LOAD FORECAST PRESENTATION

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Introduction

In a workshop on electric rates, some comments should be made about the relevance and importance of load forecasting to the determination of electric rates. Future power loads--the product of the load forecasting effort--are used along with other information to determine the generating capacity needed to serve TVA's customers. Given the amount and type of capacity on the system, the level of loads determines fuel costs, labor costs, interest costs, etc., all of which are major determinants of the cost of producing electricity, which is the basis for electric rates. An oversimplified explanation, to be sure, but an important one to understand to appreciate the load forecast connection.

Historical Perspective

First, some historical perspective on the relative consumption per capita of energy (in millions of Btu per person) in the TVA area and the United States. Visual 1 shows how TVA and the U.S. contrast in terms of energy consumption. The data here reveal that TVA is slightly more energy intensive than the Nation, but much more electricity intensive than the U.S. as a whole. In 1965, TVA per capita electric utility energy consumption was twice that of the U.S. By 1975, this factor had declined to 1.6. One factor that makes TVA energy consumption per capita higher than that in the U.S. is the presence of the DOE nuclear fuel enrichment facilities in the region, as can be seen in the right-hand column which excludes DOE loads and shows TVA per capita energy consumption about the same as for the Nation.

Visual 2, which gives the percent of total energy consumed by fuel type, shows the TVA area's 1975 consumption of natural gas and oil (at 51 percent of total energy) to be less intensive than the Nation with 74 percent of its energy consumption in natural gas and oil. The TVA area can be seen to be more coal and hydro intensive--these being the relatively abundant resources which go into the production of electricity. So while the Nation is dependent on scarce oil and gas, TVA leans more heavily on coal, an abundant national resource.

In Visual 3, the top curve depicts the historical growth of TVA area net system requirements from 1960 to 1978 at a 3.4-percent growth rate. The bottom line represents the DOE electricity requirements. The middle line represents TVA energy requirements exclusive of the DOE loads, growing at 5.8 percent. Several things can be seen in this graph--the relatively strong economic growth up to 1974, when the effect of the 1974-75 recession can be seen (despite the decline in DOE loads from 1960-71); the effect of the variations in level of DOE loads; the 1975-78 recovery from the recession; and the slower growth in the 1970-78 period due to the rising price of electricity. The abrupt dropoff in loads from 1977 to 1978 is obviously the result of the drop in the DOE loads.

DOE is a large part of the TVA net system load. Historically, the DOE load has declined, but is expected to pick up again in the future. Due to its size, DOE has a substantial effect on TVA net system loads.

Prices of Electricity, Gas, Oil, and Coal

Visual 4 is a graph of the indices of prices of electricity, gas, and oil for residential use over the period 1960 to 1978, with 1960 as the base year. Natural gas and oil prices in the TVA area grew more slowly than electricity prices until 1972. The effect of the oil embargo on oil prices can be seen in the abrupt rise in oil prices after 1973. Natural gas growth has been slower than either electricity or oil because of price regulation, but may be expected to grow faster in the future with deregulation.

How TVA Forecasts

A detailed discussion of the methodologies and procedures involved in preparing TVA load forecasts would require more time than is available to us this evening. Basically, the premise on which our load forecasting procedures are founded is that the demand for electricity is determined by the level of economic activity, the relative price of electricity, the relative prices and availability of alternative fuels such as natural gas and oil, and conservation and new end-use technology programs designed to increase the efficiency with which electricity is used.

The forecast is prepared by class of customer and combined on a building block basis. Separate forecasts are made for residential, commercial, manufacturing, and large Federal loads, as indicated on Visual 5.

Several methodologies are employed in these class-of-service forecasts. These range all the way from sophisticated statistical computer models to a variety of simpler mathematical techniques.

In the case of residential loads, customer growth is a function of population. The factors that affect average residential use are dependent on saturation of appliance, intensity of electricity use, conservation practices, etc.

