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INSTITUTIONAL ANALYSIS OF ENERGY PROVISION IN HOUSING: A PRELIMINARY EXPLORATION

Andrew Reamer, Steven Heim and Thomas Nutt-Powell

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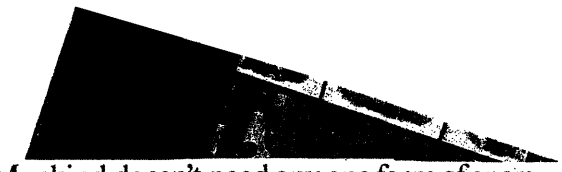

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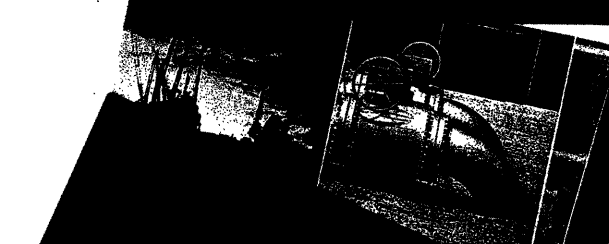

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...r energy
...ensive than
...natives?
solar generated
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...nuclear plants?
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Eastern Utilities Associates,
New England Gas and Electric Companies,
New England Power Company,
Public Service Company of New Hampshire.

THE FIVE MOST COMMON QUESTIONS ASKED ABOUT NUCLEAR ENERGY.

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ABSTRACT

This paper, one of a series resulting from institutional analysis of photovoltaic (PV) acceptance, provides preliminary exploration of the energy industry in relation to energy provision in the residential sector. It is based on theoretical formulations and utilizes methods of institutional analysis developed in an earlier paper in this series. Seven institutional functions -- production, financing, regulation, political, research, service and socialization -- are reviewed as to the manner in which they are performed in the energy industry. The structure of the energy industry is described, as is the regulatory web within which its financial decisions are made and its operations conducted. The persistent and increasing activity of all levels of government in determining the practices of the energy industry is discussed. The research section identifies recent efforts to develop alternative energy sources. The services section especially emphasizes the delivery of energy to residences, while the discussion of the socialization function highlights the ways in which attitudes on energy availability and use are developed.

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INTRODUCTION

This paper is one of a series resulting from institutional analysis of photovoltaic (PV) acceptance. These studies are undertaken with sponsorship of the US Department of Energy (DOE) as part of its Photovoltaic Program. In addition to institutional questions, DOE is interested in economic, marketing and technological issues, and is sponsoring a series of studies and field tests on these topics. Institutional analysis studies have typically been undertaken in relation to particular PV field tests although in some cases studies have focused on comparable technologies and institutional forces influencing their acceptance.

The housing institutional arena is being investigated in relation to the PV program in the context of the DOE-HUD Solar Heating and Cooling (SHAC) Demonstration program. The SHAC demonstration program involves direct federal grants to assist project developers in incorporating solar thermal approaches into various building forms. In this context institutional analysis is directed to understanding those forces which influence the rate and nature of innovation acceptance in the housing sector.

An institutional analysis involves seven steps:

(1) Identify the sector (i.e., economic, geographic) to be studied; determine study objectives.

(2) Prepare a preliminary sector exploration -- an overview that could be applied to any such sector as well as material that is location-specific.

(3) Construct an hypothesized institutional arena.

(4) Identify the "perturbation prompter."

(5) Devise the specific research design.

(6) Monitor perturbations.

(7) Analyze the institutional arena.

This paper is an element of the second of these seven steps, providing a preliminary exploration of residential energy suppliers. Its organization follows the theoretical and methodological constructs for institutional analysis of innovations acceptance presented in an earlier paper in this series. (Nutt-Powell, *et al*, 1978). That paper posits six types of institutional entities -- formal and informal organizations, members, persons, collectivities and social orders. Institutional action consists of exchanges for which the critical datum is information. Such exchanges occur within an institutional arena. Innovation forces institutional action by disrupting existing social meaning.

In preparing a preliminary sector exploration one necessarily focuses on the more structured institutions -- formal organizations, members and, to a certain extent social orders. What is discovered is the more routinized form of institutional action. The picture presented is rather static, emphasizing as it does functions and activities. The more time-and-location-specific institutional actions, often summarized in the role characteristic of institutions, are not sought in this stage of institutional analysis. Rather the intent is to develop a structure of sufficient inclusiveness as to enable the succeeding steps in the method to be taken. This element of the preliminary sector exploration provides the background

against which to assess location and time specific data, leading to the construction of an hypothesized institutional arena. Other papers in this housing series focus on the housing production process, government involvement in housing, research and socialization in housing, and standards setting. (Swetky and Nutt-Powell, 1978; McDaniel and Nutt-Powell, 1978; Furlong and Nutt-Powell, 1978; and Parker and Nutt-Powell, 1979.)

This paper is concerned with energy suppliers in the residential sector. Each of the seven functions identified in the earlier theoretical paper are reviewed from the perspective of residential energy use. The paper opens with an historical overview of residential energy sources, then considers production, financing, regulation, political, research, service and socialization functions of the energy sector, given the paper's residential orientation.

ENERGY AND THE RESIDENTIAL SECTOR

Residential energy sources have changed dramatically over the past 150 years, particularly in the past twenty-five years.

In the early 1800's the primary fuel used in the home was wood. Over 95% of homes were heated in this way. As wood became scarce in the East, coal was used as a heating fuel. By the end of the 19th century, coal accounted for much of the home heating in the country. However, coal use has declined. Coal's market share was 78% in 1935, 23% in 1955, but less than 1% in 1976.

Oil, which had been considered a geological oddity, was first extracted by oil drillers in 1859 in Pennsylvania. Oil soon after began to replace scarce and costly animal and vegetable oils as an illuminant fuel. In the first quarter of this century, oil began to gain acceptance as a home heating fuel.

Thomas Edison developed electricity in the 1870's. Soon after, he invented a lighting system for home use, and a central generating system for electric power. However, by 1900 only 8% of American homes were wired for electric lights. Since then, numerous technological advances such as AC power, high voltage transmission lines and turbine generators have made electricity much cheaper to produce and transmit. Consequently electricity is in nearly every home in the country.

In the 1920's, developments in pipeline technology and gas-heating home applicances helped make the widespread use of natural gas possible. By the 1930's, large quantities of gas were being transmitted to the

East from Texas and Louisiana gas fields. Currently, 56% of U.S. homes heat with natural gas.

In 1976, the net U.S. energy consumption was about 59.6 quadrillion BTU's, of which approximately 18% (or 10.7 quadrillion BTUs) were consumed in households (Bureau of the Census, 1977; Stanford Research Institute, 1972). Total residential energy consumed today is about double of that consumed in 1955. (See Table 1.)

The primary energy sources used in the home are natural gas, electricity and fuel oil. Coal, wood and other fuels are very minor sources at present. It is interesting to note the rapid growth in electricity use relative to the growth in natural gas use. (See Tables 2 and 3.)

According to a 1968 study,households distribute energy use among various activities as follows:

space heating	57%
water heating	15%
cooking	6%
refrigerating	6%
all other	16%

Source: Stanford Research Institute, 1972.

The key determinants of a household's energy consumption are (1) family income, (2) climate, (3) architectural design of the dwelling, and (4) energy saving features within the dwelling (e.g., insulation, storm windows). Income influences dwelling size and number of appliances, both which effect energy use.

Since space heating results in the majority of residential energy consumption, it is useful to note the extent to which various energy

TABLE 1

ESTIMATES OF RESIDENTIAL ENERGY CONSUMPTION, 1955 TO 1976

	1955	1960	1968	1976(est.)
Residential energy consumed (quadrillion BTUs)	5.7	6.7	9.2	10.7
Index (1955=100)	100	118	161	188

Sources: Schurr, 1960; Stanford Research Institute, 1972; Bureau of the Census, 1977.

