

Chapter 21

ENERGY ECONOMICS, POLITICS AND POLICIES

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In Chapters 2-20 our emphasis has been on the technical issues of fuel utilization and energy interconversion. Knowledge of facts and of all the options available is essential for making informed energy-related decisions. A good analogy is making a shopping list before going shopping. You know that you may end up buying something that's not on the list, but with a list in hand it is less likely that you will buy something you don't need.

Figure 21-1 is an illustration of what is required next. We have to integrate the technical, economic and socio-political issues. The formulation of energy policies will then follow. It is of course beyond the scope of our discussion (and beyond my competence) to address the economics, politics and policies of energy utilization in any detailed or rigorous way. Our objective here is just to introduce the most important issues and use them in a rather general discussion. In particular, as we have done throughout this book, we focus on issues that have attracted the greatest attention in media reports. Energy-related media reports, quoted primarily from the last five years, often undergo 'recycling'; it is very likely, therefore, that you will read about the same issues in the next decade as well.

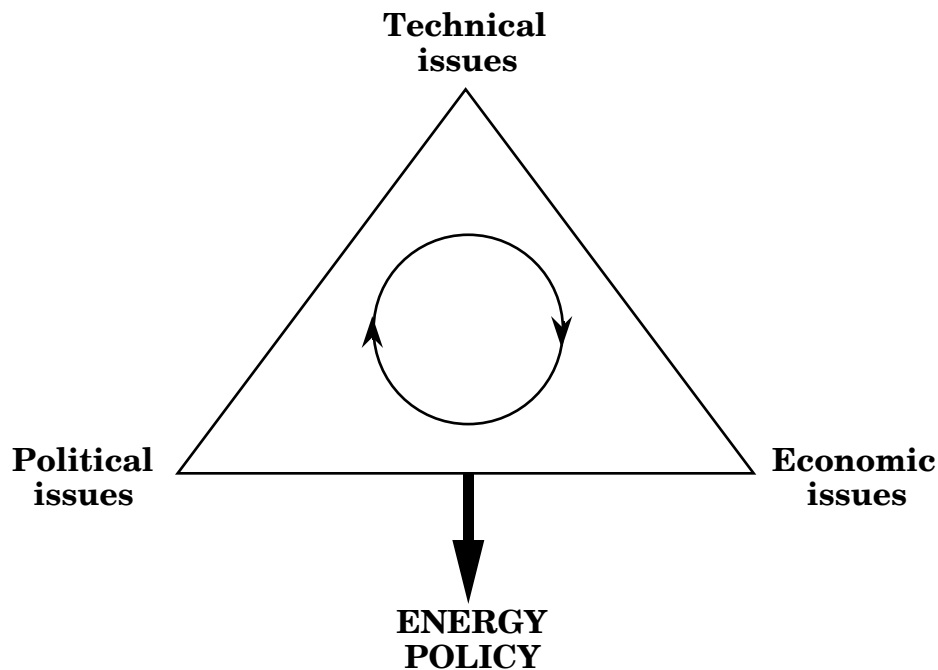


FIGURE 21-1. Formulation of energy policy requires an understanding of the complex interactions among technical, economic and socio-political issues.

The various costs associated with the utilization of energy and fuels (energy economics) must be clearly established before the various options (energy politics) are formulated and

before one of the alternatives (energy policy) is finally selected. The evaluation of costs and the formulation of alternatives, in turn, cannot be done without the knowledge of facts (technical issues). In Parts II and III we discussed most of the energy options presently available, along with their virtues and liabilities. The material covered in Part I provides the basis for their technical evaluation. So here we attempt to bring everything together, by considering the economic and political constraints that are always imposed – often in a decisive manner – on the various technically feasible options.

Economic Issues

As in all other economic analyses, both operating costs and capital expenses need to be considered. The operating costs of greatest interest are those of the fuels. The capital costs of interest are those of the energy conversion devices, ranging from a 10-dollar hair drier to a 20-thousand-dollar automobile and to a billion-dollar power plant.

Throughout this book we have emphasized the need to express the cost of fuels based on the quantity *and quality* of energy of interest. A commonly used cost is expressed in dollars per million BTU. It is important to emphasize that the BTU units to be compared need to be of the same kind (such as thermal, or electric, or mechanical), and this requires that the efficiency of energy conversion be known. Illustration 21-1 contains important examples, not necessarily because the absolute numbers are correct but because it summarizes the simple technique for comparing fuel costs that was introduced in Chapter 6. It cannot be overemphasized, however, that more rigorous economic analyses need to be based on time-specific and site-specific costs. If the various assumptions made (about fuel cost and furnace efficiency) are correct, and they are probably not too far off, the conclusion is that natural gas is the most economical residential heating fuel. In Chapter 9 we also concluded that it is the ideal fuel from a technical standpoint.

The cost of fuel is also an important consideration for the economics of the electric power plants. This is shown in Illustration 21-2. Solar energy use requires no fuel; only the capital investment is of interest here. So a ‘ball-park’ estimate of its economics is given in Illustration 21-3.

The cost of fuel is important but it is not the only component of energy costs. The other components are operational and maintenance costs and the fixed (capital) cost. All these costs are dependent on time and place of purchase and, more broadly speaking, on energy supply and demand and the state of the economy. Formulation of a policy requires explicit statements about the macroeconomic assumptions used. For example, the *National Energy Strategy* of the Bush Administration (see below) was based on the growth rates summarized in Table 21-1.

Illustration 21-1. If coal, fuel oil No. 2 and natural gas cost \$100/ton, \$1.00/gallon and \$6/1000 cubic feet, respectively, rank these fuels in order of increasing cost of residential heat (thermal energy) obtained from them. Assume that the heating values (chemical energies) of the fuels are 13,000 BTU/lb for coal, 140,000 BTU/gallon for fuel oil and 1000 BTU/cubic foot for natural gas. Assume also that the efficiencies of conversion of chemical energy to thermal energy (in typical residential furnaces) are 55, 75 and 85%, respectively. Include electric heating in the analysis also, by assuming that the efficiency of an electric heater is 100% and that electricity costs \$0.10/kWh.

Solution.

$$\text{Coal: } \left(\frac{\$100}{\text{ton}} \right) \left(\frac{1 \text{ ton}}{2200 \text{ lb}} \right) \left(\frac{1 \text{ lb}}{13000 \text{ BTU(ch)}} \right) \left(\frac{100 \text{ BTU(ch)}}{55 \text{ BTU(th)}} \right) = \frac{\$6.36}{10^6 \text{ BTU(th)}}$$

$$\text{Fuel oil: } \left(\frac{\$1.00}{\text{gallon}} \right) \left(\frac{1 \text{ gallon}}{140000 \text{ BTU(ch)}} \right) \left(\frac{100 \text{ BTU(ch)}}{75 \text{ BTU(th)}} \right) = \frac{\$9.52}{10^6 \text{ BTU(th)}}$$

$$\text{Natural gas: } \left(\frac{\$6}{10^3 \text{ ft}^3} \right) \left(\frac{1 \text{ ft}^3}{1000 \text{ BTU(ch)}} \right) \left(\frac{100 \text{ BTU(ch)}}{85 \text{ BTU(th)}} \right) = \frac{\$7.06}{10^6 \text{ BTU(th)}}$$

$$\text{Electricity: } \left(\frac{\$0.10}{\text{kWh(e)}} \right) \left(\frac{1 \text{ kWh(e)}}{1 \text{ kWh(th)}} \right) \left(\frac{1 \text{ kWh}}{3412 \text{ BTU}} \right) = \frac{\$29.31}{10^6 \text{ BTU(th)}}$$

Therefore, in this (hypothetical) case, the order of increasing cost of residential heat is:

$$\text{coal} < \text{natural gas} < \text{fuel oil} < \text{electricity}$$

TABLE 21-1

Economic base for the *National Energy Strategy* of the Bush Administration

Period	Population growth	GNP growth	Primary energy demand growth	Electricity demand growth
1990-2000	0.7	3.0	1.6	2.5
2000-2010	0.5	2.8	1.1	1.5
2010-2020	0.4	1.9	0.8	1.6
2020-2030	0.2	1.6	0.5	1.3

Note: All growth rates are given as %/year.

[Source: *National Energy Strategy*, 1991/1992.]

Illustration 21-2. A 1000-MW electric power plant burns 20 gallons of fuel oil per second.

(a) Determine the efficiency of the plant.

(b) If the efficiency were 40% (instead of the number found in part (a)), how much less oil would be needed to produce the same amount of electricity?

(c) If a gallon of oil costs \$ 0.80, and if oil savings of part (b) could be achieved, how much money would the power plant save per year?

Solution.

(a)

$$\text{Efficiency} = \frac{\text{Useful energy output}}{\text{Total energy input}} = \frac{1000 \text{ MW}}{20 \frac{\text{gal}}{\text{s}}} = \frac{(10^9 \frac{\text{J}}{\text{s}}) (\frac{1 \text{ BTU}}{1054 \text{ J}})}{(20 \frac{\text{gal}}{\text{s}}) (\frac{140000 \text{ BTU}}{1 \text{ gal}})} = 0.34$$

(b)

$$\text{Efficiency} = \frac{\text{Useful energy output}}{\text{Total energy input}} = \frac{1000 \text{ MW}}{\text{Total energy input}} = 0.40$$

$$\begin{aligned} \text{Total energy input} &= \frac{\text{Useful energy output}}{\text{Efficiency}} = \frac{(10^9 \frac{\text{J}}{\text{s}}) (\frac{1 \text{ BTU}}{1054 \text{ J}}) (\frac{1 \text{ gal}}{140000 \text{ BTU}})}{0.40} = \\ &= 17 \text{ gal/s (i.e., 3 gal/s less)} \end{aligned}$$

(c)

$$\begin{aligned} \frac{\$ \text{ saved}}{\text{year}} &= \left(\frac{\text{gallons saved}}{\text{year}} \right) \left(\frac{\$}{\text{gallon}} \right) = \\ &= \left(3 \frac{\text{gal}}{\text{s}} \right) \left(\frac{\$0.80}{\text{gal}} \right) \left(\frac{3600 \text{ s}}{1 \text{ h}} \right) \left(\frac{24 \text{ h}}{1 \text{ day}} \right) \left(\frac{365 \text{ days}}{1 \text{ year}} \right) = \$76 \text{ million (!)} \end{aligned}$$

To place into perspective the numbers in Table 21-1, Figure 21-2 shows the gross domestic product (GDP) trends in the U.S. in the last four decades. (The subtle difference between the gross national product shown in Table 21-1 and the GDP – see Chapter 5 – is not of consequence here.) It is seen that the doubling time in the first couple of decades was about 20 years, while it is more like 25 years today; so the rate of growth of the economy has been decreasing from about 3.5% per year to less than 3% per year today. The projections

shown in Table 21-1 are thus conservative; they suggest a further slowing down of the economy in the first few decades of the 21st century. (The projections for population growth are consistent with the trends observed in the industrialized nations.) The modest but sustained economic growth is expected to result in a decreasing growth of both primary energy demand and electricity demand. This is consistent with the trend in the recent past, as shown in Figures 5-3 and 18-3.

Illustration 21-3. In Illustration 17-1 we calculated that a home in Phoenix, Arizona, requires a solar collector of about 50 m² for an all-solar heating system. How much would such a system cost if the installed price of a solar system is about \$20 per square foot? How long would it take to repay the investment if the solar system replaces 80% of the existing (electric) heating system?

