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ENERGY POLICY

Developing Strategies for Energy Policies in the 1990s

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Our November 1988 transition report on the Department of Energy (DOE) summarized a number of major policy, management, and program issues facing the new Secretary of Energy.[1] That report described our concern for the nation's increasing vulnerability to oil supply disruptions; the growing uncertainty regarding future electric generating capacity; and the health, safety, and environmental problems associated with various energy options. In an effort to address a broad range of energy issues, the President announced in July 1989 that DOE would develop a national energy strategy to guide future energy policy decisions.

The information contained in this report updates and supplements the information contained in our transition report and discusses our continuing concerns about several energy issues: energy consumption, increased dependence on imported oil from Persian Gulf sources that are more likely to be interrupted, uncertainty over the adequacy of future electric generating capacity, and concern for the potentially adverse environmental effects of energy consumption. In addition, the President's initiative to develop a national energy strategy is discussed.

We believe the information contained in this report, which draws on numerous energy-related reports GAO has issued over the past several years, will be useful to the cognizant congressional committees and subcommittees involved with energy and environmental issues (listed at the end of this letter) in monitoring the development of the national energy strategy. We also believe that the information can be used by DOE as it develops this strategy.

Results in Brief

Securing sufficient and reliable future energy supplies to meet the increased U.S. energy demand projected for the 1990s is a major issue facing the nation. Since 1983, U.S. energy consumption has increased by about 16 percent, and an upward trend is expected to continue through the year 2000. Petroleum is used more than any other energy source in the United States, supplying about 41 percent of the nation's total energy needs.

[1] Energy Issues: GAO Transition Series (GAO/OGC-89-16TR, Nov. 1988).

With the increase in total energy consumption, two potentially disturbing energy supply trends are emerging:

- The U.S. is becoming increasingly dependent on imported oil, particularly from the strategically sensitive Persian Gulf, to meet its petroleum energy needs. This trend increases the nation's vulnerability to potential oil supply disruptions and increased oil prices.
- Questions are being raised as to whether there will be adequate generating capacity to meet the nation's future electricity needs. While electricity consumption has been steadily increasing in recent years and is projected to continue through the year 2000, much of the additional generating capacity projected to come on line is in the early stages of construction and may not be completed in time to meet the nation's future electricity needs during the 1990s.

It is also increasingly being recognized that energy consumption creates potentially serious environmental, health, and safety consequences, whose possible solutions can be costly to address.

As indicated by our previous work, a number of options are available to improve the nation's ability to cope with the trend toward increased dependence on imported oil and to ensure adequate supplies of future electric generating capacity. These options also recognize the importance of protecting the environment.

As directed by the President, DOE is developing a much needed national energy strategy that it expects will integrate and balance concerns for energy choices against other national concerns, such as environmental protection and economic growth. On April 2, 1990, DOE issued its interim report on the national energy strategy, which outlined goals for the strategy, obstacles to achieving the goals, and options for resolving these obstacles. Between April and December 1990, DOE plans to analyze the information in the interim report along with other data to develop energy strategy options. These options will be considered for inclusion in the strategy to be released by the President in January 1991. The effort to develop a national energy strategy is a step in the right direction toward addressing the nation's future energy needs and the environmental and budgetary implications that should be considered when developing energy policies.

Increasing U.S. Energy Consumption

Although the United States has made impressive gains in the efficient use of energy since 1973, recent low world energy prices have encouraged increased consumption, offsetting efforts to improve efficiency gains in certain energy sectors. Over the last six years, domestic energy consumption has increased by about 16 percent to an all-time national high of 84.2 quadrillion BTUs in 1989.[2] DOE's Energy Information Administration (EIA) projects U.S. energy consumption will continue to increase between 1989 and the year 2000 by about 14 percent.

Currently, petroleum provides about 41 percent of the nation's energy needs; the other fossil fuels—coal and natural gas—each provide about 23 percent; nuclear powerplants are the source of about 7 percent; and hydropower and other renewable energy sources together account for about 7 percent. While an increase in energy consumption is projected during the next decade, EIA expects the relative percentages of energy provided from the above sources to change very little during this time frame. Thus, petroleum is likely to remain the nation's primary source of energy for some years to come. Appendix I provides a more in-depth discussion of trends in overall U.S. energy consumption.

Increasing Dependence on Imported Oil

As reported in August 1988, the United States is better able to respond to an oil crisis than it was during the 1970s when U.S. oil supplies were disrupted by the 1973-1974 oil embargo of the Organization of Petroleum Exporting Countries (OPEC), the 1978-1979 Iranian revolution, and the subsequent outbreak of war between Iran and Iraq.[3] However, in that report, we also cautioned that trends toward increased oil consumption and increasing dependence on Persian Gulf oil imports were beginning to emerge, and that, if these trends continue, they could have an unfavorable effect on our ability to respond to an oil disruption in the decade to come. These trends have in fact continued, and EIA projects they will continue through the 1990s. In our opinion, the nation is more vulnerable to an oil supply disruption today than it was in 1986, and its vulnerability to such a disruption is likely to increase if current energy trends remain.

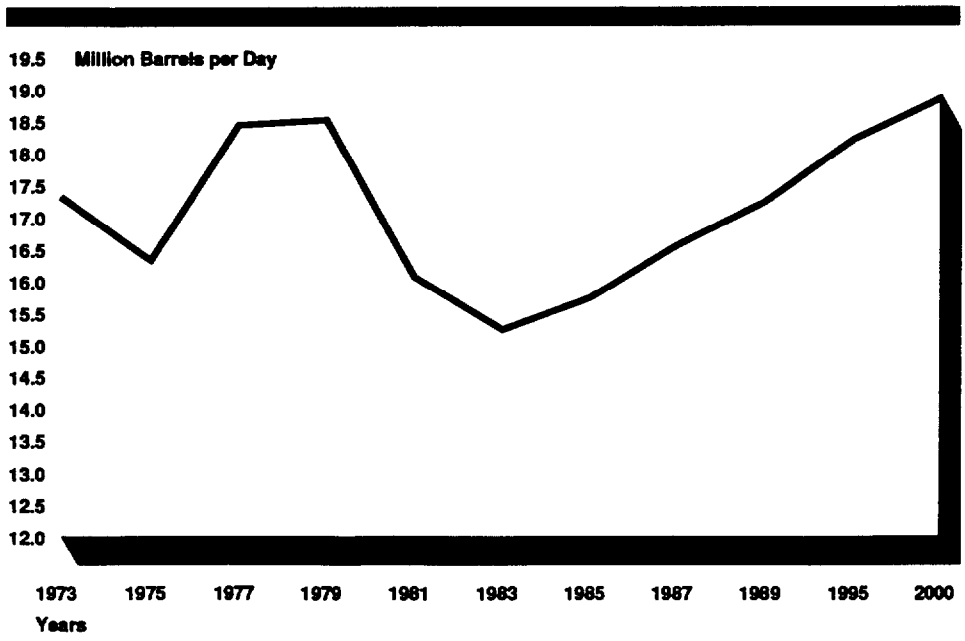
[2]One Quadrillion British Thermal Units (BTUs) of heat equals approximately 171 million barrels of crude oil, 1 trillion cubic feet of natural gas, and about 45 million short tons (a unit of weight equal to 2000 pounds) of coal.

[3]Energy Security: An Overview of Changes in the World Oil Market (GAO/RCED-88-170, Aug. 31, 1988)

Increasing Oil Consumption

According to EIA, U.S. daily oil consumption decreased steadily from about 18.5 million barrels in 1979 to about 15.2 million barrels in 1983—the lowest level in over a decade. However, as seen in figure 1, by 1988 oil consumption had increased by about 2.08 million barrels per day to 17.28 million barrels per day. This increase was sparked by the sharp decline in world oil prices in 1986—a 56-percent drop from about $27 per barrel to below $15 per barrel. In 1989, U.S. oil consumption leveled off to about 17.24 million barrels per day. However, EIA expects the trend toward increased oil consumption to continue through the year 2000.

Figure 1: U.S. Oil Consumption

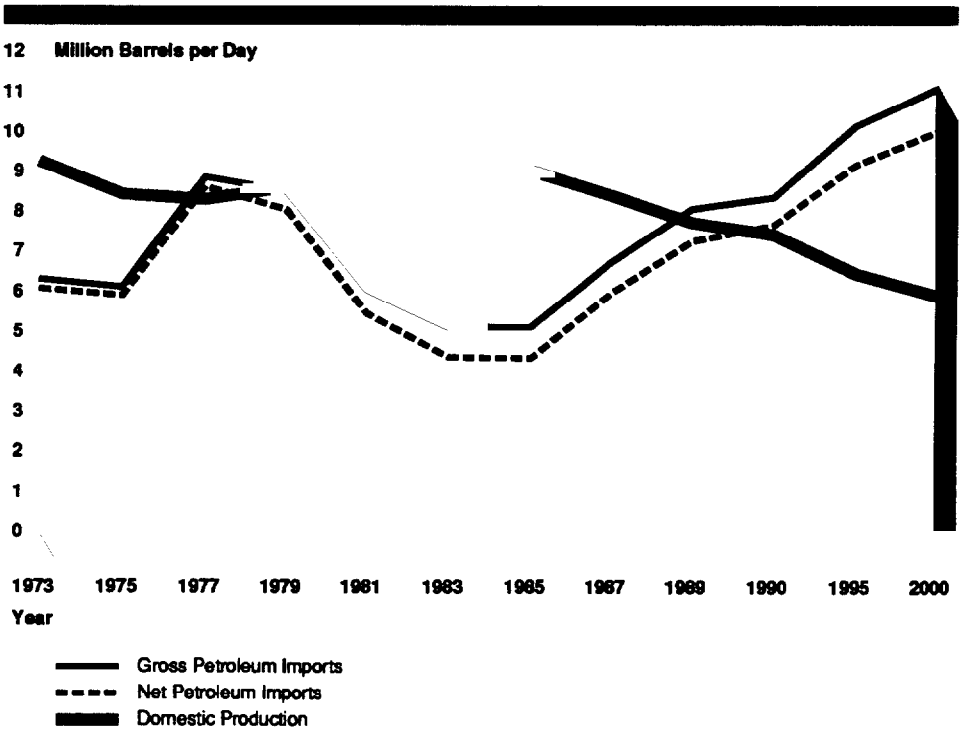


Source: Energy Information Administration

Decreasing Domestic Production

While oil consumption has been increasing, domestic oil production has been decreasing. As shown in figure 2, U.S. crude oil production generally increased from 1979 to 1985 as a result of high world oil prices, but the decline in oil prices in 1986 reversed this trend. Since 1985, domestic crude oil production has decreased by about 1 million barrels per day, and EIA expects this trend to continue. In 1989, domestic crude oil production was about 7.7 million barrels per day. EIA projects it will be about 5.9 million barrels per day by the year 2000.

Figure 2: U.S. Petroleum Imports and Domestic Production



Source: Energy Information Administration

Increasing Imports From the Persian Gulf

As indicated in figure 2, since 1985, U.S. oil imports have increased as domestic production has decreased. In 1989, net daily imports (gross imports minus exports) had increased by about 3 million barrels per day over 1985 levels to about 7.2 million barrels per day. EIA projects that net imports will increase from 42 percent of total U.S. oil consumption in 1989 to 55 percent of total U.S. oil consumption by the year 2000. Persian Gulf oil imports accounted for 26 percent of total U.S imports in 1989—a 19-percent increase from its 1985 share of total imports. The trend toward increased imports from Persian Gulf nations is also expected to continue since this region has 63 percent of the world's proven oil reserves and has more than 70 percent of the world's idle oil production capacity. Adding to the concern caused by increasing oil imports from the strategically sensitive Persian Gulf area is the fact that efforts to fill the U.S. Strategic Petroleum Reserve (SPR), which is designed to buffer against supply disruptions, have not kept pace with rising imports. Also, it is recognized that the nation's transportation sector, which is 97-percent dependent on oil, has limited ability to

switch from oil to other fuels in the event of a supply disruption or rapid price increase.

Options to Improve the Nation's Ability to Cope With an Oil Supply Disruption

The nation has a number of options for improving its ability to cope with a protracted oil supply disruption. Among these options are to (1) expand the size of the SPR beyond its original mandate of 750 million barrels, (2) improve the drawdown and distribution capability of the SPR, and (3) reduce oil consumption in the critical transportation sector.

We testified in May 1989 before the Senate Committee on Energy and Natural Resources that we agreed in concept with a provision of S.694, 101st Cong., 1st Sess. (1989) that calls for DOE to plan for the expansion of the SPR beyond the original mandate of 750 million barrels to 1 billion barrels.[4] Also, we reported in March 1989, on DOE's planned efforts and related costs to improve the drawdown and distribution capability of the SPR.[5] In addition, we reported in August 1988 that certain options are available to policymakers which could help moderate our nation's growing dependency on foreign oil. For example, options to displace or reduce oil consumption in the critical transportation sector include encouraging the development and use of alternative fuels for motor vehicles—which was a provision of the President's proposed July 1989 amendment to the Clean Air Act—and further improving motor vehicle fuel efficiency. Appendix II contains more detailed information on U.S. oil consumption, production, and dependence on foreign oil.

Uncertainty Surrounding Future Electric Generating Capacity

According to the North American Electric Reliability Council (NERC), the electric utility industry is planning to bring on line about 72,200 megawatts (MW) of additional generating capacity by 1998 to meet the nation's anticipated electricity needs. However, the current construction status of these generating facilities as well as regulatory, environmental, and other issues create uncertainties as to whether these powerplants will be available when needed.

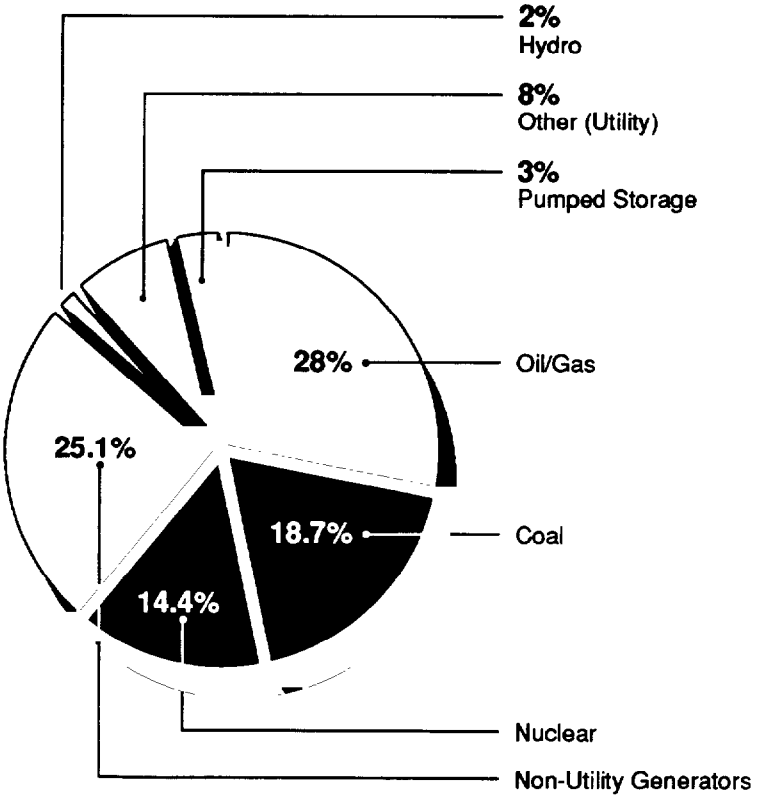
NERC reported that the additional capacity needed by 1998 is to be met by the generating options shown in figure 3 below. As indicated, oil- and

[4]The Strategic Petroleum Reserve Amendments of 1989 (GAO/T-RCED-89-38, May 4, 1989).