TABLE 2

RESIDENTIAL NATURAL GAS USE, 1950 TO 1976

	1950	1960	1970	1976
Sales (quadrillion BTUs)	1.384	3.188	4.923	5.012
Index (1950 = 100)	100	230	356	362
Number Customers (1000s)	22146	30418	38097	41328
Index	100	137	172	187
Sales/Customer (million BTUs)	62.5	104.8	129.2	121.3
Index	100	168	207	194
Residential sales as % of total gas sales	32.9	34.3	30.7	33.8

Source: Bureau of the Census, 1977.

TABLE 3

RESIDENTIAL USE OF ELECTRICITY, 1950 TO 1976

	1950	1960	1970	1976
Sales (billion kwh)	70	196	448	613
Approx. BTU equivalent (quad BTU)[1]	0.2	0.7	1.5	2.1
Approx. heat rate BTU equivalent (quad BTU)[2]	n.a.	2.1	4.7	6.4
Sales Index	100	280	640	876
Customers (1000s)	38900	51400	64000	74200
Index	100	132	165	191
kwh/customer	1800	3900	7100	8400
BTU equivalent (million BTU)[1]	6.1	13.3	24.2	28.7
Heat rate BTU equivalent (million BTU)[2]	n.a.	42.0	74.5	87.2
kwh/customer index	100	217	394	467
Residential sales as % of total electricity sales	25.0	28.7	32.2	33.2

Index: 1950=100

Source: Bureau of the Census, 1977; Edison Electric Institute, 1977.

[1] The energy in one kilowatt equals 3412 BTU.

[2] The heat rate is the number of BTUs it takes to make one kilowatt. Heat rates: 1960 - 10,760 BTU, 1970 - 10,494 BTU, 1976 - 10,383 BTU. The industry gets slightly more efficient over time. (Bureau of the Census, 1977.)

sources are used for space heating in this country. 1976 and 1970 data are presented in Table 4 to show that significant changes occured even over a very short period of time. In particular, during this time period the share of the market held by electric heat almost doubled.

The various regions of the U.S. differ significantly in the level of residential energy use and uses of various types of fuel sources. The differences are accounted for by factors such as differences in climate, proximity to natural gas, prices of various types of energy, and custom. For example, differences in reliance on type of energy for residential space heating are shown in Table 5.

Regional differences are also reflected in levels of per customer electricity consumption, as shown in Table 6. The higher levels in the southern regions are probably due to a higher proportion of electric-heated homes and high levels of air conditioning due to the climate.

According to a 1972-73 study carried out by the Washington Center for Metropolitan Studies, energy use is fairly income inelastic, i.e., the difference between the incomes of poor and rich families is greater than the difference in their level of energy use. This means energy costs take up a bigger portion of the budget of lower income people than that of higher income people, as illustrated in Table 7.

TABLE 4

U.S. HOUSEHOLDS BY TYPE OF SPACE HEATING, 1970 AND 1976

	1970		1976	
	# occupied units	%	# occupied units	%
Total	63445	100	74005	100
Utility gas	35014	55.2	41219	55.7
Bottled/tank gas	3807	6.0	4239	5.7
Fuel oil/kerosene	16473	26.0	16451	22.2
Electricity	4876	7.7	10151	13.7
Coal/coke	1821	2.9	484	0.7
Wood	794	1.3	912	1.2
Other	266	0.4	86	0.1
None	395	0.6	463	0.6

Source: U.S. Department of Commerce and U.S. Department of HUD, 1978.

TABLE 5

HOME HEATING BY REGION, 1976

	Northeast	North Central	South	West
# units (1000s)	16544	19723	23741	13997
Percentages:				
Utility gas	37.1	70.0	48.2	70.2
Bottled/tank gas	0.8	6.8	10.0	2.9
Fuel Oil/kerosene	55.4	15.2	14.7	5.7
Electricity	5.1	6.9	23.2	17.4
Coal/coke, wood, other	1.6	1.0	3.3	1.7
none	0.1	0.0	0.7	2.1

Source: U.S. Department of Commerce and U.S. Department of HUD, 1978.

TABLE 6

ANNUAL AVERAGE KILOWATT HOURS/CUSTOMER -- BY REGION, 1976

New England	6,672 kwh
Middle Atlantic	6,147
North Central	7,665
South Atlantic	10,086
South Central	10,750
Mountain	8,163
Pacific	8,271
United States	8,360 kwh

(Note: the number of regions differ here from that in Table 5 due to different data sources.)

Source: Edison Electric Institute, 1977.

TABLE 7

HOUSEHOLD INCOME AND ENERGY USE, 1972-73

	Poor	Lower Middle	Upper Middle	Well off
Mean Income	$2500	$8000	$14000	$24500
Index (Poor=100)	100	320	560	980
Natural Gas (million BTU)	118	129	142	174
Index	100	110	120	150
Electricity (million BTU)	55	81	108	124
Index	100	150	200	230

Source: Newman and Day, 1975.

THE PRODUCTION FUNCTION

The production function involves the creation of resources. This section describes organizations which are directly involved in the production, transmission, or marketing of electric power, natural gas, or fuel oil for residential use. Organizations that supply equipment, fuels, or expertise to production organizations and to customers are discussed in the service section.

Electric Power Industry

The electric power industry in the U.S. is about 100 years old, having started as a street lighting and electric railway business. Today it has become one of the largest groups of business enterprises in the nation, with $53.5 billion in revenues in 1976.

The electric power industry is made up of many utility systems, some owned by private companies (investor-owned utilities or IOUs), some owned by the federal government or by other public bodies such as states, municipalities or public utility districts, and some owned by electric cooperatives. In all there are some 3,500 individual enterprises in the electric power industry. As with some other industries, a substantial proportion of the production is controlled by a small part of the total industry.

The total U.S. electric utility generating capacity, as of January 1, 1977 was 531 million kilowatts (Bureau of the Census, 1977). Investor-owned utilities own nearly 80% of all generating capacity; the Federal government owns about 10%; with municipal utilities, state projects, power districts and cooperatives owning the remaining amount.

There are some 300 investor-owned operating companies, nine-tenths of which serve ultimate electric customers. Most of these companies are vertically integrated, generating, transmiting and distributing electric power. In addition there are about 25 wholesale-only generating companies, 4 transmission-only companies and 7 industrial companies which service ultimate electric customers.

There are 29 IOU holding companies and systems, some of which bring together major utilities on a regional basis. These holding companies and their subsidiaries are responsible for a large percentage of the IOU share of the nation's generating capacity. Some utilities are "combination companies"; they market both electricity and gas in their service areas.

There are over 1900 municipal utilities. Nationally, municipals purchase half the power they sell and generate the rest. They usually purchase their power from an IOU or a federal agency selling bulk power in their area.

There are about 120 public utility districts and other state and county systems. Two-thirds of their capacity is in hydroelectric power systems. The largest state entity is the Power Authority of New York. Examples of large public power districts are the Public Power District of Omaha, Nebraska and the Salt River Project in Arizona. The State of Nebraska, and most of the State of Washington, are served entirely by public utility districts, municipals and other public power entities and cooperatives.

There are 965 rural electric cooperatives, of which 40 are generation and transmission (G&T) cooperatives. The cooperatives were set up to

provide electricity in rural areas which IOUs were unwilling to service with transmission and distribution lines. Rural electric cooperatives purchase most of their power requirements primarily from federal agencies. Ten of the twenty largest distribution cooperatives are in Kentucky and Tennessee. As the cooperatives grew in size, they organized G&T cooperatives to provide some of their own power. Cooperatives have recently been undertaking joint projects with IOUs by purchasing an interest in new power plants being built by IOUs.

