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The Future of Nuclear Energy in Florida

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THE FUTURE OF NUCLEAR ENERGY IN FLORIDA

BY

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CHAPTER 1

FLORIDA'S ELECTRIC ENERGY REQUIREMENTS

1.1 Florida's Total Energy Requirements

During the period 1950-1970, Florida's gross energy use has increased fivefold. During this same period, its population grew by a factor of 2.4. The growth in energy use is presented in Figure 1. As can be seen in this figure, Florida's growth rate far exceeds that of the United States and the world. During the period 1960-1972, Florida's annual energy growth rate was 7.6 percent. This is shown in Figure 2. The energy requirement is plotted in terms of BTU's and barrels of crude oil as a function of year.[1]

Florida is almost entirely dependent on petroleum products. As a comparison, the United States derives 75 percent of its total energy from petroleum products. Ninety seven percent of the total energy used in Florida must be imported. Hence Florida is more sensitive to fuel shortages than other regions of the United States.[1]

1.2 Florida's Present Day Electrical Energy Requirement

In Florida, electricity generation is consuming an increasingly larger portion of the petroleum products used because the demand for electricity has grown approximately

Figure 1

INCREASES IN GROSS ENERGY USE[3]

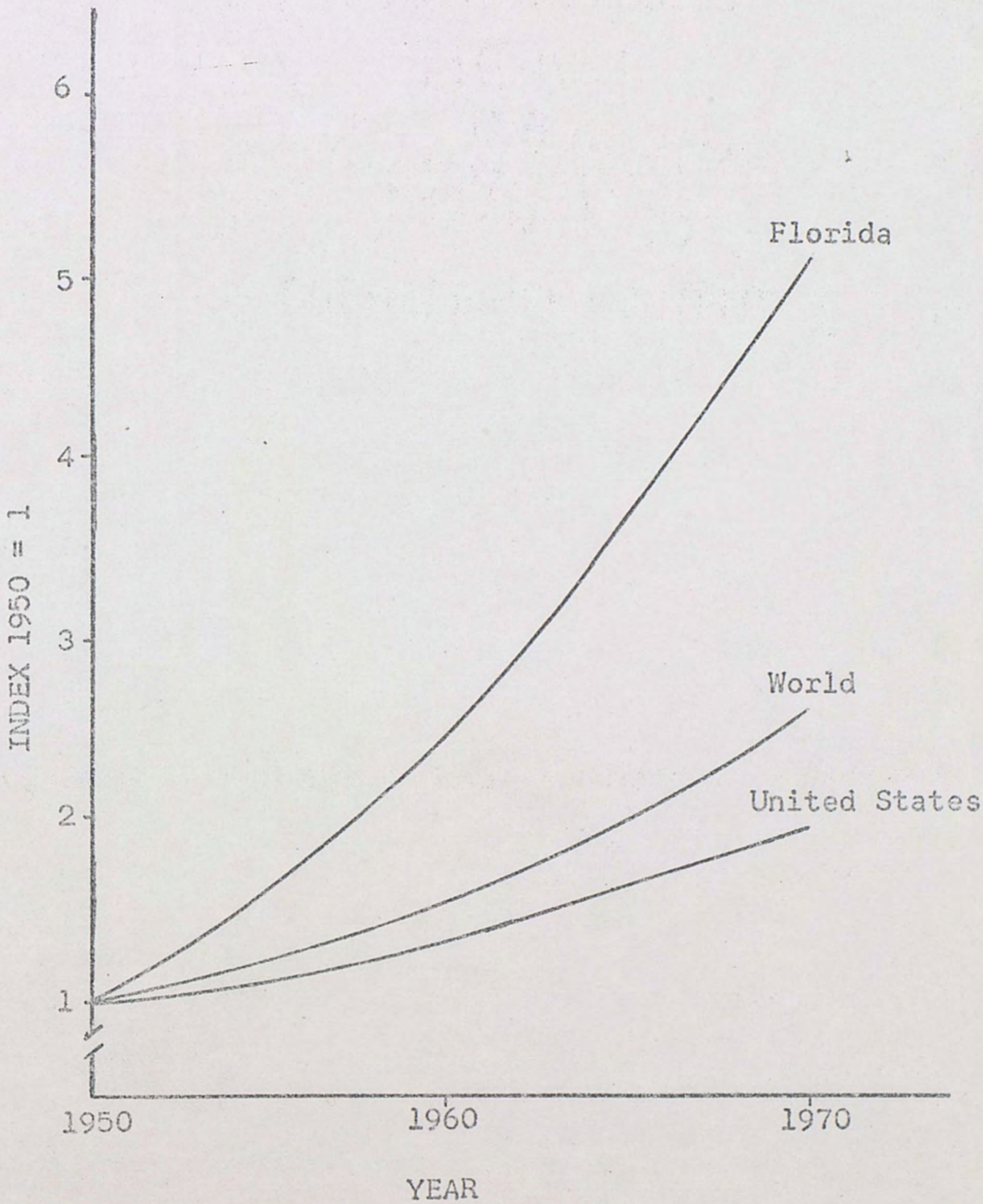
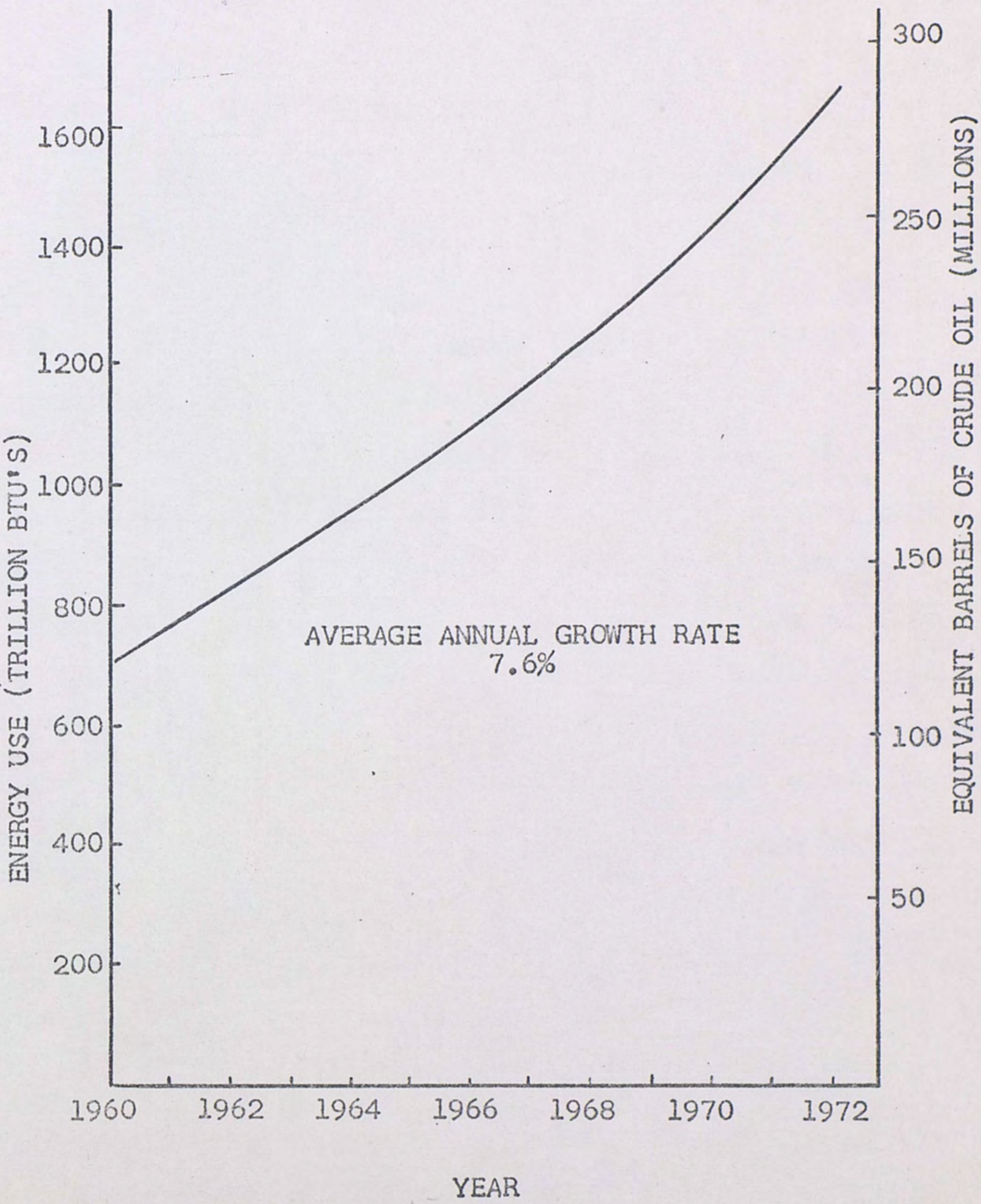


Figure 2

FLORIDA ENERGY USE[2]



1.25 times faster than the demand for total energy. In 1972, 43.2 percent of the total energy consumed in Florida was used in the generation of electricity. This compares to 28.9 percent of the total energy consumed in 1960.[4] Tables 1 and 2 show the total energy consumed in Florida by types for 1960 and 1972. Figure 3 shows the types of energy used for the generation of electricity.

The annual growth rate of over 11 percent for electricity consumption was much higher for the period 1960-1972 than the average annual growth rate for total energy consumption of 7.6 percent. This has caused the disproportionate increase in the amount of fuel used to generate electricity.[5]

Per capita growth in electrical use, as a result of the rising affluence of Florida citizens, and increasing population have resulted in a high growth rate in electricity consumption. Other factors which affect the rate of electricity growth are shown in Chapter 5. From 1960-1972, Florida's per capita use of electricity increased at an average growth rate of 7.4 percent per year. This per capita growth combined with Florida's population growth has given Florida its very high growth rate in electrical energy use. For comparison, the average national growth in electricity use during the same time period was slightly more than 6 percent.[4]

The total energy used for electricity generation in 1972 was equal to 724 trillion BTU's. Only about one third of this energy was converted to electricity and delivered to the consumer. The remainder of the energy was lost as waste

TABLE 1

ENERGY CONSUMED IN FLORIDA - 1960[6]

Product	Quantity	Trillion BTU	Per Cent of Total**
Middle Distillates	12,187,000 bbls	70.37	10.16
Residual Fuel	27,515,000 bbls	172.99	24.75
LP Gas	4,935,000 bbls	19.79	2.83
Gasoline	45,488,000 bbls	238.72	34.15
Jet Fuel	2,330,000 bbls	13.21	1.89
Natural Gas	139,524,000,000 cu.ft.	144.41	20.66
Coal	1,447,500 tons	37.90	5.42
Hydroelectric	278,000,000 KWH	0.95	.14
Nuclear			
	Total	698.34	100.00

* Fuels consumed by the military and feed stocks are not included

** Percentages are shown to two decimal places to permit the the inclusion of minor sources.

TABLE 2

ENERGY CONSUMED IN FLORIDA - 1972[7]

Product	Quantity*	Trillion BTU	Per Cent of Total**
Middle Distillates	21,900,000 bbls	126.40	7.59
Residual Fuels	76,058,000 bbls	478.18	28.55
LP Gas	7,870,000 bbls	31.57	1.89
Gasoline	94,476,200 bbls	495.83	29.61
Jet Fuel	19,125,000 bbls	108.43	6.47
Natural Gas	301,121,000,000 cu.ft.	311.66	18.61
Coal	5,464,000 tons	120.20	7.18
Hydroelectric	292,000,000 KWH	1.00	.06
Nuclear	43,400,000 KWH	0.64	.04
	Total	1673.91	100.00

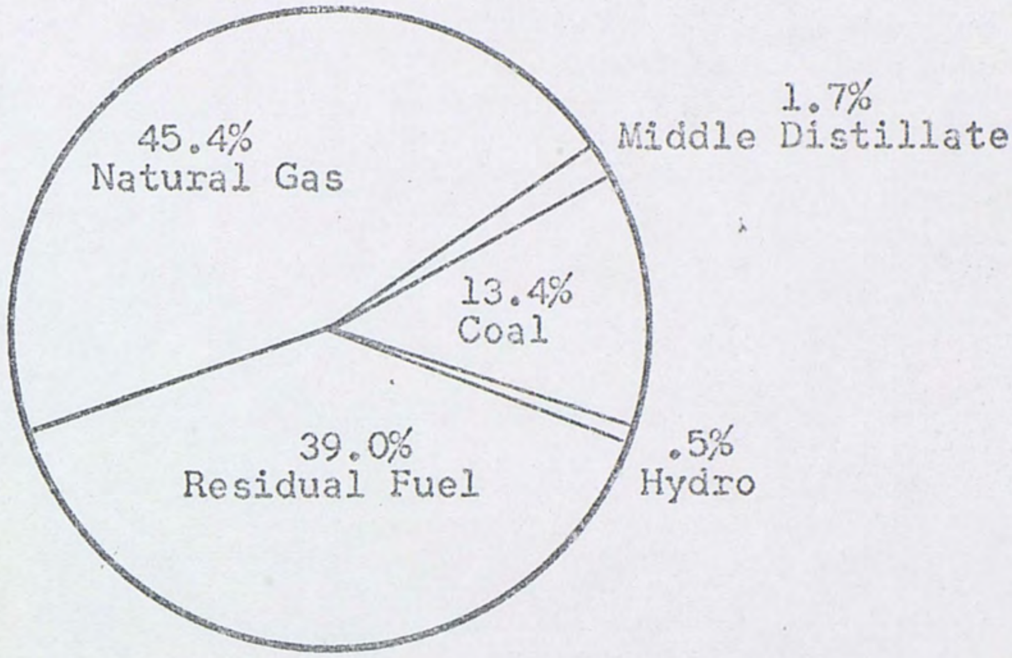
* Fuels consumed by the military and feed stocks are not included.

** Percentages are shown to two decimal places to permit the inclusion of minor sources.

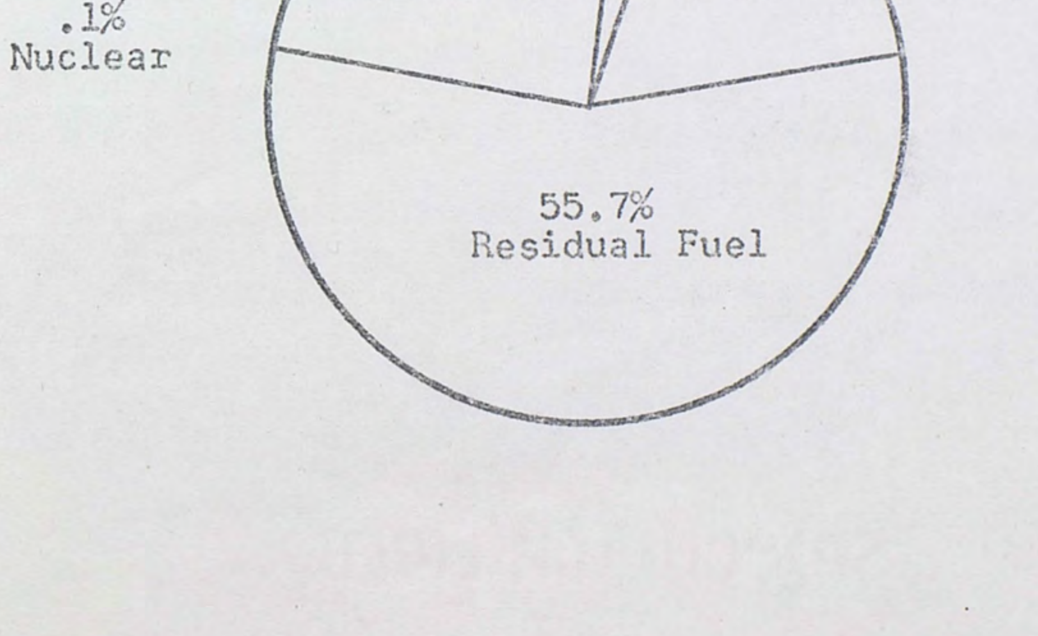
Figure 3

ENERGY USED FOR GENERATION OF ELECTRICITY IN FLORIDA[8]

1960 (202 Trillion BTU's)



1972 (724 Trillion BTU's)



heat due to the inherent generation and transmission inefficiencies.[4] Figure 3 shows the energy used for the generation of electricity for the period 1960-1972.

As seen in Figure 3, petroleum products were the primary source of fuel used for the generation of electricity in both 1960 and 1972. Nuclear energy used for electricity generation made only slight contributions in 1972.

Residential use of electricity in Florida was over 44 percent of the total electricity consumption. Figure 4 gives a comparison of the electricity use by sector. It is interesting to note that Florida's residential use of electricity is much higher than the national average. Florida's average resident used approximately 1.5 times more electricity than did the average national residence.[9]

Figure 5 shows a comparison of Florida's growth in electrical energy use with that of the nation for the period 1955-1970. As can be seen in this figure, Florida's electrical energy requirements increased almost exponentially.

