ENERGY AVAILABILITY IN CONNECTICUT

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AND

INVESTIGATIONS

COMMITTEE

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CONNECTICUT GENERAL ASSEMBLY
LEGISLATIVE PROGRAM REVIEW AND INVESTIGATIONS COMMITTEE

The Legislative Program Review and Investigations Committee is a joint, bipartisan, statutory committee of the Connecticut General Assembly. It was established in 1972 to evaluate the efficiency, effectiveness, and statutory compliance of selected state agencies and programs, recommending remedies where needed. In 1975, the General Assembly expanded the committee's function to include investigations, and during the 1977 session added responsibility for "sunset" (automatic program termination) performance reviews. The committee was given authority to raise and report bills in 1985.

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Project Staff

Anne E. McAloon, Principal Analyst

STATE CAPITOL ROOM 506 HARTFORD, CT 06106 (860) 240-0300
Email: pri@po.state.ct.us www.cga.state.ct.us/pri

LEGISLATIVE PROGRAM REVIEW
& INVESTIGATIONS COMMITTEE

Energy Availability in Connecticut

FEBRUARY 2002

Digest
Energy Availability in Connecticut

CONSUMPTION AND EXPENDITURES

FINDINGS

In 1999, 839 trillion Btu of energy was consumed in Connecticut at a cost of $7 billion. This represented 256 million Btu and $2,167 per person.

- Connecticut is in the lower third of states in terms of consumption, but near the median in terms of expenditures.

FACTORS AFFECTING SUPPLY AND DEMAND

FINDINGS

The availability of energy is dependent on a number of disparate elements, many of which are inter-related.

- Factors include economic conditions, energy conservation efforts, regulatory requirements, grid reliability concerns, environmental considerations, the weather, and geographic location.

ENERGY-RELATED ENTITIES

FINDINGS

No single individual or governmental entity has overall responsibility for energy policy in Connecticut.

- More than a dozen state governmental bodies, several federal agencies, and numerous types of private businesses have energy-related roles.

LEGISLATIVE EFFORTS

FINDINGS

On multiple occasions since the 1970s, the legislature has taken steps to describe and implement energy-related goals.

- C.G.S. Sec. 16a-35k, adopted in 1978, spells out a detailed vision for energy in Connecticut. On at least two occasions, state entities have been asked to develop recommendations to implement the policies outlined in that statute.

FUTURE ACTIONS

FINDINGS

One of the best short-term opportunities for the legislature to influence the overall energy situation in the state is through efforts related to energy conservation, including both improved efficiency and curtailment of consumption.

RECOMMENDATIONS

The program review committee recommends C.G.S. Sec. 16a-48 be amended to require a review of the state's energy efficiency standards for appliances at least every four years. As part of that process, new products appropriate for inclusion within the requirements of the statute should be identified.

The program review committee recommends the State of Connecticut endeavor to be a model energy consumer. As such, it should identify and then demonstrate best practices for reducing the quantity of energy consumed and diversifying the mix of fuel sources used in a variety of settings.

ELECTRICITY CONCERNS

FINDINGS

A variety of solutions exist for solving transmission problems. In most cases, successful resolution of the issue requires a mix of approaches.

- The primary options include energy conservation measures, increased use of distributed generation, construction of new power plants, and new or upgraded transmission lines.

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Introduction

Nationally in recent years, Connecticut ranked in the bottom half of all states with respect to the quantity of energy used, but third in terms of the price paid per unit of energy. In terms of total expenditures, in 1999 Connecticut nearly matched the median, with an outlay of $7 billion. State government expenditures for energy for state fiscal year 1999-2000 totaled almost $100 million.

In 2001, the Legislative Program Review and Investigations Committee undertook two reviews of energy-related issues. Early in the year, the committee authorized a study of energy management by state government. Of particular interest was the effectiveness of the state's efforts to manage demand for energy, use alternative and renewable sources of fuel, and procure energy supplies efficiently.

In August, the committee voted to temporarily set aside that management study to look at the broader question of energy supply and demand in Connecticut. About the same time, the legislature's Energy and Technology Committee was preparing to convene a working group to deal with issues related to implementation of the 1998 electric restructuring act. In recognition of that concurrent effort, the program review committee specified it would defer recommendations related to electric restructuring to the energy committee.

The key focus of the program review committee's study of energy availability was on identifying the factors that affect the supply of and demand for energy in Connecticut and examining the opportunities the legislature has to influence those factors. The study also looked at other public and private parties whose actions might affect the quantity and price of the energy available within the state. The role of energy conservation and the existence of alternative fuels also were considered.

In December 2001, program review staff prepared a briefing document containing an overview of energy usage in Connecticut and a detailed discussion of the factors that influence the supply of and demand for energy. A public hearing was held on January 23, 2002, to obtain comments on the identified factors and suggestions for future governmental actions.

In February 2002, the program review committee adopted recommendations that focus on efforts to enhance energy conservation, including actions to curtail consumption as well as increase the use of more efficient equipment. The committee's key recommendation calls for state government to serve as a model energy consumer. Past and present efforts by state agencies to manage energy consumption will be examined further as the committee resumes its original energy study. If warranted, additional recommendations related to this goal may be proposed.

Report Format

The report contains two chapters. The first provides answers to a series of questions regarding the type, amount, and cost of energy in Connecticut. It also identifies the many entities involved with energy and discusses more than a dozen issues expected to affect future

energy supplies and demand. The second chapter describes some of the steps the Connecticut General Assembly has already taken to describe and implement energy-related goals and presents the program review committee's recommendations for future action. Appendices summarize the sources of energy in Connecticut, the key energy-related governmental entities in the state, and the characteristics of distributed generation being retained for self use within the state.

Chapter One

What is energy?

Sometimes people use the term "energy" as shorthand for "electricity." Likewise, because various fuels are used to create electricity, some discussions about fuel availability address the issue solely from the perspective of the requirements for generating electricity.

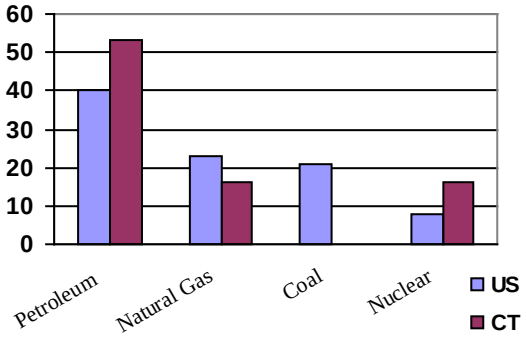
In the Legislative Program Review and Investigations Committee's study, the term "*energy*" is used in its broadest sense to mean the various scientific processes by which heat or power are created and utilized for purposes such as:

- heating;
- cooling;
- lighting;
- operating equipment, including motor vehicles; and
- the generation of electricity.

What are the primary sources of energy?

Sources of energy include coal, petroleum, natural gas, nuclear, diesel, gasoline, and a variety of renewable fuels such as solar, wind, and fuel cells.[1] Primary fuel sources vary in different regions of the country, depending on local resources and access to reliable supplies.

FIG. I-1 Primary Fuel Sources: Percent of Total Consumption, 1999



The most commonly used fuel in the United States is petroleum. In 1999, it was the source of 40 percent of the energy consumed nationwide. The next two most commonly used fuels were natural gas and coal.[2]

In Connecticut, the top three fuel sources that year were petroleum, natural gas, and nuclear electric power. Very little coal is consumed in the state. Figure I-1 compares the

[1] The petroleum category encompasses a number of products including distillate fuel, jet fuel, kerosene, and motor gasoline. References to fossil fuels includes petroleum, natural gas, and coal.

C.G.S. Sec. 16-245n defines "*renewable energy*" as solar, wind, ocean thermal, wave or tidal energy, fuel cells, landfill gas and low emission advanced biomass conversion technologies, and other resources and emerging technologies that do not involve the combustion of coal, petroleum, petroleum products, municipal solid waste, or nuclear fission. In *Energy Efficiency and Renewables Sources: A Primer* (July 1998, p.5), the National Association of State Energy Officials notes a characteristic of renewable energy sources is that their supply is virtually endless.

[2] U.S. Department of Energy, Energy Information Administration (EIA), *State Energy Data Report 1999*, Table 1, Energy Consumption Estimates by Source and End-Use Sector, 1999.

market shares of the top fuel sources in the United States and Connecticut.[3] (Petroleum is the primary source in all of the New England states, but the predominance of other fuels varies widely among the six states.)

Trends. Figure I-2 presents a timeline showing the evolution of fuel sources used within the United States since colonial days. Until the late 1950s, internal production and consumption of energy were nearly always in balance in the U.S. Since then, demand has grown more quickly than domestic production. In 2000, approximately one-quarter of the energy consumed in the U.S. was imported; a small amount of energy -- mostly coal -- was exported. Looking forward to 2020, the U.S. is expected to still be relying heavily on fossil fuels.[4]

FIG. I-2. Major Sources of Energy in the United States, 1650 - 2020.

1650	***Early 1800s***	***1860***	***1880s***	***1950s***	***2000***	***2020 (est.)***
Wood dominant	Coal introduced	Petroleum introduced	Coal most commonly used; natural gas and hydro-electric introduced	Petroleum most commonly used; natural gas exceeds coal; nuclear power introduced	Petroleum still first; natural gas and coal nearly equal	Petroleum first and natural gas second

Sources of data: EIA, *Energy in the United States: 1635-2000* and *Annual Energy Review 2000*.

Since the 1950s renewable energy has been a small, but consistent fuel source in the U.S. providing approximately 6 to 9 percent of the energy consumed nationally. Last year, 7 percent came from renewable fuels. About half of that was from hydroelectric power, one-third from wood, and smaller portions from waste products, geothermal, alcohol, solar, and wind.[5]

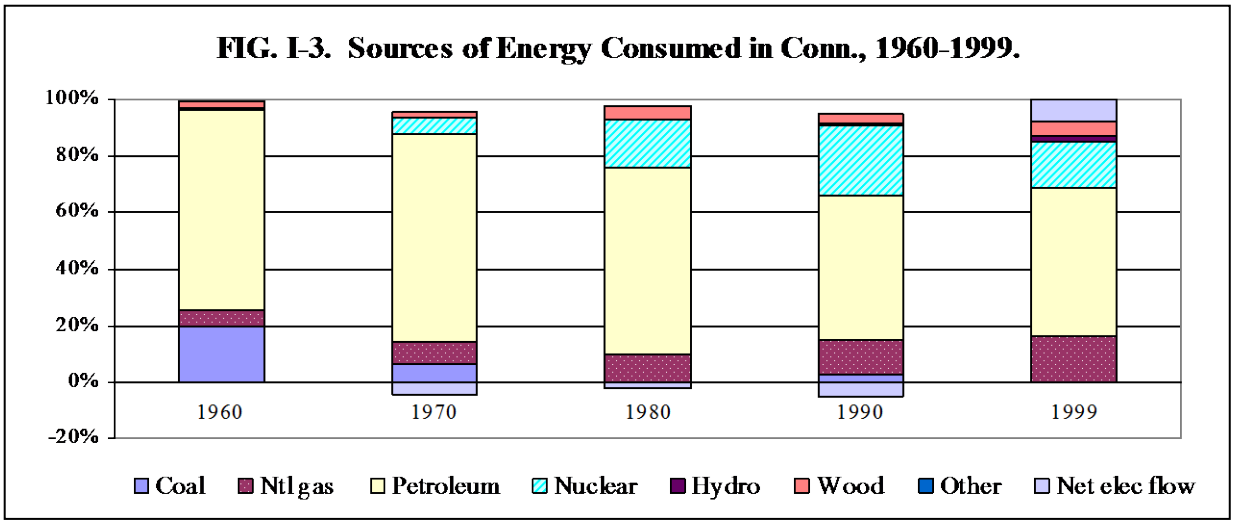
Figure I-3 shows the distribution of fuel sources used in Connecticut at 10-year intervals, beginning in 1960. Petroleum has consistently been the primary source; coal declined and natural gas increased. Renewable energy increased, but remains low. Nuclear power was growing, but plant closures reversed that trend. In addition, Connecticut, which used to export more electric power than it received from sources outside the state, has recently been a net importer of electricity.[6] (See Appendix A for information about the future availability of specific fuel sources.)