A number of federal agencies market generated power wholesale. Under the Department of Energy are the Bonneville Power Administration, Southwestern Power Administration, Southeastern Power Administration, and Alaska Power Administration. Prior to the formation of the Department of Energy in 1977, these agencies were in the Department of Interior. Still in the Department of Interior is the Bureau of Reclamation which constructs and operates hydroelectric power facilities. The U.S. Army Corps of Engineers had constructed and was operating 60 hydroelectric projects by the end of 1973. This power was marketed by the agencies of the Department of Interior before DOE took over this function.

The Tennessee Valley Authority was set up in 1930s by the federal government to control flooding and improve the navigation of waterways, as well as to sell cheap electric power in the area. In fiscal year 1972, more than 60% of TVA power sales were made to 110 municipal utilities and 50 rural cooperatives. TVA also sells to private industries, to federal agencies, and exchanges power with investor-owned companies.

Electric utility ownership patterns vary among regions of the U.S. Almost one-fourth of the investor-owned utilities are in the Northeast region. In New England, investor-owned utilities own more than 90% of the region's generating capacity. Nearly one-third of the public non-federal utilities and cooperatives are in the West Central region.

Nearly every major electric utility system in the U.S. is connected with neighboring systems to form large interconnected networks. The gradual evolution from small isolated systems in the early 1900's to groups of interdependent systems reflect both recognition of economies of scale and the establishment of large holding company systems controling wide-spread power systems.

There are thousands of arrangements between electric utility systems; these arrangements provide for various degrees and methods of electrical coordination. The variations reflect differences in load density, and characteristics of generating resources, geography, climate, and management perspectives. A formal coordination agreement is based on a contractual and legally binding agreement; informal coordination agreements do not make members take specific courses of actions.

In recent years many power companies have banded together in regional power pools. Activities range among power pools from members agreeing to supply emergency power to other members, staggered planning of new generating plants, information exchange, and central dispatching of the power coming from all members' generating systems.

NEPOOL/NEPEX (New England Power Pool/Power Exchange) engages in the last activity. From a central facility in West Springfield, Massachusetts

TABLE 8

SOURCES OF ENERGY IN PRODUCTION OF ELECTRICITY, 1960 to 1976

	1960	1970	1976
Percentages:			
Coal	53.6	46.1	46.5
Nuclear	--	1.4	9.4
Oil	6.1	11.9	15.7
Gas	21.0	24.3	14.4
Hydro	19.3	16.2	14.1

Figures do not sum to 100 due to rounding errors.

Source: Bureau of the Census. 1977.

the "lowest cost power" is dispatched; whichever plants are running most efficiently (economically) will be used to supply power to one's power grid.

Following the Great Blackout of 1965, regional electric reliability councils were formed which reported to the National Electric Reliability Council. Their purpose was to oversee and advise members to improve the region's "bulk power adequacy and reliability". Each regional reliability council has its own rules about operations and membership.

The extent to which electric utilities have used various sources of energy to produce electricity is shown in Table 8.

Oil Production

The oils burned in most home heating systems are light distillate fuels (#1 and #2). This fuel is but one of many petroleum products refiners make from thick crude oil -- the home heating market is one of many markets at which oil companies aim. An analysis of the petroleum industry therefore, must include all sections of the industry, not just fuel oil retailers.

Activities of the petroleum industry may be divided into five categories: (1) exploration and drilling, (2) production, (3) transportation, (4) refining, and (5) marketing.

At the exploration, drilling and production levels, the Bureau of Census reported that there are about 8,000 establishments in the U.S. operating oil and gas properties, 3,600 establishments providing service related to oil and gas production (e.g., well surveying and cementing) and 1,900 organizations engaged primarily in drilling for oil and gas

by contract. Because inland exploration does not require large amounts of capital investment, many small companies are involved. The big oil producing states in the U.S. are Texas, Louisiana, Oklahoma, and California. (It should be kept in mind that in 1976, the U.S. imported 41% of its crude oil (Bureau of the Census, 1977).)

Crude oil is transported by pipeline, barge, or tanker depending on the refiner's proximity to the oil field and access to transportation facilities. Most crude oil in the U.S. is transmitted by pipeline companies. Supertankers are used to bring crude oil from the Middle East and South America to American refineries. About a quarter of these tankers are owned by major U.S. oil companies; the rest are chartered.

Refining companies depend on a firm supply of crude oil to keep their facilities in constant (and therefore economical) use. Since oil refiners do not own all the reserves they need, they are dependent on other suppliers (like OPEC countries) to stay in business.

Refining capacity in the U.S. in early 1975 was 15 million barrels per day (U.S. Department of the Interior, 1976). In mid-1975 some 126 U.S. companies operated 284 refineries in 41 states. States with the most refinery capacity are Texas, Louisiana, California, Illinois, Pennsylvania, and Indiana. Total output in 1976 was 5.2 billion barrels. Output by type of product (percentage of total) was as follows:

Gasoline	48.5%
Kerosene	1.1
Distillate fuel oil	20.6
Residual fuel oil	9.7

Jet fuel	6.5%
Lubricants	1.2
Other	12.4

Source: Bureau of the Census, 1977.

Heating fuel oils (#1,#2) are types of distillate fuel.

Refining companies sell their refined products to marketing companies which in turn sell to retail distributors or large wholesale customers. The marketing arms of oil companies sell many varieties of refined products: petrochemical feedstock, gasoline, jet fuel, kerosene, asphalt tars, and distillate fuels (grades 1-6). These marketers sell to different industrial users or retailers, such as chemical companies, railroads, gasoline retailers/service stations, and home heating oil retailers.

Bulk storage terminals located near the major consuming centers receive supplies of refined petroleum products mainly by pipeline and water transport; pipeline takeoff points service local terminal areas across the nation. Gasoline and heating fuels are trucked from these terminals to service stations and consumer markets.

Electric utilities which run oil-fired plants buy "residual" oil (which is the dregs of the refining process) directly from major refining companies. Since utilities burn huge amounts of residual oil, they buy their oil by a bid system to get the cheapest possible price from the oil companies.

Some companies in the petroleum industry are integrated companies which own subsidiaries which control the whole process from production to marketing. A continuing issue (since the 1870's) has been the degree of monopoly control these integrated companies exert on the price and supply of petroleum products.

Natural Gas Production

The natural gas industry in the United States has three basic activities: production, transmission, and distribution. Typically companies perform at least two (and frequently all three) of the activities, often by forming subsidiary companies. Virtually all gas production in the conterminous United States is interconnected by a pipeline system that extends throughout the lower 48 states and into Mexico and Canada. Total assets of investor-owned gas utilities were $47 billion in 1974; revenues from sales to ultimate consumers were about $17 billion.

There are a relatively small number of large firms involved in the U.S. natural gas industry. It is estimated that less than 1 percent of natural gas producers account for more than two-thirds of the wellhead sales to interstate pipelines. An estimated 8,000 operators produce natural gas and crude oil in the United States. Often, however, the production of natural gas is secondary to the task of producing crude oil, and the revenues collected from natural gas production are frequently less than the receipts from other petroleum industry operations. About twenty percent of natural gas is found in connection with oil deposits, so the exploration/extraction process is similar to that of oil. Seventy percent of U.S. production occurs in Texas and Louisiana; Kansas, Oklahoma and New Mexico produce another 18%; and the remainder is spread around a very large number of states. (American Gas Association, 1976.)

The transportation activity of the industry involves approximately 1,000 natural gas pipeline companies. Approximately 60 percent of U.S. marketed production is produced or purchased by interstate pipeline

companies. Before natural gas can be transported, gas processing operations remove impurities from the gas. Gas pipeline companies have several pumping stations to keep the gas moving at a fast rate.

There are approximately 1,700 gas utility distributors throughout the United States. During 1974, these distributors served approximately 16,000 communities which included about 40.7 million residential customers, 3.4 million commercial establishments, and 0.2 million industrial users. Approximately 0.8 million more residential customers, 0.9 million commercial customers, and additional industrial users are served by producers and pipeline companies. (U.S. Department of Interior, 1976.)