Solution.

$$\text{Cost of solar system} = \left(\frac{\$20}{1 \text{ ft}^2}\right) (50 \text{ m}^2) \left(\frac{1 \text{ ft}^2}{0.1 \text{ m}^2}\right) = \$10,000$$

In Figure 19-6, it is seen that an average house in the southern and western parts of the country consumes about 80 million BTU per year. For an all-electric heating system, that would cost (at, say, 10 cents per kilowatthour):

$$\left(\frac{8 \times 10^7 \text{ BTU}}{\text{year}}\right) \left(\frac{1 \text{ kWh}}{3412 \text{ BTU}}\right) \left(\frac{\$0.10}{1 \text{ kWh}}\right) = \$2345/\text{year}$$

Eighty percent of \$2345 is \$1876 per year in saved electric bills. So with no tax credits for solar energy (which used to exist in many states), one would recover the (hypothetical) cash investment in less than six years.

Political Issues

Consideration of the economic issues (cost of fuel, cost of energy conversion devices, financing options, tax credits, etc.) is usually sufficient for making choices at the level of an individual or a family. The two most important “policy decisions” here are those regarding a system for residential comfort and an automobile. These were discussed in Chapters 19 and 20. At all other levels – local, regional, national and international – it is old-fashioned politics that has a significant and sometimes even decisive impact on the formulation of energy policies. Here we limit our discussion to only one or two political issues. We start with the most important one, the OPEC factor. It was at the root of all

“energy crises.” It still has a large influence on world economics in general and energy economics in particular, though not as overwhelming today as it did 15-20 years ago (see cartoon on p. 427). We then briefly summarize some of the most recent events and their impact on energy supply or demand. These are explored in more detail in the Investigations at the end of the chapter.

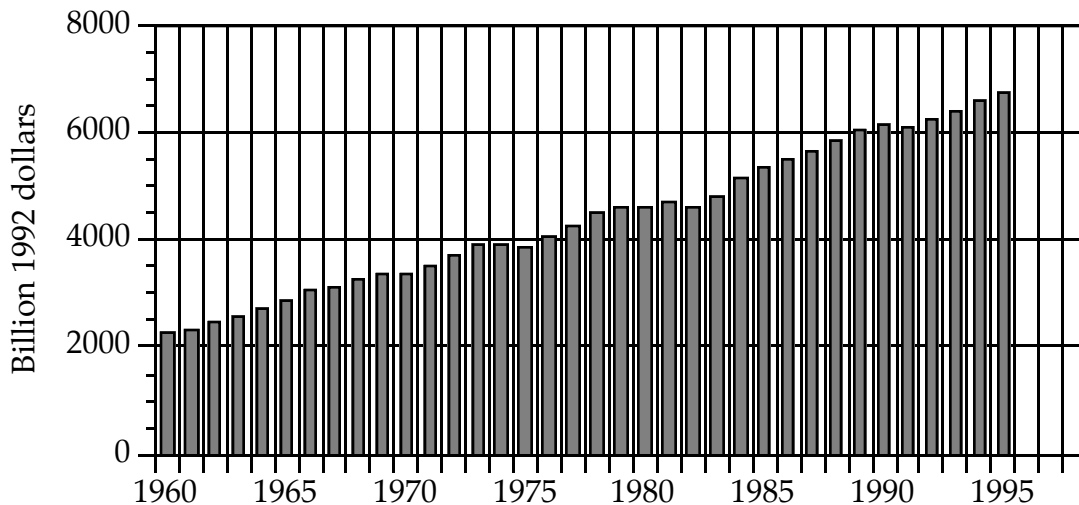


FIGURE 21-2. Growth of gross domestic product (GDP) in the U.S. in the last forty years.

The acronym OPEC stands for Organization of Petroleum Exporting Countries. It is a cartel of petroleum-rich countries, created in 1960 by Saudi Arabia, Venezuela, Kuwait, Iran and Iraq, in response to unilateral oil price cuts by major international oil companies, which in turn were triggered by an oversupply of oil in the 1950s. The oil surplus persisted until the early 1970s. Significant imports of oil into the United States, for example, did not start until the late sixties, but in the early seventies they rose dramatically to about 35% of consumption (see Figure 8-3). A switch from a buyer's market to a seller's market was occurring in this period. The international oil companies agreed to give up the traditional ‘fifty-fifty’ deal with the oil-rich countries and make it a 55-45 deal (55% to the country and 45% to the company).

In October 1973, in the midst of one of the political crises in the Middle East, an embargo on the shipment of Arab oil to the United States was imposed, triggering the first “energy crisis.” The price of oil increased by as much as 500% in a matter of months. (The official OPEC price went from \$1.80 in 1970 to \$11.65 per barrel in late 1973; see Figure 20-3). Long lines at gasoline pumps in the United States made the public realize that the era of endless abundance and low cost of energy had come to an end. Another shock (the second “energy crisis”) – with its own gas lines and all – came in the wake of the Iranian

revolution of 1978/79, when Iranian oil exports ceased and the price of a barrel of oil went from \$12 to \$34. The Three Mile Island accident in the spring of 1979 could not have come at a worse time.

In response to the new prices of oil came – as expected (see Figure 21-3) – conservation, new oil explorations in non-OPEC countries and intensified development of alternative energy sources. The OPEC countries were soon forced to defend their price by cutting production levels. Quotas were established for each country – thirteen of them were in OPEC by that time – and were negotiated at highly publicized meetings every six months. (Table 21-2 shows the recent quota trends and production levels in OPEC countries.) By this time, as much as the world was hooked on Middle East oil, many of the OPEC countries were highly dependent on ‘petrodollar’ revenues for everything from fighter planes to toilet paper. As the growth of demand decreased (see Figure 8-3, for example), quota violations became more frequent. An outright price war among the OPEC countries – the third “oil shock,” this one in the opposite direction – began in late 1985, when Saudi Arabia abandoned its defense of oil price in favor of regaining its share of the oil market. In a matter of months, the prices dropped by 200% (see Figure 20-3).

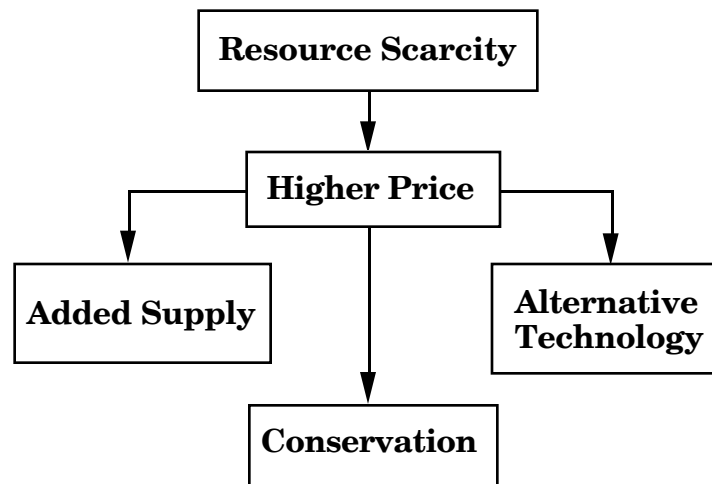


FIGURE 21-3. Possible responses to price increases: interplay among what is technically available, economically feasible and politically implementable.

The fourth oil shock came in the summer of 1990, when Iraq invaded Kuwait. The oil price roller coaster for those months is shown in Figure 21-4. The price of oil came down again, but some estimates of the cost of the Persian Gulf war – which has been called the “war for oil” – are in the range of several hundred billion dollars. This has prompted some analysts to claim that the ‘real’ price of oil is much higher than the current \$25/bbl (approximately).

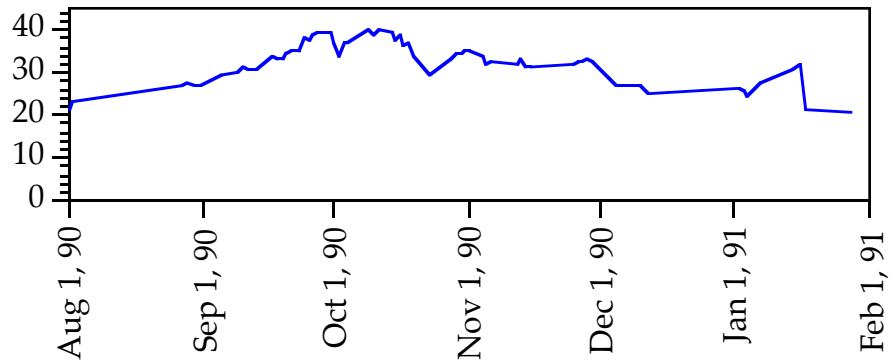


FIGURE 21-4. Price of crude oil (in dollars per barrel) on the New York Mercantile Exchange in the period August 1990-January 1991.

TABLE 21-2
OPEC countries, their petroleum production and quotas

Country	Quotas (1000 bbl/day)			Production (1000 bbl/day)
	January 1987	January 1991	June 1996	March 1996
Saudi Arabia	4,133	5,380	8,000	8,100
Iran	2,255	3,140	3,600	3,600
Iraq	~1,500 ^a	3,140	1,200 ^b	600
Kuwait	948	1,500	2,000	2,060
United Arab Emirates	902	1,491	2,161	2,200
Qatar	285	371	378	460
<i>Persian Gulf OPEC</i>	59%	67%	69%	66%
Venezuela	1,495	1,945	2,359	2,860
Nigeria	1,238	1,611	1,865	2,020
Indonesia	1,133	1,374	1,330	1,370
Libya	948	1,233	1,390	1,390
Algeria	635	827	750	820
Ecuador ^c	210	273	-	-
Gabon ^d	152	197	-	370
<i>Total OPEC</i>	14,334	22,482	25,033	25,850

^aBoycotted OPEC agreements during the war with Iran; ^bprovisional.

^cWithdrawn from OPEC in 1992; ^dwithdrew from OPEC in 1996.

[Source: *Oil & Gas Journal*, 6/17/96.]

Given that most of the world's reserves and resources of oil are in the Persian Gulf area, it is likely that the OPEC factor – which has been quite unpredictable in the past – will continue to play a key role in world energy politics and economics. It will also play an important role in U.S. energy politics. Imports of oil from OPEC countries have decreased relative to the situation in the late 1970s, but they still represent about 50% of total imports (see Figure 20-5). Figure 21-5 shows the most recent slate of countries that export oil to the U.S. Saudi Arabia is seen to be the key partner. With a quarter of world's proven reserves (see Chapter 8 and the *Economist* of 7/20/96, p. 88), it is the most influential member of OPEC and it shares the #1 spot on the list of oil exporters to the U.S. Conspicuously absent from this list is Iran, which is under an official 'counter-embargo' since 1987 (see BW of 2/13/95, p. 6).

