RELATED CORRESPONDENCE

CP&L

Carolina Power & Light Company

P. O. Box 1551 • Raleigh, N. C. 27602

January 3, 1979

JAN 8 1979

J. A. JONES
Executive Vice President
Chief Operating Officer

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, D. C. 20555

SHEARON HARRIS NUCLEAR POWER PLANT
UNITS 1-4, DOCKET NOS. 50-400, 401, 402, 403

Dear Mr. Denton:

In the interest of keeping you informed concerning matters affecting the Harris plant, we are enclosing a copy of the North Carolina Utilities Commission's (NCUC) Order of December 28, 1978, formally adopting a 1978 load forecast and capacity plan for the State of North Carolina. A copy of the report entitled, Future Electricity Needs for North Carolina: Load Forecast and Capacity Plan - 1978 (NCUC Report), is also enclosed. In addition, copies of each document are being forwarded with a copy of this letter to the members of the Nuclear Regulatory Commission, the Atomic Safety & Licensing Appeal Board, the Atomic Safety & Licensing Board, and all parties to the construction permit proceeding.

Relying primarily on a 1978 forecast prepared by the Public Staff of the NCUC which was before the Atomic Safety & Licensing Board and the Atomic Safety & Licensing Appeal Board (as Licensing Board Exhibit 7) when the affirmative finding on the need for power was made in this case,[1] the

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[1]See Carolina Power & Light Co. (Shearon Harris Nuclear Power Plant Units 1, 2, 3, and 4) 7 NRC 92 (1978), affrm'd ALAB-490, 7 NRC ______ (Aug. 23, 1978).

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NCUC has determined that the probable range of annual peak-load growth for CP&L through 1992 is 4.4% to 6.5%. Within this range the most probable peak-load growth rate for planning was found to be 5.2%. NCUC Report at 9. In reaching this conclusion the NCUC essentially adopted the NCUC Public Staff's 1978 base case forecast of 6.7% growth and qualitatively adjusted it to account for actual 1978 peaks and to incorporate the Commission's belief that conservation and load management can reduce the rate of peak load growth. Id. at 19-21. The Commission recognized, however, that the proposed reductions "depend upon increased levels of conservation and load management" (id. at 21) and stated that "significant effort should be expended by the utilities to help effect...changes in usage patterns." Id. at 22.

Based upon its expectation of achieving a reduction in the rate of growth to 5.2%, the NCUC concluded that the inservice dates for CP&L units under construction could be extended at least one year, but in no case greater than two years, and still maintain adequate reserves. Id. at 22 and 24. Recognizing, however, the "paucity of concrete data available...concerning actual methods of achieving the expected levels of conservation and load management" (id. at 26) and its "responsibility to ensure that the continued economic growth of the State is not impaired by a lack of adequate utility services" (id. at 27), the Commission deferred any decision to require CP&L or other electric utilities to adjust their construction schedules until after completion of hearings planned for mid-1979. Id. at 26-27.

In addition to the NCUC forecast, I am also enclosing a Table showing CP&L's latest forecast and construction schedule as submitted to the CP&L Board of Directors on December 20, 1978. Like the NCUC forecast, it also forecasts slightly slower growth (5.35% through 1992) than the Company's previous forecast (5.7%). Although the generating capacity addition schedule eliminates a 1150 MW undesignated nuclear unit formerly projected for 1989 and adds two undesignated 720 MW units for 1991 and 1992, respectively, no changes in the construction schedule or inservice dates are currently projected for units under construction.

It is clear in any event--consistent with the ASLB's finding in its Initial Decision--that both the NCUC's and the Company's lowered growth rates still show "a need for Harris power in the 1980's" (7 NRC at 139) and that while the effect of the lowered forecast "could be that the timing of the Harris units might be changed,...the need to schedule...[them] for construction would remain." Id.

In the event there is any subsequent change in the Harris schedule, we will inform you.

Very truly yours,

J. A. Jones

JAJ/gmc

Enclosures

cc: The Honorable Joseph M. Hendrie, Chairman
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

The Honorable Victor Gilinsky, Commissioner
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

The Honorable Richard T. Kennedy, Commissioner
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

The Honorable Peter A. Bradford, Commissioner
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

The Honorable John F. Ahearne, Commissioner
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Office of the Commission
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Mr. Alan S. Rosenthal, Chairman
Atomic Safety & Licensing Appeal Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dr. John H. Buck, Member
Atomic Safety & Licensing Appeal Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Mr. Michael C. Farrar, Member
Atomic Safety & Licensing Appeal Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Ivan W. Smith, Esquire
Chairman
Atomic Safety & Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Mr. Glenn O. Bright
Atomic Safety & Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dr. J. V. Leeds, Jr.
10807 Atwell
Houston, Texas 77096

Dennis P. Myers, Esquire
Associate Attorney General
State of North Carolina
Post Office Box 629
Raleigh, North Carolina 27602

Charles A. Barth, Esquire
Office of the Executive Legal Director
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Thomas S. Erwin, Esquire
Post Office Box 928
Raleigh, North Carolina 27602

Docketing and Service Section
Office of the Secretary
U.S. Nuclear Regulatory Commission
Washington, D. C.

George F. Trowbridge, Esquire
Shaw, Pittman, Potts & Trowbridge
1800 M Street, N. W.
Washington, D. C. 20036

NOTE: Copies were also sent to Kudzu Alliance and to Mr. Wells Eddleman, who have a petition for intervention pending in the Harris proceeding on management capability.

Table 1

CP&L Load Forecast
and
Capacity Addition Schedule

YEAR		LOAD (MW)	ADDITION (MW)
1979	S	6056	
	W	6056	
1980	S	6442	720
	W	6442	
1981	S	6816	
	W	6816	
1982	S	7223	720
	W	7223	
1983	S	7627	
	W	7627	
1984	S	8079	900
	W	8079	
1985	S	8536	720
	W	8536	
1986	S	8980	900
	W	8980	
1987	S	9449	
	W	9449	
1988	S	9911	900
	W	9911	
1989	S	10389	
	W	10389	
1990	S	10859	900
	W	10859	
1991	S	11400	720
	W	11400	
1992	S	11930	720
	W	11930	
		5.35% 1979-1992	

Legend:
Summer S
Winter W

RELATED CORRESPONDENCE

STATE OF NORTH CAROLINA
UTILITIES COMMISSION
RALEIGH, NORTH CAROLINA

DOCKETED USNRC JAN 8 1979

DOCKET NO. E-100, SUB 32

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

In the Matter of	
Investigation, Analysis, and Estimation of Future Growth in the Use of Electricity and the Need for Future Generating Capacity for North Carolina	ORDER ADOPTING 1978 REPORT - FUTURE ELECTRICITY NEEDS FOR NORTH CAROLINA: LOAD FORECAST AND CAPACITY PLAN - 1978

HEARD IN: Commission Hearing Room, Dobbs Building, 430 North Salisbury Street, Raleigh, North Carolina, Beginning Tuesday, February 7, 1978

BEFORE: Chairman Robert K. Koger, Presiding; and Commissioners Ben E. Roney, Leigh H. Hammond, Sarah Lindsay Tate, Robert Fischbach, John W. Winters, and Edward B. Hipp

APPEARANCES:

For the Public Staff:

Jerry B. Fruitt, Chief Counsel, Paul L. Lassiter, Staff Attorney, Public Staff - North Carolina Utilities Commission, Post Office Box 991, Raleigh, North Carolina 27602
For: The Using and Consuming Public

For the Intervenors:

Richard E. Jones, Associate General Counsel, Carolina Power & Light Company, Post Office Box 1551, Raleigh, North Carolina 27602
For: Carolina Power & Light Company

Steve C. Griffith, Jr., General Counsel, Duke Power Company, 422 South Church Street, Charlotte, North Carolina 28202
For: Duke Power Company

George W. Ferguson, Jr., Attorney at Law, Duke Power Company, Post Office Box 2178, Charlotte, North Carolina 28211
For: Duke Power Company

Edgar M. Roach, Jr., Hunton & Williams, Attorneys at Law, 707 East Main Street, Richmond, Virginia 23219
For: Virginia Electric and Power Company

Thomas J. Bolch, Crisp, Bolch, Smith, Clifton & Davis, Attorneys at Law, Post Office Box 751, Raleigh, North Carolina 27602
For: North Carolina Electric Membership Corporation

David H. Permar, Hatch, Little, Bunn, Jones, Few & Berry, Attorneys at Law, Post Office Box 527, Raleigh, North Carolina 27602
For: The North Carolina Oil Jobbers Association

Thomas E. Erwin, Attorney at Law, Post Office Box 928, Raleigh, North Carolina 27602
For: The Carolina Environmental Study Group, the Conservation Council of North Carolina, Inc., the League of Women Voters of North Carolina, Inc., and the Joseph Le Conte Chapter of the Sierra Club

Mark E. Sullivan, Attorney at Law, 203 Loft Lane, #48, Raleigh, North Carolina 27609
For: The Carolina Environmental Study Group, the Conservation Council of North Carolina, Inc., the League of Women Voters of North Carolina, Inc., and the Joseph Le Conte Chapter of the Sierra Club

Richard L. Griffin, Associate Attorney General, North Carolina Department of Justice, Post Office Box 609, Raleigh, North Carolina 27602
For: The Using and Consuming Public

BY THE COMMISSION: The General Statutes of North Carolina require that the Commission annually analyze and estimate the probable future growth in the use of electricity and the need for future generating capacity in North Carolina. G.S. 62-110.1 provides, in part, as follows:

"(c) The Commission shall develop, publicize, and keep current an analysis of the long-range needs for expansion of facilities for the generation of electricity in North Carolina, including its estimate of the probable future growth of the use of electricity, the probable needed generating reserves, the extent, size, mix and general location of generating plants and arrangements for pooling power to the extent not regulated by the Federal Power Commission and other arrangements with other utilities and energy suppliers to achieve maximum efficiencies for the benefit of the people of North Carolina, and shall consider such analysis in acting upon any petition by any utility for construction. In developing such analysis, the Commission shall confer and consult with the public utilities in North Carolina, the utilities commissions or comparable agencies of neighboring states, the Federal

Power Commission, the Southern Growth Policies Board, and other agencies having relevant information and may participate as it deems useful in any joint boards investigating generating plant sites or the probable need for future generating facilities. In addition to such reports as public utilities may be required by statute or rule of the Commission to file with the Commission, any such utility in North Carolina may submit to the Commission its proposals as to the future needs for electricity to serve the people of the State or the area served by such utility, and insofar as practicable, each such utility and the Attorney General may attend or be represented at any formal conference conducted by the Commission in developing a plan for the future requirements of electricity for North Carolina or this region. In the course of making the analysis and developing the plan, the Commission shall conduct one or more public hearings. Each year, the Commission shall submit to the Governor and to the appropriate committees of the General Assembly a report of its analysis and plan, the progress to date in carrying out such plan, and the program of the Commission for the ensuing year in connection with such plan."

To assist the Commission in carrying out its responsibilities under G.S. 62-110.1, the Public Staff developed an independent electric power demand forecast and generating capacity model for the major electric utilities providing public utility service in North Carolina. The Public Staff's report was filed with the Commission on December 15, 1977.

On November 29, 1977, the Commission issued its Order setting hearing and inviting participation in this docket. The Order provided that the results of the Public Staff's report would be presented at a public hearing beginning on February 7, 1978, and that, at this hearing, the Commission would receive for consideration expert testimony from the electric utilities, private groups, and those individuals having a knowledge of electric demand forecasting and electric generation. The Order further directed Carolina Power & Light Company (CP&L), Duke Power Company (Duke), and Virginia Electric and Power Company (VEPCO) to publish notice of the hearing in newspapers throughout the State for four consecutive weeks.

Notices of intervention from the Public Staff and from the Attorney General of North Carolina were received and recognized by the Commission. The Commission also received petitions for intervention from the following parties: CP&L, Duke, VEPCO, the North Carolina Electric Membership Corporation, the North Carolina Oil Jobbers Association, the League of Women Voters of North Carolina, Inc., the Conservation Council of North Carolina, Inc., the Joseph Le Conte Chapter of the Sierra Club, and the Carolina Environmental Study Group, Inc. The Commission granted all of the petitions for intervention and made the petitioners thereto parties of record in this proceeding.

The matter came on for hearing as scheduled on February 7, 1978. The Public Staff presented the testimony and exhibits of the following witnesses: N. Edward Tucker, Jr., Public Staff Engineer in the Electric Division, who testified on areas of forecasting of future electric prices, developing customer class load factors to be used in estimating future peak demands, and analyzing the effects of alternate growth scenarios on the price of electricity; Thomas M. Kiltie, Public Staff Economist, who testified on his preparation of peak demand projections by examination of alternative econometric peak load models and the commercial sector econometric KWH forecasts for CP&L and Duke; Edwin A. Rosenberg, Public Staff Economist, who testified on the econometric estimation of the industrial usage of electricity; Dennis J. Nightingale, Public Staff Engineer in the Electric Division, who testified on noneconometric load forecasting and supply configuration development; Daniel D. Mahoney, Economist with the Research and Planning Section of the Division of State Budget and Management in the North Carolina Department of Administration, who testified in support of the forecasting procedures and methodology utilized in producing the long-term forecast of State economic activity and incorporated in the Public Staff's report; Thomas S. Elleman, Professor and Head of the Nuclear Engineering Department at North Carolina State University, who testified on alternative energy sources and nuclear reactor safety; and Brian M. Flattery, Director of the Energy Division of the Department of Commerce, who testified concerning actions which State government has taken to promote conservation and alternate energy sources. The Public Staff, by affidavit, submitted the testimony of Dennis W. Goins, formerly a Public Staff Economist, whose testimony described the methodology and results contained in the residential forecast portion of the Public Staff's report.

Duke Power Company presented the testimony of the following witnesses: William S. Lee, Executive Vice President of Duke Power Company, who testified concerning Duke's planned construction program for 1985 and beyond and why Duke has elected not to change the planned in-service dates for the McGuire and Catawba nuclear units; Donald H. Denton, Jr., Vice President - Marketing, who described Duke's load management program and its impact on future generating requirements; David Rea, Manager of Forecasting and Budgets, who testified on Duke's system peak load and sales forecasts; and Donald H. Sterrett, Manager of System Planning, who testified on the generating capacity additions scheduled for the Duke service area in the context of anticipated future growth of the Duke system.

The North Carolina Electric Membership Corporation (EMC) presented the testimony of the following witnesses: Alton P. Wall, Executive Vice President and General Manager of

North Carolina Electric Membership Corporation, who testified concerning the EMC's power supply plans; Patricia Lloyd Williams, EMC, Staff Engineer, whose testimony described the procedures followed in the development of the EMC's recent Power Requirements Study and the projection of the EMC's system demand and energy requirements; and Gerald O. Stephens, Supervisory Power Requirements Officer, Power Survey Requirements Staff, Rural Electrification Administration (REA), United States Department of Agriculture, who testified that the North Carolina Electric Membership Corporation has submitted to the REA the Power Requirements Study as testified to by Patricia Williams.

Carolina Power & Light Company offered the testimony of Wilson W. Morgan, Manager - System Planning and Coordination Department, who testified on CP&L's energy sales and peak demand forecast through 1997 and the methodology used to develop these forecasts.

Virginia Electric and Power Company offered the testimony of Gary R. Keesecker, Manager of Power Supply, who testified on VEPCO's methods of forecasting demand and energy requirements and the planning of new generation for the VEPCO system.

The League of Women Voters of North Carolina, Inc., the Conservation Council of North Carolina, Inc., the Sierra Club, and the Carolina Environmental Study Group, Inc., offered the testimony and exhibits of Jesse L. Riley, a Senior Research Associate in the Research and Development Department of Celanese Fibers Company, who presented a critique of various forecasting methodologies and described a new methodology, with the results and the applicability of that methodology to future generating mix.

CP&L and Duke jointly sponsored Robert M. Spann, Associate Professor of Economics at Virginia Polytechnic Institute and State University, who testified in rebuttal to the forecast methodology propounded by Riley.

The following public witnesses appeared and testified at the hearing: (1) John Warren, (2) Brad Stuart, (3) Helen Reed, (4) Joseph Reinckens, (5) Arthur Kaufman, (6) Slater Newman, (7) Tom Lominac, (8) Dr. Lavon Page, (9) David Springer, (10) Dr. David Martin, (11) Lloyd Tyler, (12) Stephanie Rodelander, (13) Pam Thornton, (14) William Richardson, (15) John Speights, (16) Alvin Moss, (17) Kathleen Zobel, (18) An Painter, (19) Howard Morland, (20) Karen Wilson, (21) Jack Ashburn, (22) Bonnie Shriver, (23) Dr. William Walker, (24) Dr. Constance Kalbach, (25) Jim Barrow, and (26) Thomas Gunter. In addition, John Curry appeared on behalf of Senator McNeill Smith and presented to the Commission a statement prepared by Senator Smith.

For the purpose of preparing its 1978 report, the Commission has considered the testimony and exhibits presented at the hearing in this docket and the information

contained in the files and records of the Commission. The Commission has also taken judicial notice of the evidence presented in the July and September 1978 hearings in Docket No. M-100, Sub 78, entitled "Investigation of Cost-Based Rates, Load Management, and Conservation Oriented End-Use Activities."

Based upon the evidence presented in Docket No. M-100, Sub 78, the Commission in the ordering paragraphs below will order CP&L, Duke, and VEPCO to file, within 270 days after the date of this Order, detailed plans for the implementation of two load management programs: the utility control of residential water heating and the utility control of specified interruptible industrial loads. Both programs would be offered on a voluntary basis. The guidelines for these two programs are set out in the ordering paragraphs; if the filings of the three utilities differ from the recommendations of the Public Staff set out in its proposed order filed November 20, 1978, in Docket No. M-100, Sub 78, such filings should contain appropriate justification. The Commission will also order CP&L, Duke, and VEPCO to file on an experimental basis voluntary rates incorporating time-of-day pricing to those customers who install thermal storage equipment, when used in connection with solar equipment, or installed separately, or a combination of the two for the purpose of providing space heating.

In Docket No. M-100, Sub 78, the Public Staff has filed a proposed order and the electric utilities have filed responses thereto. The Commission will issue an order in this docket at an early date.

Based upon the testimony and exhibits presented at the hearings in this docket, and in Docket No. M-100, Sub 78, the information contained in the files and records of the Commission, and the Findings of Fact set out in its Report, the Commission concludes that it should adopt its report entitled Future Electricity Needs for North Carolina: Load Forecast and Capacity Plan - 1978.

IT IS, THEREFORE, ORDERED:

1. That the report of the Commission entitled Future Electricity Needs for North Carolina: Load Forecast and Capacity Plan - 1978 including its Findings and Conclusions, is hereby adopted.

2. That the load forecasts and capacity plans included as Tables A and B in the above referenced Report are hereby adopted as the Plan of the Commission, subject to the conditions stated in the Report.

3. That Virginia Electric and Power Company shall present to the Commission in the mid-1979 hearings on load growth and capacity planning a detailed analysis of VEPCO's load growth and required capacity addition plans. The

Public Staff is requested to develop and present a separate analysis of these matters.

4. That Carolina Power & Light Company, Duke Power Company, and Virginia Electric and Power Company shall, within 270 days after the date of this Order, file detailed plans for the implementation of two load management programs:

1. Utility control of residential water heating; and

2. Utility control of specified interruptible industrial loads.

The implementation plans to be filed shall include:

1. Provisions for voluntary customer participation in these programs,

2. A description of the load management equipment to be used,

3. Detailed time schedules for implementation,

4. Proposed rate schedules and tariff provisions including limitations on interruptions,

5. An implementation date no later than January 1, 1980, in the area of greatest density served by each utility,

6. Plans for extending the offerings to other areas, and

7. Rate incentives, implementation plans, and provisions of interruption (maximum length and number of interruptions, etc.), which are to be developed and filed by each utility; however, if these filings differ from those proposed by the Public Staff in Docket No. M-100, Sub 78, such filings should include appropriate justification.

5. That Carolina Power & Light Company, Duke Power Company, and Virginia Electric and Power Company shall file voluntary rates incorporating time-of-day pricing to those customers who install thermal storage equipment, when used in connection with solar equipment, or installed separately, or a combination of the two for the purpose of providing space heating. The rate schedules shall be cost justified and shall be filed on an experimental basis with appropriate contract time designated, between the utility and the customer, sufficient to allow the customer an incentive to

adopt such a rate in connection with his solar/thermal storage installation.