[3] EIA, *State Energy Data Report 1999*, Table 1.

[4] EIA, *Energy in the United States: 1635-2000*, Total Energy, pp. 3-4, and *Annual Energy Review 2000*, p. xviii.

[5] EIA, *Annual Energy Review 2000* (August 2001), pp. xxxi, 9, and 260.

[6] EIA, *State Energy Data Report 1999*, Table 53, Energy Consumption Estimates by Source, Selected Years 1960-1999, Connecticut.

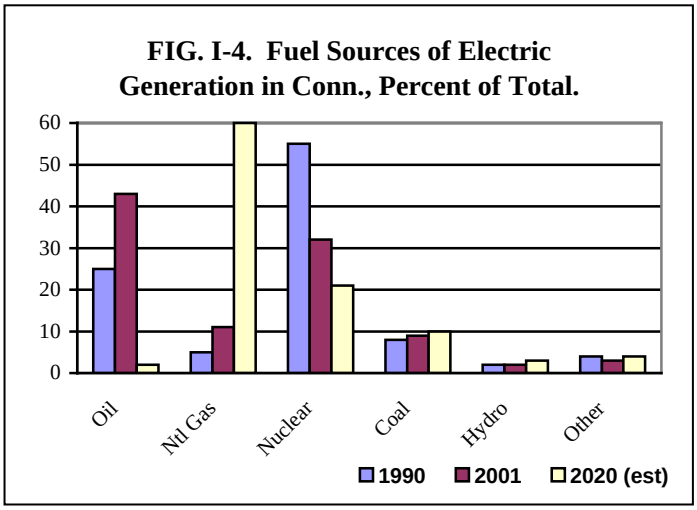


Looking at components of the energy mix in Connecticut, similar changes in fuel sources are evident. In 1990, half of the energy used to generate electricity came from nuclear power, one-quarter from petroleum, and only 5 percent from natural gas.[7] Currently, 43 percent comes from oil-fired plants (which in some cases are backed up by natural gas), one-third comes from nuclear, and 11 percent from natural gas (with oil as the backup).[8]

By 2020, it is projected as much as 60 percent of electric generation in Connecticut may be fueled by natural gas (in some cases backed up by oil) and 21 percent by nuclear. Coal is expected to continue at about 10 percent, similar to its current level, while renewable energy fuels will provide less than that.[9] Figure I-4 displays historic and projected fuel data.

Half of the net generation of electricity in the United States in 1999 came from coal. Other major sources were nuclear (20 percent) and natural gas (15 percent). Petroleum only provided 3 percent.[10]

Within the New England bulk electric power system in 1999, nuclear and petroleum each provided about one-quarter of the fuel consumed to generate electricity. The next two most commonly used sources were natural gas (17 percent) and coal (15 percent).[11]



[7] EIA, *State Electricity Profiles - Connecticut*, Table 5. Electric Power Industry Generation of Electricity by Energy Sources, 1990, 1994, and 1999.

[8] Connecticut Siting Council, *Review of the Connecticut Electric Utilities' Twenty-Year Forecasts of Loads and Resources* (October 2001), pp. 6-10.

[9] Connecticut Siting Council, *Twenty-Year Forecasts*, p. 7.

[10] EIA, *Annual Energy Review 2000*, Table 8.2 Electricity Net Generation, 1949-2000, p. 221.

[11] EIA, *State Electricity Profiles*, Table 5 (for each state).

The fuels used for home heating are also changing. Oil has been the predominant fuel in Connecticut since the 1950s, but its share of the market has declined from a high of 80 percent in 1960 to 54 percent in 1990 and an estimated 50 percent in 1996. Electricity, which increased to a high of 15 percent in 1990, was estimated to be in the 10 percent range in 1996. The fuel source gaining market share has been natural gas. It grew from 7 percent in 1950 to 26 percent in 1990 to approximately one-third of housing units in 1996.[12]

In the U.S. in 1999, half of the occupied housing units used natural gas for heating. One-third used electricity, and 10 percent used oil. Less than 1 percent used coal.[13]

Who uses energy?

Consumers of energy can be grouped into five major categories or energy-use sectors:

- *residential sector* -- living quarters for private households (with uses ranging from space and water heating, air conditioning, lighting, refrigeration, cooking, to running a variety of appliances);
- *commercial sector* -- service-providing facilities and equipment of businesses, all levels of government, other public and private organizations such as religious, social, and fraternal groups, and institutional living quarters (with the same kinds of uses as the residential sector);
- *industrial sector* -- all facilities and equipment used for producing, processing, or assembling goods (with primary use for process heat and cooling/powering machinery and secondary use of facility heating, air conditioning, and lighting);
- *transportation sector* -- all vehicles whose primary purpose is transporting people and/or goods from one physical location to another; and
- *electric power sector* -- all utility and non-utility facilities and equipment used to generate, transmit, and/or distribute electricity.[14]

The first four groups are often referred to as end-users. The fifth group represents energy consumed to generate electricity, as much as two-thirds of which may be lost during the process itself. Consumption data are available for each sector or with the electric power numbers incorporated into the end-user sectors. Using the latter method, Figure I-5 shows the proportion of energy consumed in 1999 by each of the four end-use sectors in several locations.

In Connecticut, the portion used by the industrial sector was considerably lower at 19 percent than for New England in total (28 percent) or the U.S. average (38 percent). Alternatively, the residential sector in Connecticut consumed nearly 30 percent of the total usage, a higher proportion than any other state in the country.[15]

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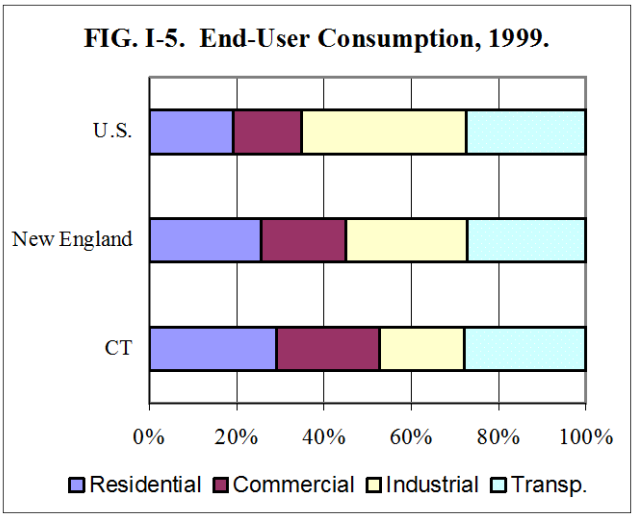
[12] U.S. Census Bureau, Census of Housing, *House Heating Fuel*, and 1996 Update of Selected Standard Metropolitan Statistical Areas (SMSAs).

[13] EIA, *Annual Energy Review 2000*, Figure 2.7 Type of Heating in Occupied Housing Units, 1950 and 1999, p. 54.

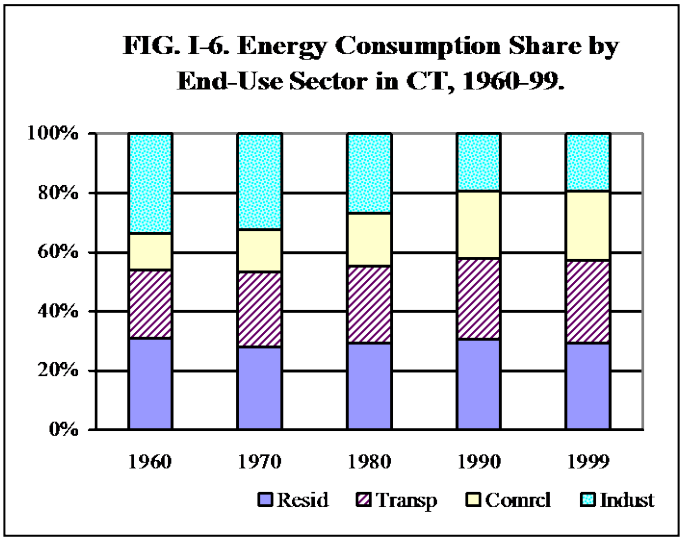
[14] EIA, *EIA Energy Definitions Glossary*, October 2001. (In earlier definitions, the electric sector was referred to as the "electric utility sector," and non-utility power producers were included in the industrial sector.)

[15] EIA, *State Energy Data Report 1999*, Table 1.



Trends. Nationally, end-use sector energy consumption patterns over the last 50 years have been consistent. The industrial sector in the U.S. has always used the largest share, although the quantities consumed decreased some years. The other sectors, which have continuously held their ranks, are in decreasing order transportation, residential, and commercial.[16]

In Connecticut, consumption has shifted among the end-use sectors. During the 1960s, the industrial sector was the major consumer of energy. Since then, residential has been the predominant end-use sector. The transportation sector took over second place in the early 1980s, after alternating that position with the industrial sector during the 1970s. The commercial sector advanced from fourth to third in 1990, moving the industrial sector to last place at that time. Figure I-6 summarizes this information.[17]



Looking forward through 2020, the U.S. Department of Energy projects total energy consumption for all five sectors will grow at rates of between 1 percent and 2 percent annually. The higher growth rates are forecast for the commercial, transportation, and electric power sectors.[18]

How much energy is consumed in Connecticut?

In 1999, energy consumption in Connecticut totaled 839 trillion Btu or 256 million Btu per person.[19] In comparison with other states, Connecticut ranked 33rd in total expenditures, higher than all of the other New England states except Massachusetts.

In terms of per capita consumption, Connecticut ranked 45th, in close proximity to all of the other New England states except Maine, which was 12th. Table I-1 presents comparative 1999 data for Connecticut, the other New England states, New York, and the U.S. median.

[16] EIA, *Annual Energy Review 2000*, Figure 2.1a Energy Consumption by Sector Overview, p. 36.
[17] EIA, *State Energy Data Report 1999*, Tables 53-57, Energy Consumption Estimates, Selected Years 1960-1999.
[18] EIA, *Early Release of the Annual Energy Outlook 2002* (November 2001).
[19] EIA, *Annual Energy Review 2000*, Table 1.6 State-Level Energy Consumption, Expenditures, and Prices, p. 15.