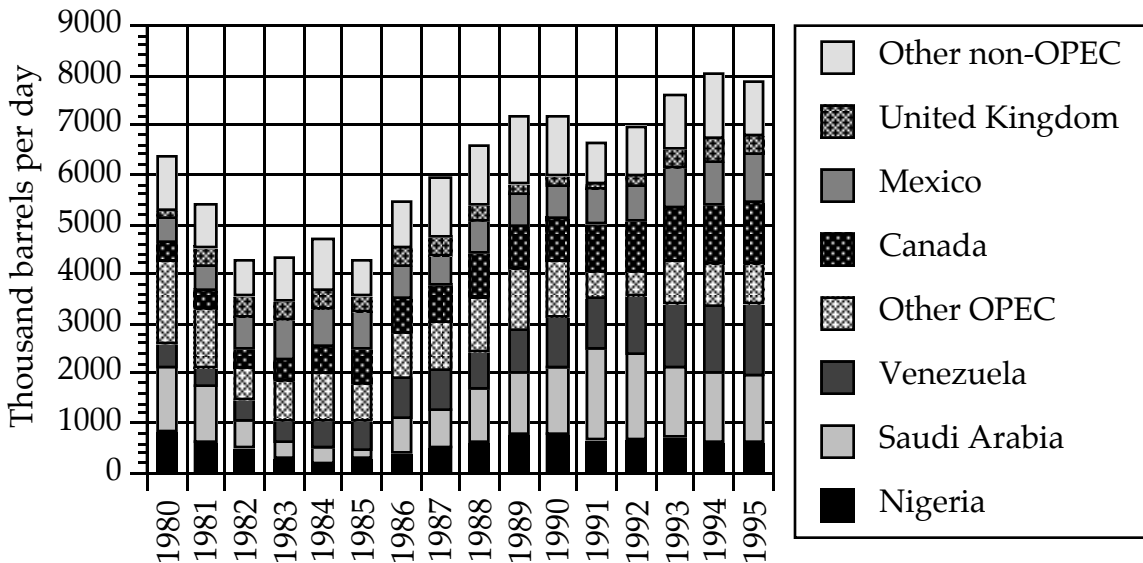
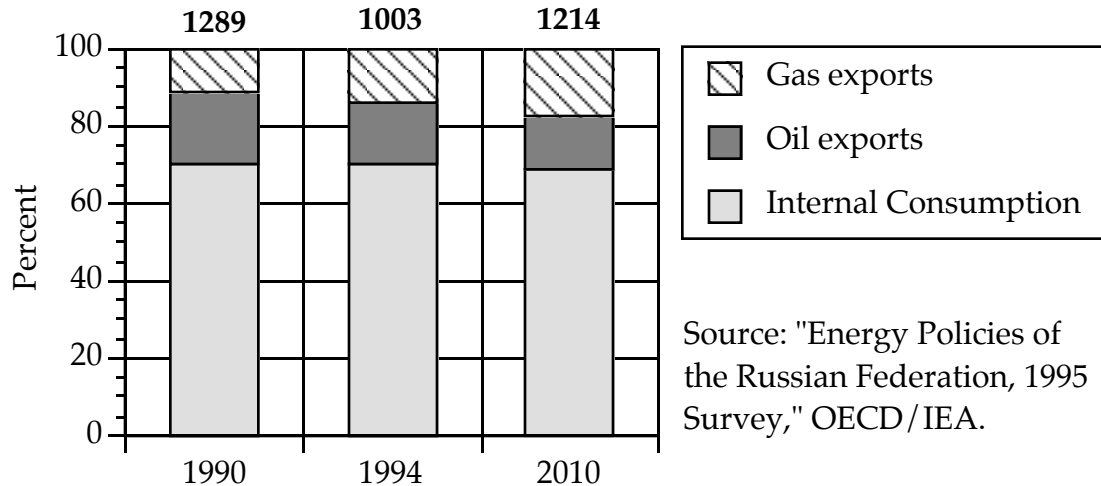


FIGURE 21-5. U.S. imports of petroleum by country or region of origin. [Source: Energy Information Administration.]

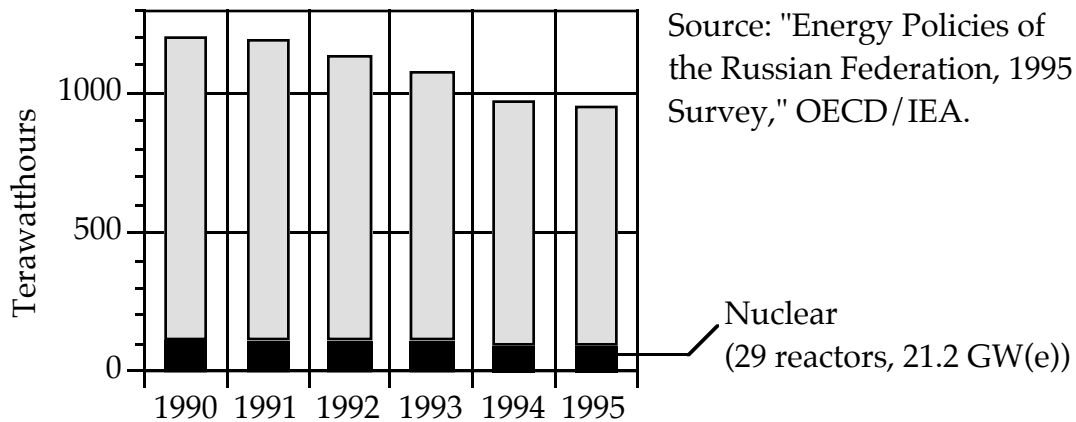
The world has changed rather dramatically in the last decade. The collapse of the Soviet Union and the political changes there have had major energy-related consequences as well. In the late 1980s, Russia was the world's largest oil producer; today its exports are shrinking, as shown in Figure 21-6. Most oil companies are feverishly drilling for oil in the ex-USSR (see Investigations 8-1, 8-3 and 8-11). Some 35% of world's proven gas reserves are there too. So future oil and gas supplies will be very much influenced by the political stability of this region. The nuclear program of the ex-USSR has also undergone major changes in the wake of the Chernobyl disaster and the country's political collapse. In the 1980s Russia had the largest nuclear program in the world, which was expected to add

another 200 GW of electricity by the year 2000. Today 30 projects were cancelled or placed on hold and only one is under construction. After the Chernobyl experience, Europe is more comfortable (see Investigation 15-17) with the electricity generation mix shown in Figure 21-7.



Source: "Energy Policies of the Russian Federation, 1995 Survey," OECD/IEA.

FIGURE 21-6. Prospects for exports of petroleum and natural gas in the Russian Federation (numbers shown are millions of tons of oil equivalent).



Source: "Energy Policies of the Russian Federation, 1995 Survey," OECD/IEA.

FIGURE 21-7. Role of nuclear energy in the generation of electricity in the Russian Federation.

Energy Policies

Everyone should have an energy policy, particularly when energy costs are high. At the (ultra)microeconomic level, each household should have one. Because there are relatively few conflicts of interest among household members, it should not be difficult to devise one and implement it. In Chapter 19 we provided the bases for the development of such a policy.

At the macroeconomic level, the situation becomes much more complicated. Proposals abound, particularly when the price of oil is high, as was most recently the case in the period August-January 1991. Among the ideas most often heard are tougher federal standards on vehicle mileage and a gasoline tax (see Chapter 20). A relatively new and interesting idea is that of a ‘feebate’, advocated by Amory and Hunter Lovins (see *The New York Times*, December 3, 1990; see also www.rmi.org). Instead of imposing a gasoline tax, which – they argue – is not sufficient incentive to buy an efficient automobile, a fee or a rebate would be instituted at the time of automobile purchase. A fee is paid if the selected car is inefficient and a rebate is received if the selected car is efficient.

The energy specialist of *The New York Times*, Matthew Wald, has summarized in a very convenient way the ten most frequently cited proposals, including the *laissez faire* approach, and their prospects for adoption (*The New York Times*, September 24, 1990). They are explored in Investigations 21-14, 21-15 and 21-17.

National Energy Strategy. Despite the conclusion by Matthew Wald, that doing nothing has the best prospects, it has been both fashionable and necessary – in the last two decades – for governments to have an energy policy. The Administration of Jimmy Carter was particularly visible with its National Energy Plan of 1977 and its ambitious synfuels program, which collapsed when the price of oil collapsed in the early 1980s. The Administration of Ronald Reagan left pretty much everything to the market place, including the energy issues. President Reagan even wanted to abolish the Department of Energy, but he didn’t get his way on that one.

One of the most recent versions of the U.S. energy policy is called the *National Energy Strategy*. It was announced in July 1989 and published in February 1991. In it, the Bush Administration “addresses the range of institutional and regulatory barriers preventing the best use of all of our Nation’s energy resources – supply and demand, intellectual and physical.” It also expresses the hope that “working together at all levels of government and with the American people, we can achieve a cleaner, more productive, and more secure energy future.” At the beginning of most chapters, I have quoted (what I feel are) the most important statements contained in this document, as they relate to the particular topic covered in each chapter. One of the cornerstones of the strategy (see, for example, NYT of 9/24/89), and probably the one with most important consequences, is the Clean Air Act Amendment of 1990.

Clean Air Act. There is no question that the use of fossil fuels is the principal cause of air pollution. So even a superficial analysis of energy policies requires that clean air legislation be considered. In Chapter 11 we discussed the technical issues of air pollution. Here we summarize the history of the Clean Air Act and the key aspects of the current legislation contained in the 1990 Clean Air Act amendments. The most important milestones in the evolution of this legislation are the following:

- 1953 Photochemical smog problems detected in Los Angeles.
- 1963 Congress passes the Clean Air Act, which calls for a study of the problem of air pollution.
- 1970 Congress establishes the Environmental Protection Agency (EPA) and President Nixon signs the first Clean Air Act amendments.
- 1975 Catalytic converters become mandatory in all new cars.
- 1977 Congress passes the second Clean Air Act amendments establishing the National Ambient Air Quality Standards (NAAQS).
- 1981 Senator G. Mitchell (Maine) drafts the nation's first acid rain bill.
- 1989 President Bush delivers the first clean air bill to Congress since 1977.
- 1989 The leading Democratic senators from Michigan (with the automobile industry constituency to worry about) and California (with smog-weary voters in mind) agree on auto emission provisions.
- 1990 In April the Senate defeats a proposal by Senator Byrd (WV) containing a \$500 million aid package for coal miners and other workers who lose their jobs.
- 1990 In May the House of Representatives approves a version of the bill which contains a provision similar to that of Senator Byrd but at a level of \$250 million.
- 1990 In July the House-Senate Conference Committee irons out the differences between the two bills.
- 1990 In October the House passes the final bill by a vote of 401-25 and the Senate does the same by a vote of 89-10.
- 1990 In November President Bush signs the third Clean Air Act amendments.

INTERNET For details of the current Clean Air Act legislation, see the Web site of the
INFO Environmental Protection Energy, www.epa.gov.

Table 21-3 summarizes the main provisions of the current clean air legislation. They are grouped into three areas: (1) pollution by motor vehicles; (2) urban smog; and (3) acid rain.

The momentum for its overwhelming support in Congress, even in the face of estimated annual compliance costs of \$25 billion, started to pick up after the long, hot summer of 1988 (see, for example, NYT of 9/4/88, or *Time* of 7/11/88). Somber articles with titles such as “The End of Nature,” by Bill McKibben in *The New Yorker* of 9/11/89, were typical of the prevailing mood at the time. The following statement by Philip Shabecoff in NYT of 3/7/89, in a report from Washington entitled “Clean Air Backers Like Way Wind is Blowing,” illustrates well the initial reactions to such a mood: “Almost every

TABLE 21-3
Provisions of the Clean Air Act Amendment of 1990

Previous Legislation	1990 Provisions
Motor vehicles	
<p>Maximum exhaust emission standards are 1.0 grams per mile for NO_x and 0.41 grams per mile for hydrocarbons.</p>	<ul style="list-style-type: none"> •Emissions of hydrocarbons and NO_x are to be reduced by 35% and 60%, respectively, in many new cars starting with 1994 models and in all new cars by 1996. •Starting in 1998, all new cars should have pollution control equipment that lasts 10 years or 100,000 miles. •Manufacturers of cars sold in the U.S. are to produce an experimental fleet to be sold in southern California that uses new technology to meet even stricter standards: 150,000 cars annually by 1996, 300,000 cars by 1998. •Oil companies are required to offer new kinds of gasoline that burn more cleanly; beginning in 1992, cleaner fuels are to be sold in cities with worst CO pollution problems.
Urban smog	
<p>Requires areas to meet health standards for six pollutants, including ground-level ozone, a main ingredient of urban smog.</p>	<ul style="list-style-type: none"> •Establish five categories of ozone non-attainment areas (marginal, moderate, serious, severe, extreme); set deadlines of 3, 6, 9 and 15 years, respectively, for attaining standards. •All except marginal areas are to achieve 15% reductions within 6 years; thereafter, most other areas are to achieve 3% reductions per year. •Must control sources emitting 100 tons per year in marginal areas and moderate areas; 50 t/yr in serious areas; 25 t/yr in severe areas; and 10 tons per year in extreme areas.

