A Comparison of the Incentives Used to Stimulate Energy Production in Japan, France, West Germany, and the United States

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A COMPARISON OF THE INCENTIVES USED
TO STIMULATE ENERGY PRODUCTION IN
JAPAN, FRANCE, WEST GERMANY, AND THE
UNITED STATES

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This volume compares energy production incentives in four countries: France, West Germany, Japan, and the United States. Research on French incentives was conducted by C. Massetti of the Battelle Geneva Research Centres, Geneva, Switzerland. Investigation of incentives in West Germany was carried out by S. van Buiren and G. Purper of the Battelle-Institut e.V., Frankfurt, West Germany. The Japanese incentive research was conducted by a team at the Mitsubishi Research Institution in Japan, including O. Ozeki, K. Fjuii, T. Imaoka, M. Ishida, K. Kinoshita, S. Nakamori, O. Nakayama, Y. Sato, Y. Yanase, and R. Yokoyama. The research reports prepared by our three non-U.S. research teams are available on request to R. J. Cole; references to these volumes are provided in the Appendix. The United States incentives volumes were prepared by three teams of researchers led by B. W. Cone at Pacific Northwest Laboratory, with contributions from the Battelle Human Affairs Research Centers directed by R. J. Cole, and inputs from Battelle Columbus Laboratories led by W. J. Sheppard.

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I. EXECUTIVE SUMMARY

In this chapter we summarize the conclusions of each of our three non-U.S. incentives volumes,⁽¹⁾ and the conclusions of the comparisons volume which looks at incentives in four countries including the United States.⁽²⁾ Summaries of the patterns of incentive actions in France, West Germany, and Japan are presented first, followed by a summary of the four-country comparisons volume itself. The final section of this chapter contains suggestions for solar policy which are based on our comparison of incentive actions in the four countries.

The definitions and methods used in each of the single-country studies are explained in detail in those volumes. Here we offer the following brief explanation of the procedures. Each volume was divided into three parts: a survey of current thought about incentives for solar energy production; a view of the energy incentive landscape for one particular year; and an analysis of the major energy forms (nuclear, hydro, coal, electricity, oil, and gas) along the path from exploration to waste management, including the costs of incentives at each step in constant national currency.

Following the theoretical approach developed for studying U.S. energy incentives, the researchers in each country classified incentives into the following six categories: (1) Taxation, including exemption from or reduction of existing taxes; (2) Disbursements, in which the national government distributes money without requiring anything in return; (3) Requirements, including demands made by the government, backed by civil or criminal sanctions; (4) Traditional Services, including those almost always provided exclusively by a governmental entity; (5) Nontraditional Services, including those sometimes performed by non-governmental entities, as well as governmental entities (e.g., research and development); and (6) Market Activities, including government involvement in the market under conditions similar to those faced by non-governmental producers or consumers.

FOREIGN INCENTIVES SUMMARY

France

In France, three conditions are important to keep in mind in interpreting the pattern of incentives given to energy production:

- the great share of imports in French energy supplies
- state ownership of underground resources and
- state ownership of equity in the major energy companies, and state operated energy producing entities.

Imports accounted for 32% of French energy supplies in 1949, and this share has grown to about 75% at present. Two governmental entities provide funds for energy production activities: the Caisse nationale de l'energie (CNE), and the Fonds de developpement economique et social (FDES). The CNE provides funds to public companies to carry out their investment programs, and manages security offerings of public companies. The FDES gives specific approval to investments suggested by such public companies as Electricite de France, the national electric generation utility, and Gaz de France, the national gas and electricity service company.

A total of \$24.8 billion was spent for energy production incentives in France (see Tables 1 and 2). About 48% of these incentives went to nuclear power. These funds consisted of research and development funds, loans, and assistance in uranium prospecting. A substantial nuclear power industry exists in France with production of over 37,000 gigawatt hours in 1979.

Hydroelectric power has received incentives totaling about \$1.4 billion. These funds were used for the construction of publicly owned hydroelectric facilities and for regulation of the power producing entities. Much of the incentive funding was in the form of loans and direct subsidies to the operating entities.

Coal received incentives of slightly over \$6 billion, about 25% of the total incentive spending in France. The coal companies are nationalized in France; hence, most of these funds are for the operation of the public companies. These companies operated at a loss and required

TABLE 1. Cumulative Total Incentive Expenditures
(1950-1976)^(a) in Millions of 1976 Dollars

	France	Germany	Japan	United States	Total
Nuclear	11,864	7,389	5,862	15,297	39,810
Hydroelectric	1,456	19	14,757	14,020	30,252
Coal	6,088	39,142	9,287	8,112	62,629
Oil	2,367	1,219	535	83,570	100,553
Natural Gas	747	3,268	2,409	14,310	20,734
Electricity	2,265	2,052	752	51,760	56,829
TOTAL	24,787	53,089	33,807	187,070	298,753
Total Incentives Per Quad Produced ^(b)	16,307	11,320	17,874	3,304	
Total Incentives Per Capita (1976) ^(c)	477	871	300	870	
Total Incentives ^(d) Per Dollar of 1976 GDP	0.08	0.12	0.06	0.11	

(a) Data on incentives spending begin in different years in each country. 1950 is the approximate date for all four countries.

(b) Calculated by dividing cumulative total incentive expenditures by cumulative total domestic energy production in quads for 1950-1976. See Appendix A for discussion of energy production and consumption of each country.

(c) Calculated by dividing incentive total by 1976 population for each country - See Appendix B for further discussion.

(d) Calculated by dividing incentive total by 1976 gross domestic product for each country. See Appendix B for further discussion.

TABLE 2. Incentive Expenditures by Energy Form as Percent of Cumulative Total Incentives, 1950-1976^(a)

	France	Germany	Japan	United States	Average ^(b)
Nuclear	47.86	13.92	17.5	8.18	21.87
Hydroelectric	5.88	0.04	43.9	7.49	14.33
Coal	24.56	73.73	27.6	4.34	32.56
Oil	9.55	2.30	1.6	44.67	14.53
Natural Gas	3.01	6.15	7.2	7.65	6.00
Electricity	9.14	3.86	2.24	27.67	10.73
Total	100.00	100.00	100.00	100.00	100.00

(a) Data on incentives spending begin in different years in each country. 1950 is the approximate date for all four countries.

(b) Average is the sum of the rows divided by 4.

subsidy from the state. Funds were also provided for research and development.

Oil received over \$2 billion in incentives, about 10% of the total incentive spending in France. These funds were for research and development, exploration, and construction of ports to facilitate oil imports. The objectives of French oil policies have been to develop whatever domestic resources are available, and to control energy supplies located outside of France.

Natural gas received only \$747 million in incentives, just 3% of the total incentive spending. France has quite limited gas resources, limiting the ability of the state to stimulate gas production. The French state has provided incentives in the form of capital grants and loans to the national gas distribution utility, Gaz de France.

The electricity sector received incentives of almost 2.3 billion, about 9% of the total incentives. The electric power sector was nationalized in France after World War II. The national electric utility, Electricite de France, receives incentives in the form of disbursements to facilitate rural electrification, state guarantees for loans to the national utility, research and development funds, and low-interest loans from the FDES.

The distribution of French energy incentives by incentive type across all energy forms (see Tables 3 and 4) reveals a heavy concentration of incentive funds in the disbursements category (72.0%), with a secondary emphasis on market activities (24.8%). Nontraditional services,

TABLE 3. Cumulative Incentive Expenditures (1950-1976) by Incentive Type in Millions of 1976 Dollars^(a)

	France	Germany	Japan	United States	Total
Taxation	(b)	9,095	341	93,610	103,046
Disbursements	17,936	35,795	5,105	930	59,766
Requirements	(b)	(b)	1,153	31,520	32,673
Traditional Services	95	(b)	229	7,880	8,204
Nontraditional Services	614	7,613	4,083	16,327	28,637
Market Activity	6,142	586	22,897	36,810	66,427
Total	24,787	53,089	33,807	187,070	298,753
Average ^(c)	6,197	13,272	5,635	31,178	49,792

(a) Data on incentives spending begin in different years in each country. 1950 is the approximate date for all four countries.

(b) Not quantified in source.

(c) Average is the sum of the columns divided by the number of elements that are quantified.

TABLE 4. Incentive Expenditures by Incentive Type, as Percent of Cumulative Total Incentives, 1950-1976^(a)

	France	Germany	Japan	United States	Average ^(c)
Taxation	(b)	17.13	1.0	50.04	23.19
Disbursements	72.3	67.42	15.1	.50	38.83
Requirements	(b)	(b)	3.4	16.85	10.13
Traditional Services	0.4	(b)	.7	4.21	1.77
Nontraditional Services	2.5	14.34	12.1	8.72	9.42
Market Activity	24.8	1.1	67.7	19.67	28.32
Total	100.00	100.00	100.00	100.00	

(a) Data on incentives spending begin in different years in each country. 1950 is the approximate date for all four countries.

(b) Not quantified in source.

(c) Average is the sum of each row divided by the number of elements.

especially research and development, have been provided, accounting for 2.5% of incentive spending, and traditional services account for just 0.4% of the incentive spending.

From 1975 to 1979, the French government had been giving incentives specifically for solar energy. Starting in 1975, 91% of these incentives were for research and development, while this proportion falls to 67% by 1979. Subsidies and demonstration projects accounted for just 9% of the solar budget in 1975, but this category has grown to about 33% of the budget as of 1979. A variety of technologies has received incentives, including solar thermal power stations, photovoltaic cells, water and space heating technologies, and biomass technologies. A special subsidy is offered for solar water heating applications starting in 1979.

West Germany

In Germany, a total of over \$53 billion has been spent on energy production incentives. Nearly \$7.4 billion of these incentives were for nuclear power, just under 14% of the total incentive spending (see Tables 1 and 2). These funds were used for basic and applied nuclear research, uranium prospecting and other fuel cycle activities, construction of prototype and demonstration plants, reactor safety research, provision of liability insurance, and public information campaigns attempting to increase public acceptability of nuclear power. The goal was a German nuclear power technology which can compete economically with fossil fuels, and a technology which can be exported.

Hydroelectric incentives accounted for barely 0.04% of German energy incentives, due to a paucity of suitable hydroelectric resources. In the state of Bavaria, hydropower accounts for 10% of electricity generation. In the other German states, much smaller proportions of power production are due to hydroelectric facilities. The \$19 million in total hydroelectric incentives were provided through a variety of tax relief schemes.

Coal received a total of over \$39 billion in incentives, nearly 74% of the total incentive spending in Germany. The coal incentives are designed to encourage productivity in the industry, to provide research and development for the industry, and to improve transportation systems. Recently, coal gasification and liquefaction have received increased emphasis in the research and development budget. Despite these incentives, the coal sector has shrunk in terms of the percentage of contribution to total energy consumption in Germany from about 78% in 1950 to just 29% in 1975. A major concern of the coal incentive program has been the orderly management of the decline of the industry.

Oil has received only about \$1.2 billion in incentives, just 2.3% of total incentive spending in Germany. This level of incentives reflects the fact that Germany has very few domestic oil resources, and is very dependent on oil imports to keep the economy going. The incentive funds have been used for research and development on prospecting and oil recovery technologies, for exploration and production, and for refining

and safeguarding energy supplies. The incentives have taken the form of disbursements, requirements, and nontraditional services.

Natural gas received somewhat more incentive funds than oil, about \$3.3 billion or about 6% of total energy incentive funds. Only very small quantities of natural gas had been discovered in Germany until the mid-1960s, after which North Sea gas discoveries have resulted in an increased share of gas in total primary energy consumption. Incentives offered to the sector include research and development on exploration and recovery methods, subsidies to promote exploration and recovery, and granting of monopoly rights to gas pipeline companies.

Incentives to the electric power sector in Germany amounted to over \$2 billion, about 4% of total incentive expenditures. Both district heating and electric power production incentives are included in these figures, since the same entities provide both types of outputs. Requirement incentives to the industry include price controls. Market activity incentives include government equity positions in the electric power companies. In addition, certain tax privileges are granted to the electric utilities. Nontraditional services, including research and development on district heating technologies, have been important incentives to the industry as well. Research and development on district heating have been funded only since 1974.

Looking at the distribution of incentive expenditures in Germany by incentive type across all energy forms (see Tables 3 and 4), the largest incentive type is disbursements, with over 67% of total incentive funds. Taxation accounts for 17% of the incentives, while nontraditional services constitute a bit over 14%. Market activity incentives constitute a very small proportion of the total, with just over 1% of incentive funds. While both requirement and traditional service incentives are offered to the energy industries in Germany, it was not possible to quantify the incentives of these types.

As in France, the German government is beginning to develop programs for encouraging solar power applications, and incentives are included in these programs. Beginning in 1974, research and development funds were allocated for solar technologies, amounting to 49 million German marks

over the period 1974 to 1977. Subsidies have been offered for solar technologies, starting in 1978 with a funding level of 8.5 million Marks. In addition, programs of income tax deductions and direct subsidies have been started in recent years.

Japan

The Japanese incentives volume covers the period from 1945 to 1976. Four distinct periods with different energy policies are distinguished:

- 1945-1951, a period of control over energy by the American military officials who assumed control of Japan after the Second World War
- 1951-1960, a period in which the coal industry was protected from incursions by lower-priced oil
- 1960-1972, a period in which cheap oil became the primary energy source, with coal receding in importance, and
- 1973-1976, a period in which energy conservation assumed new importance.

Over this entire period of time, a total of 33.8 billion U.S. dollars was spent to encourage the production of various forms of energy (see Tables 1 and 2).

The nuclear industry received 5.9 billion of these incentive dollars, about 17.5% of the total incentives. These funds took the form of disbursements for research and development programs, research and development which was conducted by the government itself, provision of liability insurance for reactor operators, subsidies for uranium exploration, and creation of a public entity which conducts uranium exploration. In addition, tax incentives are provided to the nuclear industry and government grants are provided for nuclear power plant construction (see Tables 3 and 4).

Hydroelectric power has received incentives totaling nearly \$15 billion, and accounting for nearly 44% of the total incentive dollars. These funds are used for the construction and operation of hydroelectric facilities, including transmission facilities as well as the generating plants.

Coal, an energy source whose importance has varied greatly within the period studied in Japan, received a total of \$9.3 billion in incentive funds, about 28% of the total incentive funds. The incentive dollars have been used alternately to increase production of coal immediately after the war, and to rationalize coal production in the face of declining demand in later years. The incentives have taken the form of research and development funds, tax exemptions for mining operations, disbursements to aid in closing down mines, disbursements to aid the industry's pollution control efforts, and various types of market activity.

Oil and gas incentives in Japan amounted to a total of \$2.9 billion, or about 8.8% of total incentive funds. These incentives included research and development funds, exploration and production services, market activity carried out by entities of the government, tax exemptions for the refining and transportation of oil, special interest subsidies for oil tanker construction, and construction of oil tanker ports.

The electric power sector has received over 700 million in incentives, about 2% of the total incentive funds. These funds have been used to encourage development of geothermal power plants. Exploration and environmental impact assessments have been provided by the government, loans have been provided to geothermal resource development agencies, and grants were provided for research and development activities in the geothermal area.

Japan concentrates its incentive expenditures in market activities as 68% of Japan's total expenditures are made in this incentive type (see Tables 3 and 4). The rest of Japanese expenditures are largely accounted for in disbursements and nontraditional services. Fifteen percent of incentive spending is done through disbursements and 12% is spent in nontraditional services. Interestingly, taxation incentives constitute only 1% of Japan's energy expenditures and traditional services constitute even a smaller percent (0.7) of total expenditures. Finally, requirements account for a measurable but small percent (3.4) of total incentives in Japan.

In Japan, solar energy is now encouraged through the "Sunshine Project," a program of the Ministry of Industry and Technology. The funds

disbursed by Sunshine Project will result in the creation of solar development organizations. In addition, a solar energy development corporation, a public entity, will carry out research and development and market activities in the solar energy field. Special depreciation allowances for solar equipment are provided as a tax incentive, and some existing hydroelectric dams are to be fitted with solar panels to provide an additional energy output.

COMPARISON OF ENERGY INCENTIVES IN FRANCE, WEST GERMANY, JAPAN, AND THE UNITED STATES

The major focus of the comparisons volume is on comparing the patterns of incentives used to stimulate the production of energy in the four countries we have studied. A summary of findings from those comparisons is presented below, followed by a discussion of the implications of these results for solar policy in the United States.

Energy consumption and production patterns in each of the four countries vary considerably across the four countries. Total energy consumption in the United States is over five times as high as that in Japan, seven times as high as that in West Germany, and nearly ten times higher than that of France. Oil is the most important fuel in all four of these countries. Coal is the second most important fuel in France, West Germany, and Japan, followed by natural gas. In the United States, natural gas is more important than coal as a fuel source. The United States is the most nearly energy independent, with 78% of its requirements provided by domestic production. West Germany meets 43% of its needs with domestic production, while France produces just 24% of its requirements, and Japan, only 14%. Energy production, industry, transportation, and residential sectors each account for between 19 and 27% of energy consumption in the United States, while commercial and other sectors account for just 6% in total. In the other three countries, industry consumes a larger portion of total energy consumption, ranging from 30% in West Germany to 43% in Japan. Comparing the three foreign countries to the United States, energy production accounts for a similar proportion of energy consumption, as in the United States, while transportation accounts for much less energy consumption in the three foreign countries.

Residential consumption in the other three countries brackets that of the United States, with Japan using less in this sector, and France and West Germany using somewhat more. The commercial and other sectors are similar in their energy consumption abroad and in the United States.