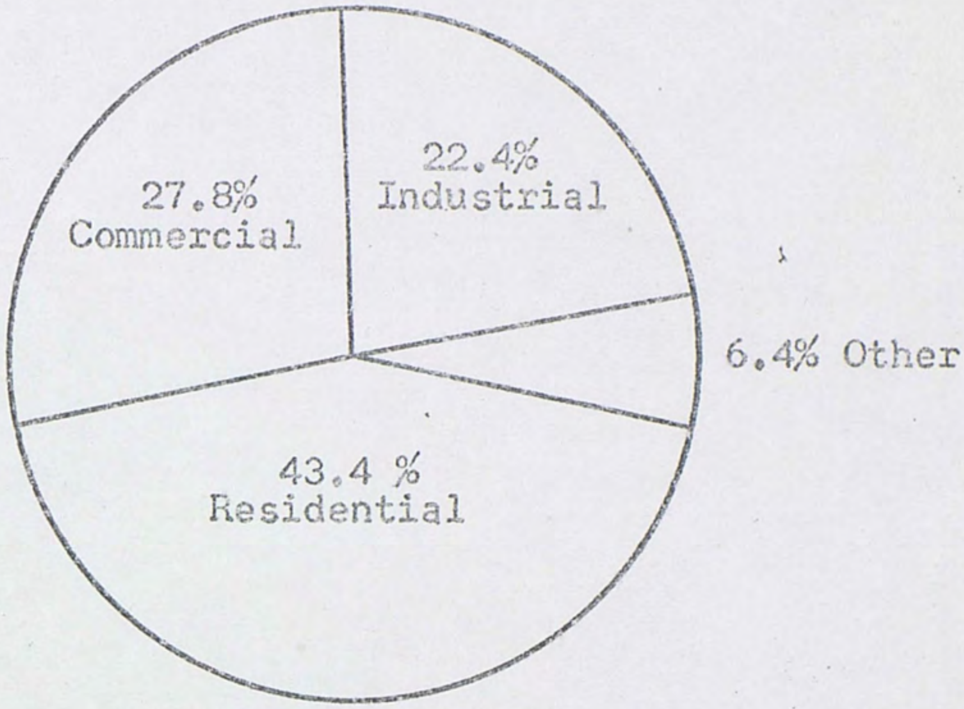
1.3 Florida's Future Electric Energy Requirements

Forecasting electrical energy requirements for the future is quite difficult. In addition to generating capacity requirements and demands, fuel requirements must also be predicted so that fuel contracts may be established. Most energy requirement forecasting methods depend on historical data in order to generate a pattern of load growth over a period of time. According to reference 6, there are

Figure 4

ELECTRIC ENERGY CONSUMED BY CONSUMING SECTORS IN FLORIDA[10]

1960 (17,850 Million kwh's)



1972 (62,995 Million kwh's)

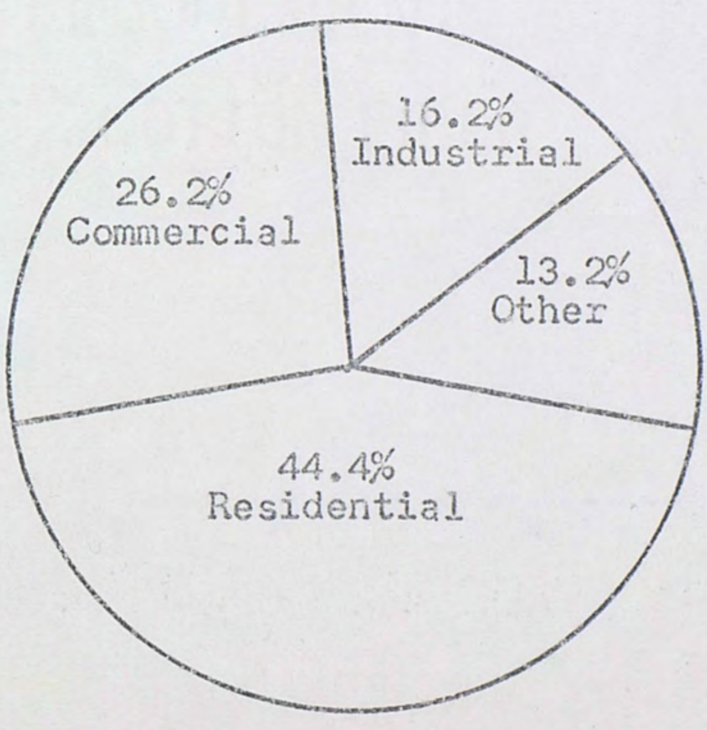
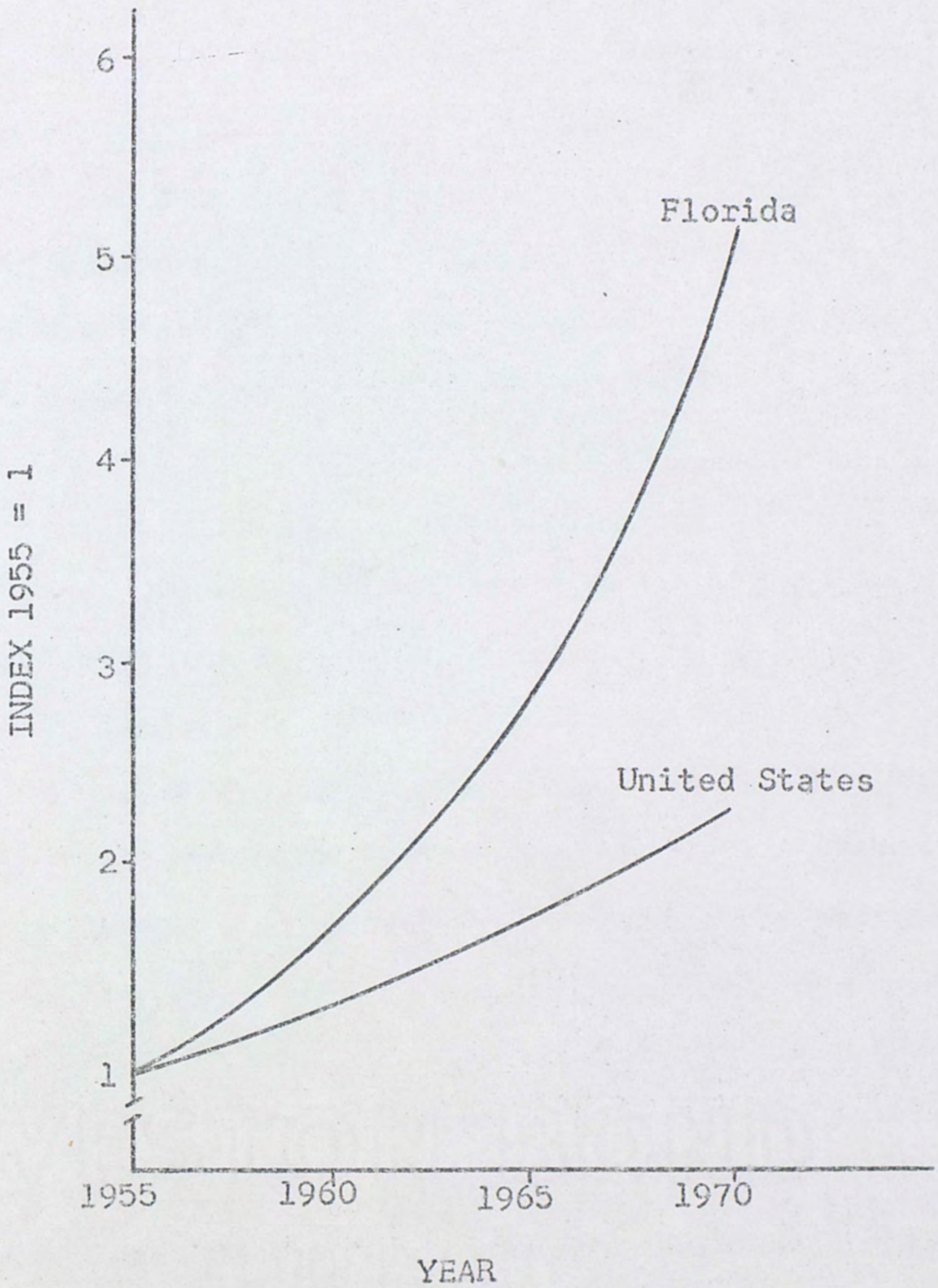


Figure 5

INCREASES IN ELECTRICAL ENERGY USE [11]



generally three projection ranges used in the electrical energy requirement forecasts. These are:

1. Short Range - Up to 2 years
2. Intermediate Range - Up to 10 years
3. Long Range - Up to 30 years

Florida's requirements for these ranges will be discussed separately.

The short range period is an extension of present day requirements and generating capacities. It is during this period that the power producing companies formulate energy interchange agreements since generating plants cannot be built in a period of 2 years. Florida's short range requirements can be seen in Table 3 and Figure 6. As would be expected, the peak load requirements occur during the months of August and September when the air conditioning load is the greatest.

During the intermediate range, new generating facilities and transmission line facilities are planned. Each power company is required to submit a ten year plan to the planning department of Florida. Projections during this period are based on historical data, social and economic trends, and population change. As it requires up to 10 years to initiate and construct a modern nuclear plant, decisions made today will result in new generating plants in the mid 1980's.[12]

The intermediate forecast for peak power demand and energy requirements is shown in Table 4 and Figures 7 and 8.

Table 3

STATE OF FLORIDA

MONTHLY PEAK LOAD ESTIMATES[13]

	1974 Peak Load (MW)	1975 Peak Load (MW)
JAN	11,909.2	13,608.3
FEB	12,150.0	13,485.0
MAR	11,827.9	13,099.6
APR	12,893.1	14,372.3
MAY	13,638.6	15,191.5
JUN	15,143.9	16,859.3
JUL	15,492.6	17,219.8
AUG	15,813.1	17,564.1
SEP	15,617.5	17,361.4
OCT	14,683.2	16,377.1
NOV	13,402.2	14,918.0
DEC	13,633.9	15,142.3

* Peak Load is non-coincident adjusted net 60-minute for normal weather conditions.

Figure 6

MONTHLY PEAK LOAD ESTIMATES [14]

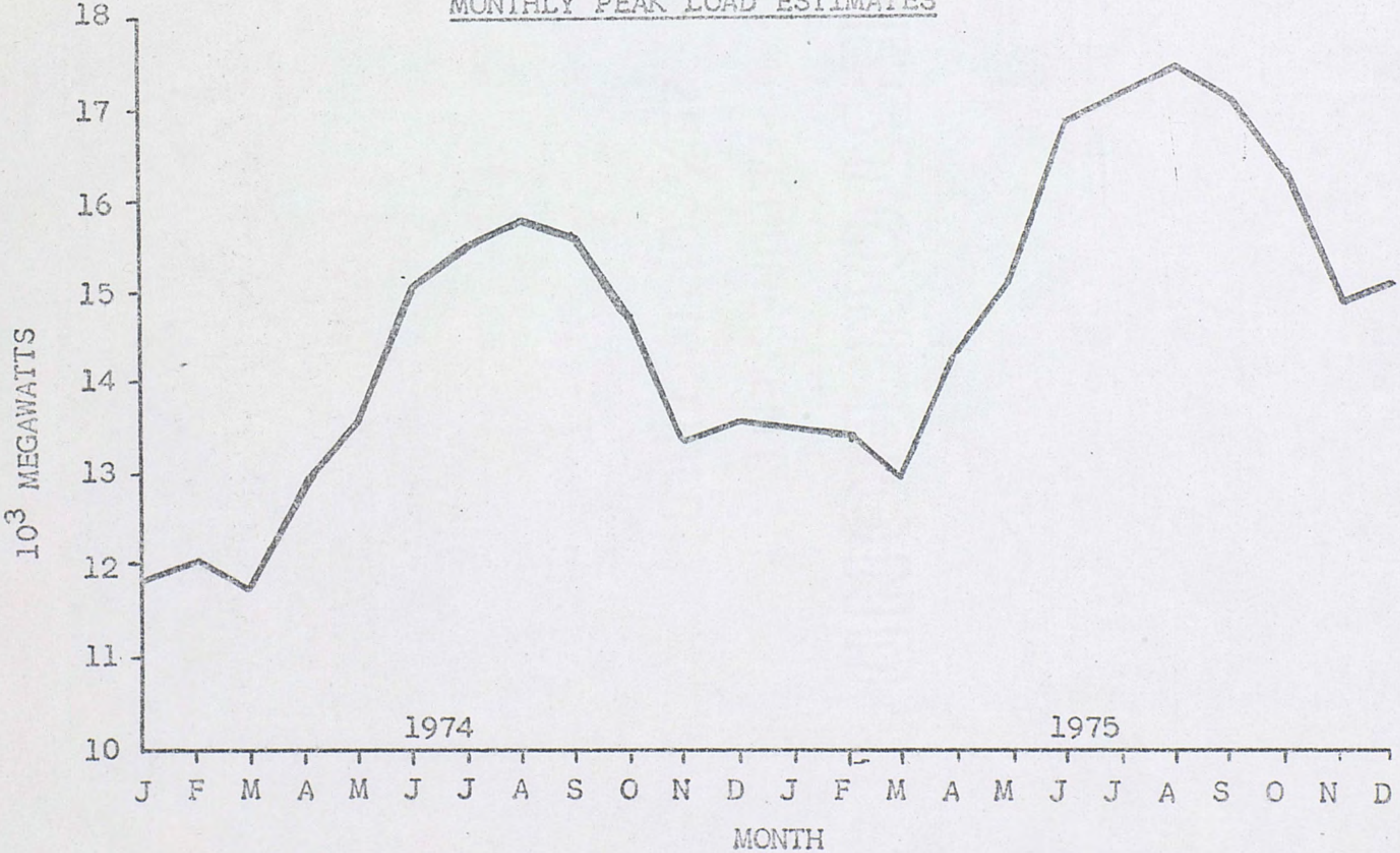


Table 4

FORECAST OF NET PEAK DEMAND AND ENERGY REQUIREMENTS[15]
1974-1983

	SUMMER PEAK DEMAND			NET GENERATION		
Year	Total-MW	Change-MW	% Change	Total-GWH	Change-GWH	% Change
1974	15,853	1,242	8.50	83,630	8,030	10.62
1975	17,630	1,797	11.21	92,132	8,502	10.17
1976	19,615	1,965	11.26	100,120	7,988	8.67
1977	21,761	2,146	10.94	109,296	9,176	9.17
1978	24,095	2,334	10.73	119,509	10,213	9.34
1979	26,661	2,566	10.65	132,147	12,638	10.57
1980	29,497	2,836	10.64	145,555	13,408	10.15
1981	32,562	3,065	10.39	160,072	14,517	9.97
1982	35,840	3,278	10.07	175,180	15,108	9.44
1983	39,323	3,483	9.72	189,921	14,741	8.41
		Average	10.41		Average	9.65

Figure 7

FORECAST OF NET PEAK DEMAND AND ENERGY REQUIREMENTS[16]

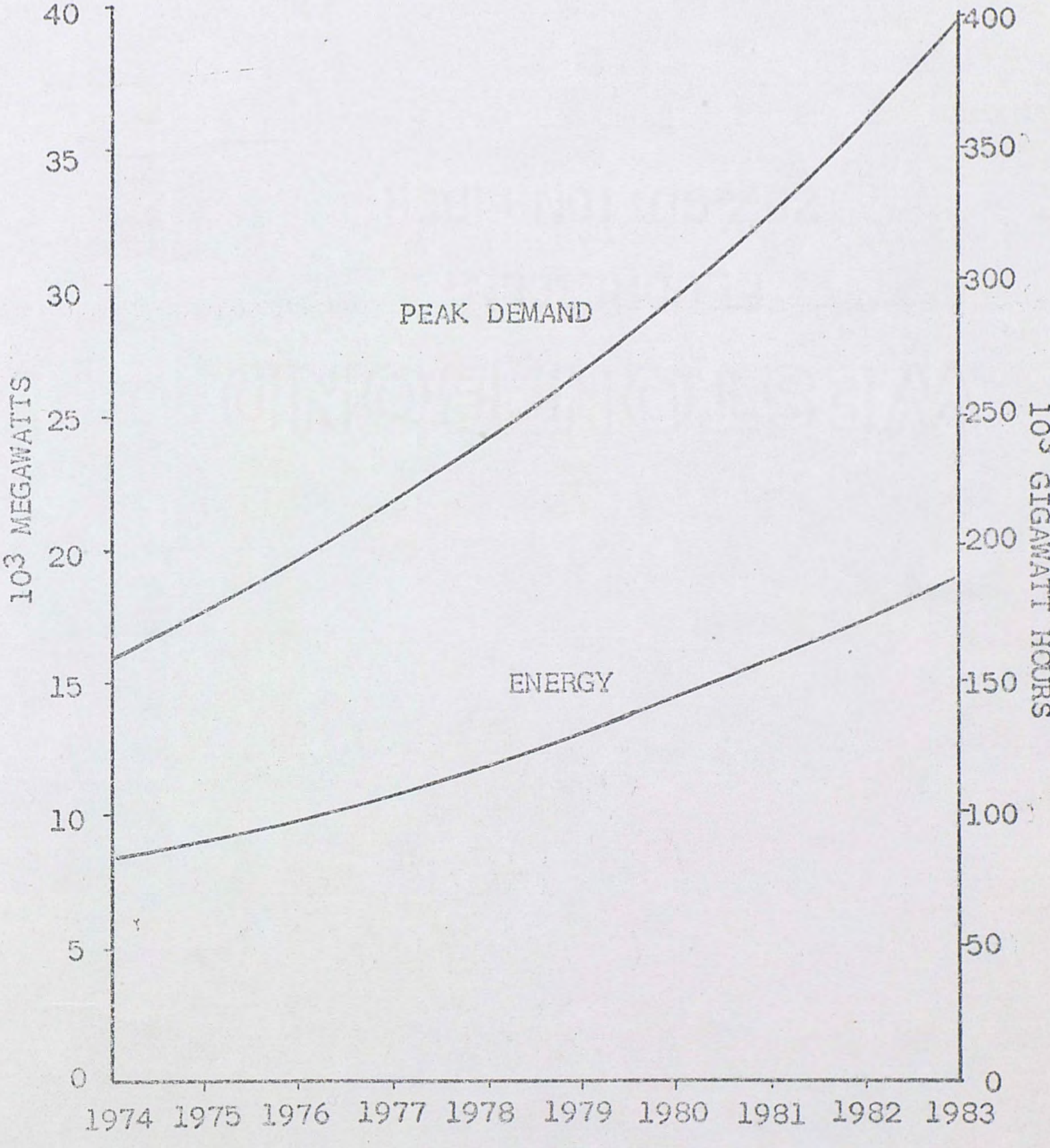
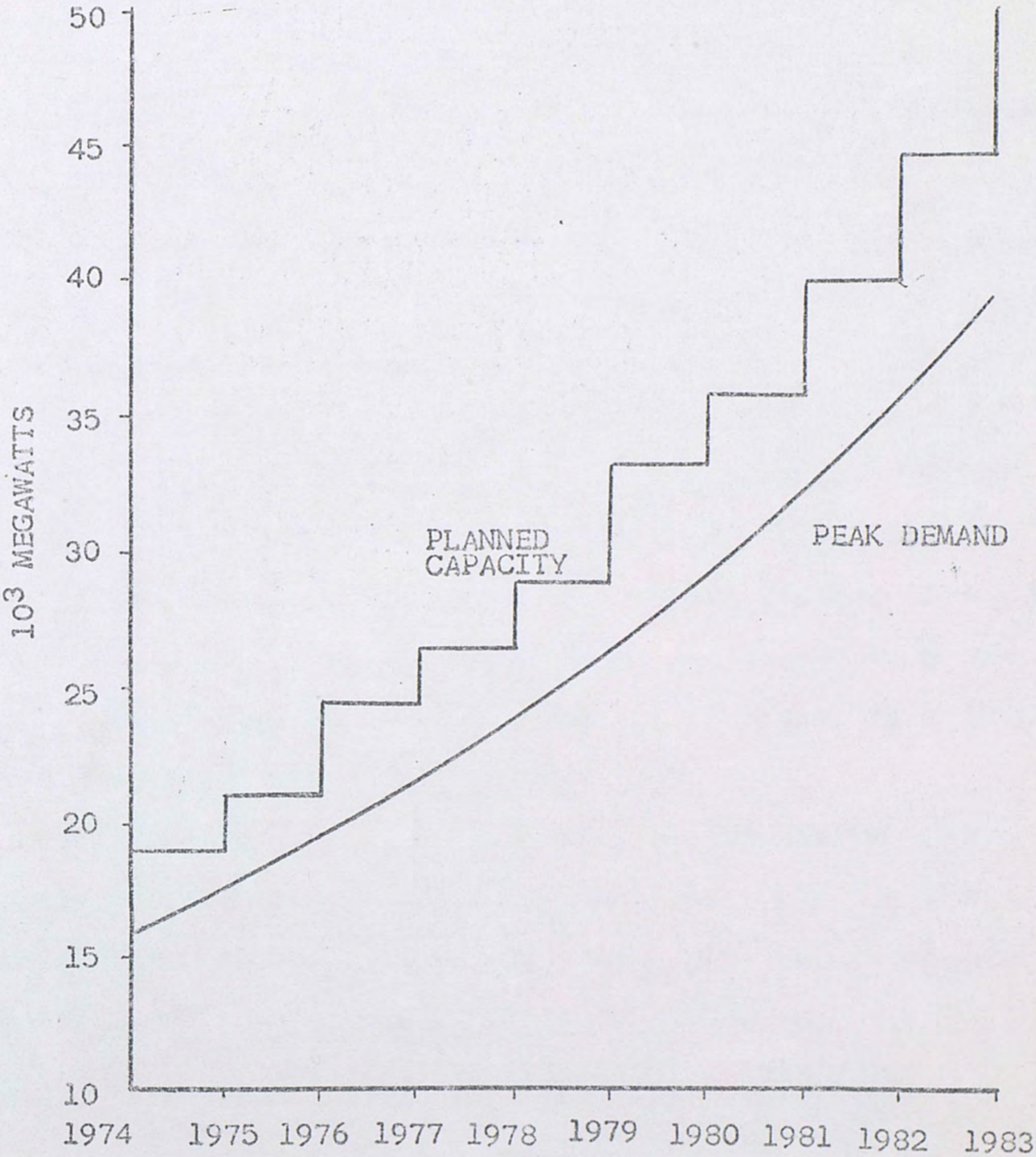