[5]Strategic Petroleum Reserves: Analysis of Alternative Financing Methods (GAO/RCED-89-103, Mar. 16, 1989)

natural gas-fired generators are expected to make the largest contribution to future capacity providing 28.0 percent of the additions; nonutility generators—firms, such as chemical plants, that use the steam from generators for their industrial processes to also generate electricity and other facilities constructed solely to sell power to utilities—are expected to provide about 25.1 percent of the new capacity by 1998.

Figure 3: Projected U.S. Additions to Electric Generating Capacity by 1998



Source: North American Electric Reliability Council

Powerplant construction and licensing times for new generating capacity are concerns affecting whether planned electricity supplies will be available when needed. Currently, only about 37 percent of the projected additions to capacity are under construction. Of those under construction, about one-third are less than 50 percent complete. Experience indicates that the time required to plan, construct, and license large-scale central station power plants can take between 7 and 10 years, or longer. However, EIA expects that nonutility power producers will be

able to construct their facilities in less time. Even if these nonutility sources are constructed on time, a shortfall in meeting future electricity needs could still exist because these sources represent only about 25 percent of new needed capacity.

In addition to the concerns about the construction status of the planned capacity additions, a number of regulatory, environmental, and other issues could affect when utilities complete the needed new facilities, or when these powerplants come on line. For example, there are concerns whether natural gas supplies can be delivered to meet the expected increase in demand by electric utilities. Also, the timing and pace of future additions to electric capacity from coal-fired generators will be affected by the stringency of requirements to reduce acid rain-causing emissions, which are being debated in amendments to the Clean Air Act. In addition, public concern for the potential health and safety hazards of nuclear-powered generators may impede or stop altogether the eventual start-up of nuclear plants presently under construction—as it did for the Shoreham facility in New York—and plans for future capacity from this source. Finally, although concerns for the reliability of power from nonutility generators have been minimized through negotiated contracts with electric utilities, uncertainty remains about this generating option because utilities have had little experience with such facilities.

Options to Ensure Adequate Future Electric Generating Capacity

Policymakers have a number of options to ensure adequate supplies of future electric generating capacity. Among these options are (1) concentrating on the more promising clean coal technologies that could be used to generate electricity while meeting emission reduction requirements, (2) supporting the Nuclear Regulatory Commission's (NRC) effort to compress the time needed to license a nuclear plant by reducing the process from two steps to one step, and (3) supporting the effort to develop a standard design for nuclear plants that would enhance safety and speed construction times.

As we reported in October 1989 and in March 1990, remaining funds in DOE's clean coal technology program could be focused on multiple demonstrations of the technologies with the most promise for reducing emissions that contribute to acid rain.[1] This approach could speed the ultimate deployment of these technologies and enable utilities to expand

[1] Perspectives on the Potential of Clean Coal Technologies to Reduce Emissions From Coal-Fired Power Plants (GAO/T-RCED-90-3, Oct. 18, 1989); Fossil Fuels: Pace and Focus of the Clean Coal Technologies Program Need to Be Assessed (GAO/RCED-90-67, Mar. 19, 1990); Utilities' Potential Use of Clean Coal Technologies (GAO/T-RCED-90-56, Mar. 28, 1990).

the use of coal—our nation's most abundant domestic energy resource. In the nuclear area, as we reported in March 1989, consideration should be given to supporting the NRC's proposal for preapproved, standardized nuclear plant designs.[7] Reducing the NRC's license approval process for nuclear facilities from two steps to one step could shorten construction times and ease the concerns electric utilities have for regulatory review. Standardized plant designs could also lead to a set pattern of maintenance procedures and training activities that could contribute to safer nuclear operations. Finally, as reported in November 1988, policymakers should monitor the changing nature of utility regulation. For instance, widespread concern exists over the issue of nonutility generators' access to the transmission lines of electric utilities. Appendix III contains more detailed information on these electricity generation issues.

Increasing Concerns Over the Environmental Effects of Energy Choices

In recent years, energy issues have become increasingly linked to environmental problems caused by energy fuel choices. The use of fossil fuels, in particular, has contributed to global warming, ozone pollution, and acid rain. U.S. coal reserves are expected to last at least 300 years. However, an increase in U.S. coal consumption during the next decade will depend, in part, on the successful reduction of environmentally damaging emissions from coal-fired generators, especially sulfur dioxide and nitrogen oxide emissions, which contribute to the formation of acid rain.

More recently, additional concern has been expressed about carbon dioxide emissions which, thus far, can only be reduced by decreasing fossil fuel consumption. There is general consensus that these carbon dioxide emissions contribute to a warming of the earth's surface temperature, which could have serious adverse health and environmental effects. The concern for increased levels of carbon dioxide emissions has focused attention on actions to mitigate the negative environmental effects of fossil fuel use. Nuclear power is a potential option to meet the nation's energy needs while reducing the environmental concerns of fossil fuel consumption. However, the particular health, safety, and environmental concerns of this energy option cause problems about its continued or increased use. The future of nuclear power in the United States will be determined, in part, by whether new technologies can

[7] Electricity Supply: What Can Be Done to Revive the Nuclear Option? (GAO/RCED-89-67, Mar. 23, 1989).

improve the nuclear safety record and by resolution of the nuclear waste disposal issue.

Resolving the concerns for energy production and consumption, particularly in light of the projected increases in energy demand, requires that U.S. policymakers increasingly consider the environmental impact when deciding on policies about energy choices. Appendix IV discusses the environmental issues associated with fossil fuel consumption and nuclear power in more detail.

The Administration Is Developing a National Energy Strategy

In announcing the need to develop a national energy strategy, the President stated that the United States is at a critical juncture in ensuring the availability of reliable, competitively priced supplies of clean energy in the 1990s. According to DOE, the national energy strategy will enable policymakers to chart a course, set a pace, and evaluate U.S. progress in providing the reliable energy supplies the economy needs while protecting the nation's health, safety, and environment. The strategy is being developed with public, industry, and congressional input, and DOE expects it to be announced by the President in January 1991. On April 2, 1990, DOE issued an interim report on the national energy strategy, which is a compilation of publicly identified goals for the strategy, and obstacles to achieving these goals along with options for resolving the obstacles. Between April and December 1990, DOE plans to analyze this information and other data to develop energy policy options for inclusion in the strategy to be approved by the President.

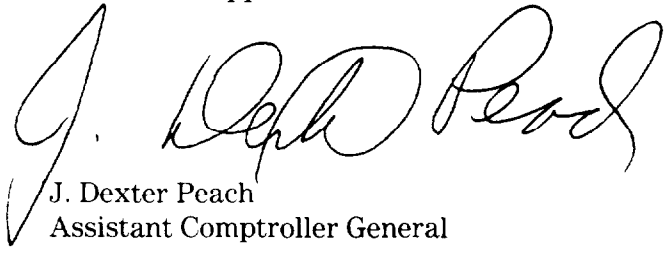
We support the initiative to develop a national energy strategy and believe that such a strategy is sorely needed and long overdue as evidenced by the trends toward increased U.S. energy consumption and the related concerns for the reliability of energy supplies and environmental protection. Timely completion of the strategy is also important because the electric utility industry, the automotive industry, and others in the energy sector will be making decisions about what technologies and energy sources to pursue, particularly as changes to the Clean Air Act occur. Because of its importance, we plan to monitor DOE's efforts to develop a national energy strategy. Appendix V contains more detailed information on the national energy strategy.

The information in this report was obtained primarily from prior GAO reports (see Related GAO Products on p. 64) and reports prepared by EIA, DOE, and others involved in the analysis of energy usage and future

energy supply. EIA base case projections of energy trends (supply, production, and consumption) were used in this report.[8] However, the Administrator, EIA, has cautioned that base case projections of future energy supplies and consumption should not be considered predictions because some past projections have differed from what actually occurred. During the preparation of this report we met with DOE's Deputy Director, Office of Policy, Planning and Analysis, who is responsible for coordinating the development of the national energy strategy.

Although we did not provide this report for formal agency comment, we did meet with officials from the Environmental Protection Agency (EPA) and DOE to discuss its contents. Both the EPA and DOE officials agreed with the factual content of the report. However, the DOE officials were concerned that the overall tone of the report was more alarming than their perception of the U.S. energy situation. We took EPA's and DOE's specific comments into consideration and modified the report where appropriate.

Copies of this report are being sent to the Secretary of Energy; the Administrator, EPA; and other interested parties. This work was performed under the direction of Victor S. Rezendes, Director of Energy Issues, who may be reached at (202) 275-1441. Other major contributors are listed in appendix VI.



J. Dexter Peach
Assistant Comptroller General

[8]EIA develops three forecasting assumptions based on projected future energy conditions. GAO uses EIA's base case assumption as it reflects EIA's best assessment of future energy conditions.

Congressional Committees

Senate Committee on Energy and Natural Resources

Senate Committee on Environment and Public Works

Subcommittee on Energy and Water Development, House Committee on Appropriations

Subcommittee on Economic Stabilization, House Committee on Banking, Finance and Urban Affairs

House Committee on Energy and Commerce

Subcommittee on Energy and Power, House Committee on Energy and Commerce

Subcommittee on Health and the Environment, House Committee on Energy and Commerce

Subcommittee on International Economic Policy and Trade, House Committee on Foreign Affairs

Subcommittee on Environment, Energy and Natural Resources, House Committee on Government Operations

Subcommittee on Energy and the Environment, House Committee on Interior and Insular Affairs

Subcommittee on Mining and Natural Resources, House Committee on Interior and Insular Affairs

Subcommittee on Water, Power and Offshore Energy Resources, House Committee on Interior and Insular Affairs

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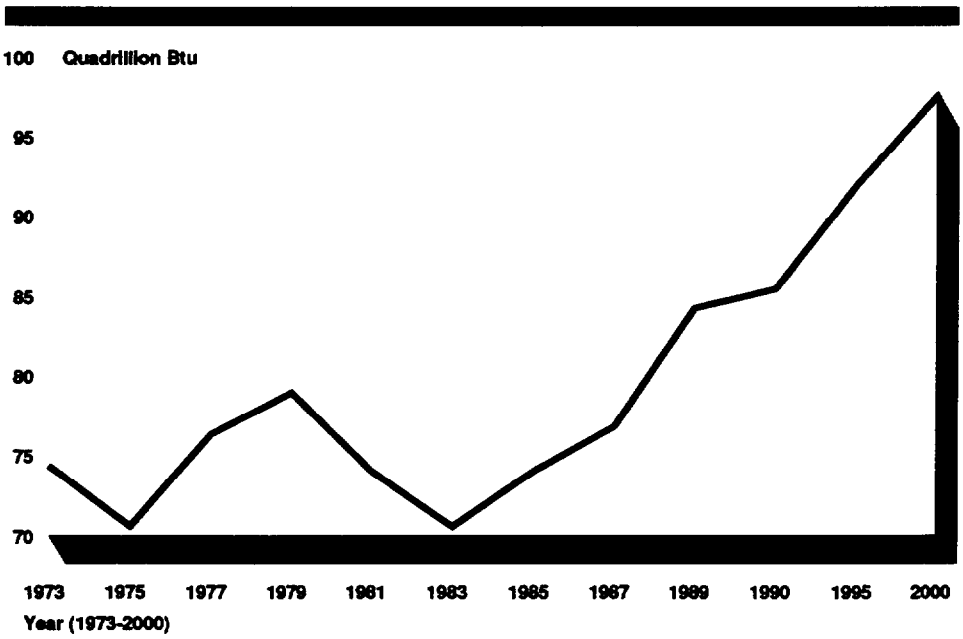
Abbreviations

BTU	British thermal unit
CAFE	Corporate Average Fuel Economy
CRS	Congressional Research Service
CCT	Clean Coal Technology
DOE	Department of Energy
EIA	Energy Information Administration
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
IEA	International Energy Agency
IPPs	Independent Power Producers
GAO	General Accounting Office
GNP	Gross National Product
MW	Megawatts
NAAQS	National Ambient Air Quality Standard
NARUC	National Association of Regulatory Utility Commissioners
NAPAP	National Acid Precipitation Assessment Program
NERC	North American Electric Reliability Council
NRC	Nuclear Regulatory Commission
OPEC	Organization of Petroleum Exporting Countries
PURPA	Public Utility Regulatory Policies Act
QUAD	quadrillion British thermal units
SPR	Strategic Petroleum Reserve

Overall U.S. Energy Consumption Trends and Projections Through the 1990s

Securing sufficient and reliable future energy supplies to meet the increased U.S. energy demand projected for the 1990s is a major issue facing the nation. As shown in figure I.1 below, energy consumption has been steadily increasing since 1983. From 1983 to 1989, U.S. energy consumption increased by 16.3 percent, and in 1989 domestic energy consumption, at 84.2 quadrillion BTUs (QUADs),[1] was higher than any previous year in U.S. history. EIA projects that, at an annual growth rate of 1.1 percent, energy consumption will increase to 97.4 QUADs by the year 2000.[2]

Figure I.1: Total U.S. Energy Consumption



Source: Energy Information Administration

According to DOE, U.S. energy use has increased only 8 percent since 1973 while the gross national product (GNP) increased 46 percent, indicating a substantial increase in the efficiency of energy use. However, according to EIA, recent low world oil prices appear to have diminished

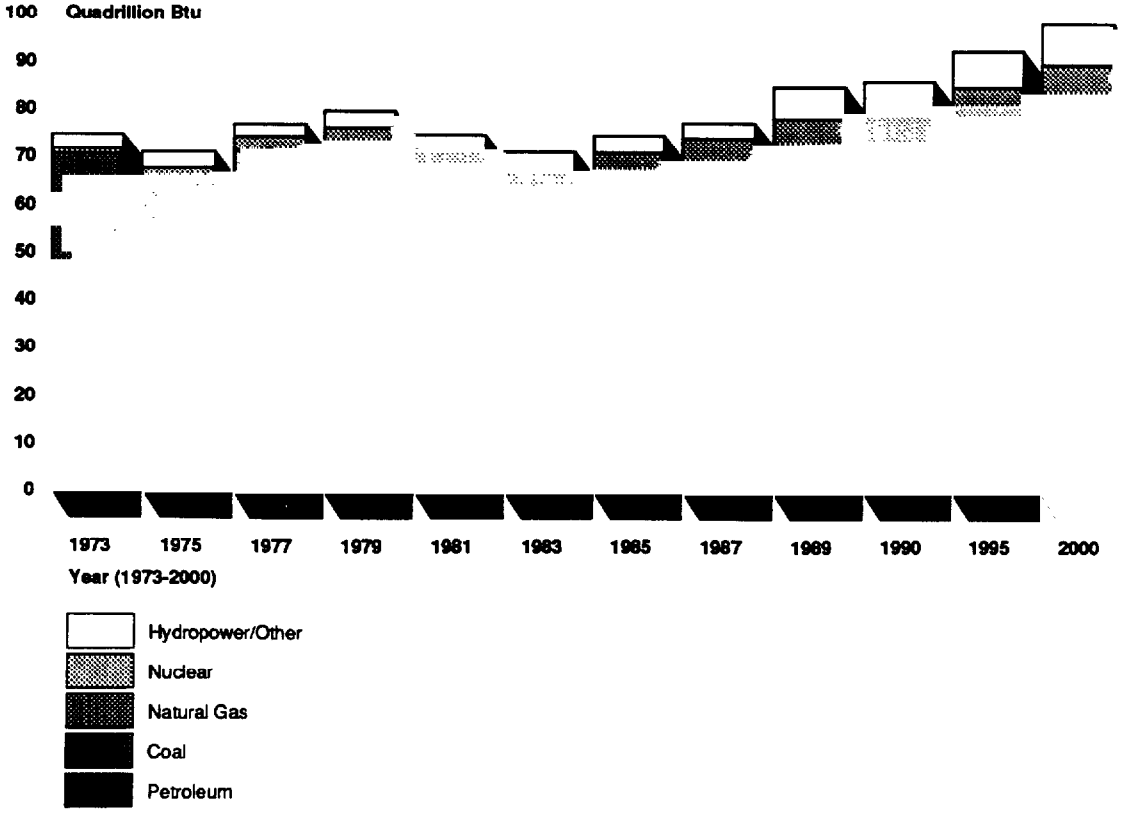
[1]One quadrillion British thermal units (BTU's) of heat equals approximately 171 million barrels of crude oil, 1 trillion cubic feet of natural gas, and about 45 million short tons (a unit of weight equal to 2000 pounds) of coal.