The institutional context of the four countries is also quite varied. Data on the demographic composition and trends in each of the countries show that the population of the United States is twice that of Japan, and three to four times that of West Germany and France. In addition, population density in the United States is drastically lower than that of any of the other countries. Transportation energy use is much higher than in the other countries because our large population is spread out over a large area. Data on government structure and policy-making show that Japan and France have governments relatively centered on the executive branch, with more direct participation in economic and energy activities; West Germany and the United States have governments more balanced across the executive and legislative branches and less direct participation in economic and energy activities.

Comparisons of the level of energy incentives, energy form by energy form, across the four countries suggest that the resource base and level of economic activity in each country are major determinants of incentive actions. The United States has excellent energy resources and a very high level of economic activity. It has also spent more on incentives than any other country, but at a relatively low cost per quad of energy. French spending for nuclear incentives is quite high, even in dollars per quad of energy produced, perhaps because of a need to satisfy consumer preferences for electric power over other energy forms. German spending on coal incentives seems to be an attempt to compensate for the social costs of the mining process, especially when it becomes necessary to close down older facilities. In Japan, incentive programs reflect the paucity of domestic energy resources, and the necessity to exploit aggressively whatever resources are available, as well as to protect outside sources of energy supply.

A comparison of incentives by incentive type across the four countries demonstrates that each country has tended to emphasize one or

two incentive types quite heavily, placing less emphasis on the others. Different emphases were chosen by each of the countries. France relied almost exclusively on disbursements and market activity. In Japan, market activity is emphasized with secondary reliance on disbursements. West Germany has relied mainly on disbursement incentives, backed up by tax and service programs. In the United States, taxation incentives, requirements and market activities have been extensively used. A comparison of incentive costs with the percentage going to market activity suggests that this incentive type is relatively expensive, although desirable because it can be precisely directed. Associations of institutional conditions with incentive type emphases reveal that more centralized governments are likely to choose market activity or disbursement incentives as their major incentive type, while taxation, requirements, and disbursements are chosen as the major emphasis by the less centralized countries.

CONCLUSIONS FOR SOLAR POLICY

The comparison of energy incentives across four countries shows that the pattern of incentives spending by energy form and by incentive type varies considerably. The patterns of incentives appear to be related to both resource conditions in these countries and to the institutional environments within which governments operate. It is likely that solar policy, too, will have to be adapted to resource conditions and to institutional constraints. Just as it makes more sense to stimulate the production of oil at locations where good oil resources can be found, it makes sense to stimulate the conversion of solar energy only in areas where good solar resources are available. The mix of incentives used to accomplish this task must be sensitive to prevailing institutional conditions in the country. Thus, past patterns of spending on incentives in the United States may be good guides to the kinds of incentives which should be considered for solar energy forms.

However, solar policy-makers should not feel unduly constrained by historical incentive spending patterns in any one country such as the United States. The fact that we have studied only four countries means that the associations we have found between resource conditions and

incentive spending, and between institutional contexts and incentive-type choices, should be regarded as tentative and suggestive rather than as well-tested and relatively immutable social "laws." The very fact that different incentive choices have been made in the four countries we have studied indicates that different emphases in incentives can be considered as feasible. Unless further investigations reveal reasons why the present pattern used in the United States cannot be changed and bettered, one should regard the alternative patterns found in the other countries as options to be considered in formulating solar policy for the United States.

A final point is that every country we have studied has devoted significant resources to stimulating the production of traditional energy forms. None of these countries has allowed the "invisible hand" of the market to be the sole determinant of energy production decisions for the country. For reasons of national security and public economic policy, all four countries have chosen to intervene in the energy marketplace. Governmental intervention therefore may be required for solar energy, if only to counteract effects of incentives given to traditional energy forms. Even if existing incentives to these forms were removed, their past existence has cumulative and continuing effects into the future. In addition, in the world market, new energy forms will have to compete with forms subsidized by other countries. Finally, the national security and public policy concerns that led to the original interventions in the traditional energy sector markets may call for intervention in this market as well.

NOTES - CHAPTER I

1. C. Massetti et al., An Analysis of French Incentives Used to Stimulate Energy Production. Draft report for U.S. Department of Energy by Pacific Northwest Laboratory, January, 1981. O. Ozeki et al., An Analysis of Japanese Incentives Used to Stimulate Energy Production. Draft report for the U.S. Department of Energy by Pacific Northwest Laboratory, July, 1980. S. van Buijen et al., An Analysis of West German Incentives Used to Stimulate Energy Production. Draft report for U.S. Department of Energy by Pacific Northwest Laboratory, August, 1980. These volumes are in draft form and available at reproduction cost from R. J. Cole at Battelle Human Affairs Research Centers, 4000 N.E. 41st Street, Seattle, WA 98105. Our volume on U.S. incentives has its own Executive Summary: An Analysis of the Results of Federal Incentives Used to Stimulate Energy Production. Executive Summary. U.S. Department of Energy. February, 1981.
2. R. J. Cole et al., A Comparison of the Incentives Used to Stimulate Energy production in Japan, France, West Germany, and the United States. Report for the U.S. Department of Energy by Pacific Northwest Laboratory (PNL-3788), March, 1981.

II. APPROACH TO INCENTIVE COMPARISON

OBJECTIVES

This volume compares the governmental incentives used to stimulate energy production in various countries in order to develop insights for solar policy in the United States. The countries involved are Japan, West Germany, France, and the United States, because we have studied the incentives used in each of those countries. Each individual study attempted, insofar as possible, to apply the definitions and methods first used in our examination of U.S. incentives. By comparing and contrasting the use of incentives in each of the four countries, we hope to identify alternate patterns of incentives and to develop information about the characteristics and results of specific mechanisms in different contexts.

Of course, lessons for the U.S. cannot be derived in a simple-minded fashion. Examples from foreign contexts need to be "translated" into the U.S. context before they can be applied. That is, the analyst needs to make appropriate adjustments for differences in technological, economic, and institutional factors from one country to another. This need for translation arises in other situations as well, of course. The experience with incentives for traditional forms of energy in the United States needs to be translated into implications for incentives involving nontraditional forms.

This volume provides information necessary for a comparison among countries, makes some of those comparisons, and draws out implications for solar policy in the United States.

LIMITS TO THE ANALYSIS

The definitions and methods used in each of the single-country studies are explained in detail in those volumes. Here is a brief explanation.

Each volume is divided into three parts: a survey of current thought about incentives for solar energy production; a view of the energy incentive landscape for one particular year; and an analysis of the

incentives provided to major energy resources (nuclear, hydro, coal, electricity, oil, and gas) along the path from exploration to waste management. We made serious efforts to estimate the costs of incentives in each country in constant national currency (dollars, francs, marks, yen).

Using the theoretical approach developed for studying U.S. energy incentives, the researchers in each country classified incentives into the following six categories: (1) Taxation, including the exemption or reduction of existing taxes; (2) Disbursements, in which the national government distributes money without requiring anything in return; (3) Requirements, including demands made by the government, backed by civil or criminal sanctions; (4) Traditional Services, including those almost always provided exclusively by a governmental entity; (5) Nontraditional Services, including those sometimes performed by non-governmental entities, as well as governmental entities (e.g., research and development); and (6) Market Activities, including government involvement in the market under conditions similar to those faced by non-governmental producers or consumers.

The results of these analyses gave us what we called a pattern of incentives for each country. That is, we can describe cumulative total spending, for the period 1950-1976, by energy form and by incentive type for each of four countries. These patterns are described in more detail later in this chapter. Our reason for discussing these patterns in a section called "Limits to the Analysis" is to stress that the analysis in this volume is limited to comparing the rows and columns of these incentive pattern tables to each other. Obviously, these row and column comparisons are only two of the many ways in which the data we have gathered could be compared. The limits of our present assignment forced us to concentrate on this macro level of comparison, but we hope that analysis of these data does not end here. We hope to be analyzing these data further in other assignments, and we encourage others to perform their own analyses with them.

OUTLINE OF CONTENTS

This chapter introduces the idea of comparison, the value served by it, and the general way in which we went about it. It also sets out the patterns of incentive spending (totals by energy form by incentive type) that are the subject of comparison in later chapters. Chapter III compares the incentives across energy forms. For instance, oil incentives are compared with one another, natural gas incentives are compared with one another, and the relative emphasis on each is compared. Chapter IV compares incentives by incentive type. For instance, market activities are compared with one another, and the relative proportion of market activities versus other types of incentives is compared. Chapter I summarizes our analysis and draws out implications for solar policy in the United States based on these comparisons.

The appendices in this volume are perhaps more important than appendices often are. The appendices are included in this volume to provide background information for the kinds of "translations" we made in comparing one incentive pattern to another.

To us, two of the most important contextual attributes of a policy area are the technologies and institutional arrangements involved in that policy area. The policies that exist in an area are partially shaped by, and help shape, the technological and institutional factors involved. In the case of the energy policy area, the technological factors include a country's resources and its production and consumption of those resources. The institutional factors include the characteristics of government generally, the roles of the legislative, executive, and judicial branches, and the processes of economic and energy policymaking. As a consequence, when comparing the pattern of incentives among countries, we wanted to be sensitive to the differences in energy-related technological and institutional factors as well as differences in the incentives used.

Of course, these differences are not the only important ones. In addition to organizational and institutional aspects of energy policymaking in the various countries, economic influences on energy policymaking are also highlighted in our interpretation of the data

presented in this volume. Each country presumably feels strong pressure to direct its energy policy towards what its policymakers perceive as the most economically advantageous course. There are a great number of factors that enter into a country's perception of its own economic advantage. The resource base is one of these contributing factors. Another important factor is the relative value a given energy form has in a given country. The value of energy in a specific form, such as a solid, rather low Btu per unit volume energy form like coal versus a more easily transportable liquid fuel with a higher Btu per unit volume such as oil differs in various countries depending on the degree of technical sophistication in the country and social values toward energy use. Hence, a Btu of a specific energy form may be valued differently in various countries. Certain physical properties of one energy source may be more important in one country than they are in another.

Each of the comparisons in Chapters III and IV tries to be sensitive to the kinds of contextual differences described in Appendices A and B. Appendix A compares the energy context in each of the four countries. It focuses on resources, amounts of production and consumption, and the technologies involved. Appendix B compares the institutional context in each of the four countries. It focuses on demographic variables and governmental variables.

PATTERNS OF INCENTIVE SPENDING

To make comparisons among countries, we constructed tables using the incentive estimates prepared in the French, West German, Japanese, and U.S. incentive cost volumes. The same methodology was used to construct the tables in Chapter III and Chapter IV as well.

The incentive programs in the four countries began in different years, and the estimates of the cost of these programs, are of course, made in the currency of each of the four countries. Thus, to compare these cost estimates, it is necessary to convert marks, francs, dollars, and yen to the same currency unit, and to establish a common basis with respect to time, adjusting for the effects of inflation.

Further difficulties stem from the small differences in the manner in which the estimates were prepared in the four countries. The initial and final years for which estimates were reported varied from country to country according to data availability. Somewhat different standards were used in allocating expenditures among energy sectors, especially with respect to electricity.

We proceeded as follows. First, since the Japanese incentives report ended with expenditures in 1976, we decided to make 1976 the common end-point for our foreign comparisons estimates. Therefore, it was necessary to subtract between one and three years of spending from the estimates for the other three countries. We used the constant own-currency estimates of spending after 1976 in each volume, and subtracted these quantities from total spending on incentives. We then converted each country's spending estimates to constant 1976 units of its own currency, using the price deflator each country's analyst thought best. In France this was a gross domestic product deflator, and in the United States the consumer price index.

The next problem was to convert yen, francs, and marks to U.S. dollars. There are two methodologies for doing this. One can use market exchange rates as set in the international currency market, or one can use the Purchasing Power Parity (PPP) methodology developed by Kravis et al.⁽¹⁾ The problem with using market exchange rates is that not all sectors of the economy participate equally in international trade. Thus, the bulk of purchases in each country are set by internal economic conditions, and a unit of one currency when converted by the market rate into another currency may have very different purchasing power. Kravis et al. report that at the time of their analysis, in 1970, a U.S. dollar could buy as much as 60% more abroad than in the U.S. due to this discrepancy between the purchasing power and market exchange rates. Therefore, Kravis et al. developed a methodology that converts currencies in a manner that preserves the parity of purchasing power. When these PPP exchange rates are used, a dollar and its equivalent in yen will buy approximately the same market basket of goods in both countries.

Because energy commodities are widely traded internationally, one might think that market exchange rates would be good proxies for purchasing power parity rates for energy commodities. This may be fairly true for the European countries and Japan, but less so for the United States, which is much more reliant on its own energy forms and which imposes a layer of regulatory price controls between the consumer and the international market. In addition, the essential problem of these incentive volumes is to determine the cost of simulating new industries in the energy sector. Building up a new industry requires a wide range of goods and services, many of which are not traded internationally.

Therefore, we decided to use the purchasing power parity exchange rates in lieu of market rates to convert yen, marks, and francs to U.S. dollars. However, we are unable, due to data availability problems, to update the Kravis et al. PPP rates to 1976. Therefore, we use the PPP 1970 rates to convert 1976 yen, marks, and francs to 1976 dollars. The practical effect of using the PPP rates rather than market exchange rates is to inflate somewhat the French and Japanese expenditures relative to U.S. expenditures. Had we used market rates, expenditures by the European countries and Japan would have been reported as somewhat less than they are reported in our tables. German spending estimates are deflated slightly by using PPP rates in lieu of market exchange rates.⁽²⁾

In addition to these conversions to a currency unit which is comparable in both time and purchasing power, we made several other adjustments in the figures reported in the original four incentives volumes. In the French incentives volume, some of the expenditures reported in the oil and gas sector are expenditures for ensuring the security of foreign supplies. Since we are concerned with a stimulation of domestic energy production, we subtracted these expenditures from the French estimates. It was not possible to deal adequately with expenditures by the French government through partially government-owned oil companies that produced oil abroad, especially in Algeria. Data were not available to subtract the portion of the government expenditures that stimulated production abroad.

In the Japanese incentives volume, expenditures for the construction of a distribution system for hydroelectric power have been separated as a distinct electricity incentives sector. Thus, while the Japanese incentives volume does not have an electricity column in any of its tables, we show an electricity column in our tables for Japan. The Japanese incentives volume also reports expenditures on ports which are used to import oil into the country. Since these expenditures do not stimulate domestic production of oil, we subtracted them from the oil sector incentive estimate. In the oil sector estimates of the Japanese volume, expenditures on highway construction are included as incentives to the oil sector. Since we have classified such expenditures as indirect incentives to the consumption of oil in another report,⁽³⁾ we subtracted the highway expenditures from the Japanese estimates. This last adjustment makes a major difference in the Japanese incentive cost estimates. An estimate of \$217 billion U.S. is reduced to a total of about \$33.6 billion.

Finally, both the Japanese and German incentive volumes report oil and gas expenditures as a single number, since the programs for the two sectors are the same. For the purpose of comparing the U.S. and German estimates, where there were some separate programs for each of the two sectors, we have disaggregated the Japanese and German oil and gas estimates into two sectors using the ratio of Btu produced. This same estimating procedure was used for estimates of U.S. programs which applied to both sectors.

A final qualification must be considered in interpreting the results reported in this chapter and the next. The incentives estimates are aggregates of different programs and policies ending in 1976 but beginning at different times for the different countries. Therefore the dollar values may not always capture all of the incentives to production. In 1976 the various energy forms were in different stages of development. In other words, if the quantification of incentives only goes back to 1961, as is the case in France, the expenditures capture a larger portion of the funds appropriated to nuclear energy production in the early stages of industry development but capture only a few of the costs associated with

the early stages of the development of the oil industry. This fact might not be a problem if the energy production figures did not reflect the stream of production incentives granted over a long and variable period of time. However, a quad of oil produced in 1976 may be related to incentives granted before 1961, whereas a quad of nuclear energy produced in 1976 is largely accounted for by the stream of incentives granted after 1961. Thus, there is a problem of comparability among these aggregate expenditure figures. The incentive estimates are likely to be biased downward for more mature energy forms. The degree of bias differs across countries depending on when the estimates begin.

The tables in this chapter show the pattern of incentive spending by energy form and incentive type in each of the countries. In France, nuclear energy clearly receives the highest level of incentive expenditures (11.8 billion 1976 dollars). Nuclear incentives amount to nearly two times its closest follower, coal, with \$6 billion spent in incentives. In the case of both coal and nuclear, the largest bulk of incentive expenditures were made in the disbursements incentive type. France spent nearly equal levels of dollars to encourage oil and electricity production (\$2.37 and \$2.26 billion respectively) and spent the bulk of that money in market activities in both cases. Hydroelectric power received about \$1.5 billion in incentives which were again largely spent in market activities. Natural gas received the fewest incentives to production, only \$750 million, all of which was spent in market activities.

When all energy forms are considered, the two incentive types that are most commonly used in France are disbursements and market activities. Incentive spending through disbursements is the largest (\$17.94 billion with spending in nuclear composing nearly \$11 billion of that total). The spending in market activity is fairly consistent across energy forms, with four of the six energy forms receiving between \$1.0 and \$1.5 billion in market activities. Only coal (\$84 million) and gas (\$750 million) were below that range. Table 5 shows the French pattern.

