Energy Law and Policy for the 21st Century

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Summary of Contents

CHAPTER EIGHT

Natural Gas

by Suedeen G. Kelly

I. INTRODUCTION TO NATURAL GAS

Natural gas is a desirable energy source today because it is inexpensive and clean, when compared with other energy sources, and is currently plentiful in the U.S. Proved natural gas reserves in the U.S. rose to 167.2 trillion cubic feet (Tcf) in 1997 for the fourth consecutive year of increase in reserves in spite of four consecutive years of increased production.[1] Domestic production was about 19 trillion cubic feet.[2] Proved reserve additions come from unproven volumes of gas in known fields or new fields through the exploration and development process. The majority of proved reserves are located in the Gulf Coast area. The U.S. Department of Energy reports that the U.S. has a technically recoverable resource base of 1,156 Tcf of natural gas, exclusive of Alaskan gas.[3] The U.S. Department of Energy projects that natural gas will increase from its current share of 24% of the energy consumed in the U.S. to about 28% in the next twenty years (see Figure 1). An increase in consumption is expected because natural gas is lower in cost and greater in supply than other fossil fuels, the infrastructure needed to produce and transport it already exists, and it emits fewer air pollutants than most other fossil fuels.[4]

The natural gas industry has been transformed over the last twenty years from a highly regulated industry to one based on competitive markets. The energy crises of the 1970s propelled significant deregulation and restructuring of the industry and the emergence of a market that sets price and quantity of natural gas supplies.

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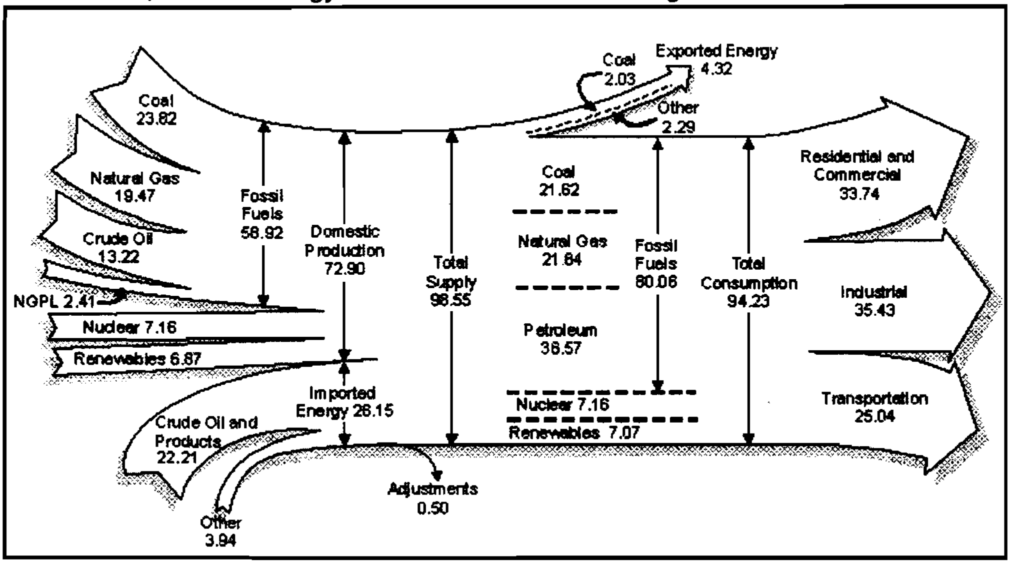
[1] Energy Information Administration (EIA), NATURAL GAS 1998: ISSUES AND TRENDS 11 (1999).

[2] EIA, *Annual Energy Review 1998: Natural Gas, Table 6.1 Natural Gas Overview, 1949-1998* (visited July 29, 1999) <http://www.eia.doe.gov/pub/energy.overview/aer98/txt/aer0601.txt>.

[3] EIA, *supra* note 1.

[4] See EIA, *supra* note 1, at 49.

Figure 1: Energy Flow, 1998 (Quadrillion Btu)
Source: EIA, Annual Energy Review 1998 www.eia.doe.gov



This transition began with the 1978 phase-out of price controls on gas at the wellhead. The next phase of change involved operation of interstate pipeline companies in the mid-1980s as common carriers. Previously, pipelines operated as private carriers. This change allowed the unbundling of the interstate sale of transportation from the sale of the gas itself, thus facilitating the growth of the natural gas market. Numerous states have followed this lead, providing for the unbundling of the distribution of gas from the sale of gas. Pipelines and local distribution companies still have a monopoly on the transportation of gas, and remain subject to economic regulation. However, even in this regulatory arena, the federal and state governments are moving from traditional rate of return regulation, with its comprehensive price control, to greater reliance on market mechanisms and alternative regulation.

II. THE NATURAL GAS FUEL CYCLE

Although gas is usually found with oil, the development of the gas industry lagged behind that of oil. In the early stages of American oil exploration, natural gas was considered a nuisance. It was dangerously explosive and required expensive separate pipelines or other capital intensive systems to move it or to store it. No valuable use of it could be made at the wellhead. Consequently, petroleum producers proceeded to eliminate it by flaring it, or simply venting it, at the wellhead. Not until the states passed laws prohibiting flaring and pipeline technology advanced, could the natural gas industry develop.

By the 1940s, gas was moving by pipeline from Texas and Louisiana to the population centers of the Midwest, the Atlantic Coast and the Northeast. Initially, a three-part gas industry developed: the producers, the long-distance transporters (pipeline companies), and the local distributors (gas utility companies). The pipeline companies were the lynch-pins of the industry. Typically, they entered into long-term contracts upstream with producers to buy gas, and entered into contracts downstream with local distribution companies to sell gas and deliver it to them.

The gas industry was restructured in the mid-1980s by Congressional and regulatory actions. Congress eliminated price controls on gas at the wellhead. The Federal Energy Regulatory Commission required interstate pipelines to sell transportation of gas separately from the sale of gas itself ("unbundling" of services), transforming pipeline companies into common carriers. Many states have followed the federal lead and required their local distribution companies to unbundle distribution and gas sales services. As a result, many wholesale and large retail gas consumers are now buying gas directly from producers or gas marketers. Concomitantly, the natural gas industry has evolved into one with four phases to its fuel cycle: production, pipeline transportation, local distribution, and marketing.

A. Production

Gas is commonly found with oil in subsurface reservoirs and, therefore, its exploration and production is similar to that discussed earlier for oil.[5] Gas is found in the interstices of porous reservoir rocks—commonly sandstones, limestones, and dolomites. Gas is almost always found in solution with oil, and will sometimes form a "gas cap" within the reservoir, due to the weight differential between gas and oil. It is recovered through drilling a well into the reservoir. Low pressure at the wellbore initiates the movement of the gas or oil through the permeable reservoir rock toward the well. While there are thousands of gas producers, the major ones are the major oil companies.

Today, all but nineteen of the states produce natural gas. The major gas-producing states are Texas, Oklahoma, Louisiana, New Mexico, Kansas,

[5] *See* the Fuel Cycle section of Chapter Seven, *supra*.

and Alaska.[6] Three states, Texas, Oklahoma, and Louisiana, account for over half of the total natural gas produced in the U.S.[7] Texas itself produced about 37% of total U.S. production in 1998.[8] Offshore well drilling technology has made offshore sites more important over the last twenty years, and about one-fifth of domestic production today comes from offshore wells.[9] About half of the U.S.'s technically recoverable reserves of gas, exclusive of Alaskan gas, lies under federal lands, evenly divided between onshore and offshore lands. Environmental concerns about drilling have led to moratoria in drilling on many federal lands. For example, drilling is prohibited off the U.S. East and West coasts (except for a few areas off the Southern California coast), and the West coast of Florida. Drilling is permitted off the Arctic coast in the Gulf of Alaska and in Cook Inlet.

Since the mid-1980s when the strict price regulation of imported gas was lifted, foreign gas producers have sold significant volumes of gas in the U.S. Imports accounted for about 14% of total U.S. consumption in 1998.[10]

By far the largest exporter of gas to the U.S. is Canada. Import levels from Canada have steadily risen along with total imports over the last ten years, but Canada has consistently provided about 98% of the total imported gas supply due to its competitiveness with U.S. market prices. Algeria and Mexico have played minor roles. From 1984 to 1992, Mexico did not export any natural gas to the U.S. Mexico resumed minor levels of export in 1993. Import of Algerian liquefied natural gas (LNG) increased during the energy crisis of the 1970s, but ceased by 1987 due to its high prices. Algerian imports resumed in 1988 and have continued at modest levels. Australia and the United Arab Emirates recently started exporting very small amounts of gas to the U.S.[11]

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[6] EIA, NATURAL GAS PRODUCTIVE CAPACITY FOR THE LOWER 48 STATES 1986 THROUGH 1998, at 6 (1997). *See also* EIA, HISTORICAL NATURAL GAS ANNUAL 1930 THROUGH 1998, *Table 5, Gross Withdrawals and Marketed Production of Natural Gas by State, 1967-1997 (1998).*

[7] EIA, *Energy in the United States: A Brief History and Current Trends* (visited July 23, 1999) <http://www.eia.gov/emeu/aer/eh1998/eh1998.html>.

[8] *Id. See also* EIA, *Annual Energy Review 1998: Natural Gas, Table 6.4: Natural Gas Withdrawals by State and Location and Gas Well Productivity, 1960-1998* (visited July 29, 1999) <http://www.eia.doe.gov/pub/energy.overview/aer98/txt/aer0604.txt>.

[9] EIA, *supra* note 2.

[10] EIA, *Annual Energy Review 1998: Natural Gas, Table 6.3 Natural Gas Imports, Exports, and Net Imports, 1949-1998* (visited July 29, 1999) <http://www.eia.doe.gov/pub/energy.overview/aer98/txt/aer0603.txt>.

[11] *Id.*

B. Pipeline Transportation

Natural gas is usually transported by pipeline. It can be liquefied and transported by tanker if necessary, but this process is expensive and dangerous. In the U.S., liquefied natural gas accounts for only a small fraction of total gas consumption.

Gas is gathered from wells through "gathering lines," processed as necessary,[12] and then transmitted by pipeline from the field to the consumers. Long-haul trunk lines take the gas from the field to the population centers where gas then enters the local distribution system. The point of entry of gas into the local distribution system is commonly called the "city gate."

About fifty major pipeline companies move most of the interstate gas in the U.S.[13] Pipelines are categorized for regulatory purposes as either interstate or intrastate. Interstate pipelines are those that are engaged in the transportation of natural gas in interstate commerce, or in the sale in interstate commerce of gas for resale. Intrastate pipelines are those that transport gas solely within the borders of a state, or into a foreign state, without at any point crossing the border of another state of the U.S. Interstate pipelines are regulated by the Federal Energy Regulatory Commission (FERC), while intrastate pipelines are subject to regulation by the state in which they are located.[14]

The gas industry is not vertically integrated. Generally, production, pipeline, and distribution companies are separately owned;[15] however, consolidation within the industry has begun to occur. There are 41 major pipeline systems within ten major transportation corridors within the U.S. and Canada (see Figure 2).[16]

Traditionally, a single pipeline, owned by one company, linked a producing field with a city gate. Today, pipeline companies have evolved into a highly connected network. The interstate pipeline network has grown 15% since 1990, primarily through greater interconnection, allowing for smoother operation and greater competition.[17] Market centers have grown up at points

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[12] Typically, gas at the wellhead is processed to remove contaminants and hydrocarbon compounds other than methane.

[13] EIA, DELIVERABILITY ON THE INTERSTATE NATURAL GAS PIPELINE SYSTEM 31 (1998).

[14] Suedeen G. Kelly, *Regulatory Reform of the U.S. Natural Gas Industry: A Summing Up*, 27 NAT. RES. J. 841, 842 (1987).

[15] Arthur S. De Vany & W. David Walls, THE EMERGING NEW ORDER IN NATURAL GAS: MARKETS VERSUS REGULATION 5 (1995).

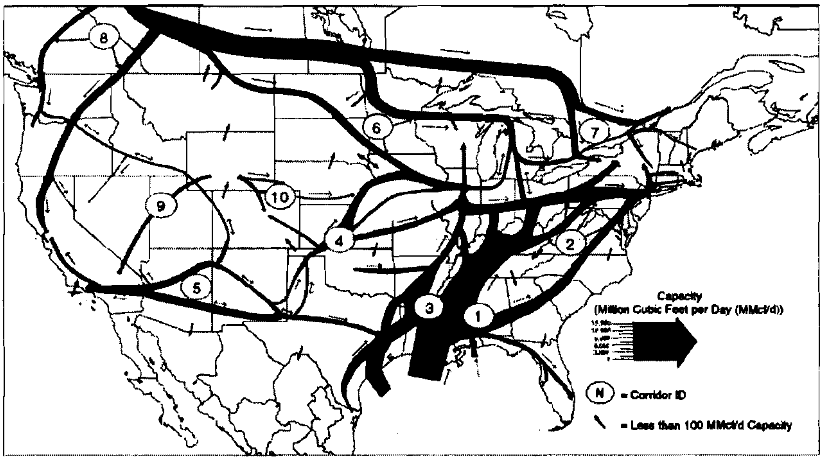
[16] EIA, *supra* note 13, at 34-48.

[17] EIA, *supra* note 13, at 31.

where multiple pipelines intersect and are supported by access to underground storage. This makes multiple routing of gas possible. Today, at least 39 market centers operate as pipeline hubs in the U.S. and Canada. The Henry Hub in Louisiana is the major natural gas market center in the U.S. Others such as the Chicago Hub are growing.[18]

Figure 2
Source: EIA, Natural Gas Issues & Trends 1998

Figure 37. Major Natural Gas Transportation Corridors in the United States and Canada, 1997



Note: The 10 transportation corridors are: (1) Southwest–Southeast, (2) Southwest–Northeast, (3) Southwest–Midwest, (4) Southwest Panhandle–Midwest, (5) Southwest–Western, (6) Canada–Midwest, (7) Canada–Northeast, (8) Canada–Western, (9) Rocky Mountains–Western, and (10) Rocky Mountains–Midwest.

Source: Energy Information Administration, EIAGIS-NG Geographic Information System, Natural Gas Pipeline State Border Capacity Database, as of December 1997.

C. Local Distribution

When the gas in the pipeline reaches the city gate, it flows into the local distribution system to the point of consumption ("the burner tip"). There are 1400 local distribution companies (LDCs) in the U.S. Typically the LDC purchases the gas from producers, pipelines, or marketers and delivers and resells it to its customers within the local distribution area. Sometimes large consumers of gas, such as electric utilities and industries using gas as a feedstock in their manufacturing process, physically bypass the LDC by building their own, private distribution lines from the pipeline to their facilities. In some states, consumers can buy their gas directly from producers or marketers and pay the LDC only for its distribution service.

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[18] EIA, *supra* note 2 at 111. *See also* Figure 2, Pipeline Corridors.

D. Marketing

With the advent of regulatory reform and increased competition in the price and sources of natural gas, the gas marketer has emerged as a new member of the natural gas industry. Prior to regulatory reform, the purchase and reselling of gas was performed almost entirely by pipeline companies. Today, there are gas marketing companies, which may or may not be affiliated with a pipeline, that purchase and resell gas and contract with pipelines and holders of excess firm transportation capacity on pipelines to transport gas. To date, marketers have primarily served large customers with fuel-switching capability.

Independent marketers are able to procure gas and ship it because of federal regulatory reform that required interstate pipelines to open access to their transportation service separately from their gas service. Not all states have required their LDCs to unbundle their services and to operate as open access transporters. Even so, most city gates are now open to at least some bypass of the LDC as merchant; however, most small gas consumers still use their LDC to sell them both transportation and the gas itself.

Gas marketers are not subject to economic regulation by the federal government or the states. However, the FERC does impose standards of conduct on interstate pipelines with marketing affiliates to ensure that they do not unfairly advantage their affiliates with transportation rates or services.[19]

III. NATURAL GAS MARKETS

A. The Modern Gas Market

Prior to the regulatory changes of the mid-1980s, the gas market was quite rigid. Natural gas was bought and sold at the wellhead through long-term contracts, typically ten to twenty year terms, and most gas sold in interstate commerce was subject to regulatorily-imposed price ceilings. The producers sold to the pipelines, which in turn sold to the LDCs, which resold to consumers, with no contact between producers and consumers. Gas was not sold separately from its transportation. Today, the price of gas is unregulated, and gas sales are unbundled from transportation, at least to the city gate. Many states have also unbundled the sale of gas from its local

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[19] *See* 18 C.F.R. §§ 161.1-161.3 (1999).

distribution. As a result, today's natural gas and transportation markets are more robust.

U.S. domestic gas producers are clearly in competition with each other and with foreign producers to sell their gas at "market price." Today's contracts for gas sales vary in length of time and have market sensitive pricing provisions. Wholesale consumers, like LDCs, contract directly with producers and marketers. With increasing frequency, large retail consumers, such as industrial users of gas and electric utilities, also contract directly with producers or marketers for gas. Wholesale and retail gas consumers who buy gas from a seller other than their LDC, purchase transportation separately from gas. Small consumers, even if they reside in states which permit them to buy gas from marketers, typically still rely on their LDCs for both gas and its transportation.

Regulatory reform has also changed the nature of the gas transportation market. The terms and costs of interstate transportation are regulated by FERC and specified in contracts between pipeline companies and shippers. Shippers include LDCs (which still hold a majority of the nation's supply of firm capacity), interstate pipeline companies themselves, electric utilities, industrial businesses, marketers, and others, including producers, gatherers and storage operators. In 1993, FERC gave the holders of firm transportation contracts the right to sell all or part of their transportation capacity for any length of time during the contract at a rate not to exceed the rate paid by the holder of the capacity to the pipeline itself.[20] Holders of excess firm transportation can sell capacity outright for a period of time or sell it subject to recall. Thus, today there is a "capacity release market." Between 1993 and 1998, firm transportation holders released capacity amounting to 8.0 Tcf, or the equivalent of 40% of the gas delivered to U.S. markets annually, to "replacement shippers."[21] The capacity release market is a way for shippers to change their transportation portfolios. It provides a mechanism to improve transportation flexibility to meet changing gas supply and demand conditions. At the initiation of the market, released capacity was selling for only about 10% of the price being paid by the holder to the pipeline. However, discounts for the year ending March 31, 1998, averaged about 50%.[22]

Shippers continue to prefer long-term contracts for firm transportation capacity, but "long-term" has become shorter over the years. For example, the average length of the contracts decreased from 10.9 to 7.0 years between

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[20] FERC Order No. 636, 57 Fed. Reg. 13267 (1992).

[21] EIA, *supra* note 1, at 27.

[22] *Id.* at 27.

1994 and 1998, a decrease in length of 36%.[23] In 1998, LDCs held 55 to 57% of total firm capacity.[24] Because LDCs have traditionally had an obligation to serve all consumers in their distribution area, they typically reserve enough capacity to ensure they can meet their obligation even on a day of peak demand. Because of this contracting practice, LDCs tend to have a lower rate of utilization of their capacity than do other shippers.

Each year a substantial amount of firm capacity is up for renewal. Some shippers are choosing not to renew these contracts when they expire and instead are turning back some or all of the capacity to the pipeline. This "turned back" capacity can be remarketed by the pipeline. A study undertaken by the U.S. Department of Energy of capacity turned back between April 1996 and March 31, 1998, showed that some of this capacity had been remarketed, but at much lower rates.[25]

The changes in capacity contracting relate to the transition to more competition in the natural gas commodity and transportation markets. The increasingly important role marketers are playing in the gas industry is underscored by the fact that they are increasing not only the amount of long-term firm transportation capacity they hold, but also the overall amount of capacity they have under contract. In 1998 marketers held 24% of the total U.S. contracted capacity.[26]

B. The Current State of Supply

Five geologic regions in the U.S. account for 81% of the total domestic gas production, which accounts for 86% of domestic consumption. The largest producer is the offshore Gulf Coast area, followed by the inshore Gulf Coast, the Anadarko/Arkoma Basins, the Permian Basin, and the Rockies (see Figures 3 and 4).[27] Canada is the major supplier of imported gas to the U.S., and its market share is rapidly increasing consistent with growing availability of new gas production in Canada. The U.S. Department of Energy projects that in 2000, Canada will supply 16% of U.S. gas supplies, doubling its 1990 share.[28]

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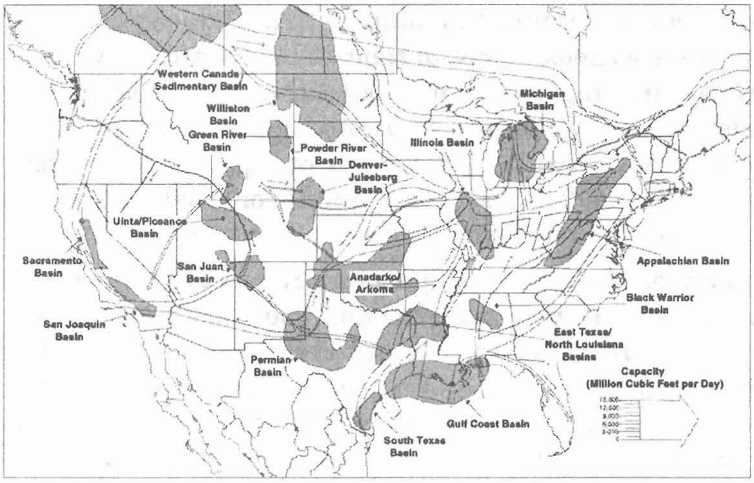
[23] *Id.* at 137.
[24] *Id.* at 129.
[25] *Id.* at 129.
[26] *Id.*
[27] EIA, *supra* note 13.
[28] *Id.*

Figure 3

Source: EIA, Deliverability on the Interstate Natural Gas Pipeline System

Figure 2. Major Natural Gas Producing Basins and Transportation Routes to Market Areas



Correspondence to Major Natural Gas Producing Regions

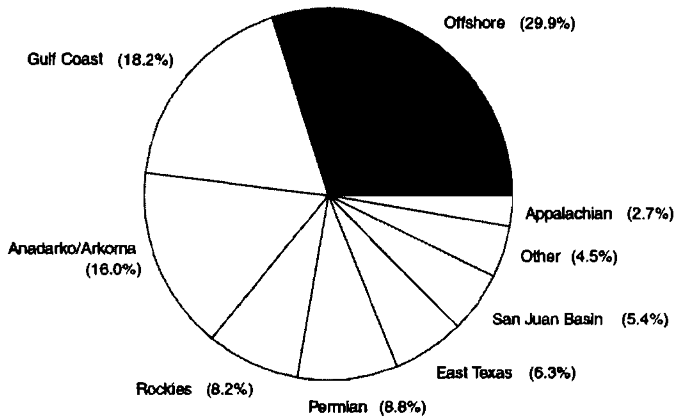
Producing Region	State or Substate Regions	Basins Contained Whole or in Part
Gulf Coast	South Louisiana (onshore) Texas RRC Districts 1, 2, 3, 4	Gulf Coast and South Texas Basins
Anadarko/Arkoma	Arkansas Kansas Oklahoma Texas RRC District 10	Anadarko/Arkoma Basin
Permian Basin	New Mexico, East Texas RRC Districts 7B, 7C, 8, 8A, 9	Permian Basin
Rockies	Colorado Utah Wyoming	Uinta/Piceance, Julesberg, Powder River, and Green River Basins
East Texas	North Louisiana Texas RRC Districts 5, 6	East Texas/North Louisiana Basins
San Juan Basin	New Mexico, West	San Juan Basin
Appalachian	New York Ohio Pennsylvania Virginia West Virginia	Appalachian Basin
Other Onshore	Alabama, California (onshore), Florida, Kentucky, Michigan, Mississippi, Arizona, Illinois, Indiana, Maryland, Missouri, Montana, Nebraska, Nevada, North Dakota, Oregon, South Dakota, and Tennessee	Williston, Sacramento, San Joaquin, Illinois, Michigan, and Black Warrior Basins
Offshore	Federal waters of the Gulf of Mexico, and State waters of California, Alabama, Louisiana, and Texas	

Source: Energy Information Administration, EIAGIS-NG Geographic Information System, Natural Gas Pipeline State Border Capacity Database, as of December 1997.

Energy Information Administration
Deliverability on the Interstate Natural Gas Pipeline System

Figure 4
Source: EIA, Deliverability on the Interstate Natural Gas Pipeline System

Figure 3. Lower 48 Natural Gas Production by Region, 1996
(Share of Total in Percent)



Total lower 48 production is 18.4 trillion cubic feet

Source: Energy Information Administration. **Total 1996 Production:** *Natural Gas Annual 1996* (September 1997). **Shares by Region:** *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 1996* (December 1997).

C. The Current State of Demand

Industry is by far the largest consumer of natural gas in the U.S., accounting for about 44% of all end-use consumption in 1998.[29] Residential use accounts for about 23% of consumption, and commercial use accounts for about 15%. Use of gas for electricity generation, while accounting for only 15% of current consumption, is expected to increase rapidly in the next decade. Gas is an appealing fuel for new electricity generation. Its price is relatively low, and it is least polluting of all the fossil fuels. Natural gas is more easily fully combustible and has fewer impurities than other fossil fuels. Therefore, when it is burned, it emits pollutants far fewer in volume and number than any other fossil fuel. Gas can also be used to fuel distributed generation, i.e., small (50 Mw or less) generating units sited near the end-user. Distributed generation is being looked to as a way to provide greater electricity reliability in a region without building new, unpopular transmission lines.

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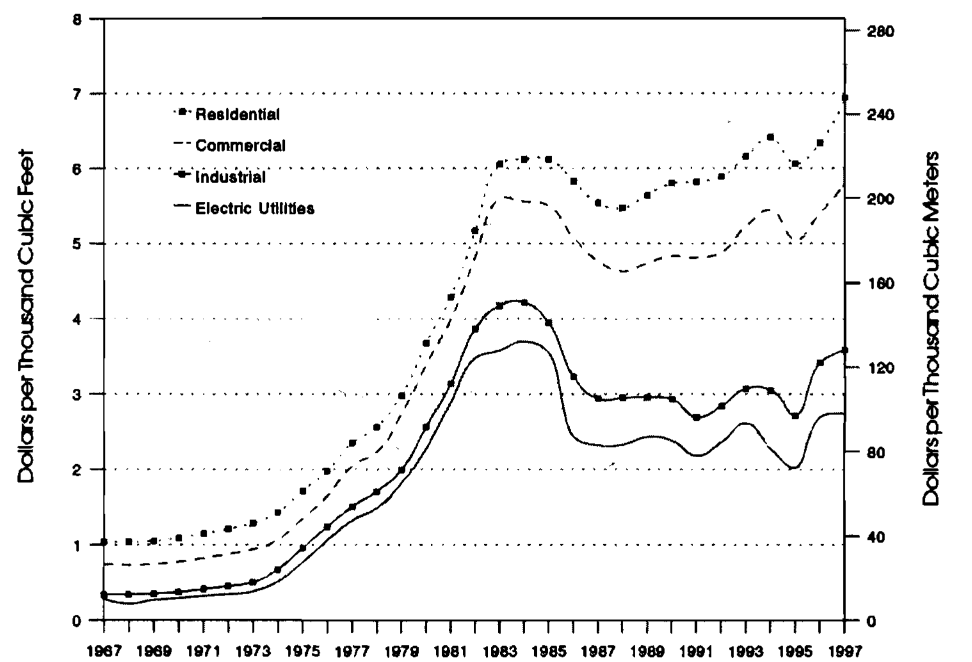
[29] Consumption data is from Energy Information Administration, *Annual Energy Review 1998: Natural Gas, Table 6.5: Natural Gas Consumption by Sector, 1949-1998* (visited July 29, 1999) <http://www.eia.doe.gov/pub/energy.overview/aer98/txt/aer0605.txt>.

Several foreign countries have been consuming U.S.-produced natural gas. The U.S. exported 157 billion cubic feet (Bcf) of natural gas in 1997, 52 Bcf to Canada, 62 Bcf to Japan, and 38 Bcf to Mexico.[30] The Southwest region of the U.S. is typically the largest consumer of natural gas, even though total energy consumption in the Southwest is far lower than in the Northeast region.[31] The Midwest is also a large consumer of natural gas. The Southeast and Western regions are relatively small consumers of natural gas.

Figure 5

Source: EIA, Historical Natural Gas Annual 1930-1997



Note: Beginning in 1996, consumption of natural gas for agricultural use was classified as industrial use. In 1995 and earlier years, agricultural use was classified as commercial use.

Sources: Electric Utilities: 1967-1977: Federal Power Commission (FPC). 1978-1993: Energy Information Administration (EIA), Form EIA-759, "Monthly Power Plant Report;" Federal Energy Regulatory Commission (FERC), Form FERC-423, "Cost and Quality of Fuels for Electric Utility Plants" and Form EIA-176, "Annual Report of Natural and Supplemental Gas Supply and Disposition." All other data: 1967-1975: Bureau of Mines, *Minerals Yearbook*, "Natural Gas" chapter. 1976-1978: EIA, Energy Data Report, *Natural Gas Annual*. 1979: EIA, *Natural Gas Production and Consumption 1979*. 1980-1997: EIA, Form EIA-176, "Annual Report of Natural and Supplemental Gas Supply and Disposition," and Federal Energy Regulatory Commission (FERC), Form FERC-423, "Monthly Report of Cost and Quality of Fuels for Electric Plants."

D. Prices

The price of natural gas delivered to the consumer consists of three components: transmission cost, distribution cost, and the cost of the gas itself. Interstate transmission rates are set by FERC. Intrastate trans-

[30] EIA, *supra* note 10.

[31] For a full discussion of regional consumption trends, *see* EIA, *supra* n. 13.

mission and local distribution rates are set by state regulators. The price of gas is set by the market.

The price of gas at the wellhead fluctuates and is affected by weather-sensitive, seasonal demand, the amount of gas in reserve and operational constraints. In 1998 the average price of gas at the wellhead was $1.74 per thousand cubic feet (mcf).[32] The wellhead price has steadily declined from its 1983 peak of $3.54 per mcf. Prices at the city gate have also declined since 1984, standing at $2.68 per mcf in 1998.[33] The decline in prices resulted from greater competition after the phase out of price controls initiated in 1978, increased production after 1978, an expanding transmission network, and improved drilling and transmission technology. The decrease in prices since 1984 is notable in that it has occurred despite the increase in demand and consumption over the same period (see Figures 5 and 6).

The price of natural gas is competitive with oil and lower than electricity for end-users. For example, the average cost of natural gas delivered to residential consumers in 1996 was $3.93 per million btu, compared with $4.54 for heating oil, and $15.62 for electricity.[34] For the month of March 1999, the average cost for natural gas delivered to residential consumers was $3.55 per million btu, compared to $3.54 for heating oil, and $14.03 for electricity.

A spot market has developed for natural gas, spurred by the emergence of market centers at pipeline hubs, or intersection points. With the advent of open access to pipelines, these markets have become more integrated. However, prices continue to be volatile, especially during the winter heating season (see Figure 7). The most important factor in spot pricing appears to be volume and accessibility of gas storage leading up to the heating season.[35]

The price volatility of the spot market can be offset somewhat by the futures market, allowing suppliers and users a hedge against risks of future price changes. A futures market in natural gas opened in 1990. A futures market is successful if it reliably predicts future spot prices at the point of delivery. So far, the natural gas futures market appears to be performing this function well.[36]

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[32] EIA, *Annual Energy Review 1998: Natural Gas, Table 6.8: Natural Gas Wellhead, City Gate, and Imports Prices, 1949-1998* (visited July 29, 1999) <http://www.eia.doe.gov/pub/energy.overview/aer98/txt/aer0608.txt>.