[2]EIA develops three forecasting assumptions based on world oil prices. GAO uses EIA's base case assumption as it reflects EIA's best assessment of energy conditions.

U.S. interest in both efficiency improvements and in developing alternative energy sources.

Figure I.2 below shows U.S. consumption of energy by source since 1973, along with EIA projections through the year 2000. Between 1973 and 1989, the nation's consumption of renewable fuels, nuclear power, and coal increased; natural gas consumption declined; and oil consumption remained at the same level. Through the year 2000, the U.S. is expected to increase its use of all energy sources. As discussed below, the percentage that the consumption of each source contributes to the nation's total energy needs will shift some over the next decade. Natural gas consumption is projected to experience the biggest gain—about 1.8 percent—and oil consumption the biggest loss—about 2.3 percent—as a share of total U.S. energy consumption.

Figure I.2: Total U.S. Energy Consumption by Source



Source: Energy Information Administration

As shown in figure I.2 above, petroleum has been the primary source of U.S. energy over the last decade, and it will continue as such. EIA expects the nation's oil use to increase from about 34 QUADs in 1989 to about 37 QUADs by the year 2000. However, as a percentage of overall energy consumption, oil use is projected to decline slightly from 40.5 percent of all energy consumed in 1989 to about 38 percent of all energy needs in the year 2000.

Since 1973, the consumption of coal has been increasing and reached 19.0 QUADs in 1989, accounting for 22.6 percent of all energy consumed in the United States. EIA projects that coal consumption through the year 2000 will increase to 22.0 QUADs. However, coal use, as a share of total energy consumption, is not projected to increase but to remain at 22.6 percent of all energy consumed. As we reported in November 1988, concerns for the environmental damage caused by emissions from coal-fired plants may lead to new laws or regulations that could affect future coal use.[1]

Natural gas consumption, declining since 1973, experienced a turnaround in demand in 1987. EIA expects natural gas consumption to increase from 18.9 QUADs or 22.5 percent of total energy consumption in 1989 to 23.6 QUADs or 24.3 percent of total energy consumption in the year 2000. According to DOE, this increase is expected partly because of the recent deregulation of natural gas prices and concerns for the environment—natural gas combustion is relatively free of the soot, carbon monoxide, sulfur oxides, and nitrogen oxides that are associated with the burning of other fossil fuels. Also, according to revised estimates by DOE and the Department of the Interior, there may be enough natural gas reserves to last until the year 2050. These anticipated reserves are expected to give consumers of natural gas new confidence about the availability of this fuel.

In 1973, U.S. consumers used 0.9 QUADs of nuclear power, which accounted for 1.2 percent of total U.S. energy consumption. By 1989, nuclear energy consumption increased to 5.6 QUADs, or 6.7 percent of all energy consumed in the nation. However, according to DOE, unless negative public perceptions, regulatory complexities, and construction costs diminish, no new additions to U.S. capacity are expected within the next decade. Consequently, EIA projects that nuclear power use will decrease slightly as a percentage of total U.S. energy consumption in the 1990s.

[1]Energy Issues. GAO Transition Series (GAO/OGC-89-16TR, Nov. 1988).

By the year 2000, EIA expects nuclear power to produce 6.2 QUADs of energy or about 6.4 percent of the nation's total energy needs.

In 1973, U.S. consumers used about 3.1 QUADs of energy generated from renewable sources such as hydropower, geothermal, and wind power, which amounted to about 4 percent of all energy consumed that year. In 1989, renewable energy accounted for 6.6 QUADs or about 7.8 percent of total U.S. energy consumption. EIA expects the consumption of hydroelectric power and other renewable energy sources to increase through the end of the century. By the year 2000, renewable energy sources are expected to account for 8.5 QUADs or 8.7 of the nation's total energy needs.

Oil Trends Cause Concern

The United States is better able to respond to an oil crisis today than it was in the early 1970s. Principal aspects of the nation's improved ability to respond include significant growth in the SPR, the continued development of the International Energy Agency (IEA) as a multilateral forum for coping with energy disruptions, improved auto fuel efficiencies, and modest improvements in the ability to switch from oil to other fuels in certain sectors of energy consumption. However, some disturbing trends in U.S. oil consumption, domestic production, and imports have occurred since 1985. Specifically,

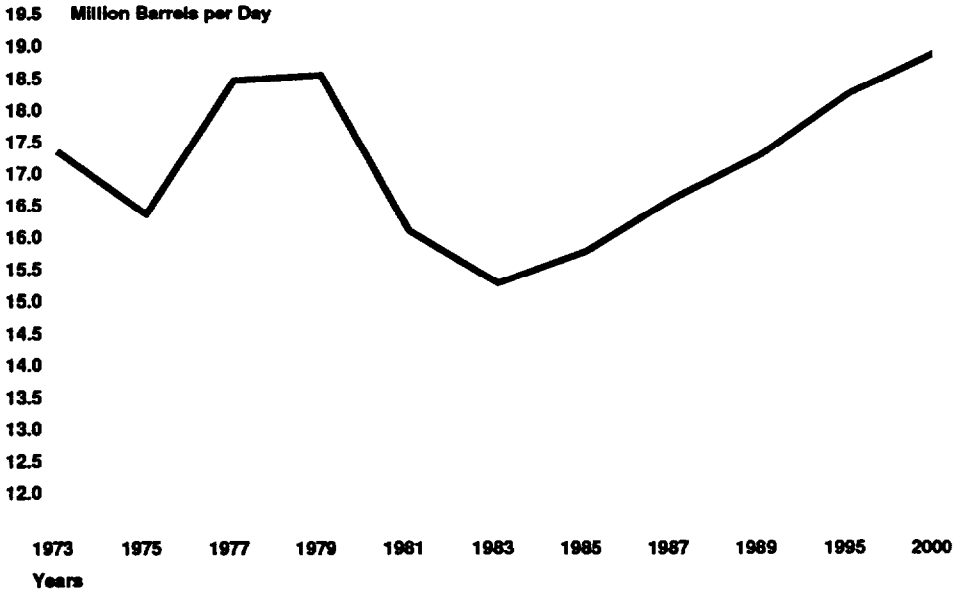
- consumption has increased by about 1.5 million barrels perday;
- production has decreased by about 1.2 million barrels per day; and
- imports have increased by about 2.9 million barrels per day.

These trends indicate an increased dependence on foreign oil and, consequently, the potential for increased vulnerability to oil supply disruptions.

Increased U.S. Oil Consumption

In 1985, U.S. oil consumption amounted to about 15.7 million barrels per day. In 1986, the average U.S. daily oil consumption jumped by 550,000 barrels to its highest level in 5 years. This trend continued, and by 1989, oil consumption was 1.5 million barrels per day greater than in 1985. Substantially lower oil prices since 1986—prices dropped sharply in 1986 from about $27 to under $15 per barrel—contributed to reversing the trend toward lower U.S. oil consumption. Figure II.1 shows overall U.S. oil consumption since 1973. As indicated, U.S. daily oil consumption had been decreasing steadily from about 18.5 million barrels in 1979 to about 15.2 million barrels in 1983—the lowest level in over a decade. In 1984, oil consumption began an upward trend, which was later sparked by the sharp price decrease noted above.

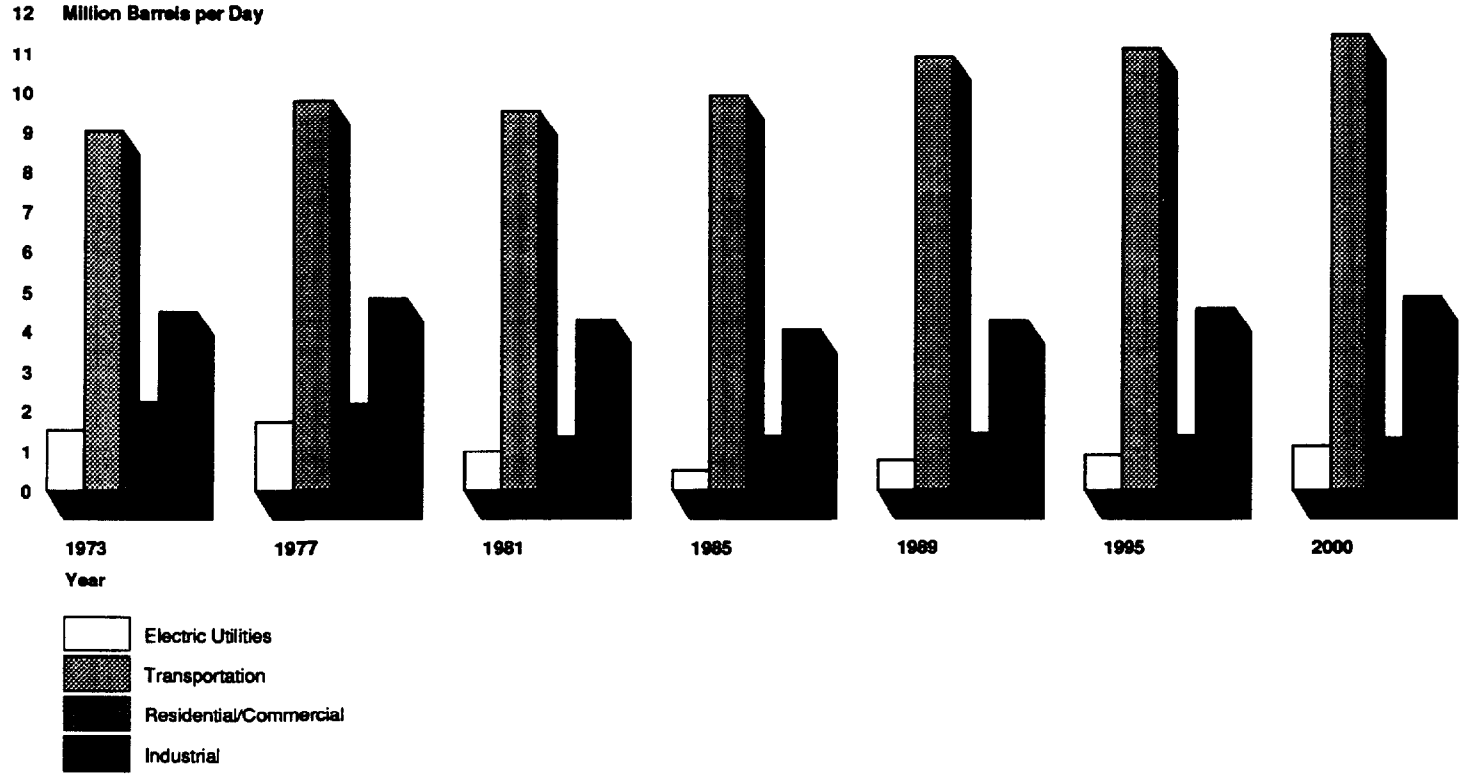
Figure II.1: U.S. Oil Consumption



Source Energy Information Administration

Although U.S. daily oil consumption leveled off from about 17.28 million barrels in 1988 to about 17.24 million barrels in 1989, EIA expects the nation's trend toward increased oil consumption to continue—increasing to 18.8 million barrels per day by the year 2000—partly because of increases in consumption by the transportation sector. The transportation sector, which consumed about 10.9 million barrels of oil per day in 1989 and accounts for nearly two-thirds of total U.S. oil consumption, is 97-percent dependent on oil and lacks the ability to switch from oil to alternative fuels. U.S. transportation alone uses more oil each year than the nation produces. Figure II.2 demonstrates oil consumption by end-use sector between 1973 and 2000.

Figure II.2: End-Use Sources of Oil Consumption



Source: Energy Information Administration

Further, 76 percent of the oil used for U.S. transportation is concentrated in highway vehicles. According to an EPA official, low world oil prices have contributed to a slowdown in fuel efficiency gains for highway vehicles in recent years. The EPA official pointed out, for example, that U.S. consumers are buying more mini-vans than station wagons, even though mini-vans are less fuel efficient. However, the industry has made significant fuel efficiency improvements over the last decade. For example, the implementation of Corporate Average Fuel Economy (CAFE) standards in 1979 contributed to improved highway vehicle fuel efficiency in the United States. Efficiency improved from about 14.4 miles per gallon in 1979 to about 19.2 miles per gallon in 1988—about a 25-percent increase.