In West Germany, coal is the largest recipient of incentives, receiving nearly \$40 billion; though nuclear is the second largest, it received only \$7.4 billion. Spending in coal is concentrated in

TABLE 5. French Incentive Expenditures (1950-1976) by Energy Form
and by Incentive Type (Million 1976 Dollars)

	Nuclear	Hydroelectric	Coal	Oil	Gas	Electricity	Total
Taxation	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Disbursements	10,839.0	191.7	5,972.5	255.5		677.8	17,936.5
Requirements	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Traditional Service	(a)	(a)	(a)	94.6	(a)	(a)	94.6
Nontraditional Service	(a)	(a)	31.0	583.2	(a)	(a)	614.2
Market Activity	1,025.4	1,263.9	84.1	1434.6	746.7	1,586.9	6,141.7
Total	11,864.0	1,455.7	6,087.6	2,367.9	746.7	2,264.7	24,787.0

Source: C. Massetti et al., An Analysis of French Incentives Used to Stimulate Energy Production.
Draft report for U.S. Department of Energy by Pacific Northwest Laboratory, January, 1981.

(a) Not quantified in source.

disbursements with 88% of coal incentives in this category. Nuclear incentives were comprised completely of nontraditional services. Natural gas received about \$3.0 billion in incentives, electricity received about \$2.0 billion and both their incentives were concentrated in taxation. Oil, which only received \$1.2 billion in incentives, also had its incentives concentrated in taxation (67%). Hydroelectric power received only \$20 million, a very small amount when compared to the level of incentives the other energy forms received. Like oil and electricity, incentives to hydroelectric power were concentrated in tax incentives.

Across all energy forms in West Germany, the disbursements category received the largest amount of domestic incentives, nearly \$36 billion in 1976 dollars. Taxation was the second largest incentive type, but its total (\$9.1 billion) was only one quarter the disbursements total. The \$7.6 billion in nontraditional incentives composed the remaining bulk of the \$53.1 billion West Germany spent in total incentives to domestic energy. Table 6 shows the German pattern.

In Japan, a total of nearly \$34 billion was spent to encourage domestic energy production. Hydroelectric power received the largest portion of the incentives. The nearly \$15 billion spent on hydropower comprised 45% of all incentives. Almost all of which (about \$14.5 billion) was in the form of market activities. Coal received about \$9.5 billion in incentives. Nearly half of the coal incentives total was in disbursements and approximately one-third market activities. Nuclear energy was the third largest recipient of domestic incentives and most of its incentives total was nontraditional services. Natural gas received about \$2.4 billion, considerably less than the three leading energy forms. Of the natural gas total, 87% was market activities.

Japan spent the smallest amount of incentives to encourage domestic production of electricity and oil (\$752 million and \$535 million respectively). Again, market activities composed a large bulk of incentives to both energy forms. Market activities in Japan comprised nearly 67% of total incentives spending. None of the other incentive types came close. The next largest incentive type was disbursements (\$5.1 billion) and was only 15% of total incentives. Nontraditional services

TABLE 6. West German Incentive Expenditures (1950-1976) by Energy Form
and by Incentive Type (Million 1976 Dollars)

	Nuclear	Hydroelectric	Coal	Oil	Gas	Electricity	Total
Taxation	(a)	19.3	4,012.4	817.9	2,193.6	2,052.2	9,095.4
Disbursements	(a)	(a)	34,916.5	238.5	639.7	(a)	35,794.7
Requirements	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Traditional Service	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Nontraditional Service	7,388.9	(a)	212.7	3.1	8.2	(a)	7,612.9
Market Activity	(a)	(a)	(a)	159.1	426.6	(a)	585.7
Total	7,388.9	19.3	39,141.6	1,218.6	3,268.1	2,052.2	53,088.7

Source: S. van Buijen et al., An Analysis of West German Incentives Used to Stimulate Energy Production. Draft report for the U.S. Department of Energy by Pacific Northwest Laboratory, August, 1980.

(a) Not quantified in source.

TABLE 7. Japanese Incentive Expenditures (1950-1976) by Energy Form
and by Incentive Type (Million 1976 Dollars)

	Nuclear	Hydroelectric	Coal	Oil	Gas	Electricity	Total
Taxation	22.4	76.9	27.9	38.9	175.0	(a)	341.1
Disbursements	96.8	25.7	4,819.6	29.6	133.4	(a)	5,105.1
Requirements	58.3	(a)	1,094.4	(a)	(a)	(a)	1,152.7
Traditional Service	77.2	74.9	74.6	.37	1.5	(a)	228.6
Nontraditional Service	4,032.4	36.3	7.3	1.3	5.8	(a)	4,083.1
Market Activity	1,575.2	14,543.3	3,468.2	464.9	2,092.8	752.2	22,896.6
Total	5,862.3	14,757.1	9,492.0	535.1	2,408.5	752.2	33,807.2

Source: O. Ozeki et al., An Analysis of Japanese Incentives Used to Stimulate Energy Production.
Draft report for the U.S. Department of Energy by Pacific Northwest Laboratory, July, 1980.

(a) Not quantified in source.

were about one fifth as large as market incentives and composed only 12% of the total domestic incentive spent in Japan.

Incentive spending in the United States totaled about \$187 billion. Oil received the largest portion of the total incentives with the bulk of these incentives spent in taxation and requirements categories. Electricity was the next largest recipient of federal incentives, receiving about \$22 billion in incentives. Electricity incentives were split between tax incentives and market incentives (\$29 billion in taxation and \$22 billion in market incentives). Nuclear energy received a total of \$15.3 billion in incentives. Nontraditional services accounted for 83% of this total (nearly \$13 billion). The rest of the nuclear incentives were accounted for by market activities (\$1.7 billion) and requirements (\$.92 billion). Spending in hydroelectric and natural gas was very nearly the same, about \$14 billion each. In the case of hydroelectricity, the bulk of incentives were directed at market activities. In the case of natural gas, virtually all incentives were in the form of taxation and requirements, with nontraditional services, and market activity incentive types adding the few remaining incentive dollars. Coal received the fewest incentives, \$8.1 billion. Tax incentives comprised about 40% of coal incentives and traditional and nontraditional services each comprised 27%. Requirements comprised only 7% and market activities comprised only .14% of coal's total incentives.

The year-by-year table illustrates the total value of incentives that each country provided each year through the various government programs for domestic energy production. One may notice that the totals may not add exactly to the total incentive figures earlier reported. This inconsistency has several explanations. First, not all the government incentives included in the total could be broken out on a yearly basis. Second, the conversion of current values to constant 1976 values introduced a degree of error that could not be corrected. Hence, while the total figures may differ, the general yearly trend of incentives in each country is reflected in these tables.

France has been providing incentives to domestic production at a declining rate since 1968. French incentives reached their highest point

TABLE 8. United States Incentive Expenditures (1950-1976) by Energy Form and by Incentive Type (Million 1976 Dollars)

	Nuclear	Hydroelectric	Coal	Oil	Gas	Electricity	Total
Taxation	(a)	1,600	3,360	46,100	13,560	28,990	93,610
Disbursements	(a)	(a)	(a)	930	(a)	(a)	930
Requirements	920	29	550	29,590	430	(a)	31,520
Traditional Service	(a)	(a)	2,090	5,350	(a)	440	7,880
Nontraditional Service	12,677	(a)	2,100	1,320	230	(a)	16,327
Market Activity	1,700	12,390	12	280	90	22,330	36,802
Total	15,297 ^(b)	14,020	8,112	83,570	14,310	51,760	187,070 ^(c)

Source: B. W. Cone et al., An Analysis of Federal Incentives Used to Stimulate Energy Production. Report for the Department of Energy by Pacific Northwest Laboratory, PNL-2410 Rev. II, June 1980.

(a) Not quantified in source.

(b) Total for nuclear may be slightly high because the exact amount spent in 1977 for uranium enrichment (Market Activity) and the mixed program contributions (Nontraditional Service) could not be determined and removed from the 1976 total.

(c) Rows and columns may not add exactly due to rounding errors.

TABLE 9. Incentive Expenditures Year by Year for France, West Germany, Japan, and the United States

	France (Million 1976 French Francs)	West Germany (Million 1976 Marks)	Japan(b) (Million 1976 Yen)	United States (Million 1976 Dollars)
1933				108.9
1934				105.2
1935				102.2
1936				161.5
1937				475.6
1938				438.1
1939				899.7
1940				510.7
1941				785.4
1942				674.7
1943				437.7
1944				608.7
1945				692.9
1946			11,813	1,114.6
1947			129,115	989.2
1948			189,559	990.2
1949			49,651	1,479.9
1950		494.8	45,755	3,816.1
1951		558.7	64,354	3,312.0
1952		649.7	92,052	3,037.9
1953		1,453.4	159,007	3,547.7
1954		1,683.1	256,674	3,823.1
1955		2,090.5	223,798	3,943.7
1956		3,007.3	219,186	4,576.3
1957		3,847.6	226,228	5,041.8
1958		3,801.3	283,045	4,573.6
1959	241.1	4,395.5	284,659	4,818.4
1960	432.6	3,967.3	256,833	5,317.9
1961	4,959.6	5,710.6	229,153	5,427.7
1962	5,281.3	5,938.5	291,026	5,522.3
1963	6,949.6	7,494.3	262,553	6,048.1
1964	6,113.3	5,724.6	198,925	6,249.9
1965	7,362.6	6,055.7	155,669	6,410.1
1966	8,527.7	6,623.6	142,116	6,542.0
1967	8,977.1	7,928.2	266,188	6,102.9
1968	10,444.6	8,639.1	279,049	6,388.8
1969	9,140.5	8,217.6	362,071	5,778.4
1970	7,579.5	8,518.6	414,362	5,575.7
1971	6,595.0	8,757.7	450,960	6,055.9
1972	6,464.0	9,653.6	508,106	7,159.7
1973	6,061.5	9,386.1	584,446	7,267.2
1974	5,289.0	10,025.8	420,606	13,514.2
1975	5,699.2	9,990.2	476,559	14,442.9
1976	5,651.0	9,921.2	630,128	17,293.1
Total	111,769.0	154,534.6	816,346	182,161.5

Source: C. Massetti et al., An Analysis of French Incentives Used to Stimulate Energy Production. Draft report for U.S. Department of Energy by Pacific Northwest Laboratory, January, 1981. S. van Buiren et al., An Analysis of West German Incentives Used to Stimulate Energy Production. Draft report for the U.S. Department of Energy by Pacific Northwest Laboratory, August, 1980. O. Ozeki et al., An Analysis of Japanese Incentives Used to Stimulate Energy Production. Draft report for the U.S. Department of Energy by Pacific Northwest Laboratory, July, 1980. B. W. Cone et al., An Analysis of Federal Incentives Used to Stimulate Energy Production. Report for the Department of Energy by Battelle Pacific Northwest Laboratory, PNL-2410 Rev. II, June 1980.

- (a) Differences in total due to rounding errors. Estimated rounding errors may be as large as 3-4%.
 (b) Japanese totals exclude tax incentives.

in 1968 when incentives totaled about 10.5 billion francs. Since that high point, total yearly incentives fell until 1975 where they rose slightly, but fell again in 1976.

In West Germany, incentives were generally increasing until 1974 where they reached a high of 10,025.8 million marks. Since 1974, total yearly incentives have been falling. By 1976, total incentives fell to levels nearly equal to levels reached in the early 1970s. Though the general historical trend in Germany has been towards increasing yearly incentives, there are a number of short interruptions in that trend. It is not uncommon for German incentives to increase for three or four years and then decrease for a year or two, then increase again.

In Japan, incentives to domestic energy production moved up and down for two and three year periods until 1966. Then in 1966, total incentives increased consistently until 1976; although total incentives fell in 1974 and 1975, they jumped to their highest level (630,128 million yen) in 1976.

Yearly domestic incentives in the United States have been largely increasing since the mid-1950s. Although there are a few of years where the yearly total incentives decreased, the trend of increasing domestic incentives is more consistent in the United States than in the other three countries. By examining the last decade, one can see that incentives began to level out at about \$63 billion in the mid-1960s. Incentives then fell in the late 1960s, but rose again in the early 1970s and nearly doubled in 1974. The high level of incentive spending reached in 1974 continued in 1975 and 1976.

CONCLUSIONS

These patterns of incentive spending are compared in subsequent chapters. Chapter III focuses on the columns, comparing spending by energy form. Chapter IV focuses on the rows, comparing spending by incentive type.

NOTES - CHAPTER II

1. I. B. Kravis et al., A System of International Comparisons of Gross Product and Purchasing Power. Baltimore: published for the World Bank by the Johns Hopkins University Press, 1975.
2. The market exchange rates for 1976 are 4.78 FF, 2.52 DM, and 276 Y to the dollar. The corresponding PPP rates calculated by Kravis et al. for 1970 (GDP conversion) are 4.48 FF, 3.14 DM, and 244 Y to the dollar.
3. Cone et al., An Estimate of Incentives Used to Stimulate the Consumption of Energy. Draft report for the U.S. Department of Energy by the Pacific Northwest Laboratory, Chapter 3, September, 1980.

III. COMPARISON OF ENERGY INCENTIVES BY ENERGY FORM

In this chapter and the next we compare the energy incentive expenditures of the four countries by energy form (Chapter IV) and by incentive type (Chapter IV).

Table 10 reports energy-incentive expenditures by energy type for each of the four countries. Total expenditures at the bottom of each column is an average expenditure number computed by dividing the total expenditures in each country by six, the number of energy types. The United States spent more on nuclear power than any other country. France has the second highest level of spending followed by Germany and Japan. The United States, along with Britain and to an extent France, pioneered the development of this technology. Thus, it is not surprising to see the United States as the leading country in the level of nuclear incentives. One reason for the relatively high French expenditures is the French breeder reactor program; the comparable program in the United States is currently stalemated.

The hydroelectric incentives row demonstrates that Japan and the United States have devoted considerable resources to hydroelectric incentives, whereas France has spent much less and Germany virtually nothing. These patterns are easily explainable by the resources of the various countries. France has some usable hydroelectric resources but Germany has virtually none. Japan is very mountainous, and its expenditures reflect the effort to capitalize on these resources. In the western and southeastern United States, there are plentiful hydroelectric resources, which have been developed with the aid of a very large incentive program.

The coal incentives row shows that France, Japan, and the United States, are relatively close together in their incentive expenditures, whereas Germany has spent four to seven times as much as the other countries. Much of the German expenditure goes to close down old mines and compensate miners who are laid off. These expenditures represent an attempt to compensate injured parties for the full social costs of the

TABLE 10. Cumulative Total Expenditures (1950-1976)(a)
in 1976 Dollars

	France	Germany	Japan	United States	Total
Nuclear	11,864	7,389	5,862	15,297	39,810
Hydroelectric	1,456	19	14,757	14,020	30,252
Coal	6,088	39,142	9,287	8,112	62,629
Oil	2,367	1,219	535	83,570	100,553
Natural Gas	747	3,268	2,409	14,310	20,734
Electricity	2,265	2052	752	51,760	56,829
Total	24,787	53,089	33,807	187,070	298,753
Average	4,131	8,848	5,635	31,178	49,792

Source: Compiled from the following volumes: B. W. Cone et al., An Analysis of Federal Incentives Used to Stimulate Energy Production, especially Table 62; Battelle Geneva Research Centers, An Analysis of French Incentives Used to Increase Energy Production, especially Table 81; S. vanBuiuren et al., An Analysis of West German Incentives Used to Stimulate Energy Production, especially Table 55; O. Ozeki et al., An Analysis of Japanese Incentives Used to Stimulate Energy Production, especially Table 84; and Executive Summary of An Analysis of Japanese Incentives Used to Stimulate Energy Production, especially Table 1.

(a) Average is the sum of the columns divided by the number of elements that are quantified.

coal-mining processes. The other three countries have not developed such extensive programs for compensating persons and organizations that incur social costs, although elements of the German programs are present in other countries. In the United States there is a program to provide benefits to black-lung victims. In Japan, a rationalization program attempted to improve mining operations and to close down inefficient mines. Thus, it is not clear whether the larger expenditure in Germany is

due to fuller accounting of social costs or to real differences in allocation of resources to coal mining incentives.

In the case of oil incentives, the United States is by far the largest incentive provider. Over 80% of the total incentives within the group of four countries was spent by the United States. France has the second highest number for oil incentives, although some of these incentives go for the production of oil outside the boundaries of France. Germany and Japan have quite low levels of incentives for oil production, reflecting the lack of suitable resources in these countries.

The natural gas incentive patterns are roughly similar to those for oil. The United States devotes more dollars to incentives on natural gas than any of the other countries. France and Japan have relatively insignificant incentives on natural gas, whereas Germany spends about a quarter of the U.S. amount on natural gas incentives.

In the case of electricity incentives, the United States is again the leading spender, with many times the level of incentives provided by any other country. France, the second highest spender, devotes only about 4% as much as the U.S. to electricity incentives. Germany and Japan spend even less than France on electricity incentives.

Thus, these four countries have chosen to emphasize different energy forms in their energy incentives spending. France's emphasis is on nuclear power. Germany emphasizes coal to a very great extent, with a significant emphasis on nuclear power as well. The major energy incentive in Japan is given to hydroelectric power, with coal second and nuclear power third. The United States has spent more on oil than on any other energy form, with electric power second. These different energy incentive patterns are most obviously related to resource endowments, although many other factors are also involved.

The overall size of the economy in each country is related to the overall spending levels. The United States, with the largest economy as measured by Gross Domestic Product (GDP), has spent more than three times as much on energy incentives. The level of GDP per capita is the same as the ranking by energy incentives (United States, West Germany, France,

Japan). Thus, there is a strong link between energy incentives and economic activity.