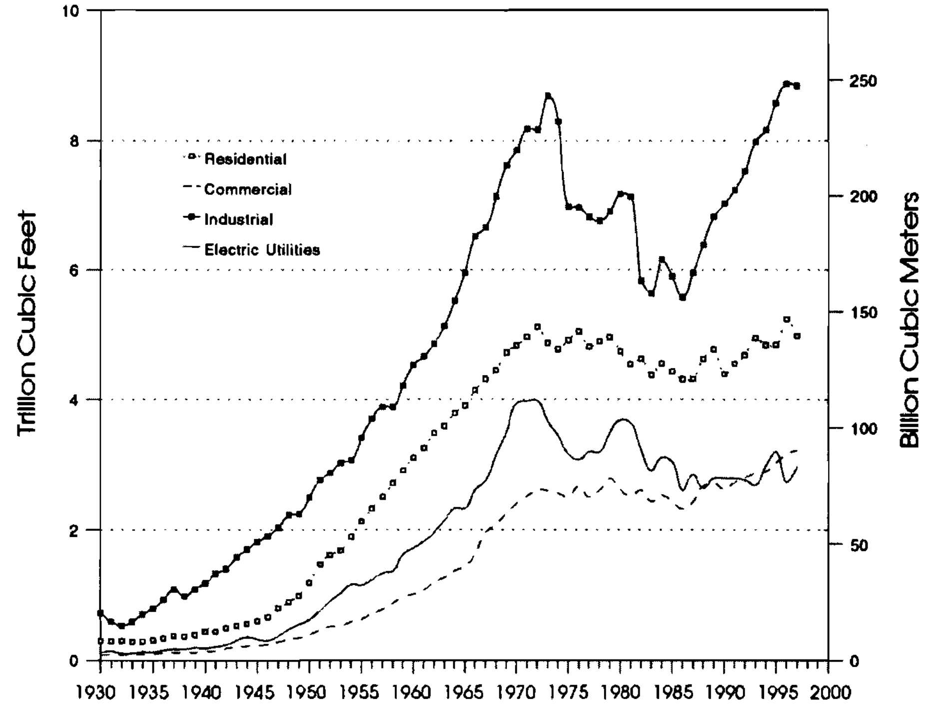
[33] *Id.*

[34] EIA, *Monthly Energy Review, July 1999* (visited July 30, 1999) <http://www.eia.doe.gov/pub/energy.overview/monthly.energy/mer1-7>.

[35] John Herbert, James Thompson & James Todaro, NATURAL GAS MONTHLY, Dec. 1997, at vii, ix-xi.

[36] De Vany & Walls, *supra* note 15, at 83-92.

Figure 6: Natural Gas Delivered to Consumers in the United States, 1930-1997
Source: EIA, Historical Natural Gas Annual 1930-1997, Fig. 2



Note: Beginning in 1996, consumption of natural gas for agricultural use was classified as industrial use. In 1995 and earlier years, agricultural use was classified as commercial use.
Sources: 1930-1975: Bureau of Mines, *Minerals Yearbook*, "Natural Gas" chapter. 1976-1978: Energy Information Administration (EIA). Energy Data Reports, *Natural Gas Annual*. 1979: EIA, *Natural Gas Production and Consumption, 1979*. 1980-1997: Form EIA-176, "Annual Report of Natural and Supplemental Gas Supply and Disposition," and Form EIA-759, "Monthly Power Plant Report."

E. Future Trends

The prospects for the future use of gas are favorable. The U.S. Department of Energy projects that natural gas consumption will increase by 50% by 2020 over the 1997 level of 22 Tcf.[37] Natural gas is expected to become more attractive to consumers because of its cost, availability and environmental qualities. It emits lower quantities of greenhouse gases (particularly carbon dioxide) and criteria pollutants per unit of energy produced than do other fossil fuels. If technology, manpower, investment, and exploration can keep pace with increased demand, as expected, then natural gas has an expanding future.

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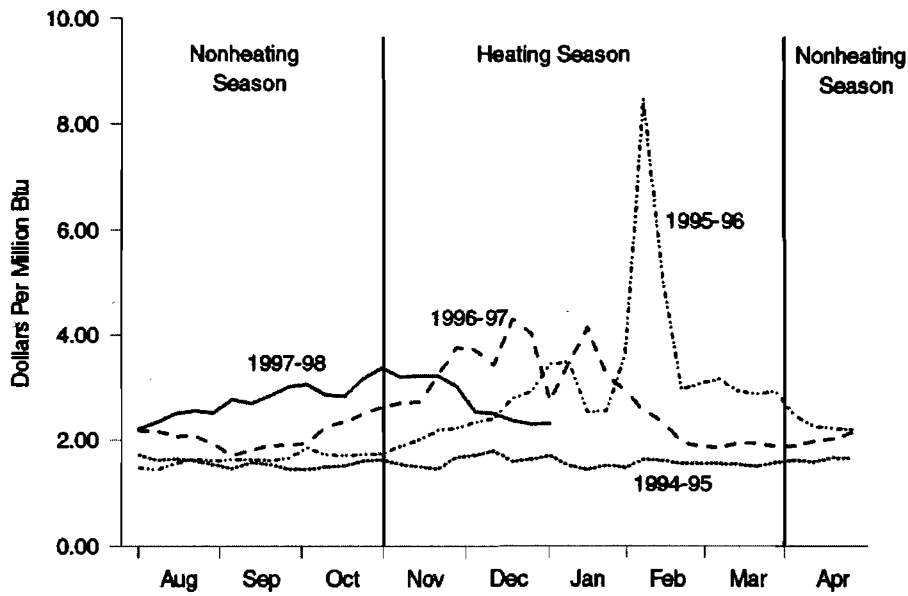
[37] EIA, ANNUAL ENERGY OUTLOOK 1999, WITH PROJECTIONS TO 2020, at 20-22 (1998).

Figure 7
Source: EIA – Herbert, Thompson & Todaro, Recent Trends in Natural Gas Spot Prices. EIA, Natural Gas Monthly Dec. 1997

Figure FE1. Henry Hub Weekly Average Natural Gas Spot Prices



Source: Pasha Publications, Inc., *Gas Daily.*

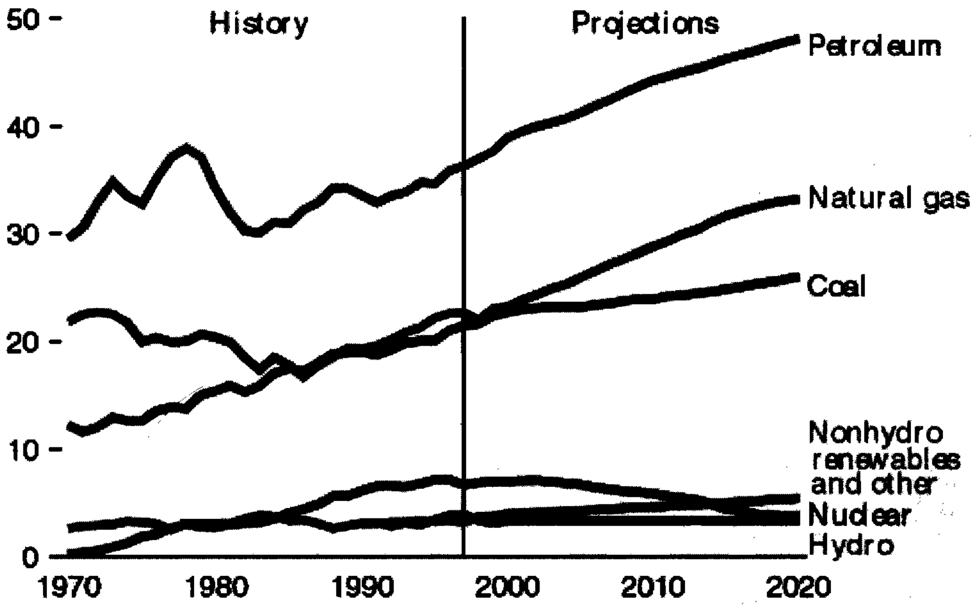
Increased use of natural gas for electric consumption is expected to account for a significant share of the overall increase in natural gas consumption. Natural gas is expected to keep pace with petroleum consumption, and to exceed demand for coal (see Figure 8). In order to supply the projected increase in demand, the government projects that a significant increase in production will be necessary as well as expansion of infrastructure. Offshore production is expected to increase by 14%, onshore production is expected to increase by 57%, and pipeline capacity must increase by 32% over 1997 levels.[38] Increased demand is expected to increase prices. The U.S. Department of Energy projects that the industry is in a favorable position to meet the expected increase in demand because the price increase should stimulate investment in infrastructure, exploration, and production. If the Kyoto Protocol's requirement to reduce carbon emissions is adopted by the U.S., the U.S.

[38] *Id.*

Department of Energy predicts that demand for natural gas will be 2 to 12% higher than previous estimates.[39]

Figure 8
Source: EIA, Annual Energy Outlook 1999

Figure 2. Energy consumption by fuel, 1970-2020 (quadrillion Btu)



IV. NATURAL GAS REGULATION

A. Regulation in the States

In the 1920s and 1930s, states enacted oil and gas conservation legislation to prevent the economic waste of natural gas through flaring or venting. Up until that time, producing states were brightly illuminated at night by the huge natural gas flares burning in the petroleum fields. As a result of the laws eliminating the flaring and venting of gas, the natural gas business was born.

Soon after enactment of conservation laws, large pipelines were built to transport the natural gas from the producing fields to developing

[39] EIA, IMPACTS OF THE KYOTO PROTOCOL ON U.S. ENERGY MARKETS AND ECONOMIC ACTIVITY, at xix and 95 (1998).

markets. By the 1940s, with the improvements made in long-distance gas pipelines, the modern gas industry developed.

The configuration of natural gas pipelines was such that it put pipelines in both a monopsony and a monopoly position. At one end of the fuel cycle, the pipeline was the only buyer that gas and oil producers had available in the field for their gas. Thus, pipelines held a monopsony on the purchase of gas. At the other end of the fuel cycle, the natural gas pipeline was the only seller and transporter of natural gas available to a local distribution company or an industrial end-user. As such, the pipeline held a monopoly on the sale of gas. These characteristics made the pipelines ripe for utility-like economic regulation. Local distribution companies were also likely candidates for economic regulation because they held a monopoly on the sale and distribution of gas to the ultimate end-users.

The states initiated regulation of local gas distribution companies in the 1910s and 1920s. LDCs were found to be businesses affected with a public interest and, thus, subject to public utility regulation. Even today state commissions typically require LDCs to obtain certificates of public convenience and necessity to do business and build pipelines and distribution lines. State regulators also oversee LDCs in setting just and reasonable transportation rates, providing reasonably priced gas, affording adequate service, and ensuring service to all customers without discrimination. State regulation, therefore, has controlled most business aspects of the investor-owned gas distribution company since its infancy. The legitimacy of this regulation was upheld by the U.S. Supreme Court in two landmark cases. *Public Utilities Commission v. Landon*[40] and *Pennsylvania Gas Co. v. Public Service Commission of New York*,[41] authorized state regulation of natural gas matters deemed essentially local and for which Congress had not attempted to legislate.[42]

The limits of state regulation were explained by the U.S. Supreme Court in *Missouri ex rel. Barrett v. Kansas Natural Gas Co.*[43] Kansas Natural Gas was a production and interstate pipeline company. It sold gas wholesale to local distribution companies, which in turn, distributed and resold the gas to consumers. When Kansas Natural Gas raised its rates for sales to distribution companies in the states of Missouri and Kansas, the public utility commissions of those states were concerned that the price increase would be passed on to their consumers, and asserted jurisdiction

[40] 249 U.S. 236, *vacated and modified*, 249 U.S. 590 (1919).

[41] 252 U.S. 23 (1920).

[42] The Pennsylvania Gas opinion was later limited in *East Ohio Gas Co. v. Tax Commission*, 283 U.S. 465 (1931).

[43] 265 U.S. 298 (1924).

over Kansas Natural Gas for the purpose of approving the increase. Kansas Natural Gas objected, arguing that the states' attempted regulation would unconstitutionally impinge on the free movement of interstate commerce. The states responded that their actions were legitimate exercises of their police power to regulate local concerns. The Supreme Court rejected the states' assertion of jurisdiction over the interstate pipeline company as violative of the Constitution's interstate commerce clause. In its opinion the Court set out its view of the regulatory power of the state commissions. The commissions could regulate the activities of local distribution companies (primarily sale and distribution of gas to local customers). State regulation would also be allowed where the interstate gas company sold directly to consumers without an intermediate sale to a distribution company. In *Kansas Natural Gas*, however, the activity was "fundamentally interstate from beginning to end," and the states were prohibited from exerting jurisdiction over it even though Congress had not acted to provide for federal regulation. Uniformity in the treatment of interstate commerce was required "even though it be the uniformity of governmental nonaction." Three years later the *Kansas Natural Gas* principle was reaffirmed in the context of interstate sales of electricity in *Public Utility Commission of Rhode Island v. Attleboro Steam Electric Co.*[44]

Kansas Natural Gas emphasized the limit of state regulatory power over natural gas transactions. A state utility commission could impose the requirement of just and reasonable prices on a local distribution company's sale to the consumer. A major part of the distribution company's costs were the costs of purchased gas; however, when this gas was gas that had moved in interstate commerce, its cost was beyond state regulatory power. If the distribution company was forced to pay unreasonably high prices for its supply of gas, the state commission typically was forced to allow those charges to be passed on to the customer as one of the distribution company's costs of service. This problem invited solution by federal regulation, which ultimately occurred, but not for fourteen years.

States have not been constitutionally prohibited from regulating the purchasing practices of interstate and intrastate pipelines. Under "common purchaser" statutes, states have required a pipeline wishing to buy gas from a particular well to take gas ratably from all other wells in the same pool. The purpose of this requirement is to protect the owners of wells in a common pool from having gas drained from under their wells by a neighboring well and to mitigate the monopsony power of pipelines.

[44] 273 U.S. 83 (1927).

Major gas producing states have also regulated gas production practices through prorationing statutes.[45] Pursuant to a typical statute, state regulatory agencies set monthly allowable volumes for each well. Although a producer is allowed to produce above or below this level in any given month, over a set period of time he must balance his production so as to produce the "allowable" level. If a producer consistently overproduces a well, it can be shut in. A consistently under-produced well can lose its right to make up that underproduction. The oft-stated purpose of this regulation is to conserve gas and protect correlative rights. There is evidence that some states have sometimes used their prorationing authority to set production levels at volumes below the true demand for gas, thereby raising its market price. As discussed *infra*, the Supreme Court has limited states' ability to regulate, even indirectly, the price of gas.

B. The Natural Gas Act of 1938

In 1935, the Federal Trade Commission issued a study concluding that the natural gas pipeline industry was indeed a natural monopoly, and recommending that the industry be regulated.[46] In light of that study and the inability of states to regulate interstate pipeline transactions, the U.S. Congress passed the Natural Gas Act (NGA) in 1938.[47] The statute, which is still in force today, provides for comprehensive federal regulation of interstate natural gas companies. The constitutionality of the act was sustained in *FPC v. Natural Gas Pipeline Co.*[48] Chief Justice Stone found the "sale of natural gas originating in one State and its transportation and delivery to distributors in any other State constitutes interstate commerce, which is subject to regulation by Congress."

Initially, the Federal Power Commission (FPC) was charged with implementing the NGA. Today's Federal Energy Regulatory Commission (FERC) is the successor agency to the FPC. The FPC focused its regulation of "natural gas companies" on the interstate pipeline companies. The NGA allowed the pipelines to remain private carriers of gas, thus permitting them to keep their monopsony on the purchase of gas at the wellhead. However, the price they paid for gas, as well as the price they charged for transportation, was subject to the FPC's jurisdiction to ensure "just and reasonable" rates.

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[45] *See* Kelly, *supra* note 14, at 843.

[46] Joseph Fagan, *From Regulation to Deregulation: The Diminishing Role of the Small Consumer Within the Natural Gas Industry*, 29 TULSA L.J. 707 (1994).

[47] 15 U.S.C. §§ 717-717z (1994).

[48] 315 U.S. 575 (1942).

The flexibility of the "just and reasonable" standard, as applied to the natural gas industry, was highlighted by Justice Robert Jackson in *Federal Power Commission v. Hope Natural Gas Co.*[49] Justice Jackson pointed out that the amount and quality of service rendered by a utility will, at least roughly, be measured by the amount of capital it puts into the enterprise. However, the "elusive, exhaustible, and irreplaceable" nature of natural gas results in the possession of an adequate supply being more erratic, irregular, and unpredictable in relation to investment than any phase of any other utility business. Conventional rate-base formulas bear no rational relationship to natural gas production. Therefore, the Court held that the Commission was not bound to use any single formula or combination of formulas in determining natural gas rates.

Under the NGA, pipelines were given certificates of public convenience and necessity to provide exclusive gas and transportation services to a particular geographic area of consumers, but in return, they had an obligation to provide reliable, non-discriminatory service. Companies wishing to construct new pipelines also need to obtain certificates of public convenience and necessity under the NGA. To assure the stability of service to consumers, as well as to limit the financial risk of pipelines, regulators routinely required pipelines, as part of the certificate process, to enter into long term contracts with gas producers for a reliable supply of gas prior to selling to a new market or constructing a new pipeline. Typically, a pipeline's contract with a gas producer was for twenty years. Sometimes, however, the contracts were for the "life of the lease," or for as long as the well was capable of producing gas. In some gas basins, such as the San Juan Basin in Northwest New Mexico, the wells produce for forty years. This requirement guaranteed LDCs and their customers an adequate and reliable gas supply and assured the pipelines and their regulator that investments in pipeline construction could be recovered. This regulatory approach also resulted in a highly structured industry which, nevertheless, worked fairly well for twenty years until the FPC was required to extend price regulation to gas producers.

C. The Natural Gas Act Applied to Gas Producers

The Supreme Court extended FPC jurisdiction to producers in 1954 in *Phillips Petroleum v. Wisconsin.*[50] In that case, the Court overturned an FPC decision and held that a producer selling gas for resale in interstate commerce fell within the regulatory jurisdiction of the NGA. Prior to *Phillips*, the subjects of FPC gas rate regulation were the small number of interstate

[49] 320 U.S. 591 (1944).

[50] 347 U.S. 672 (1954), *reh'g denied*, 348 U.S. 851 (1954).

pipelines. After *Phillips*, the Commission's jurisdiction suddenly included thousands of producers of gas for resale in the interstate market. The subsequent attempt by some members of Congress to enact legislation to change this interpretation of the NGA failed. The FPC was left with the unappealing task of regulating the price of a product not produced by monopolists. At first, the Commission attempted case-by-case determinations of just and reasonable producer rates, as it had done with the pipelines. Within a decade, however, the Commission was overwhelmed. It was estimated that if the Commission continued at its pace, it would have taken 83 years to clear its rate-making backlog.

The Commission moved from single-company rate regulation to the setting of area rates for producers within a geographic location. It used composite cost information in setting one rate for many sales in an area. Exceptions for individual producers were allowed on a showing of cost justification. Area rate regulation was sustained by the Supreme Court in *Permian Basin Area Rate Cases.*[51] The *Permian Basin Cases* also sustained a two-part rate system that allowed higher prices for newly discovered gas in order to encourage the development of new gas.

In the 1970s, the Commission moved from area rates to nationwide rates for new gas. Rates for previously discovered wells were also allowed to escalate. Rates for new gas, which were more than seven times as high as the rate under many existing contracts, brought objections from both gas producers and consumers. The producers urged deregulation of interstate rates. The consumers complained that the large increases in rates for new gas were allowing exorbitant profits to the gas industry. In 1977, the Court of Appeals for the District of Columbia Circuit rejected both arguments and affirmed the new nationwide rates in *American Public Gas Association v. FPC.*[52]

Price regulation thus relied on a "vintaging" system, causing a division of gas into "old" and "new." The "old" gas, which had already been discovered and was in production, was subject to low price ceilings. The "new" gas, which had not yet been discovered and was thus not available for production, was allowed a high price to encourage exploration of untapped reserves. The result was that established gas producers, who had mostly "old" gas to sell, were induced to confine their gas to the intrastate market, which was not subject to FPC authority, so they could charge higher prices. Pipeline customers also encouraged producers to make intrastate sales by balking at paying for higher priced "new" gas.

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[51] 390 U.S. 747 (1968).

[52] 567 F.2d 1016 (D.C. Cir. 1977).

Interstate sales of gas were suppressed as a result of the federal price controls. Although the price of intrastate gas was unregulated by the federal government, it generally tracked the interstate price, at a slightly higher rate. Thus, the overall price of gas was artificially low, which led to decreased investment in new production, and, ultimately a shortage of natural gas in the United States. At the same time, the low prices also led to an increase in demand for natural gas.

The adoption of wellhead price controls also added to the complexity of certification of pipeline construction and services. The FPC was particularly concerned that low-price old gas would not be made available on the interstate market and the interstate gas supply would thus be jeopardized. The Commission was faced with prioritizing end-users in a time of shortage, and was forced to spend more time scrutinizing pipeline certificates and balancing the needs of all the purchasers in the industry—the pipelines, the LDCs, and the customers.[53]

By 1974, there was substantial discontent with price controls on producer sales in the interstate market.[54] Public criticism was also leveled at the regulatory overload effects of the *Phillips* decision on the supply of and demand for natural gas. The widespread political consensus, which had initially supported regulatory control of the natural gas industry, began to fade and political dissatisfaction with regulation rose.

D. The Energy Crisis Spurs Gas Price Deregulation and Interstate Pipeline Regulatory Reform

The American public felt the full impact of shortages in the interstate natural gas market during the mid-1970s. The OPEC oil embargo of 1973 and record-cold winters in the later half of the decade produced a steep rise in demand for gas. This effected a price increase in the unregulated intrastate market but not in the regulated interstate market. To the extent producers had new gas, they had no incentive to dedicate it to the interstate market. The intrastate market had a surplus of the high-priced "new" gas. The discrepancy in price between the intrastate and interstate markets for gas widened, as did the discrepancy between the price of oil and interstate gas. Not surprisingly, consumers demanded more interstate gas, which was just not available. The severe shortage of gas, combined with the jump in

[53] *Id.*

[54] *See* Federal Power Commission v. Texaco, 417 U.S. 380 (1974).

price for unregulated gas, rendered producer price regulation under the NGA even more controversial.[55]

Congress sought to address these problems with the passage of the Natural Gas Policy Act of 1978 (NPGA).[56] First, the NGPA raised the price allowed to be charged for all gas, except old gas. Second, the NGPA provided for the phasing out of the regulation of gas prices. By July 1, 1987, the price of all gas, except old gas, was to be set by the marketplace.

The NGPA also addressed a number of other gas regulation issues that had been debated since the *Phillips* decision and effected a compromise between the wishes of producers and consumers. Federal price controls, and ultimately decontrol, was extended to the intrastate as well as the interstate market. Congress set maximum prices in the NGPA for a wide variety of categories of gas. As noted, price controls on most types and vintages of gas were to be removed by 1987. Newly discovered gas and gases with high extraction costs were initially deregulated. Prior to decontrol, gradual escalation of gas prices was allowed to reflect inflation and to bring gas prices in line with current and projected petroleum prices. An "incremental pricing" program required that most of the initial gas price increases be passed on to major industrial, rather than residential and small commercial, consumers of gas. Priorities were established to respond to curtailment of gas services.

The NPGA represented a major Congressional policy shift in natural gas regulation. By first raising the price ceilings that had discouraged production, Congress hoped to encourage producers to supply more gas. At the same time, it sought to protect residential consumers from part of the price increase by continuing to regulate the more plentiful "old" gas. Pipelines typically bought gas of many vintages and resold it to LDCs at the average price of the mix. After a transition period of eight years, Congress envisioned an unregulated, competitive market in natural gas.

At first, the NGPA had its desired effect. Gas producers across the country increased production capacity in response to the higher wellhead prices specified in the NGPA. The deregulated prices for certain categories of new gas also reduced the dichotomy between gas prices in interstate and intrastate markets, and gas supplies evened out between the markets.

However, by the mid-1980s, different and unforeseen problems arose. The higher gas prices had a classic, predictable effect on consumers: they steadily scaled back gas consumption. Then the country experienced a recession in 1981 which also caused a drop in the demand for natural gas.

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[55] *Id.*

[56] 15 U.S.C. §§ 3301-3432 (1994).

This effect was compounded by the break up of OPEC and the resulting drop in the price of oil between 1980 and 1983. As the price of oil, an acceptable alternative fuel for many large gas users, fell below that of gas in 1983, the stage was set for fuel switching among industrial users.[57] In 1983, it was estimated that between 23 and 35% of total U.S. gas consumption could easily switch to fuel oil.[58] This was a particularly ominous scenario for pipelines.

The pipelines' problem stemmed from their long-term contracting practices with producers, which had been in place from the early days of NGA regulation. In the1970s, to assure adequate supplies of gas to meet the extraordinary demand of the times, pipelines had contracted long-term with producers for large volumes of gas and agreed to take a high percentage of the gas the well was capable of producing on a daily basis. If the pipelines did not physically take the gas they nevertheless agreed to pay for it. These take-or-pay clauses became a problem for pipelines as the price of gas rose and demand for it fell off. The problem was exacerbated by the fact that many of the take-or-pay contracts also contained automatic price escalation clauses. As large users switched to oil and the pipelines' sales fell off, they had to pay take-or-pay penalties. Numerous pipelines were without the cash to pay the penalties and faced bankruptcy. Large producers who could wait to be paid had little incentive to renegotiate their advantageous contracts. However, by 1984, many gas producers with excess production capacity were interested in selling more gas even if they had to lower their prices to do so. Pipelines already had too much gas under contract, albeit at high prices. Producers began to talk directly with consumers. This situation helped motivate the FERC to experiment with regulatory reform of interstate pipelines. FERC issued Order No. 319-A which permitted interstate pipelines to transport gas owned by others to large users capable of switching to alternative fuels.[59] In *Maryland People's Counsel v. FERC*,[60] the D.C. Circuit approved this concept but vacated FERC's order for failure to consider the anticompetitive effects of limiting the availability of unbundled transportation of gas to large users. FERC responded to the *Maryland People's Counsel* decision with Order 436 issued in 1985, which provided a comprehensive regulatory scheme that gave pipelines strong incentives to allow any person access to their unused pipeline capacity.[61]

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[57] Suedeen G. Kelly, *Intrastate Natural Gas Regulation: Finding Order in the Chaos*, 9 YALE J. ON REG. 355, 361 (1992).

[58] *Id.* at 361, n. 18.

[59] FERC Order No. 319-A, 48 Fed. Reg. 51,436 (1983).

[60] 761 F.2d 780 (D.C. Cir. 1985).

[61] FERC Order No. 436, 50 Fed. Reg. 42,408 (1985).

Order 436 was an historic step toward unbundling pipelines' gas sales service from their transportation service. FERC realized that the goal of the NGPA to have supply, demand and price of gas set by the marketplace could not be fully realized unless the many sellers of gas (producers) could deal directly with the many consumers of gas. This could not happen unless the parties could be assured that the gas bought could be transported from the producer to the consumer.

FERC did not have the authority to directly order pipelines to carry gas for others. However, Order 436 provided incentives that enticed most pipelines to "voluntarily" begin transporting gas for others. First, Order 436, known as the "open access" order, simplified the "convenience and necessity" certification requirements. If the pipeline agreed to provide nondiscriminatory access, or transportation, to whomever requested it, the pipeline could obtain a pre-approved "blanket" certification for new services or facilities. By agreeing to act as a common carrier, the pipeline was better able to access new end-use markets.

Second, Order 436 gave pipelines the right to convert their sales obligations under their wellhead contracts to transportation-only contracts. This allowed the pipelines to lessen their take-or-pay liabilities somewhat by agreeing to surrender their sales monopoly to the downstream market. Additionally, Order 436 permitted customers to purchase gas from any available supplier.

The Court of Appeals affirmed most aspects of Order 436 in *Associated Gas Distributors v. FERC*,[62] but remanded it to the Commission to address take-or-pay problems. The competitive incentives were retained. In response, FERC issued Order 500, establishing "acceptable passthrough mechanisms" by which pipelines could recover take-or-pay buyout or buydown costs by passing the costs through to customers. The D.C. Circuit also remanded Order 500 as unnecessarily harmful to consumers. The FERC subsequently issued Order 528 allowing pipelines to develop new methods of allocating their take-or-pay costs to spread them over all segments of the industry, so that residential and small industrial users did not bear a disproportionate share.

In 1992, FERC issued Order 636,[63] known as the "comparability" order, which it characterized as a final restructuring of the natural gas industry. This order set the stage for a competitive national market in the sale of

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[62] 824 F.2d 981 (D.C. Cir. 1987).

[63] *See* FERC Statutes and Regulations Preamble 30,939 (1992). Final regulations for FERC Order No. 636 were not published until 1999. *See* 64 Fed. Reg. 43506 (1999).

natural gas by allowing buyers to access the pipeline transportation grid on equal terms with all other buyers and, thereby, connect with sellers nationwide. Order 636 requires pipelines to completely unbundle gas sales from transportation, and to provide "comparable" transportation services, with the same rates, terms, and conditions, to all customers. In short, Order 636 requires pipelines to be equal access common carriers of natural gas.

Even though pipelines are allowed to continue selling gas on an unbundled basis, a pipeline's sales division must be strictly separated from its transportation division, and the pipeline may not provide any services to its sales division that it does not provide to third-party sellers. As a result, most pipelines have abandoned the sales business, so that sales are made by either independent sellers or marketing affiliates, rather than by the pipeline itself.

Order 636 also contained a number of other major components. First, pipelines must provide "no-notice" service to distributors to meet severe peak-day requirements. Second, pipelines are required to use the straight fixed-variable (SFV) rate design methodology that allocates all fixed costs to the reservation component of two-part rates. Third, pipeline transportation contracts receive pre-granted abandonment authorization at the expiration of the contract, subject to a right of first refusal by the shipper. Fourth, holders of firm capacity may release that capacity to other shippers on the secondary market at any price up to the maximum rate paid by the releasing shipper. Existing buy-sell arrangements were grandfathered, but future buy-sell arrangements were prohibited. Fifth, pipelines may recover 100% of all their prudently incurred "transition costs," including take-or- pay costs, costs of new facilities installed to comply with the order and gas supply realignment costs incurred to unbundle the sales function.

Pursuant to federal regulation today, interstate pipelines are equal access common carriers of gas whose rates, terms and conditions of service are subject to regulation by FERC under the NGA. The price of natural gas is not regulated. This is so whether the gas is sold into interstate or intrastate commerce. In 1986, the U.S. Supreme Court clarified that the federal government has preempted the states from regulating intrastate gas prices. In *Transcontinental Gas Pipeline Corp. v. Mississippi Oil and Gas Board*,[64] the Court invalidated a Mississippi regulatory order issued pursuant to its common purchaser act. The Order in question required a pipeline to take ratably from a well interest owner with which it did not have a contract. The well interest owner's gas was in a common pool with other wells with which the pipeline company did have a contract and from which it was taking gas.

[64] 474 U.S. 409 (1986).