Commercial loads are projected by five types of commercial activity--wholesale and retail trade; services; government; regulated industries; and finance, insurance, and real estate.

Manufacturing or industrial loads are analyzed in a breakdown of 16 major industrial classification categories. In recent years we have observed a shift away from manufacturing into service-type business and industry, a shift which moves from the more electricity-intensive loads toward the labor-intensive enterprise.

TVA's largest industrial loads, including its 54 directly served industrial customers, are estimated by the four major industry groups: aluminum, chemicals, ferroalloys, and paper. These four industries account for about 83 percent of the electricity consumption of all directly served industrial customers.

Federal agency loads--primarily the DOE uranium enrichment facilities--are forecast on the basis of their announced requirements, contract demands, and historical load levels.

Major Load Growth Determinants

The major factors influencing load growth are shown on Visual 6. They are economic activity, conservation, substitution, and end-use technologies. National economic activity, which historically has had a 3.5-percent growth rate, is now growing at about 3 percent. Economic activity in the TVA area, which grew at a substantial 5 percent prior to 1973, has dropped to half that growth rate in the 1973-77 period and will continue at a reduced rate in the future. Among the demographic factors, population growth has slowed in recent years and is expected to continue in this fashion.

The rising price of electricity has been the most significant factor in impacting load growth, among those listed under the conservation heading. You will recall from the earlier slide showing alternative fuel prices that the price of electricity has increased significantly in recent years and will probably continue to increase at or slightly above the rate of inflation.

The effect of TVA home insulation programs and appliance efficiency standards has been felt primarily in the past five years, with continuing major impacts as greater acceptance of the insulation programs is realized and as national energy legislation requires new appliances to be more energy efficient. Many commercial and industrial customers in the TVA area have taken the initiative to implement the more obvious energy conservation measures. Further gains in energy conservation are being realized as a result of TVA's C&I audit program.

Substitution

The substitution of electricity for other forms of energy is being observed in areas of natural gas shortages, and as the result of increased prices of fossil fuels, and the uncertainty about the supply of fossil fuels.

End-Use Technologies

The development and implementation of solar programs as an alternative source of water and space heating is gaining momentum in efforts such as the Memphis solar program. Both solar and cogeneration installations will have the effect of reducing loads, and capacity required to serve these reduced loads. While current solar and cogeneration programs are in the process of implementation, achievement of substantial reductions in load resulting from these programs will probably be seen five to ten years in the future. Electric vehicles, which offer the prospect of reduced demand for petroleum products, will probably operate on batteries which will be recharged during offpeak periods, thus requiring primarily energy rather than additional capacity (or demand) for their operation.

Role of Conservation

Visual 7 summarizes the role of TVA conservation programs affecting both residential and commercial customers. Projected residential energy savings from insulation, $uper $aver, heat pump, biomass, and solar programs are estimated at between 5 billion and 7.3 billion kilowatthours in 1990. Commercial and industrial programs are expected to save between 9.5 and 12.7 billion kilowatthours in 1990. The total estimated energy savings from these programs is in the range of 15 to 20 billion kilowatthours in 1990, or a reduction of up to 6,200 megawatts in winter peak demand.

TVA Forecasts

The short-term load forecast outlook is of particular importance since this is an important determinant of projected revenue for the near-term period. Visual 8 depicts TVA net system requirements for fiscal years 1979 through 1981 both with and without the much-discussed 1979-80 recession. This recession scenario assumes a decline in growth rate of GNP through the first quarter of 1980, followed by a gradual recovery through the end of the period shown. The greatest percentage reduction in GNP growth (2.5 percent) is in the fourth quarter of 1979. These two short-term forecast alternatives underline the importance in forecasting of variations in economic factors.

Visual 9 is a table of five of the alternative planning forecasts resulting from five different sets of assumptions about (1) level of economic activity, (2) level of substitution of electricity for natural gas or other fuels, (3) rate of change in the real price of electricity from 0 percent to 4 percent, and (4) the effect of TVA conservation programs. The range of forecasts is provided to TVA planners and policymakers to allow for consideration of the greater uncertainty in the long term, resulting from the varying combinations of assumptions underlying each forecast.