Figure 8

FORECAST OF PEAK DEMAND AND INSTALLED CAPACITY[17]



These figures indicate a doubling of peak demand by 1981 and of electrical energy requirements by 1982. This represents average growth rates of 10.4 percent for the peak demand and 9.65 percent for the energy requirements. This compares to a growth rate of over 11 percent for the period of 1960-1972. The current energy crisis and the associated changes in the economic situation are the primary reasons for this slight decrease in average growth rate. During the peak rate of growth years between 1965 and 1973, the doubling rate of electricity demand was approximately once every 6 years. This compares to a doubling every 8 years for the lower predicted growth rates.[18]

Long range forecasting is difficult due to the many changes taking place in the energy picture today. Factors which must be considered are: population growth, economic conditions, technological advances, social factors, and political factors.. Chapter 5 will discuss a predicted electrical energy demand in the year 2000 and its associated electricity generating plan requirements.

As pointed out earlier, Florida's electricity requirements are increasing at an alarming pace. Over the next 10 years, there is not a new energy source that could be made available within Florida which would provide any significant percentage of the state's electrical energy requirement. For this argument, nuclear energy is not considered a new source. As a result, Florida must depend on existing electrical energy sources. Nuclear energy will provide a significant percentage of the total generation capacity. Chapter 2 will discuss the energy sources which will provide Florida's electrical energy requirements through 1985 and Chapter 5 will discuss requirements and energy sources in the year 2000.

CHAPTER 2

FLORIDA'S NUCLEAR POWER PLANTS

2.1 Nuclear Power In Florida

An abundant supply of electricity generated at a low cost with minimum effects on Florida's environment is desirable. Abundant electrical energy supply, low cost, and minimum environmental effects may be achieved by the use of electricity generated by nuclear fission.[19] The extent to which this statement is true for Florida will be shown in the following chapters.

The nuclear reactors used for electricity generation in Florida are of the light water type. In these nuclear reactors, pressurized water at temperatures up to 600°F is used as a coolant and as a fission moderator. Two types of light water reactors exist. These are the pressurized water reactor and the boiling water reactor. Florida's nuclear reactors are the pressurized water reactor type.[20] Appendix A describes the principle of the pressurized water reactor nuclear power plant.

As will be discussed in this chapter, nuclear power plants make a significant contribution to Florida's present electricity requirements. Future demand for electricity will be supplied by an increasing number of nuclear-powered generating plants.

212 Existing Electricity Generating Facilities

As of January 1, 1974, Florida utilities had a summer net electricity generating capability of 17,095.6 megawatts, and a net winter capability of 17,807.6 megawatts (increased plant efficiency due to lower temperature cooling water results in higher winter capability).[21] Existing capacity for Florida utilities is given in Table 1 & 5 of Appendix B. At this time, only the two nuclear plants at Turkey Point in Dade County are in operation. These two units have a net capability of 1346.0 megawatts during the winter. This represents 7 percent of the state's total generating capability.

Electric power generating facilities in Florida are comprised of fossil fuel steam turbines, combustion turbines, diesels, and nuclear steam turbines. Table 1 of Appendix B illustrates this fact. Table 6 shows that fossil-fueled steam turbine facilities make up 72 percent of the net capacity of the state. These facilities produce 84 percent of the energy supplied to the customer.[10] Fossil fuel steam facilities are considered to be those fired by residual oil, coal, natural gas, or a combination of these fuels.

Combustion turbine facilities will make up 21 percent of the total net capacity for 1974. However, these facilities will produce only 4 percent of the electricity con-

Table 5

EXISTING CAPACITY AS OF DEC. 31, 1973[23]

Utility	Net Capability - MW Summer	Net Capability - MW Winter
Florida Power and Light Company	8,308.6	8,725.4
Florida Power Corporation	2,539.0	2,720.0
Fort Pierce Utilities Authority	72.0	75.0
Gainesville/Alachua County Regional Utilities	228.0	225.0
Gulf Power Company	1,595.6	1,601.6
Jacksonville Electric Authority	1,352.8	1,412.0
Lakeland, Dept. of Electric and Water Utilities	259.4	274.5
Lake Worth Utilities Authority	87.5	92.0
Orlando Utilities Commission	412.0	426.0
Tallahassee Electric Department	277.7	280.0
Tampa Electric Company	1,899.0	1,899.0
Vero Beach Municipal Utilities	74.0	77.0
TOTAL	17,095.6	17,807.5
Total Nuclear	1,346.0	1,386.0
Total Fossil Steam	13,228.3	13,685.9
Total Diesel	58.5	59.0
Total Combustion Turbine	2,462.8	2,676.6
TOTAL	17,095.6	17,807.5

*Represents approximately 99 per cent of Florida's total generating capacity

Table 6

CAPACITY MIX[24]

Percent of Capacity[1]	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Nuclear	7	10	12	11	10	9	11	9	10	15
Fossil Steam	72	68	67	66	64	63	61	61	60	58
Combustion Turbine	21	19	17	16	16	15	15	14	13	12
Combined Cycle	0	2	3	7	9	13	13	15	16	15

GENERATION USE (CAPACITY FACTOR)

Percent of Utilization[2]	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Nuclear	86	77	75	72	79	79	74	81	78	72
Fossil Steam	59	58	52	52	51	49	51	48	47	46
Combustion Turbine	9	8	6	6	6	7	7	6	6	6
Combined Cycle	0	38	37	51	55	50	50	49	45	43

SOURCE OF ENERGY

Percent of Total Generated Energy	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Nuclear	12	16	20	17	17	16	17	17	18	24
Fossil Steam	84	79	76	74	70	68	67	65	63	60
Combustion Turbine	4	3	2	2	2	2	2	2	2	2
Combined Cycle	0	2	3	7	11	14	14	16	16	15

1 Diesel capacity less than 1%

2 Estimates only, based on present technology and fuel availability

sumed.[22] Due to the lower efficiencies of these units, they are mainly used during peak requirements. However, delays in construction of planned nuclear and fossil plants have forced a heavier than planned reliance on these units in order to prevent power shortages.

The use of diesel generators in Florida accounts for less than 1 percent of the net capacity. Although the diesel generators exhibit efficiencies equal to that of modern fossil fuel plants (approximately 40 percent), their small size of 15 megawatts or less limits their use. Like the combustion turbine systems, the diesel generators can be put on line quickly.

Turkey Point #3 was the first nuclear plant to become operational. It has since been followed by Turkey Point #4. Capacities of these two units are 673 megawatts each. A host of other nuclear plants are in the planning and construction stages.

As mentioned above, electricity generated by Turkey #3 and Turkey Point #4 power plants will represent approximately 7 percent of Florida's total electricity generating capacity in 1974. However, the output from these two nuclear plants will represent 12 percent of the electricity produced in Florida during 1974. This is because nuclear power plants will be used during times of non-peak power requirements as well as peak requirements while other types of electricity generating plants will be shut down. These two nuclear power plants will have an 86 percent utilization factor for

1974. The above figures are shown in Table 6. Corresponding figures for the other types of power plants are also shown in Table 6. It is interesting to note that the nuclear power plants have a much larger percent of utilization.

The first combined cycle generating system is planned for use by Florida Power and Light Company at its Palatka facility in 1975.

Additional combined cycle generating systems are scheduled for use according to Table 2 of Appendix B. This unit will be capable of producing 484 megawatts and consists of a combustion turbine and a steam turbine. This unit is expected to have an efficiency of over 40 percent.[25]

2.3 Forecast of Nuclear Power Plants For The Intermediate Range

Planned electricity generating stations during the period 1974-1983 are given in Table 7. A detailed summary of the additions is given in Table 2 of Appendix B. Table 7 shows the total additions to existing capacity since the previous year. Five classes of generating units are shown. These are: nuclear, fossil steam, combustion turbine, combined cycle, and diesel.

Also in Table 7 is the generating capacity for the peak requirement condition in August of each year. This capacity is detailed by the types listed above. The reserve margin of electricity generation is listed on the bottom of

Table 7

STATE OF FLORIDA

PLANNED AND PROSPECTIVE GENERATING CAPACITY ADDITIONS [26]

Additions to Existing Capacity - MW	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Nuclear	0	825	802	0	0	0	802	0	900	2535
Fossil Steam (Net)*	437	643	2202	1079	1054	2361	864	2685	2190	1189
CT (Net)	1452	66	132	0	417	466	393	266	150	66
CC (Net)	0	484	318	950	950	1450	600	1250	1300	0
Diesel	0	0	0	0	0	0	0	0	0	0
Total Additions Since Previous Year	1889	2018	3454	2029	2421	4377	2659	4201	4540	3790
Cumulative Totals	1889	3907	7361	9390	11811	16088	18747	22948	27488	31278
Total Net Dependable For Summer Peak After Additions - MW										
Nuclear	1346	2171	2973	2973	2973	2973	3775	3775	4675	7210
Fossil Steam	13665	14308	16510	17589	18643	21004	21868	24553	26743	27932
CT	3915	3981	4113	4113	4530	4996	5389	5655	5805	5871
CC	0	484	802	1752	2702	4152	4752	6002	7302	7302
Diesel	59	59	59	59	59	59	59	59	59	59
Total Available	18985	21003	24457	26486	28907	33184	35843	40044	44584	48374
Estimated Summer Peak Demand - MW	15853	17630	19615	21761	24095	26661	29497	32562	35840	39323
Reserve Margin Gross Before Maintenance	3132	3373	4842	4725	4812	6523	6346	7482	8744	9051
% of Peak	20	19	25	22	20	24	22	23	24	23

FCG 10 Year Electrical Utility Expansion Plan

*NET - Net increment considering additions, retirements, and conversions this table.[26]

Table 6 shows the capacity mix, the capacity factor, and the energy source for the various types of electricity generating plants to be added from 1974 through 1983. The capacity mix shows the mixture of the various types of generating plants to be used. The capacity factor shows the ratio of the average load to the total generating capacity, and the energy source details the type of energy to be used for electricity generation..

By 1983, nuclear power plants will account for 15 per cent of Florida's electricity generation capacity. This compares to 7 per cent for 1974 as was previously mentioned. Fossil steam turbine electricity generation on the other hand will decrease from 72 per cent of the total capacity in 1974 to 58 per cent of the total capacity in 1983. Also, the electricity produced by the combustion turbine plants will decline from 21 per cent to 12 per cent of the total electricity generated during this same period of time, and the combined cycle will be put into use and will increase to 15 per cent of the total capacity of the state. This increase in combined cycle generation plants is due to its relatively high cycle efficiency of approximately 40 per cent.[26] This is shown in the capacity mix section of Table 6.

Electricity generation by nuclear fission has the highest capacity factor or per cent of utilization due mainly to the availability and higher cost of the fuels used in the other electricity generation systems. Since the fuel costs of the other generation systems are higher than that of the nuclear plants, it becomes desirable to utilize the nuclear facilities as much as possible while the other systems are shut down when they are not needed to meet the electricity demand. The per cent utilization of the nuclear plants as well as the fossil steam plants decrease from 1974 through 1983 due to the increase in per cent utilization of the combined cycle plants. However, since combined cycle plants are dependent upon petroleum products, this may change as the petroleum supply and hence fuel cost changes. This is shown in the capacity factor section of Table 6.

The per cent of total generated energy by source is shown on the bottom of Table 6. As indicated, the per cent of the total energy generated by nuclear fission will increase from 12 per cent to 24 per cent by 1983. During the same time, the per cent of the total energy generated by fossil steam plants will decrease from 84 per cent to 60 per cent while the combined cycle will increase to 15 per cent. Although the percentage of electricity produced by nuclear fission will double by 1983, this method of electricity generation will remain subordinate to fossil steam turbine electricity generation. This is shown in the source of energy section of Table 6.

Figures 9 and 10 graphically represent the per cent of electricity production by fuel type and the total electricity production by fuel type for the period of time 1974-1983. These figures show the extent to which Florida will

Figure 9

PER CENT ENERGY PRODUCTION BY FUEL[28]

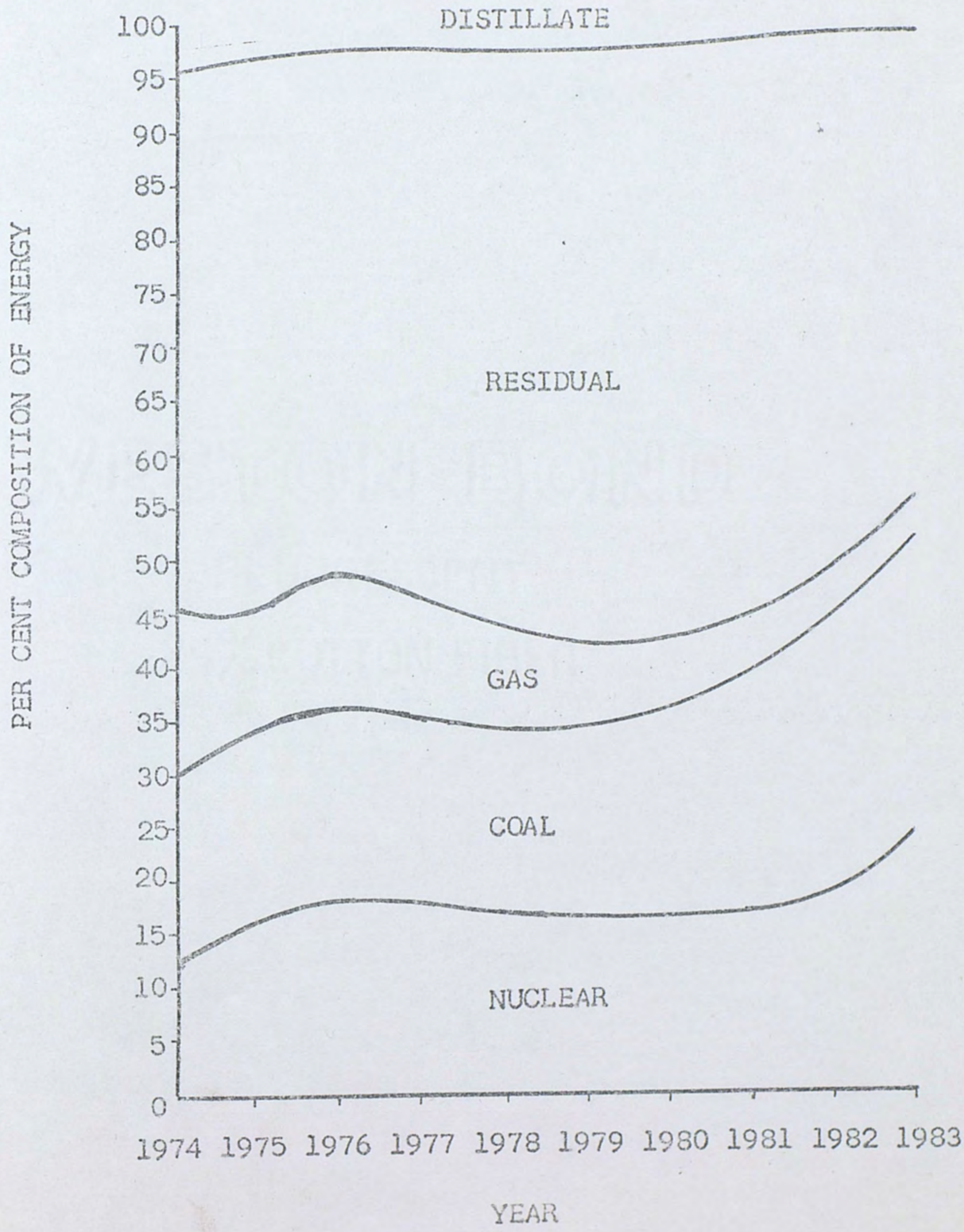
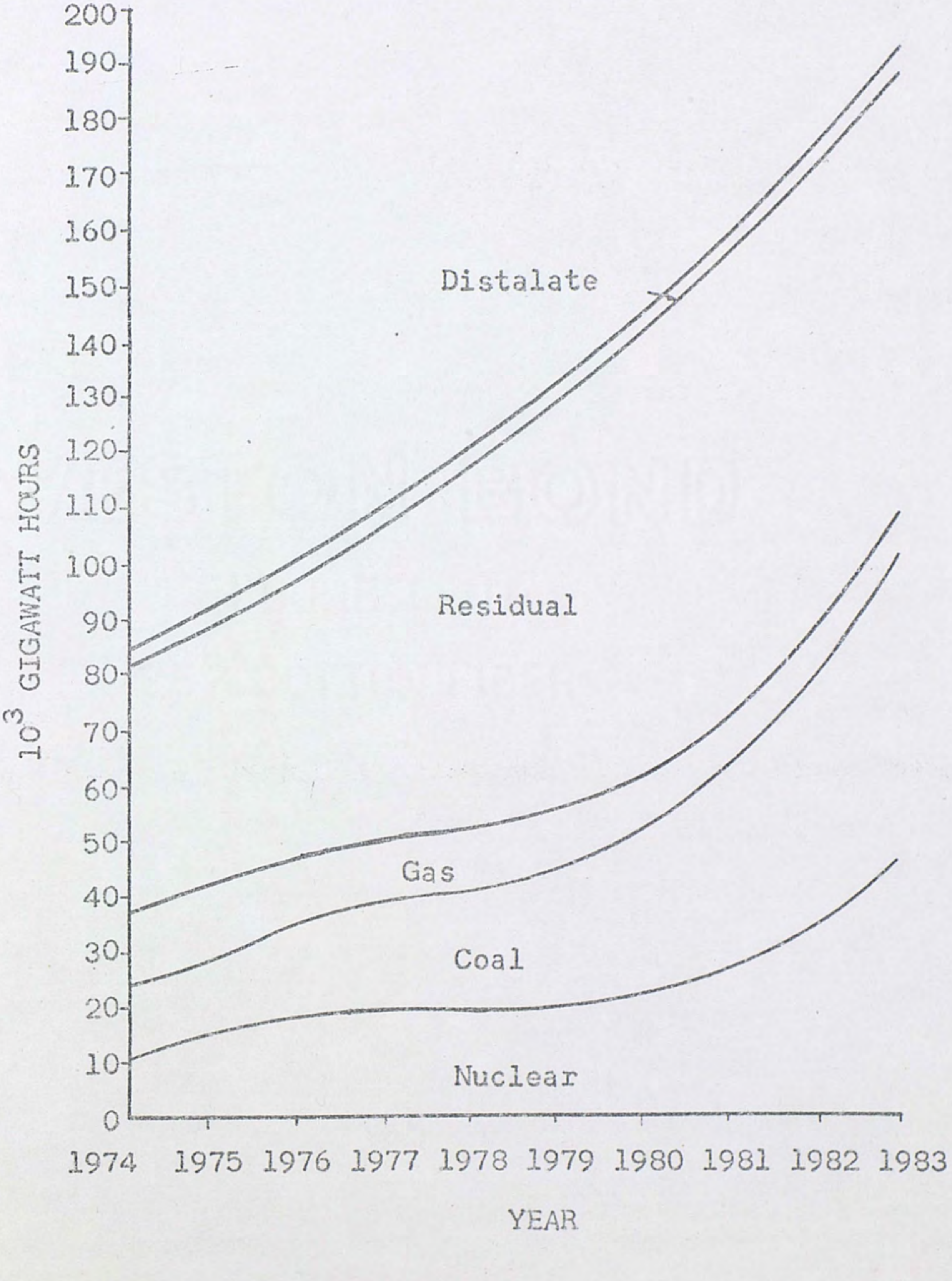