The noncontracted for gas was being sold at a higher rate than the gas which the pipeline company had contracted for. The Court found that the enforcement of the Mississippi Order would have an effect on the price being paid for gas. The Court also found that Congress' intent in passing the NGPA was to have the marketplace determine the price of gas. Thus, the Court concluded, Congress not only prohibited the federal government from regulating the price of gas, but also prohibited state governments from directly or indirectly regulating the price of gas.

By 1987, the federal price caps on all gas, except old gas, had expired pursuant to the NGPA. In 1989, Congress passed the Natural Gas Wellhead Decontrol Act,[65] which ended the remaining federal price controls as of January 1, 1993.

E. The States Reform Their Natural Gas Regulatory Policies

Most states have followed FERC's lead and reformed their regulation of LDCs and intrastate pipelines to require them to carry gas owned by others—at least for large customers. As of mid-1998, five states had implemented complete unbundling programs for small customers. Another thirteen states and the District of Columbia have pilot programs in place that give residential and small business customers the right to choose their own gas supplier. Twelve more states are considering doing the same.

In order to open up competition among gas suppliers to retail consumers, state regulators must require the LDC to unbundle its gas sales and transportation services and offer them separately. New York was the first state to reform its regulation of LDCs in this manner in 1984. Other states quickly followed suit.[66] They acted to maintain the health of their local distribution systems, which were threatened with the loss of their large gas consumers. As discussed earlier, at this time the delivered price of gas began to increase relative to that of oil. Large gas users threatened to switch to oil unless their gas prices were lowered. If these consumers bypassed the natural gas transportation and distribution system, the cost of maintaining the system would fall to the small, "captive" customers. Faced with the unappealing prospect of raising rates to these customers, state regulators had an incentive to find ways to lower the delivered cost of gas to potential bypassers. They were supported in this quest by many gas producers who had been shut out of existing markets and were clamoring to sell their gas, even at lower than prevailing prices. Regulators saw that

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[65] Pub. L. No. 101-60, 103 Stat. 157, repealing 15 U.S.C. §§ 3311 to 3320, 3331 to 3333.

[66] *See,* Kelly, *supra* note 57, at 366-69.

the easiest way to lower gas costs to potential bypassers was simply to let willing producers sell them cheaper gas. However, direct retailing of natural gas to customers by a seller other than the LDC was a significant break with tradition. Change can be difficult in any industry, but it is particularly so in one guarded by longtime economic regulation. Nevertheless, over the last fifteen years, state regulators have increasingly required gas utilities under their jurisdiction to provide gas distribution service to customers wanting to buy gas from non-LDC vendors. As a result, many large industrial consumers, including electric utilities, are buying gas in the competitive market.

Even though states have required their LDCs to unbundle services, they have not prohibited their LDCs from offering bundled service. In other words, they have preserved the LDCs' traditional obligation to serve all customers within their service territories with gas This is unlike the federal reform of interstate pipelines where FERC prohibited pipelines from selling transportation bundled with gas. As a result, in the states, customers have not *had* to find a non-LDC gas supplier and, not surprisingly, most small customers have not even considered switching from their LDC as gas supplier. The current cost of finding a lower-priced supplier and negotiating a contract far outweighs the benefit for small consumers. The U.S. Department of Energy reports that only 2% of eligible small customers actually participate in programs allowing them to choose a non-LDC provider of gas.[67] This situation has motivated a few states to affirmatively enact regulatory programs designed to make it less costly for small consumers to choose a non-LDC gas supplier. These "customer choice" programs typically require the LDC to advertise the availability of other gas suppliers' programs and handle the administrative responsibilities associated with signing up consumers for the various gas suppliers.

F. Future Issues

1. *State Initiatives*

State regulators are developing customer choice programs and customer information campaigns designed to make it easier for small gas consumers to switch from their LDC to a gas marketer for future gas supply.

State regulators are also reviewing their traditional regulation of LDCs as gas suppliers to see whether they need to revamp their regulatory approach to ensure that their LDCs obtain the best-priced gas in the competi-

[67] EIA, *supra* note 1, at 35.

tive wholesale gas market. Some of the issues include whether LDCs should be given an incentive to purchase lower-priced gas and whether LDCs should be encouraged or required to participate in the gas futures market.

The fact that LDCs are now buying gas in a deregulated gas market and having it transported by pipelines in a restructured transportation market has also raised new issues for state regulators. These include, for example, what type of gas contract portfolio is reasonable for each LDC to hold, what amount of long-term firm transportation capacity is reasonable for each LDC to keep under contract, and whether the LDC should be selling capacity in the capacity release market.

2. *Federal Reconsideration of Interstate Pipeline Regulation*

Today's interstate transportation of gas occurs through both long-term contracts and short-term arrangements. FERC is reviewing whether its regulation of transportation in either of these arenas should change.

Although the movement of gas pursuant to long-term pipeline contracts has been a staple of the industry from the beginning, today's long-term arrangements are different from yesterday's. Today's long-term contracts are shorter in length. When these long-term contracts expire, some are not being renewed; others are being renewed at lower prices. These changes underscore the fact that transportation of gas is responding to a more competitive market. These changes are also evidence that the pipeline industry is a riskier one than in the past. In light of this, FERC is asking the question whether its regulation should be reformed in order to provide the correct incentives for pipelines to offer optimal transportation services and facilities for tomorrow's market, to provide appropriate price signals, and to eliminate any regulatory bias toward either long-term or short-term transportation.[68] This inquiry is occurring against the backdrop of FERC's responsibility under the Natural Gas Act to protect consumers of natural gas from the exercise of monopoly power by interstate pipelines and to assure that rates for interstate transportation are just and reasonable.

FERC has made it clear that it will retain cost-based rate regulation for long-term transportation, but it is considering whether other types of cost-based ratemaking, such as index rates or incentive rates should be adopted. Index rates are rates based on factors other than only the pipeline's costs and volumes, such as the supply and demand characteristics of the

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[68] FERC Notice of Inquiry regarding Regulation of Interstate Natural Gas Transportation Services, 63 Fed. Reg. 42,974 (1998).

market being served. For example, in its regulation of oil pipelines, FERC has adopted an index method of ratemaking that uses the producer price index for finished goods and an industry cost-based efficiency adjustment to modify existing pipeline rates initially set on the basis of cost factors.[69] Incentive regulation is used in lieu of, or in addition to, traditional cost-based regulation to provide an incentive to regulated entities to provide better service at lower cost, usually by giving the company a share of the costs saved.

FERC is also seeking comments on whether the trend toward shorter term contracts is a natural consequence of the evolution of competition or whether it has been unduly affected by FERC's pipeline pricing policies. Additionally, FERC is considering whether it should change its ratemaking policies affecting capacity turned back to the pipelines after the expiration of unrenewed contracts with shippers. One question FERC is asking is whether this capacity might be susceptible to market-based ratemaking. Finally, FERC is considering whether long-term firm capacity contracts should be allowed to be offered at fixed rates. This is different from what happens today where the price of this capacity is subject to changes during the term of the contract resulting from rate cases brought by the pipelines at FERC. FERC realizes that now is the time to grapple with the issue of how new pipeline capacity should be priced, before a significant amount of new capacity is actually built.

Since 1993, when FERC issued Order No. 636, active short-term transportation of gas on both a firm and interruptible basis has developed. Currently, transportation can be sold short-term as long as it is sold at a price below the maximum rate set by FERC. FERC has announced a proposed rule which would eliminate cost-based regulation for short-term transportation, including the maximum price cap on short-term transportation and require, instead, that all short-term capacity be sold through capacity auctions.[70] FERC is interested in the development of a competitive short-term transportation market where capacity is freely traded so that shippers have a large number of capacity alternatives from which to choose, thereby reducing the number of captive customers. FERC also wants to see opportunity for greater flexibility in pipeline contracting practices so that pipelines can design services that better meet the needs of existing and new entrants in the gas marketplace. Some pipelines are concerned about the

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[69] FERC Order No. 561, FERC Stats. and Regs., Regulations Preambles, January 1991-June 1996, 30,985 (1993).

[70] FERC Proposed Rule regarding Regulation of Short-Term Natural Gas Transportation Services, 63 Fed. Reg. 42,982, FERC Docket No. RM98-10-000 (August 11, 1998) (affecting 18 CFR Parts 161, 250, 284).

risk this change would entail for them, and some LDCs are concerned that the auction will eliminate their ability to contract, in advance, for short-term capacity.

3. *Mergers and Acquisitions*

Mergers and acquisitions in the natural gas industry are occurring as the industry responds to the competitive initiatives of the federal and state governments in both the natural gas and electricity industries. Mergers in the natural gas industry increased 400% between 1990 and 1997. Mergers or acquisitions involving regulated gas companies must be approved by their regulators, including FERC and each state having jurisdiction over any LDC involved in the corporate recombination.

As the gas industry continues to adjust to the changes brought by increased competition into both the gas sales and transportation segments of the business, corporate changes will continue to occur to enable the industry to reposition itself to achieve lower costs, economies of scale, new expertise as needed in new market conditions, and access to new markets. State and federal regulators will also continue to adjust their regulatory policies to the changes in the industry. Because much of the transportation and local distribution segments of the industry are still monopolies, regulatory jurisdiction in FERC and the states remains substantial. ❦

CHAPTER TWELVE

Electricity

by Suedeen G. Kelly

I. THE ELECTRICITY FUEL CYCLE

Electricity represents approximately one-half of the energy used and produced in the United States. Electricity is not a natural resource, rather it is generated from oil, coal, natural gas, nuclear power, and falling water (hydropower) for the most part, with a small portion generated by alternative resources such as wind, biomass, geothermal energy, and the sun. This book is being written during a period of major restructuring in the electricity industry and later in the chapter we indicate the direction of that restructuring. We begin, however, by describing the traditional structure of the industry and the fuel cycle and then go on to describe the market for electricity. The three major components of the electricity fuel cycle are: generation, transmission, and distribution.

A. Electric Generation

The generation of electricity occurs internationally, nationally, and regionally and is the largest sector in the electricity business. Generation accounts for half of an electric utility's assets and can amount to half of the cost of producing and delivering electricity to consumers.[1]

As noted, electricity is generated from a variety of natural resources. Yet, whatever source is used, the production is similar. In a basic steam turbine, fossil fuel is burned to produce steam, which in turn rotates a shaft, which with the help of generators converts mechanical energy into electric energy. A magnet is placed on the shaft and as it rotates its magnetic lines cross a wire to generate electricity. Similarly, in a gas engine a hot jet turns the turbine, and in the case of hydroelectricity, the shaft is rotated by falling water. Ultimately, as the rotations increase, the angles of the magnetic lines

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[1] Leonard S. Hyman, AMERICA'S ELECTRIC UTILITIES: PAST, PRESENT, AND FUTURE 19 (6th ed. 1997). *See also* Ronald D. Jones, Jeffrey W. Meyers & Robert J. Glasser, *Electricity,* 2 ENERGY LAW & TRANSACTIONS, ch. 52 (David J. Muchow & William A. Mogel, eds., 1998).

of force in relation to the wire change directions thus increasing or decreasing the number of force lines cut with wire. Consequently, the electric current generated gets stronger or weaker and reverses direction producing an alternating current (AC).

The combination of turbines, electric generators, and necessary auxiliary equipment comprises a generating station. The ability of a generator to produce a given output of electricity at an instant in time is known as the generator's capacity. Capacity ratings of an electric generator are measured by watts and are expressed in kilowatts (1000 watts) (kw), megawatts (million watts) (Mw), or gigawatts (billion watts) (gw). A kilowatt used for an hour is a kilowatt hour (kWh).

The generation process is incapable of capturing all of the heat that is produced. Consequently, electricity generation produces waste heat. Utilities attempt to capture as much of the excess heat as possible and have developed two procedures to do so: *cogeneration* and *combined cycle generation*. Through *cogeneration*, waste heat is used by the utility or sold to an end user. *Combined cycle generation*, on the other hand, combines a gas turbine and a steam turbine. The gas turbine produces electricity and its waste heat is passed on to the steam turbine which also produces electricity. Such a procedure can reach 50% efficiency whereas a traditional steam turbine generally has a 35% efficiency.

Once electricity is generated it cannot be stored effectively. The closest utilities come to storing electricity is the *pumped storage plant* where water is stored in a reservoir until water is released turning electrical turbines below. For the most part, electricity must be produced at the generator at the time the customer demands it.

Fluctuation in customer demand requires an electric utility to raise or lower its output instantaneously. For that purpose, electric utilities must have a mix of capabilities. First, electric utilities must have power plants which are operated at a constant output to serve the minimum demand on the system. These are called *base load* plants. Second, electric utilities must have sufficient production facilities available to meet the maximum demand on its system. As a result, electric utilities maintain *spinning reserves* plants. Spinning reserves are kept in low level operation and are ready to be switched on to serve increased load changes above the base load. Finally, other plants, referred to as *cold reserves*, are available for service but require some lead time to "fire up."

Utilities will use their most efficient and least expensive power plants first to meet base load and their more expensive power sources to meet peak load. Base load plants are typically large and expensive to build. Once they are built, it is efficient for utilities to to keep the plants in continuous operation. Thus, the utility is able to spread the fixed costs of operating the plant over a long period of time. Peaking units are typically less expensive to build but their operating costs are often higher—because of higher fuel costs. Therefore, a utility is better off using these plants to meet peak load.

Utilities attempt to keep generators idle as little as possible. How the load is spread and whether there is a difference between the average demand on the system and demand at peak is measured by the *load factor* which is defined as the average load in a period of time as a percentage of peak load. The higher the load factor the better positioned the electric utility is to maximize the use of its generation. A load factor can also be too high when a utility uses its generators so much that it does not have enough reserve in order to allow for maintenance of its base load plants. An electric utility's ability to meet its reserve needs is normally measured by the *reserve margin*. A reserve margin is the difference between peak load and capacity as a percentage of peak load. Reserve margin is generally 20% or more.

In the traditional regulatory environment, utilities have tried to ensure that their capacity is available to meet the peak load, and constructed a sufficient number of plants to meet that expected demand. In today's more competitive and cost conscious regulatory environment, utilities and regulators experiment with alternative approaches. *Demand side management* is a technique by which utilities cut down peak load by charging more for power at certain times of the day or year depending on peak demand. Other devices, such a marginal cost ratemaking or incentive pricing also allow utilities to manage load by having rates more closely reflect competitive prices rather than historic costs.

B. Electric Transmission

Once generated, electricity is transmitted to either a distributor or to an end-user through transmission lines. Electricity is transmitted across large distance using high voltage transmission lines. Typically, substations increase voltage over long distances and then decrease it before it reach the end-users at home.

Throughout the process, transmission losses reduce the amount of electricity available for consumers and increase electromagnetic radiation. While recent technological development of better conductors may reduce transmission losses, the process remains inefficient. Furthermore, because transmission lines form a regional grid which are connected in a network, electricity does not flow directly from point A to point B. As a result of the way intervening lines are loaded, the flow may loop around, loading some lines more than others. In short, selecting the appropriate voltage level for a transmission line involves tradeoffs among cost, electric line losses, and space and distance considerations. Conversely, higher voltage lines are more costly and require some separation of conductors and more space.

Electric transmission and supply in the United States today is coordinated and synchronized among the many electric systems and companies through the physical interconnection of electric facilities, regional reliability councils, and power pools. Through *interconnections*, every utility is either connected or capable of being connected with its neighbor. The United States and Canada have four large interconnected power systems. While it is technically accurate to say that there is a national electric grid, there are basically three large grids throughout the united States. One grid operates west of the Rocky Mountains, one operates east of the Rocky Mountains, and one operates in Texas.

Electric reliability councils maintain and improve the reliability of interconnected electric operations and ensure the adequacy of regional electricity supplies. Voluntary regional electrical reliability were formed in the later half of the 1960s. In 1968 the National Electric Reliability Council was formed in response to a massive blackout in New York City. Today there are nine voluntary regional councils which formulate strategies to deal with the effect on reliability of mergers in the industry.

Electric utilities also rely on *power pools* to coordinate electric supply. Power pools are formal and informal agreements by groups of utilities to operate and plan their respective electric systems. A formal power pool is defined as two or more electric systems which coordinate the planning and/or operation of their bulk power facilities for the purpose of achieving greater economy and reliability in accordance with a contractual agreement that establishes each member's responsibilities. There are two kinds of power pools: tight and loose. In a tight power pool, reserve requirements are enforced by penalties and system operation is assured by a central dispatch system. A loose power pool provides both operating and planning coordination but generally does not include penalties or central dispatch provisions. Informal power pools are coordination arrangements which are chiefly characterized by the absence of contractual commitments. A grouping of utilities generally agree to establish principles and practices for interconnected operation, to jointly review area power supply adequacy, to exchange generation and transmission construction plans, and to seek coordinated action for best economy and reliability. The informal grouping relies on voluntary adherence by members to pool principles and criteria.

C. Electric Distribution

The distribution of electricity is made through direct purchases from producers and through local distribution companies (LDCs). An LDC is a local utility such as Pacific Gas and Electric or Pennsylvania Power and Light. These local utilities are regulated by state public utility commissions (PUCs) as well as by federal regulators. Regulatory responsibilities will be discussed in more detail later. The distribution function is generally carried out by a utility that is given a set territory and has the obligation to serve all customers in that territory.

There are basically three consumer classes: residential, commercial, and industrial. Each customer class puts different demands on the system for the amount of electricity that it consumes, the amount of plants necessary to generate that electricity, and the amount of service required from the LDC. The significance of these customer classes is addressed when we discuss electricity rates.

II. ELECTRICITY MARKETS

A. History

The history of the electric industry dates back to 1831, when Michael Faraday invented the dynamo which converted mechanical energy into electric energy. That technology was put to use to power batteries for telegraphs. Thomas Edison, a telegrapher, began improving the instrument when in 1879 he managed to develop the first incandescent lamp.[2]

Edison expanded the use of electricity for both lighting and power, replacing candles and gas. In 1879, he patented an electric distribution system, formed the Edison Electric Light Co., and organized the Pearl Street Station in New York City in 1882. The Pearl Street station was the first commercial plant for generating electricity.

While Edison was building central plants in New York, the English firm of Gaulard and Gibbs developed the *alternating current*. In 1886, George Westinghouse bought the Gaulard and Gibbs rights and formed the Westinghouse Electric Company. AC current was less expensive to transport than direct current which enabled a utility to transport electricity across long distances. Eventually, AC systems and DC systems were linked.

In the late 19th and early 20th centuries, central station plants served local areas and were competitive. Still, a franchise from the local municipality was necessary to run electrical wires over public streets. In the beginning, franchises were non-exclusive, thus allowing competition. As technology developed and electric systems found widespread use, and

[2] *See generally*, Joseph P. Tomain, *Electricity Restructuring: A Case Study in Government Regulation*, 33 TULSA L.J. 827 (1998).

utilities began to show a profit, there was a proliferation of electric power companies. In addition, municipalities entered the electricity business. In fact, municipally owned utilities outnumbered privately owned utilities until the mid 1920s.

As the number of independent electricity generating plants grew, the technology of transmission also grew. In turn, this led to an increase in networks, which with advanced technology, allowed interconnections into a grid. Finally, there was no operational reason to have independent generating stations and the industry began to consolidate in order to capitalize on economies of scale and to avoid inefficiencies.

Eventually, individual central stations gave way to corporate holding companies which owned some or all of the shares of stock or assets of other companies and thereby controlled them. Holding companies developed complex structures containing many subsidiaries and combinations of unrelated business. In 1932, almost half of the investor-owned electric utility industry was controlled by three holding companies and another 35 percent was controlled by the twelve next largest systems. The eight largest holding companies controlled 73% of the investor-owned business.[3]

The growth of the holding companies also led to widespread abuses. Securities companies were selling stocks to employees and customers who did not understand what they were buying. The continued expansion of the holding companies created liabilities that the system could not meet and the practices of some companies' management reduced investor confidence in the market.

In an effort to curb the abuses of holding companies, Congress enacted the Public Utility Act of 1935 Title I (Public Utility Holding Company Act)(PUHCA) and Title II (amendments to the Federal Water Power Act of 1920, also known as the Federal Power Act.)[4] The PUHCA was passed in response to concerns that while local regulatory agencies supervised electric utilities, nobody was regulating the holding companies which owned those utilities. The PUHCA defined a holding company and required them to register with the Securities and Exchange Commission and conform to its rules. In addition, the Act broke up holding companies that did not satisfy their regulation. After passage of the Act, most holding companies were dismembered. In fact, since 1935, only one holding company had been formed.

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[3] Hyman, *supra* note 1 at 106.

[4] *Id.* at 116; Public Utility Holding Company Act of 1935, 15 U.S.C. §§ 79-79z-6 (1994 & Supp. II 1996); Federal Power Act of 1920, 16 U.S.C. § 791a-823b (1994 & Supp. II 1996).

B. Market Structure and Demand

The electric industry is comprised of integrated and non-integrated producers, mostly privately owned, with some federal generation and some municipal or locally owned distribution. Several government agencies such as the Tennessee Valley Authority are in the business of generating and selling electricity. Five federal power marketing authorities supply power from federally owned projects developed in large part by the Corps of Engineers. In 1995, 68.9% of electric generating capacity was owned by investor owned systems[5] and approximately 11.8% by rural electric cooperatives, largely through umbrella combinations of cooperatives known as generation and transmission companies. The remaining 19.3% was generated by government entities. Most investor owned systems are vertically integrated. Vertical integration has been driven by the difficulty of storing electricity and the need to produce it continuously as well as the utilities' continuous search for economies of scale.

From the turn of the century, electricity markets grew rapidly through the mid 1960s. After World War II, the annual growth rate of electricity was a predictable 7%. Energy consumption grew with the economy in 1945-65, but electricity sales rose much faster because the real price of electricity was dropping relative to the prices of other fuels.[6] Continuous improvement in the generation process led to reduced prices. The industry opted for larger generating stations in order to realize economies of scale. In transmission, construction cost per mile increased. However, that was offset by increasing the voltage of the lines, resulting in more capacity per mile. The industry overall also had sufficient reserve capacity, in 1945-1965, to encourage new demand without fear of being unable to meet demand. Most notably, from the late 1950s to the early 1970s investment in and construction of nuclear power plants grew to approximately 20% of the nation's generation capacity. In 1973, the Organization of Petroleum Exporting Countries (OPEC) began embargoes of crude oil shipments to the United States causing supply shortages and fuel price increases. Utilities passed the increase in fuel prices on to consumers, and Americans reduced their consumption of electricity. In 1974, the public's faith in investment in the utility industry, particularly in nuclear plants, declined significantly. To complicate matters further, in 1979, the Three Mile Island accident dampened post OPEC embargo efforts to switch to nuclear energy. Eventually, the industry's overall reserve margins rose sharply, indicating its over-capacity.

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[5] Hyman, *supra* note 1.

[6] *Id.* at 120.

In an effort to encourage more efficient pricing of electricity, reduce the consumption of foreign oil, help energy conservation, and develop competition, Congress passed the Public Utility Regulatory Policies Act of 1978[7] (PURPA) as part of a comprehensive package of national energy legislation. Title I required utilities to develop information about their rate structure. Title II created a new class of generators, qualifying facilities, that could sell electricity to electric companies. (QFs were mostly cogenerators.) In addition a new entity called independent power producer (IPP) emerged. IPPs do not enjoy the financial advantages of PURPA and do not own transmission or distribution facilities.

In 1992 Congress enacted the Energy Policy Act (EPAct) of 1992.[8] The Act was designed to allow newcomers to enter the electric supply industry. The law opened the utility's transmission lines for use by competing generators. The Act also created a new nontraditional generator called the *exempt wholesale generator* (EWG), which was exempt from PUHCA requirements. In 1996, FERC articulated its open access policy by issuing Orders 888 and 889, which together formed the "Open Access Rule." Through those orders utilities could receive wholesale power sold by distant generators through the national transmission grid (called wholesale wheeling). Today, a number of utilities are meeting increased demand for electricity by purchasing power from others rather than building their own new generating plants. EPAct prohibits the Federal government from ordering retail wheeling. However, states can order this and many are doing so. These changes to the electricity fuel cycle are being accompanied by a restructuring of the industry. Mergers among investor-owned utilities have accelerated dramatically. In 1996, in an attempt to facilitate the process, FERC issued its Merger Policy, stating how it intended to evaluate mergers among public utilities. FERC promised to speed up the process, deciding cases on a summary basis if it finds no problems with the paperwork. Municipal systems have so far resisted the merger trend.

III. ELECTRIC POWER REGULATION

A. Electric Companies Compete (1882-1920)

As noted, the electricity industry began in 1882 in New York City with Thomas Edison's Pearl Street Station. This station generated electricity that was distributed to 85 customers. Over the next several decades cities grew

[7] Public Utility Regulatory Policies Act of 1978, Pub. L. 95-617, 92 Stat. 317 (codified as amended in scattered sections of titles 15, 16, 42 & 43 U.S.C.).

[8] Energy Policy Act of 1992, Pub. L. No. 102-486, 100 Stat. 2776 (1992).

interested in bringing electricity to their residents; entrepreneurs had a similar interest. Competition to serve municipalities and their residents began. Initially, about half the cities decided to provide electric service themselves. The other half typically entered into franchise agreements with private, investor-owned utilities (IOUs) that allowed the IOUs to use city streets and rights-of-way for distribution and transmission lines to provide city residents with electricity. Some franchise agreements also required the IOU to provide service and gave the IOU an exclusive franchise to serve for a period of years.[9]

In the early stages of the industry, power stations were constrained by existing technologies and did not exceed 10 MW. With increasing demand for electricity, producers entered the market with a multiplicity of electricity generation and distribution stations. It was also common for a large business, e.g., hospital, university or even resort, to build its own small power plant.[10] By 1922, there were 3,774 privately owned electric utilities.[11] Faced with growing demand and vigorous competition, these firms sought greater market share through technological innovation and corporate restructuring. They vertically integrated from generation to transmission and distribution and expanded their capacities in each area of the business to try to capture economies of scale and a greater share of the market. The larger firms even built generators, ground conductors and electric fixtures, including light bulbs. For example, Edison's company merged with others to become the General Electric Company.[12]

B. Electric Companies Concentrate—and Become Regulated (1921-1934)

As the electric industry pursued economies of scale, larger entities absorbed smaller ones. The states responded by passing legislation authorizing economic regulation of utilities. From 1922 to 1927, over 1600

[9] Once states began regulating the electric industry, they usually assumed the responsibility of granting an IOU the right to serve particular areas or customers. So, today a typical franchise agreement between a municipality and an IOU does not include a right to serve the residents of the city with electricity.

[10] Jon R. Mostel, *Overview of Electric Industry Bypass Issues*, 37 NAT. RESOURCES J. 141, 142 n. 2 (1997).

[11] Peter C. Christensen, *Overview of Electricity Generation and the Industry,* THE ELECTRIC INDUSTRY: OPPORTUNITIES AND IMPACTS FOR RESOURCE PRODUCERS, POWER GENERATORS, MARKETERS, AND CONSUMERS at 1-2 (Rocky Mtn. Min. Law Fdn. 1996).

[12] TECHNOLOGY FUTURES, INC. & SCIENTIFIC FORESIGHT, INC., PRINCIPLES FOR ELECTRIC POWER POLICY 231 (1984).

privately-owned electric systems were absorbed, and many companies were consolidated into holding companies. By 1927, sixteen holding companies controlled 85 percent of the nation's electric industry. These holding companies helped advance the capture of scale economies but at a real cost to consumers. The electric trusts, like the oil trusts before them, were susceptible to stock manipulation and shareholder abuses. The public clamored for more effective regulation, and Congress responded.[13]

1. *States Regulate the Rates and Activities of Electric Utilities*

The first general steps taken by state legislatures were to provide for regulation of electric utilities to protect consumers in cases where there was no competition. Expansive power to regulate rates, entry and exit, and terms and conditions of electric utility service was granted to public utility commissions in all the states. A jurisdiction grant typically looked something like this:

> The commission shall have general and exclusive power and jurisdiction to regulate and supervise every public utility[14] in respect to its rates and service regulations and in respect to its securities, taking into account the public interest, the interest of consumers and the interest of investors, to the end that reasonable and proper services shall be available at fair, just and reasonable rates, and to the end that capital and investment may be encouraged and attracted so as to provide for the construction, development and extension, without unnecessary duplication and

[13] Joseph P. Tomain, *Electricity Restructuring: A Case Study in Government Regulation*, 33 TULSA L. J. 827, 830-31 (1998).

[14] Numerous states exempt cooperatively owned and municipally owned utilities from state rate regulation, or even from all state regulation. In the case of cooperatives, the rationale for exemption is that the consumers are also the owners and elect the board of directors that operates the cooperative and sets its rates. Thus, the consumers can protect themselves from any monopoly abuse through their power to elect their board. Likewise with municipally owned utilities, the residents of the municipality elect the city's governing body, which is responsible for operating the municipal utility and setting its rates. Even when states exempt municipally owned utilities from state rate regulation, they might empower the state commission to supervise the rates the municipal utility sets for persons it might serve residing outside the municipal boundaries who do not have the right to vote for municipal officials.

> economic waste, of proper plants and facilities for the rendition of service to the general public and to industry.

This broad authority to regulate electric utilities continues in force in states today.

State regulators also used their power to prescribe electric rates in regions where electric utilities initially did compete. Inevitably rate wars ensued between competing utilities and resulted in the destruction of one of them, or a division of the territory between them. As the Idaho Supreme Court explained in a 1914 decision, "experience shows that there can never be any permanent competition in matters of [supplying electricity]."[15] This type of competition was judged unsatisfactory by both utility investors, who wished investment stability, and consumers, who wished to be served at the lowest cost–"and such an end cannot be reached if the community is served by duplicate plants, [which is] a waste of resources and an extra tax on the people."[16] As a result, state regulators fixed a specific rate, instead of a rate maximum. This took away the opportunity for rate-cutting, one of the principal instruments of warfare between competing utilities. In addition, state regulators exercised their authority to determine which utilities could serve which areas. The general rule was that one utility serving an area could continue to do so unless the public convenience and necessity, as determined by the state commission, required an additional utility. State regulators also have taken on the responsibilities of assuring adequate service by the utility, protecting the parties who furnish the money for utility construction, and supervising the utility's service "in every material particular."[17]

2. *The Federal Government Regulates the Rates and Activities of Electric Utilities*

a. *The "Attleboro Gap" in Regulation*

In 1927, the U.S. Supreme Court limited the power of states to regulate interstate sales and transmission of electricity. A Massachusetts electric utility, Attleboro Steam & Electric Company, had been purchasing all its electricity from a Rhode Island electric utility, Narragansett Electric Lighting Co., under a twenty year contract at a specified special rate. In 1924, Narragansett sought a rate increase. It filed a new rate schedule that

[15] Idaho Power and Light Co. v. Blomquist, 26 Idaho 222, 141 P. 1083 (1914).
[16] *Id.*
[17] *Id.*

applied only to its sales to Attleboro with its regulator, the Public Utilities Commission of Rhode Island (PUC). The PUC approved the new rate schedule and ordered it replace the rate in the Narragansett-Attleboro contract.