Unlike electricity, natural gas can easily be stored for times of high demand. It is stored by distributing companies in underground caverns or in liquid form in large metal tanks.

THE FINANCING FUNCTION

The financing function involves establishing standards of exchange for scarce resources. A study published in 1974 estimated that the energy industry would make $679 billion in capital investments (1970 dollars) between 1971 and 1985. The study further concluded that expenditures would constitute about 30% of total business capital outlays for the same period, a substantial jump from the 20% share held by the energy industry in the 1961-71 period (Hass, *et al*,1974). The predicted investment by type of energy industry was as follows:

Petroleum	$225 billion
Electric utilities	363
Other*	91
	$679 billion

* includes natural gas transmission and distribution.

If these investments indeed materialize, it is thought that the price of energy must rise to meet capital costs (debt, dividend payments, and so on).

Financing the Electric Utility Industry

In 1976 the value of IOU plant and equipment totalled over $117 billion (up from $93 billion in 1970) (Edison Electric Institute, 1977). From 1970 to 1976, the industry spent $107.4 billion on new electric plant and equipment. It is now averaging over $20 billion a year in new investment (Bureau of the Census, 1977).

Investor-owned utilities finance their operations in two ways: internally, through depreciation tax allowances, retained earnings, and deferred taxes; and externally, by borrowing from banks and by selling bonds (debt securities) and stocks (equity securities). Investor-owned utilities are publicly regulated and are permitted to realize a predetermined level of profit on capital investments in order to attract investors to buy their securities. Money for plant and equipment that cannot be provided by internal sources must be obtained in the capital markets. Nonfinancial corporations typically seek external financing for only one-fourth to one-third of their financing needs. In contrast to this, investor-owned electric utilities in recent years have raised more than one-half of their cash requirements by outside financing. To meet short-term cash needs (one to seven years), utilities borrow from bank consortiums which can handle their large borrowing needs. Long-term debt is handled by selling bonds in the bond market through an investment company. The bonds are typically held by institutions, mutual funds, insurance companies and pension funds.

Selling stocks is the last way in which utilities can raise money. In the past few years, electric utility stock has declined in attractiveness to investors due to many factors. Environmental battles, rising electric rates, and uncertainties regarding stable fuel supplies have tarnished the image of utilities to lay investors. Investors are also less attracted to utility stock because of the trend of regulators to grant lower returns on common equity at a time when construction financing may be accelerating; and the erratic and lackluster earnings growth, which portends future slowdowns on dividend rate increases.

Electric utility executives today consider raising capital for new construction to be their number one problem. Investor confidence in utilities has declined since the 1960's. Consequently, IOUs will continue to press for greater revenues through higher rates ("rate relief") in order to raise new capital and attract more investors. Furthermore, the huge future capital needs of IOUs may lead them to be defensive about alternative energy systems gaining too large a share of their revenues.

Except for the Tennessee Valley Authority, all federal power agencies depend solely on Congressional appropriations for financing. Since 1959, the TVA has been allowed to obtain funds by issuing its own securities, notes and bonds. In 1975, the gross value of Federal electric plant and equipment totalled about $15 billion (Bureau of the Census, 1977).

Internal financing supplies much (60%) of the financial needs of non-federal public systems. Almost all external financing is done by selling revenue bonds. The interest on these bonds is exempt from federal income taxes, so these systems can borrow more cheaply than investor-owned companies. In 1974, the gross value of plant and equipment for these systems totalled about $16.5 billion (Federal Power Commission, 1975).

Since the formation of the federal Rural Electrification Administration in 1936 more than $7 billion in loans to cooperative systems have been approved by the REA of which more than $2 billion of principal has been repaid. Distribution cooperatives rely mainly on depreciation accrurals and net margins as sources of funds, with less than 25 percent of funds coming from borrowed capital, usually in the form of REA loans (Hass, *et al*, 1974). Generation and transmission cooperatives, which have been growing

more rapidly than the others, rely on borrowed funds for new capital. Cooperatives are aided in raising funds in the private market by the National Rural Utilities Cooperative Finance Corporation.

Financing the Natural Gas Industry

In 1975, the gross value of the natural gas industry's plant and equipment came to $51 billion, 77% of which was for transmission and distribution equipment. Only 9% was for production equipment. Ninety-seven percent of the total investment belongs to privately-owned gas companies (American Gas Association, 1976). Total new investment between 1970 and 1976 amounted to $18.6 billion. Real new investment in 1976 was about 30% lower than in 1970 (Bureau of the Census, 1977). The financing patterns of the gas industry, including reliance on external funding sources, are similar to those of the electric industry.

Natural gas has three basic price categories: (1) the wellhead price, (2) the city gate or wholesale price, and (3) the price to the consumer. How these prices are set is discussed in the Regulation section.

Financing the Petroleum Industry

In 1971 gross value of plant and equipment in the petroleum industry was estimated to be $94 billion (Hass, *et al*, 1974). Between 1970 and 1976 total investment amounted to $52.3 billion, averaging $5-6 billion/year in 1970-73, jumping to $8 billion in 1974 and taking off after that. 1977 investments are estimated at $13.7 billion (Bureau of the Census, 1977). Based on the investment figures, the value of total plant and equipment in 1976-1977 was probably in the $125-140 billion range.

Because the oil industry lacks the degree of vertical integration and state control which the electric and gas industries have, there are diverse patterns of financing within the industry. The large multi-national oil corporations, for instance, are internally financed to a great degree.

THE REGULATION FUNCTION

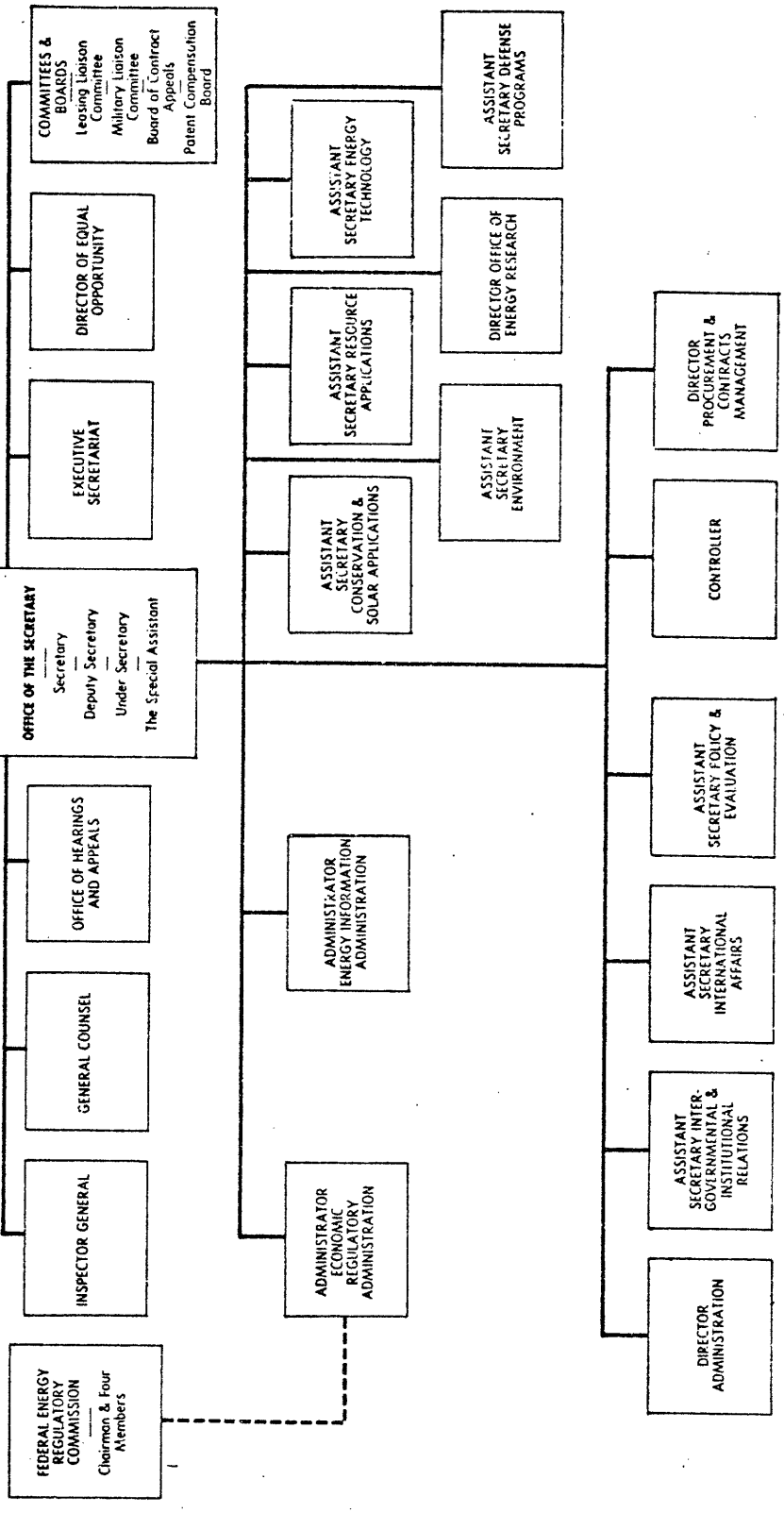
Regulation is the administration of formal structures for behavior. A number of government agencies regulate actions in the energy sector. Regulatory agencies may be differentiated according to (1) type of energy regulated; (2) fuel cycle phases regulated; (3) regulatory tools and (4) policy goals. The commodities regulated are primarily oil, natural gas, coal, nuclear fuels, hydro and geothermal. The key fuel cycle phases are exploration, extraction, fuel preparation, transportation, energy conversion, distribution and waste disposal. Regulatory agencies become involved in aspects of the fuel cycles through their regulatory tools: rulemaking (standard setting), licensing and leasing, and monitoring and enforcement. Different agencies pursue different policy goals, so their regulatory actions often conflict. Some of these policy goals are: (1) development of economical energy supplies; (2) sound management of public lands and wise use of energy resources thereon; (3) "fair" rates to consumers while providing "fair" return on investment to the utility; and (4) protection of health, safety and environmental quality. A number of government organizations regulate activities which are not primarily within the energy sector, but have a secondary impact on it. These situations are discussed in the section on the political function.

