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**PENNSYLVANIA PUBLIC UTILITY COMMISSION v.
PHILADELPHIA ELECTRIC COMPANY
Docket No. R-850152**

**DIRECT TESTIMONY OF
WILLIAM C. HOCH, JR.**

DOCKETED
DEC 23 1985

**DESCRIPTION OF
1974-1981 ENERGY FORECASTS**

**DOCUMENT
FOLDER**

September 27, 1985

TESTIMONY OF WILLIAM C. HOCH, JR.

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4 Q. Please state your name and business address for the record.
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6
7 A. My name is William C. Hoch, Jr., 2301 Market Street, Philadelphia, Pennsylvania.
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10 Q. What is your present position?
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13 A. I am Manager, Marketing Department, a department within Commercial
14 Operations, of Philadelphia Electric Company (PECO or the Company).
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18 Q. Will you please state your employment history with PECO?
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21 A. I joined the Company in 1944 after a term in the Merchant Marine and have been
22 with the Company ever since, except for two years in the U. S. Army. I started as
23 an Applications Engineer. In 1953, I was transferred to the Industrial Sales
24 Department as an Industrial Sales Engineer. In 1962, I advanced from Senior Sales
25 Engineer to Supervisor, Governmental Sales. In 1965, I moved to Supervisor,
26 Lighting and Space Conditioning Section. In 1967, I advanced to Assistant Manager,
27 Marketing Services. In 1972, I was appointed Manager, Research and Forecasting.
28 In 1979, the Research and Forecasting Department and the Applications
29 Department were combined into the Technical Services Department and I was
30 appointed Manager. In 1983, the Technical Services Department was combined with
31 the Business Services Department to form the Marketing Department and I was
32 appointed Manager.
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46 Q. What is your educational background?
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49 A. I have a B.S. in Mechanical Engineering from Drexel University and am a
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1 Registered Professional Engineer in Pennsylvania. Among other courses, I have
2 completed the summer program known as The Executive Program (TEP) at the
3 Darden Graduate School of Business Administration, University of Virginia.
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8 Q. Would you briefly describe your experience in the field of utility forecasting?
9

10 A. Under the direction of Mr. William B. Morlok, Vice-President of Commercial
11 Operations, I have had administrative responsibility for preparing the Company's
12 energy forecasts since 1973. Also, I have served as Company liaison in our
13 participation in and joint-sponsorship of the regional model developed by Wharton
14 Econometric Forecasting Associates (WEFA).
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22 I have attended many Electric Power Research Institute (EPRI) conferences
23 and seminars on forecasting and participated actively in several meetings and
24 seminars. Eight years ago, I initiated a Customers Research Group made up of
25 forecasting personnel from member companies of the Pennsylvania-New Jersey-
26 Maryland (PJM) Interconnection group which meets several times a year for an
27 exchange of information. I regularly review material of the Electric Utility Market
28 Research Council (EUMRC), of which our Market Research Supervisor is an elected
29 member and past-President.
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39 I am an active member (past-Secretary) of the Citizens Advisory Committee
40 of the Delaware Valley Regional Planning Commission (DVRPC), a member of the
41 Board of Governors of the Electrical Association of Philadelphia, a past-President
42 of the Philadelphia Chapter of Construction Products Manufacturers Council
43 (CPMC), and a member of the International Association of Energy Economists,
44 among other affiliations.
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1 Q. Have you previously testified before the Pennsylvania PUC on behalf of
2 Philadelphia Electric Company?
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6 A. Yes. I have testified concerning PECO's energy forecast in the Company's 1977
7 rate case (RID 438), 1979 rate case (Docket No. R-79060865), 1980 rate case
8 (Docket No. R-80061225), and in the Limerick Nuclear Generating Station
9 Investigations (Docket Nos. I-80100341 and I-840381).
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15 Q. What is the purpose of your testimony?
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18 A. I will describe the Company energy forecasts which were issued during the 1970s
19 and early 1980s.
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23 Q. Could you briefly provide an historical review of the forecasts of kilowatthour
24 sales?
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28 A. The forecasts can be divided into four basic periods to provide an overview of
29 changes to the forecasts over time: the high-growth period prior to the first Arab
30 oil embargo late in 1973; the post-embargo period from 1974 to 1978; the two or
31 three years following the second major oil shock in 1979; and the current period
32 from 1982 to the present which finds the forecasts on a plateau reflecting a
33 projected growth rate of about 1% per year, consistent with the experience of the
34 1974-84 low-growth decade overall.
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43 Q. What were the economic and regulatory conditions surrounding the forecast prior to
44 1974?
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1 A. That period was the exact opposite of the current period in terms of general
2 expectations and media and regulatory commission perceptions and pressures.
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6 In the 1960s growth in demand for electricity exceeded forecasts, leading to
7 a decline in the reserve margins of Pennsylvania's electric utilities. This rapid
8 growth quickly reduced reserve capacity of the companies from an adequate 22.5%
9 in 1962 to a low point of 0.2% in 1966, despite the addition of new capacity by the
10 companies during this period.
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16 In November of 1965, the widespread blackout in the northeastern portion of
17 the United States dramatized the potential consequences of insufficient reserve
18 capacity. Soon thereafter, the Pennsylvania PUC, other state commissions and the
19 Federal Power Commission began to pressure utilities to accelerate their plans for
20 increasing generating capacity. At a March 1966 meeting in Philadelphia, utilities
21 were warned by the commissions of Pennsylvania, Delaware, Washington, D.C.,
22 Maryland and New Jersey that "[a] desperate situation is developing that within the
23 near future could result in possible blackouts and customer load curtailment."
24 After another power interruption in June 1967, member companies of the PJM
25 Interconnection, along with the same state utility commissions, met again in
26 Philadelphia. The electric companies were told that "excuses [for inadequate
27 reserve capacity] are unacceptable." A headline in the Philadelphia Bulletin in
28 December 1969, read: "Philadelphia area faces 'critical' shortage of electric power,
29 head of PUC says."
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46 In 1970, the Chairman of the Pennsylvania PUC suggested that a 10% growth
47 rate should be used by utilities in forecasting load growth. Although reserve
48 capacity of electric utilities had grown to a more encouraging 14.7% level by 1971,
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1 the PUC nevertheless expressed concern in a March 13, 1972 Order to all electric
2 utilities. The Order questioned "whether current plans are satisfactory to meet
3 projected future needs for electric power." In the late 1960s, as part of the effort
4 to hike reserve capacity to 20%, Pennsylvania's electric companies were urged to
5 install 2000 MW of combustion turbines. In I.D. No. 138 (March 13, 1972), the
6 Commission ordered that each company file with the Commission each May a ten-
7 year forecast and a schedule of generating plant additions necessary for each utility
8 to meet forecasted load requirements during the 10-year period. In December
9 1972, the Chairman of the PUC wrote to all members of the General Assembly
10 stating:
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22 "Unless prompt and intelligent steps are taken to avert it,
23 Pennsylvanians will shortly encounter a very serious energy
24 crisis. People in their homes will suffer from inadequate heat,
25 light and other vital necessities. Employers will be unable to
26 energize their equipment, and unemployment will be
27 widespread. Some areas have already been affected."
28

29
30 Similarly, many newspaper and magazine articles carried dire warnings of looming
31 power shortages. It was in this heated environment that most utility forecasters of
32 that time were inclined to risk erring on the high or conservative side, having
33 been castigated for low forecasts for so long.
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39 The Company forecast prepared in 1971 -- the first ten year forecast, prior
40 to which projections were only for five years -- projected an annual growth rate
41 from 1971-81 of 7.6%. In June 1972, this was reduced to 7.3% and in May 1973,
42 still prior to the oil embargo, this was again reduced to 6.7% for 1973-83. In April
43 1974, the forecast for the same period (1973-83) was dropped to 5.7%. While the
44 latter forecast was issued five months after the embargo struck, preparation of
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1 forecasts usually began about six months before issuance and the numbers were set
2 about two months before the book was ready for distribution.
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6 In the documents containing the 1971-74 forecasts, the growth rate
7 reductions were largely attributed to an early recognition of conservation inspired
8 by rising costs, an awareness of energy shortages, and our "use energy wisely"
9 programs.
10

11 Q. How were the forecasts changed in the mid-1970s?
12

13 A. By 1975, it had become evident that the severe recession induced by the oil
14 embargo as well as growing awareness of the need to conserve energy would have a
15 lasting impact. In every year going back to 1971, the projected 10-year growth rate
16 was reduced. The forecasted annual rates of growth are shown below and can also
17 be traced over a set of varying periods in Appendix A, Table I, which shows PECO
18 forecast growth rates compared to 45 forecasts made by other forecasters between
19 1975 and 1985. Note that the forecasts listed for comparison purposes are
20 concentrated in the 1970s. Tables 2 and 3 in Appendix A show more sets of
21 forecasts made in the 1980s confirming that our forecasts were consistently
22 conservative.
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	<u>Date Issued</u>	<u>Years</u>	<u>Annual Growth in kWh-%</u>	<u>20 Year* Forecast</u>
1				
2				
3				
4	4/71	1971-81	7.6	
5				
6	6/72	1972-82	7.3	
7				
8	5/73	1973-83	6.7	
9				
10	4/74	1974-84	6.4	
11				
12	4/75	1975-85	5.4	
13				
14	12/76	1976-86	4.9	3.9
15				
16	12/77	1977-87	3.5	2.9
17				
18	12/78	1978-88	2.9	2.5
19				
20	2/80	1979-89	2.6	2.3
21				
22	2/81	1980-90	2.2	2.1
23				
24	7/82	1981-91	1.5	1.5
25				
26	6/83	1982-92	1.2	1.1
27				
28	5/84	1983-93	0.6	0.8
29				
30	11/84	1984-94	0.8	1.1
31				
32				

*20 year forecasts first prepared in 1976.

The Table shows that due to greater effects expected from conservation and the deteriorating economy of the City of Philadelphia, the growth rate was halved from the 1975-76 period to 1980 after the second oil price shock. After 1980-81, in the current period, the forecast has centered around a 1% growth rate in line with recent experience, although it appears to be conservative now in view of our most recent experience and growing expectations for the local economy relative to the rest of the country, including the Sunbelt and Southwest.

1 Q. How would you describe the series of changes in the forecasts?
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4 A. By estimating the effects of the current projections of GNP, population, housing,
5
6 appliance sales, etc., each forecast was separately calculated. As more
7
8 conservative economic forecasts were issued and more data on equipment sales,
9
10 population and other inputs were collected, the series of forecasts provided an
11
12 orderly reduction enabling the Company to adjust its planned capacity accordingly.
13
14

15 Each forecast made since 1973 was put out in book form so that anyone -
16
17 Company personnel, critics or government representatives alike -- could fully
18
19 understand its assumptions and methodology.
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22 Q. Did you compare your forecasts with others, and did this ever give you reason to
23
24 suspect your forecasts were too high or low by comparison?
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27 A. As I pointed out earlier, Appendix A, Table 1 gives a comparison with 45 forecasts,
28
29 mostly made by governmental agencies. It also shows our relative position in PJM
30
31 and with all Pennsylvania utilities. In general, the Table shows that our forecasts
32
33 were low or conservative by comparison. Our growth as forecast is about 80% of
34
35 the forecasted national growth until about 1977, after which, reflecting the poor
36
37 local economy, it is 60%. Currently, most forecasters are projecting long-term
38
39 national growth at 2.5%, while we expect about 1% locally (See Appendix A, Tables
40
41 2 and 3).
42

43
44 Because our forecasts were continuously reduced as new data became
45
46 available and because we constantly checked our forecasts against others, we
47
48 continued to believe ours were conservative.
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1 Q. What are the principal factors which determine the level of forecast growth in
2 kilowatthour sales?
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6 A. The forecast depends on the expected outlook for the national and regional
7 economy, which determines growth in manufacturing sales. For these projections,
8 we rely on a broad group of government and academic economists, accumulating as
9 many economic forecasts as we can.
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15 Population is also important as it relates to housing, housing starts and
16 employment. We again gather as much data as we can from government sources,
17 using the U. S. Bureau of Census, Delaware Valley Regional Planning Commission
18 and State-generated data.
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24 Price of electricity and cost and availability of competitive fuels enters the
25 forecast indirectly, particularly in estimates for electric space heating. Price data
26 is also obtained from a variety of sources, including gas and oil industry
27 associations and Department of Energy-sponsored publications.
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33 Many other factors impact the forecast, including industry material on
34 appliance improvements.
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38 Q. Please describe how your forecasts were prepared during the period 1974 to 1981?
39

40
41 As I stated above, each forecast book since the early 1970s contained detailed
42 descriptions of factors affecting the results. These details became more explicit
43 over time as the forecasts were put to greater use as reference sources in
44 presentations to various audiences, were referenced in rate hearings and were used
45 as customer information resources by other Company departments. Descriptions of
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1 our forecast methodology were provided in my testimony in both Limerick
2 Investigations. This methodology was also described in my direct testimony in the
3 1979 rate proceeding, which is attached as Appendix B. Although it is not one of
4 our latest descriptions -- these can be found in the Limerick Investigation
5 testimony and in our recent forecast books -- it is resubmitted here to outline our
6 methodology applicable to the 1978-88 forecast.
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13 Q. What type of information do you provide to the System Planning Division which is
14 used by them to forecast peak loads?
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18 A. In addition to the material in the annual forecast book, we provide an estimate of
19 kWh sales by class of service for the months of January, April and October for each
20 year of the forecast. Sales for those three months are developed based on historic
21 data and the long-term forecast of future kWh sales. Also provided, for the same
22 months, are estimated demands for the eight customers supplied at 66 kV or
23 higher. This data is based on historic energy use plus information obtained from the
24 customers themselves. Also furnished to System Planning are connected air
25 conditioning loads for the Residential, Small Commercial and Industrial and Large
26 Commercial and Industrial classes for future years. Future air conditioning loads
27 are based on housing characteristics and estimated square footage for the Industrial
28 and Commercial classes, the expected level of air conditioning saturation in each,
29 and the efficiency and size of present and future air conditioning systems.
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43 Q. In your 1978 forecast, you indicated that you compared your forecast with one
44 derived from an econometric model. Why did you engage WEFA to prepare an
45 econometric forecast?
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1 A. As our forecasting method is mainly an end-use and technological type of analysis,
2
3 we decided that an econometric model would be valuable as a check.
4
5

6 In 1977, we analyzed proposals from several econometric consultants.
7
8 Having met several times with Dr. Lawrence Klein and others of his firm, we
9
10 selected WEFA because of Dr. Klein's reputation as the "father of econometrics"
11
12 (for which he won a Nobel prize in economics), because WEFA was part of the
13
14 University of Pennsylvania which offered us close proximity in developing the
15
16 model and data base, and because PECO and the City of Philadelphia had been
17
18 participating with WEFA in developing a model of regional economics which gave
19
20 WEFA a head start on developing a regional energy model. In 1978, the City had
21
22 contracted to pay WEFA \$40,000 for specific forecasts for the City.
23
24

25 Q. Did WEFA's econometric model support your forecasts?
26
27

28 A. Yes. Their results generally projected a slightly higher growth rate than ours for
29
30 the same time spans, so they increased our confidence in our own methodology.
31
32 WEFA results are also included in Appendix A, Table I.
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35 Q. Were any other steps taken or did anything else occur to lend support to your
36
37 forecast methodology?
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39

40 A. Yes. We kept in frequent touch with PJM forecasting procedures through meetings
41
42 of the PJM Conservation and Load Management Committee and Customer Research
43
44 Group. I initiated the Customer Research Group, composed of market research and
45
46 forecasting personnel, in 1977. In addition, our Company has been represented on
47
48 the Electric Utility Market Research Council (EUMRC) since 1970. The Council
49
50 holds two national meetings a year to exchange market research and customer

1 information. The supervisor of our Market Research Section, which has a primary
2 responsibility of preparing energy forecasts, was Chairman of the EUMRC in 1980-
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5 81.
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8 On February 28, 1979, the New Jersey Board of Public Utilities in Docket
9
10 No. 762-194 found that the forecasting methodologies of New Jersey utilities were
11 appropriate: "Based on the aforementioned forecasting testimony, cross-
12 examination and an extensive record, the parties to the proceeding have agreed no
13 controversy currently exists regarding the electric utilities current forecasts and
14 forecast methodologies." The New Jersey utilities, of course, are part of PJM and
15 we were satisfied that our methodologies were comparable.
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23 In 1977-78, the Maryland PSC, in Case No. 6807, investigated forecasting
24 methodologies. Our subsidiary, Conowingo Power Company, operates in Maryland.
25 The State of Maryland recommended no standard forecasting methodology as a
26 result of these hearings, although econometric modeling was recommended. The
27 Maryland Peoples Counsel recommended that "at least two alternate forecasting
28 methodologies" be used. At this time we were in preparation of the WEFA model
29 which, as stated previously, provided verification for our end-use and economics
30 methods.
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40 From time to time, the Pennsylvania PUC showed interest in forecasting and
41 forecasts but never specified any methodologies. In 1979, the Bureau of
42 Conservation, Economics and Energy Planning (CEEP) looked into the costs and
43 resources employed for forecasting. A copy of the PECO reply is attached as
44 Appendix C. This briefly describes the procedures and personnel engaged in
45 preparing forecasts.
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1 Q. Has the Pennsylvania PUC ever expressed an opinion of the Company's load
2 forecasting during this period?
3
4

5 A. Yes. In RID 438 (Order entered February 5, 1979), the Commission, while pointing
6 out the historical errors in the Company's forecast, found that such errors had been
7 "the general situation in the electric industry throughout the nation since the oil
8 embargo." The Commission refused to find any imprudency in the Company's load
9 forecasting.
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15 Q. What were the overall results of the application of your forecast methodology?
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18 A. As previously stated our forecasts prior to 1970 were too low, resulting in pressure
19 from the Commission to increase forecasts and move as quickly as possible to
20 improve reserves. Through the 1960s our load grew at an annual levelized rate of
21 5.8%. This was true in both the 1962-67 and 1967-73 time spans.
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29 The forecasts had been raised in the early 1970s because of higher expected
30 air conditioning and electric space heating growth. The forecast issued in May 1973
31 projected a ten-year growth rate of 6.7%.
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35 As noted earlier, following the oil embargo shock in October 1973 each
36 forecast was gradually lowered. By 1976, the growth rate compared with 1973 was
37 reduced by 27% and by 1977 was reduced by 48%, almost half, as the after-effects
38 of the embargo and ensuing severe recession were better understood. Each forecast
39 explained the differences from the earlier forecast. The effects of the weak local
40 and state economies, with high labor costs and taxes and older industrial plant
41 stock, were also more evident. Erroneous forecasts by economists and government
42 agencies greatly impacted our forecasts of energy sales.
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1 In July 1975, a 25-year forecast to 2000 was attempted. This indicated a
2 probable long-term growth of 5.0%, showing that growth was expected to taper
3 off. Further indicating the weakening local economy, our projection showed sales
4 in 2000 at 3.33 times 1975 whereas the 1976 EPRI forecast showed national sales at
5 3.5 times. From 1977 to 1981, the 20-year growth rate was dropped from 2.9% to
6 1.5%, almost a 50% reduction, following the severe recession and oil price shock in
7 1979. In summary, our forecasts were gradually lowered each year in a fairly
8 uniform way as less optimistic forecasts were issued concerning the population and
9 the economy.
10

11 Q. How did and do these economic predictions, such as Gross National Product (GNP),
12 influence the PECO forecasts?
13

14 A. While GNP forecast figures were not directly used in PECO's forecasts, various
15 components closely tied to GNP such as manhours, the Industrial Production Index,
16 and non-manufacturing employment were used.
17

18 Table VI of the 1973-83 forecast, which is reproduced as Table 1 of Appendix
19 D, shows GNP forecasts made by various economics consultants prior to the oil
20 embargo. These indicate annual growth rates from 1972 to 1980 of 4.1% to 4.8%
21 and from 1972 to 1985 of 3.7% to 4.3%.
22