ISSUED BY ORDER OF THE COMMISSION.

This the 28th day of December, 1978.

NORTH CAROLINA UTILITIES COMMISSION

Sandra J. Webster

Sandra J. Webster, Chief Clerk

(SEAL)

FUTURE ELECTRICITY NEEDS
FOR NORTH CAROLINA:
LOAD FORECAST AND CAPACITY PLAN

1978

North Carolina Utilities Commission
Raleigh, North Carolina
December 1978

50-400/401/402
Ltr 1-3-79
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RETURN TO REACTOR DOCKET FILES

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EXECUTIVE SUMMARY

The General Assembly in 1975 directed the Utilities Commission to develop and keep current an analysis of the long-range need for electric power in North Carolina. This report is submitted to the Governor and to the General Assembly in compliance with that mandate.

In preparing this report, the Commission has considered evidence presented by the Public Staff - North Carolina Utilities Commission, Carolina Power & Light Company, Duke Power Company, Virginia Electric and Power Company, and other parties in Docket Nos. E-100, Sub 32, the load forecast docket, and E-100, Sub 78, the conservation and load management docket.

This report makes the following findings:

1. The planning period under consideration for construction of new generating units is 1978-1992.

2. The probable range of annual peak-load growth for Carolina Power & Light Company is 4.4% to 6.5%. Within this range the most probable peak-load growth rate for planning is 5.2%, annually.

3. The probable range of annual peak-load growth for Duke Power Company is 4.6% to 6.7%. Within this range the most probable peak-load growth for planning is 5.4%, annually.

4. The generating reserves needed to ensure system reliability for Duke, CP&L, and VEPCO are 20% for both the summer and the winter peaking seasons.

5. The most economical and efficient generation mix for Duke, CP&L, and VEPCO for the years 1978-1992 consists of approximately one-half base capacity, one-third cycling capacity, and one-sixth peaking capacity.

6. The most economical method of electric generation for Duke, CP&L, and VEPCO is a combination of hydroelectric generation and coal fired and nuclear fueled steam generation; the projected benefits to be derived from the development and operation of renewable energy sources including wind power and solar energy when added to the combination mix of hydro, coal, and nuclear electric generation are in the public interest.

7. VEPCO has cancelled nuclear units Surry No. 3 and Surry No. 4. VEPCO's present construction schedule will not meet the required reserve level of 20%.

8. Conservation and load management activities by the

Commission, the regulated utilities, and the public can significantly impact future growth rates in peak-load demand.

9. The capacity addition plans, adopted herein, will enable CP&L and Duke to meet the Commission's forecast of peak demand for the years 1979-1992 and to have adequate reserves for contingencies.

10. Superior forecasting of the effects of conservation and load management is needed.

The result of the capacity addition plans, adopted herein, would delay the current construction schedule of CP&L at least one year and would postpone CP&L's proposed units SR1 and SR2 (totaling 2300 MW) beyond this planning period. It would also delay Duke's later plants six months to one year, but would keep Duke's early plants on schedule for economic reasons.

The Commission will require that the utilities and the Public Staff present in the mid-1979 hearing a full analysis of the present construction schedules and the reasons, if any, that the utilities should not reschedule their construction according to the capacity plans adopted herein.

This report examines the studies which underlie the Commission's forecasts and examines conservation and load management efforts that are underway in North Carolina, as well as the prospects for alternative energy sources. Duke, CP&L, and VEPCO will be required to file proposed plans for two voluntary load management programs:

1. Utility control of residential water heating, and

2. Utility control of interruptible industrial loads.

The three utilities will also be required to offer voluntary, experimental rates which incorporate time-of-day pricing to customers who either install solar equipment, thermal storage equipment, or a combination of the two for the purpose of providing space heating.

CHAPTER I

INTRODUCTION

In 1975 the North Carolina General Assembly enacted G.S. 62-110.1(c) which directed the Utilities Commission to "develop, publicize, and keep current an analysis of the long-range needs for expansion of facilities for the generation of electricity in North Carolina, including its estimate of the probable future growth of the use of electricity, the probable needed generating reserves, the extent, size, mix and general location of generating plants and arrangements for pooling power . . . ." The statute requires the Commission to conduct public hearings in the course of making the analysis and developing the plan. The statute further provides that the Commission submit to the Governor and to the appropriate committees of the General Assembly a report of its analysis and plan.

In January 1977 the Commission held its first public hearings pursuant to the statute and, thereafter, issued its first report, entitled Report of Analysis and Plan: Future Requirements for Electricity Service to North Carolina - 1977. In that Report the Commission concluded that:

1. The probable future annual rate of growth in peak load for both Carolina Power & Light Company (CP&L) and Duke Power Company (Duke) will be approximately 6.9% during the years 1976-1990.

2. The probable needed generating reserves will be 15% to 20% in the summer and no less than 20% in the winter.

3. The economically efficient generating mix for both companies will be one-half base, one-third intermediate, and one-sixth peaking capacity.

4. The most economical type of base load capacity for CP&L and Duke will be nuclear fuel generation in most cases.

5. Nuclear power provides acceptable, though not zero, risk to the public.

6. It is the objective of the Commission to encourage the growth of industries which will improve the system load factor through the promotion of interruptible rates.

7. Maximum conservation efforts should be encouraged.

On June 3, 1977, the General Assembly amended G.S. Chapter 62 to provide for a Public Staff within the organization of the Utilities Commission to represent the using and consuming public in all matters affecting public utility rates and service. With respect to the long-range forecast of capacity requirements and the capacity expansion plan, G.S. 62-15 was amended to state that:

> (d) It shall be the duty and responsibility of the public staff to...(5) intervene on behalf of the using and consuming public in all certificate applications filed pursuant to the provisions of G.S. 62-110.1, and provide assistance to the Commission in making the analysis and plans required pursuant to the provisions of G.S. 62-110.1 and G.S. 62-155;....

On December 15, 1977, the Public Staff filed with this Commission its <u>1978 Public Staff Report: Analysis of Long Range Needs For Electric Generating Facilities in North Carolina</u>. The Public Staff Report was essentially an update of the Commission's 1977 Report of Analysis and Plan, but incorporated new data and information that became available after the Commission's 1977 Report was issued. The Public

Staff Report also included refinements in the econometric forecasting models and in the capacity planning techniques. New features included both long-term economic forecasts for the United States and for North Carolina and analyses of the potential beneficial effects of conservation, load management, and peak-load pricing.

In February 1978 the Commission held hearings in preparation for its 1978 report. The Public Staff and the three major electric utilities (operating in North Carolina) presented their forecasts for the growth in electricity sales and peak load in North Carolina and the generating capacity needed to meet this projected growth. Numerous other parties intervened and participated in the hearings: the Attorney General of North Carolina, the North Carolina Electric Membership Corporation, the Carolina Environmental Study Group, the Conservation Council of North Carolina, the League of Women Voters, the Joseph Le Conte Chapter of the Sierra Club, and the North Carolina Oil Jobbers Association. In addition, a number of public witnesses provided information and comment to the Commission.

Thereafter, the Commission held extensive hearings in July and September 1978 in its Docket No. E-100, Sub 78. The purpose of this docket and the hearings held therein is to investigate the load management programs of the electric utilities and the conservation programs of the electric and gas utilities operating in the State. The publication of the Commission's 1978 load forecast report has been delayed in order to assess the evidence presented in this docket and to determine what effects the load management and conservation programs will have on the long-range growth of electricity in North Carolina.

The Commission's 1978 report, entitled Future Electricity Needs for North Carolina: Load Forecast and Capacity Plan - 1978, is submitted in compliance with the mandate of the General Assembly, as set forth in G.S. 62-110.1(c).

CHAPTER II

THE 1978 LOAD FORECAST AND CAPACITY PLAN

A. Introduction

General Statute 62-110.1(c) requires the North Carolina Utilities Commission to prepare and keep current an analysis of the long-range needs for the expansion of electricity generating facilities in North Carolina. To comply with this mandate from the General Assembly, the Commission must estimate the probable future growth of the use of electricity, the probable needed generating reserves, and the extent, size, mix, and general location of generating capacity to meet the future growth of electricity use.

The Public Staff performed independent analyses of the load growth in CP&L's and Duke's service areas. However, the Public Staff adopted and recommended the same growth rates for VEPCO that had been determined by an independent consulting firm for the Virginia Corporation Commission two years previously and reaffirmed by the Virginia Corporation Commission Staff in late 1977. The studies made by the Public Staff, the regulated utilities, and other interested parties in the load forecast proceedings presented a wide range of opinion as to the electric generating capacity needed in North Carolina over the next 20 years. Most of these studies were based on accepted scientific load forecast methods. These studies incorporate different levels of economic activities, conservation and load management efforts, population movements, customer acceptance of new appliances, air conditioning and electric heating saturation, and other factors.

The Commission has evaluated these studies in order to estimate the probable future growth of electricity use in North Carolina. In making its forecasts and evaluations, the Commission takes judicial notice of the conservation and load management evidence which was presented in its hearings in Docket No. E-100, Sub 78.

Duke Power Company and Carolina Power & Light Company provide 95% of the electricity generation utilized in North Carolina. Virginia Electric and Power Company (VEPCO) and Nantahala Power and Light Company (Nantahala) supply the remaining 5% of electricity generation. Additional generation required to serve new loads of Nantahala are planned by the Tennessee Valley Authority (TVA), to whom all of Nantahala's generation is contracted. VEPCO does not plan to add generating facilities in North Carolina in the foreseeable future. The information presented to the Commission concerning the expected growth on the VEPCO system is inconclusive. The major thrust of the Commission's 1978 report is, therefore, directed to the service areas of CP&L and Duke.

In making its forecast, the Commission has recognized that the public policy of the State of North Carolina encourages the growth of industry in order to provide jobs for and to raise the living standards of the citizens of the State. The Commission has the duty under the Public Utilities Act to ensure that adequate electric service is available at all times in North Carolina to provide for growth in the State's economy.

B. Findings of Fact

1. The planning period under consideration for construction of new generating units is 1978-1992. The current planning period must extend at least 14 years in order to allow consideration of future construction of both nuclear and fossil fueled generating units because 14 years must be allowed for designing, licensing, and constructing a nuclear unit.

2. The probable range of annual peak-load growth for Carolina Power & Light Company is 4.4% to 6.5%. Within this range the most probable peak-load growth rate for planning is 5.2%, annually. The Commission has used a growth rate of 5.2% in developing its load forecast for CP&L as shown in Table A. The generating capacity addition plan to meet this growth rate is shown in Table B. CP&L's own peak-load forecast is 5.72% for the years 1978-1992.

The Commission's use of the 5.2% growth rate is based upon its conclusion that CP&L's conservation and load management programs are embryonic and that customer acceptance of these programs will therefore accelerate. Under the Commission's forecast the expected 1985 summer peak load is 7,902 MW; and the 1990 summer peak load is 10,182 MW.

For the years 1965-1977 the peak-load growth rates for CP&L have ranged from -1.0% (1978) to 24.8% (1968); within the past five years the range has been from -1.0% (1978) to 9.3% (1977).

3. <u>The probable range of annual peak-load growth for Duke Power Company is 4.6% to 6.7%. Within this range the most probable peak-load growth for planning is 5.4%, annually.</u> The Commission has used a growth rate of 5.4% in developing its load forecast for Duke as shown in Table A. The generating capacity addition plan to meet this growth rate is shown in Table B. The 5.4% growth rate reflects the Commission's conclusion that Duke's load management and conservation programs are progressing well and will continue to gain acceptance among its customers. Duke's own summer peak-load forecast, which projected a range of growth rates from 5.05% to 6.92% for the years 1979-1990, reflects the effects of its ongoing load management program. Under the Commission's forecast the expected 1985 summer peak load is 13,518 MW; and for the 1990 summer peak load is 17,584 MW.

For the years 1965-1977 the peak-load growth rates for Duke have ranged from -2.1% (1974) to 18.0% (1968); within the past five years the peak-load growth rate has ranged from -2.1% (1974) to 11.6% (1977).

4. The generating reserves needed to ensure system reliability for Duke, CP&L, and VEPCO are 20% for both the summer and the winter peaking seasons. As pointed out by the Public Staff, there is no level of reserve margin that will absolutely guarantee reliability. Although the Public Staff recommended reserves of 15% to 20% for both seasons, Duke witnesses indicated that 20% reserves are a minimum for reliable service to its customers. The Commission concludes that, for this planning period, a minimum 20% reserve margin for both summer and winter peaking seasons is reasonable and necessary. In so deciding, the Commission has considered, among other things, the difficulties of the three electric utilities in providing service during 1977 and 1978 and the recommendations of the Federal Energy Regulatory Commission Staff.

5. The most economical and efficient generation mix for Duke, CP&L, and VEPCO for the years 1978-1992 consists of approximately one-half base capacity, one-third cycling capacity, and one-sixth peaking capacity. The Public Staff pointed out that optimal generation mix satisfies the demand for electricity at minimum cost and with acceptable reliability. The studies of the Public Staff concluded that the generation mix adopted herein is the proper one for the three major electric utilities serving the State.

6. The most economical method of electric generation for Duke, CP&L, and VEPCO is a combination of hydroelectric

generation and coal fired and nuclear fueled steam generation; the projected benefits to be derived from the development and operation of renewable energy sources including wind power and solar energy to add to the combination mix of hydro, coal, and nuclear electric generation are in the public interest. The Public Staff and the utilities presented a number of studies indicating that, in the present planning period, nuclear generation is expected to be more economical than fossil generation for new base load units. The results of the total life studies show that nuclear generation is expected to average almost six-tenths of a cent per kilowatt-hour less than fossil generation. Generation mix will continue to be reviewed by the Commission on an annual basis.

Witnesses at the load forecast hearings in February 1978 expressed concern about the safety and reliability of nuclear generation. The issues raised by these witnesses included the problem of storing spent nuclear fuel, the lack of assurance of uranium supply, and the continuing escalation of costs in nuclear plant construction. There was also evidence that nuclear generation is clean, safe, and available. In addition, evidence indicated that there is increasing opinion among the technical community that the hazards to the public from nuclear generation may be considerably less than the hazards from alternative fossil fuel systems, such as coal. Although it is true that increasing costs for nuclear plant construction and operation have narrowed the economic advantages of nuclear power over coal, it is also true that nuclear generated electric power still retains a significant economic advantage over coal and all other alternative means of base load generation in the southeastern region of the United States.

7. VEPCO has cancelled nuclear units Surry No. 3 and Surry No. 4. VEPCO's present construction schedule will not meet the required reserve level of 20%. The Commission has concluded elsewhere in this chapter that, with the cancellation of Surry No. 3 and Surry No. 4, VEPCO's present construction schedule is insufficient to prevent its system reserves from falling below the level found necessary by the Commission for adequate and reliable service. The Commission will require VEPCO to present at the 1979 hearings a full analysis of the company's expected loads and required generation through 1993.

8. Conservation and load management activities by the Commission, the regulated utilities, and the public can significantly impact future growth rates in peak-load demand. The forecast adopted by the Commission in this report is based on the premise that conservation and load management efforts are not a temporary phenomenon but represent permanent changes in the attitude of society toward the use of energy. As a result of increasing necessity for funding alternatives to our present energy

sources, significant energy-related legislation has been enacted in the last two years. The North Carolina General Assembly enacted the important Energy Conservation Act of 1977, which encourages solar energy and insulation for residential and business use. In addition, the United States Congress has recently enacted the National Energy Conservation Policy Act of 1978. Both of these acts will substantially affect state and local efforts on conservation.

The major electric utilities have undertaken conservation and load management programs. Especially noteworthy is the Load Management Program of Duke: the company's Energy Efficient Structure Program incorporates a conservation rate schedule which offers a monetary incentive by passing along the resultant savings in electric system costs to those residential customers who install insulation in accordance with program standards.

Further, the Commission has entered into cooperative agreements for research and experimentation with the United States Department of Energy. Under these agreements, the Commission is undertaking pilot demonstration projects on conservation and load management and is examining peak-pricing electricity rates. The Commission has also initiated Docket No. M-100, Sub 78, entitled "Investigation of Cost-Based Rates, Load Management, and Conservation Oriented End-Use Activities." Hearings in this docket in

July and September 1978 established that numerous and diverse conservation and load management programs are underway throughout the State.

9. The capacity addition plans, adopted herein, will enable CP&L and Duke to meet the Commission's forecast of peak demand for the years 1979-1992 and to have adequate reserves for contingencies. This is an interim plan and is subject to review by the Commission on an annual basis. Because it is impossible to exactly predict the future, the companies must maintain flexibility in their construction schedules in order to economically adjust to changes in peak-load growth as they occur. The utilities will be required in the mid-1979 hearing to show the reasons, if any, why their construction schedules should not be delayed to match the Commission's capacity plan. New generating facilities should be located on sites which are near load centers or major transmission facilities and which have ample water for cooling. Because of the long lead times required, site licensing and preparation have already begun for most facilities coming into service during the next 10 to 15 years and relocation of those facilities would not be economical.

10. Superior forecasting of the effects of conservation and load management is needed. The Commission is directing the utilities and the Public Staff to present detailed analyses concerning these matters in the 1979 hearings. To

allow sufficient time those hearings are being moved to mid-year. The forecast of future electrical power demands, the generation reserve requirements, and the types of new generating capacity will continue to be reviewed by the Commission on an annual basis in order to adequately incorporate changing conditions. The Commission, through its Staff and through the Public Staff, will continue to consider regional interchanges of power and power pooling arrangements by its participation in the Southeastern Reliability Council and the Virginia-Carolinas Interregion planning efforts.

C. Load Forecasts and Capacity Plan

The questions before the Commission are threefold:

1. What are the most likely load growth rates?
2. What levels of reserve capacities are required?
3. What types of plant most economically, safely, and efficiently produce the required capacity?

These questions are interlocking to a great degree. Load growth requires additional load capacity and corresponding reserve capacity. The amount and types of plant affect the reliability of the system and the cost of providing electricity. The cost and reliability of electricity in turn affect the rate of load growth.

As a result of the evidence in its load forecast and load management hearings, the Commission has available to it a wide variety of expected load growths, all dependent upon different levels of economic activity, conservation and load management efforts, population movement, customer acceptance of new appliances, air conditioning and electric heating saturation, and other factors.

This chapter presents the Commission's conclusions regarding the projected future electricity requirements in North Carolina. The chapters which follow summarize the evidence of the parties in these hearings. Based upon the best evidence available to the Commission today, the electricity growth plan adopted by the Commission represents a prudent and realistic strategy for meeting our electricity needs. The plan necessarily demands flexibility in the adopted construction schedule. Annual updates of the Commission forecast and capacity plan will enable the Commission to reflect both improvements in forecasting techniques and new evidence regarding the utilization of electricity. Accordingly, the timing of later plants must be regarded as tentative.

The Commission has examined in detail the level of reserve capacity which should be required. Reserve capacity is necessary to meet increased capacity requirements due to severe weather, planned maintenance outages, unexpected equipment outages, unexpected load growth, and other factors. The adequacy of electricity supply directly affects the ability of our citizens to utilize adequate space conditioning to remain comfortable and healthy. Disruption of electricity service at any time has the potential for reducing the economic output of the State and, thus, the income of its citizens.

In recent periods of severe weather, the utilities serving North Carolina have had difficulty, at times, meeting consumer demand, even though high levels of reserves were in place. Measures are being taken to prevent future occurrence of these outages. However, it is important to emphasize that reserves must cover probable loads and likely equipment outages. Testimony by witnesses from Duke indicates that 20% reserves are the minimum requirement for reliable operation. This is within the range indicated by the Federal Energy Regulatory Commission (FERC) of 15% to 25% and is consistent with the FERC Staff recommendation that the percent reserves should be on the high end of the range in fast growing areas. All witnesses agree that North Carolina is expected to continue to have rates of economic and demographic growth greater than the national average during the extant planning period.

Although estimates of growth are less reliable for longer planning periods, the longer planning periods also allow more time to effect conservation measures. Because the planning period is tied to the construction time required to build new generating facilities, it is imperative that the planned construction schedule be flexible enough in the later years to be capable of adjustment to meet the requirements of unforeseen changes in load growth. After reviewing recent experience, the Commission concludes that a minimum 20% reserve margin is reasonable and necessary.