This does not imply, of course, a fixed ratio between economic activity and energy incentives over time. There has been considerable debate on the question of the immutability of energy consumption/GDP ratios in various countries. If the ratio cannot be changed much, then economic development could be severely constrained in an energy-deficient future. Most analysts see opportunities for slow modification of energy/GDP ratios through the application of new technology.⁽¹⁾ Though we have not rigorously analyzed this aspect of incentives, we suspect that the energy incentives/GDP ratio is also susceptible to slow change as a result of public and private-sector decisions.

The level of incentives given to oil in the United States may be a reflection of high value placed on the portability and diversity of possible uses of this energy form. This nation has given relatively large amounts of incentives to oil in order to achieve a pattern of consumption of energy in the transportation and other sectors that is based on the use of oil. The transportation system in the United States is based on oil-fired internal combustion engines. The fact that the United States spent more on incentives to the domestic production of oil than the other countries may be related to both the resource base in the United States and the high value placed on the physical properties of oil in this country. After all, the United States has a vast resource base in low-grade coal, but has spent the least on incentives to the domestic production of coal. This illustrates the influence of preferences as well as the resource base on the pattern of incentives.

Table 11 re-expresses the energy incentive data as percentages of each country's spending. Thus, we see that France devotes 47.86% of its incentive dollars to nuclear power, a much higher percentage than in any other country. Nearly 10% of France's energy incentives are given to oil. Germany stands out as spending nearly 74% of its energy incentive dollars on coal, a level that is nearly three times that of Japan, the next highest spender. Japan spends 44% of its incentive dollars on hydroelectric power, a percentage which is much higher than in any other

TABLE 12. Expenditures in 1976 U.S. Dollars per Quad Produced

	France	West Germany	Japan	United States	Weighted Average ^(b)
Nuclear	84,743	33,586	17,764	8,009	15,253
Hydroelectric	3,386	146	16,962	5,061	7,203
Coal	9,087	11,120	16,294	525	3,097
Oil	59,175	^(c) 5,541	26,759	4,512	5,349
Natural Gas	3,113	5,539	26,762	797	1,098
Electricity ^(a)	17,423	2,631	1,233	17,910	5,065
Weighted Average ^(b)	16,307	11,320	17,874	3,304	

Source: Calculated by dividing figures from Table 10 by production figures in Table 3, Chapter II.

- (a) Electrical production was computed at 1.167 times electrical consumption to account for transmission loss. Then nuclear energy production and hydroelectric and geothermal production figures were subtracted leaving the remainder--expenditures for electrical production from fossil fuel plus all transmission and distribution expenditures.
- (b) The weighted average of a row is the sum of expenditures across countries divided by the sum of quads produced across countries for a particular energy form. The weighted average of a column is the sum of expenditures across energy forms divided by the sum of quads produced across energy forms for a particular country.
- (c) French expenditures in partially government-owned oil companies abroad (esp. Algeria) could not be identified and subtracted from total domestic expenditures in oil.

TABLE 11. Incentive Expenditures by Energy Form as Percent of Cumulative Total Incentives, 1950-1976(a)

	France	Germany	Japan	United States	Average(a)
Nuclear	47.86	13.92	17.5	8.18	21.87
Hydroelectric	5.88	0.04	43.9	7.49	14.33
Coal	24.56	73.73	27.6	4.34	32.56
Oil	9.55	2.30	1.6	44.67	14.53
Natural Gas	3.01	6.15	7.2	7.65	6.00
Electricity	9.14	3.86	2.24	27.67	10.73
Total	100.00	100.00	100.00	100.00	100.00

Source: Calculated from Table 10 by dividing by the sum of the columns.

(a) Average is the sum of the rows divided by 4.

country. And the United States spends 45% of its incentive dollars on oil, as mentioned before. Twenty-eight percent of U.S. energy incentives go to electricity, which is a level of spending at least four times as high as in any other country in percentage terms. Although the United States was one of the leaders in developing nuclear power technology, only 8.6% of its incentive dollars go to nuclear power.

Table 12 shows the ratio of expenditures to quad of energy produced. It should be noted that the quad produced are not just the quad that are the effects of the incentive dollars at the margin. Rather, these numbers are the total quad produced in the country, some of which are the result of private sector actions and would have been carried out absent the government programs, and some of which may have been produced only as a result of the government programs. It is apparent in scanning the rows

and columns of Table 12 that the dollars-per-quad numbers vary considerably. The ratios of expenditures to quad of production range from a low of \$146 per quad for hydroelectric power in Germany to \$84,743 per quad for nuclear power in France. To give some sense for the disparity in these numbers, we have computed weighted averages of both the rows and the columns. These weighted averages are simply the total expenditure for that row or column divided by the total quad associated with that row or column.

In the case of nuclear power, France clearly has spent more dollars per quad produced than any other country. France's level of spending is more than twice that of Germany, about five times that of Japan, and nearly eleven times that of the United States. All of the countries but the United States fall above the weighted average, and the U.S., with a larger total quantity of production, falls considerably below the weighted average. Differences in resource endowments may be the major explanation of these differences. The United States has a better resource base than the other countries; consequently its incentive dollars are associated with higher production figures.

The very high level of spending per quad of nuclear energy produced in France may be related to the incentive types used in France compared to the incentive types used in other countries such as the United States. The French report states that incentives to nuclear power fall into two main categories: disbursements and market activity. French disbursements were further broken down into subsidies, direct returns or receipts from power sales, and assistance for prospecting. Included in the market activity category were low-interest loans and state contributions to Electricite de France. In the United States, on the other hand, there was a very different pattern of incentives, for research and development services, as well as market activities and requirements. The mix of incentives used in the United States may be more effective in stimulating production. In particular, the research and development incentives are likely to have major effects on production in later years, as other studies of returns to R&D investments show.⁽¹⁾

The hydroelectric power row reveals that Japan has spent much more on hydroelectric incentives per quad produced than any of the other countries. While absolute spending of Japan and the United States was fairly close in dollars, the production results were very different for hydroelectric power, resulting in a much higher figure for dollars per quad produced in Japan.

In the case of coal incentives, Japan turns out to have spent more per quad produced than any of the other countries. This is despite the very high level of absolute dollars spent in Germany, reflecting a larger quantity of production in Germany which offsets the high spending level.

The dollars per quad figures for oil reveal an anomaly in the tables. France, with an estimate of \$59,175 per quad produced is nearly two times higher than any of the other countries. This is in large part because very little oil is produced in France, and some of the incentives include expenditures for oil produced outside the boundaries of France. Japan has the second highest number for dollars per quad of oil, while Germany and the United States are quite close together and about a fourth or a fifth of the Japanese figure. In the case of natural gas, Japan again has the highest incentive expenditure per quad produced, with Germany second, France third, and the United States a very low fourth.

The electricity expenditures row shows almost equal spending per quad produced in France and the United States. Germany and Japan have much much lower spending per quad produced. The reasons for this difference are not clear-cut, but population density may provide a key. The United States and France are much less dense, and electricity expenditures in all four countries are largely for transmission and distribution.

The main conclusions to be drawn from this table are that France's spending on nuclear power is unusual in terms of the quantity of production with which it has been associated. These incentives have been quite expensive for France in terms of quad produced. Japanese incentive spending reflects the relatively poor resource conditions of this country. Japan has spent more per quad produced than any of the other countries on hydroelectric power, coal, oil (with the exception of the anomalous French number), and natural gas. Japanese spending is roughly

equivalent across energy forms, with a variation from the lowest, with the exception of electricity, to the highest of only about 50%. The variations in the other countries are much greater. Thus, Japan appears to have followed a policy of intensively stimulating such energy production as is feasible in the country, and of relatively equal allocation of incentives per Btu produced. The other countries have relatively unequal allocation of expenditures per Btu produced, which may be due to resource conditions or social policies.

It is conceivable that energy incentive expenditures could be allocated in proportion to consumption levels rather than production levels. That is, the government of each country could attempt to stimulate the more popular energy forms more than the less preferred energy forms. This hypothesis gains some support from Table 13, which reports expenditures per quad consumed in each country. Electricity, a clean and convenient power source for consumers, receives more expenditure per quad of electricity consumed than any other energy form in all of the countries except Germany. In Germany, coal receives more dollars per quad

TABLE 13. Expenditures in 1976 U.S. Dollars per Quad Consumed

	France	Germany	Japan	United States	Weighted Average ^(b)
Coal	4,831	12,918	4,021	584	3,056
Oil	3,392	218	55	2,556	1,915
Natural Gas	1,098	2,238	6,022	766	977
Electricity ^(a)	24,971	9,653	13,789	11,710	12,663
Weighted Average ^(b)	5,292	5,085	2,464	2,601	

Source: Calculated from Table 87 and consumption figures in Table 4, Chapter 2.

(a) Figures included nuclear and hydroelectric expenditures.

(b) See Table 12, note (b); divisor is quads consumed in this table.

consumed than electricity, because it is the German policy to account fully for the social costs of coal mining. Interpreted in this light, the very high level of French spending on nuclear power production may be an attempt to meet the desires of French consumers for electric power over other energy forms. The level of French expenditures on nuclear power seems less anomalous in this light than in any other.

Table 14 reports energy incentives per capita. The weighted averages for each country across energy types reveal that Germany and the United States spend roughly equal amounts per capita on all energy forms. France spends about half as much as Germany and the United States. Japan spends even less, about one third as much as the other countries per capita. Since Japan is very densely populated, and has poor energy resources and a lower level of GDP per capita, it is perhaps not surprising to find a

TABLE 14. Energy Incentive Expenditures per Capita

	France	Germany	Japan	United States	Average(a)
Nuclear	228	121	52	71	118
Hydroelectric	28	0.3	132	65	56
Coal	117	642	83	38	220
Oil	46	20	5	387	115
Natural Gas	14	54	22	67	39
Electricity	44	34	7	241	82
Weighted Average(b)	477	870	300	870	

Source: Calculated from the figures in Table 10 and Table 26, Chapter III.

(a) Average is the total of the rows divided by the number of elements in the rows.

(b) See Table 12, note (b); divisor is 1976 population for each country for both row and column weighted averages.

lower level of spending per capita in this country. Both demand for incentives and the resources to supply them are likely to be relatively low under these conditions. The higher but relatively similar spending per capita in two of the other three countries is a striking finding given the sharp differences in the actual policies pursued in each country. The entries in the table vary from a low of \$0.3 per capita for hydroelectric power in Germany to \$132 per capita for hydroelectric power in Japan. Similar ranges are found for the other energy types, demonstrating the diversity of policies followed in the four countries for any particular energy form.

CONCLUSIONS

This comparison of energy incentives by energy forms suggests that the resource base and level of economic activity in each country are powerful determinants of the level of incentives. The United States, with good resources and a high level of economic activity, has spent more on incentives than any other country, but has done so at a lower cost per quad than the others. A high level of spending on oil incentives may reflect both favorable resource conditions and a high social value placed on the physical properties of this energy form. France's spending on nuclear incentives is surprisingly high in dollars per quad produced, perhaps because of a desire to satisfy consumer preferences for electric power over other energy forms. Germany has spent much more on coal incentives in programs to compensate for social costs of the mining process. In general, incentive programs appear to have been sensitive to economic and resource conditions and to social concerns in the four countries.

NOTES - CHAPTER III

1. See for example, R. E. Evenson and Y. Kislev, Agricultural Research and Productivity. New Haven and London: Yale University Press, 1975. See also E. Mansfield, The Production and Application of New Industrial Technology. New York: W. W. Norton and Company, 1977, especially Chapter 10.

IV. COMPARISON OF ENERGY INCENTIVES BY INCENTIVE TYPE

In this chapter we compare the energy incentive expenditures of the four countries by incentive type. The six incentive types are taxation, disbursements, requirements, traditional services, nontraditional services, and market activity. These incentive types are defined in Chapter I.

It should be noted that there were some slight differences in the assignment of activities to the various incentive types in the four volumes. The major instance of this is the assignment of French research and development expenditures to the disbursements category. This was done because the French government transferred money to the Commissariat à l'Energie Atomique (CEA), which is a wholly government-owned entity. The U.S. incentives analysts would have considered this a nontraditional service provided by the government, but the French incentives analysts classified these incentives as disbursements. The effect of this difference in classification is that the French disbursements figures are a little high, and the estimate for French services is a little low, but the differences are not enough to make any qualitative difference in the comparisons offered below.

Table 15 reports total incentive expenditures by incentive type for each country. In several cases, there were no quantified estimates for a particular incentive type in a given country, as in the case of taxation in France and requirements in France and Germany.

In the case of tax incentives, the United States stands out as spending an order of magnitude more on tax incentives than the next highest country, Germany. Japan spends very little on tax incentives, and no incentives were quantified for France. Germany spends more on disbursements than any other country, spending twice as much as France and much more than either Japan or the United States. For requirements, only two countries reported estimates; the United States spend thirty times as much as Japan on this incentive type. For traditional services, the United States spends much more than either France or Japan, and for Germany there is no estimate. Again in the case of nontraditional

TABLE 15. Total Incentive Expenditures in Millions of 1976 Dollars

	France	Germany	Japan	United States	Total
Taxation	(a)	9,095	341	93,610	103,046
Disbursements	17,936	35,795	5,105	930	59,766
Requirements	(a)	(a)	1,153	31,520	32,673
Traditional Services	95	(a)	229	7,880	8,204
Nontraditional Services	614	7,613	4,083	16,327	28,637
Market Activity	6,142	586	22,897	36,810	66,427
Total	24,787	53,089	33,807	187,070	298,753
Average ^(b)	6,197	13,272	5,635	31,178	49,792

Source: Compiled from the following volumes: B. W. Cone et al., An Analysis of Federal Incentives Used to Stimulate Energy Production, especially Table 62; Battelle Geneva Research Centers, An Analysis of French Incentives Used to Increase Energy Production, especially Table 81; S. vanBuijren et al., An Analysis of West German Incentives Used to Stimulate Energy Production, especially Table 55; O. Ozeki et al., An Analysis of Japanese Incentives Used to Stimulate Energy Production, especially Table 84; and Executive Summary of An Analysis of Japanese Incentives Used to Stimulate Energy Production, especially Table 1.

(a) Not quantified in source.

(b) Average is the sum of the columns divided by the number of elements that are quantified.

services, the United States spends more than any other country, although Germany spends about two-thirds as much as the United States, and Japan about a quarter as much. France spends much less on this category than any of the other countries. Spending on market activity in the United States is six times as high as in France and one and a half times as high as in Japan. Interestingly, very little is spent on this incentive type in Germany.

Table 16 re-expresses these estimates as percentages of each country's total. Table 16 reveals that the United States devotes half of its incentive dollars to tax incentives, a percentage that is nearly three times that of Germany and 50 times that of Japan. The most heavily utilized incentive type in Germany in terms of percentage of total incentive dollars is disbursements, with 67% of the total dollars. France divides most of its incentive dollars between disbursements and market activity. In Japan, market activity is the most heavily used incentive type and disbursements is a close second. In all four countries, one or two incentive types are heavily favored, and the other incentive types receive a much lower percentage of incentive dollars.

French energy policies can be described as a mixture of disbursements and market activity. This pattern of incentives is a reflection of heavy French involvement in the energy enterprises through government ownership and capital allocation policies, as discussed in Chapter II. German energy policies place heavy reliance on disbursements, with some money used for tax and nontraditional service incentives.

Japanese energy policy relies heavily on market activity, with some use of disbursements and minor allocations to the other incentive types. In large part, this pattern reflects the Japanese practice of government ownership of part, but not all, of the capital of various firms in key industries such as energy. U.S. energy policy relies most heavily on tax incentives, with some attention to requirements and market activity and much smaller allocations to the remaining incentive types. It is apparent that very different energy incentive strategies have been chosen by the four countries.

TABLE 16. Percent of Expenditure in Each Incentive Type

	France	Germany	Japan	United States	Average ^(b)
Taxation	(a)	17.13	1.0	50.04	23.19
Disbursements	72.3	67.42	15.1	.50	38.83
Requirements	(a)	(a)	3.4	16.85	10.13
Traditional Services	.4	(a)	.7	4.21	1.77
Nontraditional Services	2.5	14.34	12.1	8.72	9.42
Market Activity	24.8	1.1	67.7	19.67	28.32
Total	100.00	100.00	100.00	100.00	

Source: Calculated by dividing data Table 5.1 by the sum of the columns.

(a) Not quantified in source.

(b) Average is the sum of each row divided by the number of elements.

Market activity is an attractive incentive form because it gives a governmental actor a high degree of control over how its incentive funds are used. The other incentive types allow more discretionary decision-making by the private sector on whether to apply for a tax deduction or whether to prepare a grant application, for example. However, the incentive data suggest that market activity is also a relatively expensive incentive type. Comparing the weighted average incentive cost for each country shown in Table 12 with the percent of incentive funds going to market activity shown in Table 16, we see that France has the highest percentage of funds going to market activity and the second highest incentive cost. Japan has the highest percentage going to market activity and the second highest incentive cost. At the other end of the spectrum, Germany has the lowest percentage going to market activity and the next to lowest incentive cost, while the United States has the second lowest percentage in market activity and the lowest cost.

Other factors such as resource endowments are involved, but these data suggest that a price must be paid for the precision with which funds can be controlled using market activity.

Table 17 reports energy incentive expenditures per capita for each incentive type. The United States not only spends more on tax incentives, but it expends almost three times as much per capita as any other country. Germany spends more on disbursements than any other country, with France second and Japan and the United States much lower. For requirements and traditional services, the United States spends more per capita than Japan. In the case of nontraditional services, Germany spends more per capita as any other country.