The first and highest forecast results from the combination of high economic growth, medium substitution, 0-percent change in electricity price, and high effect of conservation--or as we refer to it, "High-Medium-Zero-High." This forecast has an average annual growth rate from 1978-1990 of 4.6 percent and a 3.5-percent growth from 1990-2000.

The low forecast (#5) represents low economic growth, medium substitution, 4-percent change in electricity price, and high effect of conservation programs. This forecast has a 2.4-percent growth in the earlier period and a growth of 0.7 percent in the later period. Of the three middle-range forecasts shown, the middle one (#3) is a "medium economic growth, medium substitution, 2% change in electricity price, low conservation programs effect alternative," with growth rates of 3.6 percent and 2.1 percent.

The last slide offers a graphic picture of these five alternative long-term forecasts compared to historical growth in the period 1960-1978. Also shown here is the July 1978 load forecast, based on medium economic growth and new end-use technology impacts. While there is relatively little difference in the short term among these alternative forecasts, the spread or range becomes very significant by 1990 and beyond.

From 1978 to 1990, all of the forecasts shown are below the July 1978 forecast. This is due initially to the current economic downturn, the lower short-term economic outlook, increased prices of electricity, and the rapid buildup of TVA conservation programs, especially the home weatherization program and the commercial and industrial program. In addition, the lower level of the current forecasts is initially influenced by the 1977-78 downturn, which provided a lower takeoff point for the later alternative forecasts.

These forecasts range in 1978-2000 rate of growth from 1.6 percent per year to 4.1 percent, and indicate a possible range of system requirements of from 161.6 billion to 210 billion kilowatthours in 1990. For the period 1978-2000, these forecasts range in growth rates from 1.3 to 4.3 percent, excluding DOE, which compares to a historical growth rate of 5.8 percent.

TOTAL AND ELECTRIC UTILITY ENERGY CONSUMPTION*

PER CAPITA

Year	Total Energy Consumption Per Capita (10^6 Btu/Capita)	Total Electric Utility Energy Consumption Per Capita (10^6 Btu/Capita)	Total Energy Consumption Per Capita Excluding DOE** (10^6 Btu/Capita)	Total Electric Utility Energy Consumption Per Capita Excluding DOE** (10^6 Btu/Capita)
		TVA		
1965	291	123	257	89
1970	365	153	346	134
1975	366	161	332	127
		U.S.		
1965	272	57	270	55
1970	336	81	335	80
1975	339	98	337	96

*Total primary energy consumption including generation losses
**Department of Energy uranium enrichment facilities