Attleboro sued the PUC, arguing that its order imposed an unconstitutional burden on interstate commerce. The U.S. Supreme Court agreed. In *Public Utilities Commission of Rhode Island v. Attleboro Steam & Electric Co.*,[18] the Court found that (1) the sale of electricity by Narragansett to Attleboro was "a transaction in interstate commerce, notwithstanding the fact that the current is delivered at the State line," and (2) state regulation of this interstate service placed a direct burden upon interstate commerce in violation of the Commerce Clause. The Court noted that if Rhode Island could constitutionally raise the rate of this transaction to benefit Narragansett's Rhode Island customers, then Massachusetts could legitimately argue it could constitutionally lower the rate of this transaction to benefit Attleboro's Massachusetts customers. The Court concluded that the "rate is therefore not subject to regulation by either of the two States in the guise of protection to their respective local interests; but, if such regulation is required it can only be attained by the exercise of the power vested in Congress."[19]

From the *Attleboro* decision in 1927 until 1935, the interstate transmission and wholesale sale of electricity went unregulated and came to be called the "Attleboro Gap" in regulation. Initially, there were few interstate electric transactions. However, as small utilities became consolidated into large interstate holding companies, a significant portion of the nation's electric business was conducted by holding companies and was unregulated.

b. *The Federal Power Act of 1935 Fills the Gap*

In 1935, Congress filled the regulatory gap with passage of the Federal Power Act,[20] which regulates electric utility companies in their engagement in interstate commerce. Like the states that had regulated electric utilities before it, Congress sought to regulate the interstate business of these utilities in order to control the economic power they had as monopolies. The federal agency that implements the Federal Power Act today is the Federal

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[18] 273 U.S. 83 (1927).

[19] *Id.* at 90.

[20] Title II of the Public Utility Act of 1935, 16 U.S.C. §§ 791a-825r (1994 & Supp. II 1996), made the Federal Water Power Act (which was enacted in 1920 to create the Federal Power Commission and provide it with authority to license private hydroelectric projects located on navigable waters of the U.S.) Part I of the Federal Power Act and added Parts II and III to the Federal Power Act.

Energy Regulatory Commission (FERC), the successor to the Federal Power Commission.

The Federal Power Act and, thus, federal regulation, applies to most, but not all, (1) transmission of electric energy in interstate commerce, (2) sale of electric energy at wholesale in interstate commerce, (3) facilities used for interstate transmission and wholesale sales of electricity, and (4) public utilities that own or operate facilities subject to the jurisdiction of FERC.[21] The Act does not apply to the United States, or any State, or any political subdivision, agency, authority or instrumentality of the United States or any State. These governmental bodies can engage in transmission and wholesale sales of electricity without being subject to FERC's jurisdiction.[22]

Except as specifically provided in the Act, the Federal Power Act does not give FERC jurisdiction over facilities: (1) used for generation of electricity, (2) used in local distribution, (3) used only for transmission of electricity in intrastate commerce, or (4) for transmission of electricity consumed wholly by the transmitter.[23] Typically, the states take regulatory jurisdiction over these facilities. However, few, if any, states regulate facilities in the last category, i.e., private transmission facilities for transmission of electricity consumed wholly by the transmitter.

Under the Federal Power Act, the Federal Energy Regulatory Commission, and its predecessor the Federal Power Commission, has exercised traditional economic regulatory control over the transmission and wholesale sale of electricity in interstate commerce, consistent with the monopoly nature of the electric business. It regulates rates for interstate transmission and wholesale sales of electricity.[24] It assures adequate interstate electric service.[25] It authorizes purchase and abandonment of utility assets.[26] It regulates the securities issued by public utilities under its jurisdiction.[27] It

[21] Federal Power Act §§ 201(b), (e); 16 U.S.C. §§ 824(b), (e) (1994). FERC has found that it does not have jurisdiction to regulate rural electric cooperatives under the regulatory authority of the Rural Utilities Service. Judith M. Matlock, *Federal Regulation and Wholesale Wheeling,* THE ELECTRIC INDUSTRY: OPPORTUNITIES AND IMPACTS FOR RESOURCE PRODUCERS, POWER GENERATORS, MARKETERS, AND CONSUMERS at 2-6 (Rocky Mtn. Min. Law Fdn. 1996) (discussing Dairyland Power Cooperative, 37 F.P.C. 12, 67 P.U.R.3d 340 (1967)).

[22] Federal Power Act § 201(f); 16 U.S.C. § 824(f) (1994).

[23] Federal Power Act § 201(b); 16 U.S.C. § 824(b) (1994).

[24] Federal Power Act § 205; 16 U.S.C. § 824d (1994).

[25] Federal Power Act § 207; 16 U.S.C. § 824f (1994).

[26] Federal Power Act § 203; 16 U.S.C. § 824b (1994).

[27] Federal Power Act § 204; 16 U.S.C. § 824c (1994).

approves mergers and acquisitions.[28] It is also responsible for directing the interconnection and coordination of electric facilities, such as transmission lines, across the United States.[29]

c. *The Line between Federal and State Jurisdiction over the Rates and Activities of Electric Utilities*

The Federal Power Act notes that the federal regulation of the transmission of electricity and sale of electricity at wholesale in interstate commerce shall "extend only to those matters which are not subject to regulation by the States."[30] However, the dividing line between federal and state jurisdiction acknowledged by this provision is not always a clear one. The courts have been called upon numerous times to clarify it in the context of different electricity transactions.

All wholesale sales of electricity are subject to plenary federal regulatory jurisdiction pursuant to section 201(b) of the Federal Power Act, except those which Congress has made explicitly subject to regulation by the states. This was the holding in *Federal Power Commission v. Southern California Edison Co.*,[31] where the U.S. Supreme Court rejected the argument that states should be allowed to regulate these sales in the first instance subject to superintending federal jurisdiction.

The U.S. Supreme Court has also upheld broad federal regulatory jurisdiction under the "transmission of electric energy in interstate commerce" provision of the Federal Power Act. In *Federal Power Commission v. Florida Power & Light Co.*,[32] the Court sustained the Federal Power Commission's assertion of jurisdiction over Florida Power & Light Co. (FP&L). All of FP&L's generation and transmission lines were confined to Florida, with none of its transmission lines being directly connected to any lines of out-of-state companies. However, FP&L's lines were connected with the lines of other Florida utilities in the Florida Pool, including the Florida Power Corp., which in turn connected with the lines of the Georgia Power Company. Through the connection between Florida Power Corp. and Georgia Power, the utilities in the Florida Pool were also members of the

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[28] Federal Power Act § 203; 16 U.S.C. § 824b (1994).

[29] Federal Power Act § 213; 16 U.S.C. § 824a (1994).

[30] Federal Power Act § 201(a); 16 U.S.C. § 824(a) (1994).

[31] 376 U.S. 205 (1964) (finding that federal, not California, jurisdiction attached to a ten-year contract between the City of Colton, California and the Southern California Edison Co. under which Edison would supply Colton with its full wholesale requirements for electricity).

[32] 404 U.S. 453 (1972).

Interconnected System Group, a national interlocking of utilities that automatically provided power in emergencies. Although there was no evidence that at any time Georgia drew electricity from the Florida Pool that came solely from FP&L, there was evidence that sometimes when Georgia was drawing power from the Florida Pool, FP&L was contributing power to the Pool. The Court found that this was sufficient to establish transmission in interstate commerce. Specifically, the Court said, if FP&L power enters the Florida-Georgia bus (a transmission line of three conductors into which a number of subsidiary lines connect) at the same moment that power leaves the bus for out-of-state destinations, then one can conclude that some FP&L power goes out of state.

The dividing line between federal and state jurisdiction has historically been a contentious issue in the context of which jurisdiction has ratemaking authority. The Narragansett doctrine[33] holds that the Supremacy Clause demands that when a utility reasonably incurs a cost to serve retail customers arising from a rate approved by the FERC, state utility regulators must pass this cost on to retail consumers in the utility's retail rates. In other words, the state utility regulator is bound by the FERC approval and has no jurisdiction to find it to be an unreasonable cost. To allow otherwise would expose the utility to unrecoverable or "trapped" costs. The state regulator does, however, maintain jurisdiction to determine whether the FERC-approved cost was reasonably *incurred* by its utility. For example, if Utility A buys wholesale power from Utility B at 4 cents per kWh and resells the power to its retail customers, the state cannot object to the 4 cents as an unreasonable price to pay. However, the state could look to see whether it was reasonable for Utility A to buy wholesale power from Utility B, given that it could have bought wholesale power from Utility C or D, at a lower price.

The U.S. Supreme Court has extended the reasoning of the Narragansett doctrine from FERC-approved rates to FERC-approved allocations of power. In *Nantahala Power and Light Co. v. Thornburg,*[34] the Court held that the Public Utility Commission of North Carolina had no jurisdiction under the Supremacy Clause to find unreasonable the amount of power one of its utilities bought from the Tennessee Valley Authority under a contract approved by the FERC. In that case, Nantahala and Tapoco were sister utilities, both wholly owned by the Aluminum Company of America (Alcoa). Nantahala served customers at wholesale as well as at retail.

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[33] The Narragansett doctrine was first enunciated in Narragansett Electric Co. v. Burke, 119 R.I. 559, 381 A.2d 1358 (1977), *cert. denied*, 435 U.S. 972 (1978). It is an extension of the "filed rate doctrine."

[34] 476 U.S. 953 (1986).

Tapoco served only Alcoa. Nantahala and Tapoco jointly received from the Tennessee Valley Authority a fixed supply of low-cost "entitlement" power pursuant to a contract filed with FERC. They also purchased higher-cost power from TVA when the low-cost entitlement power was insufficient for their needs. When the North Carolina Commission set Nantahala's retail rates, it determined that Nantahala should be receiving a greater share, and Tapoco a lesser share, of the low-cost TVA entitlement power. This change to the allocation would mean Nantahala's costs would be lower and its retail rates would be lower. The Commission set Nantahala's retail rates based on the imputation of the lower costs. The U.S. Supreme Court held this action was preempted by the FERC-approved power allocation, pointing out that to allow the North Carolina Commission to impose a different power allocation would expose Nantahala to trapped costs just as surely as allowing the commission to impose a different rate for that power—already forbidden by the Narragansett doctrine.

Two years later, the U.S. Supreme Court extended the reasoning in *Nantahala* in another case where it held a state commission was preempted from undertaking an inquiry into whether its utility had imprudently incurred costs in the exceedingly expensive Grand Gulf Unit 1 nuclear power plant. In *Mississippi Power & Light Co. v. Mississippi*,[35] Mississippi Power & Light (MP&L) was one of four utilities owned by a public utility holding company, Middle South Utilities (MSU). MSU had another subsidiary, Middle South Energy, Inc., which constructed and owned Grand Gulf to meet the power needs of MSU's utilities. Middle South had agreements with the four utilities that entitled them to wholesale power generated by Grand Gulf and allocated Grand Gulf's capacity and costs among them. These agreements were filed with FERC which approved an allocation of 33% of Grand Gulf's capacity costs to MP&L as just and reasonable. The cost of building Grand Gulf had greatly exceeded projected construction costs and thus the cost of the power produced was greater than that of MP&L's other generating facilities.

MP&L filed for a retail rate increase with the Mississippi Public Service Commission to cover its increased costs associated with Grand Gulf. The Commission eventually approved a retail rate increase to cover MP&L's 33% of the costs of Grand Gulf. The Attorney General of Mississippi, representing consumers, appealed this decision to the Mississippi Supreme Court on the grounds that the Commission should have investigated the prudence

[35] 487 U.S. 354 (1988). *See* James E. Hickey, Jr., *Mississippi Power & Light Company: A Departure Point for Extension of the 'Bright Line' Between Federal and State Regulatory Jurisdiction Over Public Utilities*, 10 J. ENERGY L. & POL'Y 57 (1989), reprinted in PUBLIC UTILITIES LAW ANTHOLOGY 1989, vol. XII (1990).

of the expenses associated with constructing Grand Gulf. The Mississippi Supreme Court agreed and ordered the commission to examine the prudence of the management decisions that led to the construction of Grand Gulf before ordering a retail rate increase. On appeal, the U.S. Supreme Court reversed the Mississippi Supreme Court, finding that the reasoning in *Nantahala* applied to preempt the state from conducting proceedings to determine whether some or all of the costs were not prudently incurred.

The Mississippi Supreme Court had reasoned that the state was not preempted by the FERC proceedings because FERC had not litigated the issue of the prudence of the costs of Grand Gulf. The U.S. Supreme Court disagreed with this reasoning, characterizing it as the sort of case-by-case analysis of the impact of state regulation upon the national interest rejected in *FPC v. Southern California Edison Co.* and analogizing MP&L's situation to that of Nantahala. Just as Nantahala had no right to obtain any more low-cost TVA entitlement power than the amount allocated by FERC, MP&L may not pay for less Grand Gulf power than the amount allocated by FERC. The practical message of this decision is that the Attorney General of Mississippi should have intervened in the FERC proceeding for approval of the MSU agreements in order to raise the issue of the prudence of the costs of constructing Grand Gulf.

3. PUHCA Regulates Public Utility Holding Companies

In 1935, Congress enacted the Public Utility Holding Company Act (PUHCA).[36] It was designed to eliminate holding company abuses. A holding company is a business enterprise which owns all or a controlling amount of the shares of stock or assets of other companies. Organizing businesses into a holding company can enable them to reduce their costs by putting them in a position to take advantage of economies of scale. The organization of electric utilities into holding companies in the 1920s and 1930s enabled them to construct large, central station electric generation plants which could supply electricity in several service territories at a significantly lower cost than that same amount of electricity could be generated by more, smaller generating plants. It also enabled utilities to lower their supplies and equipment costs because the holding company could purchase bulk amounts at a discount. These were all positive developments for consumers. However, they were also accompanied by some negative developments.

[36] 15 U.S.C. §§ 79-79z (1994).

Because the company at the top of the pyramid of electric utilities organized into a holding company does not itself directly own or operate facilities used for electricity generation, transmission or distribution, it was not regulated as a public utility by the states in the 1920s and 1930s. Also, many of the transactions undertaken by the utilities within the holding company were interstate in nature, so they went unregulated because of the "Attleboro Gap" in regulation. These regulatory voids allowed financial abuses within the holding company to go unchecked. These abuses included excessive financial charges made by one company to another, extraction of exorbitant profits from the electric operations to the parent holding company, distorted write-ups of properties, stock manipulation, and even control of the holding company by banks for their own benefit. These abuses weakened the financial strength of the companies within the holding company structure and resulted in unfair costs being passed on to ratepayers. As the Great Depression deepened in the 1930s, the financial weaknesses were exposed and the other abuses came to light. Congress passed PUHCA to reform and regulate the holding company structure and eliminate the abuses.

PUHCA achieved a major reorganization of the electric industry as holding companies reformed themselves to come into compliance with the Act, which was aggressively enforced by the Securities and Exchange Commission (SEC) and the courts. PUHCA effectively abolished the pyramiding of electric utility companies in holding companies by requiring that any electric enterprise within a holding company be limited to operating a single integrated public utility system located in a single operating area.[37] A holding company can operate more than one integrated public utility system only if it can show that this arrangement will produce substantial economies of scale, that the systems are confined to one state or its immediate neighbors, and that the systems will assure local management, efficient operation and effective regulation.[38] Furthermore, the public utility holding company cannot engage in other businesses unless they are "reasonably incidental or economically necessary or appropriate to the operations of" the utility.[39] Most of the extant public utility holding companies could not meet these tests and had to restructure themselves. PUHCA also had a broad reach because it expansively defined a holding company to include any company directly or indirectly holding ten percent or more of the voting stock of a public utility company, or of another holding company. Today, while there are thirteen public utility holding companies, they do only about fifteen percent of the country's electricity generation business.

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[37] 15 U.S.C. § 79k(b) (1994).

[38] 15 U.S.C. § 79k(b)(1) (1994).

[39] 15 U.S.C. § 79k(b)(1) (1994).

The reform of public utility holding company behavior since the enactment of PUHCA has been so dramatic that many, including even the SEC itself, have recommended its repeal.[40] Congress is currently considering this as part of its overall review of the desirability of restructuring the electric industry again through federal legislation.

C. The Golden Age of the Electric Industry and Its Regulation (1935-1965)

The thirty years between 1935 and 1965 has been called the "golden age" of the electric industry.[41] For privately owned, vertically integrated utilities, economies of scale continued as the size of generation units grew. Growth and demand for electricity also grew steadily, doubling every ten years at a rate of roughly seven percent annually. Continued technological advances, together with reliable and predictable growth, caused the average cost of production to stay relatively flat for a period of time. Utility investments were safe ones. Consumers saw their rates rise slightly or not at all. Regulators held non-controversial hearings. All the stakeholders in the industry were content. Utilities were pleased with their continued growth and growth in earnings. Shareholders were pleased with their predictable returns on investment. Consumers were pleased with the stable, or even decreasing, rates. And regulators were pleased with the absence of pressure to change regulation or the industry structure. However, this all changed as technological advances and economies of scale flattened and the energy crises of the 1970s unfolded.

D. The Energy Crises of the 1970s Stimulates the Reintroduction of Competition into Electric Generation

The regulatory compact, establishing a government protected monopoly operating essentially under a cost plus rate formula, works well in an expanding economy with accompanying technological advances. Under such circumstances, industry growth occurs and prices stabilize or fall. However, when economies of scale and technological advances flatten, the cost of doing business increases. An increased cost of doing business can have negative effects on any business. It can have disastrous effects on a regulated monopoly. These problems began for the U.S. electric industry in approximately

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[40] Douglas Hawes, *Public Utility Holding Company Act of 1935—Fossil or Foil?* 30 VAND. L. REV. 605 (1977).

[41] Leonard S. Hyman, AMERICA'S ELECTRIC UTILITIES: PAST, PRESENT AND FUTURE 119-130 (6th ed. 1997).

1965 when the marginal costs of producing electricity began to exceed the average cost, and electric utilities saw their profit margin begin to slide.

Traditionally, the rates of an electric utility are set on the basis of its historic average costs and include allowance for a reasonable rate of return on capital invested in utility assets. If costs are declining, steady rates mean increasing profits to the utility. However, as marginal costs increase, profits will decline, unless and until rates are set at marginal cost.

In the 1970s electric utilities saw costs increase all over the business. Labor costs rose and inflation increased. The international cartel called the Organization of Petroleum Exporting Countries in 1973 asserted its control over oil supplies. Oil supplies available to the U.S. fell, and the cost of oil soared. Electric utilities firing their boilers with oil sought to switch to gas or coal. Domestic interstate supplies of natural gas had been subject to stringent federal price caps since about 1960. Supplies had contracted in response to the low profitability of the industry. Accordingly, additional natural gas was not available. Liquified natural gas was imported at exorbitant prices. Conversion of plants to be able to burn coal was expensive and took time. Congress looked for ways to stimulate the production of U.S. natural gas and other forms of energy. One of its vehicles for achieving this, which related directly to electric utilities was the Public Utility Regulatory Policies Act, passed as one of five energy acts in 1978.

1. *PURPA Encourages Independent Generation*

Congress passed the Public Utility Regulatory Policies Act[42] (PURPA) in part to encourage the growth of generation not owned by utility companies. PURPA sought to achieve this by requiring the local electric utility to buy the power produced by certain types of non-utility generators, which PURPA calls "qualifying facilities"[43] (QFs). There are two types of QFs: small electric generators (80 megawatts or less) powered by a renewable energy resource, and cogenerators. A cogenerator is an electric generator that also produces another form of energy (steam or heat, for example) which is put to use. A qualifying cogeneration facility is one that meets certain efficiency standards.[44] QFs could sell their power to the local utility at the price that the utility would have paid for that power had it generated or bought that power itself. This is called the utility's "avoided cost." Only a small class of generators qualified for this treatment. And, while they

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[42] Pub. L. 95-617, 92 Stat. 3117 (codified as amended in scattered sections of titles 15, 16, 42, & 43 U.S.C.).

[43] 16 U.S.C. § 796 (1988).

[44] *Id.*

could sell their power to the local utility, they did not have access to the utility's transmission lines to wheel their power to any other utility. Nevertheless, it marked the formal reintroduction of competition into generation. Some states, such as California, adopted state regulatory policies to further this independent power development, such as requiring utilities to enter into long-term contracts with QFs. From 1989 through 1993, the number of QFs grew from 576 to 1200 and installed QF capacity increased from 27,429 megawatts to 47,774 megawatts.[45]

2. *Rising Electric Costs Add to the Pressure for More Competition*

Electric utility cost increases came from many places in the 1970s. Labor costs rose and inflation increased rapidly. In the 1950s and 1960s, nuclear power was touted as "too cheap too meter," but the cost of construction of nuclear plants skyrocketed. Nuclear plants under construction in the 1970s were generally over budget and behind schedule. As mentioned above, the cost of oil also ballooned. Eventually, so did the cost of gas. Another of the energy acts of 1978, the Natural Gas Policy Act, provided for high gas prices for new U.S. supplies of gas as an incentive to get U.S. gas producers to increase their production. These costs increases led to consumer conservation just at the time that new long-lead-time electric generation was coming on line and needed to be paid for too. The glut of expensive generation capacity, for which consumers had to pay much of the cost, shot prices up. Between 1970 and 1985, industrial electric rates quadrupled in nominal terms and saw an 86% increase after adjustment for inflation. Residential rates tripled in nominal terms with a 25% increase after adjustment for inflation.[46] People looked for new ways to bring rates down. New generation in the 1980s could be built for substantially less than the average price of existing generation. Political pressure mounted to expand competition in generation.

E. The Federal Energy Regulatory Commission of the 1980s Fosters Competition through Transmission Access

The development of the QF industry in the 1980s demonstrated that power could be produced reliably by sources other than traditional, vertical-

[45] Preamble to FERC Order No. 888, 75 F.E.R.C. ¶ 61,080, FERC Statutes and Regulations ¶¶ 31,036, 31,642, 61 Fed. Reg. 21,540 (May 10, 1996) [hereinafter Preamble to FERC Order No. 888].

[46] *Id.* at ¶ 31,640.

ly integrated public utilities. The industry also discovered that larger generation units needed greater maintenance and experienced longer downtime. As a result, the price of each incremental unit of electric power exceeded average cost. Smaller size units became cost effective. Combined cycle units, typically using natural gas, offered the advantages of lower capital costs, increased reliability and relatively minimal environmental impacts. Conventional steam units using circulating fluidized bed boilers and fueled by coal or other conventional fuels were also found to be more efficient and less polluting. As a result, the optimum size of generation plants shifted from large (e.g., 500 megawatt plants) with long lead times to build to smaller units that could be built quickly.[47] During this time, a market for non-traditional power, in addition to QF produced power, began to emerge. Independent power producers (IPPs) began to sell power in the bulk power market. These producers did not own any transmission or distribution facilities and did not have the benefit of PURPA's mandatory purchase requirement. Even some traditional utilities formed non-utility affiliates to sell power in the fledgling bulk power market. Generation owned by IPPs and affiliated power producers (APPs), exclusive of QFs, increased from 249 generators with 9,216 megawatts of capacity to 634 generators with 13,004 megawatts of capacity between 1989 and 1993.[48]

In the 1980s, IPPs needed access to transmission owned and controlled by utilities to expand their market and effectively compete with traditional utility-owned generators. FERC wanted to provide this. Some utilities provided transmission access as a result of decisions in antitrust litigation[49] or through Nuclear Regulatory Commission license conditions and voluntary preference power transmission arrangements associated with federal power marketing agencies.[50] Even though FERC did not have explicit power under the Federal Power Act to order utilities to wheel power for IPPs, FERC sought to get the utilities to provide transmission access "voluntarily." In a number of cases where utilities wanted authority for themselves and their affiliates to sell bulk power from their generators at market rates, rather than tariffed rates, FERC authorized it *if* the utility agreed to open transmission under its control to all generators on a nondiscriminatory basis.[51] FERC also approved several mergers and consolidations on condition

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[47] *Id.* at ¶ 31,640-41

[48] *Id.* at ¶ 31,643.

[49] *See*, for example, Otter Tail Power Co. v. United States, 410 U.S. 366 (1973).

[50] Preamble to FERC Order No. 888, *supra* note 45, at ¶ 31,644.

[51] *See, for example*, Ocean State Power, 44 F.E.R.C. ¶ 61,261 (1988).

that the new utility open access to its transmission.[52] These conditions on approvals were justified, and justifiable, as necessary to offset anti-competitive effects to other generators potentially arising from the utility's new ability to sell power at market rates or from its merger. These "open access" conditions required only that the utilities provide point-to-point transmission service. They did not require that the same quality of transmission service be provided as the utility-owners themselves enjoyed. Even so, these efforts by FERC spurred on competition in generation.

F. The Energy Policy Act of 1992 Eases the Way for More Competition in Generation

By the early 1990s, it became clear that the wholesale market in electricity was not as robust as it could be. There were two limiting factors. Non-utility generators, other than QFs, found it difficult to enter the market because they had no exemption from the requirements of the PUHCA. These generators seemed particularly desirable because they could provide new generation capacity which promised to supply electricity at a lower cost.[53] The second constraint on market expansion was FERC's lack of authority to mandate wheeling over transmission lines. In 1992, Congress passed the Energy Policy Act (EPAct)[54] and eliminated both these constraints.

EPAct eliminated the PUHCA constraint by authorizing persons exclusively in the business of selling electric energy at wholesale to be exempt from PUHCA's ownership restrictions.[55] A generator can be exempted from these PUHCA restrictions if FERC finds that it is engaged exclusively in the business of owning or operating a generator that sells electric energy at wholesale.[56] These generators are called exempt wholesale generators (EWGs). By amending PUHCA to exempt electric generators selling exclusively into the wholesale electricity market from being regulated as electric monopolies, EPAct set the stage for a larger competitive, and unregulated, wholesale market to materialize. Smaller and more

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[52] *See* discussion in Preamble to FERC Order No. 888, *supra* note 45, at ¶ 31, 644.

[53] State mandated competitive bidding processes for new electric generation capacity showed that the cost of new generation based on new technologies could supply new capacity at a lower cost than existing capacity. Robert E. Burns, Esq., *Electric Industry Restructuring: Finance, Mergers, and Acquisitions, Two Years In Review*, YEAR-IN-REVIEW (ABA Sec. of Nat'l. Res., Energy & Environment, ed., 1999).

[54] Pub. L. No. 102-486, 100 Stat. 2776 (1992).

[55] 15 U.S.C. § 79z-5a (1994).

[56] 15 U.S.C. § 79z-5a (1994).

efficient gas-fired combined-cycle generation facilities can produce power today at a cost ranging from three to five cents per kWh. Similarly, circulating fluidized bed combustion boilers, fueled by coal and other conventional fuels, can produce power at substantially lower costs than today's average cost of power.[57] Improved transmission facilities across the United States and an increase in coordination transactions[58] in electricity now permit consumption of power produced many miles distant.[59]

Second, EPAct authorized FERC to order utilities that own transmission facilities (including intrastate utilities, Federal power marketing agencies, qualifying cogeneration facilities, and qualifying small power production facilities) to transmit wholesale power over their system.[60] Significantly, EPAct prohibits FERC from ordering access to transmission for retail power sales.[61] Also, a wholesale power transaction that is merely a sham for a retail power sale does not fall within FERC's authority to order wheeling.[62] To be a legitimate reseller of electricity, the entity must buy

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[57] Federal Energy Regulatory Commission (FERC) Final Rule Promoting Wholesale Competition Through Open Access Non-Discriminatory Transmission Services by Public Utilities, Order No. 888, 61 Fed. Reg. 21,540, 21,544 (1996) (codified at 18 C.F.R. pts. 35 and 385) [hereinafter FERC Order No. 888].

[58] Coordination transactions are voluntary sales or exchanges of specialized electricity services, e.g., sale of electricity from temporary excess capacity.

[59] FERC Order No. 888, *supra* note 57, 61 Fed. Reg. 21,544 (1996).

[60] *See* §§ 211 and 212 of the Federal Power Act, as amended by EPAct, which gives FERC authority to order "transmitting utilities" to provide requested wholesale transmission for any electric utility, Federal power marketing agency, or any other wholesale electric generator to a legitimate reseller if FERC finds this transmission is in the public interest.

[61] Section 212(h) of the Federal Power Act states that no wheeling order issued by FERC shall be conditioned upon or require the transmission of electric energy directly to an ultimate consumer. 16 U.S.C. § 824k(h)(1) (1994).

[62] EPAct's anti-sham provision, 16 U.S.C. § 824k(h) (1994), reads as follows:

> No order issued under this Act shall be conditioned upon or require the transmission of electric energy:
>
> (1) directly to an ultimate consumer, or
>
> (2) to, or for the benefit of, an entity if such electric energy would be sold by such entity directly to an ultimate consumer, unless
>
> (A) such entity is a Federal power marketing agency, the TVA, a State or any political subdivision of a State (or an agency, authority, or instrumentality of a State or a political subdivision), a corporation or association that has ever received a loan for the purposes of providing electric service from the Administrator of the Rural Electrification Administration under the Rural Electrification Act of 1936, a person having

power wholesale and use "transmission or distribution facilities that it owns or controls" to "deliver all" the power to the ultimate electric consumers.[63] This requirement is designed to prohibit retail customers from gaining access to cheaper wholesale electric power by owning less than all of the distribution or transmission facilities.

G. FERC Order Nos. 888 and 889 Mandate Open Access Across the Country's Transmission Grid for Wholesale Power Sales

FERC used its wholesale wheeling authority under EPAct aggressively between 1993 and 1996, ordering wholesale transmission in most of the applications it acted on.[64] Then, in 1996, FERC effectively ended case-by-case wholesale transmission orders by promulgating a rule requiring all public utilities that own, control or operate facilities used for transmitting electric energy in interstate commerce to have on file open access non-discriminatory transmission tariffs that contain minimum terms and conditions of non-discriminatory service.[65] This rule is commonly called "FERC Order 888." Order 888 also requires utilities to unbundle their transmission service function from their generation and power marketing functions, and to provide unbundled ancillary transmission services. It also

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an obligation arising under State or local law (exclusive of an obligation arising solely from a contract entered into by such person) to provide electric service to the public, or any corporation or association which is wholly owned, directly or indirectly, by any one or more of the foregoing, and

(B) such entity was providing electric service to such ultimate consumer on the date of enactment of this subsection or would utilize transmission or distribution facilities that it owns or controls to deliver all such electric energy to such electric consumer.

[63] Section 212 of the Federal Power Act, 16 U.S.C. § 824k(h) (1994).

[64] In one of these, Tex-La Electric Cooperative of Texas, Inc., 67 F.E.R.C. ¶ 61,019 (1994) order on rehearing, FERC even found that it had the authority to order wholesale transmission over local distribution facilities. In doing so, FERC recognized that section 201(b) of the Federal Power Act excludes local distribution facilities from its jurisdiction. However, FERC reasoned that interpreting section 201(b) to preclude it from ordering wholesale wheeling whenever *any* local distribution facilities were involved would mean that most future applications for transmission services would have to be denied. This result, FERC concluded, would be contrary to the intent of Congress expressed in EPAct to expand the Commission's authority to order wheeling. *Id.* at ¶ 61,055.

[65] FERC Order No. 888, *supra* note 58.

allows utilities the opportunity to recover their wholesale stranded costs. Order 888 was accompanied by Order 889, that requires public utilities to participate in an open access same-time information system (OASIS) and promulgates standards of conduct designed to prevent anticompetitive activities.

1. *Order No. 888*

In Order No. 888, FERC mandated open access transmission of wholesale electric power. The goal was to create a more robust competitive market in wholesale power by allowing more customers more access to more wholesale electricity generators. FERC estimated that open access transmission would achieve two goals: increase the availability of competitively priced electricity, saving U.S. electric consumers between $3.8 and $5.4 billion a year, and encourage more technical innovation in the industry.[66] At the same time, FERC wanted to ensure that the nation's power supply reliability would not be adversely affected and that utilities losing customers because of the new market in wholesale electricity would have a fair opportunity to recover past prudently incurred costs as well as the costs of making the transition to a competitive wholesale market.

