are inescapably associated with it the capital costs of development, the operation and maintenance costs (life cycle costs), and replacement and disposal costs. One principal reason that cities are in such financial trouble is that they are confronting the need to replace much of the previously installed life-support systems—especially water, sewer, and housing stocks—on which the Second Law has taken its toll.

Discount rates, for instance, must be dramatically increased to reflect total investment costs.

**J. The Biota.** All actions should be undertaken after ensuring that there will not be placed at risk of existence any biological species or representative ecosystem, terrestrial or aquatic. The protection of the biological, physical, and chemical integrity of the biosphere must be the general criterion against which human actions are judged. It is necessary for a long-term, stable, life-supporting biosphere.

**K. Perpetual Care.** Some activities, such as electric power generation by nuclear fission, the production of certain long-lived chemicals, certain modifications of the earth's surface (as, for example, the building of dams and water distribution systems), or urbanization, and (although this is more in the nature of crystal-ball gazing) certain biological products of genetic engineering, require constant care extended almost infinitely into the future. As a result of some of these activities, increasingly large expanses of land are precluded, effectively forever, from any other use. In addition, energy and resources must be committed to them effectively in perpetuity. One application of this criterion would be that technology that requires perpetual care should not be developed.

**L. Centralization/Decentralization.** Most components of modern life seem destined to move toward more singular and central structure and function. This criterion would allow that trend to be considered explicitly in the development of any technology or support service. For instance, the Northeast is now resource-poor. It imports most of the products it uses, yet after use they are irretrievably discarded, often because markets are not available for recycling. But markets could become available, if during a transitional phase those imported materials—after use—could be stored in depots. Metals, plastics, paper, all could be segregated and stored for future use, to create future mines, as it were. Over time, this could lead to decentralization.

# Biographies

*Daniel Bell* is the Henry Ford II Professor of Social Sciences at Harvard University. Dr. Bell was educated in the public schools of New York City, received a Bachelor's degree from The City College of New York, and was awarded a Doctorate from Columbia University. He was Managing Editor of *The New Leader* and *Common Sense* and served on the Editorial Board of *Fortune*. He has also taught at Columbia University and was Chairman of the Commission on the Year 2000 of the American Academy of Arts and Sciences. His most recent book is *The Winding Passage: Essays and Sociological Journeys, 1960-1980.*

**Daniel Bell**

*Philip Handler* is the President of the National Academy of Sciences. Dr. Handler received a B.S. from the College of the City of New York and a Ph.D. in biochemistry from the University of Illinois, and has been a Professor of Biochemistry at Duke University for 40 years. He has served numerous academic and government organizations in the field of science, including the National Institutes of Health, the National Science Foundation, and the President's Science Advisory Committee. A recipient of many national and international awards, he has also published over 200 technical papers in numerous scientific journals.

**Philip Handler**

*Thomas C. Jorling* is Professor of Environmental Studies and Director of the Center for Environmental Studies at Williams College. Mr. Jorling was educated at Notre Dame University and received his M.S. in ecology from Washington State University and his LL.B. from Boston College. He has served in the Solicitor's Office, Fish and Wildlife Division, Department of the Interior; as Minority Counsel for the Senate Committee for Public Works; and also was Assistant Administrator of the Office of Water and Waste Management of the Environmental Protection Agency, which was responsible for programs that implemented the Clean Water Act, the Safe Drinking Water Act, the Ocean Dumping Act, and the Resources Conservation and Recovery Act.

**Thomas C. Jorling**

**Theodore R. Marmor**

*Theodore R. Marmor* is Professor of Political Science and Public Health and Chairman of the Center for Health Studies at Yale University. Dr. Marmor received his A.B. and Ph.D. degrees from Harvard University. Previously he has taught at the Universities of Chicago, Minnesota, Wisconsin, and Essex in England. He is the author of *The Politics of Medicare* (1970), co-author of *National Health Insurance: Conflicting Goals and Policy Choices* (1980), and has written numerous articles on the policies of the welfare state, emphasizing social security, national health insurance, and health planning. Dr. Marmor is a member of the Council on Foreign Relations, has served as Special Assistant to the Under Secretary of the Department of Health, Education, and Welfare, and was on the staff of the President's Commission on Income Maintenance Programs.

**Michael McCloskey**

*Michael McCloskey* is the Executive Director of the Sierra Club, a national environmental organization at which he has worked since 1961. Mr. McCloskey is a graduate of Harvard University and received a J.D. from the University of Oregon. He is a leading spokesman on conservation and ecology issues and is an active participant in the major organizations in this field. He serves on the Boards of the League of Conservation Voters, RESOLVE, the National Committee for Urban Recreation, the Council on Economic Priorities, and the Natural Resources Council of America. He has also worked with the Ford Foundation Energy Policy Project, the National Petroleum Council, the National Coal Policy Project, and the National Academy of Sciences Panel on Geothermal Energy.