Figure 10

TOTAL ENERGY PRODUCTION BY FUEL[29]



depend on the various fuels for electricity production. As previously mentioned, electricity generation by nuclear fuel will play a subordinate role to electricity generation by fossil fuels. From these figures, it is obvious that the cost of electricity production will be strongly affected by the rising costs of petroleum products.

In addition to Turkey Point #3 and Turkey Point #4, Table 2 of Appendix B lists 6 nuclear plants to be built between 1974 and 1983. These plants are scheduled to go into operation in 1975, 1976, 1980, 1982, and 1983. Reference to Table 6 will show increases in per cent capacity and per cent of total energy generated by nuclear fission for these years. Table 7 shows the capacity of these plants as well as the cumulative total of generation capacity for the nuclear plants through 1983. From this table, it can be seen that Florida will have an electricity generation capacity by nuclear fission of 7210 megawatts by 1983. This compares to a capacity of 27,932 megawatts by fossil steam turbine plants and 7302 megawatts by combined cycle plants.

In addition to the nuclear generating units listed above, two more are in the planning stages. The first of these two plants is Mayport #2, a 1150 megawatt floating plant which will be located off the coast of Jacksonville and scheduled for operation in 1984. This plant will be similar to the floating plant to be introduced by Jacksonville Electric Authority in 1982. Reference 30 lists both of these plants to be 1150 megawatt plants as opposed to

900 megawatt capacity plants as indicated by reference 6. Rather than modify the tables and figures of Chapter 2 because of a difference between the two references, a 900 megawatt capacity of Mayport #1 will be used and 1150 megawatt capacity for Mayport #2 will be used. If indeed both plants are to be 1150 megawatts, the curves and figures could be readily corrected.

The second plant is a 1300 megawatt capacity plant to be constructed by Florida Power Corporation and scheduled for operation in 1986. Location of this nuclear plant has not yet been decided, but tentative sites include the central part of Florida in East Orange County.[31] This results in a total of 10 nuclear power plants with a capacity of 9660 megawatts by 1986.

CHAPTER 3

NUCLEAR POWER PLANT SITING IN FLORIDA

3.1 Site Requirements and Florida's Suitability

Until recently, power plant site selection was a matter of locating the plant near where the load was developing. The primary concern was that there be cooling water available. Today, the process of site selection for power plants --especially nuclear power plants--is much more complicated because of the environmental considerations.

A variety of factors determine nuclear power plant site suitability. The major factors are briefly discussed below:[32]

Land Resources: Nuclear and coal-fueled power plants of the same capacity require approximately the same amount of land for the power plant structures and supporting equipment. Although coal-fueled plants require additional area for fuel storage, this additional area requirement is offset by the exclusion area required for all nuclear plants. As can be seen from Table 8, the required areas for typical plant sites of 3,000 megawatt capacity are approximately the same for coal and nuclear plants and considerably less for gas and oil plants.

Within the exclusion area surrounding all nuclear plants, residential and commercial activity is controlled.

TABLE 8

Land Requirements for 3,000 Megawatt Plants[37]

Plant Fuel	Acres	Remarks
Coal	900-1,200	Assumes on-site coal storage and ash disposal
Nuclear	200-1,130	Includes exclusion area around the plant
Gas	100-200	Assumes pipe line delivery and modest on-site fuel storage tanks.
Oil	150-350	Assumes adequate on-site fuel storage

However, the cleanliness of the nuclear power plants offers the opportunity to make other uses of the land such as public parks and recreation facilities.

Adequate land resources for new nuclear power plants exist along the Atlantic and Gulf coasts as well as inland along the larger rivers and on the banks of Lake Okeechobee. However, some of these sites would require rezoning before nuclear plants could be constructed. In addition, Florida offers many miles of coastline which is ideally suited for offshore floating nuclear power plants. Reference 30 describes potential sites off the coast of Jacksonville being considered for floating nuclear plants by Jacksonville Electric authority.

Water Resources: A site must have means to supply large quantities of cooling water to remove and dissipate the heat rejected in the generation cycle, and must offer a heat dissipation mechanism that is compatible with the environment. Also, the plant site must offer flood protection, adequate drainage, and storm protection.

Among the states of the United States, Florida is probably one of the most ideally suited for nuclear power plants. This is primarily because Florida is bounded by the Atlantic Ocean and the Gulf of Mexico. These two bodies of water offer almost endless amounts of cooling capacity. Also, Florida is crisscrossed with rivers, waterways, and canals which offer large amounts of water for closed cooling systems for inshore based plants. Two examples of these cooling systems are closed cooling canals and cooling towers. Both of these systems are initially fed and replenished by larger bodies of water. Florida Power and Light Company's Turkey Point #3 and Turkey Point #4 utilize the closed canal cooling system with initial cooling water coming from Biscayne Bay.

Nuclear power plants require larger quantities of cooling water than equivalent fossil fuel plants because the total heat energy wasted is approximately 60 per cent greater for the nuclear plants. Table 9 shows the waste heat in existing nuclear and fossil-fueled power plants. It can be seen that most of the wasted heat from the nuclear plants must be transferred to the cooling water with very little heat lost to the atmosphere.[32]

Florida's extensive system of drainage canals offers flood protection for the land based units, and the basic design of the offshore floating plants preludes flooding.

Types of cooling for Florida's nuclear plants (through 1986) are shown in Table 10. As is shown in this table, Florida's nuclear power plants are projected to rely mainly on the Atlantic Ocean and the Gulf of Mexico for their cooling water requirements.

Population: Surrounding a nuclear plant is an exclusion area of 1/4 to 1 mile in radius within which population must be subject to Utility Control. Outside the exclusion area, the population density and the distance to the nearest population center affect site suitability and plant character-

Table 9

WASTE HEAT IN POWER PLANTS[33]

	HEAT ENERGY INPUT TO GENERATE 1 KILOWATT-HOUR ELECTRICITY	TOTAL HEAT ENERGY WASTED	WASTE HEAT RELEASED TO ATMOSPHERE	WASTE HEAT RELEASED TO COOLING WATER
1. Modern efficient fossil-fueled power plant.	8,600	5,200	1,300	3,900
2. Average U. S. power plant today.	10,300	6,900	1,600	5,300
3. Calvert Cliffs nuclear power plant.	11,500	8,100	500	7,600
4. Predicted future fossil-fueled plant.	8,000	4,600	1,200	3,400
5. Predicted future nuclear breeder reactor plant.	8,200	4,800	300	4,500

Basic data from "Problems in Disposal of Waste Heat from Steam-electric Plants," a staff study supporting the FPC's 1970 National Power Survey, Federal Power Commission, Bureau of Power, 1969.

TABLE 10

SOURCES OF COOLING WATER FOR FLORIDA'S NUCLEAR POWER PLANTS[6,15]

In-Service	County	Plant	Company	Cooling Source
1972	Dade	Turkey Point #3	FP&L	Closed canal, makeup from Biscayne Bay
1973	Dade	Turkey Point #4	FP&L	Closed canal, makeup from Biscayne Bay
1975	Citrus	Crystal River #3	FPC	Gulf of Mexico
1976	St. Lucie	St. Lucie #1	FP&L	Atlantic Ocean
1980	St. Lucie	St. Lucie #2	FP&L	Atlantic Ocean
1982	Duval	Mayport #1 Floating	JEA	Atlantic Ocean
1983	Dade	Unknown	FP&L	Biscayne Bay or Atlantic Ocean
1983 & 1986	Unknown	Unknown	FPC	Unknown
1986	Duval	Mayport #2 Floating	JEA	Atlantic Ocean

istics. The proximity of a site to load centers has a significant influence on site eligibility, and transmission routes must be available that are compatible with land use.

Florida's population is concentrated along the coastline. As indicated above, many sites for future nuclear power plants exist along the coastline both onshore and especially within three miles offshore. Therefore, the requirement that power plants be located near large centers can be met. With the floating plants, sites may be chosen near large centers, but offer the safety of having no population within three miles in the event of a nuclear accident.[30] Reference 34 details typical studies made by Florida Power and Light Company at their Hutchinson Island Plant site with respect to population concentration. Detailed information regarding future population within 50 miles is given.

As stated previously, Florida's inland areas offer many potential nuclear power plant sites. Although inland plant sites would be distant from existing load centers, other factors make inland site locations desirable. These factors are:

1. Adequate land resources
2. Adequate cooling water
3. Greater safety from being located away from population centers in the event of a nuclear accident
4. Central location for power distribution to all parts of the state

As time passes, the population concentration will tend to move inland and thus established plants, capable of expansion, at these inland locations will be advantageous.

One example of an inland nuclear power plant is the proposed 1300 megawatt plant which will be built by Florida Power Corporation. Potential sites of this plant are in Orange County and near the Suwanee River.[31] Other nuclear power plant sites are shown in Table 10.

Foundation: The underlying soil and/or rock formation must have adequate strength to support the power plant with minimum shifting and settlement. Also, the site must not lie near active fault zones or areas where earthquakes are prevalent.

The extent to which foundation treatment is necessary can have drastic effects on power plant costs and can render the sites infeasible. Appendix B of Reference 30 indicates that the foundations upon which the nuclear power plant rests must be considered United States Atomic Energy Commission Category 1 structures. To satisfy the requirements of Category 1, the soil underneath the foundation must be capable of supporting the power plant without settlement or liquification under seismic accelerations.

The cost of supplying a satisfactory foundation for a land based nuclear power plant in Northeast Florida using available techniques would approximately $10 to 20 million per plant.[30] This is one reason Jacksonville Electric authority chose offshore sites.

Construction: Site selection is influenced by cost, availability, and adequacy of building materials, services, and labor supply within the vicinity. Also, transportation of nuclear components affects the site suitability as some components necessitate barge or rail shipment. It is interesting to note that for a two-unit plant, investment costs increase $20,000 to $30,000 per mile of distance from the nearest port on navigable water with a 6-foot maintained minimum draft.

Florida is fortunate in that it is almost surrounded by water and has many navigable canals, waterways, and rivers thus easing delivery problems. Also, due to the rapid growth of Florida, there exists an excellent building trade. Many nuclear component manufacturing firms are located in Florida. Among these firms are:

1. Offshore Power Systems in Jacksonville
2. Westinghouse in Tampa
3. Westinghouse in Pensacola
4. General Atomic in Panama City

For the floating nuclear power plants, offshore power systems, being established in Jacksonville, will manufacture turn-key plants at its facility. Shorter building times (2 years compared to 5 years), assembly line production, better quality assurance, improved allocation of manpower resources, and standardized plant design will result from this operation.[35] In the future, it is very important that the standardized approach to building nuclear power plants be adopted. This will be necessary to meet the building schedule required by 2000. Several utilities within the U. S. have submitted applications for standardized nuclear plants.[30]

Taxes and Zoning: Site selection is also affected by state and local government tax and zoning requirements. The structure of these requirements will have a direct affect on site suitability.

These requirements in Florida are not unlike similar requirements in other states. The taxes are an important source of revenue for local and state government, but are not an insurmountable burden to the utilities as they are treated as operating expenses and are included in the rates passed along to the consumer.

Zoning presents a problem in Florida as well as the rest of the nation. Each new power plant requires a change in the zoning requirements.[36] This causes a delay in construction, increases the cost, and somewhat limits the number of sites available. Florida utilities are calling for a long range plan which would effectively commit blocks of land to be zoned for power plant installation.

Along with zoning, licensing presents a stumbling block in Florida. In order to build the required number of nuclear power plants by the turn of the century, the licensing process must be revolutionized.[36] The first step toward this is standardization which is being ushered into existence by the floating nuclear plant concept. With standardization comes pre-licensing and pre-certification.

No general siting criteria can be applicable to all sites. Generally, a site is selected from many alternates after a very thorough environmental investigation of each site is made. The site which is finally chosen should offer the optimum combination of the above requirements.

3.2 Environmental Considerations

In the past, very little consideration was given to power plant location and their effects on Florida's environment. With the advent of nuclear power plants came the growing awareness of the need to protect Florida's environment. Many considerations and environmental studies must be made before plant selection is determined. The major environmental considerations are:[32]

Emissions: Nuclear power plants do not involve combustion of fuel in the conventional sense. Therefore, there are no gaseous emissions of the oxides of sulfur, nitrogen, and carbon. Also, there are no emissions of hydrocarbons, aldehydes, and fly ash. Table 11 lists the annual amounts of these emissions from a typical 1000 megawatt plant burning coal, oil, or gas. Radiation released from nuclear power plants is extremely small--on the order of .01 mrem per year. This compares to approximately 130 mrem per year received by the average American from the environment. Thus existing and future nuclear power plants contribute only an insignificant amount of the total radiation exposure received by the average American.[37] Table 12 details the amount of radiation exposure that the average American might expect from various sources.

TABLE 11

TOTAL ANNUAL POLLUTANT EMISSION (10^6 Pounds)[32]
(FOSSIL FUEL PLANTS)

Aldehydes	0.115	0.2580	0.068
Carbon Monoxide	1.150	0.0184	---
Hydrocrrbons	0.460	1.4700	---
Oxides of Nitrogen	46.0	47.8000	26.6
Oxides of Sulfur	306.0	116.0000	.027
Particulates	9.9	1.6000	1.020

1. Approximately 2.3 million tons of semibituminous coal annually fly-ash control only.
2. 460 million gallons of oil per year; assuming 0.05 per cent ash content and 1.6 per cent sulfur content.
3. 68 X 10^8 cubic feet of natural gas per year.

TABLE 12

1970 RADIATION EXPOSURES FROM VARIOUS SOURCES [37]

SOURCE	PER CENT OF POPULATION EXPOSED	ANNUAL AVE. DOSE TO TO POPULATION EXPOSED (mrem/capita)	% OF TOTAL EXPOSURE
Natural Background	100	130	57.8
Medical Diagnostic X-rays	100	90*	40.0
Fallout From Weapons Tests	100	5	2.2
Nuclear Power	22	0.01	0.044
	TOTAL	225	100.0

* Equivalent to a genetically significant dose of 55 mrem/yr. T 205 million

Nuclear power plants emit to the atmosphere controlled amounts of radioactive gases. Two principal radionuclides omitted into the atmosphere are Krypton-85 and Iodine-131 isotopes.

Coal also contains some natural radioactive materials in trace amounts (1.1 ppm of uranium-238 and 2.0 ppm thorium-232). The radioactive by-products of these elements, radium-226 and radium-228, are found in the residue of coal-burning plant having good fly-ash control will discharge approximately 28 millicuries of radium isotopes into the atmosphere per year, while a plant without fly ash control would emit many times that amount.[32]

In Reference 38, M. Eisenbud and H. G. Petro conclude that "when the physical and biological properties of the various radionuclides are taken into account, the conventional fossil-fueled plants discharge relatively greater quantities of radioactive materials into the atmosphere than nuclear powered units of the same size.

The biological effects of radiation are somatic effects which impair the health or shorten the life of those exposed to radiation and genetic effects which are transmitted to the offspring of the exposed person by mutations in the genes. The expected "life shortening" from radioactive effluents at their current release rates is approximately 24 seconds. The current maximum radioactive release levels from nuclear plants have been estimated to produce 24 mutations per year, while the average release level is predicted.

to produce one genetic mutation every 4 years. This compares to the spontaneous genetic mutation of 800,000 per year.[37] Therefore, the radiological effects of radioactive material released by nuclear power plants are negligible.

Aesthetics: Nuclear power plants are more adaptable to attractive design and appearance because of their quiet operation, lack of fuel and ash storage, and relative cleanliness. Offshore based nuclear plants are felt to be aesthetically pleasing in that they are located 3 miles offshore and present no unpleasant view and utilize a minimum of land.