TABLE I-1. Total and Per Capita Energy Consumption for Selected States, 1999.				
State	*Total Consumption (trillion Btu)*	*Rank**	*Consumption Per Person (million Btu)*	*Rank**
Connecticut	839.3	33	255.7	45
Maine	528.6	40	421.9	12
Massachusetts	1,569.1	22	254.1	48
New Hampshire	335.4	45	279.2	41
Rhode Island	261.1	47	263.5	44
Vermont	165.0	51	277.9	42
New York	4,283.0	4	235.4	50
U.S. Median	1,219.8		350.8	
U.S. Range	165 - 11,501 (but only four states consumed more than 3,900)		204 - 1,122 (but only five states consumed more than 480)	

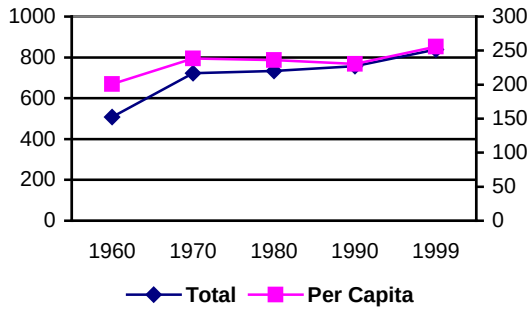
Btu = British Thermal Unit, a standard unit for measuring heat energy in a fuel source. Specifically, it is the amount of heat needed to raise the temperature of one pound of water by one degree Fahrenheit (F) at or near 39.2^{o}F.

* There are 51 rankings because the District of Columbia is included in the database.

Source of data: EIA, Annual Energy Review 2000, Table 1.6.

Trends. Total energy consumption in Connecticut increased 65 percent since 1960.[20] Per capita consumption increased 27 percent during the same period. In both cases, most of the growth was in the first and the fourth decades. Figure I-7 displays total and per capita energy consumption since 1960.

FIG. I-7. Total CT Consumption (Trillion Btu)



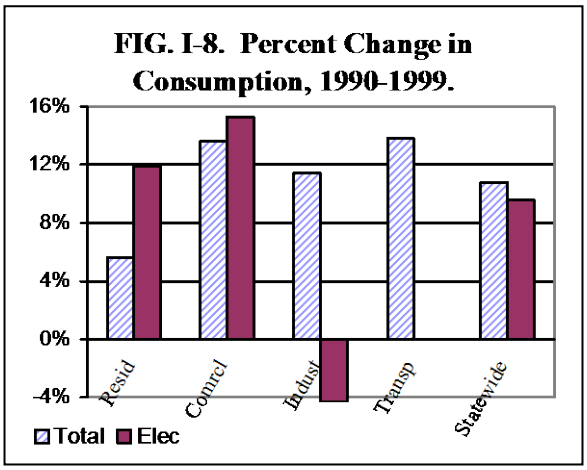
When discussing energy quantities, it is worthwhile to look at how much is consumed for some specific purposes. Two areas of particular interest are electricity and gasoline.

From 1960 to 1999, the consumption of electricity by end-users in Connecticut increased four-fold from 25 million Kilowatt hours (Kwh) to 102 million Kwh.[21]

Between 1990 and 1999, total energy consumption in Connecticut increased 11 percent, while the amount of electricity consumed grew 10 percent. The trend among categories of consumers varied, however. As figure I-8 shows, total consumption by the residential sector

[20] From 1960 to 1999, national consumption increased 115 percent. During this time, the population in Connecticut increased 29 percent, while the U.S. population increased 52 percent.
[21] EIA, *State Energy Data Report 1999*, Tables 54-57.

increased less than 6 percent, but the amount of electricity used grew 12 percent. The industrial sector used more energy overall, but decreased electricity consumption by 4 percent.[22]



Output requirements (which includes end-use consumption, losses during processing, and reserve requirements) are projected to increase 25 percent between 2000 and 2020, at a rate of 1.3 percent annually. The national growth rate is expected to be 1.8 percent annually during the same period.[23]

Over the next 10 years, annual summer peak demand for electricity in Connecticut is expected to increase 1.3 percent annually. Growth in New England as a whole during that period is estimated at 1.5 percent annually.[24]

Gasoline consumption in Connecticut in 2000 totaled 1.5 billion gallons, a 5 percent increase over 1994.[25] The pattern of growth has been very uneven, however, with swings up and down. Per capita consumption has increased as well, but it too has fluctuated. National trends have been more consistent, and with the exception of 2000, recorded small annual increases in total and per capita consumption. Table I-2 displays state and national data from 1994 to 2000.

TABLE I-2. Gasoline Consumption: Connecticut and U.S., 1994-2000.

	Connecticut			*United States*		
Year	*Gallons Consumed (millions)*	*Percent Change*	*Per Capita*	*Gallons Consumed (millions)*	*Percent Change*	*Per Capita*
1994	1,403		429.2	118,532		455.3
1995	1,292	(7.9)	395.7	120,876	2.0	459.9
1996	1,390	7.6	425.6	123,327	2.0	465.0
1997	1,400	0.7	428.3	125,045	1.4	467.0
1998	1,426	1.9	435.8	128,504	2.8	475.5
1999	1,551	8.8	472.7	132,261	2.9	485.0
2000	1,476	(4.8)	433.5	132,280	0.0	470.0

Sources of data: Federal Highway Administration (Table MF-21 for 1994 through 2000) and U.S. Census Bureau (ST-99-3, State Population Estimates for 1990 through 1999).

[22] EIA, *State Energy Data Report 1999*, Tables 53-57.
[23] Connecticut Siting Council, *Twenty-Year Forecasts*, p. 1.
[24] Connecticut Siting Council, *Twenty-Year Forecasts*, p. 2.
[25] U.S. Department of Transportation, Federal Highway Administration, Table MF-21. Motor Fuel Use for each year from 1994 through 2000.

Looking 20 years into the future, the Energy Information Administration expects overall U.S. energy demand will continue to increase, despite the growth in energy efficient products. A contributing factor is an anticipated decline in energy fuel prices, which reduces interest in conservation.[26]

How much is spent on energy in Connecticut?

Estimated energy expenditures for Connecticut in 1999 totaled $7.1 billion or $2,167 per person. The state was near the U. S. median in both total spending and per capita expenditures. In comparison with the other New England states, only Massachusetts had a higher total. Per capita spending, however, was more diverse.[27] Table I-3 presents comparative data for Connecticut, the other New England states, New York, and the U.S. median.

TABLE I-3. Total and Per Person Energy Expenditures for Selected States, 1999.

State	*Total Expenditures (millions)*	*Rank**	*Expenditures Per Person*	*Rank**
Connecticut	$7,111	27	$2,167	22
Maine	$2,987	39	$2,384	8
Massachusetts	$12,022	15	$1,947	40
New Hampshire	$2,631	40	$2,190	19
Rhode Island	$1,981	45	$1,999	35
Vermont	$1,344	50	$2,263	16
New York	$31,999	3	$1,758	47
U.S. Median	$7,160		$2,132	
U.S. Range	$1,311 - 56,007		$1,674 - 3,861	

* There are 51 rankings because the District of Columbia is included in the database.

Source of data: EIA, *State Energy Price and Expenditure Report 1999*, Table 1.

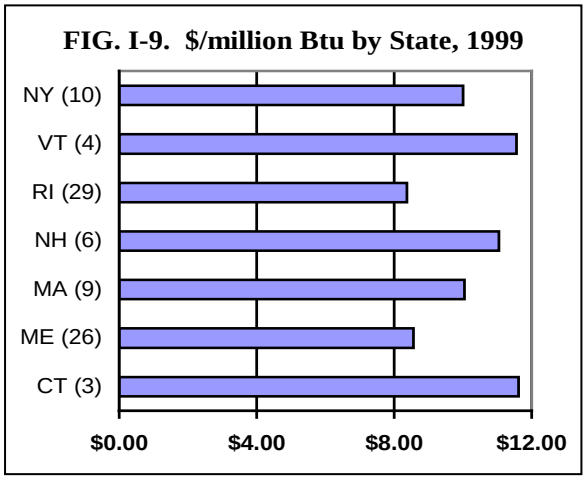
Examining the data from the perspective of cost relative to the amount of energy used, Connecticut spent $11.62 per million Btu of energy consumed in 1999. This was the third highest rate in the country. Three other New England states were in the top 10 as well, while two were at or below the median. Figure I-9 shows specific figures and rankings for the states included in Table I-3.[28]

While total energy expenditures per person in Connecticut are near the national median, consumers in the state do pay higher prices for some elements of the energy mix. Figure I-10 shows the cost per million Btu that state residents pay for different types of energy.

[26] EIA, *Annual Energy Outlook 2002*, Overview (December 21, 2001).

[27] EIA, *State Energy Price and Expenditure Report 1999*, Table 1. Energy Prices and Expenditures Ranked by State, 1999.

[28] EIA, *State Energy Price and Expenditure Report 1999*, Table 1.



Trends. Since 1970, total expenditures for energy in Connecticut have gone from $1.2 billion to $7.1 billion, an increase of nearly 500 percent.[29] Adjusted for inflation, the increase was 38 percent. In the U.S., total expenditures increased nearly 600 percent, but only 57 percent adjusted for inflation.[30]

It is worth noting costs can differ among end-use sectors. As previously discussed, The types of fuel used for different purposes may vary, and the activities of sectors certainly differ. In addition, some customers, particularly nonresidential ones, may receive special rates as economic incentives or for load management purposes. Customers may receive volume discounts or enter into contracts at fixed rates that do not change regardless of the prices in the marketplace at the time of delivery.

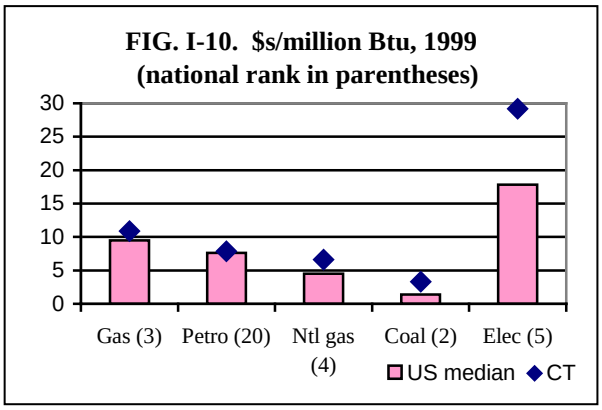
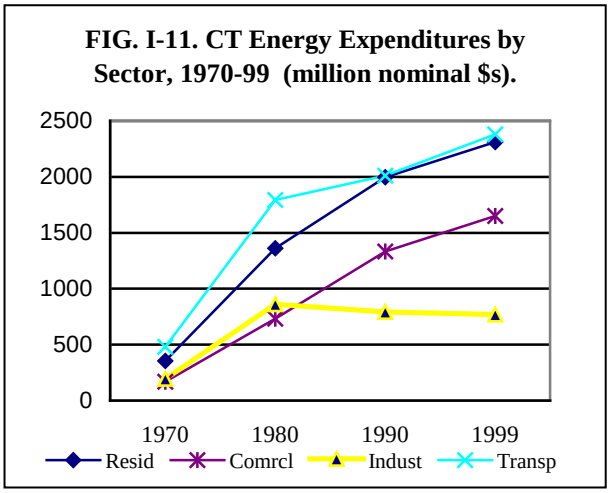


Figure I-11 shows total expenditures by end-use sector at intervals from 1970 to 1999.[31] Table I-4 presents expenditures per million Btu for the same groups and time period, adjusted for inflation.