Still, an EPA official pointed out that the effect of improved auto fuel efficiency on U.S. oil consumption has been offset to some extent by the continual growth in the number of motor vehicles, number of miles these

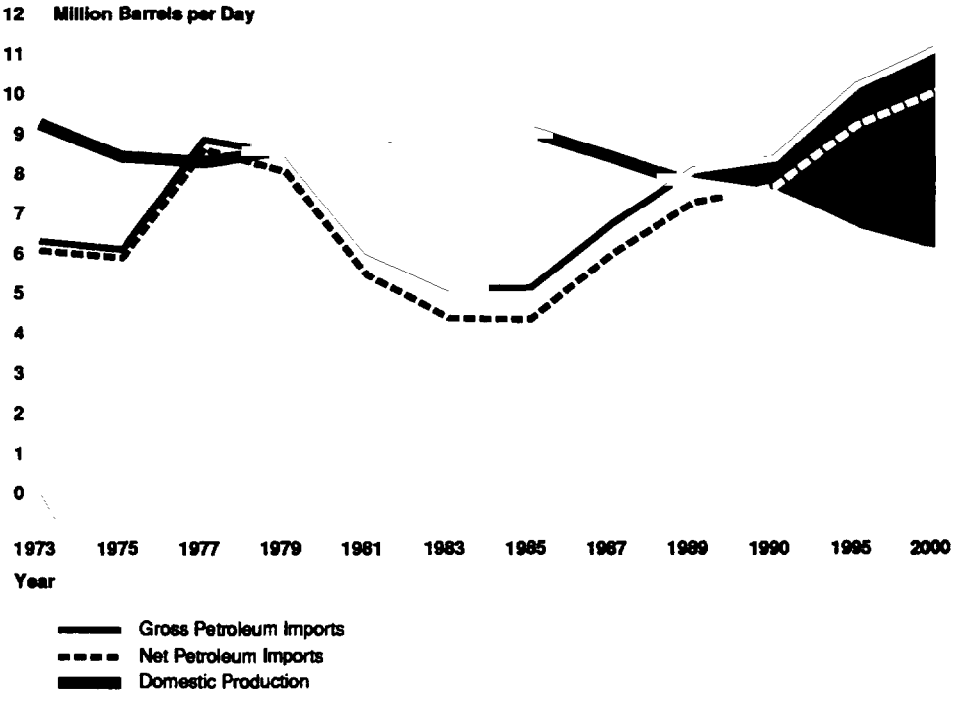
vehicles travel, and traffic congestion. The increase in vehicle miles traveled is a concern: the only way to reduce oil consumption in the short term should an oil supply disruption occur would be for people to drive less since highway vehicles have limited ability to switch from gasoline to other fuels.

The long term prospects for fuel-switching capability in this sector could improve if proposed amendments to the Clean Air Act, which contain provisions requiring the use of alternative fuels to gasoline, such as ethanol or methanol, are passed. However, an EPA official cautioned that a number of issues, including cost competitiveness, may limit the ability of alternative fuels to displace oil consumption in the transportation sector.

Falling Domestic Production

While oil consumption has been increasing, domestic oil production has been decreasing. U.S. crude oil production generally increased from 1979 to 1985 as a result of high world oil prices and the decontrol of domestic oil prices, but the decline in oil prices, which occurred in 1986, reversed this trend. Since 1985, domestic crude oil production has decreased by about 1 million barrels per day, and EIA expects this trend to continue. In 1989, domestic crude oil production was about 7.7 million barrels per day. According to EIA's 1990 assessment of energy conditions, U.S. domestic oil production will continue to decline to about 5.9 million barrels per day by the year 2000. Figure II.3 demonstrates the declining trend in U.S. oil production and upward trend of U.S. oil imports.

Figure II.3: U.S. Petroleum Imports and Domestic Production



Source: Energy Information Administration

Lower world oil prices have discouraged investment in U.S. oil exploration and development and shut down cost intensive stripper wells that had accounted for about 15 percent of total U.S. oil production. The cost to find and produce oil in the United States is higher than in any other major producing country, in part because most of the nation's oil fields have been explored and drilled extensively and remaining fields are expensive to find and tap. About 80 percent of all the wells ever drilled worldwide—2.9 million—are in the United States, and most have been in production for many years. According to one industry source, few unexplored basins are left in the United States, and these areas are smaller or more remote. Consequently, these areas are more costly to explore and develop than sites from which oil has been obtained in the past.

DOE officials stated that, although low world oil prices have had a negative effect on domestic oil production, these low world oil prices have been good for the U.S. economy. DOE believes that when U.S. economic efficiency and growth are considered, the options for increasing domestic oil production are fairly limited. However, the officials did

point out that enhanced oil recovery techniques could increase domestic production from existing oil fields as world oil prices increase. According to DOE, conventional recovery of the U.S. oil discovered, to date, has left about 300 billion barrels of oil remaining in the ground.

Environmental concerns are also a factor affecting potential increased domestic production. According to DOE, an area of promise for future U.S. oil exploration and development is the discovery of large offshore oil fields and oil fields in Alaska and off its shore. However, the environmental consequences of the March 24, 1989, oil spill by the tanker Exxon Valdez in Alaska's Prince William Sound and subsequent tanker spills elsewhere in the United States have led to congressional and public debate over the relative benefits and costs of expanded oil exploration in fields in Alaska.

The Valdez oil spill also demonstrated how susceptible the U.S. market is to the fear of supply disruption. After the accident, the temporary closing of the port of Valdez, Alaska caused relatively small oil disruptions in oil supplies that were largely confined to the west coast. However, uncertainties about the length of the closure, in addition to tight oil inventories in the months preceding the spill, contributed to a perception of tight oil and gasoline markets and to a rapid but brief increase in oil and gasoline spot market prices. The retail price of U.S. gasoline rose by 10 cents per gallon in 3 weeks, the fastest price increase in history.

Increasing Oil Imports

As the demand for oil continues to rise and U.S. production declines, imports have been increasing in order to make up the shortfall. The consumption of imported oil is expected to increase steadily through the year 2000. As shown in figure II.3, net daily imports (gross imports minus exports) increased by about 3 million barrels per day between 1985 and 1989. According to EIA, net daily imports will increase from about 7.2 million barrels per day in 1989 to about 10.0 million barrels per day by the year 2000. Thus, U.S. net oil imports would increase from about 42 percent to about 55 percent of total oil consumption.

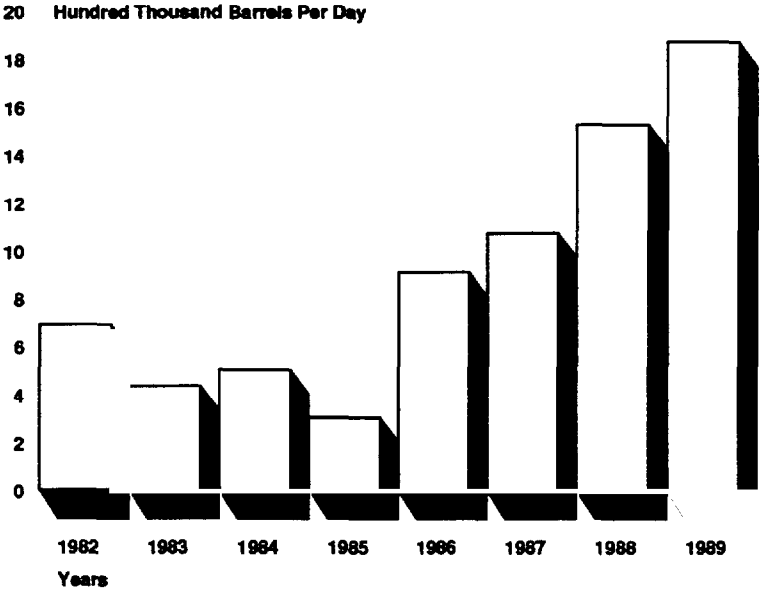
In 1989, average gross U.S. oil imports increased to about 8.0 million barrels per day. Another indicator of growing U.S. dependency on oil imports, this marked only the second time—the first was in 1977—that gross U.S. oil imports exceeded domestic oil production.

Increased imports from the Persian Gulf have heightened awareness of U.S. vulnerability to another oil crisis. Rapid oil price increases brought

on by the OPEC oil embargo in 1973-74 and again in 1978 by the Iranian revolution and the outbreak of war between Iran and Iraq, created economic havoc in the United States. The 1973-74 oil embargo, for example, resulted in an estimated $35 billion to $45 billion reduction in gross national product and the loss of about 500,000 jobs. Many industry analysts have pointed to excessive dependence on imported oil in the late 1970s as a principal cause of U.S. economic problems in the wake of the oil price shocks.

Between 1985 and 1986, U.S. imports from the Persian Gulf area increased significantly, tripling from about 304,000 barrels per day to about 909,000 barrels per day. During this 1-year period, consumption of imports from this region increased from 2 percent to 6 percent of total U.S. oil consumption. Since 1986, imports from the Persian Gulf have further increased from 909,000 barrels per day to 1.87 million barrels per day by November 1989, or about 11 percent of total U.S. oil consumption. In 1989, Persian Gulf imports represented 26 percent of all U.S. oil imports—a 19-percent increase from their 1985 levels. Figure II.4 depicts the rising level of U.S. oil imports from the Persian Gulf nations.

Figure II.4: U.S. Imports From the Persian Gulf



Persian Gulf nations include Iran, Kuwait, Iraq, Qatar, Saudi Arabia, United Arab Emirates, and Bahrain

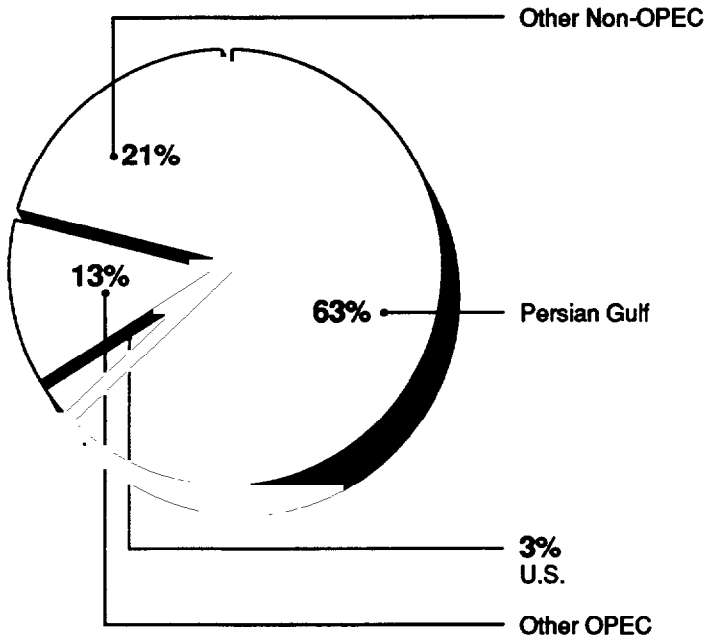
1989 Data is Averaged Through October

Source: Energy Information Administration

This trend is expected to continue, barring discoveries of oil reserves elsewhere in the world. According to EIA, about 63 percent of the proven remaining worldwide oil reserves are located in five Persian Gulf nations (Saudi Arabia, Kuwait, Iran, Iraq and the United Arab Emirates); whereas, the United States, the world's biggest consumer of oil, has only 3 percent of the total proven worldwide reserves. In addition to the concentration of proven oil reserves in the Persian Gulf, idle oil production capacity in this region is greater than elsewhere in the world.[1] The Persian Gulf countries hold more than 70 percent of the world's surplus oil production capacity. Because of the region's enormous oil reserves and surplus production capacity, the Congress has expressed concern that the Persian Gulf countries could exercise control over oil supplies and prices for years to come. Figure II.5 illustrates where the proven worldwide oil reserves are located.

[1]Idle oil production capacity refers to drilling equipment, pipeline, and skilled labor capable of being placed in operation within 30 days, or such capacity, that may be under active repair, and that can be placed into operation within 90 days.

Figure II.5: World Oil Reserves



Persian Gulf Nations include Kuwait, Iraq, Bahrain, Qatar, Saudi Arabia, Iran, and the United Arab Emirates

Bahrain is the Only Persian Gulf Nation not a Member of OPEC.
Source: Energy Information Administration

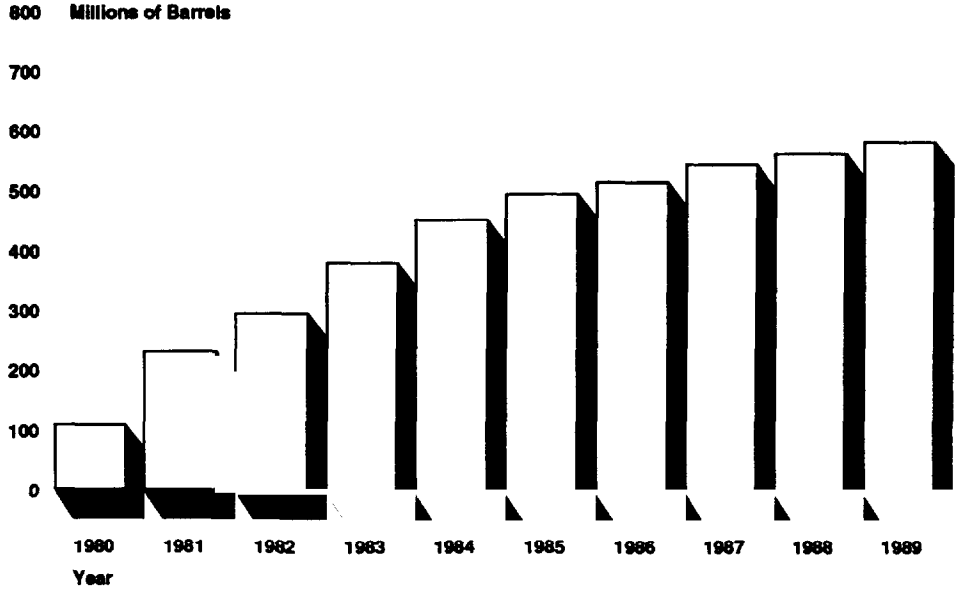
Mindful of the vast oil reserves and political instability of the area, the United States dispatched military forces between 1987 and 1988, during the Iran-Iraq war, to provide safe passage to U.S. flagged oil tankers in the Persian Gulf. Continuation of U.S. trends toward increased imports, particularly from the Gulf, could pose future energy security problems for the nation.

U.S. Strategic Petroleum Reserve

The nation is better able to sustain a supply disruption today than at the time of the 1973-1974 OPEC oil embargo. However, as stated previously, in recent years imports have increased. Increased imports, particularly from the strategically sensitive Persian Gulf area, renew concern for U.S. vulnerability to oil supply disruptions.

In 1974, as a first step toward improving our energy security, the United States along with 21 other countries affected by the embargo formed the International Energy Agency (IEA) to develop a coordinated response to a potential energy crisis.[2] With this international energy agreement in mind in 1975, the Congress authorized the creation of up to 1 billion barrels of government-owned oil reserves—the Strategic Petroleum Reserve (SPR)—to minimize the effects of future supply disruptions or shortfalls. However, no administration has ever planned for the expansion of the SPR beyond 750 million barrels of oil. As shown in figure II.6, the SPR contained 580 million barrels of oil in 1989, or about 77 percent of its projected 750 million barrel capacity. These reserves are stored in Texas and Louisiana salt dome caverns.

Figure II.6: Strategic Petroleum Reserves



Source: Energy Information Administration

As we testified in November 1989, there are concerns about the SPR's effectiveness as a buffer against supply disruptions.[3] While the size of

[2]Through the IEA's emergency sharing system, participating nations agree to (1) maintain emergency reserves equal to 90 days of net oil imports, (2) establish measures to reduce demand by at least 7 to 10 percent or substitute emergency stocks held in excess of the 90-day requirement, and (3) subject their oil supplies to an international allocation formula to calculate each country's right to receive oil or obligation to provide oil during a serious disruption.