TABLE 21-3 (Continued)
Provisions of the Clean Air Act Amendment of 1990

Acid rain	
No specific provisions; acid rain was not widely recognized as a problem when the original law was passed.	<p>The amount of SO₂ and NO that can be emitted from smokestacks into the atmosphere is to be cut in half:</p> <ul style="list-style-type: none"> •Sulfur dioxide emissions are to be cut by 10 million tons annually by the year 2000. Half of the reduction is to occur by 1995, when more than 100 largest sulfur-emitting electric utility plants in 22 states are required to meet stricter standards; the second phase begins in 2000 •Nitrogen oxide emissions are to be cut by about 2 million tons annually; first limits go into effect 18 months after bill is approved with additional limits to be established in 1997.

year for the last eight years legislation to strengthen the Clean Air Act has been introduced in Congress, and each time it died. Now there is some optimism that the law may be changed by the 101st Congress. There is, it might be said, something in the air this year.” Two months later (NYT, 5/14/89), the same reporter stepped up the rhetoric: “In Search of a Better Law To Clear the Air: After more than a decade of legislative deadlock, Congress and the White House may finally come to terms this year on an important revision of the Clean Air Act, a path-breaking but imperfect law enacted almost 20 years ago with the goal of sweeping pollution from the sky. The outcome of the debate will affect air quality in the United States for decades to come. It will determine how many billions of dollars industry will have to spend to reduce pollution and may affect the way millions of Americans live.”

As is always the case, California took the lead by adopting stringent measures for the Los Angeles basin, which by far exceeds all other metropolitan areas in the number of non-compliance smog days (see, for example, “Tough S. California smog plan looms” in *USA Today* of 3/20/89, *Time* of 3/27/89, or NYT of 3/11/90). The virtues and possible defects of such measures quickly attracted national attention, as exemplified in the following two headlines in the NYT of 3/26/89: “Yes to Clean Air, But at What Cost?” and “It’s Expensive, but the Benefits Are Clear”. In June President Bush finally took the initiative: “PRESIDENT URGES STEPS TO TIGHTEN LAW ON CLEAN AIR – BREAK WITH REAGAN ERA – Emphasis Is on Sulfur Dioxide in Acid Rain, Urban Smog and Toxic Chemicals” (front page of the NYT, 6/13/89).

The following NYT editorial of 10/4/89 is typical of media encouragements that followed and of cautious optimism: "Poll after poll has shown that Americans want cleaner air and will pay for it. Year after year, a Congress paralyzed by sloth and industry pressure has refused to grant that wish. On Monday, however, a House subcommittee agreed to stringent new controls on automobile pollution. That agreement doesn't end the legislative struggle. But given the subcommittee's history of strife, it's a giant step forward – and a fine example of political maturity for the rest of Congress." When the bill was finalized, it was widely praised as a reasonable balance between the protection of public health and economic realities, even though many specific provisions and deadlines were left for subsequent negotiations. The adequate "equilibrium point" between these two often conflicting factors is still a hotly debated issue, however.

The greatest burden was placed on the high-sulfur coal industry and on the power plants that burn high-sulfur coal, mostly in the Midwest and the Ohio Valley (see Table 7-3). These power plants are pursuing the following three options to keep the EPA 'happy':

- (a) They can install scrubbers (at a cost of about \$100 million each) which remove up to 90% of the emissions and thus allow them to continue burning high-sulfur coal.
- (b) They can switch to lower-sulfur coal, for example from Wyoming, and pay generally higher transportation costs (see Chapter 7).
- (c) They can purchase pollution allowances (see Investigations 11-15 and 21-6).

At the other extreme, diesel-powered vehicles such as buses were not affected as much. The limits on ozone levels (urban smog) were not as stringent: see, for example, NYT of 8/4/92 ("U.S. Rejects Demands to Tighten Limits on Ozone in Smoggy Cities") and BW of 10/3/94 ("We can fight smog without breaking the bank"). For example, the EPA reported in October 1994 that 43 metropolitan regions remained out of compliance, including the Los Angeles Basin (extreme pollution), San Diego, Chicago, New York, Philadelphia (severe pollution), Washington, D.C. and Atlanta (serious pollution). At the time of this writing, the EPA is getting ready to take further action on these fronts as well. Specifically, two smog-related NAAQS values (Table 11-2) are expected to be tightened; see NYT of 11/25/96 ("E.P.A. Advocating Higher Standards to Clean the Air"), to 80 parts per billion for ozone (instead of the current 120 ppb) and applied to particulate matter with sizes of 2.5 micrometers and below (instead of 10 micrometers and below).

The highly positive effects of the Clean Air Act of 1970 and its amendment of 1977 have already been illustrated (see Chapter 11). Figure 21-8 is another testimony to the great successes of the Clean Air Act legislation. In the face of a 70% increase in coal consumption (see Figure 7-2), the emissions of sulfur oxides have actually decreased. The continued decrease in SO₂ emissions projected under the National Energy Strategy is shown in Figure 21-9. For reasons discussed in Chapter 11, NO_x emissions are more difficult to reduce, as corroborated in Figure 21-8.

Some analysts and industry executives have argued that the costs of cleaning up our air will be enormous. The public polls typically show that citizens are prepared to pay more for energy in exchange for cleaner air. The corresponding bills will undoubtedly be passed on

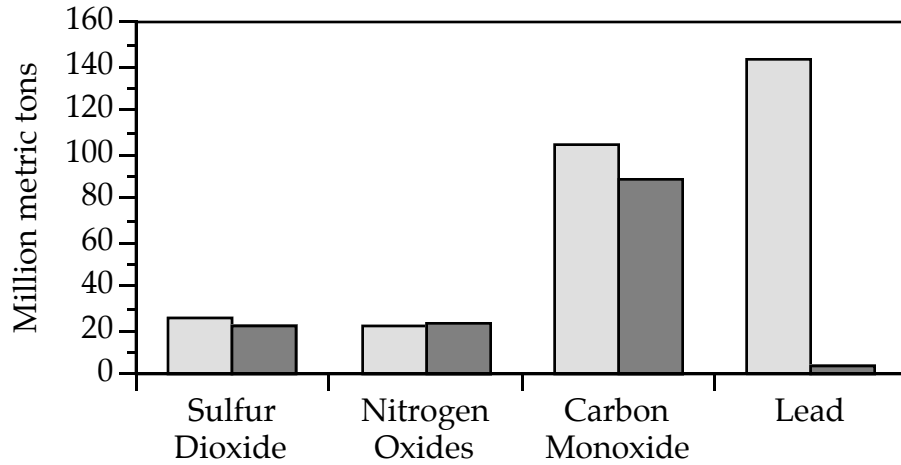


Figure 21-8. Change in emissions of key pollutants since 1970s, as a result of the Clean Air Act. [Source: *Sustainable Energy Strategy*, 1995. See also *Economist*, 3/4/95, p. 26.]

Figure 21-9. Historic trends and projections for sulfur oxides emissions in the U.S. [Source: *National Energy Strategy*, 1991/92.]

to us, the consumers. Welcome, then, to the era of more expensive energy and more complex energy policy options at all levels.

Finally, while the politics of conventional air pollution are a 'nightmare', and the national policies are thus very complex, this is probably "child's play" in comparison with the politics, necessarily international, surrounding the global warming issues and carbon dioxide emissions (see Chapter 11). President Bush preferred a wait-and-see attitude (see NYT of 10/27/89, "Bush Administration Is Divided Over Move to Halt Global Warming") and took some heat for it at the 1992 Earth Summit in Rio de Janeiro (see *Time* of 6/22/92, "Rio's Legacy"). President Clinton has been more active (see BW of 8/16/93, "Hot Air on Global Warming"; NYT of 10/19/93, "Clinton Urging Voluntary Goals on Air Pollution"), but he has not made any concrete steps toward a carbon tax. Instead he has compiled a list of 50 small-scale voluntary initiatives, including incentives to promote public transit and energy efficiency (see *Time* of 11/1/93, "Stop Polluting, Please"). Even the European Union is having second thoughts on this issue, after their initially ambitious pledge to return CO₂ emissions to 1990 levels by the year 2000 (see Investigation 21-7). In any case, it is unlikely that the industrialized nations will be able to accomplish this (see *Economist* of 4/1/95, "Stay cool", and NYT of 4/2/95, "Despite Warning, Limits on Carbon Dioxide Emission Unlikely"). It is safe to predict, therefore, that serious international legislation will be much more difficult to achieve than was the case with the Montreal Protocol of 1987, which led to a speedy international ban on chlorofluorocarbons (see *Scientific American*, December 1994). The case of China provides a convincing argument that this is so. With its vast coal reserves (see Chapter 7), it is expected to experience a fourfold increase in coal consumption by 2050; the resulting increase in CO₂ emissions would wipe out any international effort to stabilize or reduce worldwide greenhouse gases (see NYT editorial of 12/8/93, "China and Global Warming: Its Carbon Emissions Head Toward the Top"). It will take a great deal of international collaboration and negotiation to reverse the well established trend between economic growth and pollution levels in developing nations (see *Economist* of 12/11/93 for examples in Indonesia, the Philippines and Thailand).

But the politicians are definitely under continued pressure, despite the fact that membership in environmental groups is not growing as fast as it did in the 1980s (see Table 21-4). The Intergovernmental Panel on Climate Change, composed of more than a thousand scientists from around the world, has recently concluded that our planet could experience a temperature rise of 1 to 3.5 °C by the year 2100 and that "there is a discernible human influence on global climate." One of the stumbling blocks is illustrated in Table 21-5. How does one rate the polluters? Which emissions are most relevant? Per capita, per dollar of GDP or per something else? Stay tuned to the heated debates in the years ahead...

Sustainable Energy Strategy. During President Clinton's first term in office, the U.S. Department of Energy published a new National Energy Policy Plan under the title "Sustainable Energy Strategy." Its subtitle advocates clean and secure energy for a competitive economy. Not surprisingly, it addresses essentially the same issues that the *National Energy Strategy* addressed. The reader may be convinced by now that our energy

options have been more or less clear for decades; what has not been clear is how to make choices among these options and, more importantly, how to implement them. Energy issues do get a lot of politics, but they could certainly use more policies, and especially sustainable policies.

TABLE 21-4
Recent membership trends in U.S. environmental organizations

Organization	Membership (thousands)		
	1980	1990	1993
Environmental Defense Fund	35	200	250
Greenpeace USA	250	2,500	1,700
National Audubon Society	412	578	542
Nature Conservancy	99	578	708
National Resources Defense Council	29	138	170
Sierra Club	181	622	550
Wilderness Society	50	404	300

[Source: *Economist*, 3/5/94, p. 27; see also NYT of 4/22/90.]

TABLE 21-5
Different bases for comparison of carbon dioxide emissions (1988) around the world.