Radioactive Wastes: In addition to radioactive gases emitted to the atmosphere, other radioactive materials removed from the primary coolant must be processed and removed from the plant site per strict AEC regulations. Lower level wastes are released in the cooling water at controlled rates so as not to exceed maximum permissable concentration as required under AEC regulation 10CFR 20. From experience, it has been determined that these radioactive releases can be kept to a few per cent of the allowable limits.

3.3 Environmental Changes and Biological Responses:

Heat disposal and radiological effects are the two major considerations affecting the environment due to the operation of nuclear power plants. These considerations will be briefly discussed in the following text.

A nuclear power plant wastes about 60 per cent more heat than a modern efficient fossil fuel plant (see Table 9). Most of this wasted heat must be transferred to cooling water rather than the atmosphere. Eventually, the excess heat generated must be dissipated to the atmosphere. The choice of methods to transfer this excess heat depends on many factors. Among these factors are quantity of water available for cooling, temperature of the water, effects on the ecology in the water, meteorological conditions, and economics.

Several sources of cooling water exist. These are oceans. bays, rivers, lakes and reservoirs, and streams. Florida's nuclear power plants (existing and planned) depend primarily on the Atlantic Ocean and the Gulf of Mexico for cooling water. As shown in Table 10, of the ten existing or planned nuclear plants in Florida through 1986, 5 plants depend directly on the Atlantic Ocean or Gulf of Mexico for cooling water; two depend indirectly on Biscayne Bay (Turkey Point #3 and #4 use a system of closed canals for cooling water with initial fill and makeup water from Biscayne Bay); and three plant sites are yet to be chosen, hence type of cooling is not yet selected.[39] As was previously mentioned, potential nuclear power plant sites with adequate cooling capacity exist offshore, along the coast, and inland along the major rivers and on the banks of Lake Okeechobee.

Although Florida has almost infinite amounts of cooling water available, the thermal effects on the acquatic animals and organisms have to be taken into account. After exhaustive testing and marine studies, the cooling systems are designed such that minimum damage is done to the marine life. Before a license is issued to the utilities for construction of a nuclear power plant, environmental studies must be conducted. These studies are very comprehensive and detail the marine eco-system and the effects of cooling water from the nuclear plants.

Extensive studies have been made to determine the effects of radiation on the marine life. These tests have been conducted at high radiation dose rates, rates which would never be approached in the area of nuclear power plant discharges. Even with biological concentration factors of 100,000, the radiation levels expected from nuclear power plant activities are quite low compared to those where experimental damage can be shown.[32] Detailed analysis for each of Florida's nuclear power plants can be found in the environmental reports which are required for each nuclear power plant.

3.4 Nuclear Power Plant Safety

The safety of nuclear power plants depends on containing the radioactive material generated. For each plant, reactor design, containment design, and site conditions are studied rigorously by experts prior to issuance of a license. Every nuclear plant must be judged safe to the public during normal operating conditions and during the most serious conceivable accident.[32]

As of 1970, the safety record showed that there was no radiation injury to any nuclear power plant worker and that the radiation exposure to the general public was much less than that allowed by the Atomic Energy Commission Regulations. No other industry in America's history has ever established such an impressive safety record.

The impressive safety record of the nuclear industry is not accidental; it has resulted from planning, research and development, training and safety precautions instituted by the government and private industry. General public safety and welfare have been prime considerations with careful attention given to the biological & medical aspects of nuclear radiation. Also, rigorous licensing procedures imposed by the AEC assure that the interests of the public are protected.

The general public is protected from reactor accident by: superior design, construction, and operation of the reactor; the use of redundant systems to prevent malfunctions from escalating into serious accidents; the use of emergency systems, such as emergency core cooling, which are intended to limit the consequences of an accident by confining or minimizing the escape of fission products; in-service testing to assure working condition of vital components; and in-service inspection for the early detection of problems that could result in an accident.[32]

After 25 years of experience, nuclear reactors are much safer than the alternative of using coal or oil. About 19,000 deaths per year in the U. S. could be attributed to the use of coal and oil. One large nuclear plant could displace approximately 1% of the U. S. Coal consumption (for 1964). This could be equated to saving 1% of 19,000 lives or 190 lives. per year.[40]

3.5 Costs

Over the past few years, the capital costs of all power plants have risen dramatically, especially the nuclear power plant costs. The increases in nuclear power plant costs are attributable to: regulatory procedure changes; licensing process delays; shortages of labor, inflation in the costs of equipment, materials, and wages; and changes required to meet additional environmental and safety requirements.

Typical power plant costs are shown in Table 13. The dramatic increase in power plant costs is evident. It is interesting to note that while nuclear plant costs are high on a dollars per kilowatt scale compared to fossil fuel plants, the high cost is offset by the fuel costs.

With the political uncertainties in the oil producing countries, and their resultant effects on the cost of crude oil--a necessity for Florida's fossil fuel plants--nuclear power plants indeed look very attractive. However, this advantage of nuclear power plants over fossil plants may be short lived. Uranium, like oil and coal, is a depletable natural resource. The known U. S. reserves recoverable at or near current costs will supply the U. S. nuclear power industry through the mid-1980's.[43] After 1985, the nuclear

TABLE 13

ELECTRICITY GENERATING COSTS [41, 42]

YEAR	TYPE	PLANT	CAPACITY (MW)	COST/KW	TOTAL COST X 10^6	FUEL COST MILS/KWHR
1972	Nuclear	Turkey Point #3	725	$135	$ 97.7	2
1973	Nuclear	Turkey Point #4	725	$180	$ 129.6	2
1976	Nuclear	St. Lucie #1	850	$305	$ 260.0	2
1979	Nuclear	St. Lucie #2	850	$360	$ 424.0	2
1982	Nuclear	Mayport #1	2300	$767	$1770.0	2.46
1984	Nuclear	Mayport #2				
1965	Fossil	Cape Kennedy #1	402	$72	$ 28.8	3.14
1971	Turbine	Port Everglades	444	$91	$ 37.0	11.52
1972	Fossil	Sanford #4	419	$115	$ 48.3	6.34
1976	Fossil	Martin Plant #1	860	$177	$ 152.0	NA

power industry will face considerably higher fuel prices. Advanced breeder reactors, now under development and scheduled for commercial use in the mid-to-late 1980's, will help ease this fuel situation.

CHAPTER 4

LEGISLATION AFFECTING FLORIDA'S NUCLEAR POWER PLANTS

4.1 Federal Government - State Agreements

Prior to 1959, almost all nuclear power related regulatory functions were carried out by the Federal Governement in the form of the Atomic Energy Commission. However, as nuclear development progressed, so did the state's involvement in the regulation and development of nuclear power.

In 1959, Congress recognized the role of the states and of the importance of cooperation between the AEC and the states. As a result, the Atomic Energy Act was amended (Federal-State Amendment 420 U.S.C2021) enabling the states to exercise exclusive regulatory authority in designated areas. The purposes of this amendment were:[32]

1. To recognize the interests of the states in the uses of atomic energy, and to clarify the responsibilities of the states and the AEC;

2. To establish coordination between the states and the AEC with respect to control of radiation hazards;

3. To promote a regulatory pattern between the states and the AEC with respect to nuclear power development; and

4. To establish procedures for the discontinuance of certain of the AEC's responsibilities and the assumption thereof by the states (Sec 274a, 420 U.S.C. 204(a).

"Federal-State Agreements", as contemplated by this Amendment, have been entered into by Florida. Under these agreements, the governor certified that the state had a program for the control of radiation hazards adequate to protect the public and that the state desired regulatory responsibility. This program was subject to AEC approval.

The agreements made under Section 274 do not permit state regulation of some activities. Some of these activities are: possession and use of large quantities of special nuclear materials; the construction and operation of nuclear reactors; ocean disposal of waste materials or disposal of waste materials or disposal, transfer or storage of dangerous radioactive waste; import or export of nuclear materials; and the transfer of consumer products containing by-product materials.[32]

4.2 Florida Nuclear Code and Southern Interstate Compact Law

In order to accept this new responsibility relinquished by the AEC, the Florida Nuclear Code and Southern Interstate Compact Law (Sections 290.01-290.32) was put into effect.[44]

To carry out the intent of this law, the Florida Nuclear and Space Council was established as advisor to the Department of Commerce, and the powers and duties of the Department of Commerce relating to nuclear development were established. These were:[44]

1. To acquire facts concerning nuclear and space development.

2. To formulate a state nuclear and space program and

to advise the governor and governmental agencies on all nuclear and space matters.

4. To convene a coordinating council consisting of members of appropriate state agencies to secure coordinated action in matters dealing with the state's nuclear and space development.

5. To promote and support a program of education and research relative to nuclear and space development.

6. To promote the industrial development of Florida by attracting new industry based on nuclear science and engineering.

7. To disseminate information to the people relative to nuclear and space developments.

8. To advise the governor on rules and regulations that are inconsistent with rules of other state agencies.

9. To inform the various state agencies as to activities related to the development and regulations of sources of radiation.

Under the Florida Nuclear Code, the governor is authorized to designate a state agency empowered to provide licensing or registration of by-product, source, special nuclear materials, or equipment using these materials. Also, the agency is authorized to require registration or licensing of other sources of radiation and to exempt certain sources of radiation from licensing or registration when these sources will not constitute a risk to the public. Inspection rights of radiation sources by the agency is also provided.

The Florida Nuclear Code authorized Florida's governor to enter into agreements with the Federal Government providing for discontinuance of certain responsibilities and the assumption thereof by the state.

The Nuclear Code also provides the regulatory agency for injunctive relief to prevent the violation of this act through court action. Penalties for violation of this act are set forth.[37]

As a consequence of this law, Florida became party with the Southern Interstate Nuclear Compact. This Compact is made up of a board member from each member state. Among other things, the board has the following powers:

1. Analyze the position of the south with respect to nuclear and related industries.

2. Encourage the development and use of nuclear energy facilities.

3. Make available information relating to civilian uses of nuclear energy.

4. Conduct training programs for personnel engaged in any aspects of the nuclear industry. Demonstrations of safety and nuclear product, material or equipment use and disposal are also authorized.

5. Act as licensee of the U. S. Government with respect to the conduct of any research activity and operate such research facility.

6. Determine methods which may prevent and control nuclear incidents and to facilitate the rendering of aid by the party states in coping with nuclear incidents.

With the governor's approval, the board member from Florida shall be the Chairman of the Florida Nuclear and Space Council.

In april 1974, Senator Williams introduced a bill (SB1005) which would modify the Florida Nuclear Code and would be effective July 1, 1974. The proposed modification would:[45]

1. Change the name of the Florida Nuclear and Space Council to the Florida Nuclear Council and drop the space functions and responsibilities.

2. Provide qualifications for members of the Florida Nuclear Council. Included is the specification that at least five members be experienced in the use of nuclear energy or machine produced radiation.

3. Authorize the Department of Health and Rehabilitative Services to be the regulatory agency rather than the Department of Commerce.

4. Provide revised duties and powers for the Florida Nuclear Council. The main revisions are the eliminations of Items 5, 6, and 8 of the duties of the Department of Commerce as indicated earlier.

5. Licensing and registration of sources of radiation to be under the jurisdiction of the Department as opposed to an agency appointed by the governor.

6. Provide for the Department to conduct evaluations of the levels of radioactive materials in the environment.

All other changes proposed by this bill consisted of changing the wording of the existing Florida Nuclear Compact.

4.3 Power Plant Siting Act

In 1973, the Legislature passed a Comprehensive Electrical Power Plant Siting Act. This Act (Chapter 73-33 & 403.50116) recognized the need for a centralized and coordinated system for the review of power plant siting permit applications. This Act applies to nuclear and fossil fuel power plants.[45]

The Department of Pollution Control was named as the agency responsible to execute the policy of the act. The act provides that the Department of Pollution Control act on specific site plan operations and also that the Division of State Planning perform a concurrent general function.

As of January, 1974, each utility is required to submit to the Department of Pollution Control a 10-year plan of projected needs and proposed sites. A preliminary study must be made for each plan submitted and must be judged "suitable or unsuitable" within one year of receipt. In this review the Department of State Planning must consider:[45]

1. The need for electrical power in the area to be served. This must be documented by a need as determined by the Public Service Commission.
2. The environmental impact created by the electric power plant.
3. Alternatives to the proposed plan.
4. Local, state, and federal agency views.

The 10-year site plans are required by this act to contain the following:[45]

1. A description of the utilities existing facilities.
2. An electric power demand forecast.
3. A facilities requirements forecast.
4. Descriptions of proposed sites and facilities.
5. Environmental effects of the proposed facility siting.

The act details the procedure for review of the site certification application for each proposed site. The applicant is required to file an application with the Department of Pollution Control that conforms with application standards set forth by the Department of Pollution Control.

The Siting Act stipulates that the Department of Pollution Control shall notify the Department of State

Planning and the Public Service Commission within 10 days of the receipt of the application for certification. The division will review the specific site plan in relation to the 10-year plan and will have 3 months in which to forward a recommendation to the Department of Pollution Control.

After a review of the present and future needs for electric generating capacity of the area of the proposed site, the Public Service Commission will also submit a recommendation. This must follow within three months.

The Department of Pollution Control is required by this act to conduct a study. This study, financed by the application fee, must include the following:[45]

1. Cooling system requirements;
2. Proximity to load centers;
3. Proximity to navigable water and/or other transportation systems;
4. Soil and foundation conditions;
5. Availability of water for cooling;
6. Land use;
7. Accessibility to transmission lines; and
8. Environmental impact.

The Department of Pollution Control must conduct an initial hearing in a place as close as possible to the proposed site within 60 days of the application. The Department will determine whether the site is consistent with existing land use plans and zoning ordinances.

Within 12 months after receipt of the application, the

Department is required to make a recommendation to the Po-lution Control Board. Within 2 months of receipt of this report, the Board must approve, approve with modifications, or deny issuance of a certificate.[45]

Upon approval, the certificate represents a binding agreement requiring compliance with the provisions to be met with the construction or operation of the plant.

Major legislation affecting Florida's nuclear power plants was discussed above. In addition to this legislation, the utilities are still bound by some AEC rules and regulations as stated earlier. As a result, the utility companies must obtain as many as 52 different licenses and operating permits.[46] This, of course, adds to construction time and to the costs of the plants.

As will be shown in Chapter 5, construction times must be cut drastically to provide the required generating capacity for Florida. In order that this may be done, a further streamlining of the rules and regulations affecting licensing and permits will be required. This legislation is not yet forthcoming.

CHAPTER 5

LONG RANGE PREDICTIONS FOR NUCLEAR PLANTS IN FLORIDA

5.1 Forecasting Electric Energy Demand

Existing and planned nuclear power plants through 1985 were documented in Chapter 2. This Chapter will take a look at the future of nuclear power plants in the year 2000. Very little data exists detailing the types of nuclear power plants planned for the year 2000 as most utilities only prepare 10-year plans. Therefore, only a forecast for the year 2000 will be made. This forecast will be based on the predicted electric energy demand.

Detailed forecasting is difficult due to the many changes that are made. This forecast will be based on the predicted electric energy demand.

Detailed forecasting is difficult due to the many changes that are taking place in the energy picture today. The projection of future demands is at the very best questionable.

The factors which affect growth in energy and make forecasting difficult are:[47]

1. Population growth
2. Economic conditions

3. Technological advances
4. Social factors
5. Political factors

Due to the uncertainties involved with the factors listed above, a wide range of future rates of electricity consumption, might be expected. To illustrate the possible range of future rates of consumption, three cases will be investigated.[47]

Case 1 - Trends Continue

Since growth rates of electricity consumption have maintained a high degree of stability in the past, one approach to projecting electricity use is to use a continuation of past trends. Electricity consumption for the year 2000 can be projected based on per capita consumption and population since a direct relationship between electricity consumption and population is assumed. This is shown in Figure 11 as Curve 1. Curve 2 represents estimates for growth in electricity consumption in Florida prepared by the Federal Power Commission and the Southeastern Electric Reliability Council. This estimate is somewhat less, but is felt to be more realistic. As can be seen from Table 14, the projected electricity consumption increases by 775 per cent over the 1972 level.