The Federal Government

The U.S. Department of Energy (DOE) plays the major federal role in the regulation of the energy industries. (Table 9 presents the DOE organization chart). Within DOE, the Federal Energy Regulatory Commission

TABLE 9

DEPARTMENT OF ENERGY



Source: Office of the Federal Register, 1978

(FERC) and the Energy Regulatory Administration (ERA) carry out the regulatory functions.

The FERC is an independent five-member commission which replaced the Federal Power Commission when DOE was organized. The primary functions of the FERC are to set the wellhead price and interstate transportation charges for natural gas, set rates for interstate wholesale electricity, license non-federal hydroelectric projects and establish rates for the transportation of oil by pipeline (Office of the Federal Register, 1978).

The recently enacted energy law changes FERC's authority somewhat. The legislation prescribes how the controlled price of natural gas will rise through 1985. In 1985, federal price controls on gas will be removed. Under the law, FERC also loses most of its nonprice powers over interstate gas not flowing at the time of enactment (Wall Street Journal, 1978).

The ERA administers all DOE regulatory programs other than those assigned to FERC. These functions include oil pricing, allocation and import programs designed to ensure price stability and equitable supplies of crude oil, petroleum products, and natural gas liquids among a wide range of domestic users. ERA also administers other regulatory programs, including conversion of oil and gas-fired utility and industrial facilities to coal, natural gas import/export controls, natural gas curtailment priorities and emergency allocations, regional coordination of electric power system planning and reliability of bulk power supply, and emergency and contingency planning (Office of the Federal Register, 1978). The DOE also has an Assistant Secretary for the Environment who is responsible

for assuring that the implementation of all departmental progress is consistent with environmental and safety laws, regulations and policies.

A number of federal agencies outside of DOE have regulatory authority over aspects of the energy industry. These may be divided into those dealing with (1) environment, health and safety, (2) the development of natural resources (e.g. oil, gas), (3) finance and (4) the interpretation of law.

The primary agencies concerned with environment, health and safety are the Nuclear Regulatory Commission (NRC), the Environmental Protection Agency (EPA), and the Occupational Safety and Health Administration (OSHA).

The NRC regulates all safety aspects of nuclear power production and the nuclear fuel cycle. The NRC sets standards, issues licenses, and enforces regulations pertaining to the construction and operation of facilities which produce and use fissionable materials. These include nuclear power plants, fuel reprocessing plants, plutonium production facilities and radioactive waste treatment facilities. The NRC also regulates transportation and storage of fissionable materials and radioactive waste.

The EPA has primary responsibility for protecting the public health and welfare from the effects of pollution. The emissions of energy producers (electric power plants, refineries and so on) must meet emission standards set by the EPA. In particular, electric companies have come under strong pressure from the EPA to install pollution equipment. Because of cost, there has been much pressure recently to have the EPA relax its emission standards.

OSHA covers worker safety and health in all aspects of the energy industry -- exploration, production, transportation, and distribution. Specifically, OSHA develops and promulgates occupational safety and health standards; develops and issues regulations; conducts investigations and inspections to determine the status of compliance with safety and health standards and regulations; and issues citations and proposes penalties for noncompliance with safety and health standards and regulations (Office of the Federal Register, 1978).

In addition to the above noted agencies, the Materials Transportation Bureau of the Department of Transportation (pipeline safety regulation) and the Mine Safety and Health Administration of the Department of Labor have regulatory powers.

The management of federal energy and land resources is administered primarily by agencies in the U.S. Department of Interior. The Bureau of Land Management awards (under competitive bidding) oil and gas, oil shale, geothermal steam, and coal leases on federal lands. The Office of Surface Mining Reclamation and Enforcement regulates surface mining operations.

The Securities Exchange Commission, the Federal Trade Commission, and the Department of Justice oversee the energy industry regarding business practices. The SEC also has limited power over IOU holding company structures and the issuance of securities. The Interstate Commerce Commission regulates the railroad transportation of coal.

The U.S. courts regulate behavior in the energy field when disputes are brought to their attention.

State Regulatory Activity

The primary regulatory activity at the state level is that of public utility commissions. Other agencies deal with the environment, occupational safety and health and natural resources. Additionally, regulation at the state level occurs through the courts.

States grant electric and gas companies public monopolies on their service areas. These service areas are limited by the extent of sole franchises given to the companies by local governments. Utilities in the U.S. are allowed to operate monopolies because their facilities are very expensive. Local competition between two electric or gas companies theoretically would raise prices because they would have to duplicate facilities.

While utilities are allowed to have monopoly markets they are not allowed to charge monopoly prices. Gas and electric utility rates are set by state public utility commissions to be low and as fair as possible to different customer classes and to provide enough revenues to the utilities to give an adequate return on investment.

Although the specifics vary from state to state, most commissions are broadly empowered to protect the public interest and to assure that utilities provide adequate, reliable service at reasonable and non-discriminatory rates. Many commissions have jurisdiction over such matters as accounting procedures, financing arrangements and expansion plans (certificate of need for new facilities).

Investor-owned utilities are regulated by utility commissions in 46 states. Weak regulation by local governments prevails in Texas, South Dakota and Minnesota, while Nebraska has no IOUs. Public power companies are regulated in only a third of the states.

Often, state public utility commissions have review and approval powers over power plant siting. Several states have created power plant siting commissions to perform this function.

State environmental agencies have primary responsibility for setting and enforcing limits to emissions from specific pollution sources in order to meet EPA-set ambient air standards. States vary substantially in their regulation of occupational safety and health matters. Some states leave the OSH function entirely up to the federal OSHA, while other states have OSH agencies, whose jurisdiction overlaps (to varying degrees) that of the federal OSHA.