Country	Total emissions (million metric tons)	Emissions per capita (metric tons/capita)	Emissions per GNP (metric tons/\$1000)
United States	4,804.1	19.4	0.98
Canada	437.8	16.9	1.00
Czechoslovakia	233.6	15.0	1.90
Australia	241.3	14.7	0.98
Ex-Soviet Union	3,982.0	13.9	1.50
Germany*	1,116.0	12.1	-
United Kingdom	559.2	9.9	0.80
South Africa	284.2	8.4	3.60
Japan	989.3	8.1	0.35
France	320.1	5.9	0.34
Mexico	306.9	3.7	1.74
China	2,236.3	2.1	6.01
Brazil	202.4	1.5	0.63
India	600.6	0.7	2.52

[Sources: NYT of 9/11/91, 2/21/95 and 4/11/95. *Data for Germany are from 1990-91.]

Here we briefly summarize President Clinton's energy policies. They are a far cry from his ambitious BTU tax proposal (see below), for which Congress gave him quite a bit of applause, during his January 1993 State-of-the-Union address, but no support at the end of the day. The following five “strategic components” of this sustainable energy policy are perhaps more notable for what they do not contain than for what they do contain:

- increase the efficiency of energy use;
- develop a balanced domestic energy resource portfolio;
- invest in science and technology advances;
- reinvent environmental protection;
- engage the international market.

As far as increased efficiency is concerned, three energy demand areas are mentioned: transportation, buildings and industry.

In the transportation sector, the Administration supports the following measures:

- (a) promote fuel-economy improvements and maintain fuel-economy levels in the face of declining real fuel prices;
- (b) develop markets for nonpetroleum-based alternative fuels, which includes encouraging infrastructure investment and alternative-fuel vehicle technologies;
- (c) increase efficiency in transportation systems to reduce travel demand.

What this means, in more concrete terms, is that the Administration does not support the Bryan bill (see Chapter 20) and prefers to live with the CAFE standard of 28.5 miles per gallon which hasn't changed since 1990; instead, it has embarked on a cooperative program with industry, “Partnership for a New Generation of Vehicles,” whose goal is to produce a prototype 80-mpg vehicle by the year 2004. It also means that by the year 2010 less than 2% of the vehicles (some 2.5 million) are expected to use alternative fuels (natural gas, propane, electricity, methanol or ethanol). Finally, new “effective modes of alternative travel,” which are supposed to reduce demand for vehicle travel, do not include any major initiatives to support mass transit (such as a new high-speed train system).

Regarding energy use in buildings, the current Administration supports the following measures:

- (a) enhance the effectiveness of markets for efficiency investments;
- (b) develop new technologies to improve building efficiency;
- (c) cooperate with State and community programs that encourage building efficiency;
- (d) establish minimum efficiency standards for new buildings and appliances;
- (e) support efficiency investments.

Some of the concrete (and modest?) initiatives under these rather general statements are the following: (1) support of a “Golden Carrot” competition among manufacturers of refrigerators, which resulted in the design and production of refrigerators that are 30 percent more efficient than the current models; (2) requirement that efficiency labels be placed not only on major appliances and other home equipment (see Chapter 18) but also on windows (see Chapter 19); (3) support for natural-gas-powered (GAX) heat pump which is “40 percent more efficient than current technology and is expected to reduce

primary energy use for space heating, space cooling, and water heating in U.S. residences by 0.3 quad by 2020, while reducing emissions of carbon dioxide and other environmental pollutants by more than 40 percent.”

Finally, the Administration's initiatives in the industrial sector involve partnerships with industry in developing new energy-efficient technologies and accelerated deployment of these technologies. One example is the Motor Challenge program which, by the year 2000, is supposed to “save 25 billion kilowatts [sic] per year” and thus “reduce emissions by the equivalent of 6 million metric tons of carbon per year.” The attentive reader will note here (as on p. 6) that too often energy reports (including those by ‘experts’) do not make the crucial distinction between energy and power (see Chapter 2): the electricity savings quoted above should be, of course, in kilowatthours and not in kilowatts (see Review Question 21-1).

The development of a balanced domestic energy resource portfolio includes:

- (a) policies to enhance domestic oil production capability;
- (b) natural gas policies to increase efficient utilization;
- (c) coal policies to reduce environmental impacts;
- (d) electricity policies to promote competition in the national interest;
- (e) renewable energy policies to increase long-term investments; and
- (f) nuclear energy policies to increase safety and preserve options.

The estimates of DOE are that an additional 1 million barrels per day of domestic oil will be available by 2010 as a result of Administration's oil policies. These include supporting drilling in deep waters of the Gulf of Mexico, as well as lifting the ban on the exports of Alaska North Slope oil, but not opening the coveted Arctic National Wildlife Refuge (ANWR) for oil and natural gas development (see Investigation 21-1).

Regarding the enhanced use of natural gas, DOE estimates are more significant: a supply of additional 2 trillion cubic feet per year (10% of current U.S. consumption), by the year 2010, as a result of Administration's policies. These include stimulating markets for natural gas use (such as purchasing natural gas vehicles for Federal fleets and encouraging the use of natural gas for electricity generation), as well as providing additional revenue-neutral and tax incentives.

Continued investments in science and technology will of course be crucial for achieving greater energy efficiency and for bringing renewable energy resources to commercial scale. The Administration is pursuing here a more rapid conversion of important scientific discoveries into market winners.

Reinventing environmental protection means “increasing the flexibility with which [the nation] achieves environmental objectives, without sacrificing accountability or environmental quality.” A good litmus test of what exactly is meant by this statement will be the upcoming EPA's initiatives on curbing urban smog (see Investigation 21-19), which is the next practical ‘frontier’ in environmental protection.

Engaging the international market is a new emphasis in federal policy, which was not as prominent in the *National Energy Strategy*. It is a reflection of the fact that global economy means not only global energy but global environment as well. Growth in energy consumption and air pollution on our planet will increasingly be coming from the rest of the world, as shown in Figure 21-10. So it makes sense for us to “protect U.S. security interests, ensure U.S. economic competitiveness, and create new markets for U.S. exports, while working to limit global environmental damage from international energy development.” The litmus test for the last statement will be a pursuit of some kind of ‘non-voluntary’ agreement on carbon emissions.

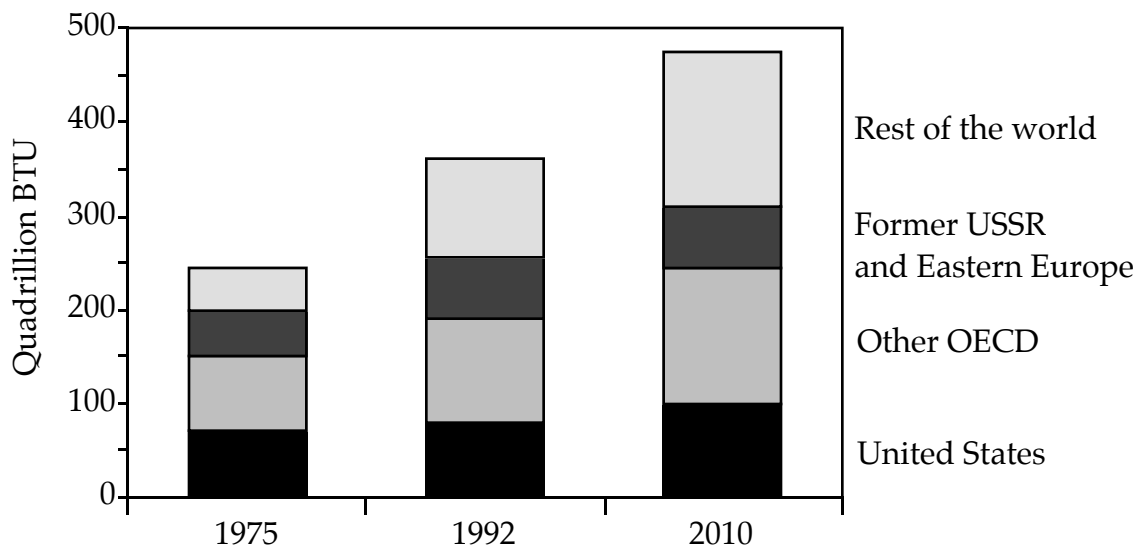


FIGURE 21-10. World primary energy consumption: past, present and future. [Source: *Sustainable Energy Strategy*, 1995.]

Summary. Perhaps the most fitting summary of these complex energy policy issues is that things are more easily said than done. It may not be surprising, therefore, that most energy policies are more often those of reaction than of action. The Investigations at the end of this chapter are meant to be group projects that will explore further some of these issues. It is hoped that in doing them, the readers will get a better sense of whether action is warranted. Or, perhaps, the world should simply sit and wait for the next “energy crisis,” when the politicians will once again be forced to (re)act. And then we’ll see once again the same headlines that we have already read in 1973, 1979 and 1990. Stay tuned! And don’t throw away those old newspaper clippings; they are likely to be recycled...

REVIEW QUESTIONS

21-1. On p. 31 of *Sustainable Energy Strategy* issued by the U.S. Department of Energy (July 1995), the following statement is made: "By the year 2000, the Motor Challenge program will save 25 billion *kilowatts* per year. This will reduce emissions by the equivalent of 6 million metric tons of carbon per year." Show that this should be 25 billion *kilowatthours* by assuming that the number for carbon emissions is correct and that the electricity is produced by burning a bituminous coal (85% C) with a heating value of 15,000 BTU/lb and 35% efficiency.

21-2. In September 1991 the European Commission proposed the following taxes to curb emissions of carbon dioxide: \$10/barrel of oil, and \$14 and \$5 for equivalent amounts of coal and nuclear energy (see NYT, 9/26/91, p. D3). These measures are supposed to result in 60, 40, 30 and 15% increase in the industrial prices of coal, oil, natural gas and electricity, respectively, by the year 2000.

(a) Determine these equivalent amounts.

(b) Explain why energy prices would increase in the order given above (coal most, electricity least). Would the same order apply in the U.S.?

21-3. Under the title "Cheapest Protection of Nature May Lie in Taxes, Not Laws," Peter Passel of the NYT (11/24/92) proposes a \$100 carbon tax. (a) Show that this was equivalent (at the time) to \$60 per ton of coal, \$12.82 per barrel of oil and \$1.60 per cubic foot of natural gas. (b) Update these taxes to today's prices. (c) Compare these taxes to those proposed by the European Commission (see #21-2 above).

21-4. The *Economist* of 2/10/96 reports the following industrial prices for natural gas in pence per kWh (for September 1995): Italy, 2.2; Sweden, 1.9; France, 1.45; Germany 1.4; Spain, 1.35; Belgium, 1.3; Holland, 1.25; Australia, 1.1; United States, 0.75; Canada, 0.7; Great Britain, 0.55. Compare these 'rankings' to those of gasoline (see Figure 20-18). Convert the U.S. price to $\$/10^6$ BTU; compare it with that shown in Figures 9-5 and 19-8.

21-5. Indicate whether the following statements are true or false:

(a) In the period 1985-1995, the rate of growth of electricity consumption in the U.S. has been greater than the rate of growth of the gross domestic product.

(b) Saudi Arabia produces more than twice the amount of oil of any other OPEC nation.

(c) In 1994, Venezuela, Nigeria and Saudi Arabia accounted for more than a third of U.S. oil imports.

(d) In 1980, Saudi Arabia, Nigeria and Venezuela accounted for more than a third of U.S. oil imports.

(e) Nuclear energy is used in Russia to generate more than 20% of its electricity.

(f) United States produces the largest quantity of CO₂ emissions per dollar of GNP.

(g) In absolute terms, the United States produces the largest quantity of CO₂ emissions.

(h) Growth of energy consumption in the U.S. is expected to be larger than in the rest of the world.