**Edmund D. Pellegrino**

*Edmund D. Pellegrino* is the President of The Catholic University of America. Dr. Pellegrino received his M.D. from New York University. His numerous academic appointments have included Chairman, Department of Medicine, University of Kentucky Medical Center; Dean, School of Medicine, State University of New York, Stony Brook; Chancellor of the University of Tennessee Center for Health Sciences; and Chairman, Yale-New Haven Medical Center, Inc. Dr. Pellegrino's current research activity involves calcium metabolism, physiology, and chemistry of calcified tissues. He has written extensively on scientific research, medical education, and philosophy, and is the author of *Humanism and the Physician*.

**Henry B. Schacht**

*Henry B. Schacht* is Chairman and Chief Executive Officer of the Cummins Engine Company, Inc. He was educated at Yale University and received an M.B.A. from Harvard Business School. Mr. Schacht is a Director of CBS, Inc., and a Trustee of The Rockefeller Foundation, The Brookings Institution, The Conference Board, the Committee for Economic Development, and the Urban Institute. He is also a member of the Council on Foreign Relations and The Trilateral Commission.

---

C. Richard Corrigan

*C. Richard Corrigan*, a member of the Senior Professional Staff for the Panel on Energy, Natural Resources, and the Environment, is a journalist specializing in energy who was on leave from *National Journal*. Mr. Corrigan received a B.S. from the University of Florida at Gainesville. He has written for numerous magazines and newspapers and has spoken on energy before a number of organizations.

## COMMISSION STAFF

### Administration

Stephen F. Durbin
Director of Administration

Loretta J. Marshall
Administrative Officer

Debra E. Brown
Administrative Assistant

Debra K. Amick
Ronald J. Benschoter
Jacquelin L. Freeman
Vondell A. Henson
Diane W. Knight
Dennis B. Melby
Lourie A. Russell-Kawecki
Romaine A. Sharp
Leesa N. Weiss
Tammy L. White

### Public Affairs

Daniel F. Dwyer
Special Assistant for Public Affairs

Thomas W. Kell
Tamara S. Rafferty

### Panel Professionals

Edward D. Berkowitz
Paul M. Bunge
Charles R. Corrigan
Steven L. Englund
Christopher H. Foreman
Lisa E. Goldberg
Robert D. Hamrin
Jeffrey A. Hart
Donald A. Hicks
William L. Jordan
Caroline M. LeGette
Keith Melville
Andrew S. McFarland
Donald J. O'Hara
Gail M. Pesyna
Dennis C. Pirages
Raymond F. Reisler
Stuart O. Schweitzer

### Production

*Editorial Adviser*
Joseph Foote
Bonnie J. Brown (Assistant)

*Editors*
Mary E. Cadette
Judith Ross Ferguson
Nina M. Graybill
Whitney Watriss

*Designer*
Morgan-Burchette Associates, Inc.

*Proofreader*
Editorial Experts, Inc.

*Composition*
TechnoGraphics, Inc.

# President's Commission for a National Agenda for the Eighties

**Chairman**
William J. McGill

Daniel Bell
Robert S. Benson
Charles E. Bishop
Gwendolyn Brooks
J. Fred Bucy, Jr.
Pastora San Juan Cafferty
Joan Ganz Cooney
Marian Wright Edelman
Herman E. Gallegos
John W. Gardner
Don L. Gevirtz
C. Jackson Grayson, Jr.
Philip Handler
Dorothy I. Height
William A. Hewitt
Ruth J. Hinerfeld
Carl Holman
Benjamin L. Hooks
Matina S. Horner
Thomas C. Jorling
Rhoda H. Karpatkin
Lane Kirkland
Juanita M. Kreps
Esther Landa
Theodore R. Marmor
Martin E. Marty
Michael McCloskey
William E. Miller
Alan B. Morrison
Roger G. Noll
Frank Pace, Jr.
Edmund D. Pellegrino
Donald C. Platten
Tomás Rivera
Paul G. Rogers
Elspeth D. Rostow
Howard J. Samuels
Henry B. Schacht
William W. Scranton
Lewis Thomas
Foy Valentine
Glenn E. Watts
Marina v. N. Whitman
Addie L. Wyatt

**Co-Staff Directors**
Claude E. Barfield
Richard A. Wegman