Many states have natural resource agencies which regulate how fossil fuels may be removed from the ground. Under coastal zone legislation, states have authority over the mining of offshore resources up to three miles. The federal government, which has authority over the resources from the three-mile mark to the edge of the Continental shelf, must consult with a state when the mining of resources in the federal area affects the state's coastal zone.

Finally, state courts regulate behavior directly or indirectly related to residential energy when disputes over behavior are brought before them.

Local Regulatory Activity

There are several types of local government agencies which have regulatory authority over aspects of residential energy use. The primary focus of these agencies is usually housing or land use. Key regulatory organizations at the local level include zoning boards, planning commissions,

building/housing inspection departments and conservation commissions. Also, local governing councils and local courts play a regulatory role at various times. One major local regulatory activity to keep in mind is power plant siting. The municipal granting of utility franchises by locality is also a key regulatory power.

THE POLITICAL FUNCTION

The political function involves the formal determination of structure and modes of behavior. A great number of organizations perform a political function in the residential energy field. Political activities primarily include proposal, debate and determination of policy and programs. A political activity determines the structure within which policy is implemented. For example, enactment of legislation and promulgation of regulations are political activities.

Federal Executive

The U.S. executive branch contains many units, agencies and departments which propose or formally determine structures and modes of behavior affecting residential energy use. The agencies with a primary political role in the residential energy arena are:

Executive Office of the President -- President, Council of Economic Advisors, Council on Environmental Quality, Office of Management and Budget, the Domestic Council, Office of Science and Technology Policy.

Department of Energy -- Office of the Secretary, Energy Regulatory Administration, Federal Energy Regulatory Commission, Assistant Secretary for Energy Technology, Assistant Secretary for Conservation and Solar Application, Assistant Secretary for Resource Application.

Department of Interior -- Office of the Secretary, Office of Mineral Policy and Research Analysis, Ocean Mining Administration, Office of Surface Mining Reclamation and Enforcement.

Department of Justice -- Attorney General, Antitrust Division.

Department of the Treasury -- Office of the Secretary, Assistant Secretary for International Affairs (develops energy policies).

Environmental Protection Agency.

Nuclear Regulatory Commission.

There are also a number of federal agencies which play a secondary and tertiary political role in the energy sector. These include:

Department of Agriculture -- Rural Electrification Administration, Forest Service.

Department of Commerce -- Office of the Secretary, Maritime Administration.

Department of Defense -- Army Corps of Engineers.

Department of Energy -- Assistant Secretary for Environment.

Department of Housing and Urban Development -- Assistant Secretary for Community Development and Planning (develops energy conservation policies).

Department of Justice -- Land and Natural Resources Division.

Department of Labor -- Mine Safety and Health Administration, Occupational Safety and Health Administration.

Department of State -- Office of the Secretary, Bureau of Economic and Business Affairs, Bureau of Oceans and International Environmental and Scientific Affairs.

Department of Transportation -- Materials Transportation Bureau (pipeline safety policy).

Federal Trade Commission.

Interstate Commerce Commission.

Securities Exchange Commission.

Congress

Many congressional committees are the battlegrounds for hearings on new energy legislation or policy deliberation. Subcommittees handle much of the specific groundwork leading to committee and chamber votes. Recent Congressional reorganization has given some committees greater jurisdiction over energy issues.

In the Senate, the newly formed Energy and Natural Resources Committee has jurisdiction over all matters relating to energy policy, regulation, conservation and R & D. Its subcommittees are: Energy Conservation and Regulation, Energy Production and Supply, Energy R & D, Parks and Recreation, and Public Lands and Resources.

The Senate Environment and Public Works Committee has jurisdiction over environmental policy and R & D. The Senate Government Affairs Committee has jurisdiction over the organization of the Executive Branch, including

its energy-related offices, and over interagency relations. Other Senate committees which can be involved in energy issues are the Banking, Housing and Urban Affairs Committee and the Commerce, Science, and Transportation Committee.

In the House of Representatives, the Interstate and Foreign Commerce Committee has primary responsibility for energy policy and clean air legislation, particularly through its Energy and Power, and Health and Environment subcommittees. The House Interior and Insular Affairs Committee has jurisdiction over the public domain, national parks, and forest reserves. Its energy subcommittee is Energy and Environment. The House Government Affairs Committee has a similar jurisdiction as its corresponding Senate committee. The Environment, Energy and Natural Resources subcommittee handles its energy matters. The House Science and Technology Committee has jurisdiction over all energy R & D. Its subcommittees are Advanced Energy Technologies and Energy Conservation R & D, Environment and the Atmosphere, and Fossil and Nuclear R & D.

The Congress is aided in its deliberations on energy policy by the Library of Congress, the General Accounting Office, the Congressional Budget Office, and the Office of Technology Assessment, which are important Congressional research and information organizations.

State Governments

Most states have executive departments, agencies, or commissions with energy-related political functions as follows: commerce/economic planning and development, energy management office/energy advisory council

(administers federal conservation and fuel allocation legislation), environmental management/conservation/resources, energy facilities siting council/land use planning, and public service/public utilities commission.

Some state legislatures have committees on natural resources/land use, revenue/taxation, public utilities/transportation/energy, energy, commerce, oil/gas. As mentioned earlier, only state legislatures can extend, limit or even establish a public utility commission.

Local Governments

Key political organizations at the local level are city councils/board of selectmen, planning commissions, zoning boards, housing/building inspection departments, conservation commissions, and regional water/air quality control boards.

Non-Governmental Organizations

A number of non-governmental organizations play a political role in interacting with the federal government. This takes place in the formal review and comment process for regulation setting. The A-84 process formally asks public interest organizations for feedback on proposed regulations; of course, non-public interest organizations also are free to comment once they have access (either privately or through the Federal Register) to the proposed regulations.

THE RESEARCH FUNCTION

The research function is the consideration of what is and/or might be. Because a large number of institutions work in the energy research field, only major research areas and institutions will be described here.

Rate, financial, operating statistic, and regulation research is undertaken by utility companies, state public utility commissions, the Federal Energy Regulatory Commission, the Edison Electric Institute, the American Gas Association, universities, and public interest groups.

Studies of electric loads, future electric demand, and electric supply vary according to time frame (daily and longterm) and location (utility service area, regional, and national). The utility service area is studied by the utility company and the state PUC; the region by regional government agencies, regional reliability councils, regional power pools, and research institutions; the nation by the National Electric Reliability Council, Electric Power Research Institute (IOU sponsored), FERC, generating equipment manufacturers, and universities and research institutions.

The national and international supply of energy dominates the attention of many U.S. energy analysts. Oil and gas supply estimates depend on industry estimates made by the American Petroleum Institute and the American Gas Association. The U.S. Department of Energy, the U.S. Bureau of Mines, and the U.S. Geological Survey are important government organizations studying energy supply. Financial institutions, universities and research institutions (such as the Electric Power Research Institute and the MIT Energy Lab) are heavily involved in this area, also.

Fuel utilization processes and pollution control research is undertaken or sponsored by the NRC, EPA, DOE, EPRI, API, NCA, AGA, and universities and national research laboratories. Energy production, conversion, transmission, and distribution equipment research is performed or sponsored by equipment manufacturers, EPRI, DOE, API, Institute of Gas Technology (AGA sponsored), and universities and research institutions. Before EPRI was founded in 1973, electric utilities depended solely on equipment manufacturers for equipment research. Under the threat of government-sponsored electric industry research, IOUs devised an industry sponsored research institute.

Much financial research also takes place. It begins from either an investment/investor perspective or energy industry perspective. Utility investment research services and Moody's Investment Service (bond ratings) rate individual IOUs on both financial earnings strength and "regulatory climate" for investors. The energy industry's financial posture is studied by the Edison Electric Institute, financial institutions, API, AGA, FERC, PUCs, and universities and research institutions.