INVESTIGATIONS

21-1. To drill or not to drill? This question is not quite as old as Shakespeare's, but it is perhaps more controversial. The Wilderness Society published an advertisement in the NYT of 9/27/95 with a clip-and-send card saying the following: "I support President Clinton's pledge to veto oil and gas drilling in the ANWR. Don't destroy America's last great wilderness." Summarize the arguments against and in favor of exploration in the Arctic National Wildlife Refuge. Would you send this card to the President? To help with your decision, read *Time* of 3/16/87 ("Enjoy Now, Pay Later"); *National Geographic* of 12/88 ("Oil in the Wilderness: An Arctic Dilemma"); NYT of 4/21/87 ("Interior Chief Urges U.S. to Open Arctic Refuge to Oil Exploration"), 5/12/87 ("Hodel Squanders Our Birthright"), 6/14/87 ("The Need to Seek Oil in Alaska's Arctic Refuge"), 9/5/90 ("Political Conflict Is Renewed Over Drilling in Arctic Refuge"), 1/27/91 ("Hickel Wants New Alaska Gold Rush"), 2/22/91 ("Energy Strategy Draws Congressional Criticism"), 3/17/91 ("New Domestic Supply of Oil Is Needed"), 10/27/91 ("The Big Giveaway: Bush insists that a wildlife refuge be sacrificed to oil interests"), 10/31/91 ("Energy Bill Is Stirring Debate on Wildlife Areas"), 5/18/95 ("Save Alaska—Again"), 8/28/95 (editorial), 9/6/95 ("Arctic Refuge Drilling Won't Threaten Wildlife"), 9/20/95 ("House Panel Votes to Allow Oil Drilling in Arctic Refuge"), 11/20/95 ("Open Alaska's Wildlife Refuge"); *The Christian Science Monitor* of 8/23/91 ("Congress Weighs Policy Choices Aimed at More Energy Security"); PI of 10/13/91 ("To drill or not?"), 10/20/91 ("To conserve or drill?"); *USA Today* of 10/31/91 ("Biggest fight will be over Arctic drilling"); WSJ of 10/18/91 ("Senate Panel Opposes Drilling In Arctic Refuge"), 11/4/91 ("Opponents of Drilling in Arctic Refuge Derail Efforts to Enact Energy Policy"), 11/19/91 ("Bush Seeks to Revive Energy Bill as Fight Over Wildlife Refuge Angers Oil Industry"); BW of 12/11/95 ("High Noon on the Alaskan Tundra"); and *Smithsonian* of 3/96 ("The Arctic National Wildlife Refuge: the best of the last wild places").

21-2. Compare the original Clean Air Act proposal (see, for example, "President Urges Steps to Tighten Law on Clean Air" in NYT of 6/13/89 and "Bush Clean Air Plan Called Energy Policy in the Making" in NYT of 9/24/89) with the final bill that President Bush signed on November 15, 1990 (see "Scrubbing the Skies" in *Time* of 4/16/90, "Lawmakers Finally Agree On Acid Rain Regulations" in NYT of 10/22/90, "Lawmakers Reach an Accord On Reduction of Air Pollution" in NYT of 10/23/90, "Ambitious Air Pollution Bill Sent to White House" in NYT of 10/28/90, "The Changing Clean-Air Law" in WSJ of 10/29/90, and "Bush signs clean-air legislation" in PI of 11/16/90). What was strengthened? What was weakened? Consult also some of the editorials on the original proposal (for example, NYT of 8/22/89) and on the final bill (for example, NYT of 8/27/91).

21-3. Find out which of the 96 cities and surrounding areas fall into the categories of extreme, severe and serious urban smog target areas. By when does each group have to comply with new federal standards? How much progress has been made? See NYT of

10/20/92 (“Air Found Cleaner in 41 U.S. Cities”), 11/13/92 (“New York City Air-Quality Measurements Improve”), 11/3/93 (“Environmental Agency Says the Air Is Healthier in Many Big Cities”), 11/16/93 (“States and Government Lag in Meeting Clean Air Law”), 11/19/93 (“Push for Clean Air Aims to Shove 300,000 Out of the Driver's Seat”); *Newsweek* of 8/23/93 (“Winning the War on Smog”); *WSJ* of 10/29/90 (“Pure Plays: Some Will Gain as Others Spend on Clean Air”), 10/16/92 (“In Many Areas, There's Improvement in the Air”), 7/31/95 (“Highflying Scientists Watch Ozone Drift”); *PI* of 10/31/91 (“EPA lists areas with dirtiest air”), 11/3/93 (“Area failed to meet U.S. clean air standards in '92”), and 10/20/94 (“Metro areas improve their air”).

21-4. Despite the fact that it still has the most polluted skies in the nation, Los Angeles is a success story, in terms of its air quality improvements over the last two and a half decades. Document some of these successes. See *Scientific American*, October 1993 (“Clearing the Air in Los Angeles”) and *NYT* of 9/12/96 (“A Back-and-Forth Smog War”).

21-5. Continued reductions in urban smog pollution is complicated by drifts of ozone-producing pollutants from state to state. This in turn complicates the compliance with CAA provisions. Investigate this issue in more detail. What is EPA doing about it? See, for example, *WSJ* of 7/31/95 (“Highflying Scientists Watch Ozone Drift”) and Mobil's advertisement in *NYT* of 9/26/96 (“Air quality: seeing our way clear”).

21-6. Investigate how polluted air (primarily sulfur dioxide emissions, but also smog-causing emissions) has become a commodity that is traded on the futures market at the Chicago Board of Trade. See *NYT* of 10/30/91 (“U.S. Unveils Rules to Limit Acid Rain”), 3/22/92 (“‘Smog Futures’ to Be Traded”), 3/25/92 (“Trying a Market Approach to Smog”), 5/16/92 (“Cleaning Up On Pollution”), 3/18/93 (“Lilco's Emissions Sale Spurs Acid Rain Concerns”), 3/20/93 (“Lung Association Getting A Donation of Cleaner Air: Utility Giving Portion of Its Pollution Rights”), 3/30/93 (“Sold: \$21 Million of Air Pollution”), 3/31/93 (“Carolina Power is Top Buyer”), 4/8/93 (“Economic Scene: Selling pollution rights isn't popular; neither are alternatives”), 6/30/93 (“Companies Agree to Cut Ozone Smog: Program is a test run for pollution credits”), 10/17/93 (Southern California Approves ‘Smog Market’ Plan), 3/30/95 (“Illinois is looking to market forces to help reduce its smog”); *PI* of 10/13/91 (“Market-based regulation: Trying to save Earth and serve capitalism”), and 9/9/93 (“EPA pushes pollution permit plan”).

21-7. Find out what has been decided about global warming at the Earth Summit in Rio de Janeiro in June 1992. Investigate also the more recent developments. What is the U.S. position today? What is the current policy of the European Union? And of Japan? See *NYT* of 2/26/92 (“Taxing Carbon: Taxing Politics”), 6/12/92 (“Pact on Environment Near, But Hurdles on Aid Remain”), 8/13/93 (“From Uncle Smoke to Mr. Clean”), 10/12/93 (“U.S. Prepares to Unveil Blueprint for Reducing Heat-Trapping Gases”), 10/19/93 (“Clinton Urging Voluntary Goals on Air Pollution”), 10/20/93 (“Clinton Addresses Warming of Globe”); *Newsweek* of 6/1/92 (“The Earth Summit: No More Hot Air”); *Time* of 6/1/92 (“Summit to Save the Earth”); *BW* of 7/20/92 (“On global warming, let the coolest heads

prevail”); *The Washington Post* of 10/18/93 (“Clinton Sets Plan to Cut Emissions”); *Economist* of 4/1/95 (“Stay cool” and “Global warming and cooling enthusiasm”), and 4/8/95 (“Climate change: Smoke”).

21-8. In contrast to the 1996 presidential contest, in which energy issues were hardly mentioned, the energy debate was very prominent in the 1992 campaign. Summarize the positions of the principal candidates (Bush/Quayle, Clinton/Gore). See *Newsweek* of 10/19/92 (“Who Would Be Cleaner”); NYT of 8/9/92 (“Environmental Fight in Prime Time”), 9/6/92 (“Ducking the Environment”), 10/5/92 (“Pulling Punches on the Environment”); *Time* of 9/21/92 (“You Still Can’t Have It All”); and WSJ of 9/22/92 (“On Energy Policy, Bush Offers Market Approach While Clinton Favors a More Activist Government”).

21-9. Summarize here the controversial EPA ruling (see #21-10 below) regarding auto emissions testing announced in July 1992. See NYT of 10/20/91 (“Repair Shops Fear the Costs of Proposed Smog Test”), 7/14/92 (“E.P.A. Proposes Strict New Auto Emissions Rules”); *Time* of 7/27/92 (“Just Clearing the Air”).

21-10. The implementation of the provisions of the Clean Air Act is not a straightforward matter. Two widely publicized cases, in Pennsylvania and Texas, are good illustrations. They are related to EPA’s proposals for biennial inspection of vehicles at central testing stations as part of the move toward use of cleaner-burning vehicles. What was the outcome of these initiatives? See the *Economist* of 3/4/95 (“Clean air (1): Where it hurts” and “Clean air (2): You’re in Texas now”); NYT of 2/14/95 (“Texas Collides With the Clean Air Act”); *Harrisburg Sentinel* of 11/16/94 (“Senate overrides emissions veto”), 11/21/94 (“EPA bending on emissions tests”); PI of 9/17/94 (“The scoop on the discussed and cursed emissions test”), 11/15/94 (“House rejects Casey veto of emissions bill”), 11/17/94 (“Casey upset by EPA’s wavering”), 12/1/94 (“EPA prepares to offer PA options for reducing air pollution”), 12/5/94 (“Override of emission veto is criticized”); and *Pittsburgh Post Gazette* of 12/2/94 (“State delay no excuse to duck car emissions test”).

21-11. An alternative to California’s ambitious clean air initiatives (to introduce electric and other alternative-fuel vehicles) is the so called 49-State Approach. Summarize the main ideas in this plan. Who supports it? Who is against it? Compare it with the California plan. See, for example, the NYT of 11/8/91 (“Weicker Drops Out of Regional Clean-Air Program”), 10/22/93 (“A Clean-Air Minuet”), 2/18/95 (“Common Sense Quiz”), and 9/28/95 (“E.P.A. Backs Plan to Allow Cleaner Cars In Most States”).

21-12. A related initiative to that described in #21-11 is that of the 12 Northeastern states, who have asked the EPA to apply the same clean air measures to them as to California. Investigate the outcome and current status of this plan. See, for example, NYT of 11/6/91 (“United Front on Air-Pollution Dissolves Into Finger-Pointing”), 11/8/91 (“Weicker Drops Out of Regional Clean-Air Program”), 7/14/93 (“New York May Proceed With New Emission Rules”), 10/22/93 (“A Clean-Air Minuet”), 8/24/94 (“E.P.A. Seeks Emissions Agreement for Northeast”), 9/14/94 (“E.P.A. Urges Compromise On Auto Pollution

Rules”), 11/21/94 (“Time Is Running Out”); and *USA Today* of 11/11/94 (“EPA misses deadline on electric cars”).

21-13. The Mobil Corporation has been very active in influencing the public debate about the implementation of the motor vehicle part of the 1990 Clean Air Act amendments (see Table 21-3). Summarize the arguments made by Mobil in its series of advertisements entitled “The Hidden Price Tags”. See 1995 NYT of 4/13, 4/20, 4/27, 5/3, 5/10, 5/17, 5/24. With which ones do you agree? With which ones do you not agree?