[3]Energy Security and the World Oil Market (GAO/T-RCED-90-12, Nov. 8, 1989).

the SPR has expanded in recent years, the import protection it affords has been declining due to rising levels of U.S. oil imports and consumption. For example, in December 1985 when the SPR contained 500 million barrels of oil, net U.S. oil imports amounted to 4.3 million barrels per day. The SPR, therefore, represented about 115 days of reserves, or 25 more days than required by the IEA agreement, that would be available to offset a cutoff or disruption in U.S. oil imports. Although the SPR reached 580 million barrels in 1989, the days of imports it could replace decreased to 81 days because average net daily imports had increased to about 7.2 million barrels.

Also, since U.S. oil imports continue to grow, by the time the SPR reaches its authorization of 750 million barrels, this amount might not be enough to ensure the agreed upon 90 days of reserves. Even when the SPR reaches its mandated 750 million barrels, it will only represent 90 days of protection if net imports do not exceed 8.3 million barrels per day—a level they are expected to reach by 1992. As far back as the 1974 IEA agreement, U.S. policymakers have agreed that 90 days of reserves without imports is necessary to buffer against potential supply disruptions.

DOE officials pointed out that, under the IEA agreement on oil stockpiles, the formula for days of reserves without imports is based on government-owned stocks as well as commercial working inventories. Adding U.S. commercial working inventories to the SPR would increase the number of days of oil consumption the nation could sustain without imports. However, as pointed out in our February 1989 report, in 1986 the United States urged other IEA members to increase the size and government control of their emergency oil stocks because the capabilities of members were exaggerated by including all company-owned stocks above the minimum operating level in the formula for measuring emergency reserves.[1] The U.S. position was that company stocks cannot be counted on in the event of an oil supply disruption because companies will tend to react to higher oil prices by building rather than drawing on oil stocks.

Additional concerns about the SPR are how quickly the oil could be taken out of reserve and how quickly it could be distributed from its reservoir salt caverns to other regions of the country. The projected drawdown capability for the SPR (the rate at which the oil can be drawn out of the

[1]International Energy Agency: Effectiveness of Members' Oil Stocks and Demand Restraint Measures (GAO/NSIAD-89-42, Feb. 6, 1989).

salt caverns) is 3.2 million barrels per day. After the SPR reaches 750 million barrels and certain system enhancements have been completed, the drawdown rate is expected to be 4.5 million barrels per day. Even with the projected improvements to the drawdown capacity, the relative amount of imports that could be replaced by stocks from the SPR during a disruption decreases as the nation's oil imports increase.

In our 1989 report and related testimony, we estimated that expenditures of between $5 billion and $6 billion may be needed to (1) increase the SPR inventory to 750 million barrels, (2) enhance its drawdown capability, and (3) improve its distribution capacity.[5] We also reported that our analysis of alternative financing proposals for funding the SPR showed that no single alternative was superior to the current method of funding the SPR through annual appropriations.[6]

A concern related to the nation's diminished number of days of SPR reserves, is that the 580 million barrels of oil are subject to the allocation formula between IEA member countries. As reported in our November 1989 testimony on energy security, a majority of the member countries participating in the IEA energy program have not emphasized developing strategic stocks. Instead, these countries plan to use such demand restraint measures as compulsory orders, allocation/rationing, and persuasion as their primary responses to an oil supply disruption.[7] The United States, meanwhile, emphasizes the early coordinated use of oil stocks and market activities as the best way to mitigate the economic damage associated with an oil supply disruption. As we reported in August 1988 and in our November 1988 transition report, because of the interdependent nature of world oil markets, the United States should continue to encourage other IEA countries to develop strategic stocks and to clarify agreements on the use of these stocks.[8]

[5]Strategic Petroleum Reserves: Analysis of Alternative Financing Methods (GAO/RCED-89-103, Mar. 16, 1989).

[6]Alternative Financing Methods for the Strategic Petroleum Reserve (GAO/T-RCED-89-27, Apr. 19, 1989).

[7]The U.S. government defines strategic stocks as those reserves either owned or controlled by the government.

[8]Energy Security: An Overview of Changes in the World Oil Market (GAO/RCED-88-170, Aug. 31, 1988); Energy Issues: GAO Transition Series (GAO/OGC-89-16TR, Nov. 1988).

Where to Focus Attention

In light of current trends indicating increased oil supply vulnerability in the 1990s, policymakers will be increasingly faced with concerns about reducing overall dependence on oil and about the possibility of future oil supply disruptions. We continue to believe, as pointed out in our August 1988 report, that the following measures are key to addressing these issues:

- emphasis on energy efficiency, particularly in the transportation sector,
- continued building of oil stocks, and
- adoption of standby measures to avoid over-reliance on the SPR.

Efforts to reduce U.S. oil dependency could begin with an emphasis on energy efficiency and fuel-switching capability in the transportation sector, stressing continued improvements in (1) fuel efficiency for highway vehicles and (2) the development of alternative fuels to gasoline such as methanol and ethanol. Second, as we stated in our testimony on the SPR amendments of 1989, the U.S. should work toward filling the SPR as quickly as is fiscally responsible, and as imports continue to rise, DOE should plan for its expansion to 1 billion barrels.[9] Third, while the SPR is the nation's principal response to an oil supply disruption, if the SPR does not operate as planned, the federal government could consider other measures to mitigate the effects of an oil shortage. Demand restraints, such as temporary emergency driving restrictions, could also be considered to help cope with an oil disruption. Other measures that may have to be taken could include providing financial assistance to low-income consumers to offset the price increase an oil disruption can cause.

[9]The Strategic Petroleum Reserve Amendments of 1989 (GAO/T-RCED-89-38, May 4, 1989).

The Electric Utility Industry Faces Difficult Supply Choices

As the U.S. electric utility industry enters the 1990s, it has reported a need for about 72,200 megawatts (MW) of new generating capacity before the end of the decade. However, regulatory, environmental, and other concerns related to these planned capacity additions, as well as their current construction status, create uncertainties that these powerplants will be available when needed.

Trends in Electricity Demand

Annual increases in the demand for electricity have varied widely over the past three decades. During the 1960s, the average annual increase in electricity sales was about 7.4 percent. However, following the oil price shocks resulting from the 1973-74 OPEC oil embargo, the increases in electricity demand fell off significantly. For example, increases in demand for electricity during the 1970s averaged 4.5 percent annually, and between 1980 and 1986 the increase amounted to the low rate of 1.9 percent per year. Since 1986, U.S. electricity demand has experienced a turnabout, partly because of a strong economy to which low oil prices contributed, and EIA expects this increased demand to continue at an annual rate of about 2.3 percent through the year 2000.

Trends in Electricity Supply

The reduced rate of demand growth, below the levels anticipated in the 1970s, occurred at a time when utilities had substantial amounts of new capacity under construction. Many of the plants planned or under construction were not needed at that time and were later cancelled. State public utility commissions found that some past utility decisions to construct plants were not prudent and are now giving more scrutiny to new powerplant construction. In addition, the 1979 accident at Three Mile Island heightened safety concerns causing an increase in the technical requirements and costs for nuclear powerplant construction. This increasing concern also made it difficult to obtain operating licenses for these plants. Finally, new emission reduction requirements under consideration in the proposed amendments to the Clean Air Act will likely affect existing and new coal-fired electric generating capacity in future years.

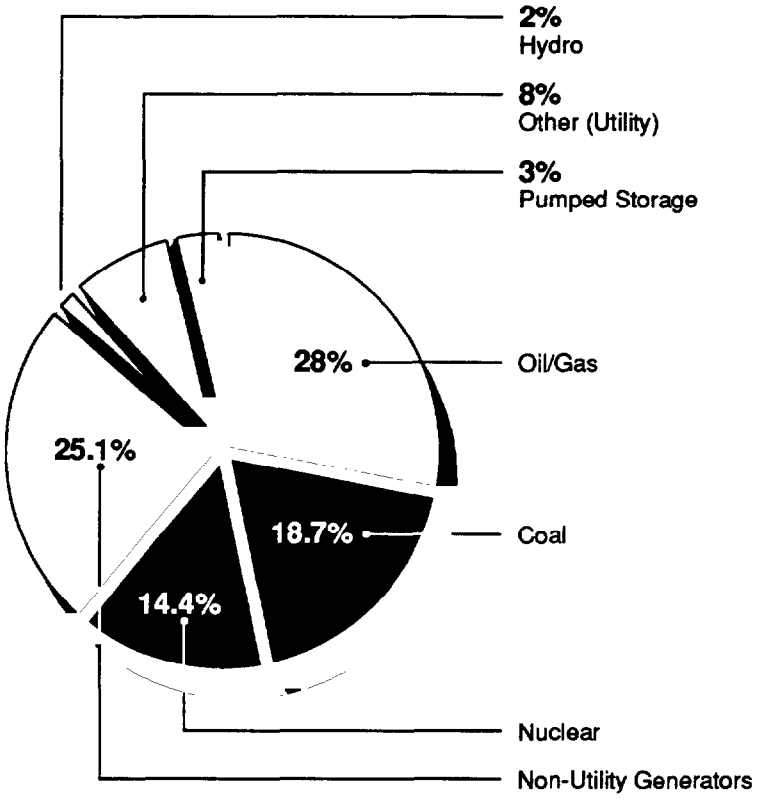
According to EIA, through the early 1990s the utility industry should be able to meet the rising demand for electricity, through programs to reduce customer demand, excess generating capacity in some regions of the country, and imported power in other regions of the country. However, by the mid-1990s, even with these options, EIA expects utilities in many regions of the country to be using all their existing capacity, and, hence, expects a need for new generators. Further, according to DOE,

additional capacity will be needed because about 50 percent of the current inventory of electrical generating plants will be over 30 years old, or near the end of their projected useful life, by 1997.

Projected Additions to Electric Generating Capacity

The North American Electric Reliability Council (NERC), which represents virtually all of the electric utility systems in the United States, Canada, and a northern portion of Mexico, has reported that U.S. electric utilities have projected they will need an additional 72,200 MW of new generating capacity by 1998 to satisfy expected demand growth. Figure III.1 shows which generating options NERC projects to contribute to U.S. capacity additions needed by 1998. However, as discussed below, regulatory, environmental, and other concerns related to the proposed mix of generating options, and their current construction status, create uncertainties about whether these options will be available when needed.

Figure III.1: Projected U.S. Additions to Electric Generating Capacity by 1998



Source: North American Electric Reliability Council

Additions to Capacity From Oil/Gas-Fired Turbines

NERC expects oil- and gas-fired boilers to make the largest contribution to future additions of electric generating capacity. As seen in figure III.1, such new electrical generating capacity is projected to add about 28.3 percent or 20,200 MW to generating capacity by 1998. In 1989, generators fired by these two fuels produced 15 percent of all U.S. electricity—petroleum contributed 6 percent and natural gas 9 percent.

As in the case of other sectors of energy consumption, electric utilities have increased their use of oil with lower world oil over the last few years. According to EIA, electric utilities increased their use of oil by 22 percent (42 million barrels) between 1987 and 1988, in part because the average cost of petroleum declined by 19 percent during this period. According to the Petroleum Research Industry Foundation, new measures under consideration to reduce acid rain may also cause the

demand for low-sulfur residual fuel oil to rise in the electric power sector.

The completed deregulation of natural gas prices in July 1989, coupled with environmental concern for other fossil fuels, will likely lead to increased utility consumption of this relatively clean burning fuel. According to new DOE estimates, domestic natural gas reserves could last until about the year 2050. Nonetheless, uncertainty remains about whether gas supplies can accommodate the expected increase in demand for this fuel by electric utilities. The National Association of Regulatory Utility Commissioners (NARUC) has expressed concerns that deliverable quantities of gas at affordable prices may not be sufficient to support all needed electricity capacity. However, DOE officials told us they believe increased gas consumption will have an impact on gas prices but will not engender shortages.

Additions to Capacity From Coal-Fired Generating Units

NERC expects electric generating capacity from coal-fired generators in the United States, as a percentage of total electricity produced, to decline over the next decade. In 1989, coal-fired generating plants accounted for 56 percent of the total electricity produced in the United States, but EIA expects that total to decline to 52 percent of total electric capacity by the year 2000. Although NERC expects additional coal-fired power plants to be constructed over the next decade, a greater percentage of the projected additions to electric generating capacity are expected from units powered by other energy sources.

About 18.7 percent of the projected additions to capacity by 1998, or 13,500 MW, as shown in figure III.1, is to come from coal-fired generators. However, the burning of coal to generate electricity contributes to various types of pollution, including acid rain. The concern over the environmental impact of coal burning has resulted in proposed amendments to the Clean Air Act aimed at further reducing emissions caused by fossil-fired generators. These requirements will affect future additions to capacity from coal-fired generators.

According to EIA, rather than retire aging coal-fired generators, the utility industry is giving more consideration to refurbishing many of these facilities in order to delay additions to generating capacity. Repowering technologies or emerging boiler designs being demonstrated under the Department of Energy's $2.5 billion Clean Coal Technology (CCT) program are one option under consideration by the utilities to refurbish fossil-fired facilities between the late 1990s and 2005. These

boiler types include integrated gasification combined cycle and fluidized bed combustion technologies, which DOE estimates to be more economical and substantially more effective in reducing sulfur dioxide and nitrogen oxide emissions, the precursors of acid rain, than conventional pulverized coal boilers.[1]

Additions to Capacity From Nuclear Generators

Continuing concern exists about future additions to generating capacity from U.S. nuclear power plants. About 14.4 percent or 10,391 MW of the projected additions to generating capacity by 1998, depicted in figure III.1, are to come from nuclear plants that are currently under construction. However, serious doubts remain about whether these units will be completed, and, if completed, when they will be brought on line. State and local authorities in New Hampshire and New York have delayed two recently completed nuclear plants (Seabrook and Shoreham) from starting service partly because of concern that the utility evacuation plans for these facilities in the event of an accident were inadequate. The State of New York recently purchased the Shoreham nuclear plant for the purpose of decommissioning it, and may consider converting this facility to a natural gas-fired powerplant.

According to EIA, although since 1984 nuclear power has accounted for more of the annual additions to U.S. electric generating capacity than power generated at conventional coal boilers or other sources, the share of electric generating capacity from this source will decrease in the 1990s because no commercial nuclear plants have been ordered in the United States since 1978. The sudden and sharp reduction in electricity demand after the oil embargo and the negative public perception that resulted from the 1979 accident at Three Mile Island contributed to the cancellation of over 100 nuclear plants in the United States since 1973.