23 Actual growth from 1972 to 1980 was 2.8%, 32% below the lowest forecast,
24 and from 1972 to 1985 (preliminary) actual GNP growth was 2.7%, 32% below the
25 average forecast. The average growth for the ten-year post-embargo period --
26 1973 to 1983 -- was only 2.0%, reflecting a decade which saw three recessions and
27 two oil-price shocks with high inflation. Previously, the worst consecutive ten
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1 years of growth in the post-war period was 2.6% from 1965-1975. Because the
2 Department of Commerce revised its system of calculating GNP in 1980, GNP
3 values in the tables are not applicable, only growth rates.
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8 Economists had coped with the lasting impact of the oil embargo and
9 associated recession by 1978 and lowered economic forecasts each year. Page 238
10 of the 1978-88 forecast, which is shown as Appendix D, Table 2, shows GNP growth
11 projections for both 1977 and 1978. Again, GNP values were revised by the
12 government so only growth rates are comparable.
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19 Projected growth for 1976 to 1985 in the 1977 forecast ranged from 3.7% to
20 3.9%, while actual growth was 2.9%. For 1977 to 1985, in the 1978 forecast,
21 economists' projections ranged from 3.4% to 3.9%, and actual growth was 2.6%.
22 Economists' forecasts have been lowered over time. In 1978, however, as just
23 pointed out, they were predicting a growth rate 40% greater than was realized.
24 The forecasts of relatively high real GNP growth in the 1976-78 period followed by
25 a trend to more pessimistic rates in the following years are analogous to the
26 changes in projected kWh growth.
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36 Our forecast for 1978-98 projected a growth rate of 2.5%, substantially
37 below the 3.3% GNP growth projected from 1977-95 by Wharton EFA and McGraw-
38 Hill Economics in 1977 (Appendix D, Table 2) and that of the EEI Task Group 20 (a
39 group of twenty economists) of 3.5%. While electric energy growth grew at about
40 twice the GNP rate and energy growth grew at about the GNP rate until 1973,
41 forecasters generally felt in the late 1970s that energy and GNP growth were
42 becoming "uncoupled". But most forecasters still expected kWh growth to parallel
43 growth in GNP.
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1 Q. You previously mentioned that population is an important factor in the forecast
2 since it has a direct relationship to the number of living units on line. How have
3 the results of the component-cohort method you have been using for making
4 projections of area population compared with projections made by other groups?
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9 A. Our in-house model for population was developed and first used in our 1976 Budget
10 forecast. Prior to that, we had relied on projections made by the Delaware Valley
11 Regional Planning Commission (DVRPC). In 1976, we based our projections on the
12 DVRPC's slow growth scenario. It was becoming more apparent about this time
13 that the DVRPC's projections were affected by political considerations, as noted in
14 a contemporaneous Inquirer article from which I quote:
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21 "Planners and politicians on the Del-Commission were....forced
22 to choose between a 'no growth' population policy and federal
23 dollars.
24
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26 They chose the policy that would mean more government
27 spending in the nine-county Philadelphia region by predicting a
28 13 percent population growth on both sides of the Delaware
29 River by the year 2000."
30
31

32 As a result, in 1977, PECO's population projection began to diverge from the
33 DVRPC's. There were other population projections being made in the 1975-1978
34 period for the area. (See Appendix D, Table 3) As can be seen, PECO's 1976
35 projection closely aligned with that of the DVRPC. This was still well below that
36 made by the Pennsylvania Department of Education. PECO's 1978 projection for
37 1980 was well below the 1980 figures for the others of that vintage. In addition,
38 PECO's population forecasts for 1985 made in 1976 and 1978 were, in all cases,
39 lower than those made by others in the same years. By the year 2000, only one
40 projection is below that of PECO. If PECO had used any of the other sources for
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1 its population projections, the forecast would have been between 0.3 and 2.1 billion
2 kWh above the 1978 forecast figure for 1980, based on 1980 average per capita
3 usage figures.
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8 In 1980, after more data became available showing a continuation of net out-
9 migrations and lower birth rates, PECO lowered its projections. These changes
10 assumed a higher level of continued net out-migrations and use of the Bureau of
11 Census low fertility series. This last projection, in our opinion, remains valid
12 today. The November 1984 projection of population is essentially the same as the
13 1980 Forecast except that it was aligned with the 1980 Census of Population
14 figures.
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23 Q. Why did the population forecasts miss the mark?
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26 A. You have to look at the sources of data available to everyone at the time the
27 projections were made. Basically, the major source is the Census of Population
28 which is conducted only once every ten years. The Current Population Reports
29 from the Bureau of the Census is the main source for the intervening years. These
30 reports indicated a reduction in the trend of declining population in the 1974-1977
31 period. The figures show the following changes in area population: 1974-1975,
32 -24,000; 1975-1976, -15,000; 1976-1977, -13,000. Everyone believed that the
33 population loss was ebbing, as reflected in this quote from an article in U.S. News &
34 World Report during this period:
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45 "Now there are signs that some big metro areas may be pulling
46 out of their slumps. Los Angeles - Long Beach, St. Louis and
47 Philadelphia had slight population gains in 1976. But losses
48 continued in New York, Pittsburgh, Detroit, Newark and
49 Cleveland."
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1 Q. Since the oil embargo of 1973 there have been three severe recessions which had a
2 very negative impact on the use of electricity. Were these recessions foreseen by
3 most economists?
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7
8 A. No. Because the nation and the world had never experienced an oil embargo, the
9 full economic effects of the embargo in late 1973 and early 1974 could not have
10 been predicted. The recession that followed was severe and lengthy. The two
11 succeeding recessions that occurred in the three-year period from 1980 to 1982 also
12 produced experiences that had never before occurred. The recovery period between
13 the two recessions, July 1980 to July 1981, was only twelve-months long and was
14 the shortest recovery since 1920. The average post-war peacetime expansion has
15 lasted thirty-four months. Further, the economic contraction from July 1981 to
16 November 1982 was sixteen months in duration, compared to the eleven-month
17 average for post-war peacetime contractions. Moreover, prior to 1974 the non-
18 recession unemployment rate remained at less than 6%. Since 1974, the
19 unemployment rate has almost always been over 6%. In the present recovery, the
20 unemployment rate has fallen or to only 7.0%. In each of the past four recessions,
21 the unemployment rate was higher in recessions and decreased less in recoveries.
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37 Q. What were the unemployment rates and the manufacturing capacity utilization
38 rates during this period?
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42 A. The unemployment rates are tabulated below:
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	<u>Recession</u>	<u>Peak</u>	<u>Trough</u>
	1969-70	3.4%	6.1%
	1973-75	4.6%	9.0%
	1980	5.6%	7.8%
	1981-82	7.2%	10.7%
	Last Actual 1985 (Aug.)	7.0%	-

The manufacturing capacity utilization rate has indicated the same type of pattern. The peaks are becoming lower and the troughs deeper, as indicated below:

MFG. UTILIZATION RATE

	<u>Recession</u>	<u>Peak</u>	<u>Trough</u>
	1969-70	91.6%	75.9%
	1973-75	87.9%	69.0%
	1980	87.5%	75.5%
	1981-82	81.0%	68.8%
	Last Actual 1985 (Aug.)	80.5%	-

Considering the abnormality of the above described events, they were and could not have been reasonably anticipated.

Q. Is there any other unforeseen economic development which has had a depressing effect on electric use?

A. Yes. Until 1970, the United States had never experienced a negative merchandise trade balance. Foreign trade tended to raise the level of economic activity and kilowatt-hour sales. In the period since 1970, the United States has experienced a

1 positive trade balance in only 2 of 14 years. In the period since 1975, this balance
2 has become more negative until by 1984 approximately 1.4 million manufacturing
3 jobs had been lost in the United States and 28,000 in Philadelphia. Using a
4 multiplier of 2, about 2.8 million total jobs have been lost in the United States and
5 about 56,000 in Philadelphia. Most if not all of the loss in manufacturing jobs, in
6 recent years, can be accounted for by this "trade problem". Neither PECO nor any
7 other forecasters could have foreseen this problem at the time forecasts were
8 prepared in the mid-1970's and before.
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18 In a recent study of the import problem, the U.S. House Committee on
19 Energy and Commerce reached the following conclusions:
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- 22 1. Changes in the value of the dollar since 1980 have effectively raised
23 U.S. export prices by 70% and lowered import prices by 40%.
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- 26 2. The import shock impact is more pervasive than even the OPEC oil
27 price shocks of the 1970s.
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- 30 3. From early 1981 through the third quarter of 1984, two-thirds of the
31 growth in real final demand for durable goods was met by foreign
32 suppliers.
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- 35 4. The most severely affected sector is capital goods, for decades the
36 mainstay of U.S. trade. Between 1980 and 1984, the real U.S. trade
37 balance in capital goods plummeted from a record \$19.3 billion net
38 export balance to a \$3.5 billion deficit.
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- 41 5. Ninety-five percent of the net increase in demand for capital goods
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1 since the last business cycle peak has been met with imported capital
2 goods, with import penetration highest in "high-tech" capital goods.
3 U S. production of capital goods has barely increased, if at all.
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8 6. The balance-of-trade effects of this recent deterioration in U.S.
9 industrial trade already exceed almost half again the combined
10 impacts of the energy shocks of the 1970's.
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14 7. Since the overvalued dollar has played a key role, the deterioration in
15 the U.S. non-energy balance since 1980 has occurred across all broad
16 industrial categories.
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22 It was impossible for any forecaster or economist to have foreseen 10 years
23 ago the present import "shock problem" and its impact on manufacturing activity
24 throughout the United States and resulting reductions in energy use, including
25 electricity.
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31 Q. Can you illustrate any results of these unforeseen economic shocks?
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33 A. Results of the strong dollar/trade imbalance problem and economic downturns stand
34 out clearly in the performance of the largest ten customers, analyzed in 1978. The
35 two steel companies used 1,587 million kWh in 1978 and were expected to increase
36 usage modestly to 2.7% per year, about in line with the GNP. In fact, in 1979 usage
37 increased to 1,701 million kWh (up 7%), but their combined load dropped in 1980 and
38 continued to decrease to 962 million kWh in 1984.
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46 The three oil companies were impacted to a lesser degree but suffered from
47 a declining oil market and imports of refined product. Consumption by the local
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1 refineries dropped from 1,205 million kWh in 1978 to 1,087 in 1984, whereas the
2 forecast for 1984 was for 1,355, a 2.0% growth rate due to plans for modernization
3 at one of the refineries which did not materialize. Two of the largest ten
4 customers -- Linde Air Products and Firestone -- unexpectedly shut down
5 operations in our area after 1978. The loss in 1984 versus the forecast for 1984
6 made in 1978 amounted to 1.6 billion kWh.
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14 Q. Were there other areas of uncertainty which affected the forecasts in the mid-
15 1970s?
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19 A. One important factor was the cost and availability of competitive fuels -- oil and
20 gas -- which affects not only space heating but also process heating and possibly
21 prospects for cogeneration.
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26 In the mid-1970s, it was widely anticipated that the real price of oil and gas
27 would increase dramatically while supplies remained uncertain. In 1978, it was
28 projected that gas prices in real dollars in 1988 would be 1.3 times higher than 1978
29 levels, while electric costs in real terms would remain constant.
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35 PECO had a PUC-imposed moratorium on new gas connections from
36 February 1972 to May 1979, which indicates the severity of the expected gas
37 scarcity. The National Energy Act, which included PURPA and the Fuel Use Act
38 (FUA), adopted in November 1978, prohibited the use of oil and gas in new electric
39 plants or major fuel burning installations. In fact, in 1974 the Federal Energy
40 Administration (FEA) had recommended a ban on oil or gas heat in new housing.
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48 Q. What was the outlook for cogenerators?
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1 A. A potential cogenerator could apply for an exemption under the Act, but he had to
2 show that he needed to buy oil or gas in order to obtain the economic benefits of
3 cogeneration and to prove that less oil or gas would be burned originally as a result
4 of each project. In 1980, FERC issued regulations temporarily excluding diesel
5 cogeneration from being a qualifying facility.
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11 The restrictions on cogeneration have changed as gas and oil availability has
12 gone from scarce to plentiful. This further indicates how the outlook for
13 competitive fuel has changed from the mid-1970s to 1984. The national situation
14 has changed from one of trying to lower the use of imported oil and finite supplies
15 of natural gas by encouraging the use of coal and nuclear energy, to one of
16 permissiveness in oil and gas consumption.
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25 Q. Will you summarize the reasons why the 1978-98 forecast of a growth rate of 2.5%
26 per year has not materialized?
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30 A. Yes. Recapitulating, there was the extremely severe recession in 1981-82 following
31 the unexpected OPEC oil-price shock to the economy in 1979. This was largely
32 responsible for the large errors in economists' expectations for the GNP. The weak
33 local economy resulted in continued loss of jobs and population to the Sunbelt and
34 Southwest.
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41 The unusually strong dollar has resulted in a drastic trade imbalance, causing
42 a loss of our capital goods and steel markets to overseas producers. The unforeseen
43 low price and temporary "glut" of gas and oil have slowed the trend to
44 electrification. These conditions have caused the growth rate from 1976 to 1984 to
45 average only 0.8 percent per year, which matches our ten-year forecast.
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1 Q. Does this conclude your testimony?

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4 A. Yes, it does.

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FORECAST COMPARISONS

	When Issued	Period	Area	% Annual Growth	PECO Forecast Same Period
1. IEEE - Elec. Energy Forecast Committee	2/75	1973-85	U.S.	6.2	4.7
2. Electrical World	9/75	1975-85	U.S.	6.25	5.4
3. N.E.R.A.	11/75	1973-80	U.S.	5.25-6.5	4.6
4. U.S. Dept of Inter- ior, Bureau of Mines	12/75	1974-2000	U.S.	6.1	5.0
5. F.E.A. - Project Independence	2/76	1975-85	U.S.	5.7	5.2
6. A. D. Little	3/76	1975-85	U.S.	5.9	4.9
7. Edison Elec. Inst. (EEL)	3/76	1975-85	U.S.	6.4	4.9
8. Elec. Pow. Res. Inst. (EPRI)	3/76	1975-85	U.S.	6.3	4.9
9. PJM	4/76	1975-85	PJM	5.2	4.9
10. Nat'l Elec. Mfrs. Assn. (NEMA)	5/76	1975-84	U.S.	6.0	4.8
11. EPRI Journal	6/76	1975-2000	U.S.	5.7	4.1 (1976-96)
12. G.E. Company	6/76	1975-85	U.S.	6.1	4.9
13. FPC	8/76	1976-85	U.S.	6.15 (6.3 peak)	4.9
14. F.E.A./ERDA	3/77	1976-85	U.S.	5.5/6.2	4.9
15. EPRI-Task Group 20	6/77	1975-90	U.S.	5.6	3.3
16. PJM	6/77	1975-85	PJM	5.0	4.8
17. NERC	7/77	1976-86	U.S. MAAC	6.1 peak 5.0	3.4 3.4
18. Nat'l Energy Plan (Carter)	8/77	1975-85	U.S.	4.5	3.5
19. Wharton Econometric Forecasting Assocs. (WEFA)	1977	1977-89	U.S.	4.3	3.5
20. GEC "Energy Parks"	1977	1977-2000	PA	3.5	3.3
21. G.E. (Center for Energy Systems)	12/77	1977-81	U.S.	5.7	2.8
22. EPRI	12/77	1975-90	U.S.	6.0 peak	3.3
23. NEMA	3/78	1977-86	U.S.	5.6 peak	3.5
24. GE	3/78	1977-90	U.S.	5.0	3.5
25. PJM	6/78	1978-92	PJM	3.7	3.4
26. The Penna. Economy-1978 Mid-year Update Albert Smigel, Ed. Hilton J. Shapp, Gov.	6/78	1975-2000	PA	4.14	2.6

FORECAST COMPARISONS

	<u>When Issued</u>	<u>Period</u>	<u>Area</u>	<u>% Annual Growth</u>	<u>PECO Forecast Same Period</u>
27. DOE	7/78	1978-85	U.S.	4.8	2.8
28. NERC	8/78	1978-87	U.S. peak	5.2	3.4
29. Int'l Congress on Large HV Elec.Sys.	9/78	1976-85	U.S.	5.7	2.6
30. WEFA	10/78	1978-87	PECO	3.8	2.9
31. A.D. Little	11/78	1978-90	U.S.	4.1	2.8
32. Chern & Just -ORNL U of Cal for DOE (ORNL SLED MODEL)	12/78	1974-90	N.Y.	4.3	2.6
33. E.I.A. Annual Report to Congress	7/79	1977-85 1985-90 1990-95	U.S.	4.4 4.0 3.7	2.5 2.9 2.2
34. Electrical World	9/79	1978-88	U.S.	3.9	3.0
35. N.Y. Energy Office N.Y. Power Pool	7/79	1978-94 1978-94	N.Y. N.Y.	2.1 2.5	2.3 2.3
36. WEFA	10/79	1979-88	PECO	2.6	2.6
37. Compiled by SRC for G.E.C.	4/80	1978-90	PA	3.1	2.8
38. Cal. Utilities	11/80	1979-92	CAL	2.1	2.0
39. WEFA	4/81	1981-90	PECO	2.9	2.5
40. EPRI - Model Forecasts of Energy Consumption to 2000	10/81	1979-2000	U.S.	2.7	2.0
41. DOE	6/82	1981-91	U.S.	3.25	1.5
42. DOE - Office of Policy Planning & Analysis (Low Oil Price Scenario)	4/83	1981-2000	U.S.	2.6	0.9
43. PEA	3/84	1983-2000	PA	1.7	0.7
44. E.I.A. -DOE Annual Energy Outlook	1/85	1985-95	U.S.	3.2	0.8
45. Gas Research Inst.	7/85	1985-2000	U.S.	2.4	1.1

COMPARISON OF ELECTRICAL ENERGY GROWTH RATES (ANNUAL AVERAGE) PERCENT

SOURCE	1982-1990	1982-2000
	North American Electric Reliability Council (NERC), Electric Power Supply & Demand, 1984-1995, May 1984	2.8
Slegel, John and John Sillin, "The Coming Power Boom: An Assessment of Electric Load Growth In the 1980's," July 1984	4.5	4.5
Starr, Chauncy and Milton F. Searl, "U.S. Generating Capacity Requirements for Economic Growth, 1990- 2000," Public Utilities Fortnightly, April 29, 1982	3.7	3.7
Westinghouse, 1984 Overview, February 1984	3.6	3.6
Wharton Econometric Forecasting Associates, Long- Term Forecast, March 1984	2.3	2.4
U.S. Dept. of Energy, Office of Policy, Planning and Analysis, Energy Projections to the Year 2010, (DOE/PE-0029/2), October, 1983	3.5	2.9
U.S. Energy Information Administration, 1983 Annual Energy Outlook (DOE/EIA-0383(82), May 1984	3.5	3.1
Average	3.1	2.9

* Medium or base case forecasts where more than one case
 † Growth rate for 1995-2000 extrapolated from 1990-1995
 ‡ Forecast to 1995
 § Growth rate for 1995-2000 extrapolated from 1988-1993 (2.7%/yr)

TABLE 2

LONG-RANGE ENERGY FORECASTS

Several long-range energy forecasts have been published over the past two years. They have been prepared by diverse organizations using a variety of methodologies. In some cases they reflect policy inclinations while in others they represent efforts to identify a "most-likely" energy future. As a group, they encompass the range of forecasts widely viewed as plausible for policy and planning purposes.

The range of projected growth rates has narrowed considerably over the past few years. Only "least cost" studies such as those of the Audubon Society and Roger Sant's *Creating Abundance* indicate substantially lower growth rates for energy consumption than

the consensus. Siegel and Sillin, the mavericks among analysts, project both higher economic growth and electricity consumption.

A review of projected growth rates computed from the base year cited in the individual reports and ranked by electricity/GNP growth ratios is provided in Tables I and II. The mid-case or base scenario was chosen when possible. Table I shows average annual growth rates through the year 2000. For comparison purposes, Table II presents the same forecasts (when available) divided into time periods, pre- and post-1990. The differences in growth rates for the two time periods are noteworthy.

TABLE 3

Table II
Average Annual Growth Rates

	From Beginning Year to 1990				From 1990 to End Year			
	Real GNP	Avg. Imp. Oil Pr.	Primary Energy	Elec.	Real GNP	Avg. Imp. Oil Pr.	Primary Energy	Elec.
AEO (1983-1995)	3.3	3.2	2.1	3.5	2.2	6.6	1.1	2.8
DRI (1983-2000)	3.6	-1.0	2.2	4.0	2.3	4.0	1.2	2.5
DOE (1982-2000)	3.3	-0.6	2.0	3.7	2.4	6.1	0.8	2.1
EL WORLD (1983-2000)	3.5	n/a	n/a	3.2	2.6	n/a	n/a	2.5
NCA (1982-1995)	2.6	0.5	1.5	2.4	2.3	3.7	1.3	2.2
WHARTON (1983-1994)	3.3	-0.7	2.0	3.2	3.0	2.4	1.9	2.6
GRI (1983-2000)	3.4	0.7	2.2	3.7	2.4	2.5	1.2	1.6
CON (1982-2000)	3.2	n/a	1.5	2.9	2.5	n/a	0.8	1.5
NERC (1984-1993)	n/a	n/a	n/a	2.8	n/a	n/a	n/a	2.5
BANK (1982-2000)	n/a	n/a	n/a	3.5	n/a	n/a	n/a	2.5

Source: Topics in Electricity and the Economy, Volume II, No. 1 (Spring 1985)

EXCERPT FROM THE TESTIMONY OF WILLIAM C. HOCH
IN DOCKET NO. R-79060865

Q. What is the purpose of your testimony?

A. I will describe the Electric 1978-88 Budget Forecast with 1988-98 Projections and discuss various aspects of that forecast. The budget Forecast has been written in a tutorial fashion with explanations as to how the results were derived.

Q. Have you prepared or had prepared under your direction and supervision an exhibit to support your testimony?

A. Yes, I have.

Counsel:

I ask that the following document be marked for identification:
Exhibit WCH-1 Electric 1978-88 Budget Forecast with 1988-98 Projections.

Q. Describe the energy sales forecasting methodology.

A. Most of the known forecasting methods are used to some degree in deriving the ten-year forecast. These include trend analysis, correlation analysis with regressions, economic projections, technological forecasting of changes in energy-using equipment, and data derived from a regional econometric model. Models of sensitive parts of the forecast such as air conditioning loads and population analysis have been programmed for a computer and a fully

computerized econometric model has recently been programmed. The econometric model was developed by Wharton Econometric Forecasting Associates (WEFA), at our request, as a separate method of establishing future forecasts.