21-14. Since the 1970s, a higher gasoline tax has been mentioned in the media every time there is an oil crisis. See PI of 11/16/92 (“Clinton should boost gas tax”) and 12/1/92 (“Facts on gas taxes are questioned”); *Economist* of 1/9/93 (“Energy taxes: Coming soon, to a station near you”) and 5/4/96 (“Petropolitics”); NYT of 9/20/90 (“The Second-Best Way to Save Gas”), 10/4/92 (“Raise the Gas Tax to Cut the Deficit”), 10/18/92 (“50-Cents-a-Gallon Tax Could Buy a Whole Lot”), 1/31/93 (“A Tax That Does Double, Triple Duty”), 7/6/93 (“Fear of Gas Tax Where Commuting Time Is Most”), 7/11/93 (“The 7½ Cent Solution: By any measure, a gasoline tax is fair. Really.”), and 9/11/96 (“Gas Tax Could Help Our Cities”); *Time* of 1/23/89 (“Fueling Up a Brawl”); USNWR of 9/10/90 (“What to do about oil?”); BW of 2/8/93 (“Whose Ox Will It Be, Anyway? Nobody wants to be gored, but new gasoline taxes may work best”), and 7/5/93 (“Now, a Gas Tax Seems Like a Drop in the Bucket”). It is a tempting measure to curb air pollution and promote oil conservation. If implemented, the big questions are (a) how high does it need to be to achieve these goals (instead of being simply a revenue-raising measure like a tax on cigarettes), and (b) what to do with the money from the tax. Look up a recent example in Great Britain, reported in *Economist* of 8/12/95 (“Rage on the roads”). It is reported that a 50% rise in fuel costs would reduce car travel by only 6%. Compare Britain's situation with that of the U.S. Who pays more for gasoline? Who pays a higher tax for gasoline?

21-15. At the beginning of his first term, in January 1993, President Clinton proposed a BTU tax. It was not adopted and was eventually diluted into a 4.3-cent-per-gallon gasoline tax. Summarize the essence of the BTU tax and the relevant events in 1993. See NYT of 1/31/93 (“Pondering an Energy Tax That Can't Please All the People”), 2/18/93 (“Fuels Tax: Spreading The Pain”), 2/19/93 (“Industry Gauges Costs Of Clinton Energy Tax”), 2/21/93 (“So What's a B.T.U.?”), 3/4/93 (“A B.T.U. tax would do the job, but there are still problems”), 4/11/93 (“A Nearly Useless Energy Tax”), 5/13/93 (“Why the energy tax has turned into a political hard sell”), 6/2/93 (“Congress's Twists and Turns Reshape Bill on Energy Tax”), 6/9/93 (“Clinton Backs Off Plan For New Tax On Heat In Fuels”), 7/12/93 (“Moynihan Predicts a Deal on a Bigger Energy Tax”), 7/30/93 (“Crux of Debate on Energy Tax: \$1.18 a Month”); *Economist* of 1/9/93 (“Energy Taxes: Coming soon, to a station near you”), 6/12/93 (“Sapping the Energy Tax: The neutering of Bill Clinton's energy tax would be a huge opportunity missed”), 7/17/93 (“An American energy tax”); *Time* of 6/21/93 (“The White House: I Hear You, I Hear You,” p. 22).

21-16. When the gasoline tax of 4.3 cents per gallon was adopted by Congress in 1993, quite a few people considered it a big deal. For an interesting view on this puzzling reaction, see *Time* of 7/26/93 (“A Tax Increase You Can Avoid”). What’s your view?

21-17. In a 9/24/90 NYT article (“Proposals for a U.S. Energy Policy: Some Possible, Most Not”), Matthew Wald has summarized ten possible proposals for a national energy policy. Find out what they are and analyze their pros and cons. Have there been any new proposals since then? See NYT of 9/10/90 (“Either Force Oil Prices Down... Or Tax Excess Profits”), 9/13/90 (“Energy Proposals Proliferate as Oil Prices Rise”), 1/5/91 (“Going Easy on Energy”), 2/17/91 (“Why America Still Hates the Words ‘Energy Policy’”), 5/12/91 (“Unlock American Energy Policy”); *Time* of 9/17/90 (“A post-crisis national agenda”); *Economist* of 1/26/91 (“Battling for an oil policy”); BW of 9/16/91 (“Conservation Power”); and *USA Today* of 10/17/91 (“How can USA fill growing energy needs?”).

21-18. Another hot political issue in the implementation of 1990 CAA amendments is the role of ethanol (grain-based alcohol) as an alternative fuel. Find out what the key issues in this debate are. Why is Archer Daniels Midland Co. often mentioned? See *Solar Today* of March/April 1991 (“Fueling the Future”); *Popular Science* of 7/92 (“The Alternate Fuel Follies”); NYT of 8/28/90 (“Alternatives to Oil Move From the Lab to the Road”), 10/2/92 (“Bush Offers Plan for Wider Use of Ethanol in Fuel”), 8/2/94 (“In valuing Archer Daniels, analysts look past ethanol”), 9/15/94 (“Court Delays New Ethanol Rule”), 2/28/95 (“Ford Planning Ethanol Car”), 1/25/96 (“Archer Daniels Plans Ethanol Expansion”), 9/9/96 (“Support Ethanol”), 10/16/96 (“What A.D.M. Ads Didn't Tell”), and 10/22/96 (“Ethanol Program Saves Taxpayers' Money”). See also the *Economist* of 7/16/94 (“Ethanol: The magic juice”) and <http://www.ethanolRFA.org>. Finally, see the following Mobil advertisements: “Fueling a debate” in *Time* of 9/21/92, “Environment or politics?” in *USA Today* of 12/9/93, “Adding (more) voices” in *Time* of 5/30/94, “A matter of opinion” in NYT of 7/28/94; summarize Mobil’s arguments against the use of ethanol in gasoline. For a response to Mobil’s ads, see NYT of 10/1/94 (“The Real Reason Mobil Opposes Ethanol Rules”).

21-19. We shall soon see new EPA action on urban smog. The cost versus benefit issues are particularly complex here (see, for example, *Science*, Vol. 252, p. 522). Find out about some of the recent initiatives. See NYT of 3/29/89 (“Getting Serious About Smog At Last”), 3/30/89 (“On Air Pollution Some See Warning From Afar”), 4/3/89 (“How Much Is Too Much to Pay To Meet Standards for Smog?”), 8/4/92 (“U.S. Rejects Demands to Tighten Limits on Ozone in Smoggy Cities”), 8/5/92 (“States With Acute Smog Problem Sign Ozone Pact”), 7/19/93 (“Studies Say Soot Kills Up to 60,000 in U.S. Each Year”), 11/14/93 (“Officials Try Many Routes to Goal of Cleaner Air”), 11/25/96 (“EPA Advocating Higher Standards To Clean the Air. Industry Warns of Costs”), 12/1/96 (“Stricter Air Rules Could Place Focus on the Midwest”); *Reason* of June 1992 (“The Environment: Insufficient data”); BW of 10/3/94 (“We can fight smog without breaking the

bank”); and *USA Today* of 11/29/96 (EPA toughens ozone standards”). See also Mobil's advertisement in NYT of 1/30/97 (“Why change what's working?”).

21-20. The cost versus benefit issues of global warming are even more complex. Get a general sense of the arguments used on both sides by referring to the following articles: *Solar Today*, March/April 1991, p. 34; *Chem. & Eng. News* of 4/1/91, p. 7; *Economist* of 7/7/90, p. 21. For a more general perspective on the relationship between the economy and the environment, see NYT of 9/25/92 (“Bush's Nonsense on Jobs and the Environment”).

21-21. Find out about the politics and economics of air pollution control in Japan. Summarize some of the most important statistical information to support the statement that Japanese pollution controls “are the toughest in the world” (*Economist* of 9/19/92). See also the *NYT Magazine* of 10/4/92 (“Japan's Choice: Scour Technology's Stain With Technology”); PI of 10/24/90 (“Japan plans war on global warming”); NYT of 7/19/92 (“Japan Confronts Global Warming”); and Mobil's ad in *Time* of 7/20/92 (“California dreaming?”).

21-22. The California Air Resources Board (CARB) has been called “California's Pied Piper of Clean Air” because “[a]nything in this country with a tailpipe, smokestack or vent is likely to be regulated eventually with rules first worked out by CARB” (NYT of 9/13/92). Summarize the history of CARB and some of its important clean air initiatives. Visit its Web site at www.arb.ca.gov.

21-23. Some years ago, the National Academy of Sciences issued what has been called a “cautious report” on global warming (*The Washington Post* of 9/22/91) and suggested that a number of “effective but inexpensive” measures be taken to reduce greenhouse gas emissions. Summarize these measures. See also NYT of 4/11/91 (“Urgent Steps Urged on Warming Threat”) and 9/18/91 (“Warmer Globe, Greener Pastures?”). Has any one of these measures been adopted by now?

21-24. Summarize the arguments used by Mobil against reformulated (oxygenated) gasoline. See “Cows, bulls, and clean air” in NYT of 12/13/90, “When the goal is clean air” in NYT of 2/18/93, “Coming soon: The alternative fuel of the future” in NYT of 3/25/94, and “When is a deal, a deal?” in NYT of 10/22/94. See also the arguments of Representative H. Waxman (Letter to the Editor, NYT of 2/6/91, “Everyone but Oil Companies Is for Cleaner Gas”) in favor of reformulated gasoline.

21-25. In a series of eleven advertisements with the title “Clearing the air,” Mobil has argued for cost-effective approaches to curbing motor vehicle pollution, as mandated by the 1990 Clean Air Act amendments. By and large, these advertisements oppose subsidies while defending the status quo, that is, gasoline-powered vehicles. Summarize these arguments. Which ones do you agree with? Which ones appear to be self-serving? See the NYT of 10/27/94 and almost every subsequent week until 1/27/95.

21-26. In September 1990 the EPA said that the 1990 Clean Air Act amendments would provide a bonus benefit: they would reduce the nation's dependence on foreign oil by up to

million barrels per day. (See NYT and PI of 9/14/90.) Compare the oil imports of 1990 with the most recent data available (<http://www.eia.doe.gov>) and find out whether this has happened (yet). See also Figure 20-5.

21-27. The U.S. has imposed a ‘counter-embargo’ on Iranian oil. Until 1995, U.S. companies were allowed to buy oil from Iran but not to resell it in the United States. Find out about the status and some of the ‘loopholes’ in the implementation of this embargo. See NYT of 7/16/93 (“The U.S.–Iran Oil Scam”), 3/7/95 (“Conoco Signs Contract With Iran To Develop Persian Gulf Oilfield”), 3/14/95 (“Conoco’s Deal In Iran Faces Board Hurdle” and “Plugging the Leak: The great Iranian loophole”), 3/17/95 (“Conoco Told U.S. Years Ago of Oil Negotiations With Iran”), 6/21/95 (“Teheran Finds Other Buyers For Oil After U.S. Sales End”); *Economist* of 3/18/95 (“Foreign fields”), 5/6/95 (“Oil: A very crude form of politics”); BW of 2/13/95 (“Loopholes: How Big Oil Defies the Great Satan”), and 3/27/95 (“Why Didn’t Conoco See This One Coming? Washington’s signals on Iran may have been too subtle”).

21-28. A similar U.S. embargo has been imposed on Libyan oil. Find out more about it. See NYT of 3/28/95 (“World Ban On Libyan Oil Sought by U.S.”) and 3/29/95 (“Imposing Ban on Libyan Oil No Easy Task, Analysts Say: Libya’s European customers are unlikely to follow Washington’s lead”).