Between March 29, 1995, when FERC proposed its open access rule and May 10, 1996, when FERC adopted the final rule as Order 888, 106 of the approximately 166 public utilities owning, controlling, or operating transmission facilities used in interstate commerce offered some form of wholesale open access. FERC noted that it was imperative that all wholesale buyers and sellers of electricity be able to obtain non-discriminatory transmission access. FERC relied on its statutory obligation under sections 205 and 206 of the Federal Power Act to remedy undue discrimination as its authority for ordering mandatory open access. Sections 205 and 206 require the FERC to ensure that, with respect to any transmission in interstate commerce or any sale of electric energy for resale in interstate commerce by a public utility, no person is subject to any undue prejudice or disadvantage.[67] Order 888 also provided for the recovery of stranded costs associated

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[66] Preamble to FERC Order No. 888, *supra* note 45, at ¶ 31,652.

[67] FERC also analyzed the cases it deemed relevant to its authority to remedy undue discrimination by ordering industry-wide non-discriminatory open access. The primary case it relied on was Associated Gas Distributors v. FERC, 824 F.2d 981 (D.C. Cir. 1987), *cert. denied,* 485 U.S. 1006 (1988) [hereinafter AGD]. The AGD case upheld FERC's authority to order access as a remedy for undue discrimination under the Natural Gas Act of 1938, 15 U.S.C. §§ 717-717w (1994). The Natural Gas Act is patterned after the Federal Power Act.

with providing open access and explained FERC's assessment of the boundary delineating federal and state jurisdiction over transmission and local distribution of electricity.

a. Open Access

Traditionally, public utilities provided electricity at wholesale and the transmission of that electricity as a bundled service at a single price. Order 888 requires that these services be unbundled and sold separately. FERC found that this functional unbundling of services was necessary to achieve non-discriminatory open access transmission. Specifically, utilities must file separate tariffs with separate rates, terms, and conditions for wholesale generation service, transmission service and any ancillary services. Ancillary services range from actions taken to effect the transmission, such as scheduling and dispatching, to services that are necessary to maintain the integrity of the transmission system during a transaction, such as load following and reactive power support. Other ancillary services are needed to correct for the effects associated with undertaking the transmission, such as energy imbalance reckoning. Under Order 888, to ensure that a utility does not favor itself with its own transmission facilities, a utility must take transmission service and ancillary services for all its new wholesale sales and purchases of electricity under the same tariff that applies to outside users of its transmission.

FERC did not require that public utilities establish separate corporate affiliates to manage the utilities' unbundled services. However, FERC indicated it was interested in accommodating voluntary utility corporate restructuring, including divestiture of generation or transmission assets. In its companion rule to Order 888 (i.e., Order 889), FERC set out a code of conduct applicable to utilities to ensure that the transmission owner's wholesale marketing personnel and the transmission customer's marketing personnel have comparable access to information about the transmission system.

Neither did FERC require utilities to set up independent system operators (ISOs) of their transmission systems to prevent undue discrimination or mitigate the market power of utility-owned wholesale generators. FERC promised that it would monitor the emerging wholesale electricity market to ensure the transmission customers were adequately protected and, if necessary, require ISOs or other mechanisms to assure non-discriminatory open access transmission.

Neither did FERC generically provide for market-based rates for the wholesale sale of electricity. Utility requests to sell wholesale power at market-based rates are still decided by FERC on a case-by-case basis.

However, FERC announced in Order 888 that it would no longer require a utility wishing to sell wholesale power from new generating facilities to prove that it lacks market power in new generation capacity. FERC based this on the fact that it had "examined generation dominance in many different cases over the years" and had "yet to find an instance of generation dominance in long-run bulk power markets."[68] FERC ascribed this to industry and legal changes which have allowed ease of market entry in new generation. However, this will not prevent parties objecting to market-based rates from raising generation dominance issues related to new capacity. To obtain market-based rates for wholesale sales from existing generation, FERC continues to require public utilities to show that there is no generation dominance in existing capacity. In all market-based rate cases, FERC will look at whether an applicant or its affiliates could erect other barriers to entry and whether there may be problems due to affiliate abuse or reciprocal dealing.

b. Stranded Costs

Under Order 888, if a utility's pre-existing retail or wholesale customer is able to reach a new generation supplier because of the new open access, any "legitimate, prudent and verifiable" costs stranded as a result of the new wholesale transmission access will be recoverable. However, if a utility's pre-existing customer ceases to purchase power from it through self-generation or use of another utility's transmission system, costs stranded by this event would not be recoverable. These costs would not be stranded as a result of the new open access order.

FERC's approach to stranded cost recovery is based on the philosophy that because utilities entered into contracts to make sales under an entirely different regulatory regime, they should have an opportunity to recover stranded costs that occur as a result of the change in law. FERC did not believe utilities should be held responsible for failing to foresee the actions FERC would take to alter the use of their transmission systems.

In order to recover stranded costs, the utility must demonstrate that it had a reasonable expectation of continuing to serve the customer, and for how long. In calculating recoverable stranded costs, FERC will use a "revenues lost" approach. Under this approach, stranded costs are calculated by subtracting the competitive market value of the power the customer would have purchased from the revenues that the customer would have paid had it stayed on the utility's generation system.

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[68] Kansas City Power and Light, 67 F.E.R.C. ¶¶ 61,183, 61,557 (1994).

c. *Federal/State Jurisdiction*

Jurisdiction over the transmission of electricity includes both the authority to order transmission and the authority to set the rates, terms and conditions of transmission. The dividing line between federal and state authority to order transmission is clearly set out in the Federal Power Act. FERC has the authority to order the transmission of wholesale electricity and is prohibited from ordering the transmission of retail electricity.[69] Opponents of state authority to order the transmission of retail electricity have argued that the federal government has preempted state authority to order retail transmission of electricity by occupying the field of interstate commerce in electricity in the FPA. They add that the retail transmission of electricity affects interstate commerce in electricity even when it is limited to the transmission and distribution facilities of the local utility.[70] Nevertheless, as discussed below, numerous states have assumed they have such jurisdiction and passed legislation mandating transmission of retail electricity.

Congress has also clearly given FERC the authority to set rates, terms and conditions for the transmission of wholesale electricity.[71] However, the law governing the division of authority between the federal government and the states to set the rates, terms and conditions of transmission of retail electricity is unclear because, having prohibited FERC from ordering retail transmission, the FPA does not speak to any authority FERC might have regarding the rates, terms and conditions of retail transmission. Nevertheless, in Order 888, FERC asserted its exclusive authority over the rates, terms and conditions of any transmission in interstate commerce associated

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[69] Section 721 of EPAct amended § 211 of the Federal Power Act to provide that any electric utility (including intrastate utilities), Federal power marketing agency, or any other person generating electric energy for sale for resale, i.e., wholesale electricity, may apply to FERC for a wholesale transmission order. Section 212(h) of the Federal Power Act, as amended by EPAct, states that no wheeling order issued by FERC shall be conditioned upon or require the transmission of electric energy directly to an ultimate consumer. 16 U.S.C. § 824k(h)(1) (1994).

[70] These arguments were made in *In the Matter of the Application of the Association of Businesses Advocating Tariff Equity for Approval of an Experimental Retail Wheeling Tariff for Consumers Power Co.*, Nos. U-10143 and U-10176, Opinion and Interim Order Remanding to the Administrative Law Judge for Further Proceedings, 150 P.U.R.4th 409 (Mich. Pub. Serv. Comm'n Apr. 11, 1994), *appeal dismissed for lack of jurisdiction*, Attorney General v. Michigan Pub. Serv. Comm'n, No. 175245 (Mich. Ct. App. June 15, 1994).

[71] Federal Power Act, §§ 201, 205, 206, 212; 16 U.S.C. §§ 824(a), 824(d), 824(e), 824k (1994).

with retail transmission, whether it occurs voluntarily or pursuant to state order. FERC reasoned that when Congress enacted the FPA, it gave the Commission exclusive jurisdiction over the rates, terms and conditions of transmission in interstate commerce by public utilities and did not limit, by any words, FERC's jurisdiction to only the transmission in interstate commerce of electricity sold at wholesale. Therefore, FERC concluded, it should also take jurisdiction over the transmission in interstate commerce of electricity sold at retail. In so doing, FERC went out of its way to explain that it did not intend to exercise any jurisdiction over the local distribution facilities associated with retail transmission—which have historically been under state jurisdiction. However, FERC declined to propose the "precise demarcation" between transmission in interstate commerce and local distribution and stated that it was a factual matter "to be decided in the first instance by the Commission." Nevertheless, FERC indicated that it thinks its jurisdiction will be extensive because the courts have construed "in interstate commerce" broadly. FERC concluded that because of the highly integrated nature of the electric system, "most transmission of electricity is in interstate commerce." In summary, FERC contends that it has jurisdiction over the transmission in interstate commerce of electricity sold at retail and the states have jurisdiction over the transmission over local distribution facilities of electricity sold at retail. FERC declined to propose where the dividing line between these activities is located. This issue will ultimately be resolved by the courts or Congress.

2. *Order No. 889*

Order No. 889 established an electronic information system to aid the competitiveness of the wholesale market made possible by open access to transmission. This system, called OASIS (open access same-time information system), provides existing and potential transmission users the same access to transmission information that the transmission owner enjoys.

Order No. 889 also requires public utilities to comply with standards of conduct intended to preclude anticompetitive conduct by transmission owners, such as favoring affiliated generators or power marketers with transmission services.

H. CONCERNS ABOUT UNDUE MARKET POWER IN A RESTRUCTURED ELECTRIC INDUSTRY REMAIN

One of the significant issues implicated by the establishment of wholesale open access is the future competitiveness of the wholesale market. There are more than 3,000 electric utilities in the United States. More than

75% of these are vertically integrated, meaning they own generation as well as transmission facilities. The vertically integrated utilities serve over 75% of the retail customers in the United States. Once wholesale generation is deregulated, the concern arises whether utilities owning transmission will favor their own generation with special access. The other concern is whether utilities already owning generation will acquire additional market share in generation when they are allowed to compete unrestrained outside their existing service areas to the extent they will gain undue horizontal market power.

When FERC first proposed Orders 888 and 889, many commenters asked it either to order transmission-owning utilities to divest their generation assets or to impose structural institutional arrangements to better assure non-discrimination in the transmission and sale of electricity. Possible structural arrangements include regional independent system operators (ISOs) or other regional transmission organizations (RTOs). ISOs and RTOs are entities that are independent of the owners of transmission but, nevertheless, manage the transmission systems. FERC did not accede to these requests, preferring instead only to require utilities to "functionally unbundle" the transmission function of the utility from its generation and power marketing functions. Functional unbundling means that the activities are functionally separated within the corporation; they need not even be put into separate corporate entities.

FERC promulgated standards of conduct to reinforce its principle of separation of competitive and monopoly functions. Under these standards, a utility must take transmission services under the same tariff of general applicability as do others; state separate rates for wholesale generation, transmission and ancillary services; and rely on the same electronic information network that its transmission customers rely on to obtain information about its transmission system when buying or selling power.

Although FERC did not require utilities to develop independent system operators in Orders 888 and 889, FERC strongly encouraged utilities and power pools to form them voluntarily.[72] Now, FERC is formally looking at the desirability of creating them.[73] In addition to structurally separating

[72] FERC approves the formation of ISOs. FERC has announced eleven ISO principles; its goal is to ensure that the ISO is sufficiently independent and operational to fulfill its responsibilities. It has approved the California ISO and Power Exchange, the PJM Group (i.e., Pennsylvania-New Jersey-Maryland Interconnection), the New York Power Pool. It has conditionally approved ISO New England, Inc. (ISO/NE) for the New England Power Pool (NEPOOL).

[73] FERC Notice of Intent to Consult With State Commissions, 63 Fed. Reg. 66158 (1998).

transmission from generation and marketing functions, ISOs, or RTOs, with authority to operate the transmission system within a region can address loop flow issues, eliminate pancaked transmission rates within the system, manage short-term transmission reliability, manage congestion, and plan transmission expansion. Under Section 202(a) of the Federal Power Act, FERC is "empowered and directed to divide the country into regional districts for the voluntary interconnection and coordination of facilities for the generation, transmission, and sale of electric energy." However, before FERC can exercise this authority it must notify the regulatory commission of each State to be affected.[74] Currently, FERC is holding conferences with the states to receive their input on how these entities should be developed, if FERC decides to require them, and what role the states should have in their formation and governance.

I. COMPETITION HAS BEEN EXTENDED TO THE RETAIL MARKET IN SOME STATES

About one-third of the states have passed legislation to extend competition in electricity to the retail level by requiring their public utilities to wheel power to the end user over their distribution and transmission lines.[75] Most of these states have postponed the opening day of competition to a few years hence. However, California's entire retail market has been open to competition since 1997. Connecticut's entire market opened in 1998, as did New Hampshire's.[76] Many states are phasing in competition. For example, Pennsylvania has opened one-third of the peak load in each customer class to competition; Arizona has opened twenty percent of its IOUs' load to competition; and Montana allows competition for the retail load of large customers (greater than one megawatt).

1. Stranded Cost Recovery

In deciding to open the state to retail competition, one of the first issues the state must address is whether to allow the incumbent utilities to recover

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[74] Federal Power Act, § 202(a).

[75] These states include Arizona, California, Connecticut, Illinois, Massachusetts, Maine, Maryland, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, Oklahoma, Oregon, Pennsylvania, Rhode Island, and Virginia.

[76] New Hampshire's market was subsequently closed by order of the federal district court in Public Service Co. of New Hampshire v. Patch, 167 F.3d 15 (1st Cir. 1998) (affirming preliminary injunction), where the legality of some of the actions taken by the New Hampshire Public Utilities Commission in implementing retail competition is being litigated.

their stranded costs. To date, most states have allowed their utilities the opportunity to collect all their stranded costs. Typically, stranded costs are recovered through a temporary surcharge levied on the distribution of kilowatt hours of electricity to all consumers in the jurisdiction. A few states allow some customers to bypass this surcharge if they generate their own electricity.[77]

In some states the actual recovery of stranded costs is more difficult than in others. For example, in some states only "unmitigable" stranded costs can be recovered.[78] Illinois' statute takes this a step further by pre-determining what percentage of stranded costs are "mitigable." New Hampshire's stranded cost recovery provision is arguably the most stringent for utilities, and has given rise to litigation challenging it. New Hampshire will allow full recovery only in those situations where utility management's discretion to invest in generation which has now proven to be above market value was significantly reduced or eliminated by government mandate.[79] Furthermore, New Hampshire will not allow full recovery in any event where to do so would result in a rate above the regional average. New Hampshire's Public Utility Commission has interpreted these terms strictly and disallowed recovery of much of Public Service Co. of New Hampshire's ill-fated investment in Seabrook Nuclear Generating Station. This regulatory order is currently stayed while its legality is being determined by the courts.

Several states have conditioned stranded cost recovery on divestiture of some or all of the utility's generation.[80] Requiring a utility to sell its generation aids in the certainty of calculating the cost that is stranded.[81] Some critics of this approach argue that the advantage of a certain price is outweighed by the risk that putting a utility's generation on the auction block all at once and on a legislatively imposed date will reduce the price buyers are willing to pay for it, thereby increasing the stranded cost.

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[77] *See*, for example, Montana and Maine. Maine also allows customers to bypass the stranded cost surcharge in certain fuel conversion situations or with the adoption of demand side management programs. Other states require customers leaving the system to self-generate to pay an exit fee designed to recover their estimated stranded costs repayment "liability." *See*, for example, Arizona.

[78] *See*, for example, Connecticut, Maine, Massachusetts.

[79] Pennsylvania's stranded cost recovery provision is similar.

[80] *See*, for example, Connecticut, which required its utilities to divest all non-nuclear generation. In Rhode Island, utilities must divest fifteen percent of their generation assets within three years. Maine will require its utilities to divest all their generation by 2001. California required Pacific Gas and Electric and Southern California Edison to divest at least 50% of their generation.

[81] If a market value is not arrived at through an actual price paid for the asset, then it must be estimated in an administrative proceeding.

2. *Amelioration of Incumbent Utilities' Market Power*

Requiring utilities to divest their generation assets also has the effect of reducing or eliminating the utilities' market power in the newly formed retail electricity market. In spite of its advantage for aiding the development of a retail competitive market, divestiture of generation assets is not being required in many states. Often it is opposed by the incumbent utilities which may have significant economic and political strength in their states. Their opposition to forced divestiture is frequently matched by the labor unions and non-unionized utility employees who have been securely employed and wish to see the same ownership continue. Maintenance of the status quo also appeals to many in the public who, while they want the lower electric rates held out by the prospect of competition, are anxious about what new electricity providers means for the reliability of their service and the level of solicitude for them as consumers.

Most states that do not require their utilities to divest generation assets set up codes of conduct designed to prevent discrimination by the utility against new entrants in the generation market. Several states are investigating the possible formation of an independent system operator to manage the distribution and transmission facilities within the state or region.[82] California has already formed one, which has been approved by FERC.

3. *Non-market Efforts to Assure Lower Rates*

One of the primary political forces behind the passage of legislation in the states to open electricity to retail competition is the belief that it will result in lower electric rates. Some states are reluctant to rely on a nascent competitive market to achieve this and have enacted programs and temporary regulatory controls designed to assure it. For example, California, Connecticut and Illinois have made state bonds available to the incumbent utilities owning generation assets to allow them to refinance at a lower interest rate. The states require this cost savings to be passed on to the utilities' traditional retail customers in the form of a rate decrease. At least in California, the rate decrease seems to have had the effect of lowering the

[82] Texas effectively has one in its Electric Reliability Council of Texas (ERCOT) which has been in existence for decades. Massachusetts calls for an ISO and perhaps a power exchange to operate with a reformed NEPOOL. New Hampshire and Rhode Island seek a regional power pool, a reformed NEPOOL. Arizona, Oklahoma, and Virginia have also called for the formation of an ISO.

price for retail electricity for residential customers below the point where new entrants can effectively compete for a share of the market.[83]

Massachusetts has phased in a mandatory, temporary rate decrease. It required its utilities to offer to sell unbundled electricity at 2.8 cents per kWh in 1998. When the utilities divest their generation they can raise this to 3.2 cents and in 2004 they can raise it again to 5.1 cents. After 2005, they are free to offer electricity at the price they see fit.

In at least a few other states, the incumbent utilities have been prohibited from recovering any stranded costs if to do so would require them to raise their retail electric rates.[84]

At least one state has authorized its political subdivisions to aggregate load, in competition with private load aggregators, for purposes of contracting with competitive generators.[85]

4. *Regulating Externalities*

About half of the states that have introduced retail electric competition have set up programs to enable them to continue to have jurisdiction over the externalities associated with the generation and distribution of electricity. Most of these states have imposed a surcharge on the distribution of electricity, usually called a competition transition charge (CTC), to fund programs variously designed to promote electricity efficiency, demand side management programs, research and development of renewable fuels, environmental improvement, universal electricity service, low income assistance, and utility employee health, retirement and retraining programs.[86] Connecticut has announced that it will establish uniform state standards for generation facilities to improve air quality.

Some states have a renewable resource portfolio requirement that must be met by electricity providers seeking to be licensed to do business in their jurisdictions. For example, Maine will require licensed power marketers to generate a minimum of thirty percent of the power offered for sale in Maine from renewable energy resources. Connecticut's minimum is six percent. Nevada's minimum is 0.2 percent beginning in 2000 and increasing annually

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[83] See the press release of Enron which pulled out of the California residential market, citing an inability to lower its prices below that of the incumbent utilities.

[84] *See*, for example, Montana and Oklahoma.

[85] *See* Massachusetts, for example.

[86] *See*, for example, California, Connecticut, Maine, Massachusetts, New Hampshire, Pennsylvania, Rhode Island. On the other hand, Virginia Corporation Commission has recommended to the legislature that it institute no CTC.

by 0.2 percent until it reaches one percent. However, Nevada has authorized its public utility commission to establish a system of tradable renewables credits.

At least one state has required all power marketers doing business in its jurisdiction to follow a standard format for all their disclosures, explanations and sales information in order to enable consumers to better compare prices and offerings.[87]

5. *Publicly and Cooperatively Owned Utilities*

Only a few states that have provided for retail competition have mandated that their publicly and cooperatively owned utilities participate. Arizona is one of these states. Arizona has made retail wheeling applicable to its rural electric cooperatives and the Salt River Project, a publicly owned water and electric utility, although Arizona has exempted municipally owned utilities from the program. Oklahoma and Pennsylvania have required their rural electric cooperatives to open their transmission and distribution lines to competitive power, but they have allowed their publicly owned utilities to opt into the program at their discretion. Most states allow their cooperatives and publicly owned utilities to opt into competition, although Montana requires its coops to participate unless they opt out. Many of the states that decline to force their publicly and cooperatively owned utilities to open their customer base to retail competition also prohibit these non-participating utilities from participating in the competitive market by selling power at retail outside their service territories. Those states that allow non-participating utilities to nevertheless sell power at retail in other utilities' historic customer service areas have been criticized by investor-owned utilities on the ground that publicly owned utilities have an unfair advantage because of the tax exempt bonds they use to finance the purchase of generation.

6. *Competition in Ancillary Services*

Several states have announced that they will require their utilities to open up their ancillary services to competition in the future. For example, in 2000, Massachusetts utilities must open up their billing and collections, metering and meter reading services to competition. In Maine this will occur after March 2002. In Arizona it is scheduled to be phased in by 2000 for large industrial customers and for all others in 2001.

[87] *See* Nevada, for example.

7. *Consumer Protection*

Many states have authorized their state regulatory commissions to educate the public about electricity choice. Many have also enacted anti-slamming legislation. Interestingly, this legislation has sometimes been criticized by new entrants for making switching electricity providers so burdensome that it will be a barrier to choice.

J. The Electric Industry is Restructuring Itself Through Mergers and Acquisitions in Response to the Changing Marketplace

1. *FERC's Merger Policy*

FERC has the authority and obligation to approve mergers and acquisitions under the Federal Power Act. FERC must ensure that a proposed merger is "consistent with the public interest."[88] In 1969, FERC's predecessor, the Federal Power Commission, devised a six factor test for evaluating mergers.[89] This test was followed until relatively recently. By 1996, the wholesale electricity market had become increasingly competitive. FERC was authorizing market-based rates for wholesale electricity sales when it found that the utilities lacked market power. States were contemplating retail competition. FERC decided the 1969 test needed to be updated to account for changing market structures, the effect of a merger on competitive bulk power markets and the consequent effects on ratepayers. FERC announced its new test as a policy rather than a rule and rather than developing it on a case-by-case basis. FERC wanted to give the public greater certainty about what the profile of an acceptable merger would be, yet retain its flexibility to adjust the test over time.

FERC's new merger policy is a three factor test. FERC looks at the effects of the proposed merger on competition, on rates, and on regulation. In analyzing the effect on competition, FERC has adopted the Department

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[88] Federal Power Act, § 203(a), 16 U.S.C. § 824b(a) (1994).

[89] These factors included the effect of the proposed merger on competition and on the applicants' operating costs and rate levels; the reasonableness of the purchase price; whether the acquiring utility has coerced the to-be-acquired utility into acceptance of the merger; the impact of the merger on the effectiveness of state and federal regulation; and the contemplated accounting treatment. Commonwealth Edison Company, Opinion No. 507, 36 F.P.C. 927, 936-42 (1966), *aff'd sub nom.* Utility Users League V. FPC, 394 F.2d 16 (7th Cir. 1968), *cert. denied*, 393 U.S. 953 (1969).

of Justice/Federal Trade Commission Merger Guidelines as its analytical framework. The Guidelines involve five steps. First, FERC will assess whether the merger would significantly increase concentration and result in a concentrated market. In light of this, FERC will then assess whether the merger raises concerns about potential adverse competitive effects. Third, FERC will look at whether entry would likely deter or counteract the competitive effects of concern. Next, FERC will assess the efficiency gains that reasonably cannot be achieved by the parties through other means. Finally, FERC will assess whether, but for the merger, either party would be likely to fail, causing its assets to exit the market. By apply an analytic "screen" based on these assessments early in the merger review process, FERC expects to identify proposed mergers that clearly will not harm competition. Applicants who demonstrate that their merger passes this market power screen will have a presumption that the merger raises no market power concerns and, therefore, will not require a trial-type hearing on the issue. In order to be approved, the post-merger market power wielded by the new company must be within acceptable thresholds or be satisfactorily mitigated.

In assessing the effect of a proposed merger on rates, FERC will require applicants to propose appropriate rate protection for customers. FERC encourages the parties to the case to settle this issue through pre-filing consensus-building efforts. In order for the merger to be approved, acceptable customer protections must be in place.

With regard to the effect of the merger on regulation, FERC adopted the approach it had used in recent cases. Where regulatory authority will shift to the Securities and Exchange Commission because the new company will be part of a registered public utility holding company, FERC nevertheless requires it to commit to abide by FERC's policies regarding affiliate transactions. Where the merger is also subject to state approval, FERC will leave the issue of the merger's effect on state regulation to the state commissions. In order to be approved, any adverse effect on regulation must be satisfactorily addressed.

2. *State Approvals*

Most states require public utilities doing business in their jurisdictions to receive approval from the state commission prior to any merger or acquisition. To date, few states have explicitly developed a merger approval policy for restructurings in the newly competitive electric industry.[90] The usual approach is for states to ask whether the merger is "in the public interest" by looking at whether the benefits exceed the costs. State regulators are typically concerned that the merger not result in a loss of state jurisdiction over the new entity, that the merger result in real economic benefits to customers (lower rates for example), and that the merger not jeopardize economic development or utility-related jobs in the state.[91] Commentators suggest that state regulators should also be particularly concerned that mergers not create excess capacity and energy which can be used to prevent new entrants into electricity markets. ❦

[90] *But see,* Robert J. Graniere and Robert E. Burns, MERGERS AND ACQUISITIONS: GUIDELINES FOR CONSIDERATION BY STATE PUBLIC UTILITY COMMISSION (National Regulatory Research Institute, ed. 1996), which propose some presumptions states might adopt for merger reviews.

[91] *Id.* at 23.

CHAPTER THIRTEEN

Alternative Energy Sources

by Suedeen G. Kelly

I. INTRODUCTION

Although America has diversified its mixture of energy sources, as we approach the year 2000, almost all of the United States' energy continues to come from the traditional sources of coal, petroleum, natural gas, hydropower, and nuclear power. In 1996, fossil fuels were the source of 80% of the energy produced in the U.S. and 85% of the energy consumed while hydropower and nuclear power, together, constituted 15% of production and 12% of consumption. Twenty-three percent of the energy consumed in the U.S. in 1996 was imported, primarily in the form of petroleum and natural gas.[1] These traditional sources of energy accounted for 99.8% of the electricity generated in the U.S. during the same year.[2]

Traditional sources of energy, particularly fossil fuels, are subject to uncertainties of supply, fluctuations in global markets, and changes in federal policy that render them vulnerable as long-term reliable fuels sufficient to meet the nation's energy needs. The eventual scarcity of fossil fuels will undoubtedly increase prices. Additionally, all traditional energy sources cause some harm to the human and natural environment. There are pollutant effects associated with all fossil fuels, and the energy industries have given rise to some of the most blatant examples of pollution in American society. Today, energy pollution is a worldwide problem. Acid rain and the "greenhouse" effect promoting global warming may demand serious international pollution control. Finally, nuclear power growth has stopped in the wake of the Three Mile Island accident and the Chernobyl disaster. All of these factors create an interest in displacing these traditional sources of energy and particularly in decreasing U.S. dependence on foreign petroleum. There are a variety of old and new technologies that constitute

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[1] Energy Information Administration (EIA), ANNUAL REPORT TO CONGRESS 1980, Vol. 2, p. 5; and EIA/Coal Industry Annual 1996. *See also* Introduction to this Text, pp. 7-8.

[2] EIA, ANNUAL REPORT—COAL EIA FORM—759. *See also* Introduction to Text, p. 4.

"alternatives" to the traditional sources of energy. They presently amount to a small percentage of current U.S. energy production and consumption. The most common alternative energy source is renewable resources, such as solar and geothermal energy. Renewable resources accounted for 5% of the energy produced and 3% of that consumed in the U.S. in 1996. Additional alternatives to traditional energy sources include conservation, fuel cells, and synthetic fuels.

Solar energy, a renewable resource, is generally described to include all sources that gain some energy from the sun. This includes not only direct solar energy, such as passive or active solar heating, but also wind energy produced by varying air temperatures, ocean thermal energy created by differing ocean temperatures, and biomass energy, such as wood heat or gasohol, since the sun is involved in photosythesis. This chapter will discuss each of these forms of solar energy as distinct renewable resources. Geothermal energy, also a renewable resource, is created by heat generated from within the earth in the form of drysteam, hot water, and hot rocks.

Conservation, while not a direct source of energy, is considered an alternative source because it reduces the consumption and depletion of primary energy sources. Conservation includes not only a reduction in energy dependence but also the more efficient use of energy. Energy efficiency can be realized through such things as improved machinery design, co-generation of energy through the use of steam or heat created by one activity to power another, or elimination of heat waste through the use of insulation.

Fuel cells are electrochemical devices that generate DC electricity similar to batteries. However, unlike batteries, they take their energy from a fuel that is supplied from the outside. The best fuel for many types of fuel cells is hydrogen but a variety of other fuels—methanol, ethanol, natural gas, and liquefied petroleum gas—can be used. Energy can also be supplied by biomass, wind and solar energy. While not a primary source of energy, fuel cells produce electricity more efficiently than conventional methods of power generation and, thus, are considered an alternative energy source.

The last category of alternative energy sources discussed in this chapter is synthetic fuels, or "synfuels." Synfuel energy is essentially the creation of a fuel resembling natural gas or petroleum from something other than traditional oil and gas resources. Synfuels include the conversion of coal (both gasification and liquification), oil shale, and tar sands.

While the cost of production of some of these alternatives is higher than traditional energy sources, the advancement of technologies typically lower costs. Additionally, even though some of the alternative sources can only be used in on-site, small-scale operations, such applications have the potential to eliminate or reduce the need for large-scale transmission and distribution systems. Economic, environmental, or political changes may push these technologies to the forefront within the foreseeable future.

II. FUEL CYCLES OF ALTERNATIVE ENERGY RESOURCES

A. Renewables

1. Solar Energy

Solar energy is probably the most widely publicized alternative energy source. Solar enthusiasts note that energy from the sun was responsible millions of years ago for the photosynthetic process that provided the raw materials for what are now the fossil fuels. From this perspective, solar energy provides more than 90% of current energy resources and, even more fundamentally, without sunlight life on the planet would not exist. Further, although it is not counted in most energy use calculations, the world's population receives much free heat, light, wind, and drying capacity from the sun.

Legal definitions of solar energy have included matters not intuitively thought of as being solar. The Solar Energy Research Development and Demonstration Act of 1974, defines solar energy in Section 3(1) as including both direct and indirect solar sources. The direct uses of the sun's rays are clearly solar and primarily include photovoltaic cells, solar thermal systems, and solar buildings. Indirect solar sources include biomass energy which relies on the sun's role in the photosynthetic process and wind energy and ocean thermal energy derived from differential solar heating of the land and water surfaces. These indirect solar sources of energy will be discussed as distinct renewable resources.