TABLE 17. Energy Incentive Expenditures per Capita

	France	Germany	Japan	United States	Average ^(a)
Taxation	(b)	149	3	435	196
Disbursements	345	587	44	4	245
Requirements	(b)	(b)	10	147	79
Traditional Services	1.8	(b)	2	37	14
Nontraditional Services	12	125	37	76	63
Market Activity	118	10	204	171	126
Weighted Average ^(c)	477	870	300	870	

Source: Calculated from data in Table 5.1.

(a) Average is the sum of each row or column divided by the number of elements in each.

(b) Not quantified in source.

(c) Weighted average is the sum of quantified column elements divided by that country's population.

In general, the numbers in this table reinforce the conclusions drawn earlier from the other tables.

The pattern of incentive choices across the four countries appears to be related to institutional conditions. Table 18 summarizes the pattern of institutional relationships, focussing on how centralized the government is in general, and on how centralized economic and energy policy-making are in particular in these four countries. Rankings such as high, medium, and low in this table refer to the relative degree of centralization in a given country relative to the other three we have studied. Overall, government centralization is relatively high in France, medium to high in Japan, and low in West Germany and the United States. These ratings were constructed by considering the descriptions of executive, legislative, and judicial independence and power provided in this appendix. Similarly, centralization of energy policy-making is rated as high in France and Japan, and medium to high in West Germany and the United States based on the descriptions of economic policy-making in general and government ownership of energy producing/converting facilities in the table, and the energy policy-making descriptions in the text.

France and Japan have relatively centralized governmental configurations. The government is centrally involved in economic decisions in these two countries, either through formal planning or through extensive consultation with the private sector, and energy policy-making has a high or medium-to-high degree of centralization as well. The incentive forms favored in these countries (see Table 17) are disbursements (France) and market activity (France and Japan). Japan places secondary emphasis on disbursements and nontraditional services as well. In contrast, Germany and the United States have less centralized governmental structures, and either decentralized, non-governmental control of the economy (United States) or centralized, non-governmental control of the economy. (This is not to deny governmental influences in either country, but is meant as a rough characterization of the major locus of control, relative to the other two countries in our sample.) Significantly, the legislative and judicial branches have more independent power in Germany and the United States relative to the other two

TABLE 18. Comparative Summary of Institutional Conditions

	France	West Germany	Japan	United States	
Centralization of Government	High	Low	Medium/High	Low	
Executive	Independent, powerful	Chancellor appointed by legislature; President is figurehead	Prime Minister and Cabinet have power	Strong	
Legislative	Restricted authority	Legislation must be approved by states	Legislation drawn up in ministries	Also powerful	Balance of Power in U.S.
Judicial	Independent but can't nullify a law	Stronger than France; Weaker than U.S.	Independent	Very powerful	
Economic Policy	Planning emphasized	Centralized, non-governmental control	Shared public/private policy making	Decentralized, limited government roles	
Centralization of Energy Policy	High	Medium/high	High	Medium/high	
Government Ownership in Energy Sector	National gas and electric utilities	Limited	Many public, public/private companies	Limited (TVA and Synfuels Corp. are exceptions)	

countries. The pattern of incentives in these two countries (see Table 16) emphasizes disbursements with secondary emphasis on taxation and nontraditional services (Germany) and taxation with secondary emphasis on market activity and requirements (United States).

These correlations of institutional conditions with incentive types are at best tentative and suggestive of underlying political/economic relationships given the limited number of countries we have studied. Centralization of government power may be associated with market activity and disbursements because the central government has ample resources at its control and it can direct them to particular incentive recipients with a high degree of precision (compared to the other incentive types such as nontraditional services). Strong and independent legislatures and judiciaries may predispose a country towards requirements since these are the agents of government who promulgate and enforce requirements. The United States is the example in our sample which conforms to this pattern. Decentralized government, coupled with a powerful private sector, may be associated with the use of disbursements if the private sector is centralized because the recipients are relatively easy to identify. A relatively decentralized but powerful private sector may be more readily stimulated by taxation incentives which leave the important allocative decisions in the private sector.

It is interesting to note that both Germany and the United States have chosen a mix of more and less precisely directed incentives in their attempts to stimulate private sector energy consumption. The division of social power between public and private sectors in these two countries may make control of the private sector by the public sector particularly difficult compared to the more centralized, government-dominated economic systems in the other two countries.

CONCLUSIONS

The data presented in this chapter reveal that each country has tended to use one or two incentive types quite heavily, placing less emphasis on the other incentive types. However, different emphases were

chosen by each country. In France and Japan, market activity and disbursements are emphasized. Germany has relied mainly on disbursements, backed up by tax and nontraditional service incentives. The United States has used taxation incentives most heavily, with secondary emphasis on requirements and market activity. Market activity may be a relatively expensive incentive type, although it is very attractive due to the precision with which funds can be directed. Patterns of association of institutional conditions and relative emphasis on incentive types suggest that market activity, and to some extent disbursements, may be more useful for very centralized, government-dominated politico-economic systems, while taxation or disbursement incentives may be more useful in decentralized systems with a strong private sector. Requirement incentives are more likely if there are independent legislatures and judiciaries. The remaining incentive types seemed to be used as supplements to the other incentive types.

APPENDIX A

THE ENERGY CONTEXT IN EACH OF THE FOUR COUNTRIES:
RESOURCES, PRODUCTION, AND CONSUMPTION

APPENDIX A

INTRODUCTION

This appendix begins to lay the foundation for comparing the incentives used to stimulate energy production in France, West Germany, Japan, and the United States. This appendix examines the production and consumption of each traditional energy form in each country and identifies the energy technologies used. It also discusses who owns the various parts of the different production processes.

A discussion of aggregate energy values is followed by individual treatment of oil, natural gas, coal, nuclear energy, hydro and geothermal energy, and electricity. For each energy type, there is a comparison of production levels, sectoral consumption, production/consumption ratios, reserves, and methods of extraction or production.

Two types of comparisons are provided. The period 1960-1978 provides a historical perspective of energy production and consumption levels. A more detailed cross-sectional view of a single year (1978) is also given to more clearly illustrate a comparison of recent energy patterns. A single information source was used as much as possible to ensure comparability of the data for the four individual countries.

The numbers in the tables and figures throughout this appendix represent net heating value and differ somewhat from the gross heating value figures normally published in the United States. The difference between the net and the gross values is the latent heat of condensation of the water vapor produced during combustion. On average, the net heating value is 5% to 8% lower. The sources for the following production and consumption data are Energy Balances of OECD Countries 1960/1974 and Energy Balances of OECD Countries 1974/1978, Organization for Economic Cooperation and Development, Paris, France, 1976 and 1980 respectively.

AGGREGATE ENERGY VALUES

In 1978, the United States consumed over five times as much energy as Japan, almost seven times as much as Germany, and nearly ten times as much

as France. Oil is the most important fuel in all four countries. Coal is the second most important fuel and gas is the third in France, Germany, and Japan, while in the United States the order is reversed. This information is illustrated in Table A-1 below.

All four countries are very dependent upon imported energy, in particular, oil. In 1978, France produced only 24% of its energy requirements, Germany 43%, Japan 14%, and the United States 78%.

Consumption patterns are shown in Table A-2.

Historical patterns of total energy production and consumption are shown in Table A-3 and A-4. Note in Tables A-3 and A-4 the large portion of industrial consumption in Japan and the large transportation energy consumption in the United States. The following pages consider energy consumption and production patterns and trends in more detail.

TABLE A-1. Total Energy Consumption (Quads)

	Solid Fuel	Oil	Gas	Nuclear	Hydro and Geothermal	Electricity Imports	Total
France	1.3	4.5	0.7	0.3	0.6	Neg.	7.5
Germany	2.9	5.8	1.6	0.3	0.2	Neg.	10.8
Japan	2.0	10.2	0.6	0.6	0.7	0.0	14.2
U.S.	14.3	35.3	18.4	2.8	2.8	0.1	73.7

Source: Energy Balances of OECD Countries 1974/78, Organization for Economic Cooperation and Development, Paris, France, 1980.

TABLE A-2. Energy Consumption by Sector (Percentage)

	Energy Production	Industry	Transportation	Residential	Commercial	Other
France	23	31	17	22	5	2
Germany	26	30	14	21	8	1
Japan	26	43	13	14	2	3
United States	27	23	25	19	5	1

Source: Energy Balances of OECD Countries 1974/78, Organization for Economic Cooperation and Development, Paris, France, 1980.

OIL

Oil constitutes a major portion of the energy consumed by each of the four countries under study. In 1978, oil accounted for 60% of total energy consumption of France, 53% of Germany, 72% of Japan and 48% of the United States. See Tables A-5 and A-6 and Figures A-1 and A-2 for each country's historical oil production and consumption levels.

The sectoral use of oil for each country is given in Table A-7.

All four countries rely heavily on imported oil to meet their demand. France, Germany, and Japan import nearly 100% of the oil they consume. All three countries are supplied primarily by the OPEC countries, although Japan also obtains oil from other producers, including China. The United States, on the other hand, is a major oil producer in addition to importing about 45% of its needs (as of 1978).

Production/consumption ratios for each country are given in Table A-8.

Domestic reserves vary substantially among the four countries. As of December 31, 1979, France had only 50 million barrels of proved reserves. These were located primarily in the Paris Basin and the Aquitaine Basin, near Bordeaux. These resources are the property of the government, which is also responsible for resource development. There were 293 producing wells in France in 1979.

TABLE A-3. Total Energy Production^{(a)(b)}--Coal, Oil, Natural Gas, Geothermal, Hydroelectric and Nuclear (Quad)

Year	France	West Germany	Japan	United States
1960	2.3	5.10	2.27	38.22
1961	2.21	5.15	2.48	38.63
1962	2.18	5.21	2.37	40.44
1963	2.15	5.28	2.37	42.23
1964	2.21	5.35	2.39	43.95
1965	2.29	5.15	2.46	45.57
1966	2.32	4.92	2.51	48.23
1967	2.18	4.51	2.28	50.85
1968	2.00	4.62	2.32	52.61
1969	2.03	4.73	2.22	54.90
1970	2.01	4.86	2.13	58.09
1971	1.86	4.86	2.04	57.71
1972	1.78	4.75	1.90	58.81
1973	1.71	4.76	1.64	58.76
1974	1.53	4.78	1.78	57.41
1975	1.66	4.71	1.75	56.27
1976	1.52	4.69	1.88	56.62
1977	1.84	4.67	1.75	57.07
1978	1.84	4.62	1.98	57.53

^(a) These figures omit imports and exports of electricity.

^(b) Computed from energy production tables of each energy source.

TABLE A-4. Total Energy Consumption(a)(b)--Coal, Oil, Natural Gas, Geothermal, Hydroelectric, and Nuclear (Quad)

Year	France	West Germany	Japan	United States
1960	3.57	5.75	3.75	40.15
1961	3.68	5.91	4.19	40.75
1962	3.95	6.41	4.45	42.77
1963	4.30	6.90	5.00	44.55
1964	4.47	7.10	5.59	46.36
1965	4.59	7.30	5.99	48.53
1966	4.66	7.38	6.71	51.44
1967	4.87	7.36	7.70	52.90
1968	5.13	7.97	8.58	55.96
1969	5.46	8.78	9.89	59.49
1970	5.94	9.32	11.24	62.19
1971	6.22	9.42	11.51	63.90
1972	6.51	9.86	12.35	66.96
1973	7.25	10.52	13.32	69.43
1974	6.92	10.29	13.49	67.95
1975	6.60	9.59	13.20	66.02
1976	7.00	10.44	13.64	69.96
1977	7.05	10.38	13.81	71.94
1978	7.52	10.79	14.14	73.43

(a) These figures omit imports and exports of electricity.

(b) Computed from energy consumption tables for coal, oil, and gas. For geothermal, hydroelectric, and nuclear, computed from production tables assuming that the production/consumption ratios for these energy forms equal 1.

TABLE A-5. Domestic Oil Production (Quad)^(a)

Year	France	West Germany	Japan	United States
1960	0.09	0.25	0.02	15.16
1961	0.11	0.28	0.03	15.49
1962	0.12	0.33	0.03	15.89
1963	0.12	0.33	0.03	16.38
1964	0.14	0.35	0.02	16.68
1965	0.15	0.36	0.03	17.10
1966	0.14	0.37	0.03	18.15
1967	0.14	0.34	0.03	19.24
1968	0.13	0.34	0.03	20.06
1969	0.13	0.34	0.03	20.46
1970	0.12	0.32	0.03	21.34
1971	0.11	0.32	0.03	21.22
1972	0.09	0.30	0.03	21.16
1973	0.08	0.27	0.03	20.59
1974	0.04	0.25	0.03	20.20
1975	0.04	0.23	0.02	18.94
1976	0.04	0.22	0.02	18.52
1977	0.04	0.22	0.02	18.70
1978	0.04	0.20	0.02	19.52

Sources: Energy Balances of the OECD Countries 1960/1974 and Energy Balances of the OECD Countries 1974/1978 published in 1976 and 1980 respectively by the Organization for Economic Cooperation and Development, Paris, France.

(a) Figures are net heating values.

FIGURE A.1. Domestic Oil Production^(a)

(a) Domestic oil production is minimal in France, Germany, and Japan, and so appears on this graph as essentially zero in comparison to U.S. production. For actual figures, see Table 5.

TABLE A-6. Domestic Oil Consumption (Quads)

Year	France	West Germany	Japan	United States
1960	1.06	1.23	1.18	17.93
1961	1.16	1.50	1.45	18.23
1962	1.35	1.90	1.83	19.03
1963	1.60	2.27	2.25	19.68
1964	1.86	2.62	2.78	20.13
1965	2.04	3.03	3.14	21.05
1966	2.18	3.41	3.68	22.14
1967	2.45	3.54	4.55	22.76
1968	2.67	3.98	5.29	24.08
1969	3.02	4.53	6.39	25.74
1970	3.48	5.06	7.72	27.23
1971	3.86	5.23	8.09	28.29
1972	4.25	5.54	8.98	30.33
1973	4.85	5.90	10.04	31.38
1974	4.58	5.30	9.69	31.14
1975	4.16	5.00	9.45	30.50
1976	4.49	5.59	9.73	32.70
1977	4.19	5.49	10.12	34.81
1978	4.53	5.78	10.17	35.18

FIGURE A-2. Domestic Oil Consumption

TABLE A-7. Consumption by Sector (Percentage)

	Energy Production	Industry	Transportation	Residential Commercial and Other
France	15	29	27	29
Germany	15	26	25	35
Japan	29	37	18	16
United States	12	18	52	18

Source: Energy Balances of OECD Countries 1974/1978, Organization for Economic Cooperation and Development, Paris, France, 1980.

In Germany and Japan, oil reserves are also quite small. German oil reserves stand at 480 million barrels, located mainly in Lower Saxony, whereas Japan possesses only 55 million barrels. In both countries, oil resource ownership is split among private individuals and companies and the national government. The resources are developed by private companies with some government direction, particularly in Japan. In 1979, there were 2,945 producing wells in Germany and 507 in Japan.

Proved reserves in the United States stand at 26.5 billion barrels. Most oil is located in the Gulf of Mexico area and in Alaska. Over half is located offshore. Much of this oil is owned by the Federal Government, and some is owned by the states. Private individuals have claim to the oil not on government land; interestingly, development is handled entirely by privately owned companies. In 1978, 13% of the total U.S. oil production came from offshore; 16% came from Alaska alone. A total of 508,000 thousand wells were producing in 1979, with average production of about 20 barrels per day.

The refining and distribution of petroleum is handled by private companies in Germany, Japan, and the United States. In France, these

TABLE A-8. Production/Consumption Ratio for Oil(a)

Year	France	West Germany	Japan	United States
1960	.09	.20	.02	.85
1961	.10	.19	.02	.85
1962	.09	.17	.02	.83
1963	.08	.15	.01	.83
1964	.08	.13	.01	.83
1965	.07	.12	.01	.81
1966	.06	.11	.01	.82
1967	.06	.10	.01	.85
1968	.05	.09	.01	.83
1969	.04	.08	.01	.79
1970	.04	.06	.00	.78
1971	.03	.06	.00	.75
1972	.02	.05	.00	.70
1973	.02	.05	.00	.66
1974	.01	.05	.00	.65
1975	.01	.05	.00	.62
1976	.01	.04	.00	.57
1977	.01	.04	.00	.54
1978	.01	.04	.00	.56

(a) Computed by dividing domestic oil production by domestic oil consumption.

TABLE A-10. Domestic Gas Production (Quads)

Year	France	West Germany	Japan	United States
1960	0.10	0.03	0.03	11.63
1961	0.14	0.03	0.04	11.99
1962	0.16	0.04	0.05	12.56
1963	0.17	0.05	0.07	13.26
1964	0.18	0.07	0.07	13.96
1965	0.17	0.10	0.07	14.48
1966	0.18	0.12	0.08	15.59
1967	0.19	0.15	0.08	16.47
1968	0.19	0.21	0.09	17.51
1969	0.22	0.28	0.09	18.79
1970	0.24	0.40	0.10	20.06
1971	0.24	0.48	0.10	20.58
1972	0.25	0.55	0.10	20.61
1973	0.26	0.61	0.10	20.72
1974	0.26	0.63	0.10	19.48
1975	0.25	0.58	0.10	18.09
1976	0.24	0.59	0.09	17.96
1977	0.26	0.59	0.10	17.90
1978	0.27	0.62	0.09	17.63

functions are largely nationalized although private companies are involved in gasoline distribution.