The transportation sector had the highest total expenditures and in most cases the highest per unit expenditures. In most years, the industrial sector had the lowest total expenditures, while the commercial sector was lowest on a per unit basis. As shown in Table I-4, although expenditures for all sectors have increased since 1970, when adjusted for inflation, they are lower than in 1980.

During the 1990s, the cost per million Btu of energy in Connecticut increased 1.7 percent. However, adjusted for inflation, the cost decreased 20 percent. Individual years

[29] EIA, *State Energy Price and Expenditure Report 1999*, Table 47. Energy Price and Expenditure Estimates by Source 1970-1999, Connecticut.

[30] EIA, *State Energy Price and Expenditure Report 1999*, Table 5. Energy Price and Expenditure Estimates by Source, Selected Years 1970-1999, United States.

[31] EIA, *State Energy Price and Expenditure Report 1999*, Tables 48-51 Residential, Commercial, Industrial, and Transportation Sector Energy Price and Expenditure Estimates, Selected Years 1970-1999, Connecticut.

varied. While a series of small increases occurred in the mid-1990s, there were succeeding decreases in 1998 and 1999.[32] Although final numbers for 2000 and 2001 are not available, preliminary data show the sharply higher fuel prices experienced by consumers during late 2000 and early 2001 were replaced by the end of 2001 with prices comparable to 1999 levels.[33]

TABLE I-4. Energy Costs in Connecticut by Sector, 1970-1999, Adjusted for Inflation ($s/million Btu).

	1970	*1980*	*1990*	*1999*
Residential Sector	$2.44	$4.28	$3.93	$3.27
Transportation Sector	$2.59	$4.85	$4.26	$3.37
Commercial Sector	$1.06	$3.26	$2.71	$1.80
Industrial Sector	$2.63	$4.56	$2.90	$2.37
Statewide TOTAL	$2.08	$4.21	$3.39	$2.71

Sources of data: EIA, *State Energy Price and Expenditure Report 1999*, Tables 47-51, and Federal Reserve Bank of Minneapolis, "What is a dollar worth?," CPI Calculation Machine.

U.S. Department of Energy estimates of energy prices for the next 20 years are mixed. The recent drop in oil prices is expected to reverse after 2002 in response to higher world demand for oil. However, the growth in price is estimated to be relatively slow through 2020. The price of natural gas is projected to increase slightly by 2020 as reduced demand and technological improvements are offset by lowered assessments of the natural gas reserves being discovered during exploratory drilling.[34]

Nationally, average electricity prices are expected to decline over the next five years, but they may begin increasing again after that at least partly as a result of increases in the price of natural gas. Another factor that will likely affect prices is the number of and extent to which states actually deregulate their electricity markets.[35]

In New England, an electricity pricing change expected in the next few years will revise the method of allocating costs within the electric power supply system. Premium pricing will be instituted, and congested locations will be charged more. At a minimum, this would affect the southwestern portion of the state because of the constraints on the existing transmission system there, but it could affect all of Connecticut depending on how broadly the boundaries of the congested regions are defined.

[32] EIA, *State Energy Price and Expenditure Report, 1999*, Table 47.

[33] EIA, *Short-Term Energy Outlook* (December 2001) and Al Lara, "Heating Oil Prices Lowest in Nearly Two Years" (November 17, 2001), and "State's Gasoline Prices Are At Lowest Levels Since 1999" (November 29, 2001), *The Hartford Courant*.

[34] EIA, *Early Release of the Annual Energy Outlook 2002*.

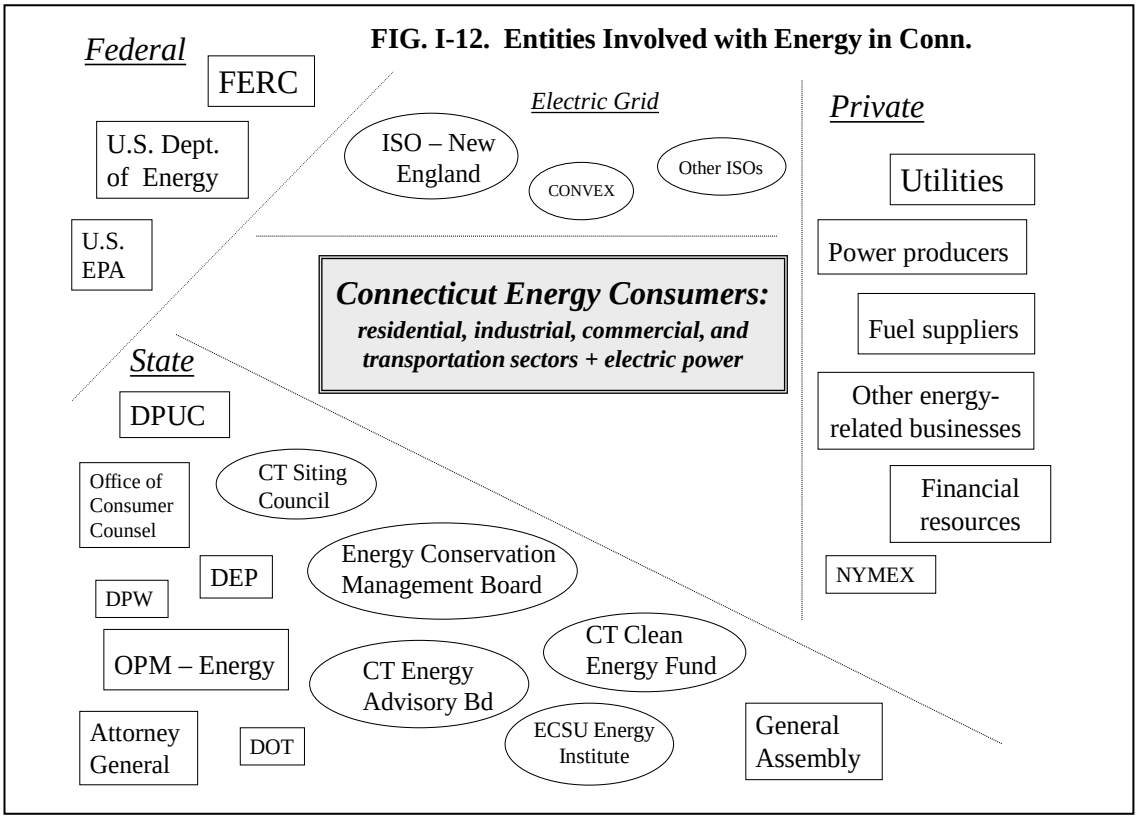
[35] EIA, *Early Release of the Annual Energy Outlook 2002*.

What entities are involved in the provision of energy in Connecticut?

Since the end of the 20th century, relationships among participants in the energy industry have been changing, and new roles are emerging. A major factor has been implementation of electric competition legislation, which in Connecticut (and other states) requires electric utilities to restructure and separate the generation side of their companies from the transmission and distribution side. Existing companies are merging or consolidating operations, and new suppliers are entering the marketplace.[36]

While private parties make most decisions regarding day-to-day energy-related tasks, government agencies also are involved. Figure I-12 identifies more than a dozen specific governmental entities and numerous types of businesses with responsibilities related to regulating, producing, and supplying energy for consumers in Connecticut. (See Appendix B for brief descriptions of the Connecticut governmental entities.)

FIG. I-12. Entities Involved with Energy in Conn.



Looking at the near future, a few of the governmental entities whose actions have the potential to strongly affect the Connecticut energy situation include:

- *Connecticut Siting Council* (CSC) -- statutorily established body whose jurisdiction includes approval of the location and type of electric transmission

[36] ISO New England Inc., *Opportunities and Challenges Facing the Electric Power Industry in New England* (September 2001), pp. 2-4.

lines, fuel transmission facilities, electric generating/storage facilities, and electric substations in the state[37]

  - also issues annual 20-year forecasts of electric power demand and resources

- *Department of Public Utility Control* (DPUC) -- statutory agency responsible for ensuring safe, reliable, modern, and fairly priced utility services (including electric and gas) are available in the state[38]

  - with advice from the *Energy Conservation Management Board* (ECMB), approves annual plans from electric distribution companies aimed at implementing cost-effective energy conservation programs and market transformation initiatives, using funds from a statutorily mandated fee on electric bills[39]

- *Connecticut Clean Energy Fund* -- statutorily established venture capital fund, managed by *Connecticut Innovations Inc.*, that promotes the use of clean power in the state by investing in projects and companies[40]

- *Federal Energy Regulatory Commission* (FERC) -- five-member appointed body within U.S. Department of Energy responsible for regulating aspects of the transmission and sale of natural gas, oil, electricity, and hydroelectric projects involving interstate commerce[41]

  - its proposal to consolidate the U.S. electric power industry into four regional transmission organizations (RTOs), including a single one for all of the Northeast, would require ISO-New England[42] to merge with the New York and Mid-Atlantic system operators and change system procedures for supplying electricity to the New England states
  - must approve new gas pipelines and expansion of existing ones

What factors affect the demand for and supply of energy?

The *demand* for energy is determined by a mix of factors, the importance of which depend on the fuel supply involved and the time of the year. Individual factors influence the direction -- up and down -- as well as the volatility of demand. The *supply* of energy is also shaped by multiple factors, many of which are inter-related and parallel those that affect demand. Figure I-13 summarizes the major factors shaping the supply of and demand for energy.

[37] C.G.S. Sections 16-50g through 16-50aa

[38] *The Digest of Administrative Reports to the Governor 2000-2001*, Volume LV (November 2001), p. 275.