Case II - Low Growth

Case II represents a low growth situation with no immigration to Florida and the population increasing at the rate of .8 per cent which was typical of the population

Figure 11

ENERGY CONSUMPTION IN FLORIDA

PRESENT TRENDS CONTINUE[48]

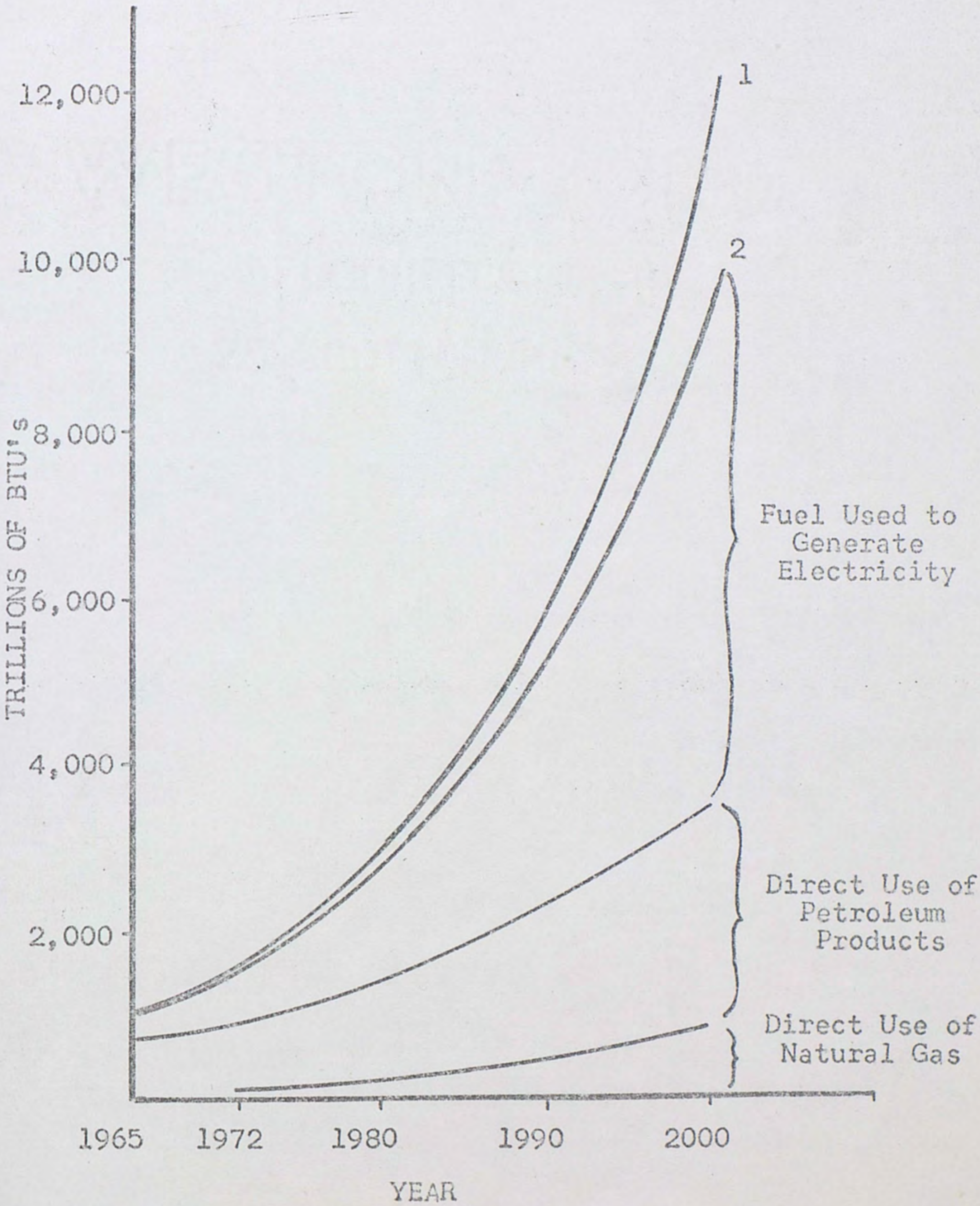


TABLE 14

ENERGY CONSUMPTION IN FLORIDA 1972-2000[49]
CASE 1

CASE 1 PRESENT TRENDS CONTINUE	ELECTRICITY SOLD BILLIONS OF KWH		FUEL CONSUMED TO GENERATE THE TRILLIONS OF BTU'S
1972	63		724
2000	608		6,337
Aug. Annual Growth Rate		8.1%	
Per Cent Increase		775	
Case 1-b	CONTINUATION OF HISTORIC ELECTRIC GROWTH		
1972	63		724
2000	838		8,734
Aug. Annual Growth Rate		9.3%	
Per Cent Increase		1,107	

Growth rate is taken from a projection of the Southeastern Electric Reliability Council to 1992 extended to 2000. For Case 1-b, 1960-1972 per capita growth rate in electricity sales is used. 1972-2000 population increases are taken from a projection by Bureau of Economic and Business Research, University of Florida. This projection shows a 95 per cent increase between 1972 and 2000 and a 2000 population of 14.5 million. Fuel consumed for electric generation in 2000 assumes a 36 per cent average thermal efficiency plus a 9 per cent transmission and distribution loss.

increase in the U. S. from 1972 to 1973. Also, no increase in per capita consumption of energy is assumed. Hence, electric energy use in 2000 would be only 20 per cent greater than in 1972. Figure 12 and Table 15 give the details.

Case III - Intermediate Growth

Case III assumes that in-migration as well as growth in per capita electricity consumption will continue. Per capita growth rates of one-half those of Case 1 were combined with Case 1 population estimates to serve as the basis for Case III estimates. Figure 12 and Table 16 show this data. As can be seen, electricity consumption increased 309 per cent over the 1972 level. Figure 13 shows the electricity consumption for Cases I, II, and III to illustrate the range that the assumptions stated earlier might have on electricity consumption by the year 2000.

5.2 Nuclear Power Potential in the Year 2000

A closer look at these cases will give an indication as to the future of nuclear power in Florida in the year 2000. For Case 1, the increase in electrical demand will require 129 new 1000 MW capacity plants. If only 50 per cent of these new plants are assumed to be nuclear, and 25 per cent each assumed to be coal-fired and oil-fired, the logistics of supplying this fuel is tremendous. For example, it would require three 100,000 deadweight ton tankers per day unloading in Florida to supply the oil fired plants plus

Figure 12

ENERGY CONSUMPTION IN FLORIDA[50]
CASE II

NO IMMIGRATION - NO ENERGY GROWTH

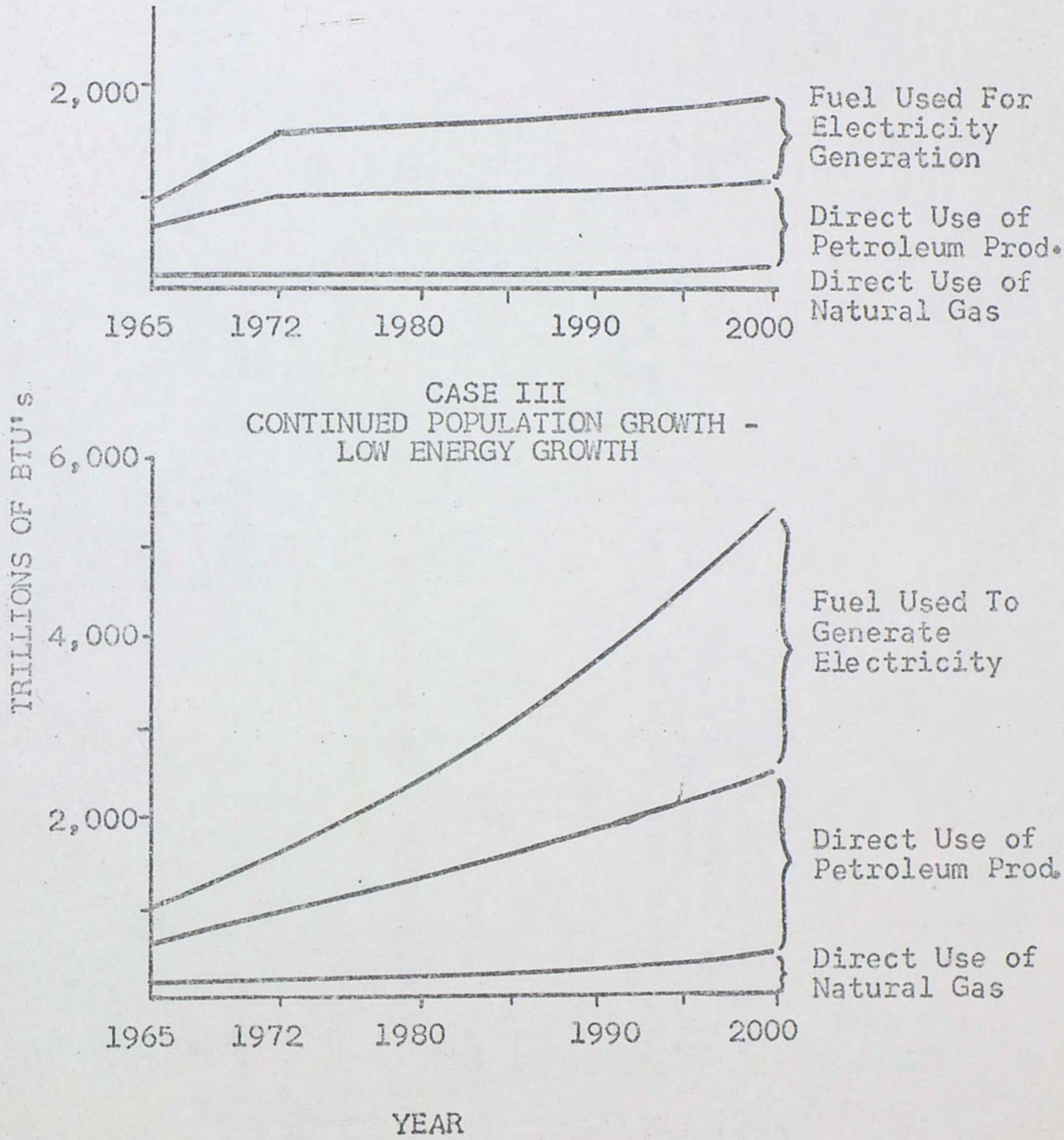


TABLE 15

ENERGY CONSUMPTION IN FLORIDA [51]
1972-2000

CASE II

CASE II LOW GROWTH	ELECTRICITY SOLD BILLIONS OF KWH	FUEL CONSUMED TO GENERATE THE ELECTRICITY (TRILLIONS OF BTU's)
1972	63	724
2000	79	869
Aug. Annual Growth Rate	.65%	
Per Cent Increase	20	

Low growth assumes no per capita increase in electricity consumption. Population is assumed to increase at .8 per cent per year yielding a year 2000 population of 9.3 million people. Generation efficiencies are assumed to increase to 34 per cent by 2000.

TABLE 16

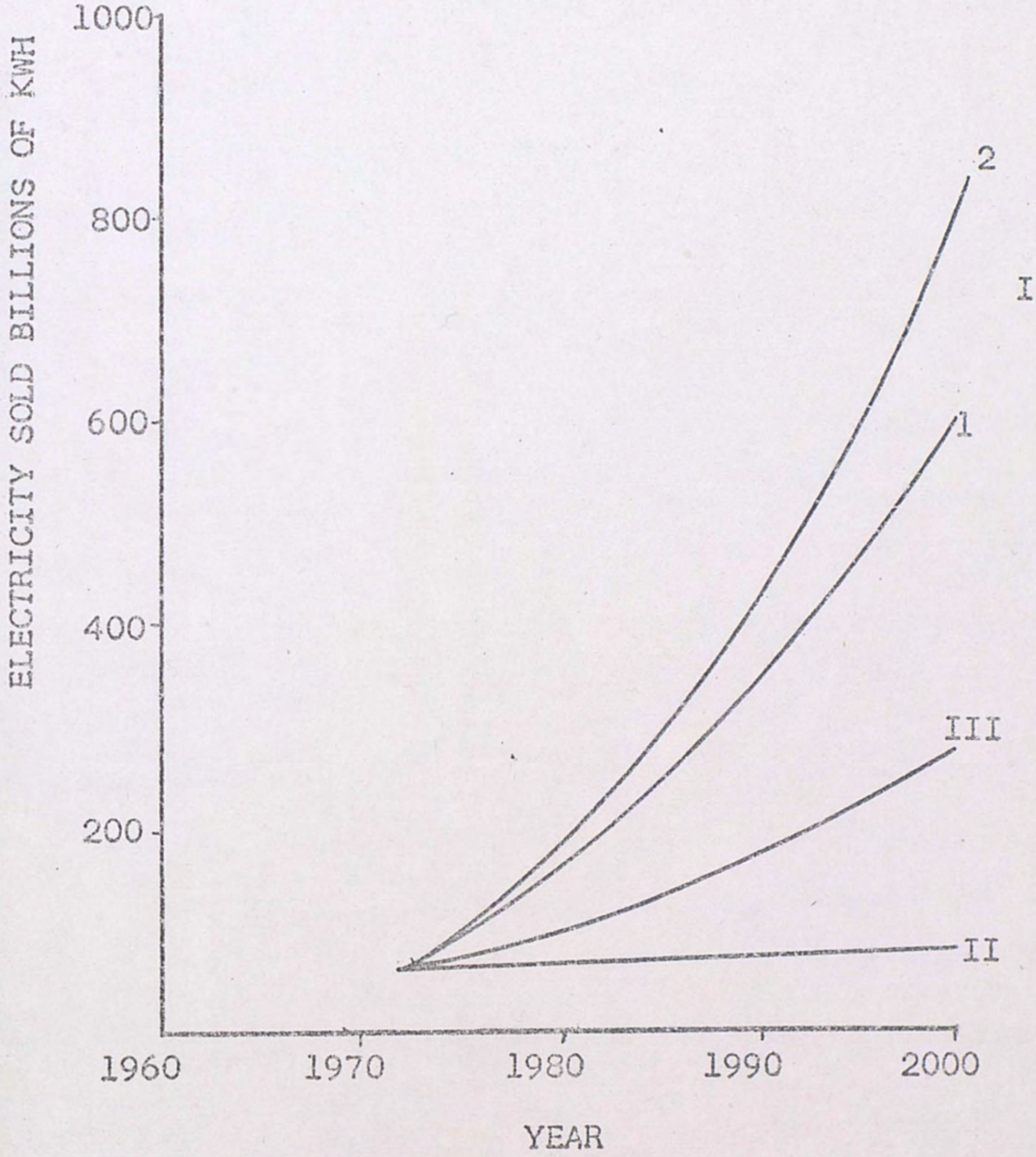
ENERGY CONSUMPTION IN FLORIDA 1972-2000[53]
CASE III

CASE III SLOWED ENERGY GROWTH	DIRECT USE: Petroleum Products		DIRECT USE: Natural Gas		ELECTRICITY: Sold	ELECTRICITY: Fuel Consumed	Total
	Millions of Barrels	Trillions of BTU's	Billions of cu. ft.	Trillions of BTU's	Billions of KWH	Trillions of BTU's	Trillions of BTU's
1972	141	819	123	127	63	724	1,670
2000	359	2,081	434	449	277	2,963	5,493
Avg. Annual Growth Rate	3.4%		4.6%		5.2%		4.3%
Per Cent Increase	154		253		309		229

This case assumes the same population growth as Case I, as projected by the Bureau of Economic and Business Research, University of Florida. This projection shows a 2000 population of 14.5 million people. Per capita growth rates of energy consumption are assumed to be one half of Case I, i.e., one half of historic 1960-1972 per capita growth rates. The growth rate for electricity consumption is assumed to be one half of that used in Case I. In this case, the average thermal efficiency for electric generation is assumed to be 35 per cent in 2000.

Figure 13

ELECTRICITY CONSUMPTION IN FLORIDA[52]



the other petroleum needs of Florida.[52] At this time, none of Florida's ports can handle a ship of this size. To supply the coal-fired plants, it would take 72 million tons of coal per year. This too would cause quite a supply problem. This is shown in Table 17.

The incentives to utilize a greater percentage of nuclear plants would be great due to the logistics of providing the fuel for the fossil fuel plants, the availability of the fossil fuels, the high cost of the fossil fuels, and the lack of pollution of the nuclear plants. This of course assumes that the excellent safety record of the nuclear plants remains intact.

In Case II, only 2 new 1000 MW capacity power plants would be needed by the year 2000. Some of the difficulties in attaining this growth condition can be seen by realizing that this prediction was based on 1972 levels. As of 1974, Florida will almost have exceeded the level predicted for the year 2000 by Case II due to continued in-migration and growth in per capita use of electricity. Therefore, it is unlikely that Case II is a realistic condition.

For Case III, 45 new power plants would be required by the year 2000. Again, assuming 50 per cent nuclear, 25 per cent coal-fired, and 25 per cent oil-fired, the coal required would be 33 million tons per year. This still creates quite a logistics problem and the emphasis would be toward nuclear plants. Table 17 compares all three cases in detail.

TABLE 17

IMPACTS OF ENERGY USE IN FLORIDA - 2000 [54]

Year 2000 Requirement	Case I Trends Continue	Case II Low Growth	Case III Slowed Energy Growth
Additional 1000 MW electric generating plants	129	2	50
Miles of new 500 KV transmission lines	3000	50	1150
Tons of coal per year	72×10^6	15×10^6	33×10^6
Barrels per day of petroleum products	2 million	.6 million	1.33 million
Deliveries per day for 100,000 DWT tanker	3	1	2

These impacts assume that additional generating plants will be one half nuclear fuel and one quarter each coal and oil fired, except that in Case II one plant is assumed to be nuclear fuel and one coal fired. Electric generating capacity is calculated assuming a 59 per cent plant factor and a 12 per cent reserve in 2000. Estimates of 500 KV transmission line requirements are arrived at from examination of Federal Power Commission projections for 1990 for Florida.

5.3 Alternate New Sources of Electric Energy

The above discussion considered low, medium, and high cases for electricity growth in Florida. Nuclear and fossil-fueled power plants were discussed as being the suppliers of electric energy in the year 2000. To complete the discussion, other sources of electric energy and their future in the year 2000 will be briefly discussed.[55]

A large number of alternatives to nuclear and fossil fuel power sources are presently under consideration. However, none of these sources have the potential of supplying a large percentage of Florida's electric energy requirements. However, the total contribution of all the alternates may be significant.

For a comparison basis, the potential of any one source will be evaluated in terms of 10 per cent of Florida's total energy demands in the year 2000 as predicted by Case III. Table 16 shows a total energy consumption of 5,500 trillion BTU per year by the year 2000. Of this, 2,000 trillion BTU will be wasted in electricity production. Therefore, the 10 per cent requirement is 350 trillion BTU or approximately 21,000 megawatts of generating capacity. This assumes a 60 per cent plant factor and a 9 per cent transmission loss.[55]

Solar Energy

The technology necessary to make use of solar energy currently exists and the availability of solar energy in Florida is excellent. However, using existing technology, for solar energy to contribute 10 per cent of Florida's total energy requirements, at least 2 billion square feet of solar collector would have to be installed. In the year 2000, this would amount to approximately 500 square feet of collector per family. The use of solar energy to this extent without benefit of advanced technology solar collectors is felt to be unlikely.

Ocean Thermal Gradient

Presently under consideration is the energy utilization of temperature differences in the Gulf Stream. Small demonstration plants utilizing this technique are in existence, but there remains much development work before a large scale plant can be built. It is felt that such a plant might be capable of 400 MW of generating capacity. However, the development time for a demonstration plant of this size would require at least 15 years. Assuming that these plants are feasible, 52 such plants located off Florida's coast would be required to produce 10 per cent of Florida's total energy demand in the year 2000. Construction of 52 such plants between 1990 and 2000 is not likely.

Wind Energy

Utilization of wind as an energy source for electricity generation in Florida is not expected to contribute greatly to Florida's needs in 2000. Current estimates for generating stations using wind as the primary energy source range up to 2 MW per unit generating capacity. Up to

20,000 of these wind powered generating plants would be required to meet 10 per cent of Florida's needs in 2000. Again, this is felt unlikely.

Geothermal Energy

Presently there is no indication of geothermal availability in Florida.

Fusion Energy

Fusion offers an almost endless supply of energy. However, technology necessary to utilize fusion energy in electricity generation will not be available until late this century. Hence electricity generation by fusion is not expected to be available until early in the next century.

Breeder Reactor Energy

In view of steeply rising fossil fuel prices and the relative scarcity of uranium resources, obtaining more energy from our nuclear fuel resources has become a matter of urgent national importance. The existing uranium reserves would be increased by up to 50 times by the development and commercial use of the breeder reactor. This reactor would utilize the much more plentiful uranium isotope U-238.[56]

The breeder reactor would probably not be necessary if there existed an adequate supply of uranium at present price levels. However, if the number of nuclear plants grow as predicted, uranium requirements will increase greatly and soon exceed the supply. Therefore, the nuclear fuel costs will greatly increase in order that the less productive uranium ores might be utilized.