After review of the evidence presented concerning the probabilities of various occurrences, the most detailed and supported of which was that presented by the Public Staff, the Commission concludes that the maximum growth rates which should be utilized in planning future capacity are those for the "base case" presented by the Public Staff. This is essentially a forecast of future growth which assumes that the factors causing the demand for electricity, including conservation and load management practices, will continue unchanged. Plant additions are not now scheduled at a rate fast enough to provide adequate reserve margins for such loads; increased use of conservation and load management techniques can be expected to obviate the need for such large scale construction.

Various scenarios of the impact on growth rates of different levels of conservation and load management techniques were presented by the Public Staff. Included were the following:

1. A 15% reduction in electric energy consumption by 1992 (conservation case);

2. A 10% improvement in load factor by 1992 (load management case); and

3. Both of the above.

The effects of either 1 or 2 are to reduce the average load growth approximately 1% per year. Many benefits can be gained through increases in conservation and load management. For example, by 1992, CP&L would have to provide an additional 10,977 MW under the base case but only 5,177 MW under Scenario 3. For Duke, the required construction would fall from 17,890 MW to 10,770 MW. If these savings could be accomplished, the combined construction requirements of CP&L and Duke would be reduced by more than $10 billion during this planning period.

Significant changes in conservation and load management efforts are occurring and will be of significant assistance in the 1980's. After examination of the assumptions underlying each scenario, the Commission concludes that, based upon the evidence available at this time, it is not reasonable to expect that both conservation and load management will be practiced substantially enough to produce the effects of the combined load management and conservation scenario. However, it does appear that, with effective effort by utilities, consumer groups and government, combined reductions in load growth equivalent to the level of either the full load management or full conservation scenario can be realized (i.e., approximately 1% reduction in growth from the "base case").

Since the time of the hearings, the 1977-1978 winter and 1978 summer peaks have been established at much lower values than had been predicted. The Commission has taken into account the two additional actual peaks in its adopted load forecast. Although some of this reduction was obviously weather related, a substantial portion of the remainder must be attributed to conservation and load management measures by customers. The Commission expects that customers will continue to add such measures in the near term future to existing installations and to design them into future expansion and construction. At some point, however, it can be expected that these measures will be sufficiently employed so that normal growth of the economy and population in North Carolina will raise the rates of growth again. The Commission concludes that the most reasonable expectation for the possible reduction in "base case" growth rates over the planning period is 60% of the combined load management and conservation scenario reduction.

The Commission concludes that, for planning purposes, CP&L's load can be expected to grow at an average annual rate of 5.2%. Duke's load can be expected to grow at an average annual rate of 5.4%. These growth rates are approximately 1.5% (CP&L) and 1.3% (Duke) less than the Public Staff base case recommendations. These reductions depend upon increased levels of conservation and load management. The Commission concludes that significant effort should be expended by the utilities to help effect such changes in usage patterns.

The Commission presents in Table A the adopted load growths used in developing its plan for the capacity additions shown in Table B. Table C shows the percent reserves which will result if these load forecasts and capacity addition plans are met. The result of these capacity addition plans is to delay the complete construction schedule of CP&L at least one year and to delay CP&L's proposed units SR1 and SR2 (totaling 2300 MW) completely beyond the planning period. CP&L provided no evidence, either economic or operational, to indicate that its present construction schedule should not be delayed to match the expected load growth. Duke, on the other hand, provided evidence that the ratepayers would benefit from lower net operating costs if its early units are completed as previously scheduled. The Public Staff supported this evidence and the Commission concurs.

TABLE A. Commission Load Forecasts (MW)

YEAR		Carolina Power & Light Company LOAD (MW)	Duke Power Company LOAD (MW)
1979	S	5830	9860
	W	5930	10070
1980	S	6133	10392
	W	6238	10614
1981	S	6452	10954
	W	6563	11187
1982	S	6788	11545
	W	6904	11791
1983	S	7141	12169
	W	7263	12428
1984	S	7512	12826
	W	7641	13099
1985	S	7902	13518
	W	8038	13806
1986	S	8313	14248
	W	8456	14552
1987	S	8746	15018
	W	8896	15337
1988	S	9200	15829
	W	9358	16166
1989	S	9679	16683
	W	9845	17039
1990	S	10182	17584
	W	10357	17959
1991	S	10712	18534
	W	10895	18929
1992	S	11269	19535
	W	11462	19951
		5.2% Per Year	5.4% Per Year

Legend:
Summer S
Winter W

TABLE B. Commission Plan for Capacity Additions and Retirements

Year		Carolina Power & Light Company	Duke Power Company	
1979	S		McGuire	
	W		(1) 1180 MW	
1980	S			
	W			
1981	S	Roxboro (4) 720 MW	(2) 1180 MW	
	W		(1) 1145 MW	
1982	S		Catawba	
	W			
1983	S	Mayo (1) 720 MW	(2) 1145 MW	(69 MW)
	W			
1984	S			(228 MW)
	W			
1985	S	Harris (1) 900 MW	Cherokee (1) 1280 MW	(261 MW)
	W			
1986	S	(2) 720 MW		(93 MW)
	W			
1987	S		(2) 1280 MW	
	W			
1988	S	(2) 900 MW	Bad Creek	
	W		(1)(2) 500 MW	
1989	S		Perkins (1) 1280 MW	
	W	(4) 900 MW		
1990	S		(3) 1280 MW	
	W			
1991	S	(3) 900 MW	(3)(4) 500 MW	
	W			
1992	S	Intermediate (1) 720 MW	(2) 1280 MW	
	W			

Legend:
Retirements ( )
Unit Number ◯

Summer S
Winter W

TABLE C. Commission Load Forecasts, Capacity Plans and Resultant Reserves

YEAR		Carolina Power & Light Company LOAD (MW)	ADDITION (MW)	CAPACITY (MW)	RESERVES (%)	Duke Power Company LOAD (MW)	ADDITION (MW)	CAPACITY (MW)	RESERVES (%)
1979	S	5830		7433	27.5	9860		12317	24.9
	W	5930		7773	31.1	10070	1180	13497	34.0
1980	S	6133		7433	21.2	10392		13497	29.9
		6238		7773	24.6	10614		13497	27.2
1981	S	6452	720	8153	26.4	10954	1180	14677	3[illegible].0
	W	6563		8493	29.4	11187	1145	15822	41.4
1982	S	6788		8153	20.1	11545		15822	37.0
	W	6904		8493	23.0	11791		15822	34.2
1983	S	7141	720	8873	24.3	12169	1145-69	16898	38.9
	W	7263		9213	26.8	12428		16898	36.0
1984	S	7512		8873	18.1	12826	-228	16670	30.0
	W	7641		9213	20.6	13099		16670	27.3
1985	S	7902	900	9773	23.7	13518	-261	16409	21.4
	W	8038		10113	25.8	13806	1280	17689	28.1
1986	S	8313	720	10493	26.2	14248	-93	17596	23.5
	W	8456		10833	28.1	14552		17596	20.9
1987	S	8746		10493	20.0	15018	1280	18876	25.7
	W	8896		10833	21.8	15337		18876	23.1
1988	S	9200	900	11393	23.8	15829		18876	19.2
	W	9358		11733	25.4	16166	500	19376	19.9
1989	S	9679		11393	17.7	16683	1280	20656	23.8
	W	9845	900	12633	28.3	17039		20656	21.2
1990	S	10182		12293	20.7	17584	1280	21936	24.7
	W	10357		12633	22.0	17959		21936	22.1
1991	S	10712	900	13193	23.2	18534	500	22436	21.1
	W	10895		13533	24.2	18929		22436	18.5
1992	S	11269	720	13913	23.5	19535	1280	23716	21.4
	W	11462		14253	24.4	19951		23716	18.9
		5.2% Per Year				5.4% Per Year			

Legend:
Summer S
Winter W

Duke's plants scheduled for 1985 and beyond are delayed in the plan by six months to one year, but its earlier plants remain on schedule for economic reasons. However, CP&L's complete schedule is delayed. With regard to CP&L, the Commission feels that the company has not provided satisfactory evidence concerning the economics of its construction schedule. The Commission will require that the utilities and the Public Staff present to the Commission in its 1979 hearing a full analysis of the present construction schedules and the reasons, if any, that the utilities should not reschedule their construction according to the capacity addition plans adopted herein.

The forecasts of expected loads adopted by the Commission are the result of the Commission's consideration of the evidence concerning rates of growth, including rates of reduction in growth due to conservation and load management, and the Commission's subsequent finding of the most probable rates of growth in electric loads. The Commission is concerned about the paucity of concrete data available in this docket concerning actual methods of achieving the expected levels of conservation and load management. Further quantification of these programs is expected in the 1979 hearings. In addition, the State Budget Office is making major modifications in its planning model and those results should be available in that hearing. The Commission is aware that industry has expanded this year at about twice the rate of last year. The Commission wishes to see more detailed projections of industrial usage. The Commission has the responsibility to ensure that the continued economic growth of the State is not impaired by a lack of adequate utility services. For these reasons, the Commission holds open the time to require the utilities to delay their construction schedules pending examination of this matter in detail in the 1979 hearing.

If the capacity plan is completed as herein shown and the reduction in annual load growth achieved, both CP&L and Duke will meet the 20% reserve requirement which this Commission concludes is necessary for reliable system operation. It is imperative that generating unit construction be so planned as to be economically deferable in the event that even more significant reductions in load growth can be effected.

In the early years of the adopted capacity addition plan, both companies are expected to have reserve capacities which are above the levels which the Commission finds are reasonable and necessary for operational purposes only. After examination of Duke's evidence and the Public Staff's supporting comments concerning the costs of delaying construction of the units which are near completion (including the increased inflation costs) and the benefits which can be gained from completing the units on schedule (including the reduced overall fuel costs) the Commission concludes that it will be advantageous to bring Duke's early units on line as planned. Even though this will result in high reserves until the mid-1980's, the result will be less total cost to the consumer than if the units are delayed. In other, less inflationary times, this decision would not be valid. The Commission concludes, however, that the later units should be delayed and rescheduled in accordance with the reserve requirements which the Commission finds necessary. Due to the large sizes of units presently planned for the later years, occasionally there will be abnormally high reserves for short periods of time. However, the reduced construction costs per kilowatt of installed capacity, reduced operating costs per kilowatt-hour, and reduced environmental impact of the larger units over the long-term overshadow the short-term excesses.

The Commission reiterates that it is absolutely imperative that the construction of the later units be planned so as to be economically deferrable in the event that load management and conservation efforts can significantly reduce the load growth below present planning levels. The Commission will require that the major parties in the 1979 hearings present detailed discussions of the economics of the various construction possibilities for planned units and the steps being taken to ensure maximum flexibility at minimum cost.

If it appears that the State's economic forecast is revised upward or that the reduction in peak demands through load management and conservation will not occur as projected, then it is important that this information be provided to the Commission as early as possible and no later than the subsequent yearly hearings so that the capacity plans can be revised to meet demand requirements. Governor Hunt's Administration has been extremely successful in attracting high wage industry to North Carolina; whatever capacity plan that is adopted must be flexible enough to assure adequate electric power to potential or expanding industry. This Administration's emphasis on providing more and better jobs for North Carolinians must not fail for lack of adequate planning for electrical power.

Based on the evidence received in this docket and in the load management and conservation docket, the Commission is of the opinion that the forecasts for electrical power for CP&L and Duke are as accurate as possible under present conditions. The Commission also concludes that its adopted capacity addition plans are reasonable and will result in adequate and economical electrical power in North Carolina for the future period up through 1992.

With respect to VEPCO, the Commission concludes that the available evidence is conflicting in many respects. The Public Staff adopted and recommended the same growth rates for VEPCO that had been determined by an independent consultant for the Virginia Corporation Commission. The rate of peak growth was approximately 5.8%. VEPCO recommended that the proper rate of growth for planning purposes was approximately 5.4%. Neither party presented clear evidence of the underlying factors used to develop these growth rates.

The Public Staff presented a capacity addition plan for VEPCO which would provide reserves at the time of the summer peak from 14.8% to 18.5% above the Public Staff forecast. This was generally consistent with its stated design objective of 15% to 20% reserves. VEPCO presented a capacity addition plan which would provide reserves at the time of the summer peak which oscillate between 19.1% and 7.1%. This plan does not appear to be consistent with <u>any</u> design objective. The capacity plans of VEPCO and the Public Staff are shown in Table 1. The resulting reserve requirements are shown in Tables 2 and 3.

In Docket No. E-22, Sub 224, VEPCO President Ragone indicated VEPCO's concern that it would not be able to build enough plants to satisfy the load. Tables 2 and 3 also show that, if VEPCO builds according to its plan and the load continues to grow at rates equal to the Public Staff forecast, VEPCO's reserves will fall to the 5.6% level. On the other hand, if the lower VEPCO forecast occurs and the higher Public Staff capacity plan is met, the reserves over summer peak load will not rise above the 22.4% level. The former clearly violates reasonable construction planning policy and the latter is a reasonable reserve level.

The foregoing comments speak to the probable inadequacy of the capacity of VEPCO's planned construction schedule.

Another major question of equal importance concerns the relative efficiency and overall operating costs of the planned construction. The Public Staff recommends use of nuclear units to provide base load capacity. VEPCO witness Keesecker testified in this docket that VEPCO studies indicated that nuclear generation was less costly than fossil base load generation. In Docket No. E-22, Sub 224, VEPCO witness Profitt concurred in this conclusion. Yet, the Commission is faced with the decisions by VEPCO to cancel Surry Unit No. 3 and Surry Unit No. 4 and replace this necessary nuclear generation with fossil generation. This does not appear to be in the best interest of the ratepayers of North Carolina.

The Commission concludes that VEPCO is planning neither adequate nor efficient electrical generating facilities. The Commission further concludes that VEPCO and the Public Staff present in the 1979 hearing a complete analysis of expected loads and required generation for VEPCO through 1993.

The Commission concludes that it is reasonable to expect that the planned reduction in annual growth rates for Duke and CP&L will be met. This will require that significant changes occur in the levels of usage and the time of that usage. The Commission now has underway extensive experiments in time-of-day pricing and load management techinques. The Commission will intensify its efforts to promote conservation and load management and encourages the utilities to increase their efforts accordingly.

As part of its conservation programs, the Commission will go forward with additional examination of the effects of load reduction which it can encourage through its own actions and those which may be encouraged by actions of other bodies such as the utilities, the North Carolina Energy Division, the North Carolina Building Code Council, the schools, the Federal Government, and others. It is imperative that policy makers and electricity consumers understand options open to them and the effects of their actions on the costs of delivering electricity.

The 1979 hearings will consider studies now underway to further refine the Commission's forecasts, to define the impact of changes in weather on electricity demand, to improve plant reliability, and to quantify the effects upon load and load factor of increased use of solar assistance and other alternative energy sources. The Commission delayed publication of this year's report in order to examine the evidence obtained in its conservation and load management hearings in Docket No. E-100, Sub 78. There is abundant evidence on the possibilities of wind energy, biomass conversion, interruptible rates, radio controlled water heaters, peak-load pricing, and other tools to help lower future electricity demand. However, there is little evidence on predictions of the magnitude of help the

Commission can expect and of how soon that help can reach significant proportions. These are matters which must be considered carefully in the 1979 hearing. Especially needed is better evidence on the need for generating plants near the end of the planning period. The 1979 hearings are being delayed to mid-year in order to give the Public Staff and other parties time to adequately develop reliable forecasting information on these matters.

CHAPTER III

FORECAST OF NATIONAL AND STATE ECONOMIC AND DEMOGRAPHIC GROWTH

A. Introduction

Electricity is an essential input to the production of goods and services by factories, institutions, and commercial establishments. It is also used in the home to provide services and entertainment. The demand for electricity is similar to the demand for other resources and depends upon its price and the cost, availability, and efficiency of the equipment which utilizes it. The demand also depends upon costs associated with the alternatives to electricity. Most important is the level of demand for the service which electricity can render. Further, both the level of demand for the service and the costs and availabilities of electricity and its alternatives are influenced by the level of economic activity.

The Public Staff Report presented the results of the November 1977 forecast of economic conditions in North Carolina, which was completed by economists in the Office of State Budget and Management of the North Carolina Department of Administration. This forecast for the 14-year period 1977-1990 utilized an econometric model of the State's economy. This model was developed by Budget Office economists in conjunction with consultants from Data

Resources, Inc., a national consulting firm in Lexington, Massachusetts. A forecast of the national economy to 1990, which had been made by Data Resources in the fall of 1977, served as the foundation of the North Carolina economic forecast.

The Public Staff Report on the forecast is in three parts. The first sets forth a description of the national forecast to establish the basic assumptions of the State forecast. The second part discusses the historical relationship between economic growth in the United States and economic growth in North Carolina. The third part presents a summary of the long-term forecast for North Carolina. As will be explained in more detail below, a decision was made to constrain the econometric model results in the last five years of the forecast to reflect an anticipated dampening of the growth rates of income and employment. Thus, strictly speaking, the State economic model was followed only until 1985. The national forecast from Data Resources was accepted as given throughout the entire period 1977-1990.

The results of these forecasts are significant because the level of national and state economic activity will greatly affect the future growth in the use of electricity in this state. The Commission presents below a shortened version of the Public Staff Report.

B. The National Forecast

Real growth in the gross national product (GNP) is expected to occur at a faster rate in the period 1977-1985 than in the period 1985-1990. In the 1977-1985 period, the average annual rate of growth in real GNP is expected to be 4%; in the 1985-1990 period, that rate of growth is expected to average about 3%. The difference reflects the expectation that underlying conditions will be different in the two periods. The forecast assumes that the current levels of plant capacity and unemployment are not at full utilization. The slack in the economy is assumed to be gradually absorbed so that, by 1986, the economy will operate at full employment of both capital and labor and will continue to operate at that level to the end of the forecast period. As increased production absorbs the excess industrial capacity in the early period 1977-1985, real growth will be higher than long-term trend levels. In addition, the labor force growth rate and the capital stock growth rate will slow down over the forecast period and, consequently, the long-term growth rate will decline. The increasing participation of women in the labor force only partly offsets the decline in the labor force growth rate.

The severity of the 1974-1975 recession and the increased uncertainty about business conditions have slowed the growth rate of investment since 1975 and is expected to continue to dampen investment plans. The rate of increase of the productive capital stock is also expected to slow down in the mid-1980's. Worldwide excess capacity in some industries, such as the steel industry, is expected to continue to dampen new investment in the foreseeable future. In addition, Data Resources predicted that the decline in spending on research and development in the United States will take its toll on future investment. Finally, increased expenditure requirements in the area of pollution abatement are expected to absorb funds that earlier would have gone into investments to expand productive capacity.

Prices are forecast to increase at fairly high rates throughout the period, but the forecast shows a pattern of declining rates of increase. From an inflation rate of around 6% as of February 1978, the forecast shows a fairly continuous decline in inflation rates to 1990, at which time the rate of growth of the Consumer Price Index (CPI) is expected to be in the neighborhood of 4%. The persistence of inflation in the forecast is predicated on several assumptions, as follows:

(a) Energy prices will continue to increase ahead of the general price level, averaging 13.6% through 1980, and then will moderate toward the rate of increase for the general price level, but will never get below a 6% annual rate;

(b) Energy prices will contribute at least an additional percentage point to the inflation rate throughout the forecast; and

(c) Wage settlements will continue to be in the range of 7 1/2% to 9 1/2%.

Real per capita income growth rates follow the same pattern as real income in the forecast, increasing faster between 1977 and the early 1980's than in the mid-1980's and late-1980's. Through 1982 the expected growth rate in real per capita income ranges from 3.3% to 4.2%, with the exception of the projected slowdown in 1979 when it bottoms at 1.7%. From 1983 to 1990 the expected growth rate in real per capita income ranges from 2.4% to 2.9%. As explained above, this pattern reflects the gradual elimination of the excess capacity in capital and labor.