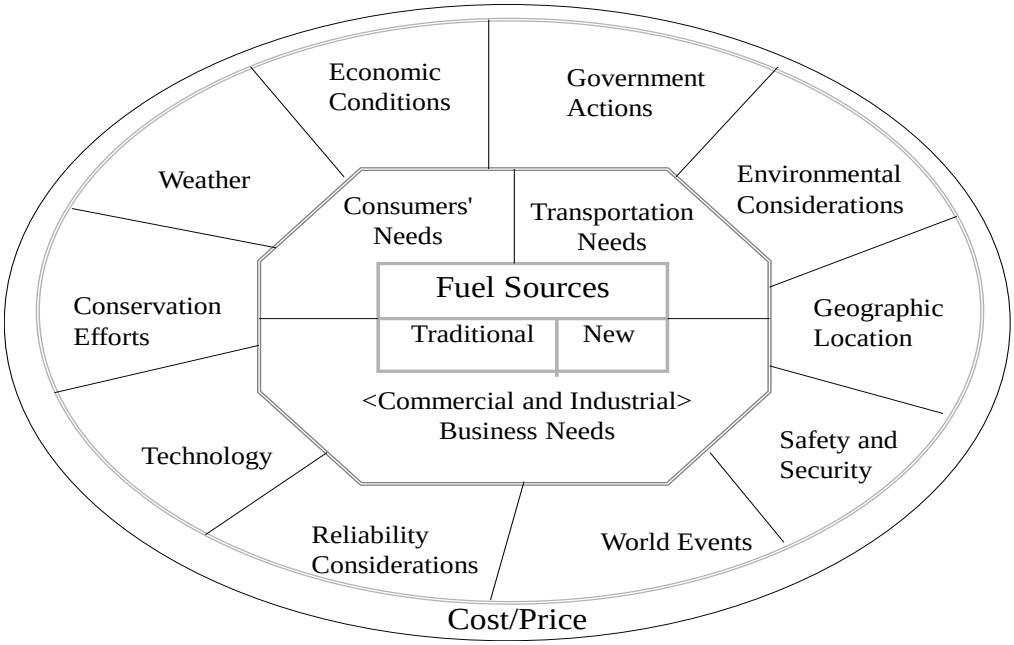
[39] C.G.S. Sec. 16-245m

[40] C.G.S. Sec. 16-245n

[41] Federal Energy Regulatory Commission web site (www.ferc.gov).

[42] The Independent System Operator (ISO) - New England Inc. is the not-for-profit corporation currently responsible for managing the New England region's electric bulk power generation and transmission systems.

FIG. I-13. Factors Affecting Supply and Demand



In general terms, the components shown in Figure I-13 can be grouped into five categories:

- *structural* -- technological or societal changes that cause consumption requirements to shift (e.g., use of electricity versus manual power for a task or the creation of new reasons to use energy);
- *governmental* -- local, state, and federal controls and legislative policy decisions (e.g., siting regulations, electric deregulation provisions, and tax incentives for renewable energy);
- *individual* -- decisions made by consumers regarding how and when they will use energy (e.g., conservation efforts);
- *uncontrollable* -- events beyond the direct authority of anyone (e.g., geographic location of the state); and
- *outcomes* -- results from the interactions of other factors (e.g., fuel prices).

What issues are expected to affect future energy supply and demand?

The impact of natural and manmade events that occur throughout the world can have swift and unpredictable effects on the availability of energy. The results can disrupt the smooth flow of supplies, alter the price of fuel, heighten security concerns about the energy infrastructure, and upset the stability of the overall economy, all of which influence the supply of and demand for energy.

Assessing the potential availability and cost of energy in Connecticut in the future requires an examination of a number of disparate issues. Many of these elements are interrelated and contribute to maintaining a balance between energy supply and demand. However, most are outside the control of the legislature.

Economic conditions. Energy consumption levels are closely tied to economic activity. The demand for electric power and motor fuels increases during periods of business growth, and levels out or declines when the economy slows or enters a recession. These patterns are cyclical, but variable in length.

When economic conditions are good, businesses may turn out more products, causing them to use more resources. Residential use of energy tends to follow the pattern of the business cycle. When workers' pay increases, it allows them to purchase more items or bigger homes and cars, requiring more electricity and other fuels to operate.

When market conditions falter, businesses cut back on production and purchasing. Periods of job cutbacks cause a corresponding cutback in consumer purchasing. The reductions in energy consumption can cause energy prices to fall, resulting in decreased energy production. As the supply of fuel available to the marketplace decreases, prices increase. When they reach a sufficient level, production begins again, and supplies increase.

Throughout this cycle, most consumers will be faced with the need to continue using electricity to light their homes and offices, and when temperatures drop, a variety of fuels for heat. This will occur regardless of price.

The deregulation of products such as electricity and natural gas means their prices will likely become more volatile. The ability of consumers to adapt to this trend will be important given the more continuous nature of consumer demand for at least some minimum quantity of energy.

Energy conservation. Programs aimed at conserving energy may reduce the overall amount of energy consumed or change the type of fuel used. Actions that conserve energy -- either by curtailing usage or switching to more energy-efficient products -- are important mechanisms for altering the impact of high prices. Such programs also can benefit society by decreasing the consumption of resources and improving the environment.

Energy conservation programs often involve a psychological component that convinces consumers to change their behavior even when it may mean a reduction in physical comfort or an increase in work load. Successful programs require a variety of steps by assorted parties over an extended period of time.

For example, in the short-run, property managers and homeowners might install more efficient equipment (e.g., thermostat setbacks). In the medium-term, those who work or live in a building might adopt behaviors that use less energy (e.g., turning off the lights when they leave a room). In the long-term, society must adopt cultural changes supportive of behaviors that use less energy (e.g., preference for high gas mileage or alternative fuel vehicles).

It is worth noting products that help businesses operate more energy-efficiently can help them in other ways as well. For example, companies (including at least one in Connecticut) that use injection molding equipment in their manufacturing process have found installation of new equipment can cut their electricity costs for machinery, reduce air conditioning requirements, and lower noise levels within the shop area. In addition to the savings from operating the equipment, these businesses also may be eligible for rebates or incentives from their local utility company.[43]

In discussing fuel efficient products, it is should be noted that although individuals may consume less energy using such appliances or vehicles, more people own a greater variety of appliances today. For example, while only 7 percent of the households in New England owned microwave ovens in 1980, by 1997 they were in 80 percent of homes. (Nationally, the corresponding figures were 14 percent and 83 percent.) People also may own more than one of the same kind of appliance. In 1997, 15 percent of households (in New England and the U.S.) had two refrigerators.[44] As a result, total energy consumption may increase.

Regulatory requirements. Local, state, and federal agencies place a variety of obligations on energy-related businesses and consumers. Some restrictions are imposed for public protection purposes. These may include constraints on where facilities can be located, what prices can be charged for commodities, and allowable levels of environmental emissions.

Sometime, governmental mandates are used to provide temporary safeguards during a period of transition. As part of the process of deregulating the generation of electricity in Connecticut, a standard offer rate (i.e., the amount customers who did not choose a new energy supplier would be charged for electricity by the electric distribution company) was put in place for the first four years of the process. Set to expire on December 31, 2003, termination of the standard offer rate is an issue currently being discussed by the legislature's Energy and Technology Committee.

Statutory requirements may also serve as vehicles to promote change. For example, C.G.S. Sec. 16-245a requires increasing portions of the output of licensed electric suppliers to come from two classes of renewable energy sources. Estimates of the electricity that can economically be obtained from those resources by 2005 are low.[45] However, the fact that a specific goal has been established may spur efforts to attain greater levels of output.

Public fiscal policies. Government also influences the energy area through its tax policies and grant programs. The imposition of sales taxes on products such as gasoline affects energy availability and can influence consumer behavior. (Even more aggressive efforts to use the tax system to change behavior though are evident in Europe where some countries tax motor vehicles based on weight.) Deciding whether or not to impose property taxes on items such as natural gas pipelines is another way government can have a role in the energy area.

Decisions regarding how much public money to allocate toward exploration for traditional fuel resources versus development of new fuel sources has the potential to hasten the

[43] "All-Electric Injection Molding Saves Energy," *Energy User News*, November 2001, p. 18.

[44] EIA, *New England Appliance Report* (July 2001).

[45] Booz·Allen & Hamilton, *Clean Energy Market Assessment of Southern New England: Final Report* (June 25, 2001) prepared for the Connecticut Clean Energy Fund, pp.44-45.

availability of alternatives. Government can be a particularly important partner in efforts to develop projects involving new technologies. Such products often face financial obstacles until there is enough demand for the product to be manufactured at a competitive price. If the initial demand for such a fuel is low, government funding can be a key source of support.

Indeed, one of the energy policy strategies identified by the Connecticut Energy Advisory Board (CEAB) last year was support for emerging and renewable energy technologies. Among the potential actions listed to achieve that goal was increased state funding.[46]

Technological advances. Research into new technologies can offer two types of benefits -- the potential to develop new ways of providing energy and the opportunity to create more energy-efficient and environmentally sensitive products.

Of course, technological advances also may increase the demand for energy or at least more reliable energy. More sensitive electronic equipment (e.g., computers) at ever cheaper prices means more customers will be using more electricity.

Fuel cell research is an example of an effort to produce another energy option. It is also an energy source of particular interest in Connecticut, given the presence of several private companies working on this technology. The production of fuel cells that generate sufficient quantities of energy within a reasonable physical size at a reasonable price has the potential to be part of the solution to concerns about electric generating capacity and security.

Another type of technological enhancement that might some day increase the availability of electricity is the potential of storing electric power. Superconductivity lines would retain unused electricity for discharge at a later time, providing an opportunity to take advantage of fluctuations in demand.

Evaluations of the feasibility of some of the new technologies must take into consideration the aesthetics of the products. For example, the noise and visual appearance of some types of wind machines would have to be weighed against the amount and cost of the power that can be derived from this renewable source.

In early 2001 when energy prices were rising, renewed interest in nuclear powered electricity was being expressed. New technological approaches to constructing nuclear generating plants and extending the useful life of existing plants have been developed since the plants currently operating in the U.S. were designed. An ongoing problem that remains is how to deal with the storage of used fuel rods. And, in the aftermath of the events of September 11th, security concerns about the vulnerability of nuclear plants have arisen.

Grid reliability. The electric grid system moves electricity from the location where it is produced to the site where it is consumed. The electricity used by customers represents only one part of the system's capacity requirements. In addition, a proportional amount of reserve power greater than customer demand must be maintained to ensure reliable operations. The power being delivered also must meet voltage stability requirements.

[46] Connecticut Energy Advisory Board, *The Energy Policy Report* (February 1, 2000), p. 21-22.

Short surges and sags of power do occur routinely within the electric distribution system. However, modern electronic equipment, sensitive to such interruptions, makes them more discernable to the public.

Reliability is of great importance to an increasing number of businesses that use electronic processing systems (e.g., credit card companies) or computerized production lines (e.g., manufacturing plants). For them, even a short power outage can cost millions of dollars. As a result, there is increased demand for a new standard of dependability known as the "six 9s" (i.e., 99.9999 percent) of reliability. These energy consumers are likely to require on-site, backup systems that provide an uninterruptible power supply.

Transmission lines. Transmission lines represent the middle component of the infrastructure of the electric power system. At the front of the system is the equipment used to generate electricity. At the end, are a series of distribution feeders, substations, and transformers that move the electricity to customers.

The amount of electricity that can flow through transmission lines is dictated by the size and type of lines transporting the power. Lines with descending levels of voltage are used to move electricity from generating plants to overhead transmission lines to individual customers.