The forecast is produced by estimating energy sales for individual years for each rate class - Residential, House Heating, Small Commercial and Industrial, Large Commercial and Industrial, Other Public Authorities, Railroads & Railways, Street Lighting, Resale, and Interdepartmental. In order to satisfy the needs for special data to compute revenue, peaks, etc., energy sales for key months are forecasted for each year along with numbers of customers and selected data on special uses such as air conditioning and electric heat.

The forecast is estimated by classes and then aggregated. Each class in turn is made up of parts. Because of the substantial amount of data collected from field forces as well as trade associations and government agencies, we believe that establishing each component with its own correlations and data - based on uniform assumptions concerning the region and economy - leads to a more precise forecast than deriving a general forecast from a national econometric model. This is especially true of local large manufacturing customers whose use and plans often bear little resemblance to the performance of the national industry. This forecast is also more useful as a future reference source when fore-

casts for separate applications and appliances are determined.

Q. Describe how residential sales are forecast.

A. The residential energy sales forecast is based on two main determinants; the number of living units and the average use per living unit.

Using Bureau of Census materials including the Census of Population and the Census of Housing, as well as local data, population and housing units are determined for the service area and the relationship between dwelling units and population is established. A component-cohort method is used to advance the population through the year 2000, analyzing the effects of different fertility, mortality and migration rates. Correlations are determined between various segments of the population (e.g., females over nineteen and total population) and dwelling units. In addition, sociological data is reviewed to determine the effects of change in life style and marriage and divorce rates on the size of household and the mix of dwelling units (e.g., apartment, single dwellings, etc.)

New Construction must be estimated because of its large effect on electric space heating and electric water heating sales as well as other applications. Construction data collected from our field representatives, as part of the continuing reporting program, and correlations to various demographic housing and economic factors are used to determine the long term trend in new construction. Short

term new construction units are based on information from construction reports, local builders and builder's associations.

The new construction units are forecast by detached houses, townhouses, individually metered apartments and single point-metered-apartments. Single-point-metered apartments are forecast along with the other residential units, although their consumption is included in the Large Commercial and Industrial class.

Demolitions and abandonments are included in a "net losses" category. Demolition numbers are obtained from figures compiled by the Bureau of Census, county planning agencies and Philadelphia Electric Company.

Space heating for new construction is based on historical penetrations in the new housing market, availability of fuels and present and future fuel costs. Space heating conversions are estimated based on past and current trends, projected fuel prices and the size of the potential market. Electric space heating in both the new construction and conversion markets are divided into resistance and heat pumps, with consideration given to the anticipated improvements in the latter's efficiency. Residential air conditioning has been tracked since 1947. Data on size, type of unit and energy efficiency ratio, whenever available, are collected on a continuing basis from distributors and manufacturers through the Electrical Association. Annual residential surveys, conducted since 1972, are used to update the air conditioning data base. Forecast consumption

for air conditioning is based on the level of market saturation, the replacement rate and the expected continuation of strong success in our high efficiency air conditioning program.

Other appliances are forecasted separately. The annual residential surveys provide saturation data and the acquisition rate. Monthly sales statistics are also received from the Electrical Association, but these must be adjusted for anticipated replacements. Annual use of appliances is obtained from test data and industry average data (EEL and other utilities).

The consumption for each appliance and application is then summed to obtain the class totals for Residential, House Heating and the single-point-metered apartment component of Large Commercial and Industrial Sales.

- Q. Describe how the large commercial and industrial sales are forecast.
- A. This class is broken down into the largest ten manufacturing customers, all other manufacturing, single-point-metered apartments, and other non-manufacturing (commercial, education, government, utilities).

The big ten manufacturer's sales forecasts - which are 40% of the total manufacturing sales - are based on frequent interviews with these customers concerning their plans.

Forecasts of other manufacturing sales were made using three

different methods:

Manhours - This method used historic and forecasted manhours and kWh per manhour for the various industrial SIC's. Using actual kWh sales plus manhours per SIC from the Wharton (WEFA) Regional Model, the growth rates in kWh per manhour were calculated for the 1969-77 period. These growth rates were then applied to WEFA's forecasted manhours for the two digit SIC's for the period through 1988. Adjustments were made to SIC's 29 and 33 because the three major oil companies and the two major steel companies in these classes are in the big ten and are forecasted individually.

Relationship of Population and Employment - the ratios of population to employment by two digit industrial SIC's were determined as was the kWh per employee by SIC, by year, for the period 1965 to 1976. Through the use of linear regression, the kWh per employee was projected by year through 1988. Regressions were then run to estimate future employment by SIC using both State of Pa. Dept. of Commerce population forecasts and PE Company's population model. Using the kWh per employee and the estimates of future employment resulting from the two different population models, two slightly different kWh projections were obtained for the 1978-88 period. The average of the two was used as the base case.

Regression Analysis - A total of 30 different models were run and the three which were statistically significant and reasonable in terms of functional form and dependency were selected. The three models

used have the following independent variables: (1) Industrial Production Index, (2) the personal consumption expenditures for durable and nondurable goods and the fixed nonresidential investment components of the Gross National Product 1972 %; and (3) the third model augments the first with a lagged dependent variable of kWh sales to the manufacturing sector which assumes that the stock of electric using equipment in industry does not instantaneously adjust to changes in the economy.

The results of the three methods just described produced 1978/88 growth rates for other manufacturing sales of 2.7%, 2.8% and 2.8% respectively. The manhour method with its 2.7% growth rate was selected for the base case. Value added was also investigated as a possible forecasting technique but was found to have a number of serious deficiencies which precluded its use.

Large commercial sales were forecast using four different methods:

Manhours - The method is the same as described for other manufacturing sales.

Relationship of Population and Employment - This method is also the same as described for other manufacturing sales.

Regression Analysis - 30 different models were run and three were selected because of their reasonableness of structure, their statistical properties and their observed behavior over the estimation period. The three models used have the following independent variables: (1)

the services component of Gross National Product 1972 \$ (2) Real Disposable Income 1967 \$ and the lagged value of kWh sales to the nonmanufacturing sector and (3) the third model uses the services component of Real GNP 1972 \$ and the lagged value of Real Disposable Income 1967 \$.

Commercial Square Footage - An analysis of various data resulted in the assumption that there are 465 square feet of floor space per commercial employee. Using WEFA's regional projection of commercial employment, an estimated 121 million square feet of new commercial construction in the 1978/88 period was obtained. This figure was multiplied by 34 kWh per square foot, which was the average for new construction in PECO's service area for the 1974-77 period. The resultant figure was adjusted for known specific "non-commercial" type loads included in this class such as water and sewer plants, the Navy Yard, oil pumping stations, etc. Existing weather corrected loads were increased 1% for additional equipment, mainly data processing equipment. However, existing weather corrected loads, less the "non-commercial" segment, were also reduced by 7% to allow for additional conservation by existing customers over the 1978-88 period. Conservation in new construction was forecast to lower consumption somewhat less than the maximum impact of ASHRAE 90-75, which is based on pre-1973 construction. The new construction kWh, less conservation, were combined with the adjusted existing kWh sales to produce the final result.

The results of the four methods produced 1978/88 growth rates for large commercial sales of 5.1%, 3.7%, 4.8% and 3.7% respectively. The lower figure was selected as the base case.

Q. How are small commercial and industrial sales forecast?

A. This class was forecast by a method very similar to that just described in the Large Commercial Square Footage method. The customers in this class are not broken down into SIC's. The forecasted sales for 1988 are 3,520 million kWh which is a 1978/88 growth rate of 2.0%.

Q. How were the other classes forecast?

A. The forecasts for the other classes are made based on discussions with the limited number of customers involved and on time-series analysis and the technological changes expected (as in street lighting sources).

Q. Are high and low ranges of the forecast prepared?

A. The forecast is prepared as a base forecast based on assumptions considered most likely to occur, with high and low ranges based on variations of these assumptions. The basic assumptions which apply to all classes of service are listed in Appendix A. Many other assumptions are included with the individual discussions of the various classes of service in the Budget Forecast. Ranges are developed because outcomes will vary from forecasts for many reasons. Deviations based on business cycles and errors from the mean

economic forecast based on a band of predictions will occur. It is inevitable that the economy will be influenced by factors not now considered probable by most economists. Such things as the effects of government policy changes; OPEC actions; unanticipated technological changes or lack of improvements in appliance efficiencies; and behavioral changes affecting consumer spending, migration, jobs or life style, which, taken together, could greatly influence the growth of regional output and population away from the projected probable trend.

In addition, seldom can the future be counted on to reflect the past. In this century, there was World War I, the boom of the roaring twenties, the crash and Great Depression, World War II, the sustained postwar boom, the wide swings in birth rates, Korea and Vietnam. Since 1970, the economy has been influenced by the oil embargo, the severe recession, and the job and population outflow from the Northeast. None of these major events was foreseeable a few years in advance by the economists of the time. The base case growth rate for 1978/88 is 2.9% while the high range is 4.4% and the low range is 1.3%. In all three scenarios normal weather is assumed.

Q. How do the results of the WEFA econometric forecast model compare with the Budget Forecast results?

A. The WEFA model in 1978 forecasted consistently higher kilowatt-hour sales growth than our in-house forecasting methodology. WEFA forecasts prepared in the fall of 1978 projected total electric

consumption to grow at 3.8% annually compared to PE Company's forecast of 2.9%. Under the present circumstances, a higher forecast could be expected from the econometric model because it is based on history and might not take into consideration the full impact of government regulation on appliance efficiency and building standards.

Q. How do you factor into the forecast future fuel prices and technological improvements?

A. Projections of energy prices are prepared by PE personnel. These are applied to various heating system types as a basis for estimating saturation percentages for each fuel. The assumptions in Appendix A show the ratios currently expected. The cost of electricity and salaries and wages are expected to increase at approximately the same rate as the consumer price index over the next ten years. Therefore, with the cost of electricity taking a relatively constant percentage of the consumers' income, no special coefficient of elasticity is used. Past studies here and elsewhere were inconclusive as to values for price elasticity of electricity. However, the forecast does assume that energy conservation will continue because the high price of electricity and the optimum efficiency of energy use will remain facts of life. When forecasting energy sales for each component, whatever is applicable in optimizing energy use, such as full insulation, ASHRAE-90 standards, high efficiency (high EER) air conditioning, accelerating acceptance of heat pumps with continually

approving COP's, solid-state appliances, microwave cooking, high efficiency light sources, and others is assumed. A strong restrictive effect is thus derived which reflects the high value of electricity without relying on a fixed coefficient of elasticity with its necessary estimate of future prices. Forecasts of technological changes and data on future improvements are obtained from following a large number of publications such as Futurist, Technology Review, Spectrum, Electrical World, Electrical Week, Business Week, Energy Review, and the U.S. Information Service energy materials.

Q. How are weather and business cycle effects taken into consideration?

A. The energy sales forecasts for the base case and high and low ranges are based on normal weather (see Appendix A for description of weather-corrected sales) and normal, average economic conditions. Whether the economy is in a recession or at a peak will cause energy sales to swing considerably from the probable forecast trend line.

Q. What steps do you take to keep up with changes in forecasting techniques?

A. Meetings with other forecasters from PJM utilities are held several times per year and forecast data and techniques are interchanged. Members of the group also participate in the Electric Utility Market Research Council, Wharton Regional Model meetings, and special conferences, meetings and seminars on energy forecasting as available.

Q. Is PE Company's forecast of electric sales for the 1978/88 period compared with forecasts made by other electric utilities and industry forecasts?

A. A file is maintained on forecasts of national forecasters (such as McGraw-Hill, EPRI, FEA, FPC, A. D. Little) and of utilities all over the country as a check on the positioning of our forecast, though these are not a direct input in making projections. With the ten PJM companies, the individual forecasts range from 2.5% to 5.4%, with PE Company's forecast being 2.9%. The average for the ten companies is 3.7% and the median is 3.4%. At the time the Budget Forecast was prepared, the national forecasts of electric consumption growth were in the 4% - 5% range (e.g., McGraw-Hill 4.1%, NERC 5.2%, General Electric 5%, DOE 4.8%).

Energy Sales Forecast Assumptions For 1978 Forecast

The following assumptions apply to all classes of service in the ten year forecast and cover the base, high, and low cases.

1. GROSS NATIONAL PRODUCT - Real GNP and real Gross Regional Product (GRP) for the Philadelphia SMSA (Pennsylvania portion) are projected to grow at the following indicated average annual rates

	<u>1978-79</u>	<u>1977-82</u>	<u>1982-87</u>	<u>1977-87</u>
GNP - <u>Base</u>	2.0%	3.7%	3.2%	3.4%
GRP - <u>Base</u>	1.5%	2.3%	1.8%	2.1%
GNP - <u>Low</u>	1.5%	3.4%	3.0%	3.2%
GRP - <u>Low</u>	1.0%	2.2%	1.3%	1.8%
GNP - <u>High</u>	4.1%	4.2%	3.2%	3.7%
GRP - <u>High</u>	4.7%	2.5%	2.2%	2.3%

2. POPULATION - Service area population, derived from the 1970 Census, was the base upon which the computerized population model, using the cohort-component method, constructed estimates and projections through the year 2000. Calculations were based on the Census Bureau's Series II fertility rates and current survival rate tables. Estimates from 1970-76 include the 156,000 net out-migration estimate made by the Bureau of Census for the Pennsylvania portion of the Philadelphia Standard Metropolitan Statistical Area. All estimates and projections for the Conowingo Power Company's service area assume a neutral net migration over the entire period from 1970-2000.

Base case projections for the Philadelphia Electric Company service area decrease net out-migration, over a ten year period, from the 0.7% annual rate seen in the 1970-76 period, to the 0.1% experienced from 1965-70. This rate is continued through the year 2000. The low forecast's projections maintain a constant net migration rate at the 1970-76 level for the entire period. The high forecast assumes neutral net-migration after the initial 1970-76 period.

3. FERTILITY RATES - The Census Bureau's Series II fertility rates were used for all forecast scenarios. This schedule ultimately leads to replacement level fertility, which is equivalent to 2.1 births per female.

4. COSTS OF ENERGY - The following annual average rates of growth were assumed for fuel costs for the ten-year forecast period. The percentage figures apply to constant 1972 dollars so that the changes indicate a relationship to the Consumer Price Index (CPI) which is expected to increase at an inflation rate of about 5.5% per year during the period.

	<u>Real Annual Increase</u>	<u>1988/1978 Costs - 1972 \$</u>
Electricity	0	1.
Oil - No. 2	1.5%	1.15
Gas - Rate GR	2.7%	1.30

Electricity projections are taken from the corporate financial model based on the current outlook for generation costs and mix. Coal and oil prices are based on data provided to Purchasing by their fuel suppliers and two studies prepared for EPRI. (1) (2)

The gas price projection is developed by Gas Operations and agrees generally with the AGA forecast for Mid-Atlantic region dated July 3, 1978 and conforms with an EPRI staff study (3) which also reinforces the electric assumptions.

The many unresolved policy decisions and the instability of the Middle-East situation make forecasts of energy prices an inexact process at best.

The fuel price projections in PECO's corporate assumptions are based on the best available studies, but in light of the great uncertainties should only be considered as relative indicators of competitive relationships.

For the low case, it was assumed the cost of oil will maintain its present relationship to electric costs and that oil will be in adequate supply.

For the high case, it was assumed oil and gas will be in tight supply, contributing to increased penetration of electric space heat.

5. CONSERVATION - In all three scenarios, government agencies and private organizations including PECO will continue to encourage energy conservation through the use of high efficiency appliances and applications and energy-efficient construction. Government regulations will play a growing role. Assumed efficiency improvements, which are attributed to both the high cost of energy and the desire to conserve, are covered in later sections.

6. PRICE ELASTICITY will continue to lead to the purchase of high efficiency appliances and energy-efficient buildings and systems as mentioned in 5. above and in the later discussion on Price Elasticity. Efficiencies are based on technology and expected government policy rather than an estimated coefficient of elasticity because of inexactness to be expected in projecting relative energy prices and elasticity coefficient values for each class.

7. OFF-PEAK APPLICATIONS - PECO will continue to promote off-peak applications -- electric space heating (particularly heat pumps) and night lighting for safety -- which improve load factor, for the base and high forecasts. A neutral stance is implied in the low forecast.

8. GAS - For the base and low cases, the improved gas supply outlook is expected to enable gas sales to resume in 1979. As a result, the penetration of electric space heating for new construction might be restricted.

For the high range, additional gas supplies would be limited to additional residential customers only to match gas service removals.

9. BUSINESS CYCLES - The three forecasts assume the currently expected economy in 1979 and are based on a normal peacetime economy through 1988.

Based on an analysis of sales for the 20 years from 1952 to 1972, whether the economy is in a recession or at the peak of a boom can cause a +5% to -7% deviation from the base trend which is based on a smooth growth rate.

In addition, recognized economists offer different projections of national economic growth, some of which are given in Table

If the high and low projections shown are imposed on the business-cycle effect described in the above paragraph, deviations from these two causes could cause an increase in sales of 8% or a decrease of 13% from trend in the later years of this forecast while most of the listed assumptions would still be applicable. Projections by class based on these high and low factors are given in Table II.

10. Average weather conditions are projected, affecting heating and cooling loads.

Normal weather for each calendar day of the year is determined by averaging actual weather data over a historic period. For the heating season, this average is computed over a 45 year period from 1930 to 1974. For the summer cooling season, the historic data covers a 30 year period from 1946 to 1975. Monthly and seasonal normal weather are the sum of normal weather for individual days. A new normal is calculated every five years.

To correct actual sales for normal weather conditions in any given year, the difference between actual weather and normal weather for the heating and cooling season is computed. These differences are then multiplied by either a summer or winter weather electric usage factor. These factors were developed using linear and multiple regression techniques and are a measure of the relationship between the changes in electrical usage and changes in weather. The resulting product, when subtracted or added from actual sales, gives kWh usage on a normal weather basis.

Other assumptions, the impact of which is concentrated on specific classes of customers or uses, appear later in the appropriate sections.

Response To Conrad J. Six Letter of December 14, 1979
Regarding Generating Capacity Planning

1. Organizational Responsibilities and Staffing Request

PE's Forecasts are prepared in 2 separate Steps

Step 1 - kWh Energy Forecast

A forecast is prepared annually by the Market Research Section of our Commercial Operations Department, providing ten and twenty year projections of electric energy. This forms the basis for projecting peaks and capacity requirements by the Engineering Department.

The resources devoted to the kWh Energy Forecast are as follows. Note that these are calculated equivalent manpower inputs; no individual spends full time on the forecast.

1. Personnel - The long-term electric sales budget is prepared by the Market Research Section which applied about five person-years to the project in 1978 at a cost of \$180,000. The personnel working on the forecast are Supervisor, Market Research and the others are titled Market Analyst. These all have college degrees including 3 MBA's and one M.S.E.E. Salaries range from about \$26,000 to \$35,600 per year for the top non-supervisory analysts.

Step 2 - Generation Planning

We do not have any engineers whose sole job is the planning of new generation. A new generation study will involve a number of engineers who are also performing other functions; e.g. an engineer involved in the engineering for the Eddystone station flue gas scrubbing system may provide the cost estimate for new coal unit scrubbing systems. By evaluating all the various engineering contributions to a generator study we can estimate an equivalent engineering staff requirement.

We interpret generation planning to include all studies which concern decisions on generation additions, retirements, or conversions; e.g. an existing unit being converted from oil fired to coal fired. This would not include the actual engineering for any generation changes nor the development of any of the regulatory filings for state and federal agencies. As best we can estimate, an equivalent engineering staff for generation planning would consist of about 8 people including:

a) Reliability Analysis: (1 Engineer)

Determining need of capacity to meet Loss-of-Load Probability (L.O.L.P.) requirements. Developing generation outage data and load for L.O.L.P. modeling. Participating in joint studies with other utilities. Maintaining state-of-the-art capability in L.O.L.P. techniques including sensitivity studies of existing models.

b) Operating Cost Analysis: (1 Engineer)

Calculating annual operating costs on a bi-hourly basis using computer models. Providing generation and load data for models. Extracting and comparing operating data from output of models for cost, fuel consumption, capacity factors interchange, etc. Maintaining state-of-the-art capability in production cost modeling.

c) Generation Installed Cost Estimates: (2 Engineers)

Developing installed cost estimates for new units including special requirements; e.g. flue gas scrubbers, cooling towers, etc. Maintaining state-of-the-art capability for evaluating new generation types such as fuel cells, wind powered generators, etc. Developing cost estimates for retrofitting equipment on old units; e.g. flue gas scrubbers, etc.

d) Generation Economic Comparisons: (1 Engineer)

Performing overall economic comparisons for generation additions, retirements or conversions considering reliability requirements, operating costs and carrying charges on installed costs. Developing alternate generation plans for consideration including location, size and types of generations to be considered.

e) Transmission Analysis (2 Engineers)

(Every change in generation has an effect on transmission requirements and must be evaluated to get true cost comparisons). Performing load flow calculations to develop new transmission requirements for every generation change. Performing transient stability analyses to evaluate new generation. Performing short circuit analyses to evaluate new generation. Estimating cost of new transmission and substation facilities required by generation changes.

f) Computer Program Maintenance: (1/2 Engineer)

Maintaining and updating L.O.L.P. reliability, production cost, load flow, transient stability short circuit and subsidiary computer programs.