The rate of growth of total national nonagricultural employment is expected to stay above its long-term trend rate through 1982 and then is expected to taper off and settle into a lower long-term growth trend than that which actually occurred in the 1960's and 1970's. Manufacturing employment should grow at a slower rate than total nonagricultural employment, continuing a trend which dates back to the 1950's. Growth rates in employment are expected to drop from around a 3% annual rate in the early forecast period through 1981 to a 1.7% rate throughout the rest of the forecast period. Within manufacturing, employment growth in the durable goods industries is projected to continue as in the 1960's and early 1970's to be roughly twice as great as in the nondurable goods industries. Growth in nonmanufacturing employment is forecast to be greater than growth in manufacturing employment, but the difference is not expected to be as great as it has been in the last 15 years.

Past trends in the composition of industrial expansion are continued in the forecast with a few exceptions. Industrial production is forecast to grow at an annual average rate of 5.3% through 1985. The changing age structure of the population is forecast to boost the rate of household formation in the 1980's, and this trend is strengthened by the trend toward single individuals establishing separate households. The increasing affluence of these middle-aged households is forecast to result in strong demands for housing, travel, recreation, medical services, home furnishings, and nonautomotive durables throughout the 1980's. The only significant break with past trends is that the automobile industry is not forecast to grow as strongly as it has in the recent past.

C. <u>Historical Comparisons Between the Economies of the United States and North Carolina</u>

An examination of the 16 years from 1961 to 1976 gives some perspective on the relationship between growth in the national economy and growth in the North Carolina economy. The economy of North Carolina has been growing more rapidly than the national economy. Annual population growth has been marginally higher in North Carolina than in the nation, having averaged 1.14% in North Carolina as compared with

1.11% for the nation. However, total annual nonagricultural employment growth in the 1961-1976 period has averaged a full percentage point higher in North Carolina than in the nation: 3.4% compared to 2.4%. The movement away from agricultural employment occurred later in North Carolina than in the United States. This fact, together with the rapid growth in the labor force in North Carolina, especially among women, accounts for the difference between population growth and employment growth in North Carolina and in the nation as a whole.

The labor force for manufacturing in North Carolina has grown at triple the rate of that in the United States, 2.6% average annual growth compared to 0.8%. In the nonmanufacturing categories of employment, North Carolina averaged a 1% higher growth rate than did the United States: 4% compared to 3%. Thus, North Carolina has become increasingly more dependent on manufacturing in the last 16 years and the United States has become less so. Within the manufacturing sector, growth in nondurable goods employment increased three times faster in North Carolina than in the United States: 3.0% compared to 1.1%. Annual growth in nondurable goods employment in North Carolina outpaced the United States: 2.4% compared to 0.5%.

The rapid growth of manufacturing employment in North Carolina can be attributed to at least four factors. First, the shift from farm employment, which gained momentum throughout the 1950's, created a large pool of potential manufacturing employees. This movement was reinforced by the relatively low employment in the rural areas of the State. Second, the investment in roads in North Carolina in the late 1950's and early 1960's opened up the rural areas for industrial development, creating an abundance of relatively inexpensive open space for new plant locations. Third, the traditional industries in North Carolina, lumber and wood, furniture, and textiles, created a widely dispersed network of viable small towns which have served as nuclei for new industrial development throughout the State. Finally, the central location of North Carolina between the great northeastern markets and the surging southern markets has made it an attractive location for manufacturers of consumer goods.

The rapid growth in employment opportunities in North Carolina, the increasing labor force participation rates, and the growth of higher wage, consumer goods industries have all combined to produce a higher rate of growth in per capita personal income in North Carolina than that in the nation. In real terms, per capita income grew at an average annual rate of 4.0% in North Carolina between 1961 and 1976, whereas the same measure averaged a 2.9% rate of growth in the United States. Comparative data on housing starts, car sales, bank deposits, and retail sales all confirm that growth in North Carolina has proceeded at a faster pace than in the nation.

As rapidly as economic activity in North Carolina has been growing relative to activity in the nation, the State's level of economic welfare remains significantly below the national level. In 1976 per capita income in North Carolina was 85% of the comparable national figure; in 1960 it was 71%. The same kind of relationship between North Carolina and the nation can be observed in other areas from housing starts per person to expenditures per pupil in education. Therefore, even if one takes the conservative position that growth in the North Carolina economy has proceeded more rapidly than growth in the national economy solely because it is "catching up" with national levels of economic welfare, the fact that there is still considerable difference implies that growth rates in economic variables for North Carolina will continue to be higher than those for the nation.

D. <u>The Long-Term Forecast for North Carolina</u>

The long-term forecast for North Carolina was divided into two time periods. The forecast of the econometric model was accepted by the Public Staff as given through 1985. However, in order to reflect the deceleration of the catching up process, lower growth rates than those obtained from the model were imposed on economic variables in the period 1985-1990. Quite clearly, there is an element of catching up in the recent North Carolina development experience. Growth has been especially rapid in the areas of durable manufactures, excluding furniture; in the nondurable areas of chemicals and rubber; and in the nonmanufacturing areas of finance, insurance, real estate, state and local governments, services, and trade. For some manufacturing industries, initial levels of employment in the early 1960's were so very small that modest absolute increases in employment in these categories produced very high, and probably unsustainable, annual percentage rates of growth. The model equations in these areas picked up these high rates of growth and projected them into the future. However, there will almost certainly be a slowing in these rates of growth in the future as the proportion of employment in these industries in North Carolina reaches a balance with the market opportunities in North Carolina and adjacent areas. A similar argument applies in the nonmanufacturing areas. It was a matter of informed judgment to determine at what point in the forecast to override the model results, and a decision was made to make that point the year 1985.

The Public Staff Report of the Budget Office forecast indicates that population in North Carolina is expected to increase at a 1.2% annual average rate throughout the forecast period. This compares with the Data Resources forecast of 0.9% annual growth in population for the nation.

The forecast for employment growth to 1985 indicates that past trends will be accelerating. Total nonagricultural employment is forecast to increase at an annual average rate of 4.1% from 1977 to 1985. Continued decline in the unemployment rate, further shrinkage in the agricultural sector, and some increases in labor force participation rates enable total nonagricultural labor force growth to outpace population growth. Within the nonagricultural employment category, manufacturing employment is forecast to grow at an annual average rate of 3.6%, and nonmanufacturing employment is forecast to grow at a 4.3% average annual rate. Thus, North Carolina is being forecast to follow the national trend toward becoming a more service-oriented economy. Within the manufacturing employment category, durable goods industries are forecast to increase their employment at twice the growth rate of the nondurable goods industries; durable goods employment is forecast to grow at an average annual rate of 5.6% and nondurable goods at an average annual rate of 2.7%. Thus, the "burden" of growth is placed on the newer industries in North Carolina, e.g., electrical machinery, stone, clay, glass, fabricated metals, instruments, and nonelectric machinery. These industries are forecast to grow quickly at the national level, and North Carolina should continue to increase its share of employment in these industries because of its continuing locational advantages.

Real per capita income is forecast to grow at an average annual rate of 3.8% from 1977 to 1985. The comparable forecast for the United States is 3.3%. From 1985 to 1990 the rate of growth of real per capita income for North Carolina is forecast to be an average annual rate of 3.1%, whereas the national forecast is for an average annual rate of 2.7%. Total real personal income is forecast to grow at an annual rate of 5.0% through 1985 and at an annual rate of 4.3% during the 1985-1990 period. The same forces operating at the national level will tend to slow North Carolina's growth in the mid-1980's and late-1980's. Real retail sales are expected to grow at an annual average rate of 4.7% to 1985 and at an annual average rate of 4.1% from 1985 to 1990.

E. <u>Conclusion</u>

In summary, the forecast for North Carolina over the period 1976 to 1990, as set forth in the Public Staff Report, is that the growth trends established in the period 1960 to 1976 will continue but not at the same levels. North Carolina will continue to grow more rapidly than the nation but the differences in growth rates will diminish. As the levels of economic welfare in North Carolina approach national levels, some moderating in the State's growth rate is expected.

The national forecast of strong growth in industries which are not raw material oriented, such as nonautomotive consumer durables, plastics, and electronics, bodes well for North Carolina. These industries have located in North Carolina in the past to take advantage of the availability of labor, open land, transportation, and access to growing markets and will continue to locate in North Carolina in the future. These industries will raise average wage rates in the State and feed the expansion of the nonmanufacturing industries, such as: services, trade, finance, insurance, real estate, and construction. All of these forces point to a continuation of past trends into the future. Table 4 summarizes those parts of the Budget Office's economic forecast which were used in the Public Staff forecast.

CHAPTER IV

LONG-TERM ELECTRIC ENERGY AND PEAK-LOAD FORECAST

A. Introduction

The Public Staff of the North Carolina Utilities Commission presented the most complete and detailed set of studies on the long-term forecast of electric energy sales and the growth in peak load in North Carolina. The Commission's own forecasts are derived from the forecasts made by the Public Staff. Major emphasis was placed on the "base case" with significant downward adjustment to reflect the Commission's consideration of the effects of the "load management" and "conservation" scenarios. This chapter examines the studies of the Public Staff, Duke Power Company, Carolina Power & Light Company, Virginia Electric and Power Company, and the various intervenors and public witnesses whose testimony influenced the Commission's decisions. Major considerations leading to the Commission's conclusion that the "base case" forecast would not occur and leading to the Commission's ultimate reduced load growth expectations are contained in Chapter VI, "Outlook for Conservation and Load Management; A Survey of Alternative Energy Sources."

B. The Use of Econometric Analysis

The basis of econometric forecasting is the formulation of historical models of electricity consumption. Within these econometric models, the demand for electricity is related to a set of relevant demographic and economic factors, such as: population, income, employment, industrial activity, electricity prices, prices of alternate fuels, and temperature. With the use of historical data, statistical relationships can be developed between electricity consumption and these social and economic factors. Given reasonable projections of the expected growth in population, income, employment, and the like, the estimated historical relationships can be used to forecast the future level of electricity consumption. The reliability of the forecast is dependent on the following:

1. The adequacy of the econometric model in explaining the historical rate of growth in electricity consumption;

2. The accuracy of the projections of economic and demographic growth; and

3. The degree of homogeneity between the historical period and the forecast period.

The Public Staff presented separate econometric energy (KWH) models for the residential, commercial, and industrial customer classes. Summaries of the long-term Public Staff TREND forecast for CP&L and Duke are provided in Tables 5 and 6. The TREND forecasts revealed an expected rate of growth in energy sales of approximately 6 3/4% for both companies. Peak demand projections were developed by applying average customer class load factors to the forecast energy requirements. As pointed out by the Public Staff, the TREND forecast must be considered an optimistic projection of energy sales in view of the assumptions upon which the forecast was based. These assumptions include the following:

1. Strong economic growth in North Carolina and South Carolina in the 1976-1990 period as evidenced by rates of growth for such indicators as:

	N.C.	S.C.
Real personal income	4.8%	5.0%
Real retail sales	4.5%	4.7%
Manufacturing employment	3.2%	3.5%

2. Electricity prices rising slightly above the general level of prices (Table 7);

3. Net substitution of electricity for alternate fuels;

4. No dramatic change in energy-related technology;

5. A continuation of the present form of rate design; and

6. No direct consideration for possible energy and peak-load reductions due to conservation programs and policies, system load management, and peak-load pricing.

The Public Staff base case forecast was generally consistent with the 28th Annual Electrical Industry Forecast (Electrical World, September 15, 1977), which is based on similar assumptions. The 1978 Electrical World forecast is lower than the 1977 forecast: the average annual rate of growth in peak load for the nation is now forecast to be only 5.0% until 1985, then dropping to 4.6% by 1995. In each of the energy sales sectors, the two North Carolina companies have historically grown more rapidly than the industry as a whole. This relationship should certainly continue for the 1976-1990 period, given the probable outlook for economic growth in the Carolinas.

The three major electric utilities presented their forecasts of growth in electricity sales. CP&L, whose estimates of future electrical load were based on estimates of customer energy requirements, forecast an average compound growth rate in energy sales of approximately 5.7% through 1987, dropping to 5.4% through 1997. CP&L's forecast of energy sales through 1997 is set out in Table 8.

Duke's forecast of future peak loads and sales included several major assumptions. First, Duke assumed that its service area will continue to grow, especially since the governments of North and South Carolina are encouraging industrial growth. However, as Duke witnesses pointed out, the economy of Duke's service area will grow at a more moderate rate compared with the fast pace of the 1960's and early 1970's; customers will contribute to the lower growth by continuing their conservation efforts and by adopting Duke's suggestions for load management programs. Second, Duke's forecast assumed that there will not be an extraordinary conversion from fossil fuels to electricity. Duke made sales projections for a number of different classes of customers and utilized more than one method for each group whenever possible. The methods involved projecting the usage per customer and the number of customers, relationships between sales and economic variables, and historical growth patterns. The projections were first made including the effect of load management that has already occurred. Adjustments to the sales forecast were then made for the effects on sales of additional load management. The sum of Duke's sales projections by customer classes yields the forecast of company regular sales that are set forth in Table 9.

VEPCO's current energy forecast for the years 1977-1987 is shown on Table 10. The compound annual kilowatt-hour growth rate for this period is 6.6%. Little explanation of the underlying methodologies was given by the company.

C. Forecast of Electricity Sales to Residential Customers

In its base case, the Public Staff forecasted residential sales for CP&L and Duke, as follows:

Carolina Power & Light Company - Residential Sales

	1976 (actual)		1985		1990		1992
GWH Sales	6,491		10,722		14,024		15,614
% Rate of growth		5.7%		5.5%		5.5%	

Duke Power Company - Residential Sales

	1976 (actual)		1985		1990		1992
GWH Sales	11,327		18,237		23,776		26,438
% Rate of growth		5.4%		5.5%		5.5%	

The analytical approach used by the Public Staff to forecast the demand for electricity by residential customers was to estimate econometric models of residential electricity demand using multiple regression analysis. The residential forecast was based on the assumption that the residential demand for electricity is basically a function of several economic variables, including the number of residential customers, the real price of electricity, and the amount of real income available to residential customers.

The Public Staff used multiple regression models which describe the determinants of residential electricity demand to derive estimates of the isolated effects that changes in particular variables have on the residential demand for electricity. Long-run elasticities of these variables (e.g., the real average price of electricity, real personal income, and seasonally adjusted real retail sales) were used with the forecast growth rates of the variables to obtain growth rates in residential electricity sales for different time periods. These estimated growth rates were applied to historical values of residential electricity sales to obtain forecasts of the expected levels of sales of electricity to residential customers.

In order to check the reasonableness of the econometric forecast, the Public Staff investigated several noneconometric forecasts. Basically, these forecasts consisted of performing linear and exponential trends on historical data, such as: the number of customers, actual energy sales, actual peak load, historical average use per customer, and appliance saturation. Table 11 shows the results of the Public Staff residential noneconometric energy forecasts. These results support the results of the econometric forecasts.

Carolina Power & Light Company

To forecast residential energy usage, CP&L first estimated the total number of customers that would be on its system in the future. Since the total number of residential customers on CP&L's system correlated closely with the total number of housing and mobile home units in the nation, CP&L used projections of the future total national number of housing and mobile home units to forecast the total system number of future residential customers.

Within the residential sector, CP&L's largest number of customers is in the class which uses electric water heaters but does not use electric heat. In order to determine the relative proportions of each type of residential customer, CP&L correlated the historical rate of growth of "water heated only" residential customers to the total number of housing units and mobile homes. Using projections for the total number of housing units and mobile homes for future years, and assuming that the rate of growth of this class customer would follow historical patterns, CP&L was able to forecast the total number of residential customers with electric water heaters but without electric heat. It was assumed that a large portion of those residential customers presently using natural gas would continue to have it available, even with the curtailment of natural gas. These customers represent a large proportion of minimum use electric customers. Therefore, the total number of customers in this class was assumed to decline only slightly. (Subsequent events have shown that prediction to be a good one. The natural gas utilities have enough gas available now, due to decreased curtailments, to actively pursue new residential customers.) By subtracting the customers in these two classes from the total expected number of residential customers, CP&L arrived at the forecast for the number of customers with electric heat. As a result of these assumptions, CP&L now expects a saturation of electric heating customers of 38% by 1997. This is an increase over the 23% saturation of electric heating customers in 1976.

In order to estimate the average use per customer for the residential sector, CP&L used historical data to determine the effects of weather, growth in the residential class, price, abnormal usage during December (due to the holiday season), and conservation. In order to project future usage, CP&L assumed that normal weather would occur and assumed also that a real increase in the price of electricity (over the inflation rate) of 1% per year would occur.

<u>Duke Power Company</u>

Duke's residential sales forecast was based on projections of two parameters: customers and kilowatt-hours per customer. The customer forecast was based on the historical relationship between Duke's total residential customers and the population of its service area. Duke used the population estimates by the Bureau of Economic Analysis, United States Department of Commerce, to compute the number of customers. This estimate of total residential customers was then disaggregated to the individual residential rate schedules.

Projections of kilowatt-hours per residential customer were developed by using multiple regression techniques to analyze monthly usages by rate schedule and to estimate 1977 temperature-corrected sales. Projections for usage per customer were developed by combining elasticities from econometric models with growth rates for the applicable independent variables. The resulting projection of usage per customer multiplied by the number of customers yielded estimates for future KWH sales. The projections of usage per customer for each residential rate schedule were verified by independent projections made by Duke's marketing department.

D. The Forecast of Electricity Sales to Commercial Customers

The commercial energy sector encompasses a wide variety of customers and uses of electricity. The commercial classification is a heterogeneous mix of wholesale and retail trade operations, service activities, and governmental units. Many of the commercial uses of electricity are similar to residential uses, such as indoor lighting, refrigeration, cooking, air conditioning, and space heating. There are also specialized commercial uses of electricity, such as outdoor lighting displays and business machinery.

The 1964-1973 period was characterized by a rapid growth in the commercial consumption of electricity. As pointed out in the Public Staff Report, Duke and CP&L experienced an approximate 12% annual growth rate in commercial sales during the 1964-1973 period. The combined effect of economic recession, rising real electricity prices, and voluntary conservation caused a dampening of the annual growth rate in commercial energy consumption down to approximately 3% for both companies during 1973-1976. As a degree of stability was brought to the national economy and to the energy markets, sales to commercial customers achieved a modest growth rate of 5 1/2% to 6% during 1975-1976.

The econometric forecast analysis of the Public Staff results in an estimated rate of growth in commercial KWH sales for CP&L and Duke of approximately 6.5% for the 1976-1992 period. The forecast of commercial GWH sales for CP&L and Duke for selected years is set forth as follows:

Carolina Power & Light Company - Commercial Sales

	1976		1985		1990		1992
GWH Sales	4,016		7,018		9,662		10,979
% Growth rate		6.4%		6.6%		6.6%	

Duke Power Company - Commercial Sales

	1976		1985		1990		1992
GWH Sales	7,987		13,959		19,214		21,834
% Growth rate		6.4%		6.6%		6.6%	

As discussed in detail in the Public Staff Report, the commercial econometric models used the following as dependent variables: the real average price of electricity, the real retail sales, the real price of #2 fuel oil, and a weather variable. Alternative model specifications were estimated using a data set for each company consisting of monthly observations over the period 1965 to 1976. The statistical method of multiple regression was used to separate the effects of each of the variables which determine commercial KW demand. Time lags were included in the models to estimate the dynamic response of commercial customers to changes in the price of electricity, the level of retail sales, and the price of fuel oil. An estimated rate of growth in commercial sales was generated by applying long-run elasticities to assumed growth rates in the model variables. The econometric analysis for CP&L and Duke results in an estimated rate of growth in commercial KWH sales of approximately 6.5% for the period 1976-1992. Although this growth rate is above the expected future rate of growth in commercial sales for the United States, a 6.5% growth rate is well below the historical commercial growth rates of 9.8% and 10.1% over the period 1964 to 1976 for CP&L and Duke, respectively.

As in the case of residential energy sales, the Public Staff performed a noneconometric investigation of commercial sales to check the reasonableness of the econometric forecast. The initial analysis was to forecast energy sales with simple linear and exponential trends of the available historical data. The exponential trend shown in Table 12 appears to increase dramatically after 1982 and was considered to be an upper bound estimate. The second type of analysis was to trend, linearly and exponentially, the historical average use per customer and multiply these trends by the linear trend of commercial customers. As shown in Table 12 this type of analysis resulted in forecasts which lie between the aforementioned historical sales trends. Table 12 also includes an average of all commercial energy estimates and the average of the most likely estimates.