21-29. The United Nations have had an embargo of their own against Iraq’s oil. Find out more about it. See the *Economist* of 7/10/93 (“Iraqi Oil: In the pipeline”), 3/11/95 (“A bonus for Saddam? Western oil firms are itching to get their hands on Iraq’s huge reserves—but not at the cost of tumbling oil prices”), NYT of 1/25/96 (“New Flexibility By Iraq on Oil Worries Market”), 2/21/96 (“Crude Oil Prices Rise Sharply On Lack of Agreement With Iraq”), 11/26/96 (“Iraq and U.N. Make Deal on Oil Sales for Aid”).

21-30. It was seen in this chapter that Saudi Arabia is the key ‘strategic’ nation for the oil-thirsty industrialized nations. Why is it often said that it would be disastrous if Islamic fundamentalism took hold of Saudi Arabia? See *Time* of 9/3/90 (“Why Are We in Saudi Arabia?”); *Economist* of 3/18/95 (“The cracks in the kingdom: There are reasons for alarm about the world’s biggest oil producer, which is economically enfeebled, politically decrepit and beset by Islamic dissent”), 11/18/95 (“Chairman Fahd: It is hard to be boss of Saudi Arabia Inc, even if you’re king”); WSJ of 1/15/96 (“Five Years On, the Persian Gulf Still Simmers”); NYT of 11/4/94 (“Saudi Arabia, Its Purse Thinner, Learns How to Say ‘No’ to U.S.”), 1/30/96 (“Odds of Another Oil Crisis: Saudi Stability Plays a Large Role”), 12/1/96 (“U.S. Takes Hard Look at Saudis With Bombing and Shah in Mind”).

21-31. Energy showed up on the balance sheet among the major accomplishment of the 102nd Congress. Summarize these accomplishments. See NYT of 2/20/92 (“Senate Votes Energy Bill Without Allowing Arctic Drilling”), 2/24/92 (“Modest Goals for an Energy Bill”), 10/2/92 (“Energy Bill Cleared for Final Votes”), 10/6/92 (“House Approves Energy legislation”), 10/9/92 (“Energy Bill Is No Panacea”), 10/11/92 (“The Gridlock Congress

Exits in Embarrassment”); and *USA Today* of 10/31/91 (“Little common ground found on energy bill”) and 10/26/92.

21-32. Whether or not OPEC will be “in the driver's seat” again and whether it will “get its act together” some time soon is a \$64,000 question that many Wall Street analysts are struggling with. Find out about some of the recent issues. Has OPEC's share of the world market increased or decreased since the 1970s? See BW of 12/13/93 (“It May Be a Cold Winter for Oil Prices: OPEC squabbling means cheap oil—and big trouble for independents”), 6/3/96 (“OPEC's Joyride Was Great While It Lasted”); NYT of 1/22/89 (“Get Ready for Longer Gasoline Lines: A ‘super OPEC’ that will control world oil prices may soon arise”), 1/25/89 (“There's No Energy Crisis Brewing”), 11/25/90 (“A Saudi Explanation of Oil Pricing”), 3/20/91 (“Cheap Oil, Expensive Cartel”), 10/17/93 (“OPEC Sits Atop Shaky Barrels”); PI of 11/3/93 (“OPEC, GOPEC or SCHMOPEC, the good news is oil will stay cheap”); *Economist* of 4/2/94 (“Oil rolls over”) and 3/16/96 (“Saddam's last laugh?”); WSJ of 1/10/96 (“OPEC Faces a New Threat to Its Power”).

21-33. As much as the industrialized world is hooked on Middle East oil, the oil-exporting countries in the Middle East are hooked, to a greater or lesser degree, on revenues from oil. Find out about the fuel exports of these countries, and how these have changed since the oil crises of the 1970s. See the *Economist* of 11/18/95 (“Oil Dependence”).

21-34. An imported oil tax is another one of those proposals that are made every now and then, especially when oil prices are low. Summarize the pros and cons of such a measure. See NYT of 1/22/89 (“It's Time to Put a Tax on Imported Oil”).

21-35. The Strategic Petroleum Reserve (see Investigation 8-13) is supposed to be tapped in the case of major oil disruptions. However, there have been pressures (and successful ones at that) to use it as a price-fixing tool. Find out about some of the recent such episodes. See NYT of 9/18/90 (“Pressure Is Mounting to Tap U.S. Oil Stockpile”), 9/27/90 (U.S. Plans Sale of Reserve's Oil to Lower Prices”), 10/11/90 (11 Buyers are Selected in Reserve Oil Auction”), 4/30/96 (“President Decides to Have U.S. Sell Oil From Reserves”); WSJ of 9/5/90 (“No Panacea: U.S. Strategic Petroleum Reserve Has Plenty of Oil, but Tapping It Could Be a Challenge”); USNWR of 9/10/90 (“Should the U.S. tap its oil reserve?”).

21-36. How dependent is Japan on imported oil? See WSJ of 9/10/90 (“Oil Security: Japan Pushed Industry to Save Fuel, Diversify to Other Energy Sources to Raise Efficiency”). Comment on the following text of a recent Doonesbury cartoon: “(1) Sold! Despoiling rights to the Arctic Wildlife Refuge go to Mr. Jim Andrews of Universal Petroleum. (2) Thanks for contributing to America's energy security, Mr. Andrews! (3) Actually, we'll be sending the oil to its natural market, Japan. It's a lot cheaper to ship it to Asia. (4) Oh! (5) Well, I'm sure a grateful Japan salutes you, sir! (6) Yeah, I feel good about that.”

21-37. A simplistic calculation suggests that if a barrel of oil goes up by a dollar, gasoline should go up by at least 2.5 cents per gallon. The economic reality is much more complex than that, of course. Find out more about the relationship between the increase in crude oil

prices and prices of gasoline, jet fuel and heating oil. See NYT of 11/4/90 (“Why Some Oil Prices Rise While Others Rise Faster”). Retrieve the relevant historical data from the DOE web site (<http://www.eia.doe.gov>) or from this textbook, and prepare additional graphs to illustrate your findings.

21-38. Western Europe is as starved for energy as the United States or Japan. With the exception of France, which relies heavily on nuclear energy (see Chapter 13), most European countries place high hopes on natural gas from the former Soviet Union. Find out more about these prospects. See WSJ of 10/27/92 (“Disruptions in Flow of Natural Gas From Russia Give Europe Jitters”) and BW of 11/28/94 (“A Russian gas giant may get some foreign fuel”).

21-39. It is no surprise that the politics surrounding the energy bill of 1992 was mind-boggling. Get some of its flavor by reading *USA Today* of 10/31/91 (“Senate’s energy bill is a much-needed start” and “Stop this flawed energy bill”). Summarize some of the main controversies. See also NYT of 11/18/91 (“No Energy Bill This Year? Good.”), 2/20/92, 2/24/92, 10/2/92, 10/6/92, 10/9/92, and 10/11/92 (see Investigation 21-31). See also the PBS Frontline special movie entitled “Politics of Power.”

21-40. China’s use of vast domestic coal reserves to fuel its rapid economic development may make meaningless much of the industrialized world’s efforts to limit carbon dioxide emissions. Summarize the main points in a NYT article entitled “China’s Inevitable Dilemma: Coal Harms the Environment but Equals Growth” (11/29/95). Hazel O’Leary, President Clinton’s first Energy Secretary, took some heat for extensive travel to China, and other places. What did she (seek to) accomplish in China? See NYT of 2/21/95 (“For U.S. Energy Industry, Big Barriers in China”).

21-41. Compromises between need (for imported oil) and ideology (condemnation of non-democratic regimes) have to be made quite often. This was most recently the case in Nigeria, when Shell took some heat for its oil business there. Find out what the issues were (are). See NYT of 11/17/95 (“The Oil Weapon: How to punish Nigeria—and Shell”), 12/3/95 (“Shell Game in Nigeria”), 2/13/96 (“Nigeria’s Deadly Oil War: Beleaguered Shell Defends Its Record”); *Economist* of 12/2/95 (“Multinationals and their morals: It is not only Shell’s judgment that is on trial in Nigeria”).

21-42. The following table shows oil prices that are typically quoted in the newspapers:

CRUDE GRADES, \$/barrel	Monday	Year ago
European spot or free market prices:		
Arabian light	18.56	15.00
Arabian heavy	17.71	14.30
Iranian light	19.25	16.05
Brent	19.66	16.15
Domestic spot market:		
Texas intermediate	20.48	17.40

West Texas sour	19.62	16.65
North Slope (delivered US Gulf)	19.28	16.15
REFINED PRODUCTS, \$/gallon		
Fuel oil No. 2	0.6227	0.4185
Diesel fuel 0.05 S	0.6202	0.4845
Gasoline unleaded premium (nonoxygenated)	0.6133	0.5380
Gasoline unleaded premium (oxygenated)	0.6623	0.5655

[Source: *The Wall Street Journal*, January 9, 1996.]

Find updated prices for these same crude oils and refined products and comment on the trends with respect to 1/9/96. Why is a ‘heavy’ oil less expensive than a ‘light’ oil? Why is the West Texas ‘sour’ oil cheaper? Where does Brent oil come from? Where does the North Slope oil come from and why is it quoted as delivered to a port in the Gulf of Mexico? What does it mean that the gasoline is ‘oxygenated’ and why is oxygenated gasoline more expensive?

21-43. The NYT of 11/20/96 (“U.S. Trade Deficit Rises, Particularly With China”) reports that the U.S. trade deficit with Mexico was 1.68 billion dollars for the month of September. How much of it can be attributed to crude oil imports? See Figures 20-3 and 21-5.

21-44. The clout of energy-related companies is illustrated by their ‘rankings’. Among the world’s largest industrial companies are five automobile manufacturers and four oil companies. Which ones are they? See the *Economist* of 8/6/94 (p. 83). Among the world’s largest companies, the competition is tougher. Only three oil companies make it to the top ten, among the banks and telecommunication conglomerates. Which ones are they? (Find the relevant information in the *Economist*.)

21-45. Political and environmental considerations aside, the choice between coal-fired and nuclear power plants often boils down to dollars and cents. For one comparison of trends (in terms of operating costs in cents per kWh), see NYT of 4/14/92 (“Cheap and Abundant Power May Shut Some Nuclear Plants”). Summarize the most important arguments in this dilemma for many electric utilities.

21-46. A cartoon in the April 1991 issue of *Scientific American* (p. 23) ‘explains’ the \$1,001.39 sticker price for unleaded gasoline as follows: “The gas is only \$1.39. The aircraft carrier is \$470, the tank is \$125, the Stealth fighter is \$330, the gas mask is \$45 and the gun adds a \$30 a gallon.” What’s the (serious) point of this cartoon? See also the article by H.M. Hubbard, “The Real Cost of Energy” in the same issue. What does the author advocate?

21-47. In an interview with Matthew Wald (NYT of 1/20/97, “Energy Secretary Says Power Is Underpriced”), the outgoing Energy Secretary Hazel O’Leary reflected on U.S. dependence on foreign oil and on the need for conservation. Summarize her main arguments as she is replaced in the second Clinton Administration by ???. (Check the Web

site of the Department of Energy, www.doe.gov, to find out who the new Energy Secretary is.)

21-48. Not surprisingly, Mobil is not only against ethanol-based transportation fuels (see Investigation 21-18) or reformulated gasoline (see Investigation 21-24). It is also against methanol-based transportation fuels. Summarize the arguments that Mobil uses to defend its position and comment on them. See its 1989 advertisements in *Time*, “Methanol: Panacea with problems” and “More problems with methanol,” as well as *Time* of 4/20/92 (“Making sense out of nonsense”).