According to Reference 56, there exists enough uranium at the present price level to supply the nuclear power plants through 1985. According to this reference, the first commercial breeder reactor power plants will not be in use until around 1990. Therefore, it is expected that a significant rise in uranium fuel costs will be encountered.

In order that breeder reactors supply 10 per cent of Florida's total energy needs in the year 2000, 21 reactors of 1000 MW capacity would be required. Since the first breeder reactors will not be commercially available until 1990, it is considered unlikely that these reactors will provide 10 per cent of Florida's total energy requirements by the year 2000.

5.4 Conclusion

As was stated previously, none of these new sources are expected to handle a large percentage of Florida's requirements in the year 2000. Therefore, the bulk of Florida's requirements will have to be met by the existing fossil fuel and light water reactor nuclear power plants.

Light water reactors are the first generation reactors in the U. S. These reactors will be an essential part of Florida's nuclear power economy in 2000. They do have inherent limitations relating to excessive use of U_3O_8, an unfavorable environmental impact resulting from an inefficient thermal cycle, an inability to burn plutonium efficiently in recycle operations, and can be expected to have high fuel cycle costs in the futures.[56] A comparison of existing fuel cycle costs for fossil and nuclear plants is given in Table 18.

Breeder reactors will fit into Florida's energy picture in the 1990's and will help bridge the gap between the current light water reactors and fusion. As stated earlier, the total contribution of the breeder reactors is expected to be less than 10 per cent of Florida's total needs by the year 2000.

Therefore, by the year 2000, Florida's electric energy demands will be met primarily by fossil fuel and nuclear power plants. The nuclear plants will consist mainly of light water reactors and to a smaller extent breeder reactors.

As a point of interest, the projected cost of operating the fossil fuel and nuclear plants is shown in Figure 14. This figure shows that once the nuclear power plants work the "bugs" out and get underway, the generating costs are considerably less than for the fossil plants. This reason combined with the uncertainties in obtaining fossil fuels--even at high costs--promote the use of nuclear energy in Florida.

TABLE 18

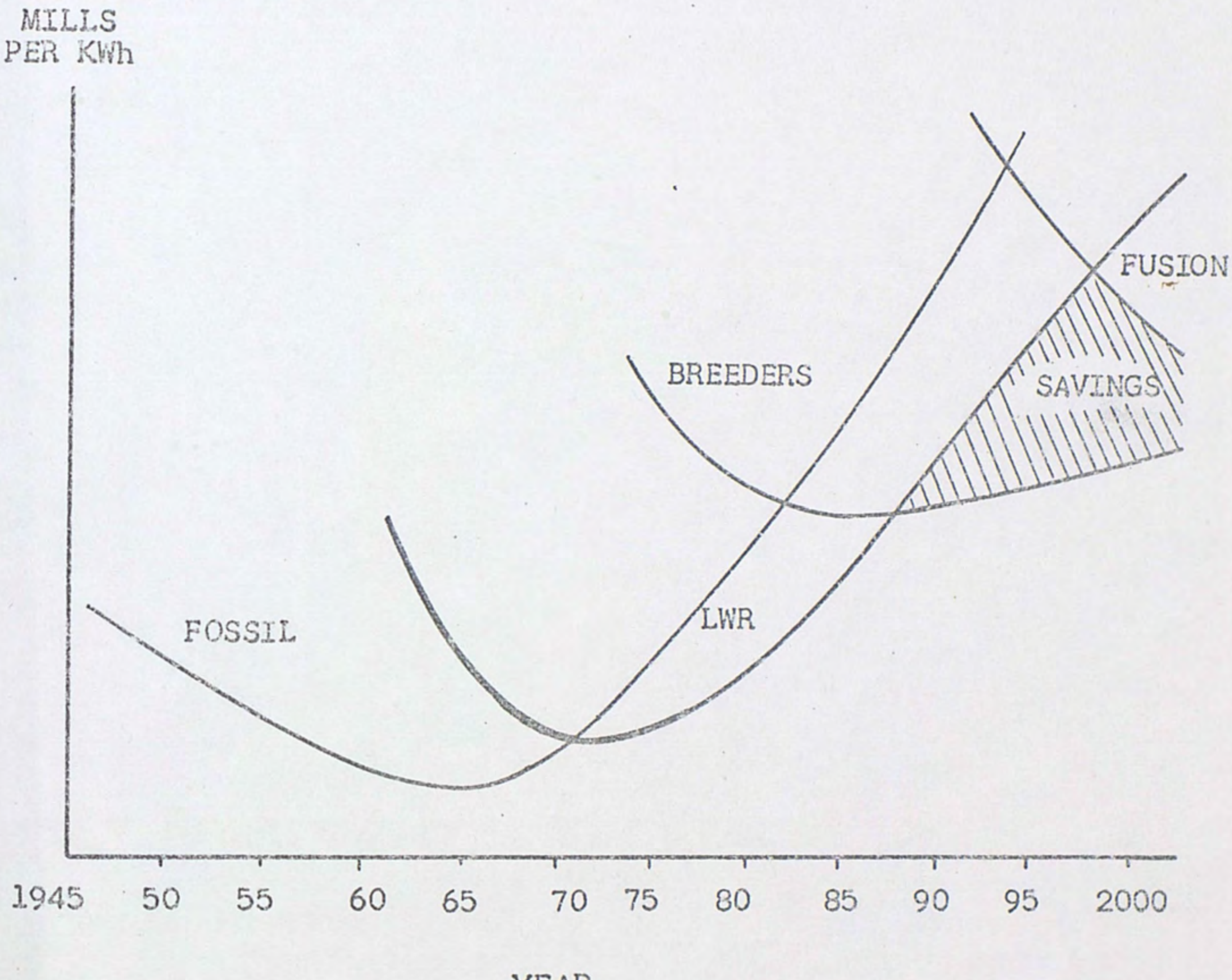
Fossil Fuel and Nuclear Fuel Cycle Costs[57]

(On An Equivalent BTU Basis)

Fuel	Per Million BTU
Oil	\$2.00 - \$2.50
Synthetic Natural Gas } Shale Oil }	\$1.00 - \$1.50
Coal (Except mine-mouth)	50¢ - 80¢
Nuclear - Converters	18¢ - 20¢
Nuclear - Breeders	12¢ - 15¢

Figure 14

ELECTRIC POWER GENERATION COST
OF ENERGY SYSTEMS FOR THE UNITED STATES[58]



APPENDIX A

The following description of a pressurized water nuclear reactor is taken from reference 8.

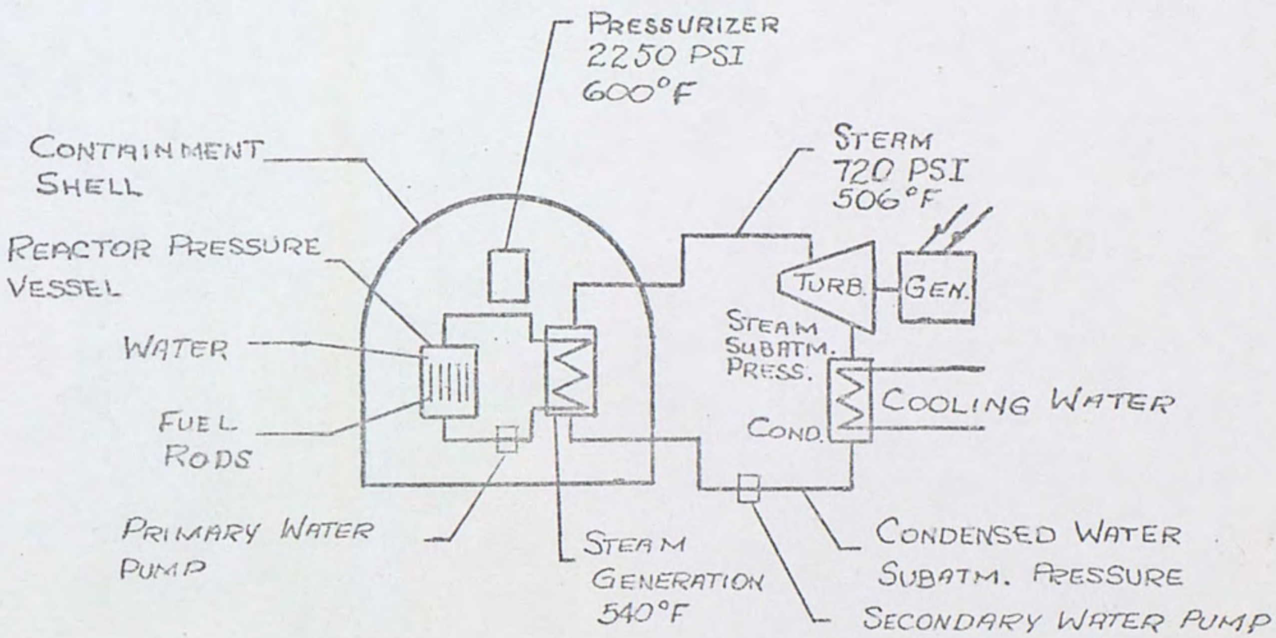
"The principle of the PWR nuclear power plant is illustrated in Figure A-1. Fuel rods for this reactor consist of Uranium Dioxide enriched to about 3 per cent in Uranium-235, hermetically sealed in tubes of zirconium alloy. This zirconium tubing constitutes the first barrier against escape of the highly radioactive fission products which form in the fuel as the end product of the nuclear reaction. Assemblies of these zirconium-clad fuel rods are mounted in a heavy-walled steel pressure vessel, and are surrounded by flowing water entering at a temperature of around 540°F and leaving around 600°F, held at a pressure of around 2,250 pounds per square inch to prevent boiling. The water slows down neutrons produced in fission and increases their probability of reacting with Uranium-235 to such an extent that the Uranium fuel constitutes a critical mass capable of sustaining a nuclear fission chain reaction. To hold the chain reaction at a steady rate, a variable amount of neutron absorbing boron is used in the reactor, partly as moveable control rods, and partly as Boric Acid dissolved in the water. Pressurized water is pumped through the reactor by the circulating pump, past the gas-cushioned pressurizer which holds the pressure constant, and through the steam generator. There, heat is transferred from the primary pressurized water at 600°F and 2,250 pounds per square inch to secondary water boiling at a lower pressure of around 720 pounds per square inch to make steam at around 506°F.

The steam flows through a turbine driving an electric generator and then passes to the condenser where it is condensed at subatmospheric pressure. The condensate is returned to the steam generator by the condensate pump.

In the condenser, heat from the condensing steam is transferred through cooling coils to cooling water at a pressure above atmospheric, which leaves the condenser at a temperature typically 20°F warmer than the incoming water. In some plants this cooling water is drawn from the ocean or other natural sources; in others it is recirculated through cooling towers. Disposal of the heat contained in this warm water without adverse effect on the environment is one of the problems of all steam-electric plants, nuclear as well as fossil. In light water reactor plants, however, about 50 per cent more warm water must be handled than in an efficient fossil-fuel plant because the thermal efficiency of the water-cooled nuclear plant is only 32.5 per cent owing to its relatively low steam temperature of 506°F, compared to a fossil-fueled plant with a thermal efficiency over 40 per cent obtainable from steam temperature around 1000°F."

TABLE I-A

SCHEMATIC DIAGRAM OF PRESSURIZED WATER NUCLEAR POWER PLANT



APPENDIX B

Table 1

EXISTING CAPACITY AS OF DECEMBER 31, 1973[59]

Plant Name	Location	Type*	Primary Fuel	Alter. Fuel	Net Capability-MW Summer	Net Capability-MW Winter
ORLANDO UTILITIES COMMISSION						
Indian River	Titusville	F	No.6 Oil	Gas	295.0	301.0
Lake Highland	Orlando	F	No.6 Oil	Gas	87.0	93.0
Lake Highland	Orlando	CT	No.2 Oil	Gas	30.0	32.0
Total					412.0	426.0
VERO BEACH MUNICIPAL UTILITIES						
Vero Beach	Vero Beach	F	Gas	No.6 Oil	61.0	64.0
Vero Beach	Vero Beach	D	No.2 Oil	-----	13.0	13.0
Total					74.0	77.0
GAINESVILLE/ALACHUA COUNTY REGIONAL UTILITIES						
Deerhaven	Hague	F	Nat.Gas	No.6 Oil	810	81.0
J. R. Kelly	Gainesville	F	Nat.Gas	No.6 Oil	102.0	102.0
J. R. Kelly	Gainesville	CT	Nat.Gas	No.2 Oil	45.0	42.0
Total					228.0	225.0

Table 1 (Con't)
EXISTING CAPACITY AS OF DECEMBER 31, 1973

Plant Name	Location	Type*	Primary Fuel	Alter. Fuel	Net Capability-MW Summer	Net Capability-MW Winter
FLORIDA POWER CORP.						
Avon Park 1 & 2	Highland Cnty.	F	Oil	Nat. Gas	57.0	60.0
Avon Park 1 & 2	Highland Cnty.	CT	Gas	No.2 Oil	52.0	70.0
P. L. Bartow	Pinellas Cnty.	F	Oil	Nat.Gas	468.0	479.0
P. L. Bartow	Pinellas Cnty.	CT	Crude	No.2 Oil	168.0	204.0
Bayboro	Pinellas Cnty.	F	Oil	----	48.0	53.0
Bayboro	Pinellas Cnty.	CT	Jet	No.2 Oil	184.0	232.0
Crystal River	Citrus County	F	Oil	----	863.0	865.0
Higgins	Pinellas Cnty.	F	Oil	Nat.Gas	130.0	139.0
Higgins	Pinellas Cnty.	CT	Gas	No.2 Oil	118.0	150.0
Inglis	Levy County	F	Oil	Nat.Gas	48.0	49.0
Port St. Joe	Gulf County	CT	No.2 Oil	Jet	14.0	17.0
Rio Pinar	Orange Cnty.	CT	No.2 Oil	Jet	14.0	17.0
Suwannee River	Suwannee Cnty.	F	Oil	Nat.Gas	153.0	157.0
G. E. Turner	Volusia Cnty.	F	Oil	Nat.Gas	194.0	194.0
G. E. Turner	Volusia Cnty.	CT	No.2 Oil	Jet	28.0	34.0
Total					2539.0	2720.0
GULF POWER COMPANY						
Crist	Pensacola	F	Nat.Gas	Oil	81.7	81.7
Crist	Pensacola	F	Coal	Gas	512.6	512.6
Crist	Pensacola	F	Coal	----	516.2	516.2
Scholtz	Sneads	F	Coal	----	89.2	89.2
Smith	Panama City	F	Coal	----	358.3	358.3
Smith	Panama City	CT	No.2 Oil	----	37.6	43.6
Total					1595.6 (a)	1601.6 (a)

Table 1 (Con't)
EXISTING CAPACITY AS OF DECEMBER 31, 1973

Plant Name	Location	Type*	Primary Fuel	Alter. Fuel	Net Capability-MW Summer	Net Capability-MW Winter
TAMPA ELECTRIC COMPANY						
Big Bend 1 & 2	Nr. Tampa	F	Coal	-----	626.0	626.0
Big Bend GT-1	Nr. Tampa	CT	No.2 Oil	-----	14.0	14.0
Gannon Units 1-6	Nr. Tampa	F	Coal	-----	1058.0	1058.0
Gannon GT-1	Nr. Tampa	CT	No.2 Oil	-----	14.0	14.0
Hookers Point	Tampa	F	No.6 Oil	-----	187.0	187.0
Total					1899.0	1899.0
JACKSONVILLE ELECTRIC AUTHORITY						
Kennedy	Jacksonville	F	Residual	-----	215.8	226.0
Kennedy	Jacksonville	CT	Diesel	-----	241.0	282.0
Northside	Jacksonville	F	Residual	-----	523.0	523.0
Northside	Jacksonville	CT	Diesel	-----	23.0	28.0
Southside	Jacksonville	F	Residual	-----	315.0	323.0
Southside	Jacksonville	CT	Diesel	-----	25.0	30.0
Total					1342.8	1412.0
CITY OF TALLAHASSEE						
A. B. Hopkins	Tallahassee	F	Nat.Gas	Oil	82.0	82.0
A. B. Hopkins	Tallahassee	CT	Nat.Gas	No.2 Oil	45.0	46.3
S. O. Purdom	St. Marks	F	Oil	-----	15.6	15.6
S. O. Purdom	St. Marks	F	Nat.Gas	Oil	110.1	110.1
S. O. Purdom	St. Marks	CT	Nat.Gas	No.2 Oil	25.0	26.0
Total					277.7	280.0

Table 1 (Con't)
EXISTING CAPACITY AS OF DECEMBER 31, 1973

Plant Name	Location	Type*	Primary Fuel	Alter. Fuel	Net Capability-MW Summer	Net Capability-MW Winter
FLORIDA POWER & LIGHT COMPANY						
Turkey Point	Dade County	N	Nuclear	-----	1346.0	1386.0
Turkey Point	Dade County	F	Oil	Nat.Gas	760.0	822.0
Turkey Point	Dade County	D	Oil	-----	13.5	13.5
Cutler	Dade County	F	Oil	Nat.Gas	327.0	355.8
Miami	Miami	F	Gas	Oil	45.0	49.0
Lauderdale	Lauderdale	F	Oil	Nat.Gas	290.0	314.0
Lauderdale	Lauderdale	CT	Oil	Nat.Gas	888.0	888.0
Port Everglades	Hollywood	F	Oil	Nat.Gas	1186.0	1271.0
Port Everglades	Hollywood	D	Oil	-----	13.5	13.5
Port Everglades	Hollywood	CT	Oil	Nat.Gas	444.0	444.0
Riviera	Riviera Bch.	F	Oil	Nat.Gas	694.0	702.0
Cape Canaveral	Nr. Cocoa	F	Oil	Nat.Gas	760.0	822.0
Sanford	Nr. Sanford	F	Oil	-----	903.0	953.0
Palatka	Nr. Palatka	F	Oil	Nat.Gas	113.6	123.6
Ft. Myers	Nr. Ft. Myers	F	Oil	-----	525.0	568.0
Total					8308.6	8725.4
CITY OF LAKELAND						
Larsen Memorial	Hwy.92 East	F	No.6 Oil	Nat.Gas	112.7	117.0
Larsen Memorial	Hwy.92 East	CT	No.2 Oil	Nat.Gas	33.0	39.0
Power Plant #3	N. Lk. Parker	F	No.6 Oil	Nat.Gas	88.0	89.3
Power Plant #3	N. Lk. Parker	CT	4&2 Oil	-----	20.2	23.7
Power Plant #3	N. Lk. Parker	D	Diesel	-----	5.5	5.5
Total					259.4	274.5

Table 1 (Con't)

EXISTING CAPACITY AS OF DECEMBER 31, 1973

Plant Name	Location	Type *	Primary Fuel	Alter. Fuel	Net Capability-MW Summer	Net Capability-MW Winter
LAKE WORTH UTILITIES AUTHORITY						
Tom G. Smith	Lake Worth	F	Nat.Gas	Navy Sp.	74.5	78.5
Tom G. Smith	Lake Worth	D	Diesel	--------	13.0	13.5
Total					87.5	92.0
FORT PIERCE UTILITIES AUTHORITY						
Henry D. King	Ft. Pierce	F	Nat.Gas	No. 6 Oil	72.0	75.0

*N - Nuclear Steam
F - Fossil Steam

D - Diesel
CT - Combustion Turbine

(a) Inclues overpressure operation for peak hour only - not for continuous operation.