Although a region may have a sufficient supply of electric power overall, limitations of the transmission system may prevent delivery of electricity to a particular area in the quantities desired. If the problem is a lack of sufficient long-distance transmission lines able to transport power from the regions with excess supply to the areas with insufficient supply, problems will arise during periods of peak demand. However, in some places (such as southwest Connecticut and the Metro Boston area), a combination of limited local generation and transmission constraints can result in more frequent problems.[47]

Solutions to transmission problems range from increasing the capacity of the lines to encouraging more conservation of energy. In Connecticut, more than a dozen projects to rebuild, upgrade, or build new electric transmission lines within or adjacent to the state have been proposed for completion within the next seven years.[48]

A proposal to upgrade or install new lines requires approval by the Connecticut Siting Council. Processing time -- from the concept of a project through various required reviews to actual operation -- generally takes several years. Despite the societal benefits projects such as these may provide, community support may be limited. As the program review committee found in a previous study, siting decisions are often controversial and may be opposed by the towns where the project is to be located. Host communities worry about a range of real or perceived negative side effects including:

- health and safety risks (e.g., the possible effects of electromagnetic fields);
- diminished property values and other economic harm; and
- adverse environmental and social impacts.[49]

[47] ISO-New England, *Opportunities and Challenges Facing the Electric Power Industry in New England*, pp. 6-7.
[48] Connecticut Siting Council, *Twenty-Year Forecasts,* p. 17.
[49] Legislative Program Review and Investigations Committee, *Siting Controversial Land Uses* (January 1992), p.3.

Another issue with some of the proposed transmission line projects is who will actually benefit from them. The question has been raised whether those adjacent to the lines will receive additional or improved service as a result of the projects, or whether the primary beneficiaries will be energy users in other geographic areas.

In considering that question, it is important to recognize that Connecticut is not currently self-sufficient in meeting the demands of its citizens for electricity. During six of the years from 1990 to 1999, more electricity flowed into Connecticut than went out of the state.[50]

As a participant in the power system managed by ISO-New England, Connecticut's need for electricity is balanced with the demands of the other states in the region, and power is shifted among areas as required. However, as noted above, the existence of surplus power in one area can only help another area if the electricity can be transported there. The installation of lines in Connecticut that seem to benefit only consumers outside the state, might in fact help the overall electric transmission system in New England by providing more flexibility for the transfer of power.

Distributed generation. The generation of electricity from self-contained generating units located at or near the point of end-use consumption is known as distributed generation. These types of facilities are expected to have an important role in the future as alternatives to the main electric power grid.

Distributed generation is appealing for security and reliability reasons, and it can help individual users as well as the overall electric transmission system. For example, if the grid fails as a result of a storm or sabotage, the availability of electricity from small, locally based generating sites would allow at least some customers to maintain power. In high load situations, distributed generation offers opportunities for portions of the system to go off-line, reducing demand sufficiently to allow all customers to retain power.

The production of distributed power has the potential of providing financial rewards to the owners of the generating facility, who may be paid to stay off the grid. Alternatively, as this technology improves and more sites are in operation, there may be opportunities to sell excess power to the grid system, which would also help with local reliability. The Connecticut Energy Advisory Board has identified removal of barriers to the use of distributed generation as one of the strategies that will help achieve the state's energy policy goals.[51]

Natural gas pipelines. A similar supply issue involves the amount of natural gas that can be brought into the New England region. While additional quantities of fuel are available from Canada and elsewhere, the capacity of existing pipelines is already heavily used. According to a recent U.S. DOE report, all of the New England states except Vermont are using 80 percent or more of capacity during peak months.[52]

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[50] EIA, *State Energy Data Report 1999*, Table 53.

[51] CEAB, *Energy Policy Report*, pp. 19-20.

[52] James Tobin, *Natural Gas Transportation - Infrastructure Issues and Operational Trends* (October 2001), EIA Natural Gas Division, p. 13.

Several pipeline expansion projects are underway in the region, and others are being proposed. The Federal Energy Regulatory Commission is responsible for those siting decisions.

Environmental considerations. Many aspects of the energy system, regardless of the type of fuel involved, have potential environmental implications. Examples range from ongoing concerns about the effects of automobile emissions on air quality to the new attention being given to the ecological implications of dams used to produce hydropower.

Despite significant investments in emissions reducing equipment, creating electricity is still one of the major sources of air pollution in the U.S. Emissions do vary by region, but nationally two-thirds of all sulfur dioxide (SO_2) emissions, 28 percent of all nitrous oxides (NO_X), and one-third of all mercury released in the atmosphere come from electric power generators. In addition, one-third of all carbon dioxide ($CO_{2)}$ comes from this source.[53]

Methods of further reducing these levels include the use of emissions controls on smokestacks, new coal-burning and processing technologies, and cleaner fuels including renewables such as biomass and wind power. Another approach is to encourage more energy efficiency. The latter encompasses less use of energy as well as load management programs that encourage the use of electricity at off-peak times of day.[54]

In Connecticut, the Energy Conservation and Load Management Fund, financed by an assessment on ratepayer bills, provides approximately $85 million a year for a variety of energy conservation activities including conservation and load management programs. The Energy Conservation Management Board issues an annual report that summarizes the results of funded programs, including reductions in peak demand and the quantities of NO_X, sulfur oxide (SO_X), and CO_2 avoided.[55]

Efforts to resolve environmental concerns connected with the energy system require balancing individual demands for power with the desire of society for a healthy environment. Given the current structure and fuel mix of the energy system in Connecticut, decisions about how to ensure adequate capacity can have far-reaching consequences. Indeed, the importance of coordinating environmental and energy policies was another of the key policy strategies identified by the Connecticut Energy Advisory Board.[56]

Transportation. In the United States, reliance on the automobile as a means of transportation is high, and it is the dominant mode of transportation to work. A review of 1990 census data found 87 percent of people who commuted to work used private vehicles to get there, and three-quarters drove alone. Only 5 percent used public transit services, while 4 percent walked to work. Three percent worked at home.[57]

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[53] Matthew H. Brown, "The Link Between Energy Efficiency and Air Quality," *NCSL State Legislative Report*, Vol. 25, No. 16 (December 2000).

[54] Brown, "The Link Between Energy Efficiency and Air Quality."

[55] *Report of the Energy Conservation Management Board Year 2000-2001 Programs and Operations* (January 31, 2001).

[56] CEAB, *Energy Policy Report*, p.30.

[57] ENO Transportation Foundation, Inc., *Commuting In America II* (1996), p. 49.

Data for Connecticut were similar. In 1990, three-quarters drove alone, 4 percent used public transportation, and 4 percent walked.[58]

Reducing the consumption of gasoline and diesel fuel is beneficial to air quality, and it could facilitate the production of home heating oil by freeing up petroleum resources. Opportunities for reducing the amount of gas used include:

- adoption of Corporate Average Fuel Economy (CAFE) standards for all automobiles and light duty trucks, including sport utility vehicles and minivans;
- encouragement of ever more fuel efficient vehicles;
- increased use of alternative fuel (or dual fuel) vehicles; and
- support for the use of mass transportation systems.

The fuels consumed by mass transit vehicles, in particular buses, are also changing. Approximately 50 hybrid electric buses and a few fuel cell buses have been tested in on-road demonstrations. However, the big switch has been from diesel fuel to compressed natural gas, which significantly reduces the amount of pollutants emitted.[59]

Another development expected to reduce traffic levels in the future is growth in the number of people working from home (i.e., telecommuting). This trend will ultimately affect other energy components as well. For example, companies able to reduce their office space needs, can decrease their overall energy consumption levels. At the same time, increased reliance on electronic communication will expand the number of customers concerned about the reliability of the electric grid system.

Safety and security. Safeguarding infrastructures that contain fuel supplies and generate power are important from a public health standpoint. So too is ensuring the safety of workers and local residents who come into proximity with fuel sources and other components of the energy system.

Security of the system is important because of the needs of businesses and individuals in the world today for a reliable electric power grid. Threats to the energy system can come in two forms. First, is the possibility of cyber attacks on today's highly computerized fuel distribution and utility systems. Second, is the threat of physical attacks against pipelines, nuclear plants, and other equipment.

Weather. Snow, ice, and wind storms in the local area can cause equipment damage that must be repaired. Actual weather problems in other locations can disrupt the flow of fuels into the state, while threatening weather can push prices higher in anticipation of disruptions.

Extreme temperatures -- both hot and cold -- cause consumers to use more fuel. Connecticut as well as the rest of New England have dual peak power demand seasons. In recent years, considerable attention has been given to the high demand for electricity during summer

[58] Connecticut Department of Transportation, *1998 Long-Range Transportation Plan*, p. III-18.
[59] U.S. Dept. of Energy, "Transit Agencies: At a Fork in the Road", *Alternative Fuel News*, Vol. 4, No.3, pp. 4-5.

heat waves, but there are comparable peak demand days in the winter. This situation is important because it limits the time available to perform maintenance work on generating facilities and the transmission system.

Geographic location. The physical location of Connecticut at an outer boundary of the U.S. and the lack of indigenous fuel sources affect the ability of the state's citizens to obtain plentiful, low-cost fuel supplies. The small size of the state and the density of its population create traffic and energy congestion areas. These characteristics in turn complicate decisions regarding the siting of transmission and gas pipelines and efforts to provide economic development opportunities.

Summary

With the potential for declining availability and increasing prices at some point in the future, Connecticut's energy policies need to balance the quantity of energy used, the environmental effects of the type of fuel consumed, and the economic effects (direct and indirect) of the choices made.

The ability of the legislature to institute changes in the supply of and demand for energy is often indirect. It can place restrictions on prices and the location of facilities. Alternatively, it can offer financial incentives for energy conservation efforts and research into new technologies. It cannot control the decisions of private businesses regarding their willingness to sell electricity in Connecticut or continue operating a manufacturing plant within the state. Nor can it change the physical characteristics of the state or the unpredictability of the weather.

The General Assembly (along with other governmental entities) can articulate a vision for the future of energy in the state. It also can work to ensure other energy decision-makers, including federal regulatory authorities, are aware of the needs and concerns of energy consumers in Connecticut.

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Chapter Two

Findings and Recommendations

In 1999, a total of 839 trillion Btu of energy was consumed in Connecticut at a cost of $7 billion. This represented:

- 256 million Btu per person (versus the national average of 351 million);
- $2,167 per resident (versus the national average of $2,049); and
- $11.62 per million Btu (versus the national average of $8.41).[60]

According to the data from the Energy Information Administration, these numbers placed Connecticut 33rd among all states in terms of total consumption and 45th in per capita consumption. The state ranked just below the median in terms of total expenditures and 22nd in terms of per capita expenditures. Connecticut was third in terms of price per million Btu.

The availability of energy is dependent on a number of disparate elements. As shown previously in Figure I-13, the factors affecting energy supply and demand include economic conditions, energy conservation efforts, regulatory requirements, grid reliability concerns, environmental considerations, the weather, and geographic location. The extent to which each factor increases or decreases the quantity or the price of energy in Connecticut varies, with the type of fuel an important determinant of the degree of influence. Many of the key elements are inter-related.

No single individual or governmental entity has overall responsibility for energy policy in Connecticut. As displayed in Figure I-12, more than a dozen state governmental bodies have specific energy-related responsibilities. In addition, numerous types of private businesses play important roles making energy products and services available. Federal entities also are important participants in setting energy policies.

Legislative Efforts

In dealing with the question of energy availability, of particular importance to the Connecticut legislature is the fact many of the elements included in Figure I-13 are outside its control. In some cases, this is because of the way the private enterprise system functions; in other cases, it is a result of broader relationships.