Additions to Capacity From Nonutility Generators

As shown in figure III.1, about 25.1 percent, or 18,100 MW, of the projected 1998 capacity increase is to be supplied by nonutility generators. Nonutility generators are generally classified into two groups—qualified facilities and independent power producers (IPPs). The Public Utility Regulatory Policies Act of 1978 (PURPA), directs the Federal Energy Regulatory Commission to require that electric utilities purchase power from qualified facilities. These facilities include firms, such as chemical

[1] Integrated gasification combined cycle is a boiler configuration that combines use of hot-combustion-gas turbines and steam turbines to generate electricity. Fluidized bed combustion is a boiler configuration that suspends crushed coal on a "bed" of upward-blowing air during combustion; the boiler can be operated at atmospheric pressure or may be pressurized

plants, that use the steam from generators for industrial purposes and to produce electricity. Qualified facilities also include small power producers that generate no more than 80 MW of power; use biomass, waste, or renewable resources as their primary fuel (75 percent or more); and have no more than a 50-percent equity interest by an electric utility. IPPs are generating sources that do not qualify under PURPA but that sell power to utilities.

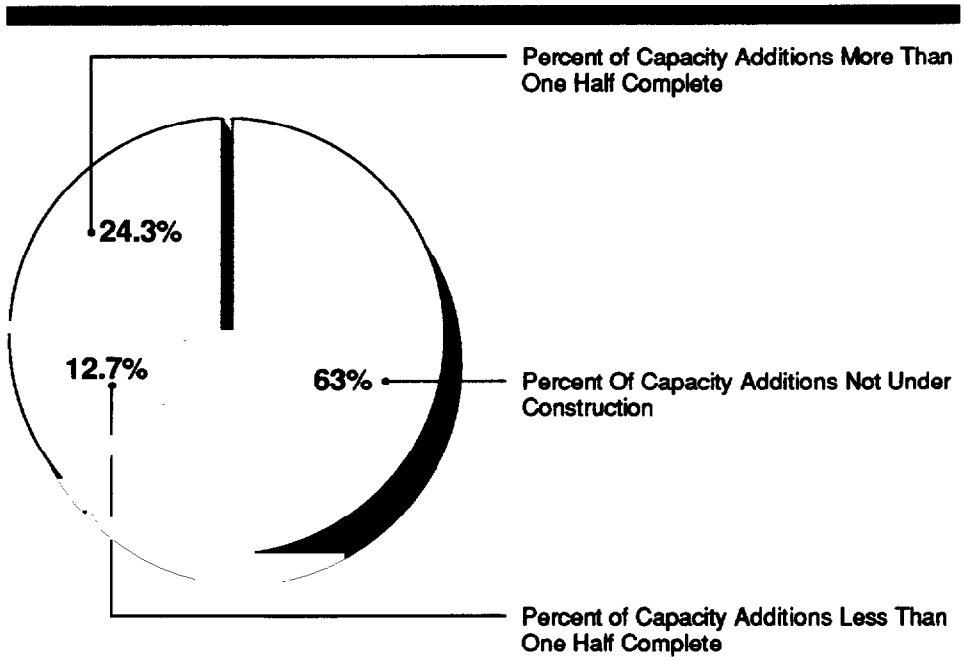
Rather than initiate new power plant construction, a growing number of utilities are seeking to purchase power from nonutility generators. PURPA requires electric utilities to purchase power from qualified nonutility generators in their local service areas. However, electric utilities are also seeking to purchase power from nonutility generators outside their immediate service area to meet their capacity needs. Because the experience with nonutility generators is limited, such issues as access to utility transmission systems, legislative constraints on the ownership of independent power producers, and the methods of pricing power from these nontraditional generators cause uncertainty about the reliability of this generating option. However, according to NERC, these concerns will be minimized because electric utilities are securing increasing amounts of nonutility generation through the bidding process and by negotiated contracts.

Other Issues Facing Capacity Additions

Meeting the nation's needs for electric generating capacity is of additional concern when the construction and licensing times are considered for the capacity additions projected to be needed by 1998. Recent historical experience shows that the time required by utilities to plan, construct, and license large-scale, central station power plants can take between 7 and 10 years and sometimes longer. EIA expects that nonutility power producers will be able to construct their facilities in less time than is necessary for an electric utility to build a central station power plant. According to EIA, about 40 percent of the projected nonutility supplies will be from gas-fired units, which take less time to construct than large central station coal-fired or nuclear-powered plants. Utilities are, however, beginning to construct some smaller scale units in order to reduce their construction lead times.

The status of the projected capacity additions compounds the concern over whether future electricity supplies will be available when needed. As shown in figure III.2, 63 percent of the projected capacity additions are not yet under construction, and 12.7 percent of the power plants whose construction has started are less than 50-percent complete.

Figure III.2: Status of Projected U.S. Electric Utility Capacity Additions in 1989



Source: North American Electric Reliability Council

Electric utilities are considering emerging technologies, such as certain clean coal technologies being pursued by DOE, as potential electric generating options for meeting future demand growth. However, their consideration of these technologies hinges on their commercial availability and on the emission reduction requirements that are likely to be enacted in proposed amendments to the Clean Air Act. To increase coal use, DOE has a $2.5 billion dollar program to co-fund the demonstration of emerging clean coal technologies that are expected to have enhanced capabilities to reduce emissions and greater boiler efficiencies than conventional boilers. These new capabilities are expected to be available for commercial order beginning in the mid-1990s.

In our March 1989 report and related testimony, we recommended that the clean coal technology program be linked with compliance dates for emission reduction requirements in proposed amendments to the Clean Air Act because we were concerned that stringent legislative compliance deadlines to control acid rain might preclude potential use of the emerging technologies by utilities.[2] We also discussed problems, such as difficulties in negotiating cooperative agreements between the project

[2]Fossil Fuels: Commercializing Clean Coal Technologies (GAO/RCED-89-80, Mar. 29, 1989); Status of DOE-Funded Clean Coal Technology Projects (GAO/T-RCED-89-25, Apr. 13, 1989).

sponsors and DOE, project financing problems, and equipment failure, that were contributing to delays that could affect the commercial availability of the clean coal technologies.

In our March 1990 testimony we expressed reservations about whether these new technologies, at their current pace of development and anticipated time tables for widespread deployment, would contribute significantly, during the next 15 years, to the nationwide reduction of acid rain-causing emissions.[3] Thus, we concluded that greater emphasis on funding multiple demonstrations of the more promising clean coal technologies could accelerate their successful demonstration and allow them to play a greater and more timely role in reducing emissions that cause acid rain.

Further, in our March 1990 report we suggested that the Congress may want to have DOE delay selecting projects for rounds four and five of the clean coal technology program until it obtains additional demonstration results from the 38 projects already selected through the first three rounds; as of December 31, 1989, only 3 of these projects were in the demonstration or operation phase and none had been fully demonstrated. This delay would allow DOE to target the remaining funds to the more promising technologies and, in view of the nation's current budget constraints, help ensure that program funds are used efficiently and effectively.

Options to Mitigate the Need for Capacity Additions

Improved energy conservation, which the administration has noted as a primary national goal, and the purchase of excess electric generating from electric utilities in Canada and Mexico could delay the need for additional electric generating capacity.

Demand Reduction Efforts

Efforts to reduce the demand for energy may help delay the need for capacity additions. These efforts range from utilities directly controlling electricity consumption, such as reducing power provided to consumer water heaters and air conditioners at certain time periods of each day, to providing information and assistance to the consumer on more efficient electricity use. According to the Electric Power Research Institute (EPRI), these efforts helped reduce electricity consumption by 13,000 MW from 1977 to 1983 and offer continued potential for reducing demand in

[3]Utilities' Potential Use of Clean Coal Technologies (GAO/T-RCED-90-56, Mar. 28, 1990).

the 1990s. Further, NARUC believes these efforts are the best short-term strategy for reducing electricity demand and harmful utility emissions and for moderating the impact of increased costs on consumer electric bills.

However, the Congressional Research Service (CRS) points out in its November 1989 report that, while demand reduction efforts appear to be a viable resource option for electric utilities, some barriers discourage their use. Evaluative information about the contribution that can be expected from demand side strategies is not available, and uncertainty exists about consumer response to these efforts. Also, measuring the benefits of conservation efforts is difficult because it involves tracking the decisions and activities of millions of customers.[1] DOE's Oak Ridge National Laboratory issued a report that noted EIA's shortcomings in developing measures to quantify the possible reductions in fuel use that result from energy conservation.

NERC agrees that these efforts may only provide limited assistance in reducing demand because pilot programs do not indicate strong customer participation, and the benefits of these programs vary across utility systems. However, NERC also believes that while demand management techniques may not forestall the need for capacity additions indefinitely, economic savings such as avoided fuel purchases and reductions in acid rain-causing emissions can be benefits of these measures.

Electricity From Foreign Sources

Purchasing excess power generated by foreign utilities in Canada and Mexico may also delay the need for capacity additions by U.S. electric utilities in some regions of the country. According to EIA, on the basis of contracts, licensing agreements, and negotiations between U.S. utilities and their counterparts in Canada and Mexico, net imports of electricity are projected to grow from 26 billion kilowatt hours in 1989 to 60 billion kilowatt hours by the year 2000. Thus, imported power would contribute about 1.7 percent of total electricity demand. However, DOE officials informed us that the regional impacts of Canadian imports are much larger; in certain regions of the country these imports could supply 15 percent of total electricity demand.

As discussed in our April 1986 report, since 1981, U.S. utilities have purchased increasing quantities of Canadian electricity to meet their

[1]Energy Conservation: Technical Efficiency and Program Effectiveness (CRS Issue Brief, IB85130, Nov. 1, 1989)

electricity generation capacity needs.[5] These purchases have saved U.S. consumers hundreds of millions of dollars because the Canadian provincial utilities offered this power to U.S. utilities at a cost that was less than it otherwise would have cost the U.S. utilities to produce this electricity in their own plants. Furthermore, these purchases deferred the construction of domestic power plants that otherwise would be needed.

As in the case of some domestic supply options, concerns have existed about the reliability of power generated by foreign utilities. In our 1986 report, we addressed New England utility representatives' concern about the technical reliability of the Hydro-Quebec electric system and, more specifically, the vulnerability of that system to major power outages. The concern centered around the likelihood that possible outages could, in turn, affect interconnected U.S. systems. We reported that Hydro-Quebec had experienced eight system-wide outages between 1969 and 1978, but since had reduced the incidence to two outages by constructing new transmission facilities. In our March 1989 report, we discussed actions since 1986 and further action being considered by Hydro-Quebec and U.S. utilities interconnected with Hydro-Quebec's main power transmission grid to reduce the risk of possible future power outages by the Canadian utility.[6]

Another cause for concern over imports of Canadian electricity is that hydroelectric power, a primary source of Canadian power, requires adequate water levels to spin the turbine connected to the electric generator. According to EIA, a 1988 drought in midwestern Canada and low reservoir levels in British Columbia and Quebec contributed to a 33-percent drop from 1987 levels in electricity exports to U.S. utilities.

Where to Focus Attention

We continue to believe, as pointed out in our March 1989 report, that the questions affecting each of the electricity generating options point to a need for an intensive congressional review of the nation's electric utility industry.[7] Sufficient uncertainty has surfaced concerning the source of future electricity supplies. Given issues related to the changing utility industry infrastructure, the environmental implications of fuel choices, the future of nuclear power, and the nation's growing dependence on

[5] Canadian Power Imports: A Growing Source of U.S. Supply (GAO/RCED-86-119, Apr. 30, 1986).

[6] Canadian Power Imports: Update on Electricity Imports in the Northeast (GAO/RCED-89-51, Mar. 3, 1989).

[7] Electricity Supply: What Can Be Done to Revive the Nuclear Option? (GAO/RCED-89-67, Mar. 23, 1989).

imported oil, it will be important to address and debate the difficult electricity supply choices that the nation is confronting.

Expanding the Use of Coal

Expanding the use of coal is one of the major options for meeting future U.S. electricity needs. Since coal is the nation's primary domestic fossil energy source, with proven reserves expected to last at least 300 years, greater reliance could be placed upon the use of this fuel. To develop additional electric generating capacity for expected demand increases in the 1990s, utilities will need to decide whether to build new coal-fired powerplants or upgrade existing ones. However, environmental concerns for the effects of coal combustion have retarded the expanded use of this energy source and may affect the industry's technology choices for future generating capacity.

As we have suggested, the Congress may want to have DOE target the remaining funds in the CCT program on the more promising technologies that offer the electric utility industry the best and quickest options for increasing the clean use of coal. This delay would also help ensure that program funds are used efficiently and effectively.

Ultimately, the industry must weigh the costs of continued reliance on coal against other fuel options to generate electricity. According to growing scientific consensus, in addition to the environmental concerns about acid rain-causing emissions produced when coal is burned, the primary product of coal combustion—carbon dioxide—may also be contributing to global warming. The significant implications of coal's contribution to the atmospheric effects of carbon dioxide will need to be weighed by the Congress as it reviews the nation's reliance on fossil fuels.

Reviving the Nuclear Option

As reported in March 1989, the Congress should consider enacting legislation to reform the licensing process and promote utilities' use of NRC preapproved nuclear plant designs to help revive the nuclear option. Because of U.S. uranium ore reserves and technical knowledge of nuclear power, electricity produced at nuclear facilities could play a major role in meeting future energy demands and in displacing fossil fuel consumption, thereby reducing harmful emissions.

To build the public's confidence in nuclear power, the nation must resolve issues of nuclear waste disposal and safe plant operations. To that end, the Congress selected a national repository for nuclear waste

to be built below Yucca mountain, Nevada. However, because of controversy surrounding the choice of this site, the repository may not open on schedule. DOE also recently announced it would co-fund a project to demonstrate a standard design for smaller nuclear reactors with inherent safety features. As reported in March 1989, the Congress should weigh the costs and benefits associated with nuclear power as it resolves the issues with the repository for radioactive waste and consider supporting these efforts to demonstrate standardized nuclear plant designs.

Monitoring Nonutility Generators

Nonutility electric power producers are another option for meeting future electric capacity needs. However, we reported in November 1988 that the Congress will need to carefully consider issues such as access to transmission lines as competition increases between the regulated electric utility industry and independent power producers and other nontraditional sources.[8]

Improving the Information on Demand Management Contributions

Finally, programs to manage energy demand could delay the need for new electric generating capacity. However, to broaden utility use of these programs, better information is needed on the contributions these demand side strategies could make to reducing electricity consumption, demand for fossil fuels and nuclear fuels, and, in turn, the harmful emissions and radioactive waste materials produced when these fuels are consumed. Also, better information on the potential economic savings and other benefits of these programs for the consuming public could promote more acceptance of demand management efforts.

[8]Energy Issues: GAO Transition Series (GAO/OGC-89-16TR, Nov. 1988).

Environmental Issues Will Affect Future Energy Choices

In recent years, energy policy issues have become increasingly linked with environmental policy issues, and the decisions affecting one issue cannot be made without some consideration of the other. For instance, proposed amendments to the Clean Air Act aimed at reducing harmful automotive emissions include provisions for alternative fuels that are cleaner burning than gasoline and automobiles capable of using these fuels. In 1989, coal, oil, and other fossil fuels provided nearly 90 percent of the total energy consumed in the United States. However, fossil fuel combustion is the primary source of carbon dioxide emissions as well as other "greenhouse" gases. These gases contribute to global warming, ozone pollution, and acid rain.