APPENDIX B

Table 2

NEW OR PLANNED ADDITIONS IN CAPACITY [60]

Plant Location	Owner	In-Service Date	Net Capacity - MW Summer	Net Capacity - MW Winter	Type	Primary	Alter.
Gannon 6	TEC	2/74	38	38	FO	Coal	None
Indian River 3	OUC	2/74	335	335	F	N.Gas	#6 Oil
Ft. Myers	FPL	3/74	683	840	CT	Oil	None
Northside	JEA	3/74	200	200	CT	#2 Oil	#6 Oil
Big Bend 2	TEC	5/74	64	64	FO	Coal	None
Intercession	FPC	5/74	300	300	CT	#2 Oil	None
Turner	FPC	6/74	139	139	CCT	Crude	#2 Oil
Big Bend GT	TEC	6/74	130	130	CT	Oil	None
Anclote	FPC	8/74	515	515	F	#6 Oil	None
Fort Pierce	FPUA	12/74	57	60	F	N. Gas	#6 Oil
			2461	2461			

Additions before expected peak - from 12/31/73

	To Summer Net Capacity - MW	To Winter Net Capacity - MW
N - Nuclear	0	0
F - Fossil Steam	335	910
CT - Fossil Combined Turbines	1452	1609
CC - Fossil Combined Cycle	0	0
FO - Fossil Other (Upratings and Retirements)	102	102
	1889	2621

Table 2 (Con't) Year 1975

STATE OF FLORIDA
NEW OR PLANNED ADDITIONS IN CAPACITY

Plant Location	Owner	In-Service Date	Net Capacity - MW Summer	Net Capacity - MW Winter	Type	Fuel Primary	Fuel Alter.
Big Bend 1	TEC	1/75	14	14	FO	Coal	None
Tom Smith	LWUA	1/75	28	28	CT	#2 Oil	None
Crystal River 3	FPC	3/75	825	825	N	Nuclear	None
Plant 3-2	LAK	3/75	118	125	F	#6 Oil	None
Avon Park	FPC	4/75	-11	-12	FO	N. Gas	None
Bayboro 2,3,4	FPC	4/75	-50	-53	FO	N. Gas	None
Inglis 1,2,3	FPC	4/75	-46	-48	FO	N. Gas	None
Turner 1	FPC	4/75	-9	-10	FO	N. Gas	None
Palatka	FPL	4/75	484	552	CC	Oil	None
Deerhaven	GVL	4/75	38	40	CT	N. Gas	#2 Oil
Vero	CVB	7/75	55	55	F	N. Gas	#6 Oil
DeBary	FPC	8/75	300	300	CT	#6 Oil	#2 Oil
Anclote 2	FPC	12/75	515	515	F	#6 Oil	None
			2261	2331			

Additions Before Expected Peak- From Previous Year	To Summer Net Capacity - MW	To Winter Net Capacity - MW
N - Nuclear	825	825
F - Fossil Steam	745	180
CT - Fossil Combined Turbines	66	368
CC - Fossil Combined Cycle	484	552
FO - Fossil Other (Upratings and Retirements	-102	-109
	2018	2331

Table 2 (Con't) Year 1976

STATE OF FLORIDA

NEW OR PLANNED ADDITIONS IN CAPACITY

Plant Location	Owner	In-Service Date	Net Capacity - MW Summer	Net Capacity - MW Winter	Type	Fuel Primary	Fuel Alter.
Gannon 1	TEC	1/76	10	10	FO	Coal	None
St. Lucie 1	FPL	1/76	802	817	N	Nuclear	None
Hookers Point	TEC	1/76	14	14	FO	#6 Oil	None
Big Bend 3	TEC	2/76	375	375	F	Coal	None
Manatee 1	FPL	2/76	775	825	F	Oil	None
Northside 3	JEA	3/76	541	541	F	#6 Oil	None
Turner 2	FPC	3/76	-28	-28	FO	#6 Oil	N.Gas
Bartow	FPC	4/76	150	150	CC	Crude	#2 Oil
Manatee 2	FPL	12/76	775	825	F	Oil	None
			3414	3529			

Additions before expected peak—from previous year	To Summer Net Capacity - MW	To Winter Net Capacity - MW
N - Nuclear	802	817
F - Fossil Steam	2206	2566
CT - Fossil Combined Turbines	300	0
CC - Fossil Combined Cycle	150	150
FO - Fossil Other (Upratings and Retirements)	-4	-4
	3454	3529

Table 2 (Con't) Year 1977

STATE OF FLORIDA

NEW OR PLANNED ADDITIONS IN CAPACITY

Plant Location	Owner	In-Service Date	Net Capacity - MW Summer	Net Capacity - MW Winter	Type	Fuel Primary	Fuel Alter.
MCPD 10	FPL	3/77	500	520	CC	Oil	None
Hopkins 2	TAL	3/77	235	235	F	#6 Oil	N. Gas
DeBary	FPC	4/77	45-	450	CC	#6 Oil	#2 Oil
Big Bend 1	TEC	6/77	23	23	FO	Coal	None
Big Bend 2	TEC	6/77	23	23	FO	Coal	None
Gannon 6	TEC	6/77	23	23	FO	Coal	None
Martin 1	FPL	9/77	775	825	F	Oil	None
			2029	2029			

Additions before expected peak - from previous year	To Summer Net Capacity - MW	To Winter Net Capacity - MW
N - Nuclear	0	0
F - Fossil Steam	1010	1060
CT - Fossil Combined Turbines	0	0
CC - Fossil Combined Cycle	950	970
FO - Fossil Other (Upratings and Retirements)	69	69
	2029	2099

Table 2 (Con't) Year 1978

STATE OF FLORIDA
NEW OR PLANNED ADDITIONS IN CAPACITY

Plant Location	Owner	In-Service Date	Net Capacity - MW Summer	Winter	Type	Fuel Primary	Alter.
MCPD 10	FPL	3/78	500	520	CC	Oil	None
Plant 3 GT	LAK	3/78	37	40	CT	#2 Oil	#4 Oil
Big Bend GT	TEC	3/78	130	130	CT	#2 Oil	None
DeBary	FPC	4/78	450	450	CC	#6 Oil	#2 Oil
Unknown	FPC	4/78	250	250	CT	#6 Oil	#2 Oil
Tom Smith	LWUA	6/78	75	75	F	N. Gas	#6 Oil
Gainesville	GVL	6/78	-16	-16	FO		
Deerhaven 2	GVL	6/78	220	220	F	#6 Oil	N. Gas
Martin 2	FPL	11/78	775	825	F	Oil	None
			2421	2494			

Additions before expected peak - from previous year	To Summer Net Capacity - MW	To Winter Net Capacity - MW
N - Nuclear	0	0
F - Fossil Steam	1070	1120
CT - Fossil Combined Turbines	417	420
CC - Fossil Combined Cycle	950	970
FO - Fossil Other (Upratings and Retirements)	-16	-16
	2421	2494

Table 2 (Con't)

STATE OF FLORIDA Year 1979

NEW OR PLANNED ADDITIONS IN CAPACITY

Plant Location	Owner	In-Service Date	Net Capacity - MW Summer	Winter	Type	Fuel Primary	Alter.
MCPD 10	FPL	3/79	500	520	CC	Oil	None
MCPD 6	FPL	3/79	500	520	CC	Oil	None
Plant 3-3	LAK	3/79	236	250	F	#6 Oil	None
Big Bend 4	TEC	3/79	400	400	F	Coal	None
Unknown	FPC	4/79	350	350	CT	#6 Oil	#2 Oil
Unknown	FPC	4/79	450	450	CC	#6 Oil	#2 Oil
Northside 4	JEA	4/79	450	500	F	#6 Oil	None
Indian River	OUC	6/79	116	116	CT	#6 Oil	None
Unnamed	GPC	6/79	500	500	F	Coal	None
			3502	3606			

Additions Before Expected Peak - From Previous Year	To Summer Net Capacaty - MW	To Winter Net Capacity - MW
N - Nuclear		
F - Fossil Steam	0	0
CT - Fossil Combined Turbines	2361	1650
CC - Fossil Combined Cycle	466	466
FO - Fossil Other (Upratings and Retirements)	1450	1490
	0	0
	4277	3606

Table 2 (Con't)

STATE OF FLORIDA Year 1980

NEW OR PLANNED ADDITIONS IN CAPACITY

Plant Location	Owner	In-Service Date	Net Capacity - MW Summer	Net Capacity - MW Winter	Type	Fuel Primary	Fuel Alter.
St. Lucie 2	FPL	1/80	802	817	N	Nuclear	None
Hopkins GT-3	TAL	3/80	285	285	CT	#2 Oil	N. Gas
Purdom 1, 2	TAL	3/80	-5.6	-5.6	FO	#6 Oil	None
Purdom 3,4	TAL	3/80	-5.6	-5.6	FO	N. Gas	#6 Oil
Beacon Key	TEC	4/80	50	50	CT	#6 Oil	None
Unknown	FPC	4/80	600	600	CC	#6 Oil	#2 Oil
Martin 3	FPL	5/80	775	825	F	Coal	Oil
Indian River	OUC	6/80	58	58	CT	#6 Oil	None
Unknown	FPUA	6/80	100	100	U		
MPCD 7	FPL	9/80	775	825	F	Coal	Oil
			3433.8	3548.8			

Additions Before Expected Peak - From Previous Year	To Summer Net Capacity - MW	To Winter Net Capacity - MW
N - Nuclear	802	817
F - Fossil Steam	775	1650
CT - Fossil Combined Turbines	393	393
CC - Fossil Combined Cycle	600	600
FO - Fossil Other (Upratings and Retirements)	-11	-11
U - Unknown	100	100
	2659	3549

Table 2 (Con't) Year 1981

STATE OF FLORIDA

NEW OR PLANNED ADDITIONS IN CAPACITY

Plant Location	Owner	In-Service Date	Net Capacity - MW Summer	Net Capacity - MW Winter	Type	Fuel Primary	Fuel Alter.
MCPD 6	FPL	3/81	500	520	CC	Oil	None
Beacon Key 1	TEC	3/81	400	400	F	Coal	None
Unknown	FPC	4/81	750	750	CC	#6 Oil	#2 Oil
MCPD 6	FPL	4/81	775	825	F	Coal	Oil
Unknown	JEA	4/81	150	150	CT	#2 Oil	#6 Oil
Indian River	OUC	6/81	116	116	CT	#6 Oil	None
Unnamed	GPC	6/81	500	500	F	Coal	None
Unknown	GVL	6/81	235	235	F	#6 Oil	None
			3426	3496			

Additions before expected peak- from previous year	To Summer Net Capacity - MW	To Winter Net Capacity - MW
N - Nuclear		
F - Fossil Steam	0	0
CT - Fossil Combined Turbines	2685	1960
CC - Fossil Combined Cycle	266	266
FO - Fossil Other (Upratings and Retirements)	1250	1270
	0	0
	4201	3496

Table 2 (Con't) Year 1982

STATE OF FLORIDA

NEW OR PLANNED ADDITIONS IN CAPACITY

Plant Location	Owner	In-Service Date	Net Capacity - MW Summer	Net Capacity - MW Winter	Type	Fuel Primary	Fuel Alter.
MCPD 7	FPL	3/82	775	825	F	Coal	Oil
MCPD 10	FPL	3/82	500	520	CC	#6 Oil	None
Hopkins 3	TAL	3/82	235	235	F	#6 Oil	N. Gas
Purdom 1,2	TAL	3/82	-10	-10	FO	#6 Oil	None
Unknown	JEA	3/82	-10	-10	FO	N. Gas	#6 Oil
Gannon GT 1-3	TEC	3/82	150	150	CT	#2 Oil	None
Unknown	FPC	4/82	800	800	CC	#6 Oil	#2 Oil
MCPD 10	FPL	4/82	775	825	F	Coal	Oil
Indian River 4	OUC	6/82	425	425	F	#6 Oil	N. Gas
Lake Highland	OUC	12/82	-86	-92	FO	#6 Oil	None
			4454	4568			

Additions before expected peak - from previous year

	To Summer Net Capacity - MW	To Winter Net Capacity - MW
N - Nuclear		
F - Fossil	900	900
CT - Fossil Combined Turbines	2210	2310
CC - Fossil Combined Cycle	150	150
FO - Fossil Other (Upratings and Retirements)	1300	1320
	-20	-112
	4540	4568

Table 2 (Con't) Year 1983

STATE OF FLORIDA

NEW OR PLANNED ADDITIONS IN CAPACITY

Plant Location	Owner	In-Service Date	Net Capacity - MW Summer	Net Capacity - MW Winter	Type	Fuel Primary	Fuel Alter.
MCPD 6	FPL	3/83	775	825	F	Coal	Oil
Unknown	FPC	4/83	1300	1300	N	Nuclear	None
South Dade 1	FPL	4/83	1235	1235	N	Nuclear	None
Beacon Key 2	TEC	4/83	400	400	F	Coal	None
Plant 3 GT	LAK	4/83	66	70	Ct	#2 Oil	#4 Oil
Tom Smith	LWUA	6/83	100	100	F	N. Gas	#6 Oil
			3876	3930			

Additions before expected peak - from previous year	To Summer Net Capacity - MW	To Winter Net Capacity - MW
N - Nuclear	2535	2535
F - Fossil Steam	1275	1325
CT - Fossil Combined Turbines	66	70
CC - Fossil Combined Cycle	0	0
FO - Fossil Other (Upratings and Retirements)	-86	0
	3790	3930

FOOTNOTES

[1]Florida Energy Committee, Energy In Florida, Report and Recommendations on Energy Policy In Florida, 1974, p. 2.

[2]Ibid., p. 38.

[3]Ibid., p. 4.

[4]Ibid., p. 49.

[5]Ibid., p. 37.

[6]Ibid., p. 46.

[7]Ibid., p. 47.

[8]Ibid., p. 48.

[9]Ibid., p. 49.

[10]Ibid., p. 54.

[11]Ibid., p. 55.

[12]Robert E. Uhrig, Statement presented to Florida section Meeting of the American Nuclear Society, Key Biscayne, Florida, June 7, 1974.

[13]Florida Electric Power Coordinating Group Ten Year Electric Utility Expansion Plan, presented to State of Florida, Department of Administration, Division of State Planning, May, 1974, p. 19.

[14]Ibid., p. 20.

[15]Ibid., p. 21.

[16]Ibid., p. 22.

[17]Ibid., p. 40.

[18]Florida Energy Committee, Energy In Florida, p. 17.

[19]Manson Benedict, "Electric Power From Nuclear Fission," Bulletin of the Atomic Scientists, Vol. 27, September, 1971, p. 8.

[20]Ibid., p. 10.

[21]Florida Electric Power Coordinating Group, Ten Year Electric Utility Expansion Plan, p. 5.

[22]Ibid., p. 6.

[23]Florida Electric Power Coordinating Group, Ten Year Electric Utility Expansion Plan, p. 9.

[24]Ibid., p. 29.

[25]Ibid., p. 8.

[26]Ibid., p. 24.

[27]Florida Energy Committee, Energy in Florida, p. 17.

[28]Florida Electric Power Coordinating Group, Ten Year Electric Utility Expansion Plan, p. 46.

[29]Ibid., p. 47.

[30]Feasibility Report, Floating Nuclear Power Plants for Jacksonville Electric Authority, Power Engineering Department publication. May, 1974.

[31]Florida Power Corporation, "News Release", St. Petersburg, Florida, March 13, 1974.

[32]Nuclear Power In the South, Report by the Southern Governors' Task Force for Nuclear Policy, William W. Eaton, Chairman, September, 1970. pp. 60-105.

[33]Ibid., p. 89.

[34]Florida Power and Light Company, Hutchinson Island Plant Environmental Report, Volume 1.

[35]J. C. Stadelman, Statement presented to Staff of Florida Governor's Conference on Energy Supply and Use, Tallahassee, Florida, March, 1973.

[36]Robert E. Uhrig, Statement presented to Florida Section Meeting of the American Nuclear Society.

[37]Nuclear Power and the Environment, American Nuclear Society, Hinsdale, Ill., 1973.

[38]M. Eisenbud, and H. G. Petrow, "Radioactivity in the Atmospheric Effluents of Power Plants that Use Fossil Fuels," Science, Vol. 144, April 17, 1964, pp. 288-289.

[39]"Canals Cool Hot Water For Reuse," Environmental Science and Technology, Vol. 7, No. 1, January, 1973, pp.20-21.

[40]R. P. Hammond, "Nuclear Power Risks," American Scientist Volume 62, March-April, 1974, p. 159.

[41]Southeastern Electric Reliability Council, Florida Sub-region; data supplied by Florida Public Service Commission.

[42]H. C. Ott, A Comparison of Alternate Nuclear Reactor Types, Ebasco Services Incorporated, May, 1974.

[43]J. F. Emerson, The Domestic Uranium Resource Base, AIF Seminar on Uranium, Oak Brook, Ill., March 22, 1973.

[44]Florida Nuclear Code and Southern Interstate Nuclear Compact Law, Sections 290.01-290.32.

[45]P. Bradley, Letter from Florida Energy Committee to Kenneth J. Nemeth of the Southern Interstate Nuclear Board, June 12, 1974.

[46]American Nuclear Society, Nuclear Power and the Environment, (Illinois: American Nuclear Society, 1973), p. 33.

[47]Florida Energy Committee, Energy in Florida, pp. 92.

[48]Ibid., p. 97.

[49]Ibid., p. 100.

[50]Ibid., p. 101.

[51]Ibid., p. 102.

[52]Ibid., p. 113.

[53]Ibid., p. 104.

[54]Ibid., p. 118.

[55]Ibid., p. 115.

[56]Leonard R. D. Reichle, Breeder Reactors in National Energy Programs, AIF Working Group On Energy, May, 1974.

[57]Ibid., p. 30.

[58]Ibid., p. 28.

[59]Florida Electric Power Coordinating Group, Ten Year Electric Utility Expansion Plan, pp. 10-13.

[60]Ibid., pp. 30-39.

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