Carolina Power & Light Company

In order to estimate commercial customers, CP&L developed a trend which tied the growth in commercial customers to residential customers. This assumed that the two growth rates would stay reasonably close in the future.

As in the case of its residential customers, CP&L estimated the average use per commercial customer by using historical data to determine the effects of weather, growth in the customer class, price, abnormal usage during December, and conservation. In order to project future usage, the occurrences of normal weather and a real increase in the price of electricity of 1% per year were assumed.

Duke Power Company

Duke's commercial customers are served under the company's General Service Schedules (G and GA). For each schedule, the kilowatt-hours per customer were analyzed separately to allow adjustment for the effects on usage of changes in ambient temperature and to calculate estimates for 1977.

These usage per customer estimates, together with the number of estimated customers, were used to determine the temperature-corrected sales for Schedules G and GA. Duke then applied declining growth rates from the historical trend to the 1977 estimates of General Service sales in order to calculate the long-range projection.

E. The Forecast of Electricity Sales to Industrial Customers

The Public Staff's industrial sales forecast was the result of the application of two methodologies. The first was based on multiple regression techniques. The second was based on the historical relationship between growth in manufacturing employment and growth in industrial KWH sales. The final forecast was based on a combination of the two methodologies. The forecast rates of annual growth in industrial KWH sales during the 1976-1985 period are 8.53% for CP&L and 7.59% for Duke. The 1985-1992 forecast annual growth rates are 7.89% for CP&L and 6.98% for Duke. The main determinant of the expected growth in the industrial use of electricity is the strong rate of growth in manufacturing employments in North Carolina and in South Carolina. The Public Staff concluded that the rates of growth in industrial sales for CP&L and Duke did not appear unreasonable in view of the current forecast for growth in manufacturing employment in the two states.

The Public Staff forecast of industrial GWH sales for CP&L and Duke for selected years is set forth below:

Carolina Power & Light Company - Industrial Sales

	1976 (actual)	1985	1990	1992
GWH Sales	8,759	18,293	26,738	31,123
% Growth rate		8.5%	7.9%	7.9%

Duke Power Company - Industrial Sales

	1976	1985	1990	1992
GWH Sales	18,417	35,574	49,858	57,067
% Growth rate		7.6%	7.0%	7.0%

Carolina Power & Light Company

CP&L's industrial energy forecast was basically a consensus of the estimates of its customers, i.e., the company's industrial sales manager called upon its large industrial customers to learn their future plans.

Duke Power Company

Duke's textile sales, which amounted to 56% of its industrial energy sales in 1976, were forecast using an econometric model. This projection was supported by two other models, one involving the textile production index and the other using textile mill consumption of fiber. The textile sales forecast was between the two alternate projections. Sales to other industrial customers were projected in two parts: man-made fiber plants, which comprise about 22% of these sales in 1976, and the remaining group. The 1978-1979 projections for man-made fibers were estimated by Duke's marketing department based on expected

KW load and hours use of demand for each customer. The long-range projection was based on the historical relationship between Duke's sales and the national production of man-made fibers.

The remainder of the industrial class was projected using a declining growth rate trend. Duke added to this projection the energy associated with a 100 MW industrial plant that Duke expected to start serving in 1981. The forecasts of sales to other classes were based on growth factors from historical trends, except for interdepartmental sales. The latter sales were projected based upon the experience of the manager in charge of the water systems.

F. The Peak-Load Forecast

The Public Staff made its estimates of "base-case" peak demand by utilizing three independent but closely related forecast methods. First, a peak forecast was developed from the forecast of total system energy production through use of an average (7 years) system load factor. Second, a peak-load forecast was calculated by using forecasts of future KWH sales for each major customer class in conjunction with average (6-7 years) class coincidental peak-load factors which had been obtained from historical cost-of-service studies. The third method used a direct econometric estimation. The Public Staff determined that the second method, the customer class energy requirement - load factor method, was the most reliable approach to developing a forecast of peak demand. The econometric peak-load models were used only as checks on the validity of the results of the load-factor estimates, due to statistical problems inherent in the econometric models. The strong point of the customer class approach is that it provides a direct linkage between the customer class energy forecast and the system peak-load forecast. The customer class approach recognizes changes in the mix in energy sales by class of service and directly reflects them in the peak-load estimates through the coincident peak customer class load factors.

The peak demand estimates for CP&L and Duke resulting from this analysis are shown below:

Carolina Power & Light Company - Peak Demand

	1976 (actual)		1985		1990		1992
Peak Demand (MW)	5,121		9,375		12,777		14,486
% Rate of Growth		6.9%		6.4%		6.5%	

Duke Power Company - Peak Demand

	1976 (actual)		1985		1990		1992
Peak Demand (MW)	8,601		15,385		21,209		24,127
% Rate of Growth		6.7%		6.6%		6.7%	

Using the long-term TREND forecast as a bench mark, the Public Staff developed three alternative peak-load projections which attempt to quantify the possible growth effects of such measures as new conservation programs and load management. These alternative scenarios reflect reasonable upper limits of the impact of conservation and/or load management on capacity expansion planning. These scenarios are:

1. Conservation - a 15% reduction in estimated system energy sales by 1992 with a constant load factor;

2. Load Management - a 10% increase in system load factor (not exceeding a load factor of 75%) by 1992; and

3. Combination Load Management and Conservation - a 15% system energy sales reduction and a 10% increase in load factor by 1992.

New construction schedules were designed for each of these alternatives and new estimates of the price of electricity under each scenario were made.

A fourth scenario was studied to determine the effect on the price of electricity of the overbuilding of electric generating facilities. It was assumed that generating facilities would be constructed under the "base case" capacity expansion schedule with load actually growing as shown under the Combined Load Management and Conservation scenario. The impact of this occurrence would be to simultaneously raise and lower near term prices because extra plant would be on line, but these more efficient new plants would have lower fuel costs. Prices of electricity in later years would be reduced because the plant cost included in the rate base would include less inflation. It was found by the Public Staff that such "overbuilding" of generating facilities would not dramatically increase the price of electricity during the study period. The study shows that the net effect of the additional plant would be a 1% to 2.5% increase over the nominal price of electricity.

Carolina Power & Light Company

As pointed out by the company, CP&L's estimate of the future electrical load which its customers will place on the system is to a large extent based on estimates of customer energy requirements. CP&L first estimated total energy requirements for the system. Then, in order to develop the company's load forecast, CP&L determined coincident peak-load factors for each energy classification and combined them into a composite annual system load factor. The total projected system energy input and the projected annual system load factors were then used to forecast the CP&L system peak load for each year. CP&L's current peak-load forecast is set out in Table 13.

Duke Power Company

Several assumptions underlying Duke's projection of its system future peak loads have been discussed previously, but it is important to reiterate that Duke's projections of peak load take into account the effects of its load management program and the conservation efforts of its customers.

In making its forecast of peak loads, Duke projected separately the summer and the winter peak loads. These peaks have been growing at different rates due to the degrees of saturation of air conditioning and electric heating. The summer and winter peak loads were separated into two components: temperature-responsive loads and base loads by using regression analysis techniques. The company determined growth factors for both types of loads. Duke's long-range forecast of summer peaks is shown on Table 14. Its forecast of winter peaks is shown on Table 15. Duke's peak-load forecasts are lower than the "base case" forecast of the Public Staff and are approximately the same as the Public Staff's conservation scenario. Duke's forecast also showed that the company will remain a summer peaking company through 1990.

Virginia Electric and Power Company

VEPCO's current peak-load projections were based on econometric models, weather models, and historical projection techniques. The company used the service of outside consultants to provide an independent forecast for a review of the reasonableness of VEPCO's own forecast. As pointed out by the company, VEPCO is a summer-peaking company and, barring unusual growth in winter load, expects to remain a summer-peaking company for the foreseeable future. VEPCO's summer peak-load forecast for the period 1978-1987 is shown on Table 2. Growth is expected to remain well below the long-term historical growth rate and will be affected by implementation of load management techniques beginning in 1980. The compound annual growth rate predicted by the company for the 1977-1987 period is 5.3%.

G. Comments by Public Witnesses and Intervenors

The Commission encourages participation in its hearings by public witnesses who have concerns about the matters under discussion or suggestions for Commission consideration. A mixture of concerns, criticisms, and suggestions for improvement of the forecasting methodologies of the Public Staff and the companies were offered during the February 1978 hearings. Response to concerns relating to nuclear power safety will be treated in another section of this report.

A novel approach to forecasting, utilizing only residential meters as a predictor for total system growth, was presented to the Commission by the Carolina Environmental Study Group (CESG). It was asserted that electricity consumers will shortly saturate their usage at 9000 watts. After fitting an integral of the ordinate of the normal curve of error (IONCOE) to recent historical data, CESG asserted that Duke would gradually peak at 11,000 MW in a few years. At that time, the growth rate would be zero.

Some, but not all, of the data used by CESG was adjusted for weather variance. The data was adjusted by a discretionary income ratio (DIR) between .99 and 1.02 and by a rate factor. This DIR level was criticized because a DIR of 1.0 implies that the real discretionary income of North Carolinians would never increase and that all programs for upgrading jobs and wages in the State are a complete failure. Using a DIR of 1.02 implies a 2% annual growth in discretionary income.

If the CESG methodology is used as corrected in the hearing by multiplying the claimed saturation point of 9000 watts per customer by the number of customers, by the CESG annual customer growth factor of 1.03, and by a DIR of 1.02 the result is a forecast of an exponential growth rate, after saturation, of 5.06% per year. If the average DIR value of CESG's 17 years of data is used; namely, 1.02276, the rate of peak growth would increase to 5.344%. For demand to level off at 11,000 MW as claimed by CESG, the number of customers would have to start to decrease in the near future. Using CESG's methodology with realistic assumptions yields a forecast of future loads which is comparable to the companies' forecasts.

The apparent deliberate attempt by CESG to force saturation by choosing the parameters of the IONCOE curve cannot be judged to be a credible examination of past history or expectations for the future planning period. To assume that the per capita electricity use of North Carolina's citizens is saturated would imply that (1) all programs to upgrade the standard of living of citizens in this State are not working or (2) conservation and load management are practiced so effectively that they completely offset the additional energy used to upgrade the standard of living. For conservation and load management to be so practiced is an admirable goal and should be pursued, but that does not appear attainable within the planning period of this report. The CESG testimony did, however, present a good explanation of the phenomena of peak loads occurring at times of extreme coldness or warmness of ambient ground temperature as a result of the differences in radiant energy available in different months. This information may be of value in future studies attempting to further define the probability of peak-inducing weather conditions.

The "load management" scenario of the Public Staff utilized a maximum improvement in load factor of 10%. Several public witnesses expressed concern that this improvement was too low an expectation. However, it was pointed out that daily load factors are already over 80%. Since most of the load management and conservation aids now under practical consideration involve improving the daily load factor and do not involve transferring loads between seasons, it would be extremely difficult for these aids to improve the annual load factor beyond approximately 75%. Even if such improvement could be accomplished, the effect would not be particularly helpful because, once load factor exceeds approximately 75%, the system has insufficient off-peak time to perform major maintenance and the system must add new units to carry the load during maintenance.

The expected limit of 15% on conservation effect during the planning period, which was used in the "conservation" scenario of the Public Staff, appears at this time to be reasonable. Studies by the Tennessee Valley Authority have indicated that even less conservation may be the practical limit.

CHAPTER V

RESERVE CRITERIA, GENERATION MIX, AND CAPACITY PLANS

A. Reserve Criteria

The magnitude of a system's generation reserve requirements depends upon the nature of the system, the characteristics of the load, and the quality of service required by the system's customers. Since these factors change over time, a reserve which was adequate in the past may be inadequate in the future. Consequently, the Commission recognizes the need for periodic review of the generating reserve requirement.

In developing its future capacity plans, the Public Staff made several important investigations prior to its selection of the set of generating facilities it recommends that the electric utilities should construct. The first study involved the selection of acceptable reserve criteria to provide for the day-to-day variations in operating conditions. These variations include maintenance on generating equipment, partial outages due to physical and ambient conditions, unexpected (forced) outages of generating facilities, changes in load pattern, and errors in projected load estimates. It should be noted that an allowance for delays in the commercial operation of new facilities is not generally included in a utility's reserve capacity.

There are various methods to determine reserve requirements. These methods can be broken down into two broad groups: the nonprobabilistic (NOPROB) group and the probabilistic (PROB) group. Nonprobabilistic reserve capacity requirements are generally based on maintaining some minimum level of additional capacity above that required to meet the expected annual or seasonal peak load. The more common NOPROB methods are (1) the standard percent reserve and (2) the loss of the largest unit. The most widely used probabilistic reserve requirement is Loss of Load Probability (LOLP).

It was the conclusion of the Public Staff, based upon its detailed analysis of the historical peak-load conditions for Duke, CP&L, and VEPCO, that a reserve criterion of 15% to 20% for both summer and winter would provide adequate and reliable electric service to the citizens of North Carolina. The Public Staff also concluded that a loss of load probability not to exceed 15 days per season (based upon weekday peak hour loads) should also be used in the planning of North Carolina's future capacity requirements.

Duke witnesses testified that a 20% reserve would be the minimum necessary for North Carolina during the present planning period. This is consistent with Federal Energy Regulatory Commission recomendations of 15% to 25%, with faster growing areas using the higher reserve margins.

Since the reserve margins have been substantially in excess of these values in recent years and weather conditions have still caused difficulties in maintaining service, the Commission concludes that a minimum of 20% reserves should be maintained until load growths settle down into a more predictable pattern.

B. Generation Mix

Once the general level of reserve requirement is established, the next step in developing future generating capacity is to determine the proper mix of the three basic generating capacity types: base, intermediate (cycling), and peaking. Base units are designed to run most efficiently at continuous full load, and generally operate over 60% of the time. Cycling units are generally designed with greater emphasis on lower investment cost and with lesser emphasis on obtaining maximum operating efficiency. (With the passage of time, less efficient base units are used for cycling operations.) Cycling units do not operate as many hours a day as base units and may be stopped and started more frequently. They operate usually about 25% to 60% of the time. Peaking units, which consist mostly of gas turbine and internal combustion engines, are operated only a few hours a day. Theoretically, peaking unit investment costs should be lower and the operation costs higher than those of other types of units. However, hydro units, which are used for peaking, have high investment costs in dams and reservoirs and yet have relatively low operation costs. These units are generally limited to peaking mode in this area, due to water availability. Peaking units, depending on the type and system, can operate as much as 30% of the time.

The hours of operation for each type of capacity depend upon the costs (capital and energy) of the capacity and the demand. To provide the most economical energy to their consumers, electric utilities should determine which generating facilities to operate based upon the relative energy production cost of each facility. (The capital cost of each unit is ignored for operational purposes after the unit is in service.) The unit with the lowest energy production cost is assigned the first increment of load. As each additional increment of load is added to the system, the unit with the next lowest energy production cost is placed into service. This process continues until the on-line generation equals the coincident demand of the consumers. The units with the lowest energy production expense would be considered base load units. As new units are added to a system, some base generation facilities may no longer have a relatively lower energy production cost and may become reclassified as intermediate units. Proper mix is considered to be the optimal mix of generation capacities which will satisfy the demand at minimum cost. The optimal mix of generation capacities is determined by the utility load curve, which is a graphical display of demand versus time.

In arriving at the proper mix of generating capacities, the Public Staff investigated the typical hours of operation for base and peaking capacity of the three North Carolina utilities, the standards of operation using a peak week hourly load curve, and hours of operation compared to an annual load duration curve. The Public Staff also assumed that peaking units would operate no more than 1000 hours and that base units would operate at least 6000 hours. Based upon the above, the Public Staff concluded that the proper generating mix for Duke, CP&L, and VEPCO should be approximately one-half base capacity, one-third cycling capacity, and one-sixth peaking capacity. Other witnesses generally supported this mixture, and the Commission concurs.

Major controversy exists concerning the use of nuclear versus fossil generation. The debate centers both on economic and safety grounds. Whether nuclear is more cost effective than fossil generation depends upon the total costs of construction, lifetime maintenance, and fuel consumed. In addition to its own studies, the Public Staff presented the results of a number of studies of these matters by the Electric Power Research Institute, the Federal Energy Administration, the Nuclear Regulatory Commission, the Federal Power Commission, the Energy

Research and Development Administration, and others. These studies utilized a range of assumptions about future cost trends. All of the studies projected costs of both nuclear and fossil generation from the present mid-1980's planning period into the twenty-first century. While some studies only calculated initial costs, others calculated the levelized total cost over the useful lives of the plants. The results indicated that, in the present planning period, nuclear generation is expected to be more economical than fossil generation.

The average result of the total life studies showed that nuclear generation is expected to be almost six-tenths of a cent (5.86 mills in 1978 dollars) per kilowatt-hour less expensive than fossil generation. These estimates range from a low of 0.26¢ per kilowatt-hour to a high of 0.90¢ per kilowatt-hour. A saving of six-tenths of a cent per kilowatt-hour, the net difference in capital costs, maintenance costs, and fuel costs, would be a cost saving of $6.00 per 1000 KWH generated. For systems which are at least one-third nuclear generation, e.g., the North Carolina utilities, this means a savings of $2.00 per 1000 KWH. The studies indicate that a consumer who uses an average of 1000 KWH per month is expected to save from approximately $10.40 to $36.00 per year. For an electric heat customer who averages 2400 KWH per month, the savings would be expected to range from $25.00 to $86.40 per year. In 1985 dollars, these savings would be more than double.

The Public Staff analyzed the sensitivity of its studies by calculating the effect which would be produced by (1) doubling the nuclear fuel costs and (2) by increasing the nuclear capital costs by 25%. The results of these studies, as well as those of the companies, were that nuclear generation demonstrated an expected economic advantage over fossil generation for base load additions during this planning period. It is emphasized that these results apply to the present planning period. Studies for the generation capacity which will follow those units presently in the planning stage may demonstrate that other methods of providing electric generation may become preferable in future planning periods.

Questions were raised concerning the availability of nuclear fuel to be used in scheduled reactors. The evidence indicates that sufficient quantities of nuclear fuel will be available to be used during the lifetime of plants now being planned. However, when these plants need to be replaced, there is a definite question of whether there will be sufficient nuclear fuel to be able to replace these plants with nuclear generation unless a reprocessing system is started.

Several witnesses at the Commission's February 1978 hearings expressed their concern about the safety and reliability of nuclear fueled generation. The issues raised by these witnesses included:

1. The problems of storing spent nuclear fuel,

2. The lack of firm assurances of uranium supply toward the end of the century,

3. The continuing escalation of costs associated with nuclear plant construction,

4. The use of vast amounts of water for cooling in nuclear generation, and

5. Threats from terrorist groups against nuclear plants.

There was also testimony, however, that nuclear power is clean, safe, and available. The safety of nuclear power plants can be illustrated by the observation that there has been almost 2000 reactor-years of commercial plant operation worldwide without a single fatality as a consequence of nuclear-related plant malfunction. There is continually increasing opinion in the technical community that the hazards to the general public from nuclear plants are considerably less than the hazards from many alternative systems, such as coal. The "greenhouse" effects on our atmosphere caused by carbon dioxide resulting from the combustion of coal and oil may be a problem of even more widespread and potential seriousness than the localized problems of nuclear safety. In addition, nuclear units do not have the sulfur and other emission problems of fossil units. An increasing segment of the technical community is beginning to express the view that nuclear plants are perhaps too conservatively designed, i.e., that the many redundant safety systems are not justified by experience.

With respect to radioactive waste disposal, government efforts are underway to identify two high-level waste repository sites for eventual ultimate disposal of reactor wastes. This program envisions the possible transfer of waste to these repositories during the mid-to-late-1980's. Discussions of establishing interim storage repositories by 1983 have been initiated by TVA with the Federal Administration suggesting that TVA be funded to develop an interim storage system for the southeastern utilities at Oak Ridge, Tennessee.

It is true that in the past year increasing costs for capital construction, fuel, and safety systems of nuclear plants have narrowed the economic advantage nuclear power holds over coal-fired plants. However, the southeastern region of the United States still shows a significant economic advantage for nuclear power over coal. Admittedly, the continually increasing capital costs of nuclear facilities present a financing problem for utilities and are a deterrent to the construction of new facilities.