NATURAL GAS

Natural gas consumption in France, Germany, and Japan is currently at a relatively low level, although it has been increasing rapidly. In the United States, natural gas is second in importance only to oil. The use of natural gas by each sector is given in Table A-9. Historical production and consumption levels for each country are given in Tables A-10 and 11 and Figures A-3 and A-4. For year 1978, the percentage of total energy consumption accounted for by natural gas was 10% in France, 15% in Germany, 4% in Japan, and 25% in the United States.

The United States is the only country among the four with the potential for substantial gas production. This is shown in Table A-12.

The U.S. produces most of the gas it consumes, whereas France, Germany, and Japan rely heavily on imports. The production/consumption ratio for each country is given in Table A-13. French imports come mainly through pipeline from the Netherlands and in the form of LNG from

TABLE A-9. Natural Gas Consumption by Sector (Percentage)

	Energy Production	Industry	Residential Commercial and Other
France	10	46	44
Germany	28	40	32
Japan	43	16	41
United States	31	29	40

Source: Energy Balances of OECD Countries 1974/1978, Organization for Economic Cooperation and Development, Paris, France, 1980.

FIGURE A-3. Domestic Gas Production^(a)

(a) Domestic natural gas production is minimal in France, Germany, and Japan, and so appears on this graph as essentially zero in comparison to U.S. production. For actual figures, see Table A-9.

TABLE A-11. Domestic Gas Consumption (Quads)

Year	France	West Germany	Japan	United States
1960	0.10	0.03	0.03	11.64
1961	0.14	0.04	0.04	12.06
1962	0.16	0.04	0.05	12.85
1963	0.16	0.05	0.06	13.50
1964	0.17	0.08	0.07	14.24
1965	0.18	0.10	0.08	14.78
1966	0.19	0.12	0.08	15.96
1967	0.21	0.15	0.08	16.75
1968	0.25	0.26	0.09	17.96
1969	0.29	0.36	0.11	19.31
1970	0.34	0.51	0.15	20.38
1971	0.39	0.68	0.15	21.06
1972	0.46	0.87	0.16	21.36
1973	0.54	1.09	0.23	21.20
1974	0.57	1.31	0.27	20.23
1975	0.64	1.39	0.33	18.60
1976	0.68	1.46	0.40	18.68
1977	0.71	1.54	0.45	18.28
1978	0.77	1.63	0.63	18.40

FIGURE A-4. Domestic Gas Consumption

TABLE A-12. Natural Gas Reserves, Production and Imports
(Billion Cubic Feet)

	Reserves	Marketed Production	Imports
France	6300	228	527
Germany	6350	707	1451
Japan	600	93	591
United States	194,000	19,974	966

Sources: Reserves; Oil and Gas Journal, December 31, 1979. Marketed Production; World Natural Gas 1978, Energy Information Administration, July, 1980, pp. 6-11. Imports; World Natural Gas, pp. 32-33.

Algeria. Germany imports gas from the Netherlands, Norway, and the U.S.S.R. All of Japan's gas imports are LNG from Brunei, Indonesia, the United Arab Emirates, and the United States. Most U.S. imports come from Canada; in addition a small amount of LNG is imported from Algeria.

Natural gas resources in France are the property of the government. Nationalized companies are in charge of developing gas reserves. Most domestic production has come from onshore fields. The gas is distributed by Gaz de France, a nationalized company.

In Germany, ownership of gas resources lies both with the private and public sectors. Production and distribution is controlled by private companies. Most domestic gas production comes from onshore fields, some from coal mines. The same conditions hold in Japan.

In the United States the ownership of natural gas resources is divided between the private and governmental sectors. Production is handled by private companies, typically the same ones that account for

TABLE A-13. Production/Consumption Ratio for Gas(a)

Year	France	West Germany	Japan	United States
1960	1.00	1.00	1.00	.99
1961	1.00	.75	1.00	.99
1962	1.00	1.00	1.00	.98
1963	1.06	1.00	1.17	.98
1964	1.06	.88	1.00	.98
1965	.94	1.00	.88	.98
1966	.95	1.00	1.00	.98
1967	.91	1.00	1.00	.98
1968	.76	.81	1.00	.98
1969	.76	.79	.82	.97
1970	.71	.78	.67	.98
1971	.62	.71	.67	.98
1972	.54	.63	.63	.97
1973	.48	.56	.44	.98
1974	.47	.48	.37	.96
1975	.39	.42	.30	.97
1976	.35	.40	.23	.96
1977	.37	.38	.22	.98
1978	.35	.38	.14	.96

(a) Computed by dividing domestic gas production by gas consumption.

U.S. oil production. Approximately 18% of gas production is associated with oil production, while 82% comes from gas wells. More and more production comes from offshore wells, where most of the remaining reserves are located.

COAL

Despite the fact that coal is the major energy resource of each country under study, its consumption and production has been falling until very recently in each country except the United States. The share of coal used by each sector is given Table A-14, and the historical production and consumption levels of each country appear in Tables A-15, and A-16, and Figures A-5 and A-6. As a share of total energy requirements, coal accounts for 17% in France, 27% in Germany, 14% in Japan, and 19% in the United States.

In 1977, France produced 21 million tons of coal and had net imports of 22 million tons. France imports both metallurgical coal for producing coke, and steam coal for producing electricity. The main sources are from Germany and Poland.

TABLE A-14. Coal Consumption by Sector (Percentage)

	Energy Production	Industry	Residential Commercial and Other
France	59	28	13
Germany	72	21	7
Japan	40	54	6
United States	78	21	1

Source: Energy Balances of OECD Countries 1974/1978, Organization for Economic Cooperation and Development, Paris, France, 1980.

TABLE A-15. Domestic Coal Production (Quads)

Year	France	West Germany	Japan	United States
1960	1.57	4.68	1.65	9.98
1961	1.47	4.70	1.75	9.66
1962	1.46	4.70	1.68	10.34
1963	1.34	4.76	1.60	10.96
1964	1.48	4.80	1.63	11.58
1965	1.44	4.53	1.62	12.10
1966	1.41	4.25	1.62	12.56
1967	1.34	3.85	1.49	12.97
1968	1.14	3.89	1.46	12.79
1969	1.14	3.92	1.34	13.11
1970	1.05	3.92	1.18	14.07
1971	0.93	3.88	0.98	12.93
1972	0.85	3.69	0.82	13.92
1973	0.75	3.63	0.72	13.88
1974	0.69	3.63	0.62	13.85
1975	0.68	3.56	0.54	14.81
1976	0.67	3.52	0.57	15.46
1977	0.66	3.35	0.57	15.70
1978	0.61	3.31	0.56	14.75

FIGURE A-5. Domestic Coal Production

TABLE A-16. Domestic Coal Consumption (Quads)

Year	France	West Germany	Japan	United States
1960	1.87	4.35	1.97	9.13
1961	1.89	4.23	2.04	8.97
1962	2.00	4.33	1.96	9.24
1963	2.02	4.44	2.02	9.74
1964	2.03	4.27	2.07	10.26
1965	1.84	4.01	2.03	10.81
1966	1.70	3.67	2.17	11.41
1967	1.70	3.50	2.39	11.22
1968	1.67	3.55	2.46	11.67
1969	1.61	3.70	2.63	11.90
1970	1.52	3.53	2.55	11.96
1971	1.39	3.33	2.34	11.57
1972	1.21	3.24	2.26	12.15
1973	1.24	3.28	2.26	13.28
1974	1.23	3.41	2.50	12.70
1975	1.11	2.86	2.33	12.49
1976	1.26	3.03	2.31	13.90
1977	1.27	2.84	2.18	14.08
1978	1.30	2.89	2.03	14.22

FIGURE A-6. Domestic Coal Consumption

Germany in 1977 produced 110 million tons of coal, two-thirds of which was steam coal. Although Germany imported coal from such diverse sources as the U.S., South Africa, and Poland, the country was a net exporter of 13 million tons.

Most of Japan's coal consumption was met through imports. Domestic production of 17 million tons compares to imports of 62 million, mainly metallurgical coal used in steam production. Major suppliers are Australia, Canada, South Africa, the United States, and the U.S.S.R.

In 1977, the United States produced 443 million tons of steam coal and 114 million tons of metallurgical coal. Net exports amounted to 48 million tons, mostly of metallurgical coal.

Production/consumption ratios for each country are given in Table A-17.

Resource ownership and development follow the same pattern as oil and natural gas: a combination of public and private ownership and private development in Germany, Japan, and the United States, and public ownership and development in France, under the French Coal Board, Charbonnages de France.

French coal reserves are located in three regions as shown in Table A-18. Most of these reserves are quite deep (700-1,250 meters) and thus difficult to mine. This means that practically all of the coal in France must be mined by underground methods.

In Germany, 81% of all bituminous coal reserves are located in the Ruhr district. Brown coal is found mainly (88%) in the Rhenish field (Brown coal is a low rank, unconsolidated coal similar in heating value to lignite.). Much of Germany's bituminous coal is very deep and currently uneconomical to mine. There is a more immediate potential for developing the brown coal deposits even though total resources are smaller. Coal deposits in Germany are estimated as shown in Table A-19.

Japan possesses 3.2 billion tons of recoverable coal reserves and 20.3 billion tons of theoretically recoverable reserves. These reserves lie mainly in Hokkaido and western Kyushu. Most are very deep and only marginally economical at the present time.

TABLE A-17. Production/Consumption Ratio for Coal(a)

Year	France	West Germany	Japan	United States
1960	.84	1.08	.84	1.09
1961	.78	1.11	.86	1.08
1962	.73	1.09	.86	1.12
1963	.66	1.07	.79	1.13
1964	.73	1.12	.79	1.13
1965	.78	1.13	.80	1.12
1966	.83	1.16	.75	1.10
1967	.79	1.10	.62	1.16
1968	.68	1.10	.59	1.10
1969	.71	1.06	.51	1.10
1970	.69	1.11	.46	1.18
1971	.67	1.17	.42	1.12
1972	.70	1.14	.36	1.15
1973	.61	1.11	.32	1.05
1974	.56	1.07	.25	1.09
1975	.61	1.25	.23	1.19
1976	.53	1.16	.25	1.11
1977	.52	1.18	.26	1.12
1978	.47	1.15	.28	1.04

(a) Computed by dividing domestic coal production by coal consumption.

TABLE A-18. Coal Reserves in France (Million Metric Tons)

Basin	Predictable Reserves	Exploitable Reserves
North Pas-de-Calais	30	460
Lorraine	310	800
Center	<u>110</u>	<u>110</u>
Total	450	1370

Source: Future Coal Prospects: Country and Regional Assessments, C. L. Wilson, ed., Ballinger Publishing Co., Cambridge, Massachusetts, 1980.

TABLE A-19. Coal Reserves in Germany (Billion Metric Tons)

	Economically and Technically Recoverable	Total Resources
Bituminous Coal	24	230
Brown coal	35	55

Source: Future Coal Prospects

The United States possesses the world's largest deposits of recoverable coal reserves, which are mainly bituminous and sub-bituminous but also include sizeable amounts of anthracite and lignite coal. Deposits in the east are generally deep enough to require underground mining methods, although many surface deposits also exist. Both high- and low-sulfur coals are present. Western deposits are generally close to the surface and are low in sulfur and energy content. Recent increases in U.S. production have come mainly from surface mines in the West. Abundant reserves in Alaska have yet to be fully developed.

HYDROELECTRICITY

Potential hydroelectric resources in the four countries under study have been largely developed. The greatest remaining potential is in the United States, although institutional, environmental, and other barriers stand in the path of further development. In 1978, hydroelectricity contributed 8% of the total energy requirements of France, 2% of Germany, 5% of Japan, and 4% of the United States. See Table A-20 and Figure A-7 for hydroelectricity production during the years 1960-1978.

Very little hydroelectric energy crosses national boundaries, though some utilities in the northeast United States do import hydroelectric power from Canada.

Hydroelectric power is developed by the government in France, and by both the private and public sectors in the other countries. Even in cases where private firms are involved, the government usually controls the nature and scope of the project.

NUCLEAR ENERGY

In 1978, nuclear energy provided a small share of the total energy requirements of each country under study: 4% in France, Japan and the United States, and 3% in Germany. Table A-21 and Figure A-8 show each country's nuclear production over the 1960-1978 period. A summary of nuclear power capacity and production for 1978 is given in Table A-22.

TABLE A-20. Geothermal and Hydroelectric Energy Production (Quads)(a)(b)

Year	France	West Germany	Japan	United States
1960	0.54	0.14	0.57	1.45
1961	0.49	0.14	0.66	1.48
1962	0.44	0.14	0.61	1.63
1963	0.52	0.14	0.67	1.60
1964	0.41	0.13	0.67	1.70
1965	0.52	0.16	0.74	1.86
1966	0.57	0.18	0.78	1.88
1967	0.48	0.16	0.68	2.10
1968	0.51	0.16	0.73	2.13
1969	0.50	0.14	0.75	2.40
1970	0.55	0.16	0.78	2.40
1971	0.49	0.13	0.86	2.60
1972	0.46	0.12	0.86	2.59
1973	0.48	0.14	0.70	2.71
1974	0.41	0.16	0.83	2.79
1975	0.53	0.15	0.85	2.78
1976	0.43	0.13	0.87	2.77
1977	0.71	0.17	0.75	2.21
1978	0.64	0.16	0.73	2.80

(a) Valued at the energy content of the amount of fossil fuels required to produce the same amount of electricity.

(b) Geothermal is a small part of the total.

FIGURE A-7. Geothermal and Hydroelectric Energy Production

TABLE A-21. Nuclear Energy Production (Quads)(a)

Year	France	West Germany	Japan	United States
1960	0.00	0.00	0.00	0.00
1961	0.00	0.00	0.00	0.01
1962	0.00	0.00	0.00	0.02
1963	0.00	0.00	0.00	0.03
1964	0.00	0.00	0.00	0.03
1965	0.01	0.00	0.00	0.03
1966	0.02	0.00	0.00	0.05
1967	0.03	0.01	0.00	0.07
1968	0.03	0.02	0.01	0.12
1969	0.04	0.05	0.01	0.14
1970	0.05	0.06	0.04	0.22
1971	0.09	0.05	0.07	0.38
1972	0.13	0.09	0.09	0.53
1973	0.14	0.11	0.09	0.86
1974	0.13	0.11	0.20	1.09
1975	0.16	0.19	0.24	1.65
1976	0.14	0.23	0.33	1.91
1977	0.17	0.34	0.31	2.56
1978	0.28	0.33	0.58	2.83

(a) Valued at the energy content of the amount of fossil fuels required to produce the same amount of electricity.

FIGURE A-8. Nuclear Energy Production

TABLE A-22. Nuclear Power Capacity and Production in 1978

	Number of Units	Capacity (MW)	Production (10 ⁹ kWh)
France	14	8330	31
Germany	12	5893	33
Japan	18	11,502	51
United States	71	53,500	293

Sources: Number of Units and Capacity; Info News Release, Atomic Industrial Forum, Washington, D.C., February, 1980. Production; 1979 Annual Report to Congress Vol. 2, Energy Information Administration, 1980, p. 163.

Older French reactors are gas cooled while newer ones are Pressurized Water Reactors (PWR). The newest reactors are generally about 900 MW in size, while those under construction range up to almost 1,300 MW. The French also operate a small breeder reactor, which is part of an ambitious nuclear development program. Construction and operation are under control of Electricite de France. A variety of reactors are in operation in Germany, although most are Boiling Water Reactors (BWR) and PWR. Japanese and U.S. reactors are almost exclusively BWR and PWR. Japanese reactors tend to be smaller, in the 500-800 MW range, although some under construction are over 1000 MW. Almost all recently completed reactors in the U.S. are over 800 MW, and those under construction over 1,100 MW.

Only France and the United States possess substantial uranium reserves for nuclear fuel production. Uranium reserves are estimated to be 55,000 tons in France, 1,000 in Germany, 8,000 in Japan, and 454,000 in the United States.

Nuclear energy production entails a complex set of processes, which include uranium exploration, milling, conversion and enrichment, fuel fabrication, electricity generation, and waste reprocessing and disposal.

By their nature, most, if not all, of these processes require close government regulation or direct government operation. In France, all operations are in the realm of government enterprise. In the other three countries, the private sector plays a substantial role. In the United States, the only areas under exclusive government control are enrichment and disposal, and even these are actually performed under contract by private firms. The United States maintains a large enrichment capability which supplies many foreign as well as domestic customers. Major gaseous diffusion plants are operated in Oak Ridge, Tennessee, Paducah, Kentucky, and Portsmouth, Ohio. A large gas centrifuge plant is under construction in Portsmouth. The U.S. has no commercial reprocessing facilities in operation. The French operate commercial-size reprocessing facilities, which are owned in partnership with the U.K. and Germany. The French also have a substantial enrichment capability based on gas centrifuge technology. Japan currently operates a small reprocessing plant.

ELECTRICITY

As a percentage of total final consumption, electricity is approximately 12% in France, 13% in Germany, 16% in Japan, and 13% in the United States. Net electrical consumption data are given in Table A-23 and Figure A-9. The largest user in Japan is industry, in the United States it is the residential/commercial sector, whereas in France and Germany it is evenly divided between the two sectors. Transportation use of electricity currently is limited to electric trains. These data are shown in Table A-24.