The energy available from the sun is enormous. The problem is to use a reasonable part of it. In the United States, solar energy falls on the surface, day in and day out, at an average rate of about 4.76 kilowatt-hours (kWh) per square kilometer per day or 1.7 billion kWh per square kilometer per year. If all the energy from the sun that reaches the United States were harnessed, it has been estimated that it would provide about 500 times the nation's present energy demands.

Photovoltaic (PV) solar cells convert sunlight directly to electricity. A solar cell is based upon the long-known principle that many materials, especially semi-conductors, produce free electrons when photons from sunlight strike them. These free electrons flow, thereby producing an electric current, in an electric field that is formed by a junction of two different materials. The usual solar cell is made of silicon and a layer of another substance, such as phosphorous. When exposed to sunlight, its electrons are excited and migrate toward the junction between the two. On arrival, they generate direct current (DC) electricity. The electrical current produced is proportional to the area of the cell. For greater power levels, cells are interconnected. Photovoltaic systems come in a near infinite number of sizes, ranging from a single solar cell to power a calculator or a single module (containing multiple cells) to power a light, to multiple modules to power a water pump or home, to large arrays of modules to provide industrial-scale power.

The majority of PV cells in use today are crystalline silicon flat plate collectors. These utilize single crystal silicon (more efficient but more expensive) and polycrystalline silicon, (cheaper but less efficient). The crystals are grown or cast from molten silicon and then sliced into the appropriate size and shape. The cells are then assembled onto a flat surface. Research continues into improving silicon solar cells and developing other materials.

Another kind of PV cell, the "thin film" system, is less expensive than crystalline but also less efficient. It is manufactured by placing a thin layer of PV material onto glass or metal. The silicon used includes the amorphous type rather than crystalline. Yet another manner of PV cell use involves "concentrators." Lenses or reflectors are configured in such a way as to focus sunlight on the cell and thus increase the amount of electricity it produces.

Although technology is improving, the cost for large scale generation of electricity by solar cells remains high. The manufacture of polycrystalline PV cells, for example, still has a way to go to achieve profitable efficiency as it typically produces cells with only 12% to 15% efficiencies. In 1975, the industry could produce photovoltaic cells for $30,000 a kilowatt. In 1987, the city of Austin installed a unit for peak power generation at a cost of $10,000 a kilowatt, approximately double the cost of conventional generation at that time.

While solar cells can be utilized in any area of the country and even on overcast days, the power output is maximized by keeping the PV array pointed at the sun. The amount of solar energy received in a given area over time varies daily and seasonally because of the changing relation of the earth to the sun. Single-axis tracking of the array will increase the energy production in some locations by up to 50% for some months and by as much as 35% over the course of a year. The greatest benefit comes in the early morning and late afternoon when the tracking array will be pointing more nearly at the sun than a fixed array. Generally, tracking is more beneficial at sites between 30° latitude North and 30° latitude South. For higher latitudes the benefit is less because the sun drops low on the horizon during winter months. Thus, to maximize effectiveness, it is necessary to have accurate solar data for the locale.

Not all solar energy generates electricity. Solar thermal systems operate by transferring solar generated heat to a fluid. The heated fluid is then used for any number of purposes. A relatively simple solar thermal system uses water, or water with anti-freeze in it, which is piped through a box having a glass front. The heat in this liquid is transferred to another liquid in another set of pipes and is employed for hot water use or to run through a radiator for space heating. Solar water heaters are the most common use of solar energy by home owners and are available and relatively easy to retrofit to existing homes.

A more complex mode of solar thermal energy involves concentrators. There are three basic system designs, the trough, power tower, and dish systems. Trough systems use parabolic reflectors in a trough configuration and are the most mature solar thermal technology. Troughs concentrate the sun up to 100 times onto a fluid-filled receiver tube positioned along the line of focus in the trough. Heat can be produced efficiently up to 400°C (750°F) and used as heat or to generate electricity by providing heat for boilers that power steam turbine generators. Troughs are modular, and can be grouped together to produce more heat or power.

Power tower systems, also called central receivers, use heliostats (highly reflective mirrors) to track the sun and reflect it to a central receiver atop a tower. The sunlight is concentrated on the receiver up to 800 times its normal intensity. The sun heats a fluid in the receiver typically to temperatures up to 650°C (1200°F). The heated fluid is converted to steam that drives a turbine to produce electric power. The most noteworthy example of this system is Solar Two, a 10 megawatt utility-scale solar power plant near Barstow, CA. It cost $50 million to build and consists of 2,000 computer-controlled metal and glass heliostats spread over 95 acres. These direct sunlight at a 300-foot tower, on whose top rests a tank containing molten salt. The salt is heated to over 1000°F and pumped through a steam-generating system. The salt retains enough warmth so that its energy can be transformed into electricity up to 12 hours after sunset. Scientists are hopeful that such plants can eventually produce from 30 to 200 megawatts.

Dish systems use parabolic reflectors in the shape of a dish to focus the sun's solar rays onto a receiver mounted above the dish at its focal point. The solar energy ultimately heats a fluid powering a small engine/generator mounted at the focal point of the dish. Operating at about 800°C (1500°F), a single dish module can generate up to 50 kilowatts of electric power. Like trough systems, dishes can be grouped together to produce more power. Dishes achieve the highest performance of all concentrator types in terms of annual collected energy and peak solar concentration.

Solar building technology includes both passive and active systems to provide heating, cooling, and daylight for buildings. A passive system achieves the flow of heat by natural means such as radiation, conduction, and convection. An active system uses mechanical means, such as a fan or pump, to distribute the heat. Passive systems control the transmission of solar radiation through glass, for use as lighting, and by storing heat within the building mass, for use in space heating. Passive solar buildings are well-insulated, have south-facing glass, and thick floors to absorb heat. Double or triple pane windows are used for greater insulation and the space between panes can be filled with argon to prevent heat loss. Another technique of passive heating is the thermal storage wall. The wall may be of massive masonry painted black on the outside to absorb solar radiation. Space heating is accomplished by radiation and convection from inside the wall. In other cases, the wall may be double with the outer wall of glass or black painted masonry. Air circulating within this double wall is thus heated and heats the building. Water may also be stored within the double wall to retain the heat.

In addition to these primary types of solar energy, another way to use solar energy is solar cooking. There are two basic kinds of solar cook stoves. One, more complicated and expensive, is a wooden box with a glass top and a mirrored lid. Food is placed in a black pot underneath the glass. The second, simpler and cheaper, consists of a mirrored parabolic panel. A black pot is placed at the panel's focal point and covered with plastic.

2. *Wind Energy*

Wind is an indirect form of solar energy caused by differential heating of the earth's surface and by the earth's rotation. Wind flow patterns are modified by the earth's terrain, bodies of water, and vegetative cover. This wind flow, or motion energy, when "harvested" by wind turbines can be used to generate electricity. Windmills have been useful for hundreds of years, primarily as a water pump to bring water from underground wells to the surface. The use of wind systems to generate electricity did not come into being until the early twentieth century.

Conversion of wind energy to electricity is simple. A set of turbine blades, like airplane propeller blades, driven by the wind turns a mechanical shaft coupling to a generator that then produces electricity. Wind turbines are often grouped together into a single wind power plant, also know as a wind farm, to generate bulk electrical power. Electricity from these turbines is fed into the local utility grid and distributed to customers just as with conventional power plants.

Wind turbines are available in a variety of sizes, and therefore power ratings. The largest machine, such as one built in Hawaii, has propellers that span more than the length of a football field and stand 20 stories high.

It produces enough electricity to power 1,400 homes. A small home-sized wind machine has rotors between 8 and 25 feet in diameter. It stands upward of 30 feet and can supply the power needs of an all-electric home or small business. All electric-generating wind turbines, no matter what size, are comprised of a few basic components: the rotor (or blade), the electrical generator, a speed control system, and a tower. Some wind machines have fail-safe shutdown systems for the event of a mechanical failure.

Wind energy is very abundant in many parts of the United States, but wind speed is a critical factor because the energy in wind is proportional to the cube of the wind speed. Wind resources are categorized by wind-power density classes, ranging from class 1 (the lowest) to class 7. Good wind resources (class 3 and above), which have an average annual wind speed of at least 13 miles per hour, are found along the east coast, the Appalachian Mountain chain, the Great Plains, the Pacific Northwest, and some other locations. North Dakota, alone, has enough energy from class 4 and higher winds to supply 30% of the electricity of the lower 48 states. It is estimated that there is enough wind potential in the U.S. to displace at least 45 quads of primary energy used annually to generate electricity (one Quad, a quadrillion BTUs, is equivalent to the energy produced by 167,000,000 barrels of oil).[3]

Unlike conventional power plants, wind plants emit no air pollutants or greenhouse gases. In 1990, California's wind power plants offset the emission of more than 2.5 billion pounds of carbon dioxide, and 15 million pounds of other pollutants that would have otherwise been produced. There is, however, some concern over the noise produced by the rotor blades and possible interference with television reception. Also, birds are sometimes killed by flying into the rotors.

The major challenge to using wind as a source of power is that it is intermittent and it does not always blow when electricity is needed. Wind cannot be stored, unless batteries are used, and not all winds can be harnessed to meet the timing of electricity demands. Good wind sites are often situated in remote locations far from areas of electric power demand. Finally, wind resource development may compete with other uses for the land and those alternative uses may be more highly valued than electricity generation. However, wind turbines can be located on land that is also used for grazing or even farming.

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[3] D.L. Elliot, L.L. Wendell, and G.L. Gower, *U.S. Aerial Wind Resource Estimates Considering Environmental and Land-Use Exclusions*, presented at Windpower '90 Conference, Washington, D.C., September 1990.

3. Geothermal Energy

Geothermal energy is heat from beneath the earth's surface. Most of the earth's heat resides in the earth's molten core and mantle below the earth's crust at depths presently incapable of being tapped by drilling. However, in certain parts of the world there are areas called "hot spots" where the earth's protective crust is shallow and access to geothermal heat by man is possible. In some areas molten or very hot rock is located very close to the earth's surface. Hot springs and geysers, like Old Faithful in Yellowstone National Park, are areas where geothermal energy has actually reached the earth's surface. In other areas, wells can be drilled from the surface into the geothermal reservoir. In the United States, including Alaska and Hawaii, as much as 1.3 million acres of land have potential for power production from geothermal energy.

Depending on the geology, geothermal energy may be available as dry steam, hot water, or hot rocks. Dry steam resources are the easiest to find and use, and are the least expensive to exploit. Wells are drilled into the steam reservoir. Steam then travels up the well pipe directly into a turbine that runs a generator. Once the steam is used, it is piped into a condenser, converted to water and returned by another pipe to the reservoir.

The problem with steam systems is basically threefold: First, some of the condensed water often contains boron and hydrogen sulfide and, since excess heat must be disposed of on the surface, there are environmental concerns. Second, the dry steam system is inefficient. It requires significantly more energy from the reservoir to produce one kilowatt in contrast to fossil fuel plants. Third, the number of sites are limited and are smaller than the other geothermal resources.

Hot water geothermal deposits are larger and some twenty times more abundant than dry steam deposits. Although there are no commercial hot water power plants in operation in the United States, the basic technology exists to tap this resource. The problems again are the disposal of mineral rich hot water and efficiency. Hot water is at a lower temperature than dry steam, which produces low conversion efficiencies and requires, in turn, very large turbines.

Hot rock systems have a larger power potential than the other two systems. Unlike the other systems, which depend upon steam or hot water from natural underground reservoirs, hot rock systems can be located anywhere. In a hot rock system two wells are drilled to form a closed-loop system from the surface to the hot rocks. Water is injected down one well, superheated by the hot rocks and, under high pressure, comes back to the surface through the second well to drive steam turbines or provide space heating.

4. *Biomass Energy*

Biomass is a form of alternative energy technology that includes the use of organic materials such as wood from trees, and agricultural crops such as beets and corn, and waste such as garbage or sewage. Wood may be used as a direct substitute for petroleum to provide residential heating.

Agricultural crops may be grown and converted into usable fuel such as ethane and methane which can be substituted directly for petroleum-based fuels or can be mixed with gasoline to form gasohol. Ethane normally is a colorless gas recovered as a liquid at refineries and natural gas processing plants. However, it may also be derived from agricultural products that contain sugar or starch such as corn, wheat or beets. Ethane's primary use is as petrochemical feedstocks to make chemicals and plastics. Methane is a colorless, odorless flammable gas that forms the major component of natural gas. It can also be derived from a variety of sources ranging from coal to biomass substances such as wood and waste materials (garbage and sewage). One problem with methanol is that it also produces formaldehyde, which the EPA has found to be a probable cancer-causing agent in humans.

Energy production in the form of gas from agricultural and municipal waste is a proven technology. Energy is produced from the action of microorganisms that eat decomposing garbage and sewage and excrete carbon dioxide and methane. The methane gas is collected by covering a site with a clay and soil mix, inserting a pipe into a drill hole and collecting the gas from a valve attached to the pipe at the surface. Many companies already capture and sell methane as a byproduct from the decomposition of materials like food and papers. For example, Brooklyn Union Gas uses methane recovered from the Fresh Kills landfill on Staten Island, New York, to provide heating and cooking gas to 10,000 households. Potentially, bio-conversion of waste into energy could produce the usable energy equivalent of up to 3 million barrels of oil a day.

5. *Ocean Thermal Energy*

Oceans provide two potential alternative sources of energy—ocean thermal energy conversion (OTEC) and wave energy. OTEC is really a form of solar energy since water temperature differences are created by the sun's rays and then utilized to produce energy. In tropical seas the water temperature at the surface and to a depth of 100 feet can be up to 40°F warmer than the water temperature at lower depths. The warmer surface water potentially can be used to vaporize liquid ammonia or freon contained in a piping system connected to a generator. The resulting gas from vaporization turns an electric turbine generator located at the surface. Heat is removed from the gas. The gas is then pumped into the deep or colder water, causing it to liquefy through a condenser and then the cycle is repeated. The electricity produced could be used at the ocean site by industrial facilities located there to use the electricity. It could also be transmitted to shore via electric cable or used to electrolyze water to hydrogen, which would then be shipped to shore by pipeline to be burned like natural gas.

Wave energy has a more limited application than OTEC. Although waves—the natural rise and fall of ocean waters—occur everywhere, their employment for useful energy production is thought to be quite limited. First, wave energy must be utilized near shoreline areas that are configured in a way that maximizes the wave energy and sufficiently focuses the waves on the energy system deployed. The most successful method of harnessing wave energy is by a water tower system. Here, a hollow tower is erected near shore. When a wave arrives on shore, it forces water up inside the tower, displacing air, which passes upward through a turbine at the top of the tower. When the wave recedes, the water in the tower falls, sucking air back into the tower through the turbine. (The turbine is designed to rotate in only one direction.) There are no such wave energy plants in the United States. However, the French and the Norwegians have experimented with small tidal wave power plants. One problem with a wave energy system is that it produces a very disturbing siren-like noise, but technological improvements in reducing the rotor speeds of the turbines could reduce the noise to acceptable levels.

B. Conservation

The term "energy conservation" is not consistently defined. Most people understand energy conservation to mean reduction in energy production and consumption. To some, it means primarily a reduction in dependence on traditional energy sources, especially the fossil fuels. To others, conservation means a change in life style and reduced dependence on all energy. To still others, it means more efficient use of energy and hence reduction in use without major social or economic changes. The most broadly accepted use of the term "energy conservation" implies the wise use of energy, an increased reliance on more plentiful and dependable sources, and the making of certain social and economic changes to minimize the impact of short- and long-range changes in supply. The ultimate aim is to reduce energy consumption while maintaining acceptable social and economic patterns. Thus, conservation is considered an energy source because it displaces the need for other sources.

1. *Buildings*

A major use of energy in the United States is for heating buildings. This space heating consumes about 16% of all energy produced. If water heating, air conditioning, lighting, cooking, and refrigeration are added, a total of over 20% of energy used in the United States goes into domestic and commercial building uses. For this reason a reduction in energy use in buildings would have a far-reaching effect on conservation efforts.

Many studies have shown that conservation measures taken in new home construction or in retrofitting older homes are economically justifiable. Depending on the part of the country in which the building is located, important conservation measures are the insulation of walls and roofs, the installation of storm windows and automatic thermostats, and the use of tight, leak-free construction throughout the house. As the cost of gas and oil heating rises, there will be increased attention paid to more efficient furnaces in residential buildings. Most experts agree that use of insulated ducting, the use of heat recovery in the stack, and the replacement of pilot lights with electric ignitions could reduce gas consumption of domestic furnaces by as much as one-third. Water heating in buildings consumes significant energy, an indication of why solar water heating has received considerable attention in many parts of the country. Commercial buildings can also reduce their energy consumption using the same general principles that apply to conservation in residences.

2. *Transportation*

The automobile consumes 13% of all the energy used in the United States. Trucks use another 6%. Transportation used about one-half of all petroleum (domestic and imported) consumed in this country. Of all the energy used for transportation, the automobile used about 50%, trucks about 24%, and air transport about 7%. The sharp increase in gasoline prices throughout the 1970s spurred a trend toward cars that use less fuel. The major technique for reducing fuel consumption was to reduce the weight of the car, which also allowed the use of smaller engines. As fuel use in cars is essentially proportional to vehicle weight, this was far more valuable than attempts to increase the efficiency of gasoline engines. Diesel engines are typically 20 to 30% more efficient than gasoline engines. However, they produce more pollutants, especially nitrogen oxide, create more noise, and are somewhat heavier and more costly. Other forms of transportation such as rail, truck, barge, and airplane are all undergoing studies aimed at reduced energy use. This effort is primarily driven by the high cost of fuel.

3. *Industrial Use*

The industrial sector uses about 25% of the energy produced in the Untied States. The major energy consumers are the chemical, iron and steel, and paper industries, followed by industries that support agricultural production. One-third of industrial energy is used in the form of steam, while about one-half is used as heated gases. There is considerable interest in solar energy as a source of heat for low temperature steam and gas generation. High temperature applications require sources other than solar energy.

The cost of energy as a function of industrial production has been slowly declining since World War II. This is due to better technology, increased interest by companies in management of electric consumption, and relocation and new plant development in milder climates. Other efforts to conserve industrial energy use include more efficient processes, recycling (resource recovery), and co-generation, a method of using process steam to create an energy source. Of these, co-generation has perhaps the greatest immediate potential.

Co-generation is the use of a single fuel source such as coal, oil or gas to make sequentially two usable forms of energy, usually electricity and heat. For example, oil or gas is used first in a boiler to fuel a turbine, which produces electricity. The boiler also gives off excess or reject heat in the form of steam and the steam is then used to provide heating. There are two basic types of co-generation facilities depending on the sequence of the process. A topping cycle co-generation facility generates electricity first and then uses the waste thermal energy in some way, usually to provide heating. A bottoming cycle co-generation facility operates in reverse sequence. That is, it produces thermal energy first and then uses the waste heat to generate electricity.

The primary aim of co-generation facilities is conservation of energy. It is the reuse of reject heat that conserves oil or gas. Not all industrial operations benefit equally from co-generation. Process and space requirements or fluctuating energy needs may make co-generation difficult. Co-generation was boosted by the Public Utility Regulatory Policies Act of 1978 (PURPA). PURPA, among other things, created a market for the sale and purchase of electric power produced by certain facilities that meet the statute's requirements as qualifying co-generation or small power production facilities. However, many of the prices established in long-term contracts exceed the current market price of electricity and, therefore, potentially block competition.

Food production, processing, and distribution systems also account for a significant amount of United States energy usage, with food transportation, field equipment, and chemicals (pesticide, fertilizer, container) production using the most. Increased conservation efforts in agriculture are especially directed toward the fertilizer industry and pesticide production. Conservation measures are receiving a great deal of emphasis throughout the United States. Present and anticipated rises in energy costs, concerns over dependability of supply, international marketing competition, and other factors, are causing residential, commercial, industrial, and agricultural energy users to design more energy efficient operations and installations. The wise use of energy is the basis of conservation and is likely to be an important part of our thinking for many years to come.

4. *Limitations on Conservation*

It is important to emphasize that conservation is influenced by technological and economic factors. Many of our energy conversion processes operate at far less than 100% efficiency. One unit of coal burned in the plant does not produce one equivalent unit of electricity. Some energy can be saved through the use of a cleaner raw material, a more efficient combustion process, or improved transmission of the electricity. However, present technologies have their efficiency limitations.

Economic factors also influence conservation. An economist's view of waste will consider whether the value of a conserved resource will exceed the full cost of its conservation. The economist may not regard it as wasteful to fail to extract all of the oil and gas that could be extracted from a reservoir by the most advanced technological process. If the return on the production does not pay for the added cost of extraction, the economist denies that waste has occurred. A legislator or regulator, however, may disagree. The same applies to residential energy efficiency. The layperson may regard it as wasteful to allow any heat to escape a home. Conservation would be promoted by insulating, caulking, and weather stripping every dwelling to the maximum degree. However, in many situations the cost of the process may not pay off for the homeowner.

Conservation measures must also consider the rational and irrational preferences of human beings. A mandatory 55 miles per hour speed limit, if enforced, saves gasoline and reduces highway fatalities. However, it will also slow the delivery of goods, persuade some families to fly rather than drive on vacation, and frustrate citizens who regard putting the pedal to the metal as part of the pursuit of happiness.

C. Fuel Cells

Fuel cells, which convert liquid fuel into electricity through a chemical reaction rather than combustion, have been around for more than 100 years.

But until recently, fuel cells were so expensive that they were practical only for specialized use on space missions. Due to technological and scientific improvements, however, fuel cells now appear to be a serious option for widespread use.

Fuel cells are electrochemical devices that generate DC electricity similar to batteries. However, unlike batteries, they take their energy from a fuel that is supplied from the outside. While hydrogen appears to be the best fuel for many types of fuel cells, a variety of other fuels–methanol, ethanol, natural gas, and liquefied petroleum gas–can also be used. Biomass, wind and solar energy can also supply the energy needed, thus promoting energy diversity and a transition to renewable energy sources. There are several types of fuel cell, each differing in its operating characteristics, temperatures, power densities and, therefore, in the most suitable end uses.

In principle, a fuel cell operates like a battery. Unlike a battery, a fuel cell does not run down or require recharging. It will produce energy in the form of electricity and heat as long as fuel is supplied. A fuel cell consists of two electrodes sandwiched around an electrolyte. Oxygen passes over one electrode and hydrogen passes over the other, generating electricity, water and heat. Hydrogen fuel is fed into the anode of the fuel cell. Oxygen (or air) enters the fuel cell through the cathode. Encouraged by a catalyst, the hydrogen atom splits into a proton and an electron, which take different paths to the cathode. The proton passes through the electrolyte. The electrons create a separate current that can be utilized before they return to the cathode, to be reunited with the hydrogen and oxygen in a molecule of water. A fuel cell system that includes a "fuel reformer" can utilize the hydrogen from any hydrocarbon fuel, including natural gas, methanol, and even gasoline.

Fuel cell automobiles are at an earlier stage of development than battery-powered cars, but could be an attractive alternative. They offer the advantages of battery-powered vehicles but can also be refueled quickly and could go longer between refueling. Since the fuel cell relies on chemistry, not combustion, emissions from this type of system would be much smaller than emissions from the cleanest fuel combustion processes, thereby decreasing the release of "greenhouse" gases.

Proton exchange membrane fuel cells (PEMFC) operate at relatively low temperatures (about 200°F), have high power density, can vary their output quickly to meet shifts in power demand, and are suited for applications, such as automobiles, where quick startup is required. Direct methanol fuel cells (DMFC) are similar to the PEM cells in that they both use a polymer membrane as the electrolyte. However, in the DMFC, the anode catalyst itself draws the hydrogen from the liquid methanol, eliminating the need for a fuel reformer. Efficiencies of about 40% are expected with this type of fuel cell, which would typically operate at a temperature between 120-190°F. Higher efficiencies are achieved at higher temperatures.

The phosphoric acid fuel cell (PAFC) is the most commercially developed type of fuel cell. It is already being used in such diverse applications as hospitals, nursing homes, hotels, office buildings, schools, utility power plants, and airport terminals. PAFCs generate electricity at more than 40% efficiency, and nearly 85% if steam produced by the fuel cell is used for cogeneration. This compares to 30% for the most efficient internal combustion engine. Operating temperatures are in the range of 400°F. These cells can also be used in larger vehicles, such as buses and trains.

Another type of fuel cell is the molten carbonate (MCFC), which is able to consume coal-based fuels. MCFC promises high fuel-to-electricity efficiencies. This cell operates at about 1200°F. Also promising is the solid oxide fuel cell (SOFC), which uses a hard ceramic material instead of a liquid electrolyte, allowing temperatures to reach 1800°F. Power generating efficiencies could reach 60% and it is anticipated that the SOFC could be used in big, high-power applications, including industrial and large-scale central electricity generating stations. Long used by NASA, alkaline fuel cells (AFC) can achieve power generating efficiencies of up to 70%. They use alkaline potassium hydroxide as the electrolyte. Until recently, however, they were too costly for commercial applications.

In spite of advances in fuel cell technology, fuel cells are still too expensive for everyday use. The cost for automobiles, which would probably be the biggest users of a cost-effective fuel cell, is roughly 100 times more per horsepower than an internal combustion engine. Running houses on fuel cells is also substantially more expensive than relying on power from conventional utility plants. A big part of the expense is that fuel cells are hand-assembled, mostly by scientists, because there is still no mass market. Components, as well, are expensive. However, fuel cells are beginning to look like a serious contender to conventional power generation technologies and research and development is widespread in the private sector as well as the government.

D. Synthetic Fuels

"Synthetic fuel" is a term covering a number of alternative energy sources. It is commonly referred to as synfuel. The Energy Security Act of 1980 defines synthetic fuel to mean "[a]ny solid, liquid, or gas, or combination thereof, which can be used, as a substitute for petroleum or natural gas (or any derivatives thereof, including chemical feedstocks) and which is produced by chemical or physical transformation (other than washing, cooking, or desulfurizing) of domestic sources of coal, including lignite and peat; shale; tar sands . . .; and water, as a source of hydrogen only through electrolysis." Tar sands include heavy oil resources where the cost, technical, and economic risks make extraction and processing uneconomical without federal financial assistance.

Coal gasification is the most advanced synthetic fuels technology. In this process coal is heated together with steam in a "gasifier." The gasifier causes some of the hydrogen in the steam to join with the carbon in the coal to form methane, the primary ingredient of natural gas. As the carbon to hydrogen ratio in the coal is reduced, by addition of hydrogen and/or removal of carbon, various types of gases and liquids of different properties and heating values are produced. These include low, medium, and high BTU fuel gases and heavy and light liquid fuels.

Coal gasification has certain environmental and distribution advantages, as it removes harmful sulfur, other particulates, and heavy metals to produce a clean burning gas. In addition, there already exists a network of natural gas pipelines to transport the gas to end-users; and coal is widely distributed throughout the United States. However, there are also a number of environmental concerns associated with synfuel production. Sulfur emissions are a primary concern. The disposal of wet ash produced by the coal gasification process is an additional problem. Water consumption and pollution are also major concerns, particularly in the western United States where water is often a scarce resource. Air and water pollution and water consumption are of even greater concern with the production of synfuel from oil shale or tar sands, making these technologies even less attractive.

III. ALTERNATIVE ENERGY MARKETS

The alternative energy sources addressed in this chapter vary but share a common attribute—they are not widely available presently to energy markets. There are several reasons for their lack of general availability. First, there are significant technological impediments to the full development of particular alternatives. Second, many alternatives are not financially feasible because traditional energy sources continue to be less expensive. Thus, alternative energy markets tend to be small-scale with the energy being produced and used locally. Examples are photovoltaic cells used onsite for electricity, windmills constructed on farms and ranches, and conservation efforts undertaken in a particular facility. There are, however, more and more alternative energy markets producing energy on a larger-scale, such as large wind farms in California. Following is a summary of the current state of supply, demand, and cost of the various alternative energy sources as well as the future prospects for each.

A. Renewables

1. *Solar Energy*

All life on earth is supported by the sun, which produces an amazing amount of energy. On any given day the solar radiation varies continuously from sunup to sundown and depends on cloud cover, sun position, and content and turbidity of the atmosphere. The atmosphere is a powerful absorber and reduces the solar power reaching the earth at certain wavelengths. Only a very small percentage of the sun's energy strikes the earth but, even so, it is still more than enough to provide all our needs.

The solar energy market is currently the world's second fastest growing energy source. Since 1990, the average growth rate has been 16% per year. Solar markets are even expanding at ten times the rate of the oil industry. Sales of solar cells alone have increased more than 40% in 1997.[4] Solar energy has the advantage of being plentiful, non-polluting, and reliable. However, there are also disadvantages such as the current high cost, space needed, and legal restraints.

In this country and in Europe, environmental concerns offer a paramount reason for pursuing solar options. The Kyoto Protocol calls for the U.S. and the European Community to reduce emission of greenhouse gases.[5] Switching from fossil fuels to readily available and renewable energy sources such as solar would help accomplish this. Today, powering the typical American household produces 23,380 pounds of greenhouse gases.[6] Placing a million U.S. homes on solar energy would eliminate 5 million tons of carbon dioxide per year.[7]

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[4] *See Solar Power Markets Boom*, WORLDWATCH INSTITUTE PRESS BRIEFING, July 16, 1998.

[5] *See* U.N. REPORT OF THE CONFERENCE OF THE PARTIES ON ITS THIRD SESSION, HELD AT KYOTO FROM 1 TO 11 DECEMBER 1997—ADDENDUM—PART TWO: ACTION TAKEN BY THE CONFERENCE OF THE PARTIES AT ITS THIRD SESSION, Article 3, Clause 3; Annex B (1998).

[6] *See* James Udall, *Global Climate Change Mitigation Can Start at Home*, SOLAR TODAY, November/December 1998) (visited Feb. 3, 1999) <http://<www. sustainablebusiness.com/insider/jan--/1-climate.cfm>.

[7] Dep't of Energy, *Vice President Gore Announces $2,000 Solar Tax Credit* (visited Feb. 3, 1999).

On June 27, 1997, Secretary of Energy Federico F. Peña outlined a "Million Solar Roofs Initiative."[8] This initiative calls for the Department of Energy to spearhead an attempt to install one million solar energy systems on the roofs of buildings and homes across the U.S. by the year 2010. Federal and state programs, local communities, businesses and utilities will all be employed in an effort to increase the use of such systems. The federal government alone owns more than 500,000 rooftops and, for its part, can rely on Executive Order 12902 (1994), which urged the purchase of solar systems for federal buildings. The initiative will also involve federal grant programs in the Environmental Protection Agency and Departments of Commerce, Defense, and Energy. Participation will also include eight federal lending programs overseen by the Small Business Administration, the Department of Agriculture, and the Department of Housing and Urban Development.

There are numerous examples of solar energy projects across the country. Sun Power Electric of Boston, MA (a non-profit organization), in December, 1998, dedicated 60 of the 156 PV panels that will comprise a 50 kW system. The energy generated is sold to consumers who wish to switch their electricity usage from fossil fuels to renewables.[9] In 1995, the EPA installed a solar thermal system to meet the hot water needs of its twelve-story headquarters in Washington, D.C. The system saves 33,000 kWh and $3,000 per year, along with 22,000 pounds of greenhouse gases.[10] CIA Headquarters in Langley, Virginia uses a solar water heating system, passive solar heating, and photovoltaic cells.[11]

Although the cost of energy produced by photovoltaic systems continues to drop, kilowatt-hour for kilowatt-hour, the cost of PV energy is still generally higher than energy bought from a local utility company. Also, the initial cost of PV equipment is higher than an engine generator. Yet, there are many applications where a PV system is the most cost-effective long-

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[8] *See* Dep't of Energy, *Peña Outlines Plan to Send Solar Sales Through the Roof* (June 27, 1997) (visited Feb. 3, 1999) <http://www.eren.doe.gov/millionroofs/press.html>.