Visual 1

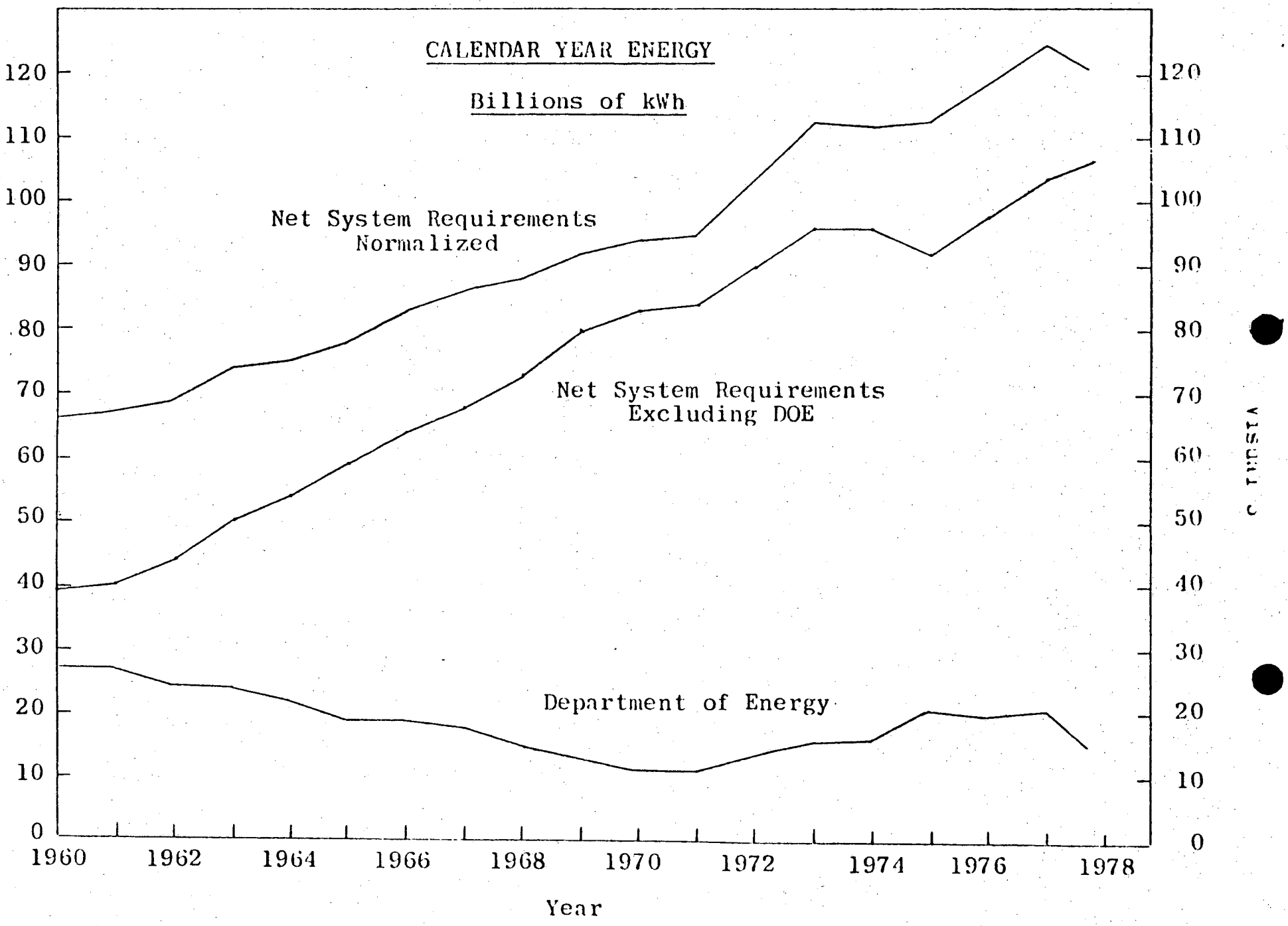
Visual 2

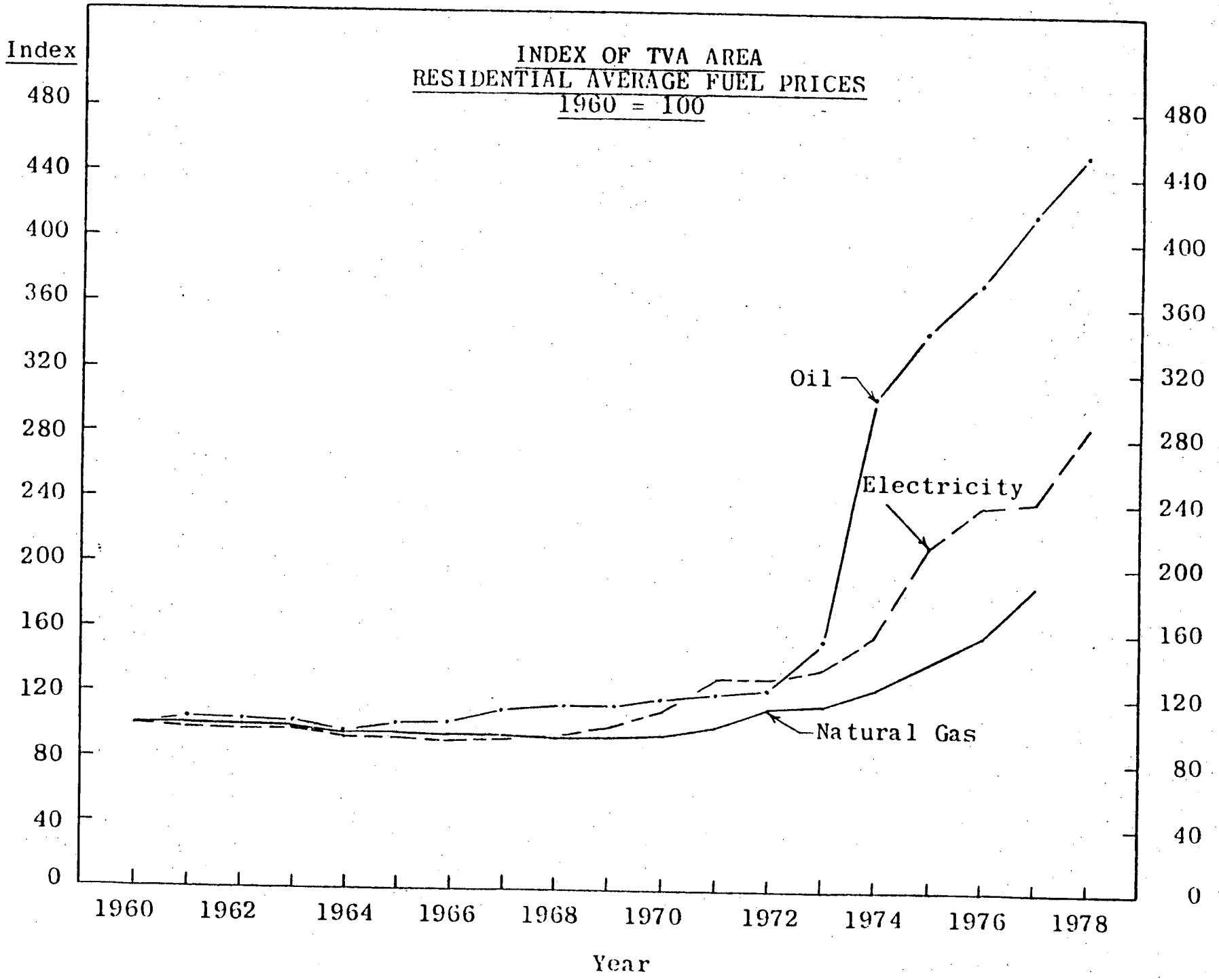
PERCENT OF TOTAL ENERGY CONSUMED BY FUEL TYPE

TVA AND THE U.S.*

Year	Natural Gas	Coal	Oil	Hydro	Nuclear
			U.S.		
1965	28.4	23.1	44.6	3.8	0.07
1970	32.2	19.5	44.1	3.8	0.30
1975	28.3	19.1	45.7	4.3	2.5
			TVA		
1965	20.3	40.3	28.6	10.8	0.0
1970	21.2	40.6	30.2	7.9	0.0
1975	17.0	37.4	34.3	10.4	1.0

*The figures show the percent of total energy consumed by fuel type. For instance, in the U.S. in 1965, 28.4 percent of the total energy consumed was in the form of natural gas.