In Japan, oil is relied upon most heavily as a fuel for electricity generation. In Germany and the United States, coal is dominant, while in France there is a relatively even distribution among fuels. Generation by fuel type is given in Table A-25.

In France, electricity is generated and distributed by nationalized firms. There is a mixture of public and private ownership in Germany and the U.S., with private ownership dominant. In Japan, private ownership is the rule.

TABLE A-23. Domestic Electricity Consumption (Quads)(a)

Year	France	West Germany	Japan	United States
1960	0.21	0.33	0.32	2.60
1961	0.22	0.35	0.38	2.77
1962	0.24	0.38	0.40	2.97
1963	0.26	0.41	0.47	3.19
1964	0.28	0.44	0.53	3.40
1965	0.30	0.48	0.56	3.66
1966	0.32	0.51	0.64	3.95
1967	0.34	0.53	0.73	4.16
1968	0.36	0.59	0.81	4.53
1969	0.39	0.65	0.95	4.92
1970	0.42	0.71	1.07	5.15
1971	0.44	0.76	1.16	5.40
1972	0.48	0.82	1.29	5.82
1973	0.52	0.90	1.42	6.20
1974	0.55	0.92	1.42	6.00
1975	0.55	0.90	1.44	6.09
1976	0.60	0.98	1.55	6.49
1977	0.63	1.00	1.61	6.81
1978	0.68	1.05	1.70	7.04

(a) Figures represent net energy available to consumers; net of generation and transmission losses and electricity used by the generating plants.

FIGURE A-9. Domestic Electricity Consumption

TABLE A-24. Electricity Consumption by Sector (Percentage)

	Industry	Transportation	Residential Commercial and Other
France	46	3	50
Germany	47	3	50
Japan	63	3	34
United States	40	--	60

Source: Energy Balances of OECD Countries 1974/1978, Organization for Economic Cooperation and Development, Paris, France, 1980.

TABLE A-25. Fuel Use for Electricity Generation (Percentage)

	Coal	Oil	Gas	Nuclear	Hydro
France	33	20	3	13	31
Germany	61	8	15	10	5
Japan	10	53	9	12	16
United States	46	16	13	12	12

Source: Energy Balances of OECD Countries 1974/1978, Organization for Economic Cooperation and Development, Paris, France, 1980.

NOTES - APPENDIX A

Unless otherwise noted, we used the following sources of information:

OIL

1. Consumption by Sector
Energy Balances of OECD Countries 1974/1978, Organization for Economic Cooperation and Development, Paris, France, 1980.
2. Production, Consumption
Energy Balances
3. Source of Imports
1978 International Petroleum Annual, Energy Information Administration, April 1980, pp. 22-23.
4. Level of Reserves
Oil and Gas Journal, December 31, 1979.
5. Location of Reserves
1980 International Petroleum Encyclopedia, The PennWell Publishing Co., Tulsa, Oklahoma, 1980.
6. Number of Wells
Oil and Gas Journal
7. Percent U.S. Production; Onshore, Offshore
1979 Annual Report to Congress Vol. 2, Energy Information Administration, 1980, p. 45.

NATURAL GAS

1. Production, Consumption
Energy Balances
2. Consumption by Sector
Energy Balances
3. Reserves
Oil and Gas Journal
4. Marketed Production
World Natural Gas 1978, Energy Information Administration, July, 1980, pp. 6-11.
5. Imports
World Natural Gas 1978, pp. 32-33.
6. Source of U.S. Natural Gas
1979 Annual Report to Congress, p. 89.

COAL

1. Production, Consumption
Energy Balances
2. Consumption by Sector
Energy Balances

APPENDIX B

THE INSTITUTIONAL CONTEXT IN EACH OF THE FOUR COUNTRIES:
DEMOGRAPHY, GOVERNMENTAL CHARACTERISTICS AND ROLES,
ECONOMIC AND ENERGY POLICYMAKING

APPENDIX B

INTRODUCTION

This appendix continues to lay the foundation for comparing the incentives used to stimulate energy production in France, West Germany, Japan, and the United States. The focus of this appendix is on the institutional context in which incentives are applied in each of these countries. We examine the political and economic arrangements typical of each country and note the legal framework in which these institutions have developed. The significant actors and institutions involved in making energy policy in each country are discussed. The actual policies used to stimulate energy production in each country have been discussed and compared in the various chapters.

DEMOGRAPHIC COMPARISON

Table B-1 provides data on characteristics of the population, economy, and energy production and consumption in each of the four countries. The United States is by far the largest of the countries in terms of population. It has twice the population of Japan. West Germany and France are relatively similar in population size, each being about half of the size of Japan. The population growth rates present a somewhat different picture, however. Japan has the highest growth rate, at 1.3% per year; the United States is second, at 0.8%; France comes in third, at 0.7%; and West Germany has a very low rate, 0.2% per year. Japan is a very densely populated country, with over 300 persons per square kilometer. West Germany is the second most densely populated country with nearly 250 persons per square kilometer. France is relatively less densely populated, with only 97 persons per square kilometer, about a third of the Japanese population density. The United States is low in population density, with only 23 persons per square kilometer. These differences in population size and population density go far in

TABLE B-1. Population, Economic and Energy Characteristics of Four Countries, 1976

	Population (a) (Millions)	Population Growth Rate(a) 1970-76 (Percent)	Population Density(a) (Pop./Sq. Km)	Gross Domestic Product(b) (Millions of US Dollars)	Per Capita Gross Domestic Product(b)(US\$)	Energy Consumption/ GDP(c) Ratio(d) (Quads/Billion \$)
France	52	0.7	97	346,731	6,552	20.2
West Germany	61	0.2	247	445,909	7,249	23.4
Japan	112	1.3	303	555,063	4,937	24.6
United States	215	0.8	23	1,702,023	7,912	41.1

B-2

(a) Statistical Yearbook, 1977, New York: United Nations, 1978, Table 18: Population, pp. 68-79.

(b) Op.cit., Table 193: Estimates of total and per capita gross domestic product in purchasers values, pp. 742-750.

(c) Gross Domestic Product is not corrected for purchasing power parity.

(d) Computed from Gross Domestic Product and energy consumption data totaled from tables in Energy Balances of the OECD Countries 1974/1978. Organization for Economic Cooperation and Development. Paris, France, 1980.

explaining the differences in energy consumption that will be discussed below.

The United States not only has the largest population of this group of countries, it also has the largest economy, as measured by Gross Domestic Product (GDP). Measured in U.S. dollars, the U.S. has a GDP of 1.7 trillion dollars, while Japan, the second largest economy, has an annual GDP of only .5 trillion. West Germany is close to Japan in economic size, at .4 trillion, and France comes in third with nearly .35 trillion, or about a fifth of the U.S. economy. However, per capita GDP falls in a much narrower range. The United States has the largest per capita GDP, at \$7,912. West Germany is second but quite close to the United States, while France is somewhat lower, and Japan is considerably lower.

The last column of Table B-1 shows the ratio of energy consumption to GDP. This index is sometimes taken as a measure of efficiency of energy use, since it shows the number of units of energy consumption per dollar of GDP produced. The United States has clearly the highest energy consumption/GDP ratio, with an index value of just about twice that of the other countries. France, West Germany, and Japan are relatively close together on this index.

Interpretations of this index as a measure of energy efficiency must be made with considerable care. Differences in population density, a factor that can be changed very little if at all by governmental policies, explain a good deal of the differences in the energy consumption/GDP ratio. A country such as the United States, whose population is spread out over vast distances, must necessarily spend more of its resources on transportation of persons and items than a relatively densely populated country such as Japan must spend. Population density differences obviously do not provide the entire explanation, as one can see by comparing the population densities and energy consumption/GDP ratios of France and Japan. France has only a third of the population density of Japan, but it has a lower energy consumption/GDP ratio. Some researchers (Darmstadter et al.) have systematically compared the energy consumption patterns of the industrialized countries of the world.⁽¹⁾ Darmstadter

and his colleagues find that population density is part of the explanation, and that specialization in different industries explains much of the rest of the difference in energy consumption/GDP ratios. The United States specializes in several relatively energy intensive industries. Relatively little of the difference in energy consumption patterns can be explained by "waste" of energy.

GOVERNMENT CHARACTERISTICS

France

Centralized government has long been a characteristic of the French political system. Indeed, strong central political control can be traced to the establishment of the French monarchy in the thirteenth century. Even during the era of revolutions in France--roughly 1780 to 1880--strong political institutions, based usually in Paris, ruled the country. This tradition continues to be reflected in France's current political institutions.

West Germany

Unlike France, Germany has a tradition of decentralized rule. Germany did not become a unified nation-state until the 1870s and local and regional autonomy continues to be an important influence. Although the norms of central authority have become more firmly established in German political culture, the Federal Republic of Germany remains a clear step away from the centralized rule that prevails in France. Since World War II each "Land"--or state government--has increased its independence while the role of the federal government has been reduced.

The federal government in Germany has control over only a few matters: chiefly foreign affairs, defense, federal finances, the postal service, telegraph and telephone services, and the railways.⁽²⁾ The Laender are responsible for education at all levels, most of the police power, radio and television media, and most of the administrative machinery. The federal government preempts any area of conflict among the states, or between a state and the federal government.

Japan

Unlike the political systems of France and Germany, the Japanese political system continues to be influenced by remnants of a monarchical system. An Emperor is the titular head of the Japanese nation. The constitution, though, curtails the power of the Emperor. All monarchical decisions have to be approved by the cabinet. The Emperor's role, therefore, is primarily ceremonial.⁽³⁾

The United States

The United States is the oldest of the world's new nations. It faced many of the problems that the world's new nations are facing today in the nineteenth century. Since 1791, the U.S. has been the world's oldest functioning democracy. Its founders established the country on three principles: federalism, separation of powers, and pluralism. Each person was subject to two governments--a state government and a national government. A system of checks and balances ensured the independence of three separate branches of government, and diversity of interests--regional, economic, religious, and social--guaranteed that no particular interest would command a majority.

THE ROLE OF THE EXECUTIVE, LEGISLATIVE, AND JUDICIAL BRANCHES

France

The Fifth Republic firmly established the independence and power of the French president.⁽⁴⁾ The popularly elected President, unlike the Japanese Prime Minister, is independent of Parliament, and can dissolve Parliament at any time. The President may call for referenda, and, even more importantly, he may issue decrees with the force of law. He appoints the Premier, and therefore has indirect control over the cabinet and the bureaucracy. The cabinet directly manages the civil service.⁽⁵⁾ The Premier and cabinet are also independent of the parliament, but the cabinet can be toppled by a motion of censure requiring an absolute majority of the assembly, as is the case in other parliamentary regimes.

The legislative branch consists of two bodies, the Senate and the National Assembly.⁽⁶⁾ Assembly members are directly elected. The

Assembly legislates on matters of law, but the constitution restricts areas of Assembly authority. The President determines the Assembly's order of business, and the President holds all budgeting powers.

Municipal and department councilors and representatives of the cities elect the Senate. Legislation must be passed in identical form by both houses; if not, the premier arbitrates the differences. If he wishes a contested bill to pass, he convenes a conference committee with representatives from both houses. If this committee cannot reach a compromise, a bill passed twice by the Assembly over-rides the senatorial veto. Thus, the Senate has less power than the Assembly.

The President also has some authority in controlling the judiciary.⁽⁷⁾ A constitutional council passes judgment on legislation only at the request of the president, premier, head of the Assembly, or head of the Senate. The courts are independent, but without the power to nullify or modify a law.

West Germany

The most powerful individual in the federal government is the chancellor.⁽⁸⁾ Although the president has direct control over the cabinet, the president is bound to follow the will of the chancellor in most matters. The chancellor is also the commander in chief of the armed forces, and assigns jurisdiction among the ministries within the constraints of the constitution. The chancellor is appointed by a majority of the legislature, and can be removed only if a successor has a similar mandate from the legislature.

The President, then, is largely a figurehead. He does, in times of emergency, wield an important power. The president, however, decides whether to call new elections when the chancellor and the legislature are divided on major issues.⁽⁹⁾

Federal legislation is devised in a two-chamber legislature.⁽¹⁰⁾ The Bundestag is the main source of legislation, and is directly elected. The Bundesrat, however, is elected by Land governments. It may initiate legislation, but mostly works as a source of state review of all federal

legislation. Thus, all federal legislation is subject to Land approval before becoming law.

West German courts are much stronger than French courts. The court system provides for judicial independence, protection of human rights, and some limited judicial review. While the German courts are not as independent as those in the United States, they still exercise considerable influence in German national affairs.⁽¹¹⁾

Japan

Actual power lies in the hands of the Prime Minister and the cabinet. The Prime Minister, elected by a majority of the legislative body (the Diet), appoints a cabinet whose members control the bureaucracy.⁽¹²⁾ The Prime Minister is the head of a party that commands a majority in the Diet. The conservative Liberal Democratic Party (LDP) has maintained an absolute majority in the Diet since 1955. The LDP, though, is largely a collection of factions.⁽¹³⁾

The Diet performs legislative functions. Although it can produce its own bills, most legislation is drawn up in the ministries. The Diet consists of two bodies, the House of Representatives and the House of Counsellors. The former is popularly elected, while 55% of the members of the latter body are selected by prefectures and 45% are selected through the popular vote. Bills must be passed by both houses, but the House of Representatives can override the House of Counsellors vetos with a two-thirds majority vote. In addition, the House of Counsellors has no authority to act on budgets and treaties.⁽¹⁴⁾

The Japanese judiciary enjoys independence from the government; it hears appeals requiring direct review of law.⁽¹⁵⁾ Although the Emperor appoints members to a Supreme Court, recall elections every ten years provide the public with the opportunity to remove the justices.

Almost all policy comes out of the various ministries. The National Diet has placed restrictions on its own authority to develop policy.⁽¹⁶⁾ This is not to suggest, however, that the member parties of the Diet have no influence on policy. Indeed, the selection of a prime

minister and the cabinet is determined by party politics, and it is in the ministries that policy is created.

Party politics partially influence policy development. In Japan, ministries are assigned largely for political reasons. In order for a political leader to gain the prime ministership, he must put together a coalition of sub-groups of the Liberal Democratic Party into a "winning coalition."⁽¹⁷⁾ The chief benefit he can offer prospective coalition members is a seat in the cabinet.⁽¹⁸⁾ Cabinet positions are generally short-lived, as a prime minister usually incurs more political debts in coming to power than he can pay back. Thus, ministers have few opportunities to learn the peculiarities of their ministries, and the ministers tend to rubber stamp policy initiatives coming from below. As many bureaucracy members are current or former party officials, the desire to placate potential foes and rivals also restricts the independence of the minister.

Policy initiatives usually begin in the ministerial bureaucracies. The policy options are selected by a rather unique process known as the "ringi" system.⁽¹⁹⁾ All members of the bureaucracy participate in the proposal preparation process. Two benefits accrue from this approach to decision making. The circulation of a draft proposal throughout the organization facilitates the flow of administrative information; a high degree of cooperation within the organization is thus achieved, as all members have already approved of a draft before it comes to the minister's attention. The disadvantages of the "ringi" system include the length of time necessary to develop policy, the dispersion of decision-making authority, and the built-in tendency to endorse policy as a matter of routine.

At all stages of the policy-development process, ministries coordinate their activities. The Legislative Bureau, the Ministry of Finance, the Economic Planning Board, or the Administrative Management Agency also work as third parties to coordinate policy.⁽²⁰⁾ Further, if the policy requires legislation, the concerned ministries seek the approval of the LDP to ensure smooth passage of a bill in the Diet. As the power of the LDP has slipped in recent years, ministries also have turned to opposition parties for support.

The United States

The most demanding job in American government is that of the President. The President is the only leader in the U.S. elected from a nationwide constituency. He is elected for a four-year term and may serve two terms in office. The President is commander in chief of the military. The President also is head of a large bureaucracy and has the right (with the advice and consent of the Senate) to appoint approximately 1,700 top policymakers including cabinet officials, judges, and ambassadors.

The American legislature has two chambers, both popularly elected. The House is based on the principle of equal representation to the people. The Senate, on the other hand, gives equal representation to the states. Members of the House serve two-year terms. Members of the Senate, in contrast, serve six-year terms. The framers of the Constitution wanted the Senate to be a counterweight to the House. They expected it to be composed of individuals who were older and more conservative and who would be capable of moderating and diluting popular passions. In practice, matters have not always worked this way. Sometimes the House has been more liberal, and sometimes the Senate has been more conservative, but often the opposite has been true. The House, which is larger and has 435 members, tends to be more hierarchically organized and to be more impersonal and formal in its proceedings. The Senate, in contrast, with only 100 members (two from each state) tends to be more flexible and less formal, but to act more slowly.

The courts in America are very powerful, probably more powerful than in any other democracy. Using the principle of judicial review--the right to decide whether a law or act is valid under the Constitution--they keep tight reins over the workings of both Congress and the President.

Also important in American politics are various interests, who play a crucial role in advancing their positions in front of the three branches and in determining policy. Included among the interests are business people, manufacturers, bankers, farmers, labor unions, the defense establishment, environmentalists, and others.

Regulatory agencies (ICC, REFC, FDA, EPA, OSHA, FTC, CAB, et al.) play important roles in economic affairs by setting rates, standards, and conditions for product entry. Rule making has become as important as legislation in recent years in determining what private enterprise is allowed to do.