[9] *See* Dep't of Energy, *Power Starts to Flow at First Solar Electric Plant Built for Deregulated Market Announces Sun Power Electric* (Dec. 10, 1998) (visited Feb. 3, 1999) <http://www/eren/gov/greenpower/sol_ma_1298_pr.html>.

[10] *See* Dep't of Energy, *EPA Helps Protect the Environment by Using Solar Hot Water* (visited Feb. 3, 1999) <http://www.eren.doe.gov/femp/newsevents/femp_focus/apr96_epa.html>.

[11] *See* National Renewable Energy Laboratories, *CIA Headquarters Complex: A Renewable Energy Assessment* (visited Feb. 3, 1999) <http://www.nrel.gov./femp/cia_ headquarters.html>.

term option. This is particularly true if the application is in a remote location where accessing an electrical grid is infeasible or expensive. In that case, there are many cost advantages to a PV system. A well-designed system will operate unattended for more than 20 years and requires minimum maintenance since there are no moving parts. Other advantages include the fact that it is modular (allowing easy expandability); there is no cost to supply and store conventional fuels since solar energy is delivered free; and PV systems do not create pollution or waste products.

PV systems have proven a reliable source of power in an ever-growing number of applications. Lighting is one common use for these systems. Cost-effective applications of lighting powered by PVs include small garden lights, street lights, lighting for recreational areas, highway signs, warning signs and signals, and businesses and homes both in the developed and developing world. PVs are ideal and commonly used for water pumping because water can be pumped into a storage tank during daylight hours, then distributed by gravity whenever it is needed. PV systems commonly pump water for remote livestock watering tanks, and in the developing world, entire village water supplies are powered by PVs.

An interesting low-tech version of the dish-type solar thermal system is currently operating in Gujarat, India. Two shallow dishes roughly 15 feet in diameter beam light into a simple structure where the energy is used to heat water and cook for over 250 persons each day.[12] Another, somewhat modified low-tech version is underway at San Juan Pueblo, New Mexico. The pueblo uses a solar oven which has reflecting panels arranged in a bowl-like pattern so as to focus sunlight on the oven itself.[13] San Juan Pueblo also has an interesting example of a solar building. A village co-operative is drying, packaging, and selling fruits and vegetables grown on the pueblo. The drying process includes a 1,200 square-foot greenhouse to which a black floor was added, resulting in internal temperatures that reach 120-140°F. If solar cooking can be successfully propagated throughout the poorest parts of the Third World, the practice could have a significant effect on deforestation, which is a serious problem where wood is used for cooking.

On a larger scale, Solar Two, the "power tower" solar thermal power plant in Southern California, was inaugurated in June 1996 and is scheduled to produce power through 1999. During this time, Solar Two will undergo continuous testing and evaluation. By testing Solar Two in a power production setting, engineers can increase confidence in the reliability and

[12] *See* <http://www.accessone.com/~sbcn/images/gujarat1.jpg>.

[13] *See Past and Future Meet in San Juan Pueblo Solar Project* (visited Feb. 12, 1999) <http://www.accessone,com/~sbcn/sanjuan1.html>.

cost of future commercial power towers. Using the experience of Solar Two, U.S. industry can position itself to take advantage of what DOE and the International Energy Agency predict will become a multibillion dollar market for power towers during the next 10 to 20 years.

It appears likely that solar power will become a more and more significant player on the global energy scene in years to come. Deregulation of electricity generation in the U.S. will allow environmentally concerned customers of utility companies the option of paying a modest surcharge for "green" energy of the sort delivered by Sun Power. Disenchantment with nuclear power may grow rather than diminish, leaving solar as an important path to pursue. Technological advances will continue and bring solar ever closer to competitive equality with fossil fuels, for both small and large-scale production and application.

2. *Wind Energy*

Worldwide, wind energy has become the fastest growing energy source, with global installed generating capacity estimated to have grown by 35% during 1998. The world wind industry added 2100 Mw to reach a total of 9600 Mw at year's end, an amount of capacity that is sufficient to generate approximately 21 billion kilowatt-hours of electricity, or enough power for 3.5 million suburban U.S. homes.[14] The most significant growth has occurred in Europe, an example of which is the north German state of Schleswig-Holstein where wind power provides 10% of the region's electricity. In the United States, wind capacity grew by more than 230 Mw in 1998, with major new wind plants built in Minnesota, Oregon, Wyoming and Iowa.

The state of California is the largest producer of wind energy with 16,000 wind turbines and a total generating capacity approaching 1700 Mw. These privately owned wind farms generate more than 3 billion kWh of electricity per year, enough to meet the residential requirements of a city of about 1 million.[15] This combined capacity is equivalent to a medium sized nuclear plant. The incredible amount of wind energy produced in California pales in comparison to the huge untapped potential found on the Great Plains between North Dakota and Texas, and running east from Colorado to Iowa. The states of North Dakota, South Dakota and Texas alone have sufficient wind resources to provide electricity for the entire nation.

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[14] *See* American Wind Energy Association <http://www.econet.org/awea>.

[15] Gerald R. Nix, National Renewable Energy Laboratory, *Wind Energy as a Significant Source of Electricity*, prepared for the 18th World Energy Engineering Conference, Atlanta, Georgia (November 8-10, 1995) <http://www.nrel.gov/wind/database.html>.

Despite the fact that the U.S. leads the world in wind power potential with the Great Plains alone able to provide one-fifth of its current power needs, several countries throughout the world are far ahead in the development of the resource. There are many reasons for the United States' slow response to developing this resource, the most prominent of which is that, at this time, wind energy is not cost-competitive with electricity produced by coal or natural gas.

Even though the cost of wind power has decreased dramatically in the past 10 years, the technology requires a higher initial investment than fossil-fueled generators. Roughly 80% of the cost is the machinery, with the balance being the site preparation and installation. If wind generating systems are compared with fossil-fuel systems on a "life-cycle" cost basis, however, wind costs are much more competitive with other generating technologies because there is no fuel to purchase. Technological development in design and manufacture of parts is also decreasing mechanical failure rates and, therefore, maintenance costs.

Technology innovations are also being adapted for remote and stand-alone power applications with smaller wind turbines. Hybrid power systems are being developed for non-grid connected generation applications. These village power systems typically use a combination of wind energy, solar, PV cell, battery storage, and conventional diesel generators to supply power for remote, small village communities. In areas without electric utility service and with good wind resources, a single wind turbine can provide electricity at lower costs than diesel generation. Larger "mini-grid" village power systems incorporating multiple wind turbines and other generation sources are often more economical than transmission line extension for communities in remote, but windy regions. Smaller wind turbines are also being explored for application on utility grids to supply power during periods of peak demand, avoiding costly upgrades in distribution equipment.

New, utility-scale, wind projects are being built all around the U.S. today with energy costs ranging from 3.9 cents per kilowatt-hour (at the very windy sites in Texas) to 5 cents or more in the Pacific Northwest. In most areas, 5 cents per kilowatt-hour is not cost-competitive with coal or natural gas produced electricity for the bulk electricity market. However, prices are expected to drop even further over the next 10 years. As a result, wind is expected to be one of the least expensive forms of new electric generation in the next century.

The wind energy industry has grown steadily over the last 10 years and American companies are now competing aggressively in energy markets across the nation and around the world. The industry, in partnership with the U.S. Department of Energy, continues to expand and develop a full range of highly reliable, efficient wind turbines. These new-generation turbines, when installed, perform at 98% reliability in the field, representing remarkable progress since the technology was first introduced in the early 1980s. Up to 5% of the new generating plant capacity in the next decade, an immense amount of electricity in practical terms, could be fueled by wind. Wind power now produces less than 1% of the nation's electricity. The Department of Energy forecasts a 600% increase in wind energy use in the nation in the next 15 years. By the middle of the next century, the wind could be producing 10% of U.S. electricity—as much as hydroelectric dams do today.[16]

3. *Geothermal Energy*

Geothermal energy, used primarily in the western U.S., is not expected to contribute much to the national energy supply. Geothermal electricity generation fell to about 14.7 million kWh in 1995 from 17.1 million the prior year. Even though total geothermal electricity generation has been decreasing, there are facilities that continue to produce steady amounts of electricity. Additionally, over the period of 1994 through 1997, over 53,000 geothermal heat pumps were manufactured and shipped worldwide. The U.S. Army's Fort Polk military base in Leesville, Louisiana has the largest installation of geothermal heat pumps in the world. A significant event in the U.S. geothermal industry was the startup, in 1996, of a new 40 Mw power plant in California, Salton Sea Unit IV. The U.S. Department of Energy continues to sponsor research aimed at developing the science and technology necessary for tapping the geothermal energy resource to the greatest extent possible.

Priority is given to projects that address the most challenging hurdles to future commercial development of geothermal energy, namely, cost barriers and environmental concerns. Principle research and development thrusts are aimed at reducing development costs, increasing efficiency of production, cutting maintenance expenses, reducing air and water emissions, producing useful by-products, and reducing water loss. In addition, since the most intense heat and steam is found below the surface

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[16] *See* U.S. Dep't of Energy Wind Energy Program (visited June 22, 1999) <http://www.eren.doe.gov/wind.html>.

of the earth, practical solutions are being sought to the challenges associated with drilling through many kinds of materials to tap these heat sources.[17]

4. *Biomass Energy*

The earth's abundant plant life is nature's storehouse of solar energy. Biomass is the largest of the non-hydroelectric renewable energy sectors, with wood being the largest part of biomass energy. While there are many uses for biomass besides fuel, available biomass, in terms of its energy content, is estimated at a total annual production of 2,740 Quads. This level of energy production is approximately eight times the total annual world consumption of energy from all sources (about 340 Quads). At present, the world uses only about 7% of the annual production of biomass.

Biomass energy consumption in the U.S. increased by 3.1% from 1994 to 1995, somewhat more than the 2.6% annual growth rate seen from 1991 to 1994. Excluding hydropower, biomass accounted for 87% of the remaining renewable energy consumption in the U.S. in 1995. Wood pellets, manufactured from finely ground wood fiber, represent a fast-growing biomass fuel market. In the residential and commercial sectors, an increase in residential wood use for heating resulted in a 10% increase in renewable energy consumption in 1995, while pellet production increased by 18%. Fuel ethanol production, however, dropped because of short corn supplies and high prices.

Production of energy from municipal solid waste (MSW) supplies, which grew rapidly during the 1980s as a result of public policy that promoted construction of waste-to-energy (WTE) facilities, has been curtailed during the 1990s. Current environmental policies encourage recycling and require costly pollution control at WTE facilities. The WTE industry is also feeling the competitive pressures of deregulation. Electricity prices are dropping, and waste streams are going to the cheapest disposal option, which in many cases is landfills. The use of landfills as a waste disposal option is likely to increase in the near term; however, it is unlikely that many landfills will begin converting waste to energy because of the unfavorable economics.[18]

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[17] *See* U.S. Dep't of Energy Geothermal Technologies Program (visited June 22, 1999) <http://www.eren.doe.gov/geothermal/program.html>. *See also* Sandia National Labs Geothermal Technology (visited June 22, 1999) <http://www.sandia.gov/Renewable_Energy/geothermal/geo.html>. *See also* U.S. Dep't of Energy Renewable Energy 1998: Issues and Trends Executive Summary (visited June 22, 1999) <http://www.eia.doe.gov/cneat/solar.rnewables/rea_issues/rea/rea_issues_sum.html>.

[18] *See* U.S. Dep't of Energy Renewable Energy Annual 1996 (visited June 23, 1999) <www.eia.doe.gov/cneaf/solar.renewables/renewable.energy.annual/hilites.html>.

5. *Ocean Thermal Energy*

The oceans cover 70% of the earth's surface, making them the world's largest solar energy collector and energy storage system. On an average day, 60 million square kilometers (23 million square miles) of tropical seas absorb an amount of solar radiation equal in heat content to about 250 billion barrels of oil. If less than one-tenth of one percent of this stored solar energy could be converted into electric power, it would supply more than 20 times the total amount of electricity consumed in the United States on any given day.

The economics of energy production today have delayed the financing of a permanent, continuously operating OTEC plant. However, OTEC is very promising as an alternative energy resource for tropical island communities that rely heavily on imported fuel. OTEC plants in these markets could provide islanders with much needed power, as well as desalinated water and a variety of mariculture products.

The most likely markets in which a land-based OTEC plant, coupled with a second-stage desalinated water production system, may be competitive include the small island nations in the South Pacific, Hawaii, Guam and American Samoa. An additional potential market for floating plants, that house a factory or transmit electricity to shore via a submarine power cable, include Puerto Rico, the Gulf of Mexico, and the Pacific, Atlantic, and Indian Oceans. However, OTEC's greatest potential is to supply a significant fraction of the fuel the world needs by using large, grazing plantships to produce hydrogen, ammonia, and methanol.[19]

B. Conservation

The single largest conservation program in the U.S. is a result of the National Energy Conservation Policy Act, as amended by the Energy Policy Act of 1992. As a requirement of the Act, each federal agency is to achieve a 10% reduction in Btu consumption per gross square foot by 1995, a 20% reduction by 2000, and a 35% reduction by 2010. The Federal Government is the largest energy consumer in the U.S., providing energy to approximately 500,000 buildings, comprising over 3 billion square feet of floor area and consuming 1.7% of the total energy used in the U.S. in 1996. In addition to direct energy usage in these buildings, the Government consumes energy

[19] *See* National Renewable Energy Laboratory Ocean Thermal Energy Conservation (visited June 22, 1999) <http://www.nrel.gov/otec>.

in vehicles and equipment, including aircraft and naval fuels and automotive gasoline.

As a result of the Federal Energy Management Program, the Government's total net energy consumption in 1996 decreased 23.4% from base year 1985. This total decrease was attributed to a decrease of 24% in buildings and facilities energy usage and a 27.7% decrease in consumption of vehicle and equipment fuels. In 1996, the Government's energy bill was $7.7 billion, representing approximately 0.5% of total Federal expenditures for the year. In real dollars, the Government spent $6.9 billion less than in 1985 with an accumulated savings of almost $44.3 billion.[20] As part of the Federal Energy Management Program, the Government also participates in new technology demonstration projects. These demonstrations, located at various Federal host sites, include cooperative research and development agreements, through which public and private collaborators share the costs and results of the projects.

Secondarily contributing to conservation in the electric power industry was the advent of utility demand-side management (DSM) programs. Electric utility DSM refers to programs implemented by utilities to modify customer load profiles. The Public Utility Regulatory Policies Act of 1978 (PURPA) helped to focus attention on the benefits of "increased conservation of electric energy" and "load management techniques." Responding to the large potential to increase efficiency of energy use, state regulators supported, and utilities implemented, a variety of DSM programs, including programs to reduce energy use, both during peak and off-peak periods. Many of these DSM programs are viewed as energy resources because they capture cost-effective energy savings that would not otherwise be achieved. However, when utility companies lose potential sales as a result of using energy more efficiently, revenues and profits go down, creating an obvious dilemma for the industry. To counteract these effects on the utilities, state commissions had to institute various financial incentive programs. The potential for restructuring in the electric power industry, however, could further affect the utilities' interest in energy savings.[21]

Despite these advances in energy conservation, energy efficiency has not sold well in the marketplace. In 1995, the Energy Information Administration of the U.S. Department of Energy collected information on specific

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[20] *See* Federal Energy Management Program Overview (visited June 22, 1999) <http://www.eren.doe.gov/femp/aboutfemp/fempoverview.html>

[21] *See* U.S. Electric Utility Demand-Side Management: Trends and Analysis (visited June 22, 1999) <http://www.eia.doe.gov/cneaf/pubs_html/feat_dsm/contents.html>.

conservation features or practices for commercial buildings.[22] They found that, while most commercial buildings have some type of building shell conservation (insulation), lighting and HVAC (heating, ventilation, and air-conditioning) features are, in general, less common. Both HVAC and lighting system conservation features are more often installed in larger than average commercial buildings, where the cost benefits are greater. In addition, information was collected on the use and sponsorship of renewable energy sources or features (besides wood). Those features were: passive solar, photovotaic arrays that convert sunlight directly to energy, geothermal or ground source heat pumps, wind generation, and well water used for cooling. Of those, passive solar was the only type that was found in a sufficient number of buildings to even report data.

Before undertaking research and development of new energy-efficient technologies and design tools, a better understanding needs to be gained of the motivation and forces that lead designers and building owners to adopt energy-efficient measures. Buildings are not built to be energy efficient; they are built or retrofitted to meet the housing or business needs of the occupants and owners. Furthermore, energy is consumed not by buildings, but by the users of buildings, the millions of individuals who turn up thermostats, turn on lights and appliances, and manipulate the environmental conditions of the spaces they occupy. By focusing on individual buildings, sight is lost of opportunities for energy efficiency at community-wide levels. The economies of scale can be lost when individuals must learn about and purchase energy conservation products. Thus, research and development must look at human factors and community systems to address the societal opportunities and barriers to implementing energy efficiency. Social scientists, urban planners, and architects must work closely with community residents, real estate professionals, public health officials, and building developers.

C. Fuel Cells

Fuel cells have been known since the 1800s but only recently have technological and scientific improvements made them an option for widespread introduction. Fuel cells are beginning to look like a real contender to conventional power generation technologies and an interesting possibility in the automotive sector. Major energy companies and most vehicle manufacturers have some form of fuel cell development program.

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[22] *See* Commercial Buildings Characteristics 1995—Energy Conservation Features (visited June 22, 1999) <http://www.eia.doe.gov/emeu/cbecs/char95/conserve.html>.

In the very short term the first applications of fuel cells are in niche markets. Mobile power sources, such as replacements for bulky battery packs are tempting for the military, where cost is not as much of an issue. The Department of Energy is involved in research in molten carbonate and solid oxide fuel cells for stationary power and has invested in demonstration fuel cell power plants that provide heat and power at selected military bases around the country. The first such plant was installed at Vandenberg Air Force Base in California. The efficiency of power output from fuel cells also makes them attractive for IT companies, where power surges have to be protected for data security and equipment preservation.

The Department of Energy further recognized the potential of fuel cells for transportation applications and began development of a phosphoric acid fuel cell (PAFC) powered bus in 1987. By 1990, the proton-exchange membrane (PEM) fuel cell had demonstrated sufficient progress in performance, and thus a light-duty fuel cell vehicle program was launched in partnership with General Motors. Methanol was selected as the fuel because of its availability, simplicity of storage, rapid refueling, high energy density, and ability to be easily reformed. In 1994, DOE initiated programs with industry leaders to develop direct hydrogen-fueled PEM fuel cell propulsion systems. In 1995, a program was initiated to develop a flexible-fuel processor capable of reforming gasoline and other common transportation fuels.

Throughout this short history, DOE has actively supported research on critical fuel cell components and materials to address technical barriers to commercialization for vehicle application. In order for fuel cell propulsion systems to reach their potential, significant technical challenges must be met, including: size and weight reduction, rapid start-up and transient response capability, fuel processing development, manufacturing cost reduction, complete fuel cell system integration, and durability and reliability. Non-technical barriers to fuel cell vehicle commercialization include capital investment for large-scale fuel cell vehicle production, an alternative fuel infrastructure, consumer awareness, industry standards for mass production and servicing, and the lack of safety regulations.[23]

In 1998, for the first time, a fuel cell began supplying all the power to a suburban house in Latham, New York, another sign that the innovation is on the verge of breakthrough as an alternative to traditional energy sources.[24] The device looked more like a home air-conditioning unit than the

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[23] *See* Office of Transportation Technologies Fuel Cell Program (visited June 22, 1999) <http://www.ott.doe.gov/oaat/fuelcell.html>.

[24] *See* Matthew L. Wald, *Fuel Cell Will Supply All Power to a Test House*, N.Y. TIMES, June 17, 1998, at A28.

small chemical plant that it was. Officials at the Department of Energy, which helped to pay for the test in Latham, say they have high hopes that within a few years thousands of homes will be drawing electric power from fuel cells, cutting pollution and fuel consumption.

Other recent developments in fuel cells include the first commercial sale of a fuel cell for remote power (to the New Jersey Department of Transportation, for a traffic warning sign) and the first street-ready car powered by a fuel cell (built by students at Humboldt State University in California). A scientist at Los Alamos National Laboratory in New Mexico is also experimenting with a tiny cell that converts methanol into enough current to run a laptop computer or a cellular telephone. What has made experts even more optimistic is the progress scientists are making in refinement of the fuel cell's super-thin membranes, which are crucial in facilitating the basic chemical reaction and look like plastic wrap or aluminum foil. W.L. Gore & Company has taken its signature product, Gore-Tex, and put it into the membranes of fuel cells, including the one in Latham, in a way than many researchers say has great promise.[25]

But for all the breakthroughs, fuel cells are too expensive for everyday use. The cost for cars is approximately 100 times more per horsepower than an internal combustion engine. In 1998, Chrysler, for example, estimated that each car-sized fuel cell stack it bought cost $170,000. Plug Power predicts that it can commercialize fuel cells for houses by 2000, at a cost of $3,000 to $5,000 each. Although prototype costs are astronomical, the production of thousands more units will lower costs. Detroit Edison, a part-owner of Plug Power, plans to purchase 30,000 to 50,000 units. A New Jersey company, H-Power, also hopes for mass sales. In 1998, it made what it described as the first unsubsidized, fully commercial sale of a fuel cell, for a trailer-mounted highway sign, the kind than commonly warns of construction ahead. The company plans to supply sixty-five of them for $759,000.[26]

The concern for the commercial future of fuel cells is not whether they can be made to work, but whether they can be made to work cheaply enough.

D. Synfuels

The Energy Security Act of 1980 established the United States Synfuels Corporation to stimulate the commercialization of synthetic oil and gas. The stimulation was to be accomplished through a federal subsidy to

[25] *Id.*
[26] *Id.*

private efforts to extract liquids and gas from among other things, coal, oil shale, and tar sands. The original goals of the Synfuels Corporation were to subsidize production of 500,000 barrels a day of synfuels by 1987 and 2 million barrels by 1992. These goals were never met. Funding was slashed over the following years and, on December 12, 1985, the Synfuels Corporation was defunded and abolished. The reasons for the short-lived history of the Synfuels Corporation and the Government's well-intentioned effort to assist in the development of a synthetic fuels industry are complex and wide-ranging. Suffice it to say, the environmental concerns were enormous and the economic viability unlikely. Despite these drawbacks, however, there continues to be limited research into new and improved synfuel technologies, particularly in the area of coal liquefaction and gas-to-liquid technology.

IV. LEGAL

A. Property Rights in Alternative Energy Sources

Whenever a new energy technology is developed, it is introduced into a society that has already defined legal rights in property. At first, the new technology may find existing law not suited to its development. Later, the new technology may influence changes in the law to accommodate its distinctive features. For example, the requirements of oil and gas extraction gave rise to the distinctive body of oil and gas law. Solar energy and geothermal energy raise unique problems concerning property rights. Without clear property rights in alternative sources, such as sunlight and wind, development of new technologies and markets will be hindered.

1. *Access to Sunlight*

Basic solar energy requires direct access to sunlight. Property rights to assure access to the sun are not well developed in the United States. The doctrine of "ancient lights" adopted in England establishes a landowner's right to continued air and sun if the access had been present for twenty years. The use creates a negative easement and gives the landowner the right to prevent others from using their property to block the sun. The doctrine of ancient lights has not been adopted in the U.S.

Americans have invoked nuisance laws to define rights to and protect interests in access to sunlight. In *Fontainbleau Hotel Corp. v. Forty-Five Twenty-Five*, the Fountainbleau Hotel brought suit against a neighboring hotel for building an extension that blocked the sun from the Fountainbleau's pool and sunbathing areas.[27] The court rejected Fountainbleau's assertion of a legal right to the free flow of light and air from adjoining land, noting that "it is universally held that where a structure serves a useful and beneficial purpose, it does not give rise to a cause of action . . . even though it causes injury to another by cutting off the light and air."[28] *Fountainbleau* states the prevailing position in American law. Common law property doctrines do not recognize either an immediate or a prescriptive (acquired after the passage of a specified time) right to forbid a neighbor from a use on his property that blocks your access to sunlight. The American cases that adopted this position and rejected the contrary English doctrine of ancient lights predate the energy crisis of the 1970s, and the recognition of solar energy as a significant energy technology.

Fountainbleau recognizes two ways of obtaining solar access rights. First, landowners can agree to a solar easement that protects the solar user. One of the most common state statutes promoting solar energy recognizes the legitimacy of a solar easement and in some cases specifies the requirements for the easement. The easement can be made a matter of public record and its terms will bind parties that subsequently acquire the covered properties. Second, local zoning ordinances can recognize limits on a landowner's ability to screen the sun from a neighbor's property.[29]

The development of solar energy systems has encouraged judicial rethinking on the subject of solar property rights. *Prah v. Marreti* uses private nuisance theory to give rights to the user of solar energy.[30] In *Prah*, the plaintiff brought suit against his neighbor for building a house which blocked the sunlight from the solar panels which plaintiff had installed on his roof. He invoked a theory of private nuisance law. The Wisconsin Supreme Court held that the reasonable use doctrine of private nuisance law was applicable, and found in the plaintiff's favor because "it will promote the reasonable use and enjoyment of land in a manner suitable to the 1980s."[31]

Comparison of *Fontainbleau Hotel Corp. v. Forty Five Twenty Five, Inc.* with *Prah v. Maretti* reveals that nuisance law might evolve to protect a landowner's reasonable use of the sun from unreasonable interference by

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[27] 114 So.2d 357 (Fla. Dist. Ct. App. 1959).

[28] *Id.* at 539.

[29] The City of Rio Rancho, New Mexico designated, by municipal ordinance, a residential area as a "solar village." The city requires setbacks and height restrictions to protect solar access. It also specifies construction and design requirements for all buildings to take advantage of solar access for domestic energy generation.

[30] 321 N.W.2d 182 (Wis. 1982).

[31] *Id.* at 191.

another's use of their property. However, reliance on this doctrine means rights are not secure until a court has intervened and balanced the interests of the respective property owners against a reasonableness standard.

Other experiments in assigning rights include actions such as those taken in New Mexico, which statutorily adopted the concept of prior appropriation of solar access as an allocative tool for sunlight in the New Mexico Solar Rights Act.[32] The doctrine of "prior appropriation" means that the first user of the resource has the use of the resource to the exclusion of others. A user initiates his right to sunlight by actual use of the sun before being blocked, or, in some instances, even after being blocked. This type of statute eliminates the "reasonableness debate" of nuisance law, but introduces a notice problem unless the act requires recordation and notice of alleged appropriations.

2. *Access to Wind*

Uncertainty over right to access to wind is likely to plague development of wind energy. For example, Texas law currently provides no protection for wind rights. Clusters of high technology wind farms are sprouting on the windy hills of West Texas. "Wind rights" are being bought and sold under contract for as much as $2400 per windmill.[33] As these contracts become more common, and prices wind rights continue to rise, Texas lawyers predict litigation over neighbors' blocking the wind.[34]

3. *Geothermal Resources*

Property rights in geothermal resources could be confused if a property has been severed into mineral and surface estates. Geothermal resources consist of heated rocks (a "dry" system) or heated liquids (a "wet" system). The liquids at least nominally resemble water. Water is generally deemed part of the surface estate.

Geothermal resources, however, have been considered part of the mineral estate because they are recovered and used in a manner similar to other energy sources that are characterized as mineral. *United States v. Union Oil* dealt with whether the United States reserved geothermal resources under a reservation of all minerals required by the Stock-Raising

[32] N.M. Stat. Ann. § 47-3-1 (1978).

[33] Susan Warren, *Where the Wind Blows, Landowners Find Profits*, WALL ST. J. (Texas Journal), October 30, 1996, at T1.

[34] *Id.*

Homestead Act.[35] As a matter of statutory interpretation, the desire of Congress to control energy sources influenced the court in deciding the resources were reserved to the United States. *Geothermal Kinetics v. Union Oil* involved a private dispute and reached the same result.[36]

B. Regulation to Move the Country From Traditional to Alternative Sources of Energy

Direct government regulation to stimulate use of alternative sources of energy dates from the energy crisis of the 1970s. The combination of a constrained supply of oil and skyrocketing prices forced the U.S. to recognize its reliance on foreign oil. This recognition and its implications for national security resulted in a spate of new laws encouraging conservation and development of alternative sources of energy. The crisis subsequently abated with the lifting of price controls and discovery of new petroleum supplies. Oil prices dropped and the stimulus for alternative energy abated somewhat. The 1991 Iraqi invasion of Kuwait and the Gulf War provided fresh stimulus for government to intervene and encourage the transition to alternatives. Once again, new federal policies and spending programs resulted. This crisis subsequently abated as well.

The federal government's stimulus for action in the alternative energy arena has been rising prices and constrained quantity of conventional sources. When a market pinch has occurred, the government has stepped up its stimulus, but this urge recedes when the market for traditional sources stabilizes and their prices drop. A stable, low-cost market for traditional energy presents a substantial barrier to development of new alternatives. The barriers imposed by the pre-existing legal system can also be a significant hurdle for use of unconventional energy sources. Over the last twenty-five years, federal, state, and local governments have attempted to adjust both the market and the legal system to support the development of alternative energy.

1. *Efforts to Remove Unintended Consequences of Pre-Existing Laws*

When new technologies and laws to promote the use of alternative sources have run into pre-existing regulatory schemes that stymie development, conflicts have usually been worked out on a case-by-case basis.

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[35] 549 F.2d 1271 (9th Cir. 1977).

[36] 141 CAL. RPTR. 879 (Cal. Ct. App. 1977).

a. *Land Use Regulations*

Local zoning measures were not prepared to deal with the interest in solar energy for domestic use spurred by the 1970s energy crisis and the resulting development of new technology. In one case from that time, *Katz v. Bodkin*, a homeowner who wanted to install a solar panel on his roof ran afoul of municipal land use ordinances limiting rooftop structures.[37] The Supreme Court of New York found that the Town Zoning Board of Appeals' refusal to approve a building permit for the homeowner was arbitrary, capricious, and contrary to both national and state policies concerning encouragement of alternative energy sources. The court chided the town by noting that "it is incumbent upon the zoning agency to adopt an attitude other than an ostrich head-in-the-sand approach, especially when adoption to changing scientific advances follows and complies with national and state interest in energy conservation."[38]

As alternative energy sources become better known, they can develop a legislative constituency that is able to promote their development through the regulatory process. Occasionally, laws will exempt alternative energy sources from the normal regulatory process. An example is an ordinance amendment to exclude solar equipment from the prohibition of rooftop structures. Several states have enacted such legislation for the development of solar energy.

b. *Other Laws*

New alternative energy laws themselves have at times resulted in unintended consequences for development of these resources.

For example, a waste-to-energy plant may seem an ideal way to kill two birds with one stone, but such plants have run into unexpected statutory hurdles. Chicago operates the Northwest "Waste-to-Energy" plant, which is a municipal incinerator that burns solid waste, recovers energy, and in the process creates MWC (municipal waste combustion) ash. The plant burns about 350,000 tons of waste per year, producing energy that is subsequently used by the facility and sold to other energy users. The incineration generates about 140,000 tons of MWC ash per year. The city then disposes of the ash—in landfills licensed to accept only non-hazardous waste. In 1988, the Environmental Defense Fund (EDF) sued the city to stop this practice.