2. Computer Services

Energy Forecasts

Data Processing is done on the IBM System/34 computer which also processes other Commercial Operations reports. Cost of data processing is about \$7,000 per year.

Generation Planning

The computer programs which we use in generation planning were either developed by PECO or obtained from other PJM members. We, therefore, have no program rental costs. These computer programs require IBM series 270 or compatible type computers. We do not normally segregate computer costs for generic generation planning studies, but an estimated annual cost would be about \$25,000.

3. Consulting Services

Energy Forecasts

There are no consultants employed in the official energy forecast. Wharton Econometric Forecasting Associates (WEFA) was engaged to prepare an independent econometric-based forecast in 1978. Based on current proposals from WEFA, the annual cost of preparing an econometric forecast in the future with the model in place would be about \$45,000. No decision has been reached by PECO at present on whether to pursue this method further.

Generation Planning

External consulting services have been hired in the past to evaluate the suitability of new sites for major generation expansions. Such evaluations have been very detailed and cover special areas of expertise such as ground strata, probability of earthquakes, wind dispersions, topographical features, etc. Such studies are very much dependant of the number of sites and the features of those sites themselves.

GROSS NATIONAL PRODUCT PROJECTIONS
1958\$

Actual 1971 - \$742-
Actual 1972 - \$790-

	<u>Year Made</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>
Wharton Model	1971	906	1,109	X	X	X
National Planning Assoc.	1971	922	1,149	X	X	X
Council of Economic Advisors	1971	936	X	X	X	X
Lionel D. Edle	1971	894	1,145	X	X	X
McGraw-Hill	1971	X	X	1,274	X	X
American Gas Assoc.	1971	894	1,103	1,361	1,681	2,075
The Conference Board	1972	X	X	X	1,695	X
King - P.E.Co.	1972	927	1,145	X	X	X
McGraw-Hill	1972	905	1,101	1,303	1,509	X
National Planning Assoc.	1972	894	1,086	X	X	X
King - P.E.Co.	1973-	906	1,109	1,332	X	X

X - No Projection made.

TABLE 1

Appendix D

Table 2

GROSS PRODUCT PROJECTIONS

1972 Billion \$

Actual 1976 GNP \$1271.0 Actual 1976 GRP \$26.7
 Actual 1977 GNP 1332.7 Actual 1977 GRP 27.4

<u>Previous Forecast:</u>	<u>Year Made</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
<u>NATIONAL PRODUCT</u>						
Wharton EFA	1977	1,518	1,788	2,088	2,413	X
EEI Task Group 20	1976	X	X	2,200	X	2,925
Merrill Lynch Economics	1976	1,496	1,782	X	X	X
Council of Economic Advisors	1977	1,562	X	X	X	X
Data Resources, Inc.	1976	1,534	1,796	2,073	X	X
Mc Graw-Hill	1977	1,508	1,761	2,061	2,388	X
P. E. Co. (D. F. King)	1977	1,530	1,789	2,080	2,388	X
<u>REGIONAL PRODUCT</u>						
Wharton EFA	1977	34.7	X	X	X	X
<u>Present Forecast:</u>						
<u>NATIONAL PRODUCT</u>						
Council of Economic Advisors.	1978	1,537	X	X	X	X
Joint Economic Committee	1978	1,532	X	X	X	X
Wharton EFA	1978	1,509	1,744	1,985	2,288	2,662
Data Resources	1978	1,517	1,815	2,105	X	X
McGraw-Hill	1978	1,498	1,794	2,099	2,458	X
Bell Telephone	1978	1,442	X	X	X	X
P. E. Co. (D. F. King)	1978	1,505	1,761	2,061	2,338	2,662
<u>REGIONAL PRODUCT</u>						
Wharton EFA	1978	30.0	32.3	X	X	X

R&F Dept.
 October 1978

PROJECTIONS OF 5 COUNTY POPULATION (THOUSANDS)

<u>SOURCES</u>	<u>1980 PROJECTION</u>	<u>1985 PROJECTION</u>	<u>2000 PROJECTION</u>
PA. Dept. of Education (9/75)	4043	4123	4385
Office of State Planning & Development (6/78)	3867	3876	3965
WEPA/ABRI (10/78)	3798	3874 *	4131
DVRPC (11/76)	3878 *	3963 *	4238
DVRPC (6/78)	3810 *	3907 *	4292
PECO (9/76)	3851	3931	NA
PECO (9/78)	3761	3843	4104
Bureau of Census Reported	3683	3700 (1984)	---

* estimates based on growth rates

PECO STATEMENT NO. 12

p 1 12-17-85
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**PENNSYLVANIA PUBLIC UTILITY COMMISSION v.
PHILADELPHIA ELECTRIC COMPANY
Docket No. R-850152**

SECRETARY
Public Utility Commission

**DIRECT TESTIMONY
of
MR. LOUIS A. GUTH**

**DOCKETED
DEC 23 1985**

**LIMERICK 1 AND COMMON PLANT
INDEPENDENT ASSESSMENT
OF LIMERICK COST AND SCHEDULE
AND PRUDENCY OF PAST DECISIONS**

**DOCUMENT
FOLDER**

September 27, 1985

1 industrial organization, managerial economics, national income theory and
2 economic principles. A copy of my personal vita is attached as
3 Exhibit _____ (LAG-1).

4 Q. Would you describe the nature of your work with National Economic
5 Research Associates, Inc.

6 A. National Economic Research Associates, Inc. was established in
7 1961 to offer economic consulting services in a number of fields, with
8 particular emphasis on regulated industries and their problems.

9 With NERA, I have prepared reports and testimony dealing with
10 antitrust matters concerning reciprocity, market structure and mergers,
11 particularly the effects of conglomerate mergers. I have also done
12 substantial work in regulatory matters. This includes a study of the role and
13 quantifications of economic cost concepts in regulation of communications
14 and other companies, a detailed statistical analysis of costs in the brokerage
15 industry and participation in a study of the future demand for fuels by
16 utilities. I have prepared a lengthy critique of studies dealing with the
17 residential demand for electricity. That report was submitted to the U.S.
18 Senate Committee on Interior and Insular Affairs. I have also prepared a
19 detailed statistical analysis of the residential demand for electricity in the
20 United States.

21 In addition, I have participated in a number of studies concerning
22 competition between regulated companies, including the preparation of
23 testimony on competitive rates and practices by electric utilities for
24 submission before a Congressional committee.

25 Q. Mr. Guth, have you testified as an expert witness?

26 A. I have testified before the Securities and Exchange Commission, the

1 Civil Aeronautics Board, the U.S. District Court for the Eastern District of
2 Wisconsin, and numerous state public service commissions in matters
3 concerning electric, gas and telephone utilities.

4 Q. Mr. Guth, in connection with the work you have done with NERA on
5 the demand for electricity in the United States, have you testified as an
6 expert witness?

7 A. I have testified on this subject before the Atomic Safety Licensing
8 Board, state power facilities siting boards, and state public service
9 commissions. In this connection, I have consulted with over fifty private
10 and publicly owned electric utilities on load forecasting issues.

11 Q. Have any of your writings been published?

12 A. I am the author of an article "Advertising and Market Structure
13 Revisited" and co-author of an article "Buyer Concentration Ratios," which
14 appeared in The Journal of Industrial Economics, April 1971 and June 1977,
15 respectively. I am co-author of an article entitled "The Use of Buyer
16 Concentration Ratios in Tests of Oligopoly Models," which appeared in the
17 November 1976 issue of The Review of Economics and Statistics. This
18 article was published as a working paper by the Graduate School of Business
19 Administration, New York University in 1973. I am also the author of
20 reports listed in Exhibit ____ (LAG-1).

21 Q. What is the purpose of your testimony?

22 A. I have been asked by the Philadelphia Electric Company (PECO) to
23 review and comment on the reasonableness of PECO's sales and peak load
24 forecasting methodologies and resulting forecasts since the Arab oil
25 embargo, i.e., from 1973 to date.

26 Q. Have you previously provided consulting services to PECO regarding

1 load forecasting issues and/or testified on behalf of PECO in these matters?

2 A. I have not previously testified on behalf of PECO. In 1984, in
3 connection with some analysis undertaken by my associate, Dr. Perl,
4 regarding the economics of Limerick, I did supervise the preparation of a
5 sales forecast for PECO using NERA's load forecasting methodology. This
6 provided a check on PECO's own sales outlook. Depending on the
7 assumptions chosen, my own forecast was consistent with, or somewhat
8 higher than, PECO's contemporaneous forecast.

9 Q. Describe the general nature of the research you undertook in
10 connection with your current assignment.

11 A. I have reviewed the actual sales experience of PECO going back to
12 the early 1950s. I have also looked at the forecasts prepared by the
13 Company since 1973, particularly with respect to how these forecasts
14 changed in response to developments in regional, national, and world
15 markets. And I have reviewed the general methodology used by PECO to
16 prepare its forecasts in the late 1970s.

17 In order to evaluate the reasonableness of the forecasts emerging
18 from this process, I have compared what PECO was saying about prospective
19 load growth during the 1970s with other generally available forecasts. I
20 have analyzed reasons why those forecasts proved to be erroneous. And I
21 have considered how PECO forecasts adapted to changes taking place
22 following the second disruption of oil supply in the Spring of 1979. Finally, I
23 have estimated what kinds of forecasts PECO might have developed based
24 on past sales trends and compared these with actual PECO forecasts. This
25 provided some indication of whether PECO could/should have been more
26 aggressive in responding to changing growth in demand for electricity during

1 the 1970s and 1980s.

2 Q. What is your conclusion as to the reasonableness of PECO's load
3 forecasting efforts?

4 A. I believe PECO forecasts were reasonable and prudent given the
5 information available to the Company at the time the forecasts were
6 adopted. Throughout the decade following the Arab oil embargo in 1973,
7 electric utility companies struggled to adjust their load forecasts to a
8 continuing wave of developments: economic recessions, energy price jolts,
9 high inflation and interest rates, and the like. PECO was no exception; the
10 Company's forecasts of the late 1970s have been at least as accurate as the
11 rest of the industry.

12 Q. What, in your opinion, are the relevant questions to raise in
13 evaluating the prudence of load forecasting efforts?

14 A. I believe the relevant questions include:

15 a. Did PECO make adequate use of available information on past
16 trends in such load growth-causing factors as economic activity, energy
17 prices, competing fuel availabilities, and conservation practices?

18 b. Were the forecasted growth rates projected for electricity sales
19 and the factors explaining those sales consistent with what other experts
20 were saying at that time?

21 c. With perfect foresight of what actually happened to the
22 economy after 1978, would the forecasts of the Company have come closer
23 to the mark?

24 In a nutshell, these questions ask: did Company forecasters do an
25 adequate job in the 1970s and were they eventually proved wrong for the
26 right reasons, i.e., economic growth slumped and energy prices soared well

1 beyond what a prudent observer would have guessed?

2 Q. To begin, what has been the history of PECO electricity
3 requirements (kilowatt-hours) and peak demand (kilowatts) during the
4 relevant time period?

5 A. I have set forth the data on sales in Exhibit ____ (LAG-2). As the
6 charts indicate, PECO sales in virtually all categories grew fairly smoothly
7 and rapidly through 1973. The first major disruption to this trend occurred
8 in 1974. Growth subsequently resumed, albeit at lower annual rates; 1979
9 brought about a second major disruption. Subsequent to that event, there
10 was very little system growth in sales (excluding sales for resale) until the
11 last few years. System peak demand has a similar pattern since that time.

12 Q. What generally accounts for the major disruptions in the early and
13 late 1970s?

14 A. There were, of course, many factors at work. But the disruptions
15 are certainly associated with events flowing from the Arab oil embargoes,
16 including supply disruptions, in 1973 and again in 1979. The direct effect of
17 these embargoes was, of course, to raise very abruptly the real price of oil.
18 But there were many additional effects, of which four are particularly
19 noteworthy. First, the prices of all forms of energy, including electricity,
20 rose following oil price increases. More expensive energy led consumers and
21 industries to cut back consumption. Second, public conservation policies
22 were encouraged or mandated by local, state, and federal authorities.
23 Third, fairly major recessions followed, and perhaps resulted from, the oil
24 embargoes. Less economic activity means reductions in the use of energy
25 and other goods and services. Fourth, inflation accelerated with a major
26 impact on interest rates. These higher rates also led to higher electricity

1 prices than would otherwise have been the case.

2 Q. Let's focus for the moment on the period between the two Arab oil
3 embargoes. Did electric utility companies modify their forecasts in
4 response to these changes?

5 A. They certainly did. My associate at NERA, Robert Uhler, has
6 depicted these changes in a report to the Electric Power Research Institute
7 entitled: "The NERC Summary Load Forecasts: A Retrospective Appraisal
8 and Technical Analysis." (Co-authored with C. R. Nelson, University of
9 Washington, RP1153-10, May 31, 1985.) The analysis is based on the
10 compiled national forecasts assembled each year by the regional member
11 councils of the North American Electric Reliability Council (NERC) from
12 the reports of individual utilities. From 1974 to 1978 the sales and peak
13 forecasts decreased each year. These changes accounted for a reduction in
14 projected electricity requirements by 1985 of roughly 850,000 GWh, or
15 21 percent.

16 Q. Did PECO modify its forecasts during this period in a similar
17 fashion?

18 A. Yes. PECO revised its forecast each year during this time period.
19 Again looking forward to 1985, changes between the 1974 and 1978 PECO
20 sales forecasts amount to reductions of approximately 18,000 GWh, or
21 35 percent. The reduction in the peak forecast for 1985 over this period was
22 over 5,000 MW, or more than 40 percent. Thus, the question is not whether
23 PECO did respond to changing conditions by modifying its load forecasts;
24 rather it is whether the response was reasonable. In my opinion, all of the
25 evidence indicates that PECO's response was reasonable.

26 Q. As of 1979, prior to the second oil supply disruption, what was the

1 outlook for electricity growth in PECO's service area?

2 A. As of PECO's forecast dated December 1978, projected average
3 annual growth in total sales, excluding sales for resale, for the ten year
4 period 1978 to 1988 was 2.9 percent. Forecasted average annual growth in
5 peak load for the same period was 2.4 percent. This compares with actual
6 growth in sales and peak load for the previous ten years of 2.9 and 2.6
7 percent respectively.

8 Q. As of this time period, how did these forecasts compare with
9 electric utility industry forecasts generally?

10 A. The load growth outlook of PECO was very much consistent with
11 forecasts on the regional and national level. This is depicted in
12 Exhibit _____ (LAG-3).

13 Q. Let's look at the NERC industry numbers first. How do the NERC
14 national numbers compare with those of PECO and the Mid-Atlantic Area
15 Council (MAAC) generally as of 1979, prior to the second disruption of
16 supply oil?

17 A. Tables 1 and 2 of Exhibit _____ (LAG-3) show regional and national
18 numbers for forecasted energy requirements as of Spring 1978 and
19 Spring 1979. Tables 3 and 4 of Exhibit _____ (LAG-3) show the same
20 information for regional peak demands. At the time that PECO was
21 forecasting energy growth of 2.9 percent and peak growth of 2.4 percent,
22 the regional and national numbers of the reliability councils were somewhat
23 higher. MAAC compiled forecasts were in the range of 3 to 4 percent, while
24 projected national growth was in the range of 4 to 5 percent.

25 Table 5 of Exhibit _____ (LAG-3) then compares the 10-year energy
26 growth forecasts of MAAC, including PECO, with the compiled national

1 forecasts. From Spring 1974 through Spring 1979, the MAAC forecasts
2 declined as fast, or faster, than the NERC national compiled forecast,
3 consistent with the decline in MAAC energy requirements as a percent of
4 national by about one-half percentage point.

5 Q. Were there other forecasts of national electricity growth available
6 as of 1979, prior to the second disruption of oil supply, in addition to the
7 industry projections?

8 A. Yes. Forecasts were available from the government, industry trade
9 press and information/data services such as Predicasts.

10 Q. What did they show?

11 A. Tables 1-3 of Exhibit _____ (LAG-4) show the forecasts of the
12 Department of Energy (DOE). Their projections reported in the 1977 Annual
13 Report were for annual growth around 4.6 percent, roughly one-half
14 percentage point below the industry forecasts. By the next year, the DOE
15 figure dropped only slightly to 4.4 percent. It was not until after the oil
16 supply disruption, that is by the Spring of 1980 when the DOE issued its
17 Annual Report for 1979, that their estimated growth fell substantially to
18 just below 3 percent.

19 Tables 4-6 of Exhibit _____ (LAG-4) show the projections of Edison
20 Electric Institute at roughly the same time. Their figures in the Springs of
21 1978 and 1979 were approximately 5 percent. After the oil supply
22 disruption, their estimates fell to 4 percent.

23 Finally, Table 7 of Exhibit _____ (LAG-4) includes a variety of
24 forecasts as cited in the trade press and reported by the Predicasts
25 organization during 1978 and 1979. Predicasts is an information/data
26 service which publishes forecasts compiled from various industry

1 publications. While the specific growth figures vary in composition and
2 detailed definition, there is a specific recurrence of figures around
3 5 percent. Thus, the generally available forecasts of government and
4 industry were all pretty much consistent with the context in which PECO
5 forecasts fit, i.e. the compiled MAAC and NERC forecasts. These forecasts
6 by no means indicate that there were no other forecasts at much lower
7 growth rates. They do mean, however, that the judgments on load growth
8 expressed by PECO during this time period were consistent with the
9 judgments of most other informed companies and agencies, given the
10 information then available. Indeed, the forecasts called for significantly
11 lower growth than nationally or regionally, reflecting the economic outlook
12 for PECO's service area.

13 Q. Describe the methodology used by PECO at this point in preparing
14 its forecasts?

15 A. PECO has relied upon a methodology which combines detailed
16 analysis of end uses of electricity and economics. The methodology has been
17 refined year-by-year as additional information is acquired. But, in struc-
18 ture it is essentially the same approach used by PECO in the last 10 years.

19 The PECO methodology is described in detail in annual reports, and
20 the Electric Budget Forecasts. Essentially, for each customer class, PECO
21 breaks down kilowatt-hour sales into type of customer, type of use, and
22 pattern of usage. The residential class has the greatest detail, dealing with
23 specific types of housing units — houses, townhouses, and apartments —
24 numerous appliances and uses, and a detailed analysis of factors which
25 account for change in usage rates. Similarly, the analysis of small and large
26 commercial and industrial customers breaks down total usage into specific

1 industry categories and identifies the key factors accounting for changes in
2 consumption within those categories. In the case of PECO's eight to ten
3 largest manufacturing customers, direct contact with each customer is
4 relied upon as the basis for projecting individual requirements.

5 Of course, PECO's approach is one of several different
6 methodologies in use, including a variety of statistical techniques. In its
7 detail and analysis of available data, PECO's methodology is, I believe, a
8 state-of-the-art representative of the end-use approach.

9 Q. What are the key factors that account for changing levels of
10 electricity requirements, as you have identified them?

11 A. These key factors include growth in economic activity -- expressed
12 in an appropriate way for each class, i.e., residential (housing construction),
13 commercial (nonmanufacturing employment and general construction) and
14 industrial (manufacturing employment and regional industrial production) --
15 growth in population and households and changes in electricity and energy
16 prices.

17 Q. Taking each of these in turn, would you please describe how actual
18 growth did happen from 1979 forward compared with recent historic growth
19 at both the national and PECO service area level?

20 A. At the national level, the analysis of Mr. Uhler, to which I referred
21 earlier, provides a nice summary of what happened. Several of his charts
22 are reproduced in Exhibit _____ (LAG-5). The first three charts show
23 measures of overall economic activity: (a) per capita income, (b) industrial
24 production, and (c) gross national product. Each series shows sharply lower
25 growth in the 1970s compared with the 1960s. And, after 1979, there is very
26 little growth at all shown for per capita income and GNP, while industrial

1 production actually declined consistently through 1982.

2 The next four charts in the exhibit show the trends for energy and
3 electricity prices. Prices of oil, coal, and natural gas accelerated after
4 1973 following the Arab oil embargo. And these prices surged again after
5 the oil supply disruption of 1979.

6 Q. Why did electricity prices rise in the way you described in this
7 exhibit?

8 A. Of course, specific factors differ for each electric utility company.
9 However, as a general matter, the principal constituent parts of electricity
10 costs are fuel and capital-related costs. Thus, rising fuel prices and interest
11 rates were bound to drive up electricity prices quickly.

12 Q. Should an electric utility forecaster in 1978 have anticipated the
13 increases in fuel costs and in interest rates of the magnitude that occurred?

14 A. Clearly not. The price of fuels and interest rates are both
15 determined in markets where there is trading in futures and foresight could
16 enable you to make considerable profits. To the best of my knowledge,
17 however, there were no major price movements in these markets in advance
18 of the oil supply disruption of 1979. Thus, an expectation of only moderate
19 changes in these factors as of that time was certainly consistent with what
20 the general market seemed to be expecting.