ECONOMIC POLICYMAKING

France

Of the market economies of the world, France is notable for its emphasis on governmental economic planning. The Commissariat du Plan produces a five-year plan for the French economy, using national income statistics and simple forecasting techniques. This plan shows growth targets for each major industry in the economy. The Commissariat du Plan has a very small staff, and is dependent on the Treasury Ministry for much of the statistical and economic analysis that goes into the forecast used in the plan. In addition the Commissariat is so small that it cannot enforce its plan. It relies on the Finance Ministry to provide some enforcement through its control of banking in the country. For the most part, the French plan is an indicative plan; that is, it provides targets that are mutually consistent and achievable, but it relies on the cooperation of the private sector and other governmental agencies for implementation of the plan.⁽²¹⁾

The French government is not without power to ensure implementation of the plan. About 35% of all investment in the country is governmentally financed.⁽²²⁾ This gives the government a large lever to ensure that the growth will be shaped along lines indicated by the plan. Use of this lever to precisely implement the plan is difficult because the planning body does not have direct control over the investment funds. These funds are administered by the province of the Ministry of Finance. Thus, implementation of the plan has not been complete, nor in exact accordance with planning targets.

The original model of the plan as an indicative plan, with some governmental leverage over its implementation, emerged in the 1950s. During the 1960s, there were attempts by the planners to broaden the scope

of the plan and to do more in the way of shaping the direction of French economic growth, rather than merely reflecting the aggregate desires of the private sector investors. Attempts to use the plan to implement an income policy, to shape the growth of the housing markets, and to provide for additional public facilities such as hospitals, all came to naught. Thus, in recent years the French planning exercise has been forced to retreat to something like its original conception in the 1950s, with the plan serving as an indicator of future developments, but not as a major instrument of governmental social policy.⁽²³⁾

West Germany

German economic traditions are quite different from those of neighboring France:

Two countries, Germany and the United States, appear to be out of the mainstream of modern capitalism . . . They show no enthusiasm for the increasingly organized pattern of economic behavior, replacing the older methods of arriving at decisions through the autonomous, if haphazard, movement of the market; indeed, they evince an ostentatious antipathy for the whole process and loudly advocate resistance to it. Their official doctrines continue to carry a high content of simple traditional capitalist folklore.⁽²⁴⁾

Germany is basically a market economy, with little of the formal governmental planning found in France. However, German economic institutions are based on strong centralized control by major banks in the country. Three major banks, the Deutsche, the Dresdener, and the Commerzbank, have enormous influence over the economy, and lesser banks also exercise considerable control over industrial decisions. The banks wield their influence through the systematic collection of proxy voting rights from stockholders, which they then exercise in stockholder meetings. In addition, banks are represented on company supervisory boards called Aufsichtsrat (board of directors). Banks often have control over about 25% of the shares in a company, which gives the bank the right to sit on the company's supervisory board. The supervisory board is a device for the company's management to systematically consult with all parties whose interests are involved in the company. These interested parties include customers, suppliers, banks, and labor. The banks, by

systematically collecting proxies from investors, have a major influence on these boards.

Another mechanism for centralized control of the economy is the industrial association structure. Companies belong to industrial associations, which belong to regional industrial associations, and the regional associations in turn belong to a national association that is specifically empowered by the German Constitution to consult with governmental ministries on matters of interest to industry. Through these institutions, German industries are coordinated to a degree that is not found in a more openly competitive economy such as the United States'.⁽²⁵⁾

Japan

Japan's economic institutions represent yet another variation on possible governmental and private sector roles in a basically market economy. Major Japanese firms are distinguishable from U.S. firms in their policy of providing permanent employment for persons that are hired. That is, a person typically spends his entire career working for a single corporation. The corporation then must have mechanisms for accomodating the ups and downs of business cycles without changing the size of its basic work force. The corporation also provides a range of services to its employees that is not typical in the U.S, including housing and insurance benefits.

Individual firms in Japan are frequently members of informal commercial groups that consist of a bank, a trading company, and a collection of enterprises that produce a variety of products, some of which may be inputs for other firms in the group or outside it, and some of which may be final consumer items. Frequently the industrial firms are joint ventures of firms associated with two groups, a way of spreading risk.⁽²⁶⁾ Prior to World War II, control was centralized, and the complex was called a "zaibatsu". Zaibatsus were abolished under MacArthur, but loose associations remain.

The government lends support to this industrial structure in a number of ways. It provides funds for R&D and assists firms in finding markets

for their goods overseas. In contrast to the United States, Japan's economic structure is built around long-term relationships among groups of companies that would not be allowed under U.S. antitrust policy. The Japanese government also sets up public enterprises from time to time. These public enterprises may make loans to implement official industrial policies as a way of building up low productivity sectors of the economy. Such corporations may conduct research or actually produce goods for sale. Finally, the government consults extensively with industry before setting economic policies into place. This consultation is facilitated by exchange of personnel from the top ranks of private sector management and government itself.⁽²⁷⁾

By using a myriad of public, public-private, and private or publicly staffed companies, the government has worked to shape and, at times, redirect the Japanese economy. Japan has created whole industries composed of public companies where the barriers or risks to entry were high enough to restrict private investment. These industries were then sold to private investors. Government's championing of a particular industry was originally used in the computer industry, and is currently the practice in nuclear and other energy technologies. Thus, through a large number of arrangements with public and private organizations, the Japanese implement energy policy and shape energy demand.⁽²⁸⁾

The United States

Of the four countries under consideration, perhaps the United States best exemplifies the spirit of Shonfield's quote concerning Germany and the United States. The government in the United States pursues a conscious policy of encouraging competition and limiting the extent of permissible industrial concentration through its antitrust policies. Most major U.S. industry is characterized by a condition of oligopoly, i.e., there are a relatively small number of major firms that account for a fairly large proportion of industry output, while a very large number of firms produce a rather small proportion of total industry output. The market share and relationships among the major firms is limited by antitrust policies. Firms are not allowed to associate with each other in groups as in the zaibatsu in Japan, nor are banks allowed to play such

major and formalized roles in the decisions of industrial companies as in Germany. No planning institution comparable to the French Commissariat du Plan exists in the United States, although a variety of public and private sector forecasting services perform some of the roles of French indicative planning.

Economic policymaking in the U.S. is primarily decentralized and relies on market forces with a few important exceptions. In the White House, fiscal policy making is carried out by the Council of Economic Advisors and the Office of Management and the Budget. Consumer demand is either stimulated or repressed by the level and kind of governmental expenditures, depending on how high or low the unemployment and inflation rates may be. Often in the year before an election a President will stimulate the economy to ensure his reelection. Thus, as many commentators have pointed out, there are political cycles to economic policymaking.

A second method that can be used to influence the rate of inflation and unemployment is by manipulating the money supply. The Federal Reserve Board, a body that is only partially dependent on the President, has the power to engage in this activity by controls on credit, setting bank reserve requirements and by open market operations, that is, buying and selling government debt instruments.

What differentiates American economic policymaking from economic policymaking in the world's other capitalist democracies is the heavy reliance on governmental regulation. Traditional antitrust, price fixing, and licensing agencies have been extensively supplemented by the recent growth of what is called social regulatory bodies. These new social regulatory agencies control firm products and processes in the name of consumer protection, occupational health and safety, and other ends.

The political power of private business in America has always been important. The government in many ways has acted to promote and to develop sectors of the economy such as airlines, communications, and electric power generation. However, because of the recent growth of the new social regulations, there has been increasing tension between business

and government, and the development of what has been called by some observers of an adversarial economy.

ENERGY POLICYMAKING

France

French public policies are formed primarily in the appropriate ministries. The French, more than the other developed market countries, conduct long-term planning. These plans--of five to ten year duration--attempt to detail French economic growth and to anticipate further demand for raw materials and finished products. Energy has held a key position in each plan since the planning cycles began after World War II.

Within the Commissariat General du Plan (General Planning Commission), the Commission de l'Energie du Plan (Energy Commission of the Plan) is responsible for long-term energy planning. The Direction de la Prevision (Forecasting Agency) in the Ministry of Finance does short- and medium-term energy forecasting, and the Ministry of Finance is responsible for public investment in energy sectors. The Delegation Generale a l'Energie (General Delegation for Energy) also plays a role in setting energy policy.⁽²⁹⁾

The French government also shapes energy production and consumption through its management of the electricity and gas industries.⁽³⁰⁾ Electricite de France and Gaz de France are public monopolies, and their policies have an effect on coal, oil, natural gas, and electricity consumption. Additionally, several administrative agencies within the Ministry of Industry and Research have actual responsibility for production of energy resources. Thus, due to extensive nationalization in energy and related sectors, governmental purchasing policies have considerable impact on energy consumption.

West Germany

West German energy policies are formed in relevant ministries at the federal level. The Ministries of the Economy and Technology are primarily concerned with energy policy.⁽³¹⁾ Policy initiatives are coordinated

among the ministries at the subcabinet level. Business and Laender interests are also incorporated through informal channels of communication.⁽³²⁾ Finally, numerous economic research institutes are usually called on to provide relevant technical data. Agreement among relevant actors is generally reached before policy options are presented to the cabinet.

Once policies are formulated and approved by the cabinet, the chancellor submits them to the Bundesrat, the legislative organ representing the Laender governments. These bills are then assigned to committees, passed through committee to the main body, and passed to the Bundestag with comments. In the Bundestag, the legislation goes through several hearings and, if approved, becomes policy for federal action.⁽³³⁾ Due to the high degree of coordination at the first stages of policy development, most bills pass unchanged by legislative amendment.⁽³⁴⁾

Japan

In the energy sector, primary responsibility for policy formation rests with the Ministry of International Trade and Industry (MITI.) Prior to 1973 MITI worked to rationalize the high cost coal industry and later to shift to oil to meet the country's growing energy needs, thus to some degree creating the very problems that today threaten the Japanese economy. After the 1973-74 oil embargo, MITI developed a six-point program to reduce Japan's dependence on foreign oil. This program included active development of off-shore oil potential, increased stockpiling of oil until a ninety-day reserve was on hand, industrial conservation ("slimming down"), development of alternative energy sources, promotion of nuclear and solar industries, diversification of sources of oil supply, and direct acquisition of oil on a government-to-government basis. The Japanese Advisory Committee on Energy was given the last two tasks.⁽³⁵⁾

Implementation of these policies involves considerable governmental intervention into the economy. Such activities are not new in Japan. The Japanese government has participated more actively in the country's economic development than have the governments of most Western nations.

Through the selective awards of loans and grants, the government provides incentives for certain sectors. The government funds oil exploration (both overseas and domestic), oil technology development, and geological research through a fiscal investment and loan plan.

The United States

The main body for formulating energy policy in the United States is the Department of Energy. The Department of Energy is a relatively recent creation, having been formed in 1978 from elements of the Energy Research and Development Administration, the Bureau of Mines, the Interstate Commerce Commission, The Federal Power Commission, and the Federal Energy Administration. Prior to 1978, energy policymaking in the U.S. was very fragmented. Nuclear energy had been (before 1975) the province of the Atomic Energy Commission (AEC), which was created after World War II to provide civilian control of nuclear fuel and weapons production, to regulate health and safety aspects of nuclear energy, and to promote non-military uses of nuclear energy. When the Energy Research and Development Administration (ERDA) absorbed the R & D and fuels and weapons product functions in 1975, the regulation of nuclear power plants was vested in a new agency, the Nuclear Regulatory Commission. ERDA, in addition to the AEC components, included R & D groups from the National Science Foundation (solar and biomass), Bureau of Mines (coal and oil), and the Office of Coal Research when the DOE was formed in 1978.

Regulation of non-nuclear fuels also has a long history. Oil imports were regulated under the voluntary quota program in 1957 and the mandatory quota program in 1959 by the Department of Interior's Oil Import Administration. Prices of crude oil as well as required products were controlled in 1971, and will be until October 1, 1981. The supervision of oil prices, entitlements, and imports and exports became the responsibility of the Federal Energy Office, later the Federal Energy Administration following the October 1973 oil shortage. Oil pipeline supervision was under the control Interstate Commerce Commission (ICC). Natural gas in interstate commerce was the responsibility of the Federal Power Commission (FPC), as was interstate sale of electricity. The FPC activities and oil pipeline activities of the ICC are now carried out by

the Federal Energy Regulatory Commission, an autonomous agency within the Department of Energy. Construction of hydroelectric facilities is still in the hands of the Tennessee Valley Authority (TVA), the Army Corps of Engineers, and the Bureau of Reclamation. Sales of government generated electricity are by TVA, the Bureau of Reclamation, and regional power administrations. Sales to many rural customers are handled by the Rural Electrification Administration.

Operations of natural gas and oil pipelines, natural gas distribution companies, and electric utilities that are in intrastate commerce are regulated by state public utility commissions. Oil and gas production within the states and offshore to the historic boundaries are regulated by state conservation agencies. (Production on Federal land and outer continental shelf is governed by the Department of the Interior.)

SUMMARY

Table B-1 summarizes population, national income, and energy consumption status of each of the four countries.

NOTES - APPENDIX B

1. Darmstadter, Joel; Dunkerley, Joy; and Alterman, Jack. How Industrial Societies Use Energy: A Comparative Analysis. Baltimore: Published for Resources for the Future by the Johns Hopkins Press, 1977.
2. Deutsch, Karl W. Politics and Government. Boston, MA: Houghton Mifflin Co., 1970, p. 379-380.
3. Ike, Nobutaka. Japanese Politics. New York: Alfred A. Knoff, 1972, 2 ed., pp. 23-24.
4. Deutsch, Karl W. Politics and Government, pp. 353.
5. Deutsch, pp. 353-355.
6. Deutsch, pp. 355-356.
7. Deutsch, pp. 356-357.
8. Deutsch, p. 380.
9. Deutsch, p. 380.
10. Deutsch, pp. 380-381.
11. Deutsch, p. 381.
12. Deutsch, pp. 24-26.
13. See Misawa, Shigeo. "An Outline of the Policy-Making Process in Japan", in Itoh, Hiroshi, Japanese Politics-An Inside View, Ithaca, NY: Cornell Univ. Press, 1973, pp. 12-14, and Ike, Nobutaka, Japanese Politics, p. 25.
14. Ike, Nobutaka, Japanese Politics, pp. 26-30.
15. Ike., pp. 30-32.
16. Misawa in Itoh, Japanese Politics-An Inside View, p. 40.
17. See Riker, William H. Theory of Political Coalitions. New Haven: Yale Univ. Press, 1962, for an extended discussion of political coalition building. Japanese politics seems a good empirical approximation of Riker's theories.
18. Ike, pp. 25-26.
19. See Misawa in Itoh, Japanese Politics - An Inside View, p. 30.

20. Misawa, p. 20.
21. See Cohen, Stephen S., Modern Capitalist Planning: The French Model, Berkeley: University of California Press, 1977, pp. 1-30 and Shonfield, Andrew, Modern Capitalism; The Changing Balance of Public and Private Power, London: Oxford University Press, 1974, pp. 121-150.
22. Cohen, p. 26.
23. Cohen, pp. 258-279.
24. Shonfield, p. 239.
25. Shonfield, pp. 239-64.
27. Johnson, Chalmers, ed. Japan's Public Policy Companies, Washington D.C.: American Enterprise Institute for Public Policy Research, 1978, p. 16.
28. Saumon, Dominique and Puiseux, Louis. "Actors and Decisions in French Energy Policy", in Lindberg, Leon ed. The Energy Syndrome, Lexington MA: D.C. Heath Co., 1977, p. 136.
29. Saumon, p. 141.
30. From telephone conversation with Helena Kohler, German Information Service, New York, 23 June 1980.
31. From telephone conversation with Dr. Arthur Hanhardt, Jr., Department of Political Science, University of Oregon, 25 June 1980.
32. Deutsch, p. 382.
33. Deutsch, p. 382.
34. Evans, Douglas. Western Energy Policy: The Case for Competition, New York: St. Martin's Press, 1979, pp. 43-44.
35. Johnson details quite clearly the myriad of avenues Japanese policymakers can use to implement energy policies. See Johnson, Chalmers, Japan's Public Policy Companies.

APPENDIX C

LIST OF PREVIOUS INCENTIVES REPORTS

APPENDIX C

B. W. Cone et al., An Analysis of Federal Incentives Used to Stimulate Energy Production. Report for the U.S. Department of Energy by Pacific Northwest Laboratory (PNL-2410 Rev. II), February, 1980.

B. W. Cone et al., An Analysis of the Results of Federal Incentives Used to Stimulate Energy Production. Report for the U.S. Department of Energy by Pacific Northwest Laboratory (PNL-3422), June, 1980.

B. W. Cone et al., An Analysis of Federal Incentives Used to Stimulate Energy Consumption. Report for U.S. Department of Energy by Pacific Northwest Laboratory (PNL-3558), February, 1981.

C. Massetti et al., An Analysis of French Incentives Used to Stimulate Energy Production. Draft report for the U.S. Department of Energy by Pacific Northwest Laboratory, January, 1981.*

S. van Buiren et al., An Analysis of West German Incentives Used to Stimulate Energy Production. Draft report for the U.S. Department of Energy by Pacific Northwest Laboratory, August, 1980.*

O. Ozeki et al., An Analysis of Japanese Incentives Used to Stimulate Energy Production. Draft report for the U.S. Department of Energy by Pacific Northwest Laboratory, July, 1980.*

B. W. Cone et al., A Comparison of the Incentives Used to Stimulate Energy Production in Japan, France, West Germany, and the United States. Report for the U.S. Department of Energy by Pacific Northwest Laboratory (PNL-3788), March, 1981.

*Drafts available from R. J. Cole at Battelle Human Affairs Research Centers at reproduction costs.

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