Other federal government organizations not mentioned above involved in or overseeing energy-related research include:

Executive Office of the President -- Office of Science and Technology, Council of Economic Advisors, Council on Wage and Price Stability.

Department of Commerce -- National Bureau of Standards (materials research), Bureau of Economic Analysis.

Department of Housing and Urban Development -- Assistant Secretary for Policy Development and Research.

Department of Interior -- Office of Minerals Policy and Research Analysis.

Department of State -- Bureau of Intelligence and Research (studies foreign oil and gas developments).

Department of Transportation -- Materials Transportation Bureau (pipeline safety research).

Department of the Treasury -- various units perform economic analysis.

Environmental Protection Agency.

Nuclear Regulatory Commission -- Office of Nuclear Regulatory Research.

(Source: Office of the Federal Register, 1978.)

THE SERVICE FUNCTION

The service function involves providing for the present and future use of desired and/or needed resources. The following discussion will consider the service function as it relates to customers, fuel oil retailing and industries.

The main customer classes for electric and gas utilities are residential, commercial, and industrial. These classes reflect both different levels of demand and regulatory rate structures to protect residential customers. Utilities are required as a part of their regulated monopoly mandate to provide services to all similarly situated customers in a nondiscriminatory manner. IOU unwillingness to supply distant rural customers led to the formation of rural electric cooperatives in the 1930's. With recent gas shortages, such as in 1974 and 1976, gas utilities would not take on new customers, since their gas supplies were limited and old customers had to be supplied first.

Services are of basically two varieties: interruptible service and firm service. Residential service is always firm service, i.e., it must always be supplied. Interruptible service agreements between the utility and customer allow the utility to cut off power or gas at a moment's notice (24 hours to 4 minutes notice). The customer gets lower rates, depending on how interruptible he chooses his service to be, while utilities can save valuable generating capacity (or gas) in the case of a breakdown or imminent black out (or gas shortage).

The common rate form used for billing residential and small commercial customers is called the block type. Energy consumed by the customer is billed by blocks or specific quantities, i.e.,the first block is billed at a fixed price and the following blocks are billed at a price for each unit decreasing on each subsequent block. This rate form has been criticized as encouraging heavier energy use, and unfairly penalizing the poor.

The customer service mix of a utility varies widely from town to town, within regions, between regions, and, especially, among different company systems. Nationally, distribution of electric power by class of customer is 32% residential, 23% commercial, 40% industrial and 5% other (Edison Electric Institute, 1977).

The recently enacted energy bill requires gas and electric utilities to provide certain services to residential customers (Boston Globe, 1978). In particular, utilities are required to:

1) give customers general information about how they can save energy on their particular type of building, its likely cost, who might do it for them and how it will be financed; information campaigns have to be approved by federal and state energy offices, and be ready by January 1, 1980;
2) inspect the customer's home, if asked, in order to suggest specific energy saving measures, estimate the cost, and estimate how much would be saved on the customer's energy bill;
3) provide a list of local contractors to do the work, and local lenders to help with financing;

4) let the customer, for a fee, repay an energy-improvement loan in installments along with the utility bill, even if the money was borrowed from a bank;

5) offer to install devices in the house which will cut off energy to certain appliances in times of peak demand; the customer would get a lower utility rate if he accepted this kind of service.

Heating oil retailers compete with electric and gas utilities for a share of the home heating market. Unlike electric and gas utilities, heating oil retailers battle each other in very competitive markets. A new home owner may be contacted by several oil dealers trying to get new business.

Heating oil retailers may be major oil company subsidiaries, large regional independents, or small dealers serving a few towns. In New England about 2200 independent heating oil distributors are operating; they collectively control about 86% of the region's total retail sales. Major oil companies are not enticed to buy out small dealers because of their low sales volume. Somtimes, a major independent will acquire a small dealer, take over the dealer's customer accounts, and usually change the name of the small dealer's business. Nationally, the independent dealers'share of the retail fuel market has diminished since 1973.

Major independent fuel oil dealers buy their own crude oil and have it refined and delivered to their oil terminal by a major oil company. Small oil dealers have accounts with most major independents in an area, shopping around for the best price. Major independents also sell heavy oils (#4 and #6) and light oils (#2) to commercial and industrial customers.

Selling wholesale to other dealers makes up a large proportion of some major independents volume sales.

Since fuel oil must be delivered to the customer by truck, long driving distances are unprofitable to a dealer who does not have many deliveries along a route. Therefore, a dealer cannot compete with other dealers past a certain distance from his oil storage terminals. The larger an oil dealer's resources, the greater the service area in which the dealer can compete. To prevent price cutting among dealers, dealers include a transportation rate for each gallon of oil sold to a customer; the rate is a function of the delivery distance from the dealer's terminal.

Important service organizations to electric utilities are fuel suppliers (coal, oil, gas, nuclear), power plant construction/architect firms, financial institutions, equipment vendors/manufacturers, and legal firms.

Coal and nuclear fuel producers are important organizations to electric utilities. Coal and nuclear combined made up more than half of the total sources of energy for electrical generation in 1976 (46.5% and 9.4% respectively (Bureau of the Census, 1977)). The importance of different fuel sources varies among utilities, depending on a company's generating mix, state and local environmental and safety regulations concerning different fuels, regional availability of fuels, and costs. Some companies depend almost entirely on coal as their fuel source; these companies are usually located in heavy coal producing areas of the country. Electric utilities are vital to the coal industry -- half of U.S. coal

production is sold to electric utilities. Demand for coal may rise because nuclear power is being stymied by rising costs and major safety questions/ problems.

The coal industry contains large, medium and small producers, all of which are located in only a few areas of the country. Large producers, having large reserves, corner the utility market since utilities demand long contracts.

In the U.S. nuclear fuel industry, the exploration, mining and milling of uranium is carried out by a few large companies (e.g. Exxon, Kerr-McGee). Much of the industry is vertically integrated. However, some companies only make the nuclear fuel (e.g. Westinghouse). The Department of Energy owns and operates the uranium enrichment facilities which make the uranium usable in nuclear power plants. The nuclear fuel companies pay DOE to enrich the uranium and then sell it to the electric utilities. At present, the uranium enrichment process is relatively energy intensive, requiring about 4% of the energy the enriched uranium will ultimately provide.[1]

A number of environmental problems have arisen due to the recent expansion of this country's nuclear power plant capacity. The three most common problems are the disposal of nuclear waste, the disposal of obsolete nuclear reactors and thermal pollution. The first two problems are very long-term because nuclear wastes and plants retain their radioactivity for thousands of years. In 1977, the power industry's inventory of spent

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[1]The information on the uranium enrichment process was gathered in a telephone interview with David Rose, Professor of Nuclear Engineering, MIT, on November 30, 1978.

fuel was 2,500 metric tons. (This does not include radioactive "sludge" left over from reprocessing spent fuel.) This is expected to rise to over 20,000 metric tons by 1985 and 190,000 metric tons by 2000 (Time Magazine, 1977).

The heat from the production of nuclear energy is either exhausted into a moving water system or into the atmosphere (via a cooling tower). In either case significant amounts of heat are put in the environment, affecting either animal life population or the weather. The cooling tower approach is seen as polluting the environment less than the water system approach.

Important service organizations to gas and oil producing companies are independent oil and gas exploring companies, drilling equipment contractors and manufacturers, pipeline companies, legal firms, financial institutions, shipbuilding firms, charter oil tanker lines, and refinery equipment firms. Important service organizations to gas and oil retailers are gas pipeline companies, oil refining companies, financial institutions, equipment manufacturers and fuel oil distributors.

Important to many organizations in the residential energy field are information service organizations such as trade magazines, DOE's Energy Information Administration, numerous abstracting and analysis publication groups, Bureau of Mines, trade association statistical services, and many "energy newletter" publishers.