The calculation of the changes in future electricity prices used by the Public Staff to develop the impacts of the "overbuilding" scenario were challenged. The basis of the challenge was the expectation of annual increases of 8% in nuclear fuel costs and 6.5% in coal costs. It was asserted that the present fuel cost difference would lessen and make future nuclear units less economical and, since nuclear units are the projected units in question, the new units should not be built. However, since nuclear fuel is presently at 4 mills per KWH and coal at 14.8 mills per KWH, the relative difference would widen, not lessen, within the lifetime of the plants. The Public Staff's calculations are correct.

It was contended that large nuclear units are more expensive to build and operate than small coal units. It was also contended that there would be less financial impact as well as less environmental impact if generating units were smaller and decentralized. The table below shows that, if units are costed out in the same time frame and with comparable environmental treatment requirements, small units are more expensive to construct per kilowatt of capacity than large units. Since nuclear fuel is so much less expensive than fossil fuels, nuclear units are economical. In addition, approximately the same number of people are required to run a plant on an around-the-clock basis, regardless of the size; doubling the number of plants would double the manpower requirement. It would also make higher voltage transmission lines less economical and would increase the use of land required for transmission and generation facilities. Smaller units are less efficient in water use and would be environmentally less desirable.

Cost Comparison Illustrating Economies of Scale

I. Duke's Coal Plants, with Scrubbers Added, 1976 Dollars

	Capacity MW	$/KW
Allen 1	165	374
Allen 5	275	348
Marshall 1	350	344
Cliffside 5	545	328
Marshall 3	650	283
Belews Creek 1	1140	275

II. Duke's Nuclear Plants, as Built, 1976 Dollars

Oconee 1	860	230
McGuire 1	1180	293

The Public Staff Report was criticized because it did not treat cogeneration as an alternative to separate power production plants. This matter will be treated in depth in future hearings. A study of this matter has been funded by the North Carolina Energy Research Institute and the United States Department of Energy. Results of that study may be available for the Commission's 1979 hearings.

Questions were also raised by intervenors concerning the viability of using tower cooling versus lake cooling, with specific reference to the possibility of moving Duke's proposed Perkins nuclear plant to Lake Norman. Perkins and its sister units have been designed to use cooling towers as a result of an EPA mandate in past years. By designing and constructing all the units the same, efficiencies will be experienced during construction and operation. It is neither economical, nor permissable to move Perkins to Lake Norman. The lake is reserved for future units; the

Environmental Protection Agency will allow no units to be added until experience has been gained with operation of McGuire and tests of water quality have been conducted.

There are benefits other than economics associated with nuclear generation. Nuclear fuel, unlike coal, avoids the problem of toxic stack gases. It is noted that nuclear plants are required to have lower routine radioactive emissions than are currently allowed at many plants burning low sulphur western coal which contains small amounts of uranium.

The likelihood of nuclear plant sabotage remains unknown, but it is well recognized that security controls at nuclear plants have been considerably increased under the new United States Nuclear Regulatory Commission Guidelines.

The concerns about nuclear power expressed by some witnesses are legitimate and the Commission shares these concerns. The evidence, however, is more than sufficient to support a finding that the projected benefits to be derived from the development and operation of nuclear power outweigh any associated risks. There is little question but that there are economic advantages in the use of nuclear power and, based on the evidence in this case. The Commission finds no reason to try to "wrest away" the primary responsibility and jurisdiction of the United States Nuclear Regulatory Commission in determining or setting safety standards for nuclear plants.

C. Generating Capacity Plan

In developing its future capacity addition requirements, the Public Staff made certain major planning assumptions:

1. No oil or gas burning base generation would be constructed;

2. Only base and peaking capacity would be constructed by the utilities; and

3. Retirements of generating facilities reported by the utilities pursuant to Commission Rule R8-43 would be carried out.

In determining an appropriate generating addition schedule, it is necessary to consider the type of facilities each utility currently has under construction, the proposed retirement of facilities, and the proposed units on which engineering has been completed and licenses have been requested or granted. It is also necessary to consider the lead time required to construct new generating facilities. If an unplanned additional 1000 MW of capacity were required 10 years hence, a coal unit would have to be constructed because it is impossible to design, construct, and license a nuclear unit within a 10-year period under current federal regulatory conditions. The following are various estimates of lead times for new units made by the three utilities and the Public Staff.

Lead Times for New Units

(Months)

Unit	CP&L	DUKE	VEPCO	Public Staff
Nuclear	131	159	151	144
Coal				
Low Sulfur	79	54*	90	86
High Sulfur	79	54*	96	86
Pumped Storage	110	130	120	120
Combustion Turbine	37	30	24	36

*Construction time only

Based upon all of the analyses discussed above and upon the "base case" energy and peak-load forecast, the Public Staff developed what it considered a prudent construction schedule for additional generating capacity for each of the three major electric utilities operating in North Carolina based upon supplying the native peak load. The schedules are shown in Table 16. The expected reserve margins, loss of load probability, and operational breakdown are shown in Tables 17A, 17B, and 18, respectively. At the time the Public Staff developed these tables, the 1977-1978 winter peak and the 1978 summer peak were not known; their estimates have not been adjusted for this new information and are consequently deemed overstated.

The construction program of CP&L is set forth in Table 19A. As the table indicates, the company now has seven generating units either under construction or planned for service between now and 1990. CP&L's current construction program will result in system reserves as shown in Table

198. Except for one year, these reserves are above the minimum 15% summer level which the Commission required in its 1977 Report.

Table 20 shows Duke's forecast summer peak loads, its scheduled unit addition, and the reserves at the times of these peaks for the years 1978 through 1990. The current Duke forecast is predicated on the successful future implementation of its comprehensive load management program for which no precedent has been established to date; consequently, generating capacity additions have been scheduled to provide a degree of flexibility commensurate with the unknown effectiveness of the load management program.

Duke's scheduled reserves through 1983 are higher than design reserve requirements. Duke considered changing the schedules for the in-service dates of McGuire 1 and 2 and Catawba 1 and 2. However, as Duke witnesses Lee and Sterrett pointed out, the in-service dates for these units reflect the substantial construction work already completed on those units and the economic benefits derived from following the present construction schedule. Consequently, Duke's schedule is as follows: McGuire 1 will come into service in time for the winter peak of 1979-1980; McGuire 2, by the summer peak of 1981; Catawba 1, for the winter peak of 1981-1982; and Catawba 2, for the summer peak of 1983.

For the years 1985 and beyond, Duke plans the construction of a combination of base load and peaking capacity, retaining maximum flexibility in the scheduling of ongoing generating units. These plans include six standardized nuclear units and four duplicate pumped-storage units, these units being the most economical types of base load and peaking generation, respectively. For example, Cherokee 2 is scheduled to come into service for the summer peak of 1987, but the flexible schedule would allow this unit to be brought into service for the winter of 1986-1987 or delayed to the summer of 1988.

VEPCO's planned generation additions to meet its forecast peak loads are set forth in Table 2. VEPCO's peak load is expected by the company to grow at a compound annual growth rate of 5.3% over this period of time. The effect of these generating addition plans on VEPCO's reserve margin during the 1978-1987 period is shown in Tables 2 and 3. VEPCO's reserve margin for planning purposes during this 10-year period ranges from 1700 MW to 2100 MW. VEPCO's current generation addition plan will not meet the Commission's reserve criteria.

CHAPTER VI

OUTLOOK FOR CONSERVATION AND LOAD MANAGEMENT; A SURVEY OF ALTERNATIVE ENERGY SOURCES

A. Introduction

The forecast adopted by the Commission for the future growth in electricity usage in North Carolina is based in part upon the premise that conservation and load management will reduce the rate of growth in electricity use. As pointed out by Public Staff witness Taylor H. Bingham, an economist with the Research Triangle Institute, conservation of energy sources should be a matter of concern for North Carolina. This State imports more than 95% of its primary fuels. The availability of these fuels depends upon a variety of factors, including price, federal and state regulation, international agreements, supplier contracts, court rulings, and the cost and availability of transportation for these fuels.

The evidence that is available to the Commission makes it clear that present conservation and load management efforts are not a temporary phenomenon but represent permanent changes in the attitude of society toward energy use. Because many of the conservation and load management programs are in the early stages of development, the total impact of these programs cannot be assessed in this report. The Commission recommends that the Public Staff and the electric utilities present additional evidence of the impact of conservation and load management as such evidence becomes available. This chapter will examine some of the recent efforts to promote conservation and load management in North Carolina. The chapter will also survey the status of alternative energy services.

B. Legislation

The 1977 General Assembly enacted significant energy-related legislation. The most noteworthy enactment is House Bill 1003, the Energy Conservation Act of 1977. In this Act, the General Assembly stated that the North Carolina economy and the welfare of its citizens have been jeopardized by shortages of natural gas, petroleum, and electric power. The Act continues:

> . . . It is therefore declared to be the policy of the State of North Carolina to encourage and promote the conservation of energy in all forms and to establish requirements and enforcement measures for mandatory conservation of energy in North Carolina, in order to prevent or reduce an adverse impact upon the economy of this State and in order to prevent interruption of employment of the citizens of this State in commerce and industry and in order to prevent injury to their health and welfare due to shortage and high cost of energy in their homes . . .

The clear purpose of this legislation is to make conservation a matter of State policy by encouraging the residential and business use of solar energy and insulation. The act provides a tax credit to any person or corporation that constructs or installs a solar hot water heating, space heating, or space cooling system in any residential or commercial building in North Carolina. The tax credit is to be an amount equal to 25% of the installation and equipment cost of the solar hot water, heating, or cooling equipment but not exceeding $1000. House Bill 1003 also allows a tax credit during the period January 1, 1977 - December 31, 1978, to any person or corporation that installs new or additional insulation, storm windows, or storm doors in any building in the State which was constructed and occupied prior to January 1, 1977. The tax credit is to be an amount, not exceeding $1000, equal to 25% of the cost of such insulation, storm windows, or doors. House Bill 1003 also provides that no single family or multi-unit residential building on which construction is begun on or after January 1, 1978, shall be occupied and connected for electricity until the building is in compliance with the minimum insulation standards for residential construction as prescribed in the North Carolina State Building Code.

House Bill 607, which was also enacted by the 1977 General Assembly, provides that buildings equipped with a solar energy heating or cooling system shall be assessed for taxation purposes as if such buildings were equipped with conventional heating or cooling systems. The bill makes it clear that no additional value should be assigned to the building for the difference in cost between a solar energy heating or cooling system and a conventional system.

House Bill 1171 authorizes the Housing Finance Agency to guarantee loans to low income persons for obtaining energy conservation materials for their residences; the maximum amount to be loaned is $1200.

House Bill 654, which recognizes that "solar energy is the world's most abundant and renewable energy resource," appropriated $125,000 for the years 1977-1979 to North Carolina State University for the development of a solar thermal conversion unit which will produce a minimum of 1000 KWH of electricity per month; the unit is to be designed to operate independent of any outside energy source as much as possible and should be reliable and relatively free of maintenance. The legislation specifically set as a guideline for the project that the size and operation of the unit should be practical for use by a home or business.

The United States Congress has recently enacted the National Energy Conservation Policy Act. This Act strongly encourages the states to undertake a residential energy conservation program under rules and guidelines promulgated by the Secretary of the Department of Energy. Within 180 days of the promulgation of these rules, the Governor of each state or an authorized state agent may submit to the Secretary a proposed residential energy conservation plan. Although the specific rules are not yet available, it is clear that this Act will materially affect State and local efforts on conservation.

C. Utilities Commission and Public Staff Activities on Conservation and Load Management

The Commission is under a continuing mandate from the General Assembly "to promote adequate, economical and efficient utility service to all of the citizens and residents of the State." North Carolina G.S. 62-155, which was enacted in 1975, declares it to be the policy of the State to conserve energy through the efficient utilization of all resources. Under this statute the Commission was expressly given the responsibility to study the feasibility of charging electricity customers by a system of nondiscriminatory peak pricing, with incentive rates for the off-peak use of electricity. Consequently, the Commission has entered into cooperative agreements with the United States Department of Energy which provide that the Commission undertake demonstration projects directed toward the actual implementation of utility conservation and load management programs and undertake the study of peak-pricing electricity rates. The Commission has entered into a number of research projects with the cooperation of the Public Staff, the Research Triangle Institute, ICF, Inc., Duke Power Company, Carolina Power & Light Company, Blue Ridge Electric Membership Corporation, and other organizations. One current program is studying the effects of peak-load pricing on residential electricity consumption; this program is funded by the United States Department of Energy and involves the cooperation of CP&L and Blue Ridge EMC.

As a part of one cooperative agreement, the Commission initiated Docket No. M-100, Sub 78, entitled "Investigation of Cost-Based Rates, Load Management, and Conservation Oriented End-Use Activities." In its Order setting public hearings in the docket, the Commission set forth three specific problems presently confronting the Commission in this area of regulation:

1. The need to conserve scarce resources;

2. Equity among rate classes in the structure of electricity (and gas) rates; and

3. Economy of operation of the electric (and gas) utilities providing service in North Carolina.

The Commission held public hearings on load management and conservation programs in July and September 1978. The evidence presented at these 1978 hearings was sufficient to establish that numerous and diverse programs of conservation and load management are underway in North Carolina. The programs are being conducted not only by the utility companies regulated by this Commission but also by other organizations and individuals. A summary of the electric utilities' conservation and load management activities are set out in Section D below.

Particular attention is called to the evidence presented by the Public Staff at the July and September hearings in Docket No. M-100, Sub 78. The Public Staff evidence showed that the State could benefit greatly from a residential energy conservation program. It was estimated that, if every homeowner installed conservation measures up to a level that gave him the greatest possible net saving, the average annual residential gas consumption could be reduced by as much as 47 dekatherms (Dth) or 47.4%; statewide usage could fall by 11,444,000 Dth, which is 17% of total current gas consumption. Further, potential energy savings for an average electrically heated home could be 1,996 KWH per year or 17% of annual heating consumption; statewide savings could reach 663,500,000 KWH. The Public Staff recommended a residential conservation program for all residential customers.

The Public Staff also offered evidence that the use of load management techniques by the electric utilities could reduce the demand on the system at selected times, alter the required generating plant construction program, and result in savings to the utilities in generation plant investment. The testimony offered by witness Spann focussed on two programs. First, the utilities could control certain industrial loads by interrupting those loads through the use of radio controlled switches: in exchange, these industrial customers would receive a discount based on the KW of controlled load. The second program involves the utility control of residential water-heating loads: in exchange for a flat monthly discount, the residential customer would allow the utility to use a radio controlled switch to interrupt residential water-heating service. Both programs would be voluntary. The Public Staff recommended that load management programs based on the utility control of residential water heating and on interruptible industrial loads should be developed by CP&L, Duke, and VEPCO.

The Public Staff witnesses testified that CP&L and Duke residential customers with electric hot water heaters would find a controlled water heating rate attractive. Mr. Bingham stated that if the customers were offered a credit of about $1.50 per month, all existing customers with heater sizes of 66 gallons or larger would appear to benefit by accepting the controlled water heating rate. Customers with available space would benefit by replacing their small water heaters with 66-gallon units. New home buyers would also find it beneficial to install a 66-gallon or larger unit. Although not all residential customers would be expected to choose the controlled water heating rate, the Public Staff concluded that, given monthly credits in the $1.00 to $2.00 range, the demand for the rate could be significant. The Public Staff also found that there are about 100 large industrial customers in the Duke and CP&L service areas which would have an immediate interest in interruptible service, if such service could be extended to noncritical loads. Under the assumptions and judgments used by witness Spann, the reduction in peak demand in 1990 resulting from the interruptible industrial rates would be 510 MW for Duke and 110 MW for CP&L. The residential water heating rate would reduce the 1990 peak demand by 175 MW for Duke and 75 MW for CP&L.

D. The Electric Utilities' Conservation and Load Management Programs

The electric utilities are engaged in a variety of conservation and load management programs. Each company is making a serious commitment to the concept of conservation and load management. The approach of the companies, however, has been cautious, consisting of experimental and pilot-scale projects rather than wide-ranging implementation. The companies have concluded that this approach is necessary to ensure that the benefits of such programs outweigh the costs which will be incurred by the companies and their customers. There are programs involving little cost, but many of the load management programs require costly switching and monitoring equipment.

Duke Power Company

Duke Power Company, in the load forecast hearings in Docket No. E-100, Sub 32, and in the conservation and load management hearings in Docket No. M-100, Sub 78, presented the most detailed evidence of any company on its conservation and load management programs.

According to Duke witness Donald H. Denton, Jr., Vice President of Marketing, Duke's Load Management Program has as its goal the reduction in the growth of the company's kilowatt peak load and kilowatt-hour sales. This program encompasses all sectors of Duke's business - residential, commercial, industrial, agricultural, and resale. Table 21 reflects Duke's projections of its load management goals during the years 1978-1990. By 1985 the accumulative reduction in peak load will have equaled the output of one large generating unit. By 1990 an additional generating unit will have been saved as a result of these load management efforts. These figures were incorporated in the company's overall forecast.

The Load Management Program includes the following activities: the Energy Efficient Structure Program (EES) for residential customers; the improvement of insulation levels in RA (all-electric) and in non-RA structures; the education of customers in the use of heat pumps and high efficiency central cooling systems; the reduction of KW demand in dairy milking operations and in large poultry houses; and the reduction of lighting levels in new buildings. Particular attention should be directed to Duke's program to reduce the industrial customers' demand at the time of the company's system peak load; Duke estimates the peak demand savings to be 84 MW in the summer and 24.6 MW in the winter.

In 1976 Duke launched its EES Program for its residential customers. This program promotes reduction in residential demand through the use of additional insulation which meets

EES standards. The Commission has approved a special conservation rate (Residential Schedule RC) which offers a monetary incentive to those residential customers who install insulation in compliance with the EES standards. This incentive is equal to the savings in Duke's construction cost which result from the lower residential demand of the Schedule RC customers. Duke estimates that 12,367 EES units will be added to the system from 1975 through the summer of 1980. The air conditioning saturation in these units will approach 90%. EES activity will reduce weather-responsive loads in these structures. The company has also started its Energy Efficient Appliance (EEA) Programs, which inform Duke's customers through participating appliance dealers of the benefits of purchasing home appliances that are energy efficient.

Duke provides its larger industrial customers with electronic information in the form of timed pulses; these customers are therefore able to continually monitor their loads and better control their maximum demands. Duke presently has 140 customers with some form of monitoring system or load control.

Duke is undertaking studies of customer load control which include not only residential water heaters but also the interruptible service to its larger customers. The company is testing radio control equipment in the homes of employee volunteers to determine the operating characteristics of this type of control.

Duke is a participant in a solar research project with Electric Power Research Institute. The company is also a subcontractor in a project to define for the United States Department of Energy the best applications of photovoltaics for commercial and industrial customers. Duke's customers who have installed solar-assisted heating and water systems are placed on the company's solar rate schedules. Duke is studying these customers in order to evaluate the benefits of this form of supplemental energy.

Carolina Power & Light Company

In Docket No. E-100, Sub 78, CP&L witness Norris Edge testified regarding the ongoing activities of CP&L in the area of conservation and load management. CP&L provides support to the Edison Electric Institute's program on load management and participates in the national study of rate design. In addition, much work on load management is being performed in-house. According to Mr. Edge, the various activities have grown to the point that CP&L is establishing a permanent staff with the technical expertise to make the appropriate analyses and recommendations for load management activities and to follow through with the implementation of such activities.

The CP&L load management program currently consists of the following: The Common Sense/Wrap Up Program; customer education regarding heat pumps, insulation, and energy efficient appliances; free energy audits; advice to customers in obtaining financing, materials, and contractors for energy conservation activities; and several experimental projects.

The Common Sense Programs encourage high levels of insulation and the use of energy efficient appliances in new houses, new apartments, and new business structures. CP&L estimates that an average 1500 square-foot house conforming to the programs will save 4,300 kilowatt-hours on heating and cooling requirements. The Common Sense House Program is also being extended to manufactured homes. These homes represent a substantial proportion of new CP&L connections each year. The Wrap-Up Program is the counterpart of the Common Sense Program which is applicable to existing buildings. These programs, as well as other means of conserving energy, are being promoted through bill inserts, personal contacts, and media advertisement. The educational efforts concerning proper lighting, efficient appliances (in commercial cooking and processing, as well as in residential use), use of heat pumps, and proper insulation are applicable to all customer classes. For customers who desire to install equipment to automatically regulate their load, CP&L will install (for a monthly facilities charge) equipment to provide the meter pulses needed for such continuous monitoring.