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[37] 1 SOLAR L. RPTR. 495 (N.Y. Sup. Ct. 1979).
[38] *Id.* at 501.

EDF argued that the MWC ash was sufficiently toxic to be regulated as a hazardous waster under Subtitle C of the Resource Conservation and Recovery Act.[39] Subtitle C requirements are more stringent than those for non-hazardous waste. The Supreme Court agreed that the ash should be regulated as a hazardous waste under Subtitle C, even though the parent waste (household and non-hazardous industrial/commercial waste) was not itself hazardous under EPA's definitions. The issue boiled down to the interpretation of Section 300(i) of RCRA,[40] which attempted to clarify an earlier definition of the household waste exclusion. A majority of the Court, in an opinion authored by Justice Scalia, concluded that the statute, on its face, did not intend the generation of hazardous waste to be included in the household waste exclusion.[41] Justices Stevens and O'Connor dissented, noting that the Report of the Senate Committee that recommended the enactment of the amendment clearly stated the purpose was "to clarify the coverage of the household waste exclusion with respect to resource recovery facilities recovering energy through the mass burning of municipal solid waste."[42] The majority, however, interpreted the amendment to mean that, while the facility itself was exempt, the ash generated by the incineration and energy generation process, was not. Therefore, the ash, due to its toxic character, must be disposed of at a landfill licensed to accept hazardous waste.

The dissent comments that, while this may make good environmental policy sense, it will also fly in the face of national goals to encourage recovery of energy from municipal wastes, a major concern motivating RCRA's enactment. "Whether these purposes will be disserved by regulating municipal incinerators under Subtitle C and, if so, whether environmental benefits may nevertheless justify the costs of such additional regulation are questions of policy that we are not competent to resolve."[43]

2. *Incentives*

When alternative sources of energy are more expensive than traditional ones, they generally will not be consumed for their energy value in a competitive market. This resistance can be overcome if the alternatives possess other desirable characteristics that are highly valued by consumers, or consumers are given a valuable incentive to consume them despite their

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[39] City of Chicago v. Environmental Defense Fund, 511 U.S. 328 (1994).
[40] 42 U.S.C. § 6921(i) (1994).
[41] 511 U.S. 328, 337 (1994).
[42] 511 U.S. 328, 343 (1994) (Stevens, J., dissenting).
[43] *Id.* at 348.

higher price. The federal and state governments have been active over the last twenty-five years in devising incentives to promote alternative energy sources.

a. *Monetary Incentives*

Government has provided monetary incentives through direct dollar payments and the tax system to promote the research, development and use of alternative energy resources. Direct monetary incentives include subsidies and grants for research of alternative energy technology or for purchase of alternative energy. Less directly, a tax credit or deduction for research or purchase of alternative energy, will influence the economics of energy choices and spur development of alternatives. Monetary incentives skew the market for alternative energy, and that is the purpose of the incentive. An incentive seeks to increase the use of the technology subject to the incentive. If use can be increased to the level where the technology can be mass produced, then the price of the technology will fall. The two objectives of government incentives in the alternative energy area have been to create a demand for it and to accelerate the development of cost-competitive technology for mass-production of alternative energy.

i. *Grants or Leases of Government Property*

Since the beginning of this country, government has regularly granted or leased its property at less-than-market prices to encourage certain behavior. We have previously examined the opening of the public lands for traditional energy development. The government has adopted this approach to support alternative energy development, too. For example, many attractive geothermal and synthetic fuel deposits are located on federally owned land or on land in which the federal government has reserved a mineral interest. Development of geothermal resources on federal land is governed by the Geothermal Steam Act of 1970.[44] The statute is similar to other federal energy resource leasing schemes in its invitation to the private sector to develop geothermal resources. However, the Act has been a general disappointment, and has not stimulated geothermal production on federal lands due to acreage limitations and competitive bidding requirements.

Other national resources are being devoted to the development of alternative energy. Today, with the end of the Cold War, the National Laboratories of the United States are being redirected from weapons research to research technologies for alternative energy resources. They

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[44] 30 U.S.C. §§ 1001-27 (1994).

have also been empowered to partner with private entities to develop these technologies.[45] The latter effort has led to the development of cost-sharing plans between the labs and private industry to conduct research under Cooperative Research and Development Agreements, called the CRADA program.

The National Renewable Energy Laboratory (NREL) in Golden, Colorado, devotes its research and development efforts to solar power, wind power, biomass, and geothermal power.[46] Included within NREL are the Solar Radiation Research Laboratory and the National Wind Technology Center. Sandia National Laboratory's Renewable Energy Technologies Division focuses on developing commercially viable technologies based on solar, wind and geothermal resources.[47] Several of the other national laboratories have alternative energy research programs. These include Brookhaven National Laboratory's efforts on energy efficiency, alternative fuels such as methanol, and geothermal;[48] the Pacific Northwest National Laboratory's research on co-generation, energy efficiency, and energy conservation for buildings;[49] and Lawrence Berkeley Laboratory's[50] and Los Alamos National Laboratory's[51] research on fuel cells and batteries.

ii. Tax Credits and Deductions

Tax incentives purposely skew the market for alternative energy sources by trying to bring their costs in line with traditional fossil energy

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[45] For a comprehensive review of all national laboratory activities, *see,* Dep't of Energy *The United States Department of Energy Laboratories and Facilities* (visited June 24, 1999) <http://www.doe.gov/people/peopnl.htm>.

[46] *See* Dep't of Energy, *NREL at a Glance* (visited June 24, 1999) <http://www.nrel.gov/lab/overview/body.html>.

[47] *See* Sandia National Laboratories, *Renewable Energy Technologies* (visited June 24, 1999) <http://www.sandia.gov/Renewable_Energy/renewable.html>.

[48] *See* Brookhaven National Laboratory, *Department of Applied Science, Energy Science and Technology Division* (visited June 24, 1999) <http://www.das.bnl.gov/est.html>.

[49] *See* Pacific Northwest National Laboratory, *Thermal Energy Storage (TES) Technologies for Utility-Scale and Industrial Applications* (visited June 24, 1999) <http://www.pnl.gov/energy/tes_ext.html>.

[50] *See* Lawrence Berkeley National Laboratory, *Advanced Energy Technology Department* (visited June 24, 1999) <http://eetd.lbl.gov/EAT.html>; and *Building Technologies Department* (visited June 24, 1999) <http://eetd.lbl.gov/EAP/buildings.html>.

[51] *See Los Alamos National Laboratory, Fuel Cell User Facility,* (visited June 23, 1999) <http://ext.lanl.gov/orgs/citpo/DTIN/open/UsrFac/userfac56.html>.

sources, in order to encourage alternative energy development and increased use. Governments have used several different tax credit programs to stimulate alternative energy.

For example, the Department of Energy initiated the "Million Solar Roofs Program" in 1997. The goal of this program is to install a million solar energy rooftop systems by 2010 by partnering with private businesses and local governments.[52] The program includes a 15%, up to $2000, solar tax credit as well as funds to support 25 partnerships with utilities, builders, local governments, and financial institutions.[53]

iii. Tax Penalties

Tax penalties on energy consumption can encourage conservation. Though many industrialized western nations utilize tax penalties, they are not in favor in the United States. President Clinton proposed a modest Btu tax in 1993 that was soundly defeated before it even got to a vote in Congress.[54] However, a 4.3 cent per gallon gasoline tax was passed.[55] The Clinton administration has not pursued tax penalties since its first year, preferring to put its efforts elsewhere to encourage alternatives.

iv. Government Spending Programs

Government spending programs include funding for public and private sector research, development and demonstration projects for alternative energy. The Department of Energy's Office of Energy Efficiency and Renewable Energy enters into private sector partnerships for development and implementation of a variety of alternative energy technologies. Many of the spending programs have been authorized by statute, prompted by the energy crisis of the 1970s. The Solar Energy Research, Development and Demonstration Act of 1974 provided funds for the study of the feasibility of development

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[52] *See* Dep't of Energy, *Secretary Announces Million Roofs Milestones* (visited June 26, 1999) <http://www.eren.doe.gov/millionroofs/earthday.html>.

[53] For more information on the Million Solar Roofs Initiative, *see* Federal Energy Management Program, *Federal Participation in Million Solar Roofs* (visited June 25, 1999) <http://www.eren.doe.gov/femp/millionroofs/ms-ovw.html>; and *Frequently Asked Questions* (visited June 25, 1999) <http://www.eren.doe.gov/millionroofs/faq.html>.

[54] *See* Alan S. Miller, *Energy Policy from Nixon to Clinton: From Grand Provider to Market Facilitator*, 25 ENVTL. L. 715 (1995).

[55] *See* Richard Williamson, *The Clinton Administration's New Energy Policies*, 2 TULSA J. COMP. & INT'L L. 115 (1994).

of solar energy.[56] The Solar Photovoltaic Energy Research, Development, and Demonstration Act was passed in 1978 to stimulate a market for solar energy through promotion of small power production, favoring tax depreciations and research and development funding.[57] The Resource Conservation and Recovery Act (RCRA) of 1976 authorized funding for the study of the potential of waste to energy conversion.[58] The Geothermal Energy Research, Development, and Demonstration Act of 1974 provided funding to assist exploration of geothermal reservoirs.[59] The Geothermal Energy Act of 1980 tried to overcome barriers to development of geothermal energy on federal lands through a program to provide loans and insurance.[60] The Wind Energy Systems Act of 1980 provides for a research and development program as well as technology application and transfer.[61] The years of the energy crisis were capped with the passage of the comprehensive Energy Security Act of 1980.[62] This legislation encouraged the development of renewables through loans, loan guarantees, purchase agreements, and price guarantees. It included a number of smaller pieces of legislation, including the Biomass Energy and Alcohol Fuels Act,[63] the Renewable Energy Resources Act,[64] the Solar Energy and Energy Conservation Act,[65] and the Geothermal Energy Act.[66]

The overall trend in federal funding for such programs over the last two decades has been downward from its high of $1.3 billion in FY 1979 (influenced by the 1970s' energy crisis).[67] With the subsequent rise in oil supplies and decrease in prices, the priority for and funding of renewables declined throughout the 1980s, reaching a low of $132 million in 1990. Interest in renewables rebounded somewhat after the Gulf War and passage of the bipartisan Energy Policy Act in 1992 during the Bush administration, followed by a strengthened commitment to alternative energy development by the Clinton administration. Funding for renewable energy research and

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[56] 42 U.S.C. §§ 5551-66 (1994).

[57] 42 U.S.C. §§ 5581-94 (1994).

[58] 42 U.S.C. § 6985 (1994).

[59] 30 U.S.C. §§ 1101-02, 1121-26, 1141-47, 1161-64 (1994).

[60] 30 U.S.C. §§ 1501, 1511-16, 1521-22, 1531, 1541-42 (1994).

[61] 42 U.S.C. §§ 9201-13 (1994).

[62] Pub. L. No. 96-294, 94 Stat. 611 (codified as amended in scattered sections of titles 7, 15, 30, 42 & 50 U.S.C.).

[63] Pub. L. No. 96-294, 94 Stat. 683 (codified as amended in scattered sections of Titles 15 and 42 U.S.C.).

[64] 42 U.S.C. §§ 7371-75 (1994).

[65] 42 U.S.C. §§ 8285-82866 (1994).

[66] 30 U.S.C. §§ 150, 1511-16, 1521-22, 1531, 1541-42 (1994).

[67] *See* Solstice, *Renewable Energy: A New National Outlook?* (visited June 24, 1996) <http://solstice.crest.org/renewables/crs/re/crs2.html>.

development in FY 1996 was $340 million.[68] Although DOE budget proposals have consistently requested increased spending levels for their research and development programs, Congress has continued the downsizing trend, and even (unsuccessfully) proposed closing the National Renewable Energy Laboratory in 1996. Congress authorized $251 million for the solar and renewable energy program in FY 1997 and $268 million in FY 1998.[69] However, related efforts in market stimulation are carried under various accounts, such as the Climate Change Technology Initiative, which is funded separately as part of the Research Fund for America. While the actual total of federal funds spent on fostering conservation and the use of renewable energy is therefore greater than it would first appear, it is unlikely to approach the peak levels of funding of the late 1970s unless oil prices skyrocket again.

Included in the Department of Energy's budget are a wide variety of programs to encourage use of alternative energy. The National Energy Conservation and Production Act of 1976 created the Weatherization Assistance Program (WAP) administered by the Department of Energy.[70] The WAP still provides grants to states which distribute these and other funds to local organizations to perform energy audits and install conservation measures in homes of qualified low-income residents, especially the elderly.[71] Conservation measures include insulation, caulking and weatherstripping, and increasing heating and cooling efficiency. The Department of Energy reports that over 5 million homes have been weatherized under this program using federal and leveraged funds, with an average energy savings of 18% and a favorable cost-benefit ratio of 1.6.[72]

Title XII of the Energy Policy Act of 1992 establishes additional spending programs for renewable energy.[73] Included is the Renewable Energy Advancement Award program.[74] This program recognizes developments in

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[68] *Id.*

[69] *See* Office of Management and Budget, *Appendix, Budget of the United States Government, Fiscal Year 2000, Energy Programs* (visited June 25, 1999) <http://frwebgate.cgi?WAISdocID=3785128791+1+0+0&WAISaction=retriev>.

[70] *See* Dep't of Energy, *History of the Weatherization Assistance Program* (visited June 25, 1999) <http://www.eren.doe.gov/buildings/weatherization_assistance/history.html>.

[71] *See* Dep't of Energy, *DOE Weatherization Assistance Program* (visited June 25, 1999) <http://www.eren.doe.gov/consumerinfo/refbriefs/la3.html>.

[72] *See* Dep't of Energy, *Weatherization Assistance Program Fact Sheet* (visited June 25, 1999) <http://www.eren.doe.gov/buildings/weatherization_assistance/fact-sheet.html>.

[73] 42 U.S.C. §§ 13311-13317 (1994).

[74] 42 U.S.C. § 13313 (1994).

practical applications of biomass, geothermal, hydroelectric, photovoltaic, solar thermal, ocean themal, and wind technologies with cash awards. The Act also calls for development of a comprehensive database and information dissemination system,[75] study of tax incentives,[76] and a comprehensive technology transfer program that encourages development of foreign and domestic markets for United States renewable energy technology and provides financial assistance to United States firms in support of market development.[77]

As mentioned previously, President Clinton established the Million Solar Roofs Initiative in 1997 to further stimulate the market for solar energy technology by providing tax credits to encourage the installation of solar rooftops systems on buildings. The Initiative also provides technical assistance grants and commits the federal government to install solar systems on 20,000 federal buildings by 2010, through the Federal Energy Management Program.[78] The Department of Energy awarded $5 million in grants under this program in 1998.[79] In April 1999, Energy Secretary Bill Richardson announced the award of $600,000 in grants to 18 partnerships.[80] That money will be leveraged with private funds to support the installation of a minimum of 500 solar systems per partnership. The total number of partnerships to date is 36, bringing the total number of solar roof systems committed to 900,000.[81]

Fuel cells are also a focus of the Department of Energy. The Department is helping to fund a demonstration project in Latham, New York, where a refrigerator-sized fuel cell is supplying all the power to a suburban home.[82] However, the private sector is in the forefront of development of fuel cells for vehicles, with DaimlerChrysler and a Toyota-General Motors partnership both pursuing marketing within five years.[83]

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[75] 42 U.S.C. § 13315 (1994).

[76] 42 U.S.C. § 13314 (1994).

[77] 42 U.S.C. § 13316 (1994).

[78] *See*, Dep't of Energy, *Million Solar Roofs: Frequently Asked Questions* (visited June 25, 1999) <http://www.eren.doe.gov/millionroofs/faq.html>.

[79] *See* Dep't of Energy, *Press Release: Sunny Day for Million Solar Roofs* (visited June 22, 1999) <http://www.doe.gov/html/doe/whatsnew/pressrel/pr98052.html>.

[80] *See* Dep't of Energy, *Press Release: Secretary Announces Million Roofs Milestones* (visited June 26, 1999) <http://www.eren.doe.gov/millionroofs/earthday.html>.

[81] *Id.*

[82] *See* Matthew L. Wald, *Fuel Cell Will Supply All Power to a Test House*, N.Y. TIMES, June 17, 1998, at A28.

[83] *See* Jeffrey Ball, *To Define Future Car, GM, Toyota Say Bigger is Better*, WALL ST. J., April 20, 1999, at B4.

The Wind Energy Systems Act of 1980 established a research and development program to increase the use of wind energy systems as a source of electricity.[84] The Act calls for federal assistance in research, development, and technology application. Although funding for wind systems research and development within the Department of Energy has fallen short of requested amounts, the budget for FY 97 was $29 million, and for FY 98 was $33 million. This money was primarily used to support wind turbine efficiency research.[85]

The Energy Security Act of 1980 established the Synfuels Corporation to encourage development of synthetic oil and gas.[86] Federal subsidies in the form of loans, price guarantees, purchase agreements and joint ventures were provided. The Corporation's initial budget was $24 billion, but was eventually slashed to $8 billion. Because synfuels are economically non-competitive with conventional oil and gas, there was little pressure to develop synfuels, and the Synfuels Corporation was eventually abolished. States have funded research and development of alternative energy sources as well. With the advent of electricity deregulation and rate re-structuring, numerous states have taken the opportunity to enact "wire charges." Such charges are a tax on consumption of electricity that, balanced against the expected decrease in costs with greater competition, are not expected to raise electricity prices, but will provide additional moneys to be used to fund research and development of renewable energy sources.

b. Market Creation

Government has also "created a market" for alternative energy by requiring itself and public utilities to consume energy specifically from alternative sources. The Public Utility Regulatory Policies Act of 1978 (PURPA) required utilities to purchase power generated by "qualifying facilities (QFs)," primarily small, independent generators of power that used alternative sources of energy, such as solar, wind and biomass.[87] The objective of PURPA was to stimulate a market for alternative sources of energy. It did so, although it has had some unanticipated consequences. PURPA required utilities to purchase the electricity generated by qualifying facilities at their "avoided cost," that is, the cost that the utilities would have had to pay to

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[84] 42 U.S.C. § 9204 (1994).

[85] *See* American Wind Energy Association, *How Much Funding is Provided for Federal Wind Energy Research and Development*? (visited June 26, 1999) <http://www.awea.org/faq/fedrfnd.html>.

[86] 42 U.S.C. § 8702 (1994).

[87] 16 U.S.C. § 796(17) (1994).

generate the electricity themselves. Some utilities entered into long-term contracts with QFs at those anticipated avoided cost levels. With the subsequent plunge in oil and gas prices, these contracts became expensive ones for the utilities and their customers. These utilities fear the trend of deregulation of electricity generation will leave them in a non-competitive position in comparison with start-up companies that do not carry such contracts.[88] California, a leader in the deregulation movement, has allowed utilities to impose a "competition transition charge" to help pay down the stranded costs associated with these contracts over a number of years.[89]

The Energy Policy Act of 1992 requires the federal government to purchase alternative fueled vehicles as part of their fleet.[90] President Clinton noted in 1998 that the federal fleet included 180 electric vehicles and hoped to increase that to 500 by 1999.[91] The Act also requires federal agencies to increase energy efficiency in federal buildings.[92] Increasing efficiency at the federal government's 500,000 plus buildings nationwide is seen as a significant contribution to national energy savings.

Executive Order 13123, signed by President Clinton on June 3, 1999 further establishes the federal government's role in energy conservation and use of alternative energy sources.[93] Executive Order 13123 superseded Executive Order 12902, which encouraged the use of solar systems for federal buildings. Executive Order 13123 requires each agency to reduce its greenhouse gas emissions by 30% by 2010 and to reduce energy consumption by 30% by 2005 and 35% by 2010. It also encourages each agency to use renewable energy sources and to participate in the Million Solar Roofs Initiative by installing 2000 solar energy systems at federal facilities by 2000 and 20,000 solar energy systems by 2010. Even the National Christmas Tree is being powered by solar energy.[94]

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[88] *See* Jeff Bailey, *'PURPA' Power: Carter-Era Law Keeps Price of Electricity Up in Spite of a Surplus*, WALL ST. J., May 17, 1995, at A1.

[89] *See* Benjamin A. Holden, *Electricity Savings to be Short-Circuited*, WALL ST. J., September 24, 1997, at A2.

[90] 42 U.S.C. §§ 13211-19 (1994).

[91] *See* Dep't of Energy, *Press Release: Feds Get Charged Up Over Electric Vehicles* (visited June 22, 1996) <http://www.doe.gov/html/doe/whatsnew/pressrel/pr98068.html>.

[92] 42 U.S.C. §§ 8253-62 (1994).

[93] 64 Fed. Reg. 30,851 (1999).

[94] *See* Dep't of Energy, *Press Release: Oh Christmas Tree, Oh Christmas Tree, How Solar Are Your Branches*? (visited June 22, 1999) <http://www.doe.gov/html/doe/whatsnew/pressrel/pr97136.html>.

Individual agencies have energy management plans tailored to their needs. The Department of the Interior has an Energy Management Program policy that includes six goals: 1) use energy-efficient and cost-effective technology to reduce energy costs, eliminate waste, and conserve energy resources; 2) design and acquire buildings, facilities, and transportation systems with energy efficiency in mind, especially using renewable energy sources; 3) encourage vehicle efficiency and decrease the consumption of petroleum; 4) use capital investment and improved operations to increase energy efficiency; 5) partner with other government and non-governmental organizations to furnish technical aid and to allot costs on initiatives in order to conserve energy; and 6) encourage achievements in promoting energy conservation, advancing Federal and Departmental energy policy, and saving money.

3. State Regulation of Public Utilities and Electric Generators

Some state utility regulators have required their electric utilities to engage in integrated resource management and, through this process, to bring on-line electric generators fueled by alternative sources, similar to federal requirements under PURPA. States have also used incentive regulation to encourage their public utilities to engage in demand-side management. There are two categories of demand-side management: conservation measures and load-shifting measures. Conservation measures are techniques used to reduce total demand for electricity over all periods of consumption. Load management measures are techniques used to shift demand from daily or seasonal peak periods to other times (total demand is spread out over a longer period of time, but not decreased overall). By decreasing peak demand for electricity, fewer generators need be built to supply peaking power. This power instead can be supplied by cheaper, more efficient baseload generation. At least half the states have some type of conservation incentive program in place.[95]

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[95] A study by the National Association of Regulatory Utility Commissioners reports that 37 states allow their utilities to recover conservation costs in rates in one form or another, 11 states allow their utilities to recover revenues due to decreased sales caused by conservation, and 26 states have additional shareholder incentives in place to encourage their utilities to actively seek conservation among their customers. *See* Michael W. Reid, Julia B. Brown & Jack C. Deem, INCENTIVES FOR DEMAND-SIDE MANAGEMENT (2d ed. 1993), reprinted in 14 NATIONAL REGULATORY RESEARCH INSTITUTE QUARTERLY BULLETIN 349 (1993). (Executive Summary only).

Some states are deregulating electricity generation, and have enacted renewables portfolio requirements for electric generators wishing to do business in the state. This typically takes the form of specifying that a minimum percentage of power sold in the state be generated from renewable sources. Maine's minimum is 30%; Connecticut's is 6%; Nevada's is .2% in 2000 and increasing annually by .2% until it reaches 1%.

V. PUBLIC POLICY CONSIDERATIONS AND NOTES

A. Market Economics

In the United States today, market economics primarily dictates the success of alternative energy. When oil prices skyrocketed during the energy crisis of the 1970s, and rose again when supply was threatened during the Gulf War, the price of alternative energy was more competitive. Today, with the price of oil less than the price for designer water,[96] the immediate future for alternatives does not look as rosy.

However, one oil company executive noted the importance of other factors in addition to price in his prediction that the world was entering "the last days of the age of oil."[97] Arco's chief executive predicted that the next 15 years would see a substantial shift away from oil to cleaner and greener alternative fuels, due to problems and perceptions of environmental pollution. Only time will tell.

1. *Electricity Deregulation: Preferences and Willingness to Pay*

Deregulation and initiation of retail competition in electricity has the potential to hurt or help the development of alternative energy. Many small, independent generators, which were fostered by the requirements of PURPA, are anticipating that price competition will put them out of business.[98] As utilities are freed from PURPA's requirements to purchase electricity from qualifying facilities which use alternative energy sources, the higher prices of the alternatives may spell doom for many of the independent generators. However, some states are adding requirements for

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[96] *See* Michelle Krebs, *Planting the Seeds for a Crop of Lean, Green Machines*, N.Y. TIMES, March 15, 1998, at 12-1.

[97] *See Arco Chief Warns of Shift from Oil to Other Energy*, WALL ST. J., February 10, 1999.

[98] *See* Ross Kerber, *Independent Electric Producers Losing Power Struggle*, WALL ST. J., August 7, 1996, at B4.

specified percentages of fuel to be derived from alternative sources, (i.e., portfolio requirements). In addition, people's preferences and willingness to pay for cleaner energy sources is a critical factor in determining the market competitiveness of alternative energy. There is emerging evidence that people are willing to pay more for "green" electricity.[99] One researcher estimates that 11 million California households may be willing to pay $5.50 more per month for electricity generated from a mix of conventional and alternative, renewable fuels. Sacramento utilities have found that about 600 customers each year are willing to pay $4.00 more per month for rooftop solar panels. In addition, a pricing experiment in Massachusetts found that 1,457 households out of 4,745 would be willing to pay 16% more for energy that offered environmental benefits. People in Traverse City, Michigan pay 20% more in order to get their electricity from a clean source of energy.[100] These preferences signal people's willingness to internalize the cost of negative externalities associated with energy use. This may be a permanent change sweeping the country, or it could be more mercurial—a willingness to spend money in such a way only during healthy economic times.

In any event, some energy companies have climbed aboard what they perceive as a "green" bandwagon, and are actively pursuing customers with "green marketing" strategies, advertising their electricity as a product of alternative energy. The Environmental Protection Agency and the Federal Trade Commission are already looking into ways to ensure that customers are getting what they are promised by such offers, by requiring utilities to print with their bills a breakdown of generation sources and resulting air pollutants.[101]

2. *Emission Allowance Trading*

In an effort to reduce air pollution as well as achieve greater economic efficiency, the EPA introduced an emission allowance trading system pursuant to the Clean Air Act Amendments of 1990.[102] The trading system allows units of emissions of particular pollutants to be issued like permits to companies, which can then sell or exchange the units they do not need.[103] If

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[99] *See* Ross Kerber, *Energy: For Sale: Environmentally Correct Electricity*, WALL ST. J., July 23, 1997, at B1.

[100] *See* Keith Schneider, *Utility Customers Put a Premium on Wind Energy*, N.Y. TIMES, July 13, 1996, at A1.

[101] *See* Ross Kerber, *id.*

[102] *See* 42 U.S.C. § 7651b (1994).

[103] *See* USEPA, *The Clean Air Act Amendments of 1990: Summary Materials*, U.S. Gov't Printing Office, Washington, D.C., 1990.

the sale price of a unit is greater than the cost of reducing pollution, then the generator will opt to reduce pollution and sell the extra units of emission allowance at a profit. Assuming that the sale price of emission units is sufficiently high, the trading system offers a tremendous market-based incentive to reduce pollution in an economically efficient manner. This has been an attractive alternative to the conventional command-and-control regulatory approach to lower emissions.

A major controversy associated with such systems is the initial allocation of units to generators, which establishes the total supply of tradable units, and necessarily influences demand for and price of the units. The success of market establishment depends on successful initial allocation. Tension is inevitably set up between established utilities and new companies seeking to reap the rewards of deregulation and increased competition. Under a proposal by existing utilities in Georgia, 100% of the tradable pollution allowances would be distributed among utilities already in operation in the state, thereby cutting out new market entrants.[104] New companies hoping to enter the Georgia power market complain that such an allocation would be anticompetitive and have proposed that some credits be set aside for future companies. The established companies counter that new companies can build new plants more cheaply than they can refurbish their existing equipment to meet pollution standards, and thus the new companies already have a competitive advantage. Such tensions are common in other states' experiences with tradable allowances. Tennessee decided to give new generators 4.3% of the state's total allowances. Other states are awaiting the outcome of a legal challenge to EPA rulemaking on nitrogen-oxide emission standards.

B. The Global Economy and Increases in Alternative Sources of Energy

1. Developing Countries

Developing countries, with their increasing demand for energy, will determine how much of their increased demand will be met by alternative sources rather than conventional fuels. The United States has adopted a policy of encouraging foreign countries to shift to alternative energy. Title XII of the Energy Policy Act of 1992 includes the establishment of a renewable energy export technology training program.[105] The Act also

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[104] *See* Motoko Rich, *Utilities Battle for Georgia Credits on Emissions*, WALL ST. J., May 5, 1999, at S1.

[105] 42 U.S.C. § 13312 (1994).

establishes an interagency working group to coordinate federal activities regarding the export of renewables, a data base on other countries' energy technology needs, a program to encourage the export of renewables to other countries and develop overseas markets for them through financial assistance, and development of opportunities for U.S. firms to compete in foreign markets.

2. *The Kyoto Protocol of 1997*

The Kyoto Protocol has the potential to spur world growth of renewable energy sources and conservation efforts. The Protocol's objective is to reduce worldwide greenhouse gas emissions. Shifting from fossil fuels to alternative sources is seen as a critical step in this direction.

The success of the Kyoto Protocol and its objectives rest with the will of governments to implement its provisions. President Clinton signed the Protocol, but to date, the United States Congress has not ratified it. The scientific basis of the Protocol and need for the specific emission reductions continues to be debated.[106]

The U.S. Department of Energy predicts that if the Kyoto Protocol becomes law, U.S. energy markets will respond by expanding wind and biomass energy production.[107] Internationally, Germany has been the leader in production of wind energy since 1997, when it overtook the U.S. Spain and Denmark also have significant wind energy production capacity, spurred by higher electricity prices and government subsidies. If energy production from biomass increases, it is likely to be in the area of ethanol production for the transportation sector. The Protocol would also likely stimulate increased capacity for solar energy production, but the Department of Energy predicts it would not be significant until 2020.[108] Should the Protocol be ratified by Congress, the persistence with which the U.S. government has supported development of alternative energy will likely translate into greater technological readiness for its implementation.

In response to the Kyoto Protocol, the Clinton Administration's 1998 Comprehensive National Energy Strategy included specific goals of increasing use of renewable energy sources, designing an international greenhouse

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[106] *See* Henry S. Rowen and John P. Weyant, *The Greenhouse Follies*, WALL ST. J., December 2, 1997, at A22; and Dolly Setton, *Some Like it Cold*, FORBES, June 14, 1999, at 152.

[107] *See* Dep't of Energy, *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*, prepared for the U.S. House of Representatives Committee on Science (October 1998).

[108] *Id.*

gas trading and credit system, and pursuing further research and development efforts to expand energy choices.[109] The strategy called for a doubling of nonhydroelectric, renewable energy production capacity in such sources as photovoltaics and solar thermal to 25,000 megawatts by 2010. It also proposed extending the government's previous efforts in stimulating development of alternative energy sources, described throughout this chapter. However, the strategy puts more emphasis on tracking milestones and relying on free markets, competition, and public/private partnerships—a direction seen as imperative to win congressional and public support. ❦

[109] *See* Dep't of Energy, *Press Release: Energy Secretary Peña Announces Comprehensive National Energy Strategy* (visited June 22, 1999) <http://www.doe.gov/html/doe/whatsnew/pressrel/pr98041.html>.