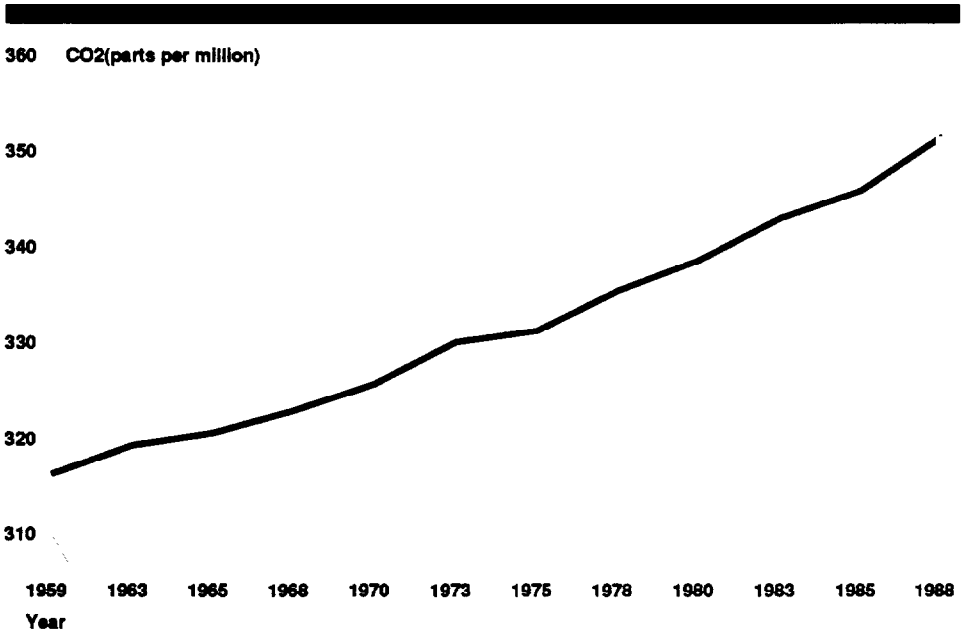
In addition, while nuclear power has provided one-third of all electricity supplied since 1974, health, safety, and environmental concerns exist regarding the risk of radiation releases from nuclear plants and the storage and disposal of the hazardous radioactive waste produced by their reactors. The environmental consequences of meeting our energy needs will continue to be a key issue in the 1990s as the United States formulates its energy policies.

Global Warming

Global warming has quickly emerged as an international concern because the five warmest years of the century all occurred in the 1980s, and the consumption of fossil fuels is projected to increase worldwide. According to EPA, the greatest single contribution to potential global warming is increasing amounts of carbon dioxide in the atmosphere. Carbon dioxide is a colorless, odorless, nontoxic gas formed by the combustion of carbon and carbon compounds found in fossil fuels—coal, petroleum, and natural gas. Green plants remove a significant amount of carbon dioxide from the atmosphere. However, increased worldwide use of fossil fuels and extensive deforestation have caused a buildup of carbon dioxide in the environment.

The earth's temperature is regulated largely by atmospheric gases. Carbon dioxide and other gases such as methane—the main constituent of natural gas—allow the sun's energy to pass through the atmosphere and reach the earth's surface, but they also trap heat that would otherwise be radiated away from the earth's surface. This "greenhouse effect" occurs naturally and contributes about 59 degrees Fahrenheit to the earth's average surface temperature. However, scientists are concerned that increasing concentrations of carbon dioxide, (shown in figure IV.1) and the other greenhouse gases being added to the atmosphere by human activities could raise the earth's surface temperature.

Figure IV.1: Increasing Global Concentrations of Carbon Dioxide



Source: C.D. Keeling, Scripps Institution of Oceanography, University of California, La Jolla, California.

While man-made releases of carbon dioxide into the atmosphere have been increasing since the beginning of the industrial revolution nearly 200 years ago, two-thirds of these carbon dioxide releases have been added in the past 15 years. Recent analyses with advanced computer models of the atmosphere suggest that, if current emission trends continue, the atmospheric buildup of these gases could result in a 3 to 10 degree Fahrenheit increase in average global temperature by the middle of the next century.

According to some studies, a warming of this magnitude could have significant effects:

- Sea levels could raise worldwide because of the breakup of Antarctic and Greenland ice caps, the thermal expansion of the oceans and the melting of small, land-based glaciers.
- Agriculture and forestry, in some parts of the world, could suffer adversely from higher temperatures caused by decreases in rainfall and soil moisture.
- Water supplies, which depend on the timing and distribution of regional rainfall, could be reduced.

Concern for the effects of fossil fuel consumption has focused attention on immediate actions to reduce carbon dioxide emissions through the following measures:

- improving the efficiency of energy use, for example, in buildings, transportation, and electricity generation;
- strengthening U.S. commitment to the research and development of other renewable energy sources, such as solar power; and
- implementing more reforestation programs to offset losses of tropical forests.

Many environmentalists and industry groups differ on whether to increase the use of nuclear power as another measure to reduce the greenhouse gases caused by the combustion of fossil fuels.

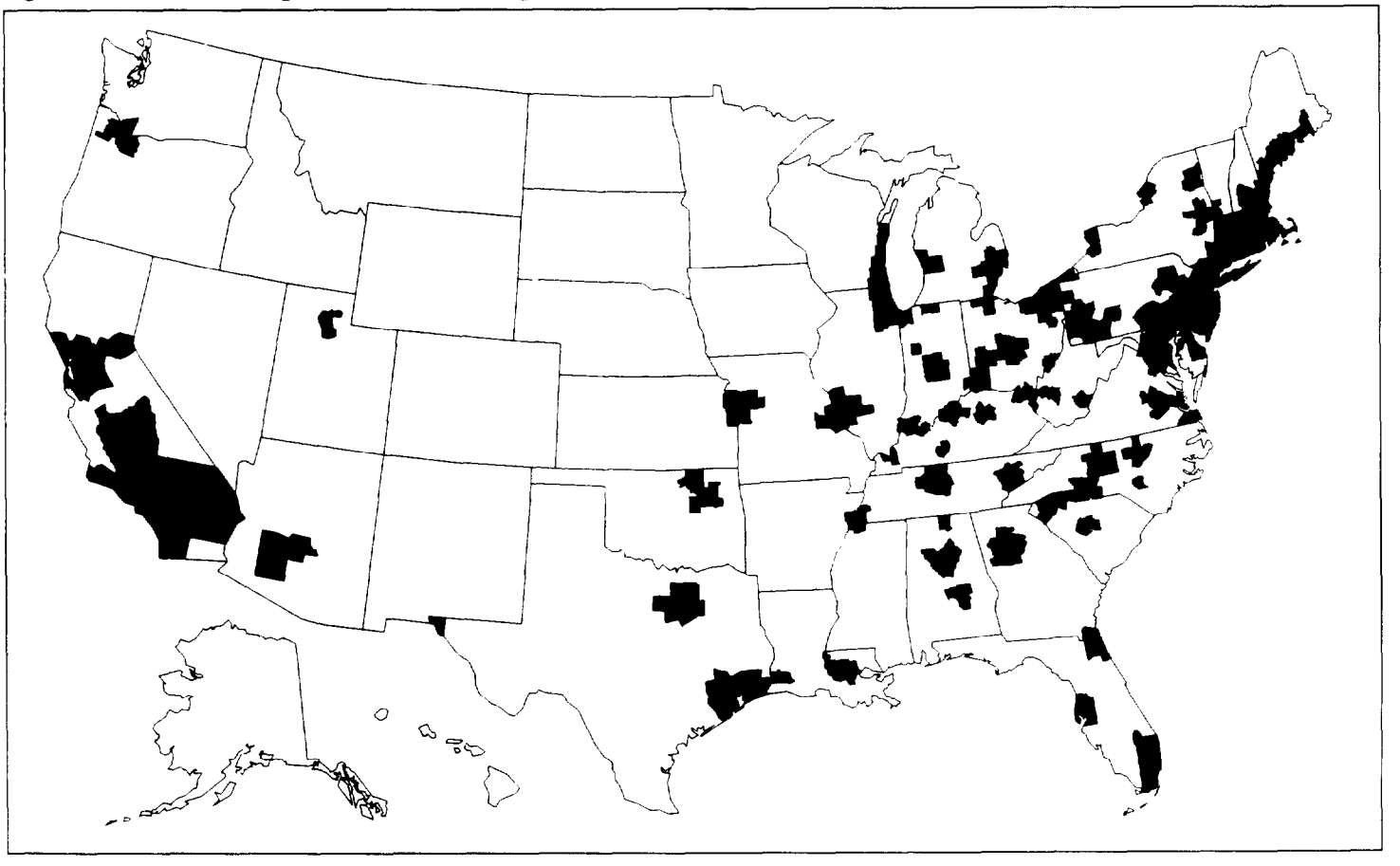
Ozone Pollution

Ozone pollution can seriously impair health, particularly in children and people with respiratory ailments. When trapped in the lower atmosphere, ozone pollution is a key component of smog. It is produced when volatile organic compounds (hydrocarbons) and nitrogen oxides react in the presence of sunlight. Hydrocarbons, a broad class of pollutants, come from man-made sources including automobile and truck exhaust, solvent and gasoline evaporation, chemical manufacturing, and petroleum refining. In some regions, natural vegetation can produce these emissions. Nitrogen oxides are primarily emitted during the combustion of fossil fuels. At least 40 percent of all nitrogen oxide emissions come from mobile sources such as automobiles, trucks, and other vehicles; other emissions come from a combination of stationary sources such as industrial boilers and processes and electric power plants.

Based on ozone's known health effects, EPA has established a national standard for maximum ozone concentration. Any area experiencing concentrations exceeding the standard more than once a year, on average, is declared a "nonattainment" area. As we reported in November 1988, most metropolitan areas have yet to meet the national safe ozone level established by EPA.[1] According to EPA, nearly 100 cities and counties now exceed the national ambient air quality standard (NAAQS) for ozone. In 1988, this list included cities comprising about half of the U.S. population. The nonattainment areas on this list are depicted below in figure IV.2.

[1] Environmental Protection Agency Issues: GAO Transition Series (GAO/OGC-89-20TR, Nov. 1988)

Figure IV.2: Areas Violating Ozone NAAQS During 1986-88



Source: U.S. Environmental Protection Agency

Since mobile sources account for a significant portion of total hydrocarbon and nitrogen oxide emissions, efforts to reduce ozone pollution have been proposed for the auto industry. One such effort is the use of vapor recovery systems. However, there has been debate between the oil industry and automakers about whether gasoline vapors that escape from vehicles during refueling should be controlled by tubing placed over the nozzle of the gas hose to withdraw hydrocarbon vapors or by canisters placed on board vehicles to capture the vapors.

Other proposed controls for mobile sources include:

- stricter tailpipe standards,

- limits on gasoline volatility,[2]
- use of alternative fuels,
- enhanced vehicle inspection and maintenance programs, and
- new highway vehicle emissions standards.

Proposals for stationary sources include:

- stricter controls on facilities that treat, store, and, dispose of hazardous wastes;
- control technologies on all existing stationary sources that emit more than 100 tons per year of nitrogen oxide and more than 25 tons per year of hydrocarbons;
- new control guidelines for smaller stationary sources for which no current legislation exist; and
- federal controls on the solvent content of architectural surface coating such as paints and stains.

Acid Rain

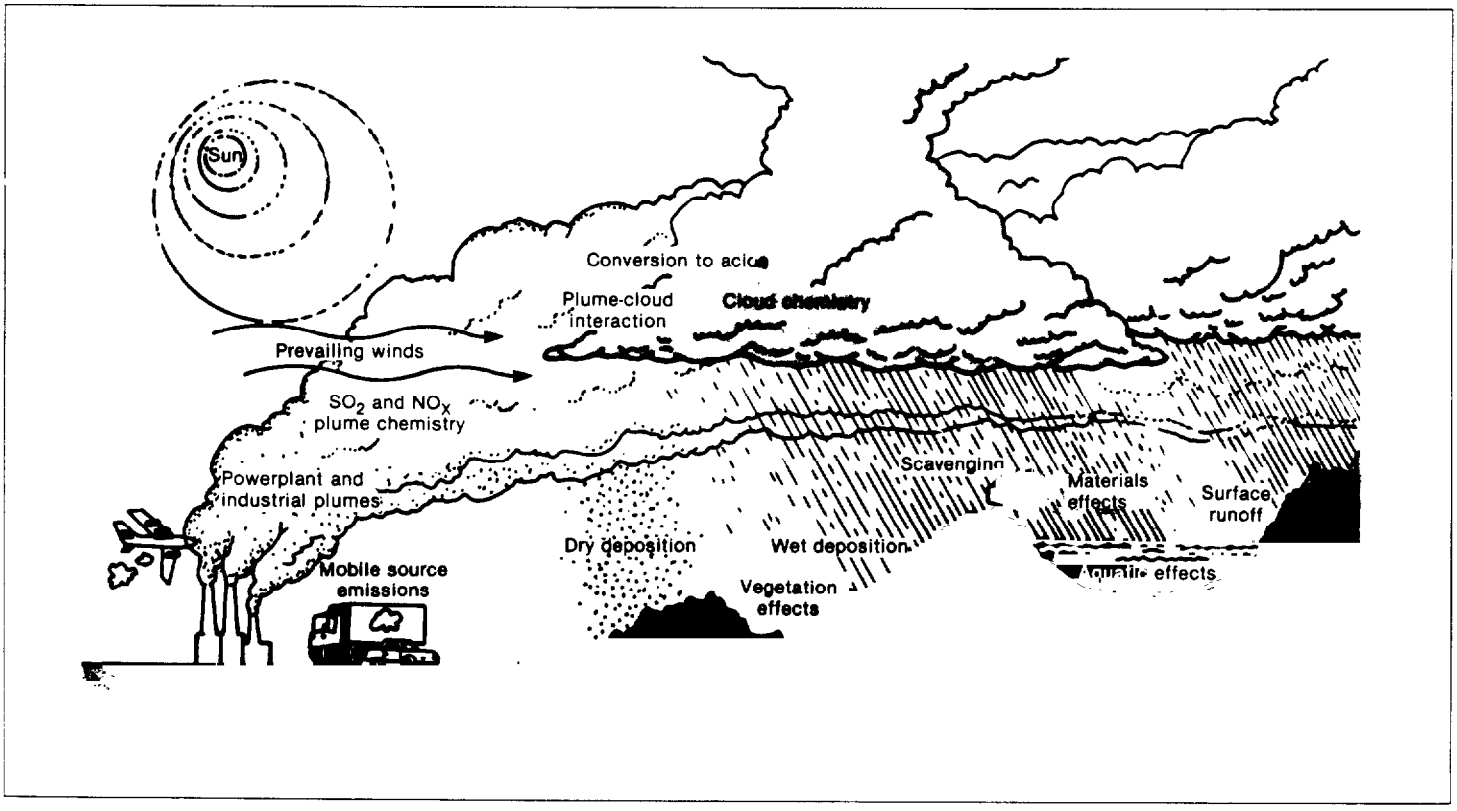
Acid rain has become a major air quality issue since harmful U.S. sulfur emissions affect not only our nation's environment but the environment of neighboring Canada as well. Acid rain is produced when sulfur dioxide and nitrogen oxides emitted to the atmosphere react with other atmospheric gases and return to the earth as acidic substances. Fine sulfate particles formed in the atmosphere from sulfur dioxide are a major contributor to visibility reduction and particulate pollution, and acidic sulfate particles may contribute to health problems. Some studies also suggest acid rain is responsible for killing aquatic life in lakes and streams in the northeast United States and Canada. However, uncertainty continues over how much environmental damage acid rain has caused.