21 Q. Please return to your discussion of changes in key economic factors
22 in the PECO service area after 1979.

23 A. I have prepared several charts, included in Exhibit _____ (LAG-6),
24 for the PECO service area that are similar to the national charts in
25 Exhibit _____ (LAG-5). The overall picture is basically the same. Of
26 course, the Philadelphia area suffered through the same economic slowdown

1 in the early 1980s that affected the rest of the country. The first two
2 charts of this exhibit illustrate this slowdown in terms of major drops in
3 housing starts. Similarly, manufacturing employment in the Philadelphia
4 area has declined steadily since 1979. Overall, these factors are associated
5 with a slowing in growth of the number of residential customers served.
6 Finally, the real price of electricity jumped sharply in 1980 as a result of
7 much higher fuel costs, leaving rates in real terms well above 1974-1979
8 levels.

9 Q. What happened to sales and peak load growth as a result of these
10 changes?

11 A. Largely as a result of these changes in economic activity and energy
12 prices, electricity sales and peak growth were further curtailed; indeed, on a
13 national basis, electricity consumption actually dropped in 1982.
14 Exhibit _____ (LAG-7) shows that the "fanning downward" of load growth
15 projections continued after 1979 because of these factors. And
16 Exhibit _____ (LAG-8) shows the same effect for PECO forecasts. Between
17 Spring 1979 and Spring 1984, national load growth projections for 1988
18 dropped by 24 percent, MAAC projections by 19 percent, and PECO
19 projections by 18 percent. (See Exhibit _____ (LAG-9)).

20 Q. Assume that the forecasters at PECO as of 1979 had perfect
21 foresight of coming changes in energy prices and economic activity. Would
22 they have forecast emerging sales and peak requirements correctly using
23 their methodology?

24 A. I believe they would have been quite accurate.

25 Q. On what do you base this opinion?

26 A. It is virtually impossible for me to reconstruct PECO's own forecast

1 of December 1978 as it would have appeared with perfect knowledge of
2 what would happen to economic growth in PECO's service area and to the
3 price of electricity. However, I have prepared Exhibit ____ (LAG-10) in
4 which I compare the forecasting assumptions used by PECO at that time for
5 the period out to 1983 with subsequent actual trends.

6 Note first that from a base of actual 1977 sales and normalized peak
7 loads, PECO forecast average annual growth through 1983 of 2.28 percent in
8 sales and 2.04 percent in peak. Sales were almost flat and peak grew only
9 1.30 percent. These differences seem entirely consistent with the shortfalls
10 in economic performance and rising energy costs of the period. For
11 example, Gross National Product grew over one and one-half percentage
12 points slower than had been forecast (1.91 percent versus 3.62 percent). The
13 effect of this slowdown is also reflected in slower new construction and
14 customer growth. Although the PECO forecast does not use GNP directly as
15 a key factor in forecasting sales growth, there is a general proportionality
16 between economic activity and electricity requirements in the model, all
17 else equal. So this slowdown should account for a reduction in the sales
18 forecast of at least one, and probably more like one and one-half,
19 percentage points. That would reduce the sales growth forecast to a range
20 of approximately 0.75 to 1.25 percent.

21 In addition, electricity price (constant dollars) rose 0.71 percent
22 annually, above the forecasting assumption of no real increase. In PECO's
23 forecast, the effect of rising energy costs is measured directly through
24 conservation and adjustments in use of equipment rather than through an
25 explicit price elasticity. For a reasonable conservative range of values for
26 price elasticity, however; that level of price increase would, in my opinion,

1 reduce the sales growth rate by 0.2 to 0.35 percentage points. That further
2 reduces the range for the sales forecast to 0.4 up to 1.1 percent, roughly
3 consistent with the actual trend. But there were also other factors at work.
4 First, sharply rising oil prices signalled all consumers about the rising cost
5 of energy and the need for conservation. And second, changing national
6 policy and gas market conditions resulted in an end to restrictions on gas use
7 and new connections. And, of course, other factors would have modified the
8 complete forecast. But I believe the general point is already illustrated: if,
9 in the late 1970s, PECO forecasters had had perfect foresight of future
10 energy and market conditions, they, and other forecasters using similar
11 methodologies, would have produced projections that were reasonably
12 consistent with subsequent actual sales and peak requirements.

13 Q. Please summarize, in your opinion, how the changes in market
14 conditions brought about by the second Arab oil embargo changed the
15 electricity sales outlook.

16 A. As is generally recognized, economic forecasting is a risky and
17 uncertain business. Yet it is precisely the difficult-to-anticipate changes in
18 economic factors that play a prominent role in determining customer
19 demand for electricity. The changes brought on by the second oil supply
20 disruption -- in economic activity and in energy price levels -- had a major
21 impact on the demand for electricity in succeeding years. Had forecasters
22 in early 1979 been sufficiently prescient to anticipate these changes, I
23 believe their product would have been very much consistent with what
24 actually did happen to electricity sales, in PECO's service area and
25 throughout the nation. But their lack of this degree of foresight hardly
26 suggests imprudence; indeed, it would require reaching a conclusion that

1 pretty much all of the forecasts then available were imprudent, either in
2 outlook for electricity requirements, or in projections for other variables
3 such as economic growth and energy prices.

4 Q. Did PECO forecasting respond to these changes?

5 A. Quite clearly it did, as indicated in Exhibit _____ (LAG-8).

6 Q. Based on your findings, in your opinion did PECO forecasts reflect
7 reasonable practices?

8 A. Yes. Since the time of the Arab oil embargo, PECO has developed a
9 state-of-the-art forecasting methodology stressing detailed examination of
10 end uses of electricity. During this time, PECO's forecasts have been
11 responsive to changing underlying economic conditions as they were
12 recognized. As a result, by 1979 PECO had cut earlier forecasts of
13 requirements by roughly 40 percent. Following the second oil supply
14 disruption, PECO continued to adjust downward its forecasts in response to
15 sluggish economic growth and rising energy costs. As a result, the PECO
16 forecasts have tracked reasonably well with those prepared by most other
17 forecasters, given the information available at the time they were prepared.
18 By 1979, with perfect foresight, the PECO forecasting methodology would
19 likely have produced projections that squared well with subsequent sales and
20 peaks.

21 Q. What additional analysis have you performed to check this?

22 A. I have duplicated, using PECO data, a portion of the technical
23 analysis performed by Professor Nelson and detailed in the report to EPRI
24 that I cited earlier.

25 Q. Please describe the general nature of this analysis.

26 A. Professor Nelson posed the following questions:

1 - Were the NERC summary forecasts farther off target than they needed
2 to be? Could NERC, using standard statistical techniques and data
3 available at the time, have made more accurate aggregate forecasts?
4 Were the individual utilities' forecasters too timid in responding to the
5 slowdown in demand for electricity in the mid-1970s?

6 He then considered answers to these questions using statistical
7 analysis of time series data. For example, he considered what available
8 information about future growth could be extracted from past growth in
9 electricity sales by forecasters using exponential smoothing and other time
10 series statistical methodologies.

11 Q. What conclusions did Professor Nelson reach as a result of his
12 investigation of the national data?

13 A. His basic result for a first-cut exponential smoothing analysis are
14 set forth in Exhibit _____ (LAG-11). In the analysis, forecasts of 10-year
15 sales growth rates are based solely on evaluating past sales data with the
16 criterion of minimizing errors in trend forecasts. Columns (4) and (5) of
17 Table 1 of Exhibit _____ (LAG-11) compare the forecast Nelson gets using
18 this approach with the actual NERC compiled forecasts from 1973 through
19 1982. The results suggest that the NERC forecasts compiled from individual
20 company analyses produce forecasts "much like" the results of Professor
21 Nelson's first-cut statistical analysis of past growth trends.

22 More generally, and on the basis of more sophisticated investigation
23 introducing the effects of income and prices into his analysis, Nelson
24 concludes:

25 Analysts must accept part of the blame [for overly optimistic
26 forecasts]. The individual utility forecasts and the NERC summary
forecasts, in retrospect, were optimistic in terms of electricity sales
growth.

Yet, it is easy to see with hindsight why those forecasters were
optimistic. They (and NERC) probably could not have done much better,
as this retrospective analysis shows. More broadly, the forecasters and

1 much more senior utility executives, in 1974, could look back on dozens
2 of years of robust growth in electricity sales. Ever concerned with
3 providing reliable and adequate service, those executives' professional
4 sense of responsibility towards the industry's customers, coupled with an
5 optimistic view of future rapid GNP growth and stable real electricity
6 prices, probably drove too many expansionist decisions forward.

7 Q. How did you use this analysis for the PECO service area?

8 A. I employed the same methodology, using PECO energy sales data
9 (excluding sales for resale) instead of national data.

10 Q. Do the PECO data generally "look" the same as the national data for
11 purposes of this analysis?

12 A. Yes they do. I have prepared a chart (Exhibit ____ (LAG-12)) in
13 which I have plotted the annual percent changes in PECO sales and in
14 national sales data. The two series correspond quite closely, although PECO
15 changes are frequently below national figures. And vagaries of weather,
16 activity in individual industries, and the like make the data for a single
17 service area somewhat more volatile. Nevertheless, the analysis used by
18 Professor Nelson should apply for the PECO data.

19 Q. Describe your findings based on the supposition that PECO simply
20 made best use of emerging sales trends for forecasting future growth.

21 A. My findings based on PECO data only are set forth in Exhibit ____
22 (LAG-13). Each set parallels the equivalent table and chart prepared by
23 Professor Nelson and reproduced in Exhibit ____ (LAG-11). Thus,
24 column (4) of the table in Exhibit ____ (LAG-13) shows the estimated 10-
25 year growth rate forecasted using exponential smoothing techniques on past
26 sales trends. And column (5) has the corresponding PECO forecast for the
relevant period. These data are plotted on the chart in this Exhibit.

Of interest first is that the PECO data yield a so-called "smoothing
coefficient" (column (3)) of 1.0 for each year through 1977. This means that

1 the best exponential smoothing forecast for PECO using data starting in
2 1952 and ranging through 1972 up to 1977 is simply the average of past
3 growth. In subsequent years — that is beginning with the availability of
4 1978 data — the smoothing coefficient is less than 1.0. This indicates that
5 more weight should be given to most recent sales growth trends and less
6 weight to historic trends.

7 The results of Table 1, Exhibit ____ (LAG-13) indicate to me that
8 PECO may have been initially cautious about new growth trends, but quickly
9 adapted their forecasts. Thus, by 1976 — that is, with 1975 sales results
10 available — the PECO forecasts were very much in line with those based
11 solely on past sales trends. Indeed, the Company forecasts have been
12 consistently below the simple trended forecasts since that time.

13 Comparing the ES/BJ forecast with the PECO forecast shows how
14 rapidly and to what magnitude PECO forecasters revised their projections.
15 The ES forecast is based on a "signal plus noise" model. That is, the change
16 in the variable (growth of electricity sales) can be described as a trend (the
17 signal) and transitory fluctuations that affect the variable (the noise).
18 PECO, likewise, forecasted based on the trend in growth rates and analysis
19 of independent economic factors which affect electricity demand. Under
20 the circumstances of the mid-1970s, the PECO forecasters had the
21 advantage of being able to recognize the effect of these economic factors
22 on the trend in electricity sales as more than mere "noise". This meant
23 downgrading their projections based on the worsening economic situation,
24 rather than relying solely on smoothing trends.

25 Since (a) the PECO data did not indicate weighting more recent
26 sales data more heavily until the 1978 data; and (b) PECO forecasts did

1 seem to respond to emerging trends around this time, I considered, as an
2 alternative, using the national smoothing coefficients with PECO sales data.
3 These results are contained in Exhibit ____ (LAG-14). PECO forecasts and
4 the exponential smoothing forecasts using this approach match up somewhat
5 more closely, suggesting that PECO did begin to weigh in more recent sales
6 growth information by the mid-1970s.

7 Q. Mr. Guth, do the results set forth in Exhibit ____ (LAG-13) modify
8 in any way your conclusion that PECO's load forecasting efforts during the
9 1970s and early 1980s were reasonable and prudent?

10 A. No they do not. As I have already stated, the problem posed by load
11 forecasting was particularly difficult during the decade starting with the oil
12 embargo in late 1973. PECO grappled with this problem, which was
13 especially formidable given that the preceding period had been one of very
14 rapid growth and concomitant concern with meeting loads. However, by
15 the latter 1970s, PECO had clearly adapted its forecasts to the new
16 emerging trends consistent with the best information available at the time.

17 Q. Does that conclude your testimony?

18 A. Yes.

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VITA

NAME: Louis A. Guth

BUSINESS ADDRESS:

National Economic Research
Associates, Inc.
123 Main Street
White Plains, New York 10601
(914) 681-7950

EDUCATIONAL BACKGROUND:

UNIVERSITY OF PENNSYLVANIA
M.A., Economics, 1965

HARVARD UNIVERSITY
B.A., Economics, 1964

PROFESSIONAL BACKGROUND:

1968-Present

NATIONAL ECONOMIC RESEARCH ASSOCIATES, INC.
(NERA)

Senior Vice President (since 1979)

Mr. Guth has prepared studies on the interrelationships of market structure, advertising behavior, risk and rate of return. He has prepared numerous reports and testimony dealing with antitrust matters concerning reciprocity, market structure and mergers, particularly the effects of conglomerate mergers. He has also prepared analyses and testimony dealing with economic and antitrust issues in professional sports.

Mr. Guth has also done substantial work in regulatory matters, including the quantification of economic demand and cost concepts, and the development of policies to balance competitive and regulatory objectives. His studies include detailed statistical analysis of costs in the stock brokerage industry and a review of proposals to modify the extent of competition between scheduled and nonscheduled air passenger services. He has performed an extensive analysis of the elasticity of demand for electric power of the major customer classes. Based on this analysis, he has prepared reports and testimony developing forecasts of growth in energy and peak demand for electric utilities. Mr. Guth has also developed NERA's regional gas demand model, RGD and NERA's energy forecasting model, NERAGEM. He has participated in and prepared numerous analyses

concerning national and regional natural gas policy. He supervises NERA efforts in forecasting state-specific, regional and national projections of gas, electricity and oil requirements and gas wellhead and burner-tip prices. He has appeared as an expert witness before the SEC, the FPC, the FERC, the CAB, the NRC, and state regulatory commissions, as well as Federal District Courts.

1965-1968

NEW YORK UNIVERSITY
Graduate School of Business Administration
Assistant Professor

ARTICLES:

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"Impact on Natural Gas Prices and Annual Requirements of Proposed Legislation: A Comparative Analysis," Oil and Gas Analyst, December 1983.

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Before the New York Public Service Commission, Direct Testimony on behalf of Rochester Telephone Company, In the Matter of The Rochester Telephone Company, Case No. 27014, 1976.

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Before the New York State Department of Public Service and the New York State Board on Electric Generation Siting and the Environment on behalf of Rochester Gas and Electric, et al., In the Matter of the Rochester Gas and Electric Corporation Sterling Power Project, Nuclear Unit No. 1, 1975.

Before the Virginia State Corporation Commission on behalf of Virginia Electric and Power Company, In the Matter of Virginia Electric and Power Company, Case No. 19426, 1975, also before the FPC in Project No. 2716.

Before the Atomic Safety and Licensing Board of the Atomic Energy Commission on behalf of Boston Edison, In the Matter of Boston Edison Company, et al., (Pilgrim Nuclear Generating Station Unit 2), Docket No. 50-471, 1975.

Before the Atomic Safety and Licensing Board of the Atomic Energy Commission on behalf of Union Electric Company, In the Matter of Union Electric Company (Callaway Plant, Units 1 and 2), Docket Nos. 50-483 and 50-486, 1975.

Before the New York Public Service Commission, on behalf of Rochester Telephone Corporation, In the Matter of the Rochester Telephone Corporation, Case No. 26215, 1974.

Before the Public Utilities Commission of Ohio on behalf of Dayton Power and Light Company, In the Matter of Dayton Power and Light Company, Case No. 74-283-4, 1974.

Before the Arizona Corporation Commission, on behalf of Duval Corporation, American Smelting and Refining Co., Cyprus Pima Mining Company and Arizona Portland Cement Co., In the Matter of the Tucson Gas & Electric Company Rate Case, Docket No. U-1933, 1974.

Before the Atomic Safety and Licensing Board of the Atomic Energy Commission, on behalf of Florida Power & Light Company, In the Matter of Florida Power & Light Company (St. Lucie Unit 2), Docket No. 50-389, 1974 and in June 1975, before the State of Florida Public Utilities Commission, Department of Pollution Control hearing, dealing with the same matter.

Before the Atomic Safety and Licensing Board of the Atomic Energy Commission on behalf of Cleveland Electric Illuminating Company, In the Matter of Cleveland Electric Illuminating Company (Perry Units 1 and 2), Docket Nos. 50-440 and 50-441, 1974.

Before the South Carolina Public Service Commission on behalf of Duke Power Company, Docket No. 17057, 1974.

Before the North Carolina Utilities Commission on behalf of Duke Power Company, in NCUC Docket E-7, Sub 159, 1974.

Before the United States District Court, Eastern District of Wisconsin on behalf of New York Stock Exchange in Thill Securities Corp., et al. v. New York Stock Exchange, Civil Action No. 63-C-264, May 1973.

Before the Missouri Public Service Commission on behalf of Union Electric Company, Case No. 17140, 1971.

Before the Civil Aeronautics Board, Testimony on behalf of Trans World Airlines, Docket No. 21866-9, 1970.

Before the Securities and Exchange Commission, In the Matter of S.E.C. Rate Structure Investigation of National Securities Exchange, August 1968 and May 1969.

ACTUAL PHILADELPHIA ELECTRIC COMPANY (PECO) ELECTRICITY SALES
1950-1984

Customer Class

Year	Residential					Small Commercial and Industrial					Large Commercial and Industrial					Govt. and Municipal					Retail					Railroads and Railways					Interdepartmental					Total Sales less Sales for Retail & Interdept.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)										
1950	1,340,111,068	1,057,578,251	3,879,358,659	97,654,572	545,078,034	1,153,676,708	39,100,723	7528179058																																
1951	1,477,439,045	1,114,380,148	4,351,739,354	101,742,590	230,820,349	1,166,017,715	39,145,053	8211318852																																
1952	1,629,986,401	1,183,791,357	4,547,538,894	108,961,324	45,280	1,144,761,440	27,612,537	8615019416																																
1953	1,794,839,702	1,240,110,170	4,903,025,366	115,050,686	7,662,123	1,092,129,580	24,807,069	9165155504																																
1954	1,952,999,427	1,312,990,029	4,897,180,619	123,071,856	8,468,006	1,025,639,630	25,495,345	9321881561																																
1955	2,159,747,504	1,378,144,632	5,501,675,723	133,904,905	9,922,263	1,041,997,640	27,426,070	10235470404																																
1956	2,402,817,221	1,473,956,004	5,791,628,881	143,217,792	11,007,149	987,506,930	26,545,971	10798926830																																
1957	2,577,895,914	1,530,019,207	6,029,503,755	149,946,068	21,357,929	923,067,740	27,641,807	11210232884																																
1958	2,732,177,203	1,542,157,186	5,921,793,881	157,412,130	28,073,544	854,273,140	30,492,068	11207813540																																
1959	2,945,101,313	1,670,137,015	6,565,071,701	168,925,206	30,697,948	836,247,520	28,140,950	12205482755																																
1960	3,056,608,112	1,683,662,411	6,881,737,380	180,026,275	20,656,849	815,472,150	27,910,350	12617506328																																
1961	3,298,458,928	1,751,456,497	7,235,036,223	191,122,362	17,782,372	829,100,670	27,018,566	1385225611																																
1962	3,405,298,471	1,780,711,036	6,143,032,277	201,788,413	21,996,040	829,100,670	28,169,026	14591508079																																
1963	3,612,622,968	1,822,865,755	6,749,383,236	204,423,979	26,593,322	808,563,100	26,519,609	1554417242																																
1964	3,847,322,933	1,911,863,504	7,499,512,000	210,312,349	24,297,633	825,535,220	24,909,000	16690015000																																
1965	4,167,574,000	2,003,082,000	9,469,512,000	219,124,000	22,737,000	830,723,000	34,701,000	17864664000																																
1966	4,456,554,000	2,086,560,000	10,267,444,000	245,487,000	29,822,000	822,917,000	35,494,000	18637937000																																
1967	4,762,716,000	2,125,184,000	10,724,644,000	259,747,000	32,293,000	780,452,000	37,534,000	20552451000																																
1968	5,379,575,000	2,256,311,000	11,940,803,000	267,720,000	35,238,000	741,669,000	43,821,000	21794030000																																
1969	5,812,139,000	2,292,579,000	12,662,784,000	270,260,000	37,575,000	713,941,000	45,532,000	23373045000																																
1970	6,380,973,000	2,427,874,000	13,296,656,000	285,817,000	39,282,000	727,321,000	47,829,000	24380281000																																
1971	6,648,886,000	2,503,484,000	14,010,947,000	288,195,000	55,524,000	715,839,000	48,532,000	25136630000																																
1972	6,885,782,000	2,663,317,000	14,621,442,000	289,200,000	105,722,000	756,396,000	48,666,000	25161972000																																
1973	7,493,526,000	2,558,043,000	14,059,944,000	275,852,000	106,635,000	759,311,000	58,605,000	26108246000																																
1974	7,159,012,000	2,623,869,000	14,661,642,000	300,454,000	108,443,000	806,322,000	58,605,000	26108246000																																
1975	7,424,017,000	2,754,933,000	14,661,642,000	300,454,000	108,443,000	806,322,000	58,605,000	26108246000																																
1976	7,584,895,000	2,754,933,000	14,661,642,000	300,454,000	108,443,000	806,322,000	58,605,000	26108246000																																
1977	8,110,432,000	2,825,124,000	14,912,141,000	311,227,000	109,527,000	817,997,000	60,278,000	27029304000																																
1978	7,875,376,000	2,889,274,000	15,428,191,000	308,566,000	111,067,000	798,529,000	59,573,000	27225202000																																
1979	7,987,522,000	2,927,754,000	15,428,191,000	308,566,000	111,067,000	798,529,000	59,573,000	27225202000																																
1980	8,341,313,000	3,064,582,000	15,056,280,000	248,093,000	113,159,000	740,219,000	57,216,000	27450487000																																
1981	8,013,558,000	3,115,239,000	14,916,155,000	199,442,000	1,332,501,000	636,612,000	60,582,000	26875006000																																
1982	7,877,026,000	3,141,611,000	14,177,602,000	194,469,000	3,458,475,000	651,356,000	60,827,000	26842866000																																
1983	8,467,240,000	3,283,906,000	14,478,093,000	195,415,000	456,789,000	633,828,000	60,914,000	27004482000																																
1984	8,515,491,000	3,543,423,000	14,880,555,000	196,058,000	1,510,287,000	685,541,000	64,001,000	27821068000																																