THE SOCIALIZATION FUNCTION

The socialization function involves the transmittal of norms through formal and informal means. Socialization regarding residential energy production, transmission, use, and so on goes on as all the institutions previously described carry out their various functions. Much socialization is carried out on a relatively small scale, e.g., between individuals or between firms on a single project. Socialization may be done formally or informally. Methods of socialization at the small scale include performance rewards and punishments and peer pressure. External socialization at larger levels is usually carried out through advertising, public information and lobbying. Internal socialization at this level involves associations (e.g., trade or public interest) socializing its members. This is often done through membership rules and newsletters.

The discussion below will deal with organizations socializing at the large scale. They can be roughly divided into three groups (1) energy industry organizations,(2) public interest organizations, and (3) governmental organizations.

Energy Industry Organizations

The major socializing components of the energy industry are the utilities, energy producers, home appliance manufacturers and retailers, and home fuel and utility service firms. Most of these organizations carry out socializing activities in their respective service areas. Most

also belong to regional and national trade associations which carry out socialization on a larger scale.

Energy industry organizations are very heavily involved in external socialization activities. The advertising employed by the energy industry can be divided into several categories: advertising aimed at encouraging certain types/levels of home energy consumption; that aimed at suppliers, vendors, and builders; public service advertising (e.g., "conserve energy"); political campaign advertising; and public relations advertising. The purpose of most advertising, of course, is to make money for the advertiser by prompting increased use of its product.

One type of advertising which is no longer run, perhaps because of price increases, is the one promoting the "All-Electric Home." This was a major campaign prior to the 1973 oil embargo, promoted by the electric utilities and home builders through the "Gold Medallion" program. It should be noted that the number of homes in the US with electric heat more than doubled between 1970 and 1976 (Bureau of the Census, 1977). Other familiar ads no longer seen are: "A country that runs on oil can't afford to run short" (American Petroleum Institute) and "Gas burns clean" (American Gas Association).

Until the 1973 oil crisis, utility ads encouraging greater energy consumption were commonplace. However since that time, most of these ads have disappeared. In fact, utilities in a number of states have been forbidden by the public utilities commissions from promotional advertising. By comparison, many current ads discuss energy conservation and the saving

of energy costs while promoting their product (or their desires, e.g., the construction of nuclear power plants).

The energy industry also engages in political advertising. For example IOUs have advertised against municipal takeovers, and statewide mortoria on nuclear power plant construction.

The public information activities of the energy industry, often hard to separate from advertising, can be divided into a number of categories: general information available by request from the organization; magazines; educational material packages available for schools and public groups; news releases aimed at mass or trade consumption; public information ads; plant tours; customer advisory councils; information centers; bill stuffers; public hearings; local and regional workshops.

Energy industry lobbying is carried out within the legislative and executive branches of all three levels of government. Lobbying is performed by both individual firms and trade associations. As a gross generalization, an organization will lobby at levels of government which cover an area roughly equal to or smaller than the organization's service area.

Given this last statement it follows that most lobbying at the state and federal level is done by trade associations. A list of a number of these organizations follows:

> Electric industry -- Edison Electric Institute (IOUs); American Public Power Association (represents 1400 municipal utilities); National Rural Electric Cooperative Association; International Association of Electric Leagues (55 regional electric utility trade associations in US and Canada); regional associations (such as the

Northwest Public Power Association, and Electric Council of New England); state associations of REA borrowers; Electrical Workers Union; trade associations for electric appliance manufacturers and retailers.

Oil and gas -- producers: American Petroleum Institute, American Gas Association, Independent Petroleum Association of America, Independent Oil and Gas Association of America, regional affiliates; exploration, drilling, transportation, refining organizations: American Petroleum Refiners Association, Association of Oil Pipelines, Gas Processors Association, International Association of Drilling Contractors, Petroleum Equipment Suppliers Association, Independent Refiners Association of America, Pipeline Contractors Association, regional affiliates; distributors and retailers: American Public Gas Association, New England Fuel Institute, National Oil Jobbers Council; other: Gas Appliance Manufacturers Association.

Coal -- National Coal Association, National Independent Coal Operators Association, American Retail Coal Association, Bituminous Coal Operators Association, United Mine Workers of America.

Finally, as noted earlier, these associations also do internal socialization through such things as membership awards, codes, and publications. Internal socialization is helped considerably by the fact that the members usually have a similar financial stake in achieving the goals of the association.

Public Interest Organizations

There are a number of public interest groups in the energy field, many of whom employ the three external socializing techniques discussed above. They usually do not rely on advertising as much as the energy industry, most likely because their smaller budgets often rule this out. Thus, they rely more on public information and lobbying. Because members of public interest groups are usually bound by similar value commitments rather than economic incentives, these groups also must rely heavily on internal socialization to keep their members committed. This is often done through newsletters. Member commitment usually is translated into financial commitment; this enables the group to finance its external socialization acitivites.

Examples of public interest groups concerned with energy use are: Associates for the Public Interest, Environmental Action Foundation, Sierra Club, Friends of the Earth, state public interest research groups (PIRGs), National Audubon Society, Union of Concerned Scientists, the Environmental Defense Fund, and New England's anti-nuclear Clamshell Alliance.

Government Organizations

Governmental organizations at all levels play a large external socialization role with regard to norms concerning energy. The targets of such efforts are usually either the mass public or certain interest groups. The means for socialization by the executive branch include the proposal and signing of legislation, promulgation of regulations,

public relations efforts, publication of studies, lobbying the legislature, publicity through the press, and discussions with outside interest groups.

Socialization measures employed by the legislative branch include the passage of laws, publishing of committee reports, and most of the means used by the executive branch. Often, individual legislative members attempt socialization efforts on their own or band together in a caucus (e.g., the Black Caucus). The courts transmit norms when they hand down and explain rulings.

In the socialization process, the government has certain advantages over outside organizations because of the elevated position of government in our society and its access to power and the press. Some of these socialization advantages have diminished in recent years because of public mistrust of the government, but they still do exist.

Social Orders

Social orders are institutions without specific members, for example, "a rule of law, not men" and "you should pay your taxes" are social orders. Social orders do not have to be accepted by all of society to be significant.

The energy industry has played an extremely influential role in promoting energy-related social orders. Generally, most energy industry behavior can be attributed to following the key social order of American business, "maximize the return on investments". Up through the 1973 oil crisis, the industry heavily promoted the social order that both

individual and societal standards of living were directly correlated with the amount of energy consumed. As can be seen from the discussion earlier, the visible social order promoted by industry has become one of efficiency. However, the call has not so much been to use fewer appliances and other energy devices, rather more efficient ones.

Some utilities, for return-maximizing reasons, are pushing energy conservation as well as efficiency. For instance, Public Service of New Mexico (an IOU) is actively encouraging energy conservation, thick insulation, and solar energy. The demand for PNM's electricity has been rising very rapidly because of newly opened uranium mines, so PNM has been forced to debt-finance new capital expansion. Heavy debt financing puts the company in an unprofitable financial position, hence the active call for energy conservation. Another social order the electric utility industry wishes the public to believe in is "nuclear energy is safe and we need it to maintain our standard of living".

There are a number of publicly held energy-related social orders, some older and therefore more entrenched than others. A very familiar and very significant one is that one's social status is directly correlated with the size of one's home -- the bigger the home, the more heat is needed. One's social status is also often related to the number and size of energy-consuming devices one has (e.g., air conditioners, TVs, microwave ovens, stereos).

Another widely-held social order is "energy must always be available at the flick of a switch". People become disturbed and upset if this is not the case over a significant period of time; this social order clearly

points out our society's extreme dependence on (some would add addiction to) mass-produced energy.

A number of well-known social orders have emerged since the oil crisis, but are certainly not as widely held as the older ones. These place positive value on energy conservation, efficiency, non-polluting energy sources, and renewable energy resources (e.g., the wind and sun).

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