Most concentrated sulfur dioxide emissions in the United States come from older coal-burning plants in the Midwest. Over 80 percent of the sulfur dioxide emissions originate in states east of the Mississippi River; about one-half of these emissions originate at electric utility plants. Nitrogen oxide emissions come from automobiles, power plants, and other combustion sources. Therefore, nitrogen oxide sources are not as geographically concentrated as sulfur dioxide sources. Studies have shown that the effects of these emissions can be far from the source of the problem. For example, while the greatest concentration of sulfur dioxide sources is located in the Ohio River Valley, prevailing winds can

[2]Gasoline volatility is defined as the tendency of gas to evaporate.

carry some emissions hundreds of miles to the northeast, where they are transformed and fall to the ground as acid rain (see figure IV.3).

Figure IV.3: Acidic Deposition Cycle



Source National Academy of Sciences

In 1980, Congress created the national acid precipitation assessment program (NAPAP) to study and evaluate approaches to control acidic deposition. NAPAP estimates that between 1973, the peak year of sulfur dioxide emissions, and 1988, sulfur dioxide emissions in the United States decreased by 23 percent from approximately 31 to 24 million short tons, despite a 45-percent increase in coal use. Most of the reduction was achieved by 1982; through 1988 sulfur dioxide emissions remained relatively constant. NAPAP attributed the decrease in sulfur dioxide emissions to increased use of low sulfur coal and flue gas desulfurization equipment (scrubbers), increased nuclear power plant production, and decreased utilization of some higher emitting plants and industrial sources. NAPAP also estimates that nitrogen oxide emissions have declined since peaking in 1978 at 23 million short tons. Data for

1988 indicated that nitrogen oxide emissions were 20 million short tons, or down 14 percent from 1978.

Recent proposed amendments to the Clean Air Act call for further reductions in both sulfur dioxide and nitrogen oxide emissions. In July 1989, the President proposed an amendment to the Clean Air Act that would require annual reductions of sulfur dioxide emissions from fossil-fueled generators to about 10 million tons below 1980 levels and annual reductions of nitrogen oxide emissions to about 2 million tons below levels projected for the year 2000, to be achieved by December 31, 2000.

According to some environmentalists and industry groups, the nation could reduce the annual sulfur dioxide and nitrogen oxide emissions that contribute to acid rain in a variety of ways, including the following:

- Technological remedies could be used (anti-pollution devices including clean coal technologies could be added to existing power plants, and more effective emission controls could be required for automobiles);
- Utilities could switch to low-sulfur coal found mostly in the West and Central Appalachia;
- Alternative fuels could be developed for the automobile industry;
- Clean burning natural gas could be substituted for high sulfur oil in electricity generation; and
- Electricity conservation could be encouraged, particularly in areas with a heavy reliance on high-sulfur coal.

However, controversy surrounds these remedial actions because of their potential negative impacts. Controversial issues include the following:

- Costs to the midwest region of the country for emission control of utilities would be greater than in other regions;
- Eastern coal companies could lose customers and eastern coal miners could lose jobs due to utilities switching to low-sulfur western coal;
- An increased consumption of natural gas for electricity generation may engender price increases and supply shortages for this fuel; and
- An increased consumption of some alternative fuels may be corrosive to automobiles.

In addition, it is difficult to measure electricity savings resulting from utility conservation programs.

Environmental Concerns Regarding Nuclear Power

Because of environmental and energy security questions facing certain alternative energy sources, the administration wants to ensure that nuclear power remains a viable option to meet the nation's energy needs. Further, according to one study, the nation's 112 licensed nuclear plants contribute to lower levels of sulfur dioxide and nitrogen oxide emissions—the precursors of acid rain—because electricity generated by nuclear power would otherwise likely be produced by fossil fuels. However, many environmentalists as well as the general public continue to have a negative perception of the nuclear option in light of the waste disposal problem, accidents, unsafe operations, and mismanagement of certain nuclear facilities.

Decisions regarding nuclear waste disposal remain politically and technologically complex as environmental concerns continue to affect solutions to this problem. For example, as discussed in appendix III, controversy continues over the selection of Yucca Mountain, Nevada, as the nation's underground repository for about 70,000 metric tons of utility generated high-level nuclear waste and may delay its scheduled opening in the year 2003. According to EIA, as of 1987, cumulative discharges of spent heavy metal fuel from U.S. nuclear power plants were 15,900 metric tons and are expected to continue to grow.[3] Also, while advances are being made in reactor designs, concern continues over the disposal of a reactor once it has reached the end of its useful life.

In addition to waste disposal problems, environmentalists charge that during the last decade U.S. electric utilities have reported nearly 30,000 mishaps at their nuclear power plants, including the partial meltdown in 1979 at Three Mile Island. Furthermore, some U.S. health authorities predict that cancer deaths in the Soviet Union will increase by as much as 70,000 over the next 70 years as a result of radiation releases from the Chernobyl nuclear plant accident in 1986. The economic losses from this accident are estimated at $3 billion, and it is not yet clear how widespread the damage is to the land, water, and wildlife. The future of nuclear power in the United States will be determined, in part by whether new technologies can improve the nuclear safety record and by resolution of the nuclear waste disposal issue.

[3]Spent fuel: Fuel removed from a nuclear reactor after it has completed a fuel cycle.

The Need for a National Energy Strategy

On July 26, 1989, the administration announced its plan to develop a national energy strategy. With this announcement, the President stated that the nation is at a critical juncture regarding the availability of future energy supplies and cited specific concerns over the U.S. oil situation, future electricity supplies, and the environment. The strategy, which is to be released by the President in January 1991, is to serve as an action plan for providing the nation with a balanced array of competitively priced, clean energy supplies well into the future. Since the strategy was announced, DOE has conducted several public hearings around the country and issued an interim report on the strategy on April 2, 1990, which summarizes the comments received at these hearings. Between April and December 1990, DOE plans to analyze this information as well as other data to develop a completed national energy strategy.

We believe DOE's effort to develop a national energy strategy is a step in the right direction toward addressing the nation's energy situation. Once completed, the strategy is expected to help decision makers examine legislative and policy choices on energy issues, by providing a framework that integrates the potential impacts these choices could have on environmental, economic, and other national concerns. As the strategy is being developed, the administration and the Congress will continue to make policy or legislative decisions on energy issues. For instance, the Clean Air Act amendments currently being debated could affect decisions by the automobile industry and the electric utility industry regarding alternative fuels and coal burning technologies that could alter energy choices and affect the nation's environment for years to come.

Reasons for a National Energy Strategy

The President is required by law to submit a national energy plan to the Congress every 2 years. Previous energy plans (1) indicated current domestic and international energy conditions, (2) stated the administration's views on the general policy direction the nation should take regarding its energy choices, and (3) declared new policy initiatives. However, according to DOE's Deputy Director, Office of Policy, Planning, and Analysis, these energy initiatives were not specific enough.

DOE expects the national energy strategy being developed to differ from prior national energy plans in several respects. The most notable difference is that the strategy is expected to serve as a blueprint for energy decisions—not just a policy statement. The strategy will generate several energy policy options, illustrate how each of the options will be

implemented at the program level, and indicate the budgetary requirements of these programs. Also, the Secretary of Energy expects the final strategy to contain specific recommendations on how to best balance energy, economic, and environmental concerns.

In announcing the development of the strategy, the Secretary of Energy expressed a number of concerns: domestic oil production is at the lowest level in 25 years; oil imports are 65-percent higher than in 1985; environmental problems are putting new pressures on the nation's ability to use coal, our most abundant domestic fuel; and the nation's margins of electricity reserves are shrinking. DOE officials said that the national energy strategy is needed to focus attention on the difficult choices of balancing these concerns against U.S. economic efficiency and growth.

Development of the Strategy

The national energy strategy is to be completed by December 1990 for the President's consideration. The report will present a range of options to the President on a national energy strategy for three baseline years: fiscal year 1992, the year 2010, and the year 2030. These options will also include guidance for fiscal year 1992 budget decisions. According to DOE, in January 1991 the President will be able to release:

- a clear statement of the administration's national energy strategy,
- the program and budget priorities for the strategy,
- DOE's program implementation plans, and
- the administration's legislative energy proposals to support the strategy.

Process of Development

In August 1989, DOE initiated a multi-stage process to forge a strategy that would reflect a consensus of opinion on the nation's energy situation. According to DOE, the public's acceptance and implementation of the strategy will determine its success. To begin the process of developing the strategy, DOE

- planned several fact-finding public hearings to obtain input from state officials, energy producers, consumers, environmentalists, and the general public on goals and concerns to include in the strategy;
- sought the participation of other federal agencies, such as EPA, in the public hearings;
- initiated several special studies by the DOE national laboratories on energy conservation, global climate change, technology transfer, and renewable energy resources; and

- requested EIA to begin the development of new improved modeling capability, to be called the national energy modeling system, that would extend projections of energy supply and demand up to forty years into the future.

Staff from EIA, DOE headquarters, and DOE's national laboratories are jointly developing the national energy modeling system. DOE expects that the national energy modeling system will continually track the future availability of energy supplies and the impacts the various energy supply options will have on such issues as global warming and emerging energy technologies. This new modeling system, which is to be completed by 1992, is expected to improve upon EIA's capability to project energy trends through (1) the development of end-use models able to reflect a variety of assumptions about the cost and performance of demand-side technologies, (2) the development of ways to integrate renewable energy resources with other models of energy supplies, (3) the development of new forecasting capability to explore long-term trends—20 years and 40 years into the future, and (4) the collection of data for these new or enhanced energy models.

Status of Development

On April 2, 1990, DOE issued its interim report on the national energy strategy for further public comment and also issued the national laboratories special studies on energy issues. The interim report represents a considerable effort by DOE. It is a compilation of about 1,000 written comments and about 380 testimonies received at the 15 public hearings DOE conducted around the country between August 1989 and February 1990. In the report, DOE organized these written and oral comments around four publicly identified themes—increased efficiency of energy use, secure future energy supplies, respect for the environment, and fortifying the foundations of scientific achievement—and listed the publicly identified energy goals, obstacles to these goals, and possible options suggested to overcome these obstacles for each of these themes.

However, the report did not contain all the information that DOE had originally planned to include for public comment before issuance of the completed strategy in December 1990. DOE's September 1989 management plan for the strategy stated that the interim report would also include the Department's proposed set of recommendations for new energy activities or changes to existing energy programs, budgetary proposals for fiscal year 1992, and EIA's new baseline forecasts for U.S. energy supply and demand. Thus, this report will not serve as the

vehicle for public comment on the Department's proposed energy recommendations and budgetary proposals, nor on the assumptions used by EIA to develop its baseline forecasts of future energy supply and demand.

As the interim report was being prepared, and, subsequent to its release, DOE testified before several congressional committees on the status of the strategy and information that had been developed for it. The Congress is likely to continue to monitor the progress of the strategy.

In May 1990, DOE decided not to develop recommendations for the final draft. In response to a request by the administration's Economic Policy Council—a cabinet level group of executive agencies—DOE decided to present the President with a range of options rather than recommendations in its draft of the national energy strategy.

According to DOE, the most difficult choices for the strategy are yet to come as it moves away from the information collection effort of the interim report to data analysis and the development of a range of options. Completing this effort by January 1991 would seem to be a formidable task. However, some efforts have already been completed. For instance, according to EIA, it has completed the baseline forecasts to be used for the national energy modeling system. EIA has now turned its efforts to constructing scenarios from the forecasts that will be used in developing the strategy. These scenarios are expected to model how plausible U.S. government policy options and technological innovations might change U.S. energy costs, U.S. energy security, and the natural environment.

Observations

We believe the effort to develop a national energy strategy is a step in the right direction. The strategy is expected to provide new information and propose initiatives for guiding future energy choices at a time when concerns are increasing about energy consumption, reliable energy supplies, and environmental protection. Timely completion of the administration's strategy is important because the electric utility industry, the automotive industry, and others in the energy sector will be making decisions about what technologies and energy sources to pursue, particularly as changes to the Clean Air Act occur. For example, as discussed in appendix III, the electric utility industry will soon be making decisions about what technologies and fuels to use for future generating capacity. A completed strategy could provide new information that may lead these industries to consider the use of alternative energy sources or

technologies that contribute to the balanced goals of reduced U.S. dependence on unreliable energy suppliers, a safer and healthier environment, and economic growth. Finally, while the strategy is being developed, we encourage DOE to continue to provide the Congress new important information that may be useful in deliberations on energy and environmental legislation.

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Related GAO Products

Canadian Power Imports: A Growing Source of U.S. Supply (GAO/RCED-86-119, Apr. 30, 1986).

Energy Security: An Overview of Changes in the World Oil Market (GAO/RCED-88-170, Aug. 31, 1988).

Energy Issues: GAO Transition Series (GAO/OGC-89-16TR, Nov. 1988).

International Energy Agency: Effectiveness of Members' Oil Stocks and Demand Restraint Measures (GAO/NSIAD-89-42, Feb. 6, 1989).

Canadian Power Imports: Update on Electricity Imports in the Northeast (GAO/RCED-89-51, Mar. 3, 1989).

Strategic Petroleum Reserves: Analysis of Alternative Financing Methods (GAO/RCED-89-103, Mar. 16, 1989).

Electricity Supply: What Can Be Done to Revive the Nuclear Option? (GAO/RCED-89-67, Mar. 23, 1989).

Fossil Fuels: Commercializing Clean Coal Technologies (GAO/RCED-89-80, Mar. 29, 1989).

Alternative Financing Methods for the Strategic Petroleum Reserve (GAO/T-RCED-89-27, Apr. 19, 1989).

Status of DOE-Funded Clean Coal Technology Projects (GAO/T-RCED-89-38, May 4, 1989).

The Strategic Petroleum Reserve Amendments of 1989 (GAO/T-RCED-89-38, May 4, 1989).

Perspectives on the Potential of Clean Coal Technologies to Reduce Emissions From Coal-Fired Power Plants (GAO/T-RCED-90-3, Oct. 18, 1989).

Energy Security and the World Oil Market (GAO/T-RCED-90-12, Nov. 8, 1989).

Fossil Fuels: Pace and Focus of the Clean Coal Technology Program Need to Be Assessed (GAO/RCED-90-67, Mar. 19, 1990).

Utilities' Potential Use of Clean Coal Technologies (GAO/T-RCED-90-56, Mar. 28, 1990).

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