Source: Philadelphia Electric Company, Quantitative Sales and Performance: Electric Gas and Steam, 1950-1984

Exhibit 1 of 3
(LAG-2)

PECO ACTUAL AND FORECASTED PEAK LOADS

YEAR	Net Peaks		1972 Forecast	1973 Forecast	1974 Forecast	1975 Forecast	1976 Forecast	1977 Forecast
	Summer	Winter						
1955	1847	2116						
1956	1993	2095						
1957	2239	2155						
1958	2125	2222						
1959	2452	2359						
1960	2511	2353						
1961	2702	2464						
1962	2721	2575						
1963	2926	2683						
1964	3136	2822						
1965	3366	2972						
1966	3673	3234						
1967	3727	3351						
1968	4375	3509						
1969	4592	3771						
1970	4712	3797						
1971	4922	3986						
1972	5313	4186	5740					
1973	5760	4189	6300	6020				
1974	5431	4160	6650	6670	6400			
1975	5530	4255	7480	7240	6760	6280		
1976	5346	4457	8110	7950	7490	6690	5820	
1977	5888	4575	8630	8400	8020	7130	6320	6000
1978	5667	4627	9240	8950	8530	7600	6660	6300
1979	5641	4702	9770	9570	9010	8040	7020	6500
1980	6095	4537	10300	10110	9480	8490	7390	6900
1981	5731	4804	10840	10680	9960	8950	7780	7200
1982	5691	4946		11240	10660	9430	8180	7500
1983	5879	4730			10950	9900	8580	7800
1984	5975	4578				10380	8990	8100
1985	6036	5238					9390	8400

YEAR	1978 Forecast	1979 Forecast	1980 Forecast	1981 Forecast	1982 Forecast	1983 Forecast	1984 Forecast
1979	5700	5800	5900	5800	5600	5900	6100
1980	5850	5900	6000	5850	5650	5930	6150
1981	6000	6000	6100	5900	5700	5960	6160
1982	6150	6100	6200	5950	5750	5990	6180
1983	6300	6200	6300	6000	5800	6020	6200
1984	6450	6300	6400	6050	5850	6050	6220
1985	6600	6400	6500	6100	5900	6080	6240
1986	6800	6500	6600	6150	5950	6110	6260
1987	7000	6600	6700	6210	5990	6150	6320
1988	7200	6700	6800	6270	6010	6190	6380
1989							6440
1990							
1991							
1992							
1993							
1994							

Source: PECO Budget Forecasts 1978-1984,
and PECO Technical Services.

Note: Forecasts from 1978-1984 project peak load for ten years
beginning in the next year.

Billions of Kilowatt-Hours

PECO RESIDENTIAL SALES OF ELECTRICITY

1960-1984

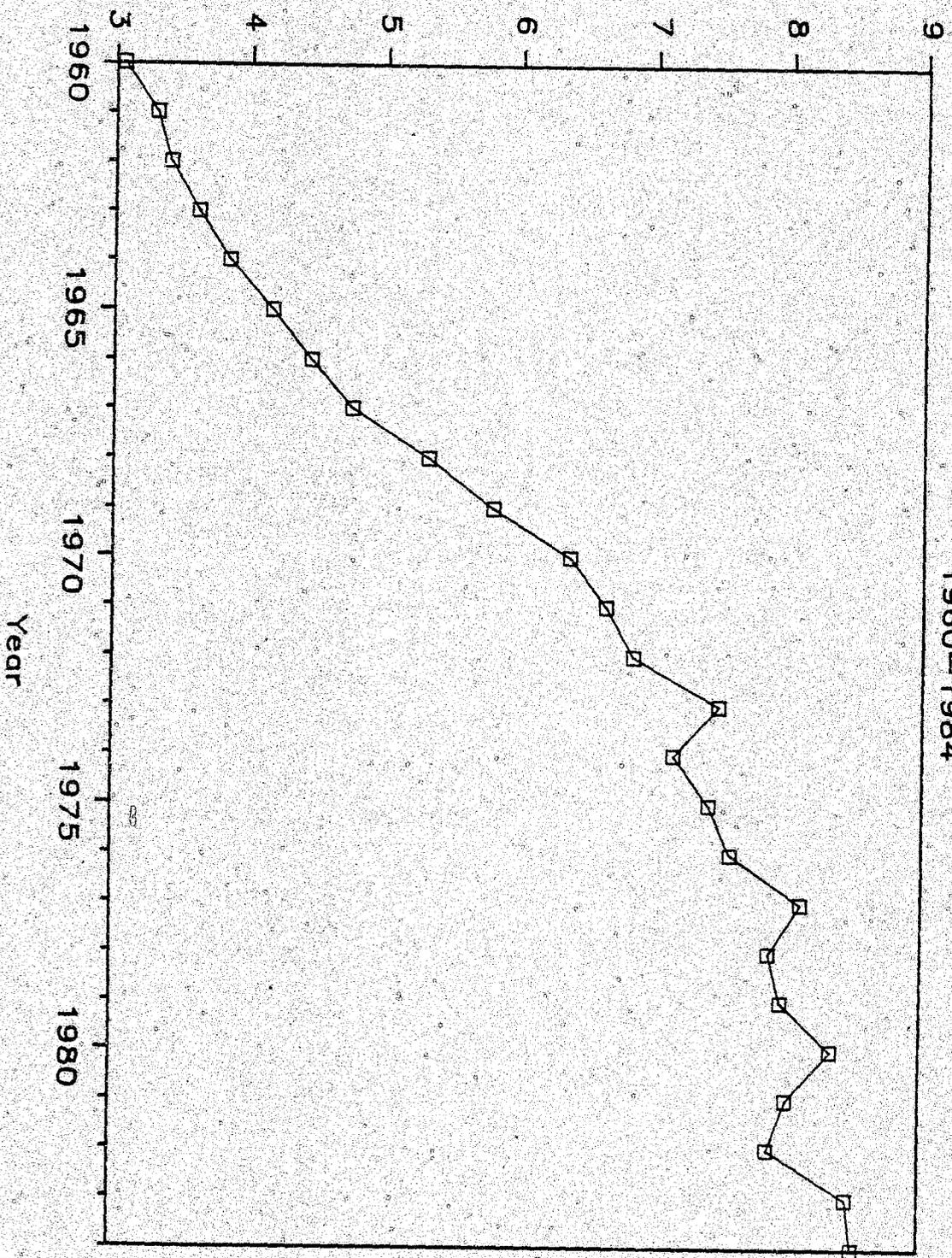
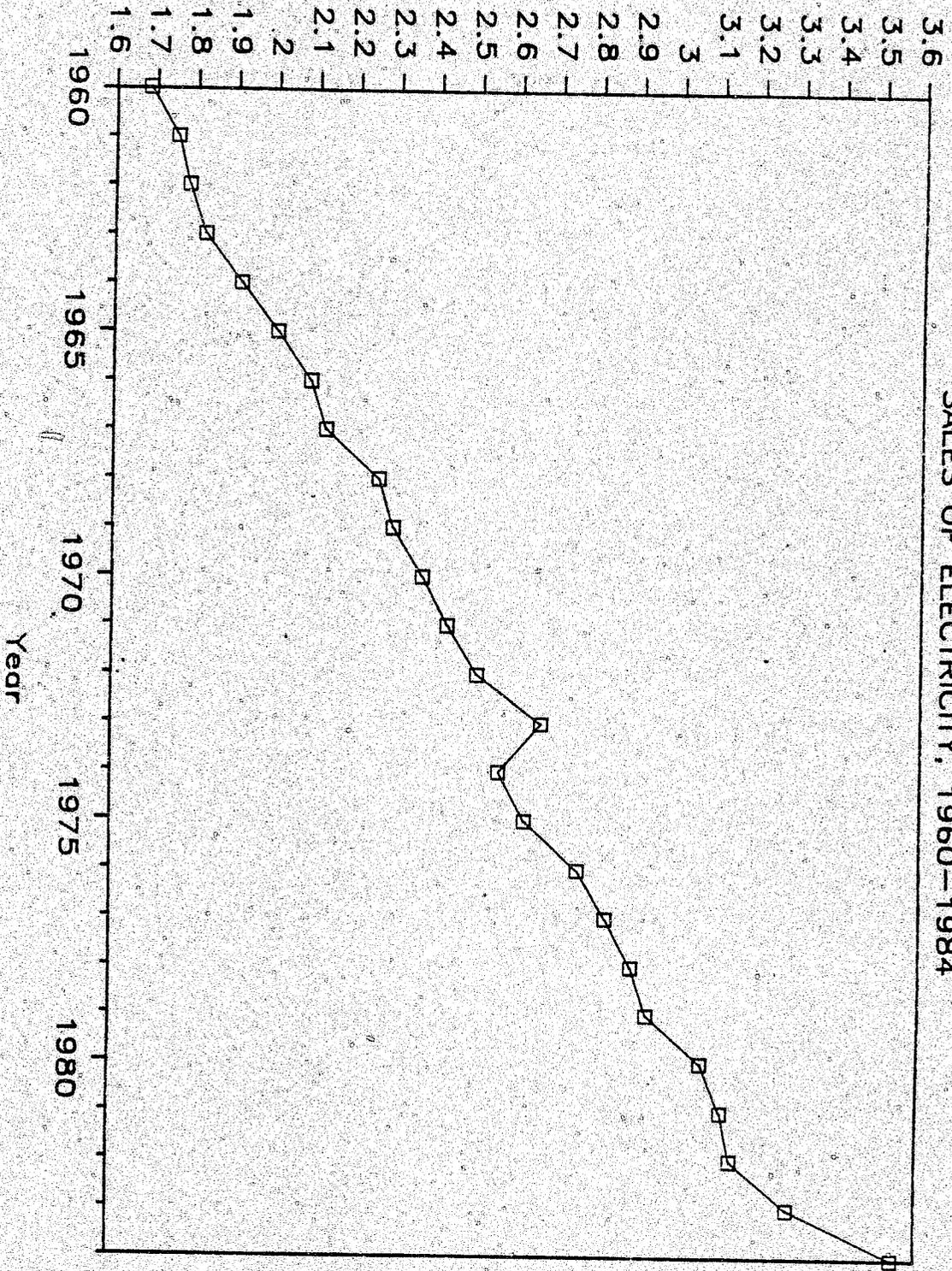


Chart 1 of 5

Exhibit (LAG-2)

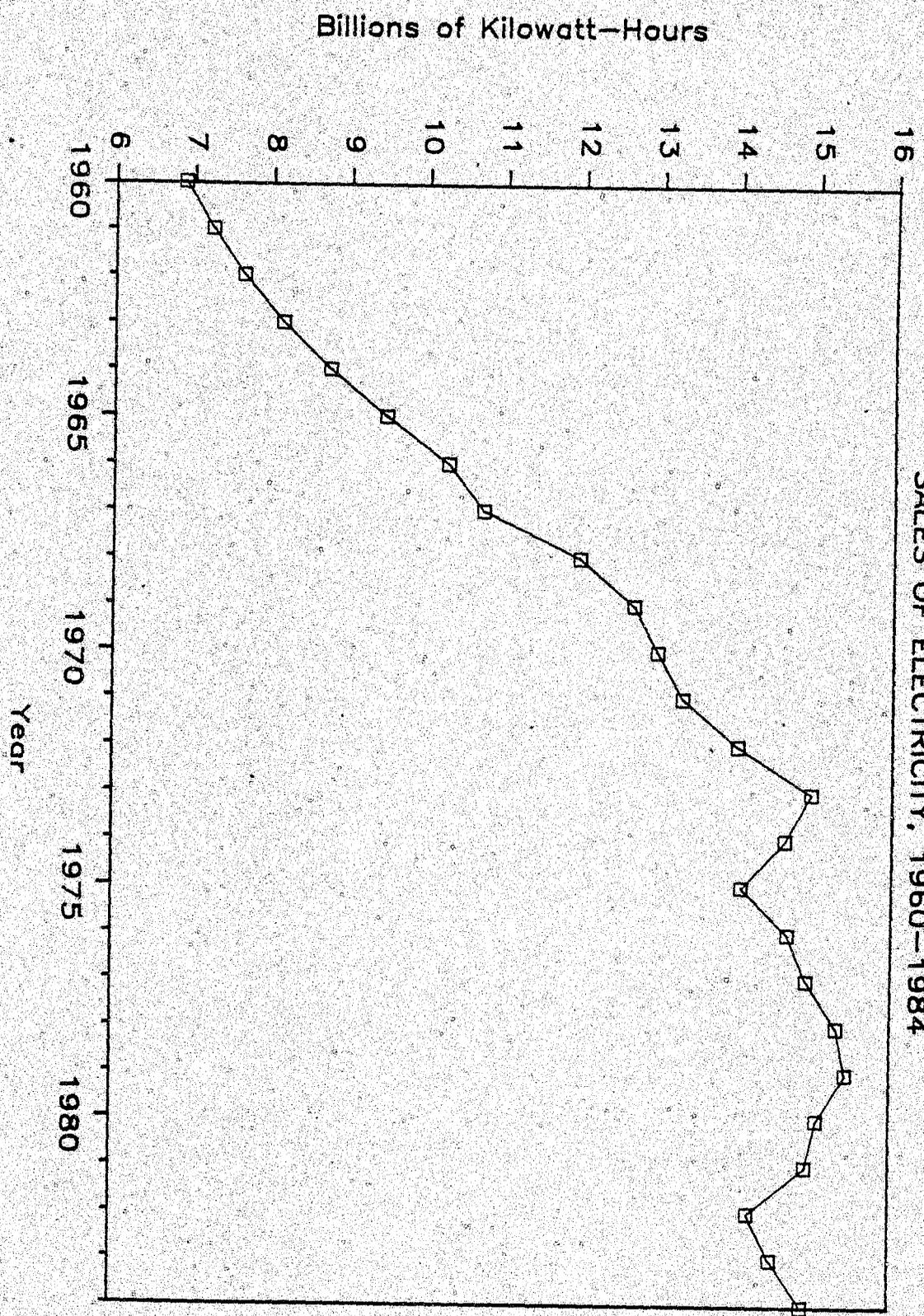
Billions of Kilowatt-Hours

PECO SMALL COMMERCIAL & INDUSTRIAL SALES OF ELECTRICITY, 1960-1984



PECO LARGE COMMERCIAL & INDUSTRIAL

SALES OF ELECTRICITY, 1960-1984



Billions of Kilowatt-Hours

PECO Total Sales less Sales for Resale and Interdepartmental Sales 1960-1984

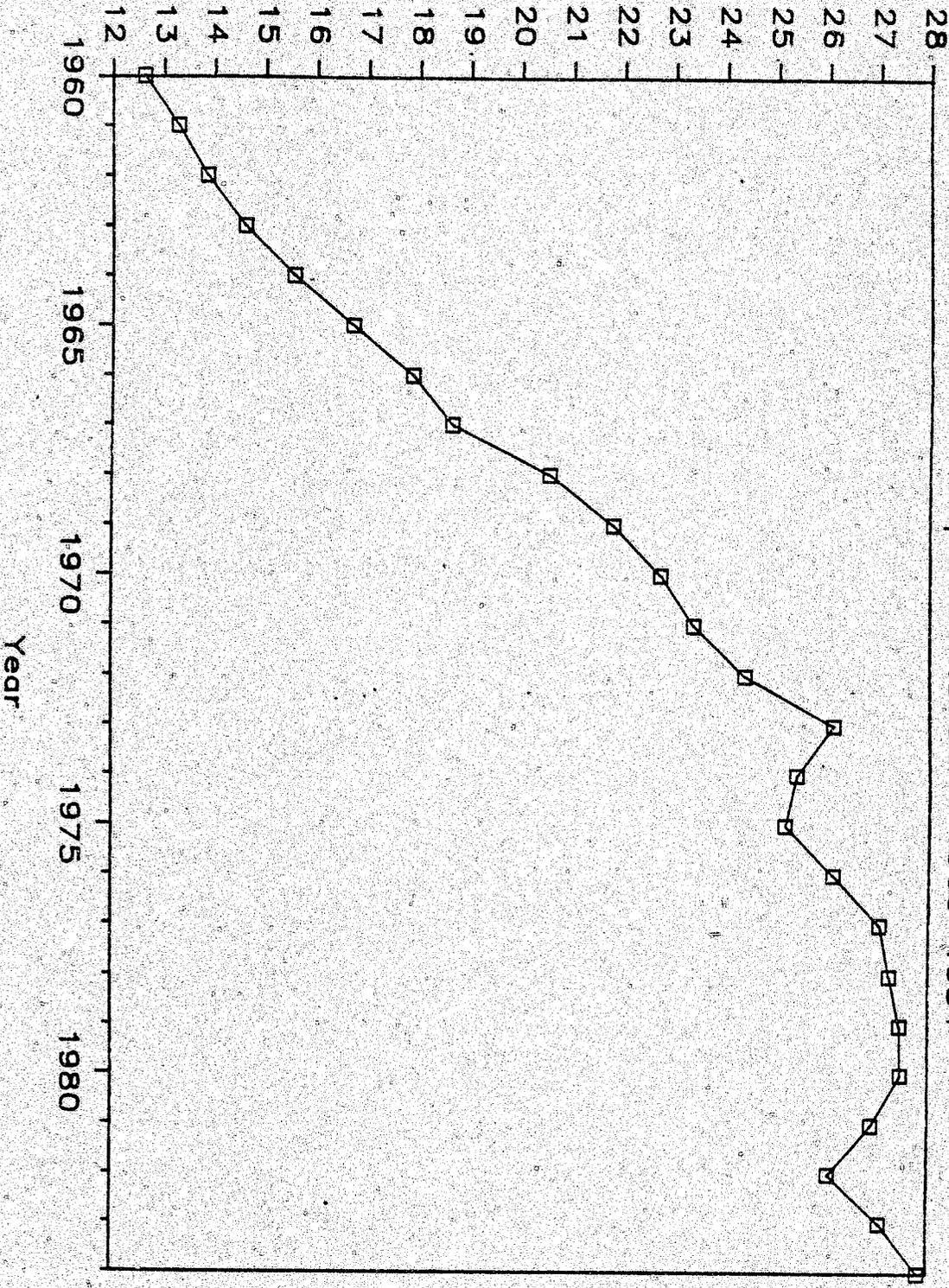
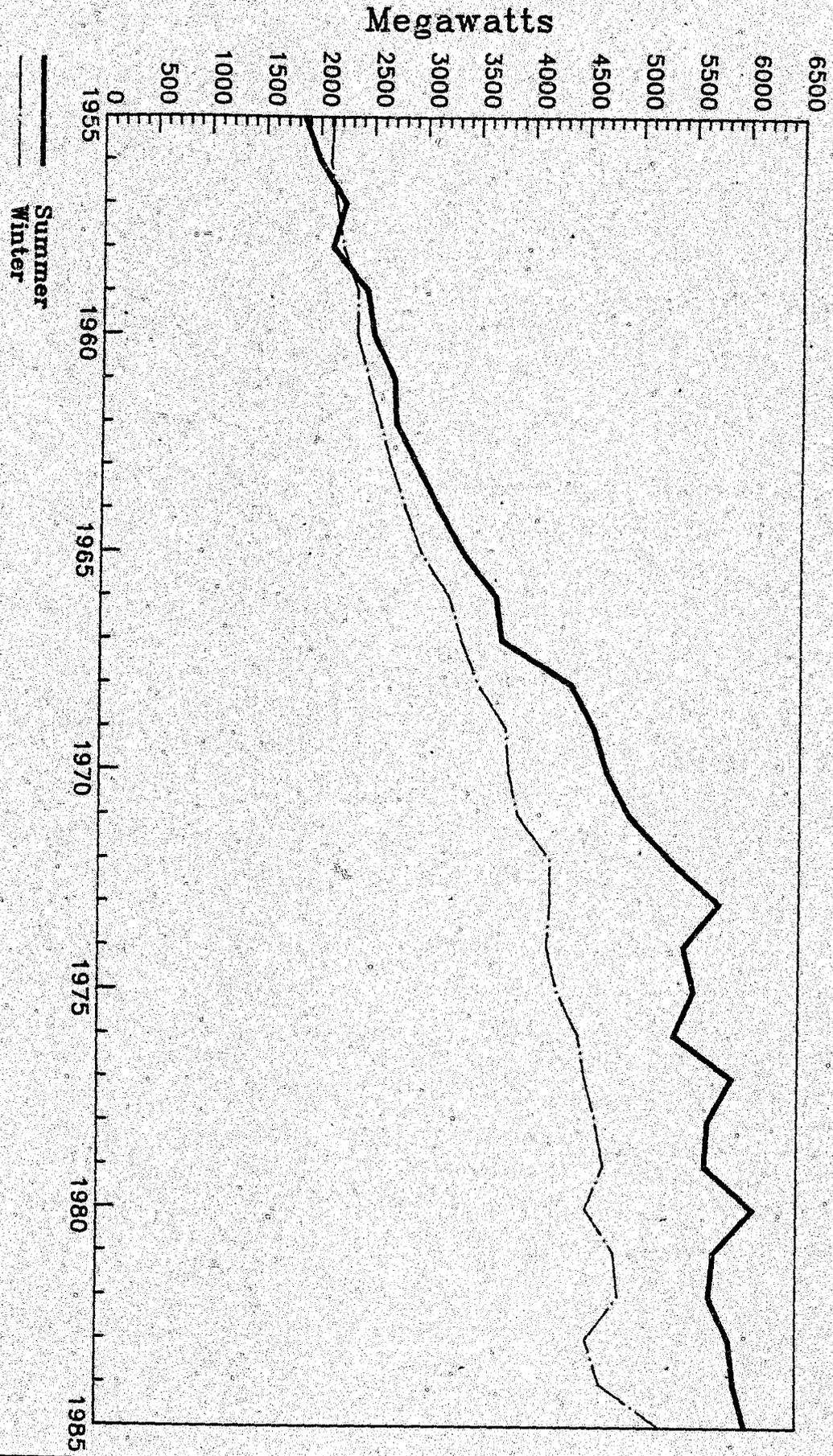