CALENDAR YEAR ENERGY
Billions of kWh
Net System Requirements
Normalized
Net System Requirements
Excluding DOE
Department of Energy
120
110
100
90
80
70
60
50
40
30
20
10
0
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
Year


INDEX OF TVA AREA
RESIDENTIAL AVERAGE FUEL PRICES
1960 = 100
Index
480
440
400
360
320
280
240
200
160
120
80
40
0
Oil
Electricity
Natural Gas
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
Year

Visual 4

Visual 5

TVA FORECASTS BY CLASS OF SERVICE

Residential

Commercial

- Wholesale and retail trade
- Services
- Government
- Regulated industries
- Finance, insurance, and real estate

Manufacturing

- 16 manufacturing classifications
- Examine in detail large industries such as:

    Aluminum
    Chemicals
    Ferroalloys
    Paper

DOE uranium enrichment facilities

Visual 6

MAJOR FACTORS INFLUENCING LOAD

Economic activity

- National economic activity
- Regional economic activity
- Demographic factors

Conservation

- Rising price of electricity
- Home insulation
- Appliance efficiency
- Improved energy efficiency of commercial and industrial consumers

Substitution

- Natural gas shortage
- Increased prices of fossil fuels
- Uncertainly as to supply of fossil fuels

End-use technologies

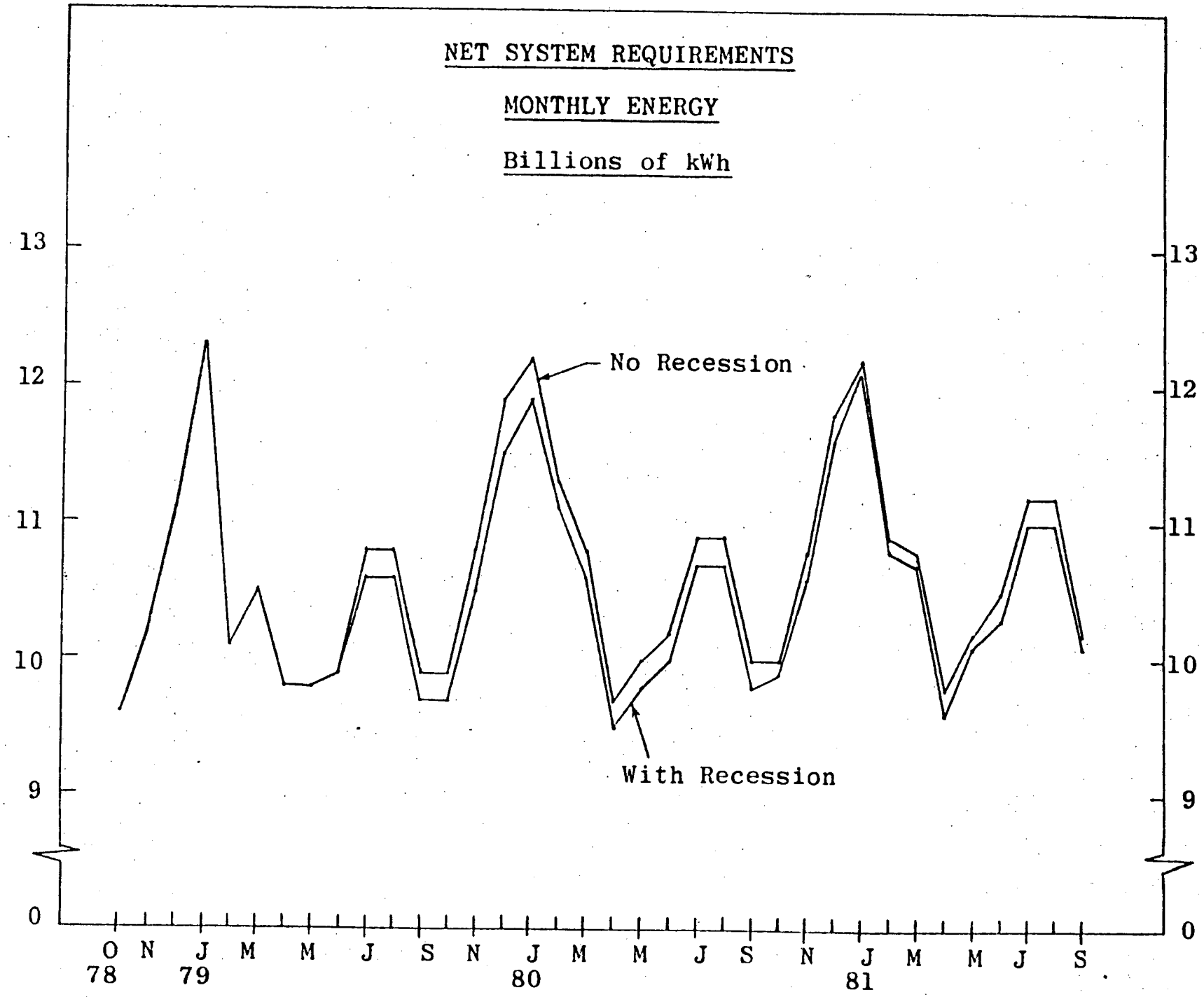
- Solar
- Cogeneration
- Electric cars

TVA CONSERVATION PROGRAMS

	Assumed Penetration	1990 Energy Savings Millions of kWh
A. Residential		
1. Retrofit programs--Home Insulation Program	43,000 homes per year--8 years	3,100