For example, decisions related to the electric grid in the state must be made within the context of what is occurring in other geographic areas. Currently, Connecticut is a participant in a transmission system that covers the New England region. In the future, the Federal Energy Regulatory Commission is expected to require the New England system to become part of a larger regional transmission organization. This new region may include all of the Northeast, which would make Connecticut part of one of the largest electricity markets in the world.

[60] EIA, *Annual Energy Review 2000*, Table 1.6, and *State Energy Price and Expenditure Report, 1999*, Table 1.

However, the Connecticut General Assembly (along with other governmental entities) can offer a vision for the future of energy in the state. Indeed, *on multiple occasions since the 1970s, the legislature has taken steps to describe and implement energy-related goals*. A number of these efforts identified the same concerns and proposed similar solutions.

In 1978, acknowledging the importance of energy to society, the economy, and the environment, the General Assembly spelled out in detail its vision regarding energy. C.G.S. Sec. 16a-35k recognizes the lack of primary energy sources within Connecticut and the dependency on petroleum. The statute calls upon the state to "address these problems by conserving energy, increasing the efficiency of energy utilization and developing renewable energy sources." The statute also calls for the state to "seek all possible ways to implement this policy," including:

- public education;
- cooperative efforts with other entities; and
- financial and technical assistance.

In 1992, the legislature directed the secretary of the Office of Policy and Management (OPM) to prepare a comprehensive energy plan every four years, beginning in 1994. Using C.G.S. Sec. 16a-35k as a base, the plan was to:

- assess the existing energy situation;
- identify progress made toward the goals in the statute; and
- recommend mechanisms for reducing dependency on fossil fuels by promoting energy conservation and alternative fuel sources.[61]

OPM initiated the process for developing the first plan in 1993. It issued a draft document and held public hearings. Recommendations addressed areas such as assistance to businesses to create and market energy-related products, cogeneration, opportunities to build energy efficiency into new buildings, transportation issues, and expansion of energy conservation programs.[62] No final plan was issued, nor were any attempts made to produce a plan in subsequent years. However, some of the recommended proposals were implemented, in several cases as part of the electric restructuring process. Others continue to be discussed.

The Connecticut Energy Advisory Board is also statutorily required to make recommendations for carrying out the purposes of C.G.S. Sec. 16a-35k as well as examining the energy component of the state's economy.[63] In February 2000, CEAB issued an *Energy Policy Report* in response to Special Act 99-15, which required "a study to update and strengthen the state's energy policy."

The report contains long-range energy policy goals in five areas -- economic, environmental, risk mitigation, competitive markets, and policy development and coordination.

[61] C.G.S. Sec. 16a-35m

[62] Office of Policy and Management, *Preliminary Draft for Public Comment: Connecticut Comprehensive Energy Plan* (November 29,1993).

[63] C.G.S. Sec. 16a-3

The plan identifies strategies and some key actions required to carry them out. Proposals particularly relevant currently to achieving previously specified legislative goals are:

- reduce barriers to distributed generation;
- support emerging and renewable energy technologies;
- support and coordinate energy conservation and efficiency programs; and
- initiate a coordinated energy education campaign.[64]

To date, implementation of the CEAB proposals has been limited. While the board has held workshops to discuss energy issues, until recently the board has not specifically tried to focus on prioritizing the steps needed to achieve long-term solutions. However, to the extent many of the same concerns have been raised by others, the issues are receiving attention.

Electric restructuring legislation is one of the most recent ways the legislature sought to influence the supply and price of energy. Public Act 98-28 required electric utilities to separate the generation side of their companies from the transmission and distribution side. As a result, existing companies reorganized, and new suppliers began entering the marketplace. It was hoped giving consumers the opportunity to choose their electric supplier would encourage competition among suppliers, leading to lower electric bills and more efficient technologies.[65]

Public Act 98-28 also created two new programs funded by assessments on electric customers. In each case, a statutorily specified charged is added to consumers' bills, based on the quantity of electricity consumed.

The Energy Conservation and Load Management Fund (C.G.S. Sec. 16-245m) pays for cost-effective energy conservation programs and market transformation initiatives. The Department of Public Utility Control, with advice from the Energy Conservation Management Board, must approve expenditures from the fund. The fee for the program generates approximately $84 million a year.[66] Projects funded during calendar year 2001 saved an estimated 314 million kWh during that year, with potential lifetime savings estimated at 4.7 billion kWh. In addition, thousands of tons of air emissions were avoided.[67]

The Renewable Energy Investment Fund (C.G.S. Sec. 16-245n), also known as the Connecticut Clean Energy Fund, provides venture capital for projects and companies that promote the use of clean power. In FY 01, the fund invested $12.3 million in projects involving a variety of renewable energy sources. The largest portion (54 percent) went toward fuel cells.[68]

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[64] CEAB, *The Energy Policy Report*, p. 16.

[65] Department of Public Utility Control, "An Introduction to Electric Choice."

[66] Written testimony submitted by Department of Public Utility Control at Legislative Program Review and Investigations Committee public hearing on January 23, 2002.

[67] *Report of the Energy Conservation Management Board: Year 2001 Programs and Operations* (January 31, 2002), pp. 8-9.

[68] Connecticut Clean Energy Fund, *2001 Annual Report*.

Future Actions

Actions taken by the Connecticut General Assembly to affect the availability of energy often work indirectly. As discussed in Chapter One, the legislature can offer financial incentives for energy conservation efforts and research into new technologies. Alternatively, it can place restrictions on prices and the location of facilities.

The program review committee believes one of the best short-term opportunities for the legislature to influence the overall energy situation in the state is through efforts related to energy conservation. Proposed changes support improved efficiency, curtailment of consumption, and increased use of alternative fuels. As the National Association of State Energy Officials noted in 1998:

> Businesses and consumers are discovering that energy efficiency and renewable energy mean not just energy savings and improved national security (less oil imported), but also cleaner air, pollution prevention, more disposable income and profitable increases in productivity.[69]

The program review committee recommends C.G.S. Sec. 16a-48 be amended to require a review of the state's energy efficiency standards for appliances at least every four years. As part of that process, new products appropriate for inclusion within the requirements of the statute should be identified.

As noted in testimony at the program review committee's January 2002 public hearing, modernizing building codes and appliance standards are important actions the state can take to improve conservation. C.G.S. Sec. 29-252 already requires the State Building Code be revised within 18 months of the publication of updated national standards from organizations such as the Building Officials and Code Administrators International, Inc. and the International Code Council, Inc. This recommendation seeks to ensure OPM in consultation with the Department of Consumer Protection periodically examines the standards for appliances to be sure they are up-to-date.

The program review committee recommends the State of Connecticut endeavor to be a model energy consumer. As such, it should identify and then demonstrate best practices for reducing the quantity of energy consumed and diversifying the mix of fuel sources used in a variety of settings.

Designation of the State government as a role model is based on its diverse energy requirements. Although it does not have the same needs as all categories of consumers, the State does require power, heat, and cooling for a wide range of facilities, including around-the-clock residential institutions, office buildings, science laboratories, and airports. In addition, the State has properties in nearly all of the territories served by major fuel suppliers operating in Connecticut.

The State also has a financial incentive to reduce its consumption of energy. Preliminary data compiled for the program review committee's study "Energy Management by State

[69] National Assoc. of State Energy Officials, *Energy Efficiency and Renewables Sources*, p.7.

Government" showed the state spent approximately $100 million on energy-related expenses in FY 00. This represented slightly less than 1 percent of the state's expenditures that year.[70]

Since the 1970s, the State has undertaken a number of conservation initiatives involving curtailment of usage as well as installation of more energy efficient equipment. A detailed examination of the results of those efforts is one of the tasks remaining to be completed as part of the committee's energy management study. More specific proposals regarding the energy consumption activities of the state will be provided at the conclusion of that review.

Communication. Part of the State's responsibility as a model consumer will be to increase the public's awareness of energy issues and opportunities. Although no government entity currently serves as a central coordinating body, greater efforts will be needed in the future to ensure the various agencies involved with energy-related tasks are aware of, at least in a general way, the work of each other.

By the conclusion of program review's energy management study, more information will be available about the performance of a number of the long-standing agencies and the roles of some of the newer entities, which may lead to specific recommendations regarding communication. In the meantime, as one speaker noted at the committee's public hearing:

> [S]ometimes decentralization is very valuable [a]nd leads to a bubbling up of ideas, new perspectives. …. [C]oordination should not mean consolidation. Coordination should really mean information flow. So that different entities involved in different aspects know what the others are doing. Many of these entities are new. …. It's part of a transition that's occurring in the state and in the region towards … a cleaner more sustainable system.[71]

Electricity Concerns

An issue of increasing interest nationally as well as in Connecticut is the question of whether consumers will have access to all of the electricity they desire at affordable prices. The answer involves two key elements -- the specific level of demand and the capability of the system to deliver that amount of electricity.

The electric power system is made up of multiple components. Equipment at a number of locations, using a variety of fuels and methods, generates electricity. This power is then transferred via high voltage transmission lines to distribution systems that deliver the electricity to consumers through a series of feeders, substations, and transformers. In New England, day-to-day operation of the system is managed by the nonprofit, independent system operator ISO - New England.

[70] Legislative Program Review and Investigations Committee, *Staff Update: Energy Management by State Government* (August 21, 2001), p.1.

[71] Daniel Sosland, Executive Director, Environment Northeast, *transcript of the Legislative Program Review and Investigations Committee's January 23, 2002 public hearing*, p.49.

Normally, the electric grid does not need all existing generating facilities to be operational or supply the grid at full capacity. However, successful operation of the system does require more potential capacity than expected demand.

First, generating plants need periodic maintenance. When those procedures occur, the units are shut down and unavailable to the system. While this usually is only a period of hours or days, it can last for months if problems are found. Second, unexpected outages can occur as a result of equipment failure, weather conditions, or stray animals.

Third, a reserve of power proportionate to the actual amount of on-line consumption is required in order to run the system reliably. Fourth, some generating plants have higher operating costs or environmental emissions, and they only run when demand is expected to exceed the capacity provided by routinely operating plants.

In 2001, summer peak electric demand in Connecticut reached 6,255 megawatts (MW), while installed capacity totaled 6,336 MW. Transmission import capability of 2,200 MW and load shift options of 562 MW increased resources to a level providing a reserve of 31 percent.[72]

On any given day, Connecticut may send power to and/or receive power from other New England states, New York, or Canada as the electricity available within the transmission system is dispatched to respond to changing demand. Detailed consumption data for the 1990s show Connecticut was a net importer of electricity during six of those 10 years, including all of the years from 1996 through 1999.[73]

Indeed, although a region may have a sufficient supply of electric power overall, limitations of the transmission system may prevent delivery of electricity to a subregion in the quantities desired. If the problem is a lack of sufficient long-distance transmission lines able to transport power from areas with excess supply to areas with insufficient supply, problems arise during periods of peak demand. Then local generation of electricity, which may not be the most cost-effective source, is required to meet demand. In some areas including parts of Connecticut, this situation is compounded because the transmission constraints are accompanied by insufficient local generation.[74]

A variety of solutions exist for solving transmission problems. In most cases, successful resolution of the issue requires a mix of approaches. The primary options include:

- energy conservation measures (i.e., curtailment of consumption and use of more efficient products);
- increased use of distributed generation (i.e., self-contained generating units located at or near the point of end-use consumption), particularly those using renewable energy sources;
- construction of new power plants; and
- new or upgraded transmission lines.