CP&L's load management program also includes various experimental activities. CP&L is involved in a time-of-day rate demonstration project in cooperation with the Commission and the Blue Ridge Electric Membership Corporation. This three-year project, scheduled to be completed in the summer of 1979, should provide substantial evidence on the effectiveness (i.e., customer acceptance and response) of time-of-day rates in redistributing peak loads.

Other experimental activities include a two-year project that examines the potential of interrupting service to residential customers via radio control. In addition, CP&L has surveyed the possibility of interruptible service to large industrial and commercial customers.

Joint efforts with industrial companies are also part of CP&L's experimental activities. One such project is testing a line carrier communication system which also attempts to determine an optimum carrier frequency. In another project, distribution automation options which can perform multiple load management functions are being tested. These activities are part of the continuing efforts to make many of the technically feasible load management options economically feasible as well.

Virginia Electric and Power Company

The load management efforts and energy conservation activities of VEPCO were also presented in Docket No. E-100, Sub 78. Edmond Wickham, Director of Load Management Applications for VEPCO, testified that an active load management program is being undertaken pursuant to a corporate goal of reducing the projected peak load by 500 MW by 1985. The VEPCO load forecast and resulting construction schedule takes account of this proposed reduction.

According to testimony by company witness Roach, VEPCO's conservation activities include providing energy audits on an informal basis to residential customers at the customer's request. Vepco has plans for a pilot program which may be expanded to a more formal program. Commercial and industrial customers are currently offered various materials to aid them in performing their own energy audit. Insulation and lighting recommendations are available to customers. Conservation is encouraged through educational materials and advertisements. VEPCO is revising its heat pump program to encourage heat pump manufacturers to make available efficient, reliable heat pumps. Other programs in planning or in developmental stages include the following: Electric Energy Efficient Home Program (similar to CP&L's Common Sense Program and Duke's Energy Efficient Structure Program), a reference manual on load management, experimental activities on alternate energy sources, and experimental projects on load management techniques.

The experimental load management activities that VEPCO is currently planning involve both direct and indirect techniques. Indirect management projects involve time-of-usage rates. For purposes of education and comparison, a selected group of residential customers will receive hypothetical time-of-usage bills in addition to actual bills. Another group of residential customers consisting only of volunteers will be actually charged by time-of-usage rates.

Planned direct load management activities include several volunteer projects to test the effects of interrupting service to hot water heaters. The experiments will allow VEPCO to evaluate the required hardware and customer acceptance of such programs.

E. Alternative Energy Sources

Recent fuel shortages and escalating prices of conventional fossil fuel or nuclear fuel energy systems have encouraged a close examination of the practical potential of other energy sources. Economic considerations of other alternatives will ultimately involve both the direct costs associated with each of the new sources and their effects on the health of the State's economy. The availability, reliability, and cost of energy, from whatever source, will largely determine the character and levels of industrial growth and resulting employment opportunities in North Carolina.

The vulnerability of this State's economy to both national and international actions further encourages development of a range of energy options. The 1973 oil embargo adversely affected both the personal and the business operations of North Carolinians. In addition, the extreme shortages of natural gas severely crippled the State in the winter of 1976. If severe economic and social consequences resulting from such occurrences are to be avoided in the future, a range of options must be available to meet the energy demands of North Carolina. While the present employment of alternative energy sources appears to be supplemental in nature, the potential of these sources must be examined. Conservation, which the Commission considers to be an extremely important alternative energy source, has been examined in an earlier section. However, in addition to the conservation efforts of the utilities, other groups are making contributions. The North Carolina Energy Research Institute has several projects dealing with conservation and alternative energy sources. The Energy Division of the North Carolina Department of Commerce has developed a Comprehensive Statewide Energy Conservation Plan, which is designed to conserve 8.05% of the State's total projected 1980 energy consumption of 1,736.08 trillion BTU's, a savings of 139.72 trillion BTU's. The major program for the residential sector is Project Conserve, which provides the homeowner with an objective analysis of the costs and savings likely to result from such measures as adding or increasing insulation, installing storm windows and doors, and setting back thermostats.

The Commission reasserts its belief in the potential impact of conservation. However, due to its extensive treatment in earlier sections, conservation will be omitted from further discussions of alternative fuel sources.

In Docket No. E-100, Sub 32, the Public Staff and other interested and concerned groups presented testimony regarding alternative energy sources. In addition, the Commission has taken judicial notice of other available material. The following energy sources have been brought to the attention of the Commission:

1. nuclear fusion
2. wind
3. geothermal
4. biomass and plant energy
5. fuel cells
6. tar sands/oil shale
7. coal gasification/liquification
8. solar

Electric generation systems which use wave action and tidal energy, both of which were discussed in last year's Report, appear unlikely to be developed further during the present planning period. The technology required to obtain energy from wave action is very complex and expensive. Therefore, wave generation systems will probably be delayed until less complex alternative sources of generation have been perfected and accepted. Due to the nature of the tidal conditions off the mid-Atlantic shores, it appears that there will be little application for tidal energy generators in this area. However, there has been limited discussion of placing these units in some of the inlets between the Outer Banks to take advantage of the concentrated tidal water flows at those locations. In addition, some examination is being made of ocean thermal energy gradient devices, although there is little expectation of any substantial development of this source in the near future.

Fusion

Research on the nuclear fusion system has progressed to the point that most plasma physicists accept its technological feasibility. The fact that the actual fusion device is presently being designed is certainly a step towards a power-producing system. However, the practical utilization of such a source remains uncertain, due primarily to the high costs and the problems associated with the very high temperatures involved. However, the fact that the supply of fuel for this source of energy is virtually inexhaustible and that there are no major radioactive waste disposal problems make nuclear fusion very attractive. Nevertheless, recent shifts of research and development funding from fusion research to solar research have significantly delayed the program; it now appears that this country will not see any major impact of this source during the twentieth century.

Wind

Interest in wind power continues to focus on the design of devices to be used as wind generators. However, the problem of land needed for giant windmill installations has yet to be solved. For example, a University of California research study estimated that by the year 2025, 86% of that state's energy could come from renewable sources, but that this effort would require 23% of the state's land area for energy farms (for biomass fuel) and huge windmill installations. Recently, the California Energy Commission ordered 10 experimental windmills to further its studies. In North Carolina, a wind turbine is to be built near Boone for the Blue Ridge Electrical Membership Corporation. It will be the largest wind turbine ever constructed and will supply 500 homes with required electricity. Although work is continuing on this source of energy, few expect it to have a significant impact on the supply picture in the next few years.

Geothermal

Within the last year, interest in geothermal energy sources and optimism concerning their practical application have grown. However, the optimism for more extensive application continues to be associated with the western United States and will probably have little impact on the energy requirements and sources of North Carolina.

Biomass

The possibility of using biomass as a fuel source is receiving much attention from national and local groups. The Institute of Gas Technology (IGT) is involved in several such projects. For example, the design and potential of large advanced digestive systems which involve a mixture of water hyacinth, Bermuda grass, municipal solid waste, and sewage sludge are being investigated on a pilot plant scale. Earlier laboratory testing indicated that these mixtures would produce more methane than what many would designate as pure biomass. In other projects, IGT examined additives that may accelerate anaerobic sewage sludge digestion which may allow up to double the loadings. An anaerobic process for converting ocean kelp to synthetic natural gas was studied, and testing was conducted on processes to obtain fuel from the thermochemical conversion of biomass.

The North Carolina Energy Division, Duke University, and Duke Power Company are examining alternative sources of energy, which include plant energy and other biomass sources. A recent project funded by the Energy Division investigated the use of wood for small-scale power generation in the State. Energy production from biomass and wastes is also receiving attention from private industry, local universities, and technical groups. Champion Papers, Inc., proposed to convert municipal garbage into energy to be used for the production of paper at its mills in western North Carolina. The project proposes to use waste-derived fuel and coal to produce 300,000 pounds of steam and 8,000 kilowatts per hour. In the load management hearing, a public witness, Thomas Gunter, testified that waste from agricultural processing, sewage sludge, residues from feed lots, and municipal wastes are all potential biomass sources that are abundant in North Carolina. Thus the State's potential for energy production from this alternative source is enormous; the question is the economic feasibility.

Tar Sands, Oil Shale, Coal Gasification and Liquification

The use of tar sands and oil shales for processes that yield an oil-like material is both costly and environmentally questionable. The large amounts of water needed for the processes and the solid waste disposal problems are primary concerns. Currently, the technology involved is in a very early stage of development and is not expected to contribute to alternate fuel sources for many years.

The work on coal gasification and liquification is continuing. The Environmental Protection Agency is conducting several projects on the various processes involved; however, the carcinogenic and mutagenic agents that result from these processes continue to be important concerns. Since no major breakthroughs have occurred recently, it is probable that this technology will not be accelerated in the near future.

Fuel Cells

The development of fuel cells has advanced from the first generation phosphoric-acid cells to the second generation stage of molten carbonate cells. The Department of Energy has funded several projects to improve the performance and endurance of these second generation cells. Production methods, selection of stable anode materials, and the optimization of the fuel cell electrolyte (mainly through the production of a lithium aluminate electrolyte tile) have been studied in the ongoing efforts to improve the cost effectiveness of this source. Other experimental programs have evaluated the feasibility of using heavy fuel oils for producing fuel cell quality fuels through processes of hydrogasification, steam reforming, hydrodesulfurization, and hydrocracking. Development has also been initiated for a reversible electrochemical cell, serving both as a fuel cell and an electrolyzer.

The Edison Power Research Institute is involved in a multi-year endeavor to develop fuel cell components that can function even if the fuel gas stream contains as much as 200 ppm sulfur by volume. Sulfur tolerant anode catalysts and anode polarization must be studied.

In New York City, the Consolidated Edison Power Company recently received approval for a 4.8 megawatt fuel cell demonstration plant which will involve EPRI, DOE, United Technologies, and several utilities. The New York City Board of Standards and Appeals ruled that fuel cells are not refineries and thus approved the plan for the installation of the planned equipment. This approval is quite significant and makes fuel cells the only power-generating equipment that can be installed in the city. In addition, the acceptance of this planned demonstration plant by the Manhattan residents is allowing the schedule to move ahead, in contrast to other energy related projects. The areas to be investigated during the project include verification of emission, load following characteristics, and aesthetic characteristics of the plant. If the results are favorable, it is anticipated that commercial development of the plant will begin.

Solar

The interest in solar energy as an alternative fuel has been enhanced because of the rising costs of oil and gas and because many persons consider it the most attractive alternative that is currently available. A witness for the Public Staff testified that the use of solar energy as a supplement to conventional energy is now economical for some hot water heating applications. With the tax credits now available to users of solar energy and the increasing prices of conventional fuel, some builders of new homes are finding that solar assisted heating of the structures is becoming more attractive. Public witnesses presented information on solar potential in North Carolina. Currently, projects are being conducted by local universities, private individuals, and other interest groups. There seems to be agreement that the potential of solar energy as an alternative fuel source deserves serious consideration. An extensive program being conducted by the United States Department of Energy attempts to identify possible commercial and industrial applications of this technology. This work may result in an increased market and a decreased price. In a report from a concerned technical group which investigated conceptual designs and photovoltaics through computer simulation, opportunities for both improved performance and reduced cost were identified, but even minor market penetration for the residential sector was not projected before the 1980's.

The use of solar thermal energy (above 400°F) to produce energy-intensive chemical products as well as various types of solar collection and storage has recently been investigated. Some researchers now believe that conventional solar storage may be supplemented with solar-photochemical storage. This procedure would increase both the temperature of the storage unit and its efficiency. Stanford University has reported that the efficiency achievable in their thermophotovoltaic (TPV) solar cell research has more than doubled in the last year. This research, sponsored by EPRI, involves converting incandescent light into electrical energy. As improved cell design further increases performance, the 35% level of efficiency that could make TPV systems economical in large plants now seems a definite possibility.

Locally, North Carolina State University and the Research Triangle Institute are both doing significant work in photovoltaics and appear to be on the frontiers of such research. EPRI is also sponsoring projects that involve the development of new concepts in solar energy, including the use of highly concentrated sunlight in high-efficiency photovoltaic cells. Production of low-cost photovoltaic thin film, which could convert sunlight to energy directly and efficiently, is also being examined. This new film, which would not require a sunlight-concentrating system, appears promising, both in terms of costs and relative efficiency.

Some proponents of solar energy expect large reductions in the costs of solar systems to result from economies of scale, technological improvements, and reduced labor costs as the ease of installation, innovative designs and competition all increase. Others do not expect dramatic reductions; the cost of these systems is mostly in the metal, glass, and plastic parts, the control systems and the fans and pumps, the costs of which are not expected to come down.

The present technologies for solar heating are such that small water heating loads are at or better than a break-even cost; some water heating can therefore be accomplished through solar energy. However, it is not now economical, nor is it projected to be economical within the present planning period faced by the Commission and the power system designers, for heating requirements to be completely served by solar energy captive systems. At present, it is only economical to use active solar systems which provide approximately 50% of the total heating requirements in most cases. This means that the remainder of the requirements on peak days must be provided by an alternate source. While the Commission is very supportive of solar energy utilization, it is concerned about solar heating systems with electrical backup.

If the backup to a solar system is electric, it appears that either some design control or some economic incentive should be placed or offered, respectively, on solar installations in order to ensure (1) that the energy available from the solar captive system is used during peak times rather than off-peak times, and (2) that the peak demand on the electric system is reduced and not effectively increased by these systems. Because the undersizing of collectors and storage systems required by economics and because of the operational technologies of most of the systems now in place, the available heat in storage will be used in the late evenings and very early morning hours on peak use days. The auxiliary heating systems will come on during some of the coldest hours of the morning and remain on into the early day, which will be coincident with the normal time of the electric system winter peak. This type of solar system would make the load factor of the electric utilities deteriorate and would thus cause an upward pressure on the cost of electricity. In fact, the increased cost from this effect may be greater than any net energy savings from the contribution of the solar equipment. The matter of "control" of these systems, then, is one which must be carefully analyzed in the near future. Thermal storage may be one answer if consumers insist on using backup electric heating or cooling systems. In order to encourage installation and proper sizing of thermal storage equipment where electric backup is used with solar heating installations, the Commission concludes that utilities should make voluntary experimental time-of-day rates available to such installations.

Summary

Alternative energy sources do exist in varying stages of development. However, the composite impact of these sources including conservation is difficult to quantify with the data currently available. It is expected that some of these sources will be further developed and will gradually become an integral part of the energy supply. While research and development in these potential areas is encouraged, the

Commission must continue to plan for the State's energy needs in the most realistic manner. Thus, the present forecast cannot be reduced as much as some parties would like. However, the Commission expects that, in future planning periods, some of these areas will be more quantifiable and, thus, will play a larger role in supplying North Carolina's energy needs.

CHAPTER VII

CONCLUSIONS

The forecast plan adopted in this 1978 report shows a decline in the rate of growth of the peak load of both Carolina Power & Light Company and Duke Power Company. In its 1977 Report the Commission found that the probable annual rate of growth in peak load for both CP&L and Duke would be approximately 6.9% during the years 1976-1990. In the 1978 report the Commission has adopted for its capacity plan an annual peak load growth rate of 5.2% for CP&L and 5.4% for Duke.

The Commission's 1978 forecast is based in large part upon the premise that conservation and load management efforts will have a substantial effect on the future growth of electricity usage in North Carolina.

The Commission has considered the conservation and load management activities presented in its Docket No. E-100, Sub 78. The Public Staff recommended that CP&L, Duke, and VEPCO develop two load management programs. First, the utility control of residential water-heating loads: in exchange for a flat monthly discount, the residential customer would allow the utilities to use a radio controlled switch to interrupt residential water-heating service. Second, the utility control of certain interruptible industrial loads: in exchange for a discount based on the KW of controlled load, industrial customers would allow the utilities to interrupt certain industrial loads through a radio controlled switch. The Commission will order the three electric utilities to file proposed plans for these two programs within 270 days.

Furthermore, the three utilities will be required to file voluntary rates incorporating time-of-day pricing to those customers who either install solar equipment, thermal storage equipment, or a combination of the two for the purpose of providing space heating. The rate schedules will be filed on an experimental basis. It is expected that this experimental rate will offer sufficient economic incentives to such customers so that the energy available from such a system will be used during the peak times of the electric utilities and that the peak demand will not be increased by solar systems.

TABLE 1. Capacity Addition Plans for Virginia Electric & Power Company

YEAR	Vepco Plan UNIT	MW	Public Staff Plan UNIT	MW
1979S	North Anna 2	907	North Anna 2 + Update	934
W				
1980S			Pooling + Uprate	286
W				
1981S			North Anna 3	907
W				
1982S	Bath County 1, 2, 3, 4	1500	Uprate + Bath County 1, 2	731
W	Bath County 5, 6	750		
1983S			North Anna 4	907
W	North Anna 3	907		
1984S			Uprate + Bath County 3, 4	731
W	North Anna 4	907		
1985S			Surry 3	900
W				
1986S			Bath County 5, 6	700
W				
1987S	Base Load Unit (fossil)	910	Surry 4	900
W				
1988S	VEPCO did not		Base	1100
W	forecast beyond 1987			
1989S			Base	1100
W				
1990S			Base	1100
W				
1991S			Base	1100
W				
1992S			Base	1100
W				

NOTE: There appear to be differences in the values used for Bath County units by the two parties.