Exhibit (LAG-2)
Chart 4 of 5

PECO ANNUAL PEAK DEMAND 1955 - 1985



NET ANNUAL ENERGY REQUIREMENTS AS COMPILED BY NERC
FOR THE MAAC AND THE CONTIGUOUS UNITED STATES
1978 - 1987

Year	MAAC		Contiguous United States	
	Energy Requirements (GWh) (1)	Percentage Change (Percent) (2)	Energy Requirements (GWh) (3)	Percentage Change (Percent) (4)
1978	170,781	--	2,263,500	--
1979	178,893	4.75X	2,386,900	5.45X
1980	186,641	4.33	2,524,200	5.75
1981	195,505	4.75	2,661,800	5.45
1982	203,999	4.34	2,804,300	5.35
1983	212,810	4.32	2,946,000	5.05
1984	221,428	4.05	3,100,700	5.25
1985	230,114	3.92	3,257,300	5.05
1986	238,810	3.78	3,418,600	4.95
1987	247,271	3.54	3,577,600	4.65
Average Annual Growth Rate				
1978 - 1985		4.35X		5.34X
1978 - 1987		4.20X		5.22X

Source: Col. (1): Economic Regulatory Administration, Division of Power Supply and Reliability U.S. Department of Energy, Electric Power Supply and Demand 1978-1987 for the Contiguous United States (Washington DC: U.S. Govt. Printing Office), June 15, 1978, Table 4.

Col. (3): Edison Electric Institute, 1978 Annual Electric Power Survey, April 1978.

EDISON ELECTRIC INSTITUTE
 PROJECTED NET ANNUAL ENERGY REQUIREMENTS
 FOR THE MAAC AND THE CONTIGUOUS UNITED STATES
 1978 - 1988

Year	MAAC		Contiguous United States	
	Energy Requirements (GWh) (1)	Percentage Change (Percent) (2)	Energy Requirements (GWh) (3)	Percentage Change (Percent) (4)
1978 <1	169,766	--	2,218,700	--
1979	175,386	3.31%	2,339,700	5.45%
1980	182,155	3.86	2,460,200	5.15
1981	188,816	3.66	2,589,400	5.25
1982	196,091	3.85	2,715,000	4.85
1983	203,286	3.67	2,838,600	4.55
1984	210,608	3.60	2,976,300	4.85
1985	217,782	3.41	3,114,700	4.65
1986	224,991	3.31	3,250,200	4.35
1987	232,248	3.23	3,391,600	4.35
1988	239,579	3.16	3,542,600	4.45
Average Annual Growth Rate				
1978 - 1985		3.62%		4.97%
1978 - 1988		3.50%		4.79%

1> Actual.

Source: Edison Electric Institute, 1979 Annual Electric Power Survey, April 1979, pp. 14-15.

PEAK DEMANDS FOR THE MAAC AS COMPILED BY NERC
1978 - 1987

Year	Peak Demand		Growth In Peak Demand	
	Summer ----- (1) ----- (Megawatts)	Winter ----- (2) -----	Summer ----- (3) ----- (Percent)	Winter ----- (4) -----
1978	32,713	28,866	--	--
1979	34,097	30,114	4.23%	4.32%
1980	35,382	31,489	3.77	4.57
1981	36,887	33,063	4.25	5.00
1982	38,362	34,528	4.00	4.43
1983	39,859	36,102	3.90	4.56
1984	41,274	37,626	3.55	4.22
1985	42,759	39,141	3.60	4.03
1986	44,191	40,715	3.35	4.02
1987	45,651	42,274	3.30	3.83

Average Annual Growth Rate	
1978 - 1985	3.90%
1978 - 1987	3.77%
	4.45%
	4.33%

Note: The demands include interruptible load and exclude inter-regional purchases and sales of capacity.

Source: Economic Regulatory Administration, Division of Power Supply and Reliability, U.S. Department of Energy, Electric Power Supply and Demand 1978-1987 for the Contiguous United States (Washington DC: U.S. Govt. Printing Office), June 15, 1978, Table 2.

EDISON ELECTRIC INSTITUTE
PROJECTED PEAK DEMANDS FOR THE MAAC
1978 - 1988

Year	Peak Demand		Growth in Peak Demand	
	Summer ----- (1) ----- (Megawatts)	Winter ----- (2) -----	Summer ----- (3) ----- (Percent)	Winter ----- (4) -----
1978 < 1	31,812	28,655	--	--
1979	33,446	29,686	5.14%	3.60%
1980	34,436	30,776	2.96	3.67
1981	35,586	32,036	3.34	4.09
1982	36,876	33,286	3.63	3.90
1983	38,066	34,566	3.23	3.85
1984	39,196	35,806	2.97	3.59
1985	40,426	37,036	3.14	3.44
1986	41,566	38,306	2.82	3.43
1987	42,756	39,576	2.86	3.32
1988	44,066	40,856	3.06	3.23
Average Annual				
Growth Rate				
1978 - 1985			3.48%	3.73%
1978 - 1988			3.31%	3.61%

1 > Actual.

Source: Edison Electric Institute, 1979 Annual Electric Power Survey, April 1 1979, pp. 6-9.

EDISON ELECTRIC INSTITUTE
FORECASTS OF ANNUAL KILOWATT-HOUR REQUIREMENTS
1974 - 1982

Year	MAAC			All NERC Regions			MAAC as % of All Regions	
	Actual Electricity Requirements (GWh)	10-Year Forecasted Requirements	Annual Growth Rate (Percent)	Actual Electricity Requirements (GWh)	10-Year Forecasted Requirements	Annual Growth Rate (Percent)	Actual Electricity Requirements (Percent)	Annual Growth Rate (Percent)
	(1)	(2)	(3)	(4)	(5)	(6)	[(1)/(4)] (7)	[(3)/(6)] (8)
1973	155,362	--	--	1,847,862	--	--	8.41%	--
1974 <1	151,274	210,713	5.68%	1,851,727	2,791,756	7.08%	8.17	80.19%
1975	151,439	260,976	5.59	1,900,670	3,510,302	6.33	7.97	88.40
1976	159,679	254,136	4.76	2,021,266	3,579,464	5.88	7.90	80.88
1977	164,135	247,271	4.18	2,115,089	3,561,179	5.35	7.76	78.22
1978	169,766	239,579	3.50	2,202,166	3,527,611	4.82	7.71	72.64
1979	172,540	236,938	3.22	2,246,927	3,380,530	4.17	7.68	77.29
1980	175,622	230,713	2.77	2,292,718	3,236,073	3.51	7.66	78.89
1981	174,668	222,013	2.43	2,311,006	3,180,947	3.25	7.56	74.77
1982	171,662	212,779	2.17	2,258,744	3,123,464	3.29	7.60	65.88

-- Not Available.

Note: The 1975 Electric Power Survey is the first survey with data on the Reliability Councils as they are currently defined.

1> These forecasts are for six years.

Source: Edison Electric Institute, Annual Electric Power Survey, annual editions, 1975-1983.

ENERGY INFORMATION ADMINISTRATION
PROJECTED GROWTH IN NATIONAL ELECTRICITY CONSUMPTION
1976 - 1985

Sector	1976			1985				
	Actual	Mid Demand Mid Supply	High Demand High Supply	High Demand Low Supply	Low Demand High Supply	Low Demand Low Supply	Mid Demand Mid Supply	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Residential	613	841	847	825	845	825	838	
Commercial	501	696	698	697	678	678	690	
Industrial	725	1,225	1,256	1,182	1,260	1,187	1,263	
Transportation	4	4	4	4	4	4	4	
Total Consumption	1,843	2,766	2,805	2,708	2,787	2,694	2,795	
Average Annual Growth Rate		4.61%	4.78%	4.37%	4.70%	4.31%	4.74%	

- 1> Increasing world oil prices.
- 2> Differs from sum given in source.

Source: Energy Information Administration, U.S. Department of Energy, Annual Report to Congress, 1977, Volume II: Projections of Energy Supply and Demand and Their Impacts (Washington, DC: U.S. Govt. Printing Office), p. 211.

ENERGY INFORMATION ADMINISTRATION
PROJECTED GROWTH IN NATIONAL ELECTRICITY SALES
1977 - 1990

Sector	1977		1985		1990	
	Actual	Mid Demand Mid Supply	Mid Demand Mid Supply	High Demand High Supply	High Demand Low Supply	Low Demand Low Supply
Residential	2.23	2.83	3.34	3.37	3.32	3.25
Commercial	1.83	2.61	3.09	3.45	2.85	2.80
Industrial	2.58	3.96	5.02	5.47	5.21	4.87
Transportation	0.01	0.01	0.01	0.01	0.01	0.01
Total Sales	6.66	9.41	11.46	12.30	11.39	10.73
Average Annual Growth Rate		4.42%	4.26%	4.63%	4.21%	3.74%

Source: Energy Information Administration, U.S. Department of Energy, Annual Report to Congress, 1978, Volume III: Forecasts (Washington DC: U.S. Govt. Printing Office), pp. 266-269.

**GROWTH IN NATIONAL ELECTRICITY CONSUMPTION
PROJECTED BY THE ENERGY INFORMATION ADMINISTRATION
1978 - 1985**

	1978		1985		
	Actual	Low 27.00	Mid 32.00	High 39.00	
World Oil Price (\$1979 per Barrel):	(1)	(2) (Quadrillion Btu)			(4)
Residential	2.4	2.8	2.8	2.8	
Commercial	1.7	1.9	1.9	1.9	
Industrial	2.7	3.6	3.6	3.6	
Total Consumption	6.8	8.3	8.3	8.3	
Average Annual Growth Rate		2.9%	2.9%	2.9%	

Source: Energy Information Administration, U.S. Department of Energy, Annual Report to Congress, 1979, Volume III: Forecasts (Washington DC: U.S. Govt. Printing Printing Office, April 1980), pp. 83 & 108. Prepared April 1980.

EDISON ELECTRIC INSTITUTE
 1978 PROJECTIONS OF PEAK DEMAND FOR THE CONTIGUOUS UNITED STATES
 1978 - 1987

Year	Peak Demand		Growth in Peak Demand	
	Summer ----- (1) ----- (Megawatts)	Winter ----- (2) -----	Summer ----- (3) ----- (Percent)	Winter ----- (4) -----
1978	421,100	390,300	--	--
1979	444,900	412,000	5.65%	5.56%
1980	469,250	436,150	5.47	5.86
1981	494,400	459,950	5.36	5.46
1982	520,400	484,100	5.26	5.25
1983	545,400	509,550	4.80	5.26
1984	573,500	537,350	5.15	5.46
1985	601,900	564,800	4.95	5.11
1986	631,700	593,350	4.95	5.05
1987	660,600	623,350	4.57	5.06
Average Annual				
Growth Rate				
1978 - 1985			5.24%	5.42%
1978 - 1987			5.13%	5.34%

Source: Edison Electric Institute, 1978 Annual Electric Power Survey, April 1978, pp. 6-9.

EDISON ELECTRIC INSTITUTE
1979 PROJECTIONS OF PEAK DEMAND FOR THE CONTIGUOUS UNITED STATES
1978 - 1988

Year	Peak Demand		Growth in Peak Demand	
	Summer ----- (Megawatts) (1)	Winter ----- (2)	Summer ----- (Percent) (3)	Winter ----- (4)
1978 <1	408,050	383,100	--	--
1979	436,600	405,250	7.00%	5.78%
1980	458,250	426,950	4.96	5.35
1981	481,400	448,950	5.05	5.15
1982	505,250	470,300	4.95	4.76
1983	526,750	493,150	4.26	4.86
1984	551,800	517,100	4.76	4.86
1985	576,950	540,650	4.56	4.55
1986	602,050	564,750	4.35	4.46
1987	628,250	589,900	4.35	4.45
1988	655,600	615,600	4.35	4.36
Average Annual Growth Rate				
1978 - 1985			5.07%	5.04%
1978 - 1988			4.86%	4.86%

1> Actual.

Source: Edison Electric Institute, 1979 Annual Electric Power Survey, April 1979, pp. 6-9.

EDISON ELECTRIC INSTITUTE
 1980 PROJECTIONS OF PEAK DEMAND FOR THE CONTIGUOUS UNITED STATES
 1978 - 1989

Year	Peak Demand		Growth in Peak Demand	
	Summer ----- (1) ----- (Megawatts)	Winter ----- (2)	Summer ----- (3) ----- (Percent)	Winter ----- (4)
1978	<1	408,050	383,100	---
1979	<1	411,550	380,700	0.86%
1980		438,150	411,350	-0.63%
1981		457,250	430,900	6.46
1982		478,550	449,100	4.36
1983		497,950	468,200	4.66
1984		518,650	488,600	4.05
1985		539,150	508,400	4.16
1986		559,400	529,000	3.95
1987		580,400	549,900	3.76
1988		601,600	570,900	3.75
1989		623,600	591,150	3.65
Average Annual Growth Rate				
1978 - 1985				3.66
1978 - 1989				4.06%
				4.13%
				3.59%
				3.34%

1 > Actual.

Source: Edison Electric Institute, 1980 Annual Electric Power Survey, 1980, pp. 6-9.

FORECASTED GROWTH RATES FOR ELECTRIC POWER
AS REPORTED IN PREDICASTS ANNUAL CUMULATIVE EDITIONS

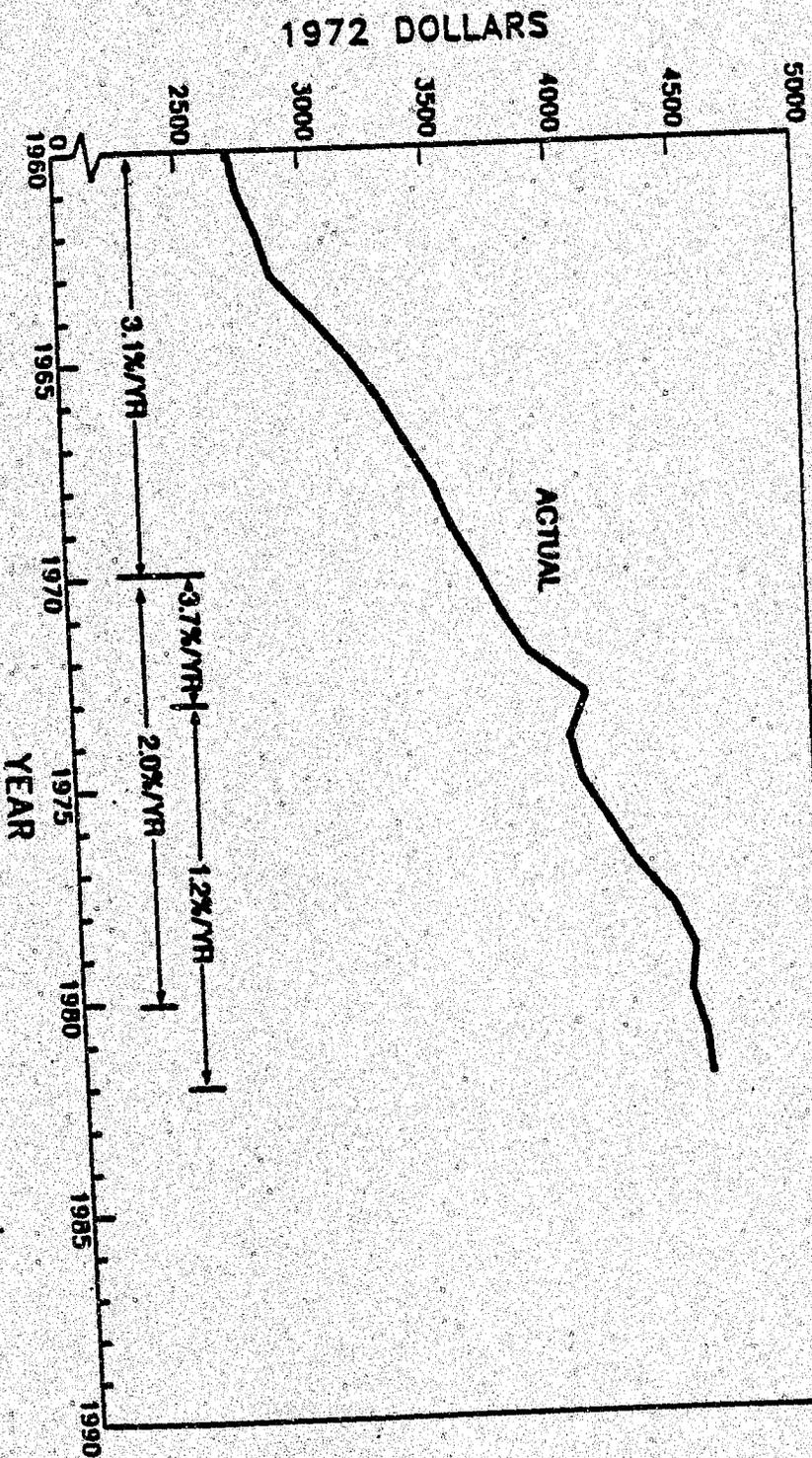
Electric Power Category	Additional Descriptor	Source			Forecast Period	Annual Growth Rate (Percent)
		Journal	Date	(1)		
1978 Predicasts						
Peak Load	(annual non-coal)	Electrical World	9/15/77	1977 - 1995	5.3%	
Peak Load		Business Week	11/7/77	1978 - 1987	5.7	
Consumption	primary energy	American Gas Association	10/ /77	1976 - 1985	4.4	
Consumption	primary energy	U.S. International Trade Commission, Publication #832	9/ /77	1975 - 1985	5.1	
Consumption	primary energy	Congressional Research Service, 93-856	7/ /77	1976 - 1985	4.4	
Consumption	primary energy	Congressional Research Service, 93-856	7/ /77	1975 - 1985	5.8	
Consumption	primary energy	Commerce America	5/9/77	1976 - 1985	2.4	
Consumption		U.S. Coal Developments -- Promises, Uncertainties	9/22/77	1975 - 1985	5.4	
Consumption		U.S. Coal Developments -- Promises, Uncertainties	9/22/77	1975 - 1985	7.7	
Consumption		Iron Age	4/10/76	1975 - 1990	4.7	
Consumption		Oil & Gas Journal	8/1/77	1977 - 1990	5.5	
Consumption		Wall Street Transcript	1/2/78	1978 - 1987	4.5	
Consumption		Wall Street Transcript	12/5/77	1978 - 1987	5.5	
Consumption		Modern Casting	1/ /78	1978 - 1990	6.5	
Sales	by sector	Energy Information Administration, Annual Report to Congress	4/ /78	1976 - 1985	4.6	
Sales		Electrical World	9/15/77	1977 - 1995	4.5	
Sales		Electrical World	1/1/78	1977 - 1981	5.9	
1979 Predicasts						
Peak Load	(winter)	Survey of Power Equipment Requirements of the U.S. Electric Utility Industry, 1973 - 1982	3/ /78	1978 - 1986	5.6	
Peak Load	(summer)	Same as above	3/ /78	1978 - 1986	5.4	
Peak Load		Industrial Research	3/ /79	1977 - 1987	5.3	
Peak Load		Chemical Week	11/15/78	1978 - 1987	5.5	
Peak Load		Energy User News	1/1/79	1978 - 1985	5.0	
Peak Load		Power Engineering	1/ /79	1978 - 1987	5.0	