[72] Connecticut Siting Council, *Twenty Year Forecasts*, p. 5.
[73] EIA, *State Energy Data Report 1999*, Table 53.
[74] ISO-New England, *Opportunities and Challenges Facing the Electric Power Industry in New England*, pp. 6-7.

Energy efficiency efforts are among the quickest, most cost-effective, and consumer friendly steps that can be taken. Incorporating less energy intensive products into the workplace and residences reduces the consumption of resources and delays the need to increase capacity.

Distributed generation is receiving growing attention as a means of reducing local congestion, addressing security concerns, and expanding the use of renewable energy sources. The electricity produced by these units can be used exclusively at the location where the power is generated[75] or sold to the grid for use by others. In order to take full advantage of this option, issues such as interconnection standards and buy-back rates have to be resolved.

Efforts involving construction activity require more time to produce results that address the problem. Such projects can take years from conception through various required reviews to actual operation. In Connecticut, more than a dozen projects to rebuild, upgrade, or build new electric transmission lines within or adjacent to the state have been proposed, but nearly half would not be completed until 2006 or later.[76]

Although the area in Connecticut most directly affected by the congestion issue is the southwestern corner of the state, failure to solve this problem could be costly for all electric customers in the state. Proposals are being discussed to institute "locational pricing" in New England. Under such a policy, customers in an area where congestion causes the price of electricity to be higher than it otherwise would have to be must pay all of the added expense rather than having it averaged across all customers in the system. Depending on how the boundaries of the congested area are defined, all of Connecticut may be required to pay higher prices, not just customers in one portion of the state.

[75] The capacity of these units is generally less than 25 MW. Data from the Connecticut Siting Council (*Twenty-Year Forecasts*, Appendix A) indicates 71 facilities in Connecticut, with a total capacity of 128 MW, were self-generating electricity and retaining it for on-site use in January 2001. See Appendix C for more detailed information about these facilities.

[76] Connecticut Siting Council, *Twenty-Year Forecasts*, p. 17.

APPENDICES

Appendix A. Energy Sources Used Within Connecticut and Estimated Future Availability.			
Energy Source	***Current Use for Electric Generation***	***Estimated Future Availability***	***Issues Re: Use/Availability***
Coal	2 coal-fired electric generating facilities supply 566 MW -- ~9% of Connecticut's electric generation capacity	current U.S. reserves expected to last 240+ years -- represents one-quarter of world's estimated recoverable coal	relatively high facility installation expense and concern about air emissions; supplied via rail transport; clean-coal technology being researched
Petroleum	46 oil-fired electric generating facilities (some of which can also burn natural gas) supplying 2,706 MW -- 43% of Connecticut's capacity	current U.S. reserves expected to last 70 years, -- represents ~2% of known world reserves; 60% of oil used in the U.S. is imported	volatility of crude oil market discourages reliance as sole fuel source for new generation; vulnerable to market manipulation by foreign nations
Natural Gas	53 natural gas-fired electric generating units (some of which can also burn oil) supplying 724 MW -- 11% of Connecticut's capacity approved projects could add 2,642 MW, while other projects under discussion total 5,000+ MW	current U.S. reserves expected to last 71 years; large percent of recent capacity increases in New England are from Canada; potential capacity of 11,896 MW in New England for new generation	high efficiency, cleaner emissions, and relatively low capital cost per kWh; less impact on air quality than coal or oil, but there are concerns about future NOx and CO_2 limits; potential for over-dependence and lack of fuel diversity; effects of competition from other uses on supply
Nuclear	2 operational units capable of supplying 2,017 MW -- ~32% of Connecticut's capacity accounted for 45% of capacity in 1996; estimated to be 1,146 MW or 21% of projected capacity in 2015 (unit providing 840 MW scheduled to retire then)	no new capacity planned in CT, but nuclear power being considered in draft national energy policy	zero-air-emission generation source; costs for scheduled and unscheduled outages; waste storage, transport, and disposal issues; public safety; security; facility costs

Appendix A. Energy Sources Used Within Connecticut and Estimated Future Availability.			
Energy Source	***Current Use for Electric Generation***	***Estimated Future Availability***	***Issues Re: Use/Availability***
Hydroelectric	39 hydroelectric facilities supplying 151 MW -- 2% of Connecticut's capacity	115 MW of capacity undergoing relicensing review	previously viewed as clean, renewable source, but increasing scrutiny by recreational/environmental groups re: effects of dams; relative cost; lack of sites
Distributed generation	can provide energy, cogeneration, and emergency power -- combined heat and power, standby power, peak shaving, grid support, and stand alone generation	current sources include reciprocating engines and small combustion turbines; emerging technologies close to being economically viable include microturbines, fuel cells, wind turbines, and photovoltaics	obstacles include lack of technology maturation, cost associated with economy of scale, and regulatory barriers (e.g., interconnection requirements, permitting and siting, code compliance); advantages include location within load pockets, secured at customer site, and less reliant on transmission infrastructure
CLASS I Renewables	currently 8.3MW		
CLASS II Renewables	currently 1,274 MW		

MW = megawatts

Source of data: Connecticut Siting Council, *Review of the Connecticut Electric Utilities' Twenty-Year Forecasts of Loads and Resources* (October 2001).

APPENDIX B. Connecticut Governmental Entities Involved With Energy.			
Entity	***Structure***	***Basis of Authority***	***Activities***
Office of Policy and Management (OPM)	statutory agency headed by a secretary -- contains an Energy Division	C.G.S. Sec. 16a-14	secretary is designated state official re: allocation, conservation, distribution, consumption, etc. of energy resources to: • implement/execute federal laws, programs, etc. • investigate complaints of federal/state rule violations • coordinate federal/state programs • cooperate with federal authorities, other states • conduct public education programs • carry out hearings/surveys/analyses
OPM	[see above]	C.G.S. Sec. 16a-35m	required to prepare comprehensive energy plan every four years reflecting legislative findings and policy stated in C.G.S. Sec. 16a-35k -- draft issued in 1993 for public comment, but no final plan ever issued
Connecticut Energy Advisory Board (CEAB)	16-member body (in OPM for administrative purposes only)	C.G.S. Sec. 16a-3	required to recommend programs to enhance the state's energy management and carry out the purposes of C.G.S. Sec. 16a-35k
Department of Public Utility Control (DPUC)	statutory agency -- executive director (selected by majority of 5-member Public Utilities Control Authority) serves as chief administrative officer	Title 16 Chapters 277-289	responsible for ensuring safe, reliable, modern, and fairly priced utility services including electric and gas are available in the state; assess fees for the Renewable Energy Investment Fund and the Energy Conservation and Load Management Fund (and must authorize disbursements from the latter)
Energy Conservation Management Board (ECMB)	12-member body	C.G.S. Sec. 16-245m	advises DPUC on electric distribution companies' plans for energy conservation programs and market transformation initiatives, using money from Energy Conservation and Load Management Fund
Office of Consumer Counsel (OCC)	statutory office directed by person appointed by the governor	C.G.S. Sec. 16-2a	acts as advocate for consumers' economic interests in matters affecting Connecticut consumers related to utilities (including electric suppliers)
Office of the Attorney General	statutory office directed by statewide elected official	C.G.S. Sec. 3-125	has general supervision over all legal matters the state is interested in -- generally involved in energy issues from consumer and environmental protection points of view

APPENDIX B. Connecticut Governmental Entities Involved With Energy.			
Entity	***Structure***	***Basis of Authority***	***Activities***
Connecticut Innovations, Inc. (CII)	quasi-public entity governed by 15-member board of directors -- chair may convene advisory committee (up to 12 members) to assist with *Renewable Energy Investment Fund*	C.G.S. Sec. 16-245n	duties include management of the Renewable Energy Investment Fund (also known as the **Connecticut Clean Energy Fund**) that provides venture capital for projects/companies promoting the use of clean power
Connecticut Siting Council (CSC)	9(+)-member body -- exact composition varies based on type of project under review	C.G.S. Sections 16-50g through 16-50aa	jurisdiction includes approval of location/type of electric transmission lines, fuel transmission facilities, electric generating/storage facilities, and electric substations; issues 20-year forecasts of electric power demand
Department of Public Works (DPW)	statutory agency headed by a commissioner	Title 16a	for state-owned and leased facilities, has wide range of duties regarding energy audits, lighting standards, life-cycle cost analyses, energy performance standards, etc.
Department of Administrative Services (DAS)	statutory agency headed by a commissioner	C.G.S. Sec.4a-51 C.G.S. Sec. 4a-56	has broad purchasing authority for all state agencies is to adopt purchasing standards and consider alternative fuel vehicles when purchasing motor vehicles
Department of Environmental Protection (DEP)	statutory agency headed by a commissioner	Title 22a	has a variety of duties related to preservation and protection of the environment that involve energy-related issues
Department of Transportation (DOT)	statutory agency headed by a commissioner	C.G.S. Sec. 13b-4	duties re: development/operation of highway system include consideration of energy-conservation; also must report on energy use analysis by mode of transportation
Consumer Education Advisory Council/ Conn. Energy Education Council	10(+)-member body	C.G.S. Sec. 16-244d	advises DPUC public education outreach coordinator on development and implementation of program to educate customers about implementation of retail competition among electric suppliers
Nuclear Energy Advisory Council	12(+)-member body	C.G.S. Sec. 16-11a	works with others to ensure public health/safety and discuss problems related to operation of nuclear power facilities
Institute for Sustainable Energy	separate unit within Eastern Conn. State Univ. -- reports directly to president	not applicable	established to promote improved awareness and understanding of sustainable energy

APPENDIX C. Entities That Self-Generate and Retain Electricity, January 2001.				
Fuel Type	***No. of Facilities***	***Total Capacity (MW)***	***No. of Towns***	***Range of Capacity of Individual Facilities***
Diesel	1	4.50	1	4.50 MW
Gas	38	44.53	23	0.02 - 23.80 MW
Gas/Oil	4	18.84	1	0.24 - 6.20 MW
Hydro	9	1.36	9	0.02 - 0.53 MW
Methane	1	0.13	1	0.13 MW
Oil	8	36.39	7	0.01 - 25.00 MW
Oil/Gas	2	20.50	2	2.00 - 18.50 MW
Propane	1	0.03	1	0.03 MW
Solar	3	0.12	3	0.02 - 0.05 MW
Waste Heat	1	2.00	1	2.00 MW
Wind	3	0.05	3	0.01 - 0.02 MW
TOTAL	71	128.45	*	0.01 - 25.00 MW

MW = megawatts

* Some towns have more than one self-generating facility within their borders, but not all of them use the same type of fuel. Forty-one towns have at least one facility.

Source of data: Connecticut Siting Council, *Review of the Connecticut Electric Utilities' Twenty-Year Forecasts of Loads and Resources* (October 2001), Appendix A.