TABLE 2. Reserves Which Will Result From Capacity Plans if the VEPCO Forecast Occurs

YEAR		VEPCO FORECAST OF PEAK LOAD (MW)		VEPCO CAPACITY PLAN Installed Capacity (MW)	VEPCO CAPACITY PLAN Reserves (%)	PUBLIC STAFF CAPACITY PLAN Installed Capacity (MW)	PUBLIC STAFF CAPACITY PLAN Reserves (%)
1979	S	8,760		10,432	19.1	10,483	19.7
	W		8,160	10,736	31.6	10,735	31.6
1980	S	9,260		10,468	13.0	10,769	16.3
	W		8,670	10,773	24.3	11,021	27.1
1981	S	9,810		10,504	7.1	11,676	19.0
	W		9,210	10,773	17.0	11,544	25.3
1982	S	10,250		12,004	17.1	12,035	17.4
	W		9,760	12,613	29.2	12,275	25.8
1983	S	10,570		12,344	16.8	12,942	22.4
	W		10,340	13,006	25.8	12,972	25.5
1984	S	11,200		12,757	13.9	13,471	20.3
	W		10,930	14,013	28.2	13,703	25.4
1985	S	11,860		13,795	16.3	14,371	21.2
	W		11,540	14,104	22.2	14,603	26.5
1986	S	12,550		13,886	10.6	15,071	20.1
	W		12,170	14,205	16.7	15,303	25.7
1987	S	13,270		14,796	11.5	15,971	20.4
	W		12,820	15,045	17.4	16,203	26.4
% Growth Rate		5.3	5.8	4.5		5.4	

TABLE 3. Reserves Which Will Result From Capacity Plans if the Public Staff Forecast Occurs

YEAR		PUBLIC STAFF FORECAST OF PEAK LOAD (MW)		PUBLIC STAFF CAPACITY PLAN Installed Capacity (MW)	PUBLIC STAFF CAPACITY PLAN Reserves (%)	VEPCO CAPACITY PLAN Installed Capacity (MW)	VEPCO CAPACITY PLAN Reserves (%)
1979	S	8,849		10,483	18.5	10,432	17.9
	W		8,280	10,735	29.6	10,736	29.7
1980	S	9,364		10,769	15.0	10,468	11.8
	W		8,762	11,021	25.8	10,773	23.0
1981	S	9,909		11,676	17.8	10,504	6.0
	W		9,272	11,544	24.5	10,773	16.2
1982	S	10,485		12,035	14.8	12,004	14.5
	W		9,812	12,275	25.1	12,613	28.5
1983	S	11.095		12,942	16.6	12.344	11.3
	W		10,383	12,972	24.9	13,006	25.3
1984	S	11,741		13.471	14.7	12,757	8.7
	W		10,987	13,703	24.7	14,013	27.5
1985	S	12.425		14,371	15.7	13,795	11.0
	W		11,627	14,603	25.6	14,104	21.3
1986	S	13.148		15,071	14.6	13,886	5.6
	W		12,304	15,303	24.4	14,205	15.5
1987	S	13,913		15,971	14.8	14,796	6.3
	W		13,020	16,203	24.4	15,045	15.6
1988	S	14,723		17,071	15.9		?
	W		13,777	17,303	25.6		
1989	S	15,579		18,171	16.6		?
	W		14,579	18,403	26.2		
1990	S	16,486		19,271	16.9		?
	W		15,423	19,503	26.4		
1991	S	17,446		20,371	16.8		?
	W		16,326	20,603	26.2		
1992	S	18,461		21,471	16.3		?
	W		17,276	21,703	25.6		
% Growth Rate		5.8	5.8	5.7		4.5	

TABLE 4. Levels and Growth Rates of Demographic Variables Used in the Public Staff's Energy Forecasts and Load Forecasts

N. C.	1976	Growth Rate	1985	Growth Rate	1990
Population (Millions)	5.469	(1.2%)	6.084	(1.2%)	6.465
Real Personal Income (Billions)	17.349	(5.0%)	25.962	(4.3%)	33.340
Real Income Per Capita (000)	3.172	(3.8%)	4.432	(3.1%)	5.157
Manufacturing Employment (000)	757.6	(3.6%)	1050.3	(2.6%)	1183.9
Real Retail Sales (Billions)	13.657	(4.7%)	20.654	(4.1%)	25.250
Households (Millions)	1.788	(2.3%)	2.198	(2.3%)	2.433
U. S.					
Industrial Production Index	1.295	(5.3%)	2.056	(4.3%)	2.540
CPI	1.705	(5.5%)	2.755	(4.4%)	3.416
WPI	1.830	(5.8%)	3.032	(3.9%)	3.675
Price Deflator Gasoline & Fuel Oil	1.644	(6.3%)	2.846	(4.8%)	3.604
WPI - Fuels	2.657	(10.4%)	6.477	(5.5%)	8.455

TABLE 5. Public Staff Trend Forecast of CP&L Energy Consumption by Customer Class (GWH)

Customer Class	1976 (Actual)	Growth Rate	1985	Growth Rate	1990	Growth Rate	1992
Residential	6,491		10,722		14,024		15,614
% CH		(5.7%)		(5.5%)		(5.5%)	
Commercial	4,016		7,018		9,662		10,979
% CH		(6.4%)		(6.6%)		(6.6%)	
Industrial	8,759		18,293		26,738		31,123
% CH		(8.5%)		(7.9%)		(7.9%)	
Wholesale and Other	6,649		10,958[1]		14,109[1]		15,611[1]
% CH		(5.7%)		(5.2%)		(5.2%)	
Total Sales	25,915		46,991		64,533		73,327
% CH		(6.8%)		(6.6%)		(6.6%)	
Company Use	36		61[2]		84[2]		95[2]
SEPA	135		121		121		121
Losses	1,492		3,302[3]		4,532[3]		5,148[3]
Total Energy	27,578		50,475		69,270		78,691
% CH		(6.9%)		(6.5%)		(6.6%)	
Peak Demand	5,121		9,375		12,777		14,486
% CH		(6.9%)		(6.4%)		(6.5%)	

[1]Preliminary 1977 Company estimates
[2]Total sales x .0013
[3](Total sales + company use + SEPA) x .070

TABLE 6. Public Staff TREND Forecast of Duke Energy Consumption by Customer Class (GWH)

Customer Class	1976 (Actual)	Growth Rate	1985	Growth Rate	1990	Growth Rate	1992
Residential	11,327		18,237		23,776		26,438
% CH		(5.4%)		(5.5%)		(5.5%)	
Commercial	7,987		13,959		19,214		21,834
% CH		(6.4%)		(6.6%)		(6.6%)	
Industrial	18,417		35,574		49,858		57,067
% CH		(7.6%)		(7.0%)		(7.0%)	
Wholesale and Other	7,227		13,951[1]		20,132[1]		23,330[1]
% CH		(7.6%)		(7.6%)		(7.6%)	
Total Sales	44,958		81,721		112,980		128,669
% CH		(6.9%)		(6.7%)		(6.7%)	
Company Use	135		238[2]		330[2]		377[2]
SEPA	264		277		277		277
Losses	3,402		6,251[3]		8,648[3]		9,846[3]
Total Energy	48,759		88,643		122,436		139,397
% CH		(6.9%)		(6.7%)		(6.7%)	
Peak Demand	8,601		15,385		21,209		24,127
% CH		(6.7%)		(6.6%)		(6.7%)	

[1] 1976 company forecast

[2] Total sales x .0029

[3] (Total sales + company use + SEPA) x .076

TABLE 7. Comparisons of Growth Rates of Electricity Prices and Inflation Measures

	1977 Estimate	Annual Growth	1985 Estimate	Annual Growth	1990 Estimate
Duke Electricity Price	28.0 Mills/KWH	6.3%	45.7 Mills/KWH	4.3%	56.5 Mills/KWH
CP&L Electricity Price	29.8 Mills/KWH	6.7%	50.1 Mills/KWH	4.2%	61.6 Mills/KWH
Consumer Price Index	181.7	5.3%	275.5	4.4%	341.6
Wholesale Price Index	194.9	5.7%	303.2	3.9%	367.5

TABLE 8. Carolina Power & Light Company's Energy Forecast

Year	MWH
1978	28,586,688
1979	30,301,864
1980	32,209,533
1981	34,208,255
1982	36,329,294
1983	38,470,979
1984	40,779,364
1985	43,064,739
1986	45,475,140
1987	47,884,926
1988	50,376,243
1989	52,945,431
1990	55,751,539
1991	58,594,868
1992	61,524,611
1993	64,539,317
1994	67,637,204
1995	70,816,153
1996	74,286,144
1997	77,777,593

TABLE 9. Duke Power Company's Energy Forecast

Year	Regular Sales GWH	Territorial Energy GWH
1978	48,968	52,915
1979	51,798	55,916
1980	54,830	59,136
1981	58,750	63,306
1982	61,881	66,625
1983	65,157	70,069
1984	68,473	73,597
1985	71,962	77,287
1986	75,599	81,128
1987	79,422	85,163
1988	83,430	89,385
1989	87,607	93,793
1990	92,004	98,425

TABLE 10. Virginia Electric & Power Company's Energy Forecast

Year	Annual Output (MWH x 10^3)	Increase %
1977	38,578*	-
1978	41,500	7.5
1979	44,800	8.0
1980	48,100	7.4
1981	51,400	6.9
1982	54,700	6.4
1983	58,100	6.2
1984	61,650	6.1
1985	63,350	6.0
1986	69,200	5.9
1987	73,200	5.8

* Actual

TABLE 11. Public Staff's Noneconometric Energy Estimates for the Residential Sector (1000 MWH)

Year	Historical Sales: Linear Trend[1]	Historical Sales: Exponential Trend[1]	Historical Average Use: Linear Trend[2]	Historical Average Use: Exponential Trend[2]	Trended Avg. Use: Linear Trend[3]	Trended Avg. Use: Exponential Trend[3]	Saturation Trend[4]	Avg. of All Estimates	Avg. of Most Likely[5]
				Carolina Power and Light Company					
1977	6980	7152	7073	6991	6980	7085	8594	7265	7549
1982	8766	11623	9708	10103	8766	10793	10770	10076	9748
1987	10522	18888	12501	14411	10522	16264	13137	13749	12503
1992	12338	30696	15640	20341	12338	24256	15538	19735	14505
1995	13410	41078	17696	24907	13410	30697	16832	22575	15977
				Duke Power Company					
1977	12250	12243	12648	12271	12250	12272	13936	12553	12945
1982	15354	10058	16838	17550	15354	17551	17408	16873	16533
1987	18458	26535	21615	24768	18458	24768	20893	22228	20322
1990	21562	39286	26977	32990	21562	34582	24551	28787	24363
1995	23425	49604	30475	40132	23425	42069	26727	33694	26876

Notes:

[1] Trend of historical residential consumption for the period 1965-1976.

[2] Trend of historical KWH/customer times linear trend of customers.

[3] Trend of sales divided by trend of customers multiplied by linear trend of customers.

[4] Modified linear trend (no value above 100.0) for each appliance multiplied by linear trend of residential customers multiplied by estimated annual consumption per customer per appliance, totaled for each year.

[5] Average of sales linear trend, average use linear trend and saturation estimate.

TABLE 12. Public Staff's Noneconometric Energy Estimates for Commercial Sector (1000 MWH)

Year	Historical Sales Linear[1]	Historical Sales Exponential[1]	Average Use Per Customer Linear[2]	Average Use Per Customer Exponential[2]	Average of All Estimates	Average of Most Likely Estimates[3]
			Carolina Power and Light Company			
1977	4311	4326	4383	4361	4345	4347
1982	5456	6270	5825	6128	5920	5641
1987	6601	9088	7470	8484	7914	7036
1992	7746	13172	9318	11609	10461	8532
1995	8433	16458	10525	13947	12341	9479
			Duke Power Company			
1977	8574	8598	8664	8685	8630	8619
1982	10808	12430	11251	11562	11513	11030
1987	13042	17969	14068	14870	15077	13555
1992	15276	25977	17118	18663	19259	16197
1995	16616	32407	19060	21196	22320	17838

Notes:

[1] Based on historical data for the period 1969-1976.

[2] Historical trend (1969-1976) of average use per customer multiplied linear trend of commercial customers.

[3] Average of historical linear trend and average use linear trend.

TABLE 13. Carolina Power & Light Company's
Load Forecast

Year	MW
1978	5829
1979	6205
1980	6614
1981	7034
1982	7480
1983	7929
1984	8427
1985	8914
1986	9424
1987	9933
1988	10463
1989	10983
1990	11549
1991	12122
1992	12732
1993	13337
1994	13959
1995	14593
1996	15286
1997	15981

TABLE 14. Duke Power Company's Summer Peak Load Forecast

Year	Peak MW	Growth MW	Growth %	Load Factors %
1978	9,522	396	4.34	63.4 %
1979	10,036	514	5.40	63.6
1980	10,601	565	5.63	63.6
1981	11,335	734	6.92	63.8
1982	11,907	572	5.05	63.9
1983	12,521	614	5.16	63.9
1984	13,170	649	5.18	63.8
1985	13,857	687	5.22	63.7
1986	14,583	726	5.24	63.5
1987	15,353	770	5.28	63,3
1988	16,175	822	5.35	63.1
1989	17,028	853	5.27	62.9
1990	17,941	913	5.36	62.6

Peak loads through 1980 were reduced slightly from "trend" to match better with the conservative energy forecast.

TABLE 15. Duke Power Company's Winter Peak Load Forecast

Year	Peak MW	Growth MW	Growth %
1977-78	9,261	441	5.00
1978-79	9,792	531	5.73
1979-80	10,376	584	5.96
1980-81	11,132	756	7.29
1981-82	11,730	598	5.37
1982-83	12,352	622	5.30
1983-84	12,996	644	5.21
1984-85	13,664	668	5.14
1985-86	14,368	704	5.15
1986-87	15,089	721	5.02
1987-88	15,838	749	4.96
1988-89	16,612	774	4.89
1989-90	17,413	801	4.82

Peak loads through '79-80 winter were reduced slightly from "trend" to match better with the conservative energy forecast.

TABLE 16. Public Staff's Capacity Addition Schedule (MW)

YEAR		CP&L		DUKE		VEPCO	
1978	S	-		-		North Anna 1	(898)
	W	-		-		-	
1979	S	Uprate	(105)	-		North Anna + Uprate	(934)
	W	-		-		-	
1980	S	Roxboro 4	(720)	McGuire 1	(1180)	Peaking + Uprate	(286)
	W	-		-		-	
1981	S	Peaking + Uprates	(212)	McGuire 2	(1180)	North Anna 3	(907)
	W	-		-		-	
1982	S	Mayo 1	(720)	-		Uprate + P.S.	(731)
	W	-		Catawba 1	(1153)	-	
1983	S	Harris 1	(900)	-		North Anna 4	(907)
	W	-		Catawba 2	(1153)	-	
1984	S	Mayo 2	(720)	-		Uprate + P.S.	(731)
	W	-		Cherokee	(1280)	-	
1985	S	Peaking	(150)	-		Surry 3	(900)
	W	Peaking	(150)	Perkins	(1280)	-	
1986	S	Harris 2	(900)	-		P.S.	(700)
	W	-		Cherokee	(1280)	-	
1987	S	Undesignated	(1150)	-		Surry 4	(900)
	W	-		Perkins	(1280)	-	
1988	S	-		Peaking	(250)	Base	1100
	W	Harris 3	(900)	Cherokee	(1280)	-	
1989	S	-		-		Base	1100
	W	Undesignated	(1150)	Perkins	(1280)	-	
1990	S	-		Peaking	(250)	Base	1100
	W	-		Base	(1280)	-	
1991	S	Harris 4	(900)	Peaking	(250)	Base	1100
	W	Peaking	250	Base	(1280)	-	
1992	S	Base	(1150)	Peaking - Cycling	(500)	Base	1100
	W	-		Base	(1280)	-	

Notes

( ) Parentheses indicates MW addition

P.S. Pumped Storage

Update - Increase MW rating of existing units

TABLE 17A. Reserve Margins Based Upon the Public Staff Addition Schedule (%)

Year	CP&L Summer	CP&L Winter	DUKE Summer	DUKE Winter	VEPCO Summer	VEPCO Winter
1978	22.7	22.4	25.5	22.5	14.2	25.3
1979	16.7	16.3	18.5	14.7	18.5	29.6
1980	20.0	19.1	21.6	17.8	15.0	25.8
1981	15.5	14.5	23.9	20.0	17.8	24.5
1982	17.6	16.2	16.0	21.2	14.8	25.1
1983	21.2	19.4	16.7	21.4	16.5	24.9
1984	21.8	19.7	15.8	20.8	14.7	24.7
1985	15.8	15.3	15.1	19.6	15.7	25.6
1986	19.3	16.9	15.2	19.1	14.6	24.4
1987	23.0	20.2	15.3	18.8	14.8	24.4
1988	15.6	20.6	16.3	19.4	15.9	25.6
1989	16.1	22.4	15.5	18.2	16.6	26.2
1990	18.1	15.0	15.5	17.8	16.9	26.4
1991	17.6	16.1	15.1	17.0	16.8	26.2
1992	20.2	16.7	15.3	16.9	16.3	25.6

TABLE 17B. Loss of Load Probabilities Expected From Public Staff Additions (days per season)

Year	CP&L Summer	CP&L Winter	DUKE Summer	DUKE Winter	VEPCO Summer	VEPCO Winter
1978	3.3	5.5	2.6	3.7	9.5	4.6
1979	6.0	9.8	6.1	8.2	6.8	3.7
1980	4.6	7.9	4.5	6.2	9.5	4.6
1981	7.2	12.1	3.6	5.0	7.5	5.9
1982	6.0	10.7	8.1	4.4	9.8	4.9
1983	4.3	7.9	7.6	4.3	8.3	5.1
1984	4.1	7.7	8.4	4.7	9.1	4.6
1985	7.1	11.9	9.0	5.3	8.3	4.1
1986	5.1	9.9	8.8	5.4	8.7	4.2
1987	3.5	7.2	8.7	5.6	9.1	4.1
1988	7.1	6.7	7.8	5.1	8.2	3.6
1989	6.6	5.4	8.4	5.8	7.7	3.3
1990	5.3	11.0	8.3	5.8	7.5	3.1
1991	5.4	9.9	9.1	6.2	7.6	3.2
1992	4.1	9.1	8.7	6.1	8.0	3.3

TABLE 18. Public Staff Projections of Percent of Plant Operated as Base Load, Cycling and Peaking

Year	Base	Cycling	Peaking
Carolina Power and Light Company			
1978	48.6	27.4	24.0
1979	48.9	27.5	23.6
1980	53.4	25.1	21.5
1981	52.8	24.4	22.8
1982	49.1	30.0	20.9
1983	53.7	27.2	19.1
1984	50.1	32.1	17.8
1985	49.4	31.7	18.9
1986	52.6	28.9	18.5
1987	51.3	31.9	16.8
1988	51.3	31.9	16.8
1989	54.4	29.8	15.8
1990	53.1	32.3	14.6
1991	55.7	30.5	13.8
1992	54.0	31.9	14.1
Duke Power Company			
1978	49.7	32.2	18.1
1979	49.7	32.2	18.1
1980	49.4	34.1	16.5
1981	49.2	35.6	15.2
1982	49.2	35.6	15.2
1983	53.1	28.9	18.0
1984	50.3	34.1	15.6
1985	54.6	32.1	13.3
1986	51.9	36.1	12.0
1987	55.0	33.9	11.1
1988	56.9	31.5	11.6
1989	55.6	33.5	10.9
1990	57.4	31.4	11.2
1991	55.6	32.8	11.5
1992	53.5	33.8	12.7
Virginia Electric and Power Company			
1978	49.5	38.7	11.8
1979	54.0	35.3	10.7
1980	52.9	34.3	12.8
1981	50.9	37.3	11.8
1982	49.7	35.3	15.0
1983	53.2	32.9	13.9
1984	51.3	30.1	18.6
1985	48.8	33.8	17.4
1986	46.5	32.2	21.3
1987	49.5	30.4	20.0
1988	48.0	33.2	18.8
1989	51.1	31.2	17.7
1990	49.9	33.5	16.6
1991	52.6	31.7	15.7
1992	55.0	30.0	15.0

TABLE 19A. Carolina Power & Light Company's Capacity Addition Schedule

Unit	Capacity (MW)	Scheduled Operation
Roxboro #4	720	1980
Mayo #1	720	1982
Mayo #2	720	1985
Harris #1	900	1984
Harris #2	900	1986
Harris #3	900	1990
Harris #4	900	1988
PROPOSED GENERATING UNITS		
SR-1	1150	1989
SR-2	1150	1991

TABLE 19B. Carolina Power & Light Company's Projected Summer Peak Reserves

Year	% Reserve
1978	30.4
1979	22.5
1980	25.8
1981	17.8
1982	20.4
1983	13.6
1984	17.6
1985	19.2
1986	22.3
1987	16.1
1988	18.8
1989	23.6
1990	25.4
1991	28.9
1992	22.7

TABLE 20. Duke Power Company's Summary of Load, Capacity and Reserves (MW)

Year	Forecast Summer Peak	Scheduled Capacity Additions	Total Capacity	Scheduled Reserves	Scheduled Reserves-%
1978	9 522	None	12 446	2 924	30.7
1979	10 036	None	12 446	2 410	24.0
1980	10 601	McGuire 1 (1180)	13 626	3 025	28.5
1981	11 335	McGuire 2 (1180) SCE&G Contract Term (-21)	14 785	3 450	30.4
1982	11 907	Catawba 1 (1145)	15 930	4 023	33.8
1983	12 521	Catawba 2 (1145) Retirements (-69)	17 006	4 485	35.8
1984	13 170	Retirements (-228)	16 778	3 608	27.4
1985	13 857	Cherokee 1 (1280) Retirements (-261)	17 797	3 940	28.4
1986	14 583	Retirements (-93)	17 704	3 121	21.4
1987	15 353	Cherokee 2 (1280)	18 984	3 631	23.7
1988	16 175	Perkins 1 (1280)	20 264	4 089	25.3
1989	17 028	Cherokee 3 (1280)	21 544	4 516	26.5
1990	17 941	None	21 544	3 603	20.0

TABLE 21. Duke Power Company's Summary of Projected Load Management Goals

YEAR	SUMMER REDUCTION (MW)	WINTER REDUCTION (MW)	ENERGY REDUCTION (MKWH)
1977	183	196	469
1978	281	313	838
1979	392	416	1130
1980	511	532	1458
1981	635	666	1809
1982	759	808	2180
1983	884	960	2572
1984	1008	1128	2977
1985	1143	1295	3422
1986	1270	1486	3893
1987	1385	1684	4334
1988	1501	1896	4789
1989	1615	2124	5259
1990	1721	2364	5674

NOTE:

1. Summer and winter megawatt reductions are accumulative
2. Energy reductions are annual values