2. New home programs--$uper $aver home program	36,000 homes per year	2,100
3. Residential heating equipment		
a. Heat pumps		
(1) Low estimate	20,000 per year or 222,000 in 1990	800
(2) High estimate	55,000 per year or 628,000 in 1990	2,200
b. Biomass		
(1) Low estimate	31,000 homes in 1990	170
(2) High estimate	94,000 homes in 1990	500
c. Solar active system--retrofit		
(1) Low estimate	2,800 units in 1990	20
(2) High estimate	28,400 units in 1990	180
4. Solar water heating		
Low estimate	53,000 units in 1990	150
High estimate	163,000 units in 1990	500
5. Passive solar homes--new homes		
Low estimate	11,600 units in 1990	70
High estimate	23,200 units in 1990	140
6. Electric cars and railroad electrification	200,000 vehicles in 1990	-1,400
Total residential energy savings		5,000-7,300

Visual 7

	Assumed Penetration	1990 Energy Savings Millions of kWh
B. Commercial and industrial		
1. Solar		
Low estimate	10-percent penetration	600
High estimate	20-percent penetration	1,200
2. Biomass		
Low estimate	2-percent penetration	400
High estimate	3-percent penetration	600
3. Commercial and industrial energy audit program		6,300
4. Cogeneration		
Low estimate	Moderate national and TVA financing incentives	2,200
High estimate	30-percent tax credit, interest-free TVA loans	4,600
Total commercial and industrial energy savings		9,500-12,700
Total energy savings		14,500-20,000


NET SYSTEM REQUIREMENTS
MONTHLY ENERGY
Billions of kWh
13
12
11
10
9
0
No Recession
With Recession
O N J M M J S N J M M J S N J M M J S
78
79
80
81

Visual 8

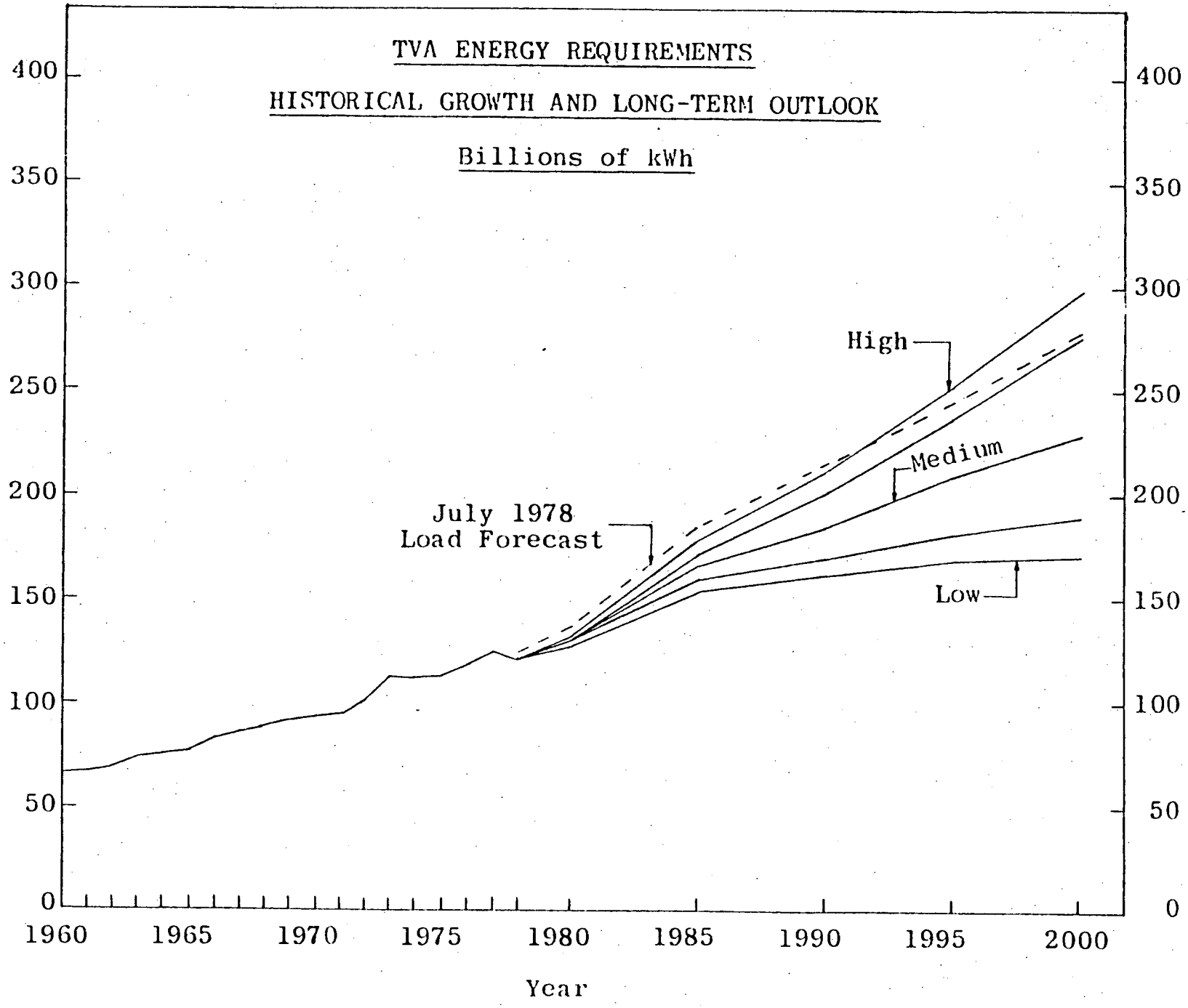
ALTERNATE LOAD FORECASTS

NET SYSTEM REQUIREMENTS

	Billions of kWh		Average Annual Growth Rate*	
	1990	2000	1978-1990	1990-2000
1. High economic growth, medium substitution, 0% increase in electricity price, high effect of conservation programs	210.0	296.8	4.6%	3.5%
2. Medium economic growth, high substitution, 0% increase in electricity price, low effect of conservation programs	200.8	274.8	4.3	3.2
3. Medium economic growth, medium substitution, 2% increase in electricity price, low effect of conservation programs	186.1	229.2	3.6	2.1
4. Medium economic growth, medium substitution, 4% increase in electricity price, high effect of conservation programs	170.0	191.0	2.8	1.2
5. Low economic growth, medium substitution, 4% increase in electricity price, high effect of conservation programs	161.6	172.4	2.4	0.7

*Fiscal 1978 net system requirements are 121.8 billion kWh.

Visual 9


TVA ENERGY REQUIREMENTS
HISTORICAL GROWTH AND LONG-TERM OUTLOOK
Billions of kWh
400
350
300
250
200
150
100
50
0
High
Medium
Low
July 1978
Load Forecast
1960
1965
1970
1975
1980
1985
1990
1995
2000
Year

Visual 10