FORECASTED GROWTH RATES FOR ELECTRIC POWER
AS REPORTED IN PREDICASTS ANNUAL CUMULATIVE EDITIONS

Electric Power Category	Additional Descriptor	Source		Date	Forecast Period	Annual Growth Rate (Percent)
		Journal	(1)			
Consumption	(per capita)	Energy User News	(2)	12/4/78	1978 - 1990	4.3
Consumption		Energy User News		8/21/78	1977 - 1985	4.3
Consumption		Economic Bulletin (Metropolitan Life)		3/ /79	1979 - 1983	4.7
Consumption		Chain Store Age		1/ /79	1976 - 1985	5.9
Consumption		Turbo Machinery International		4/ /79	1977 - 1985	4.6
Consumption		Science		9/15/78	1978 - 1987	4.4
Consumption		Science		9/15/78	1978 - 1987	5.2
Consumption		Wall Street Transcript		1/22/79	1978 - 1990	4.3
Consumption		Chemical & Engineering News		6/11/79	1978 - 1990	4.5
Consumption		Power Engineering		4/ /79	1978 - 1990	4.6
Consumption		Chemical Marketing Reporter		7/17/78	1973 - 1990	5.0
Consumption		Energy User News		12/4/78	1978 - 1990	5.0
Sales		Industry		1/ /79	1978 - 1990	4.3
Sales		Power Engineering		1/ /79	1978 - 1987	5.0

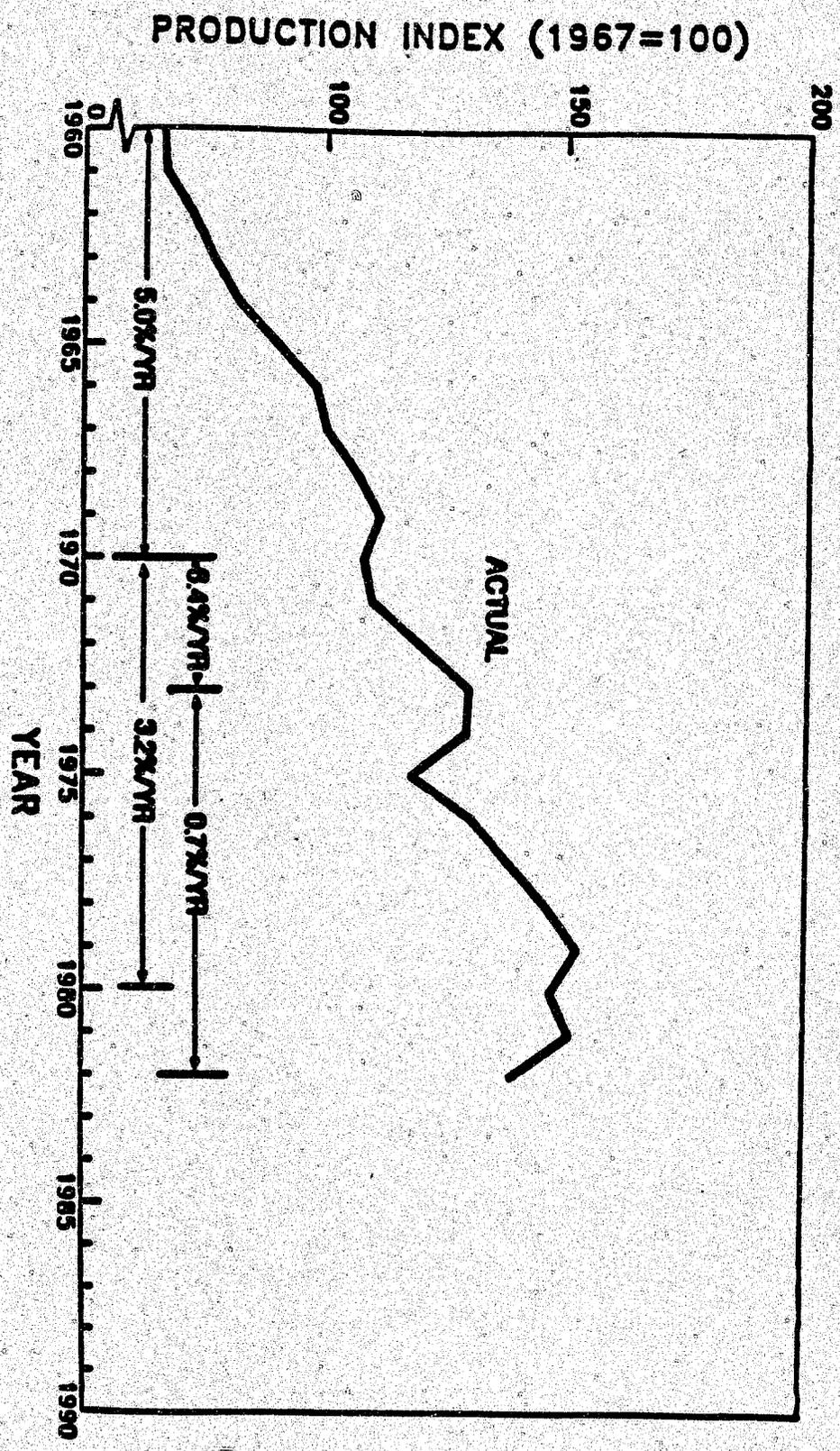
Source: Predicasts Annual Cumulative Edition (Cleveland, Ohio: Predicasts, Inc.), 1978 & 1979 editions.

PER CAPITA INCOME AND GROWTH RATES 1960-1982



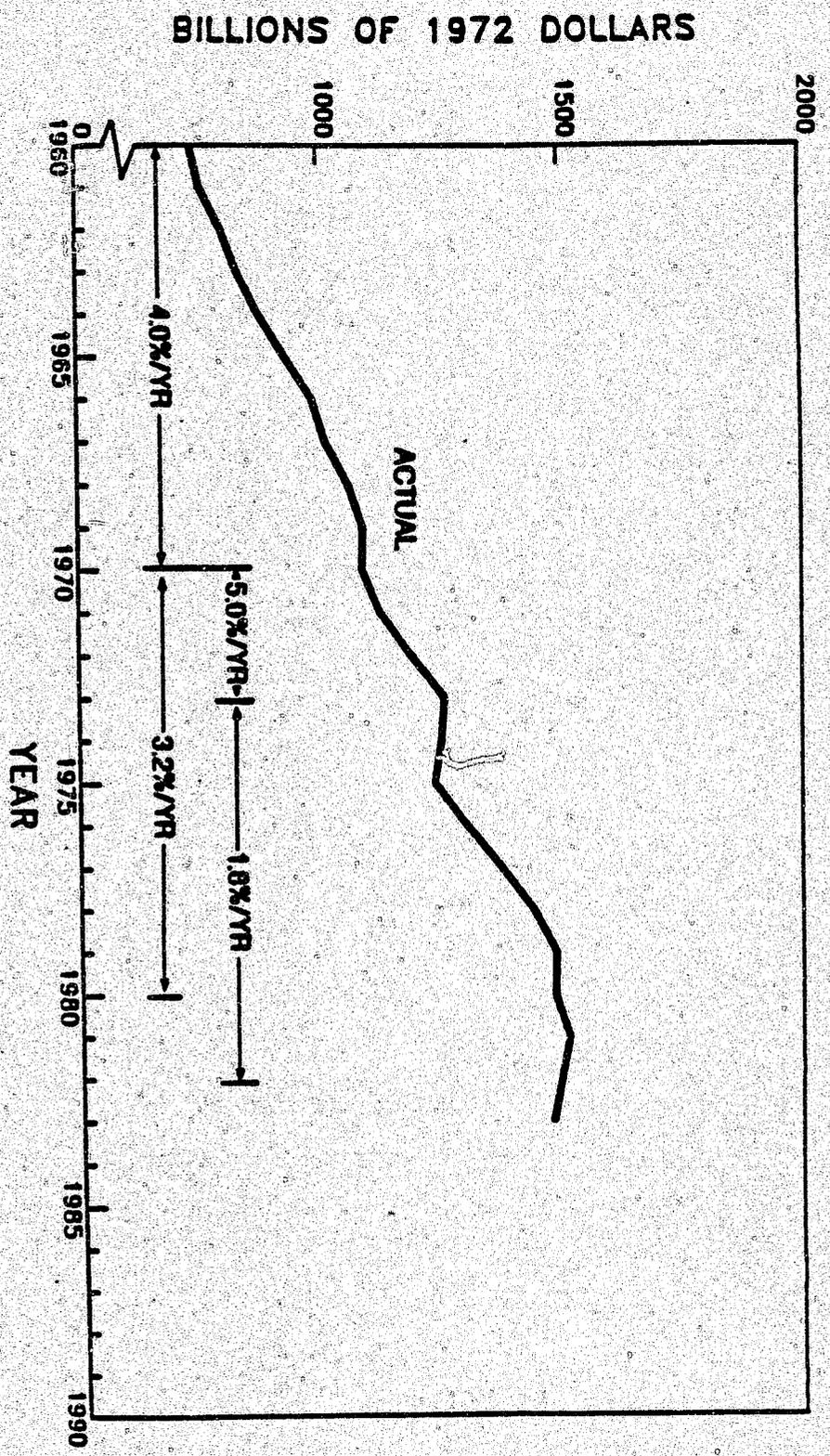
Source: Robert G. Uhler and Charles R. Nelson, "The NERC Summary Load Forecasts: A Retrospective Appraisal and Technical Analysis," May 31, 1985.

INDUSTRIAL PRODUCTION INDEX AND GROWTH RATES 1960-1982



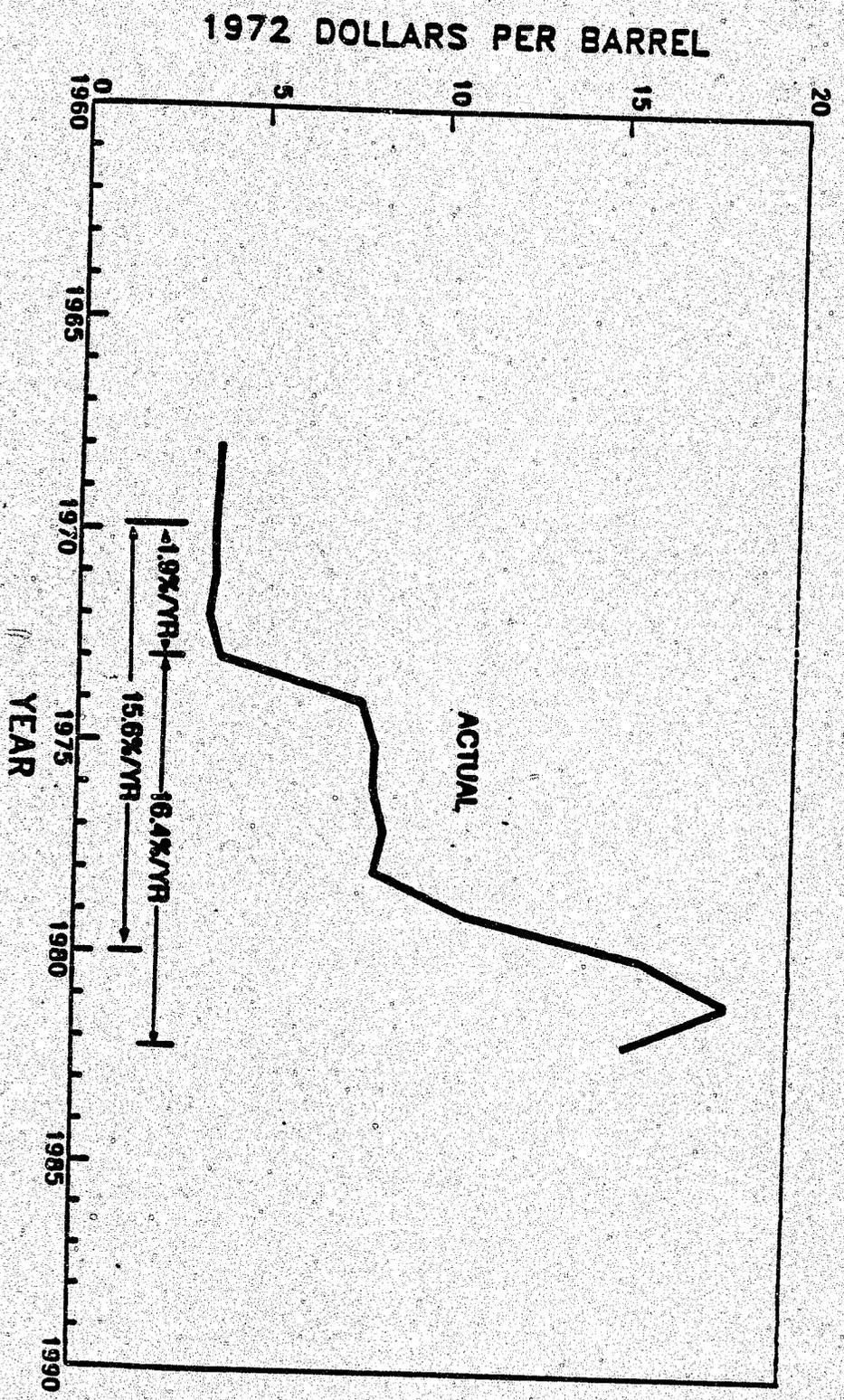
Source: Robert G. Usher and Charles R. Nelson, "The NERC Summary Load Forecasts: A Retrospective Appraisal and Technical Analysis," May 31, 1985.

GROSS NATIONAL PRODUCT AND GROWTH RATES 1960-1982



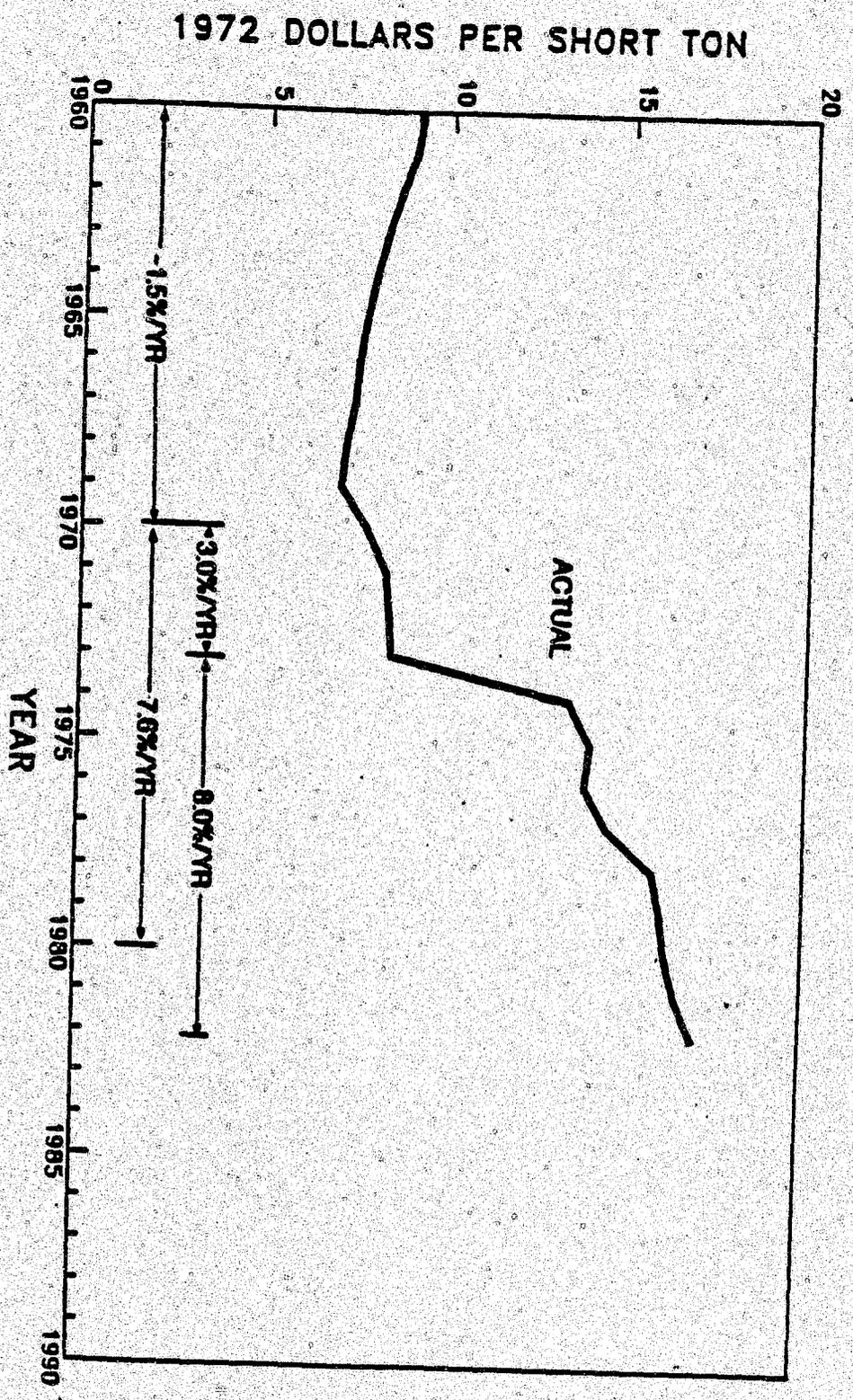
Source: Robert G. Uhler and Charles R. Nelson, "The NERC Summary Load Forecasts: A Retrospective Appraisal and Technical Analysis," May 31, 1985.

CRUDE OIL COST AND GROWTH RATES 1968-1982



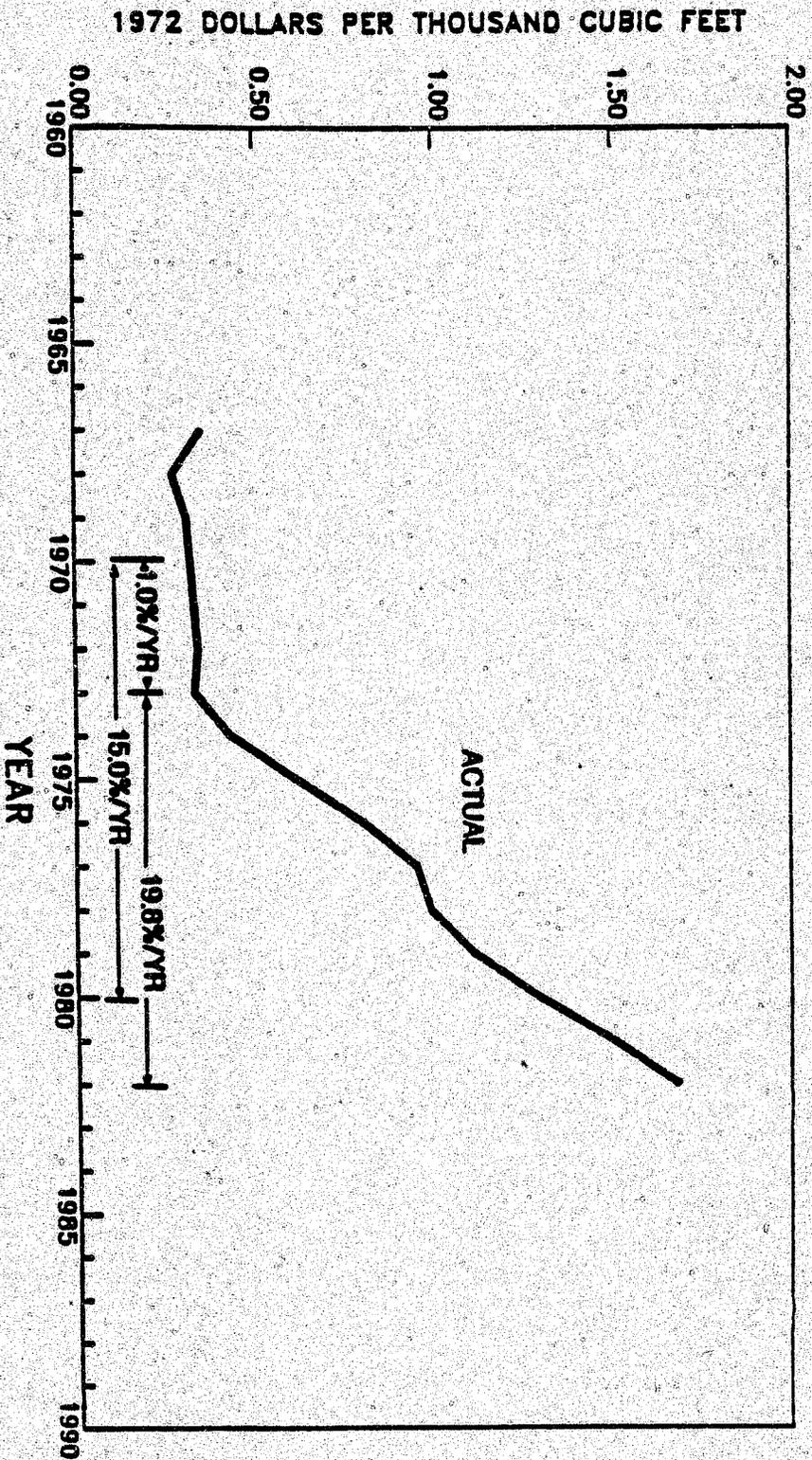
Source: Robert G. Uhler and Charles R. Nelson, "The NERC Summary Load Forecasts: A Retrospective Appraisal and Technical Analysis," May 31, 1985.

DELIVERED COAL PRICES AND GROWTH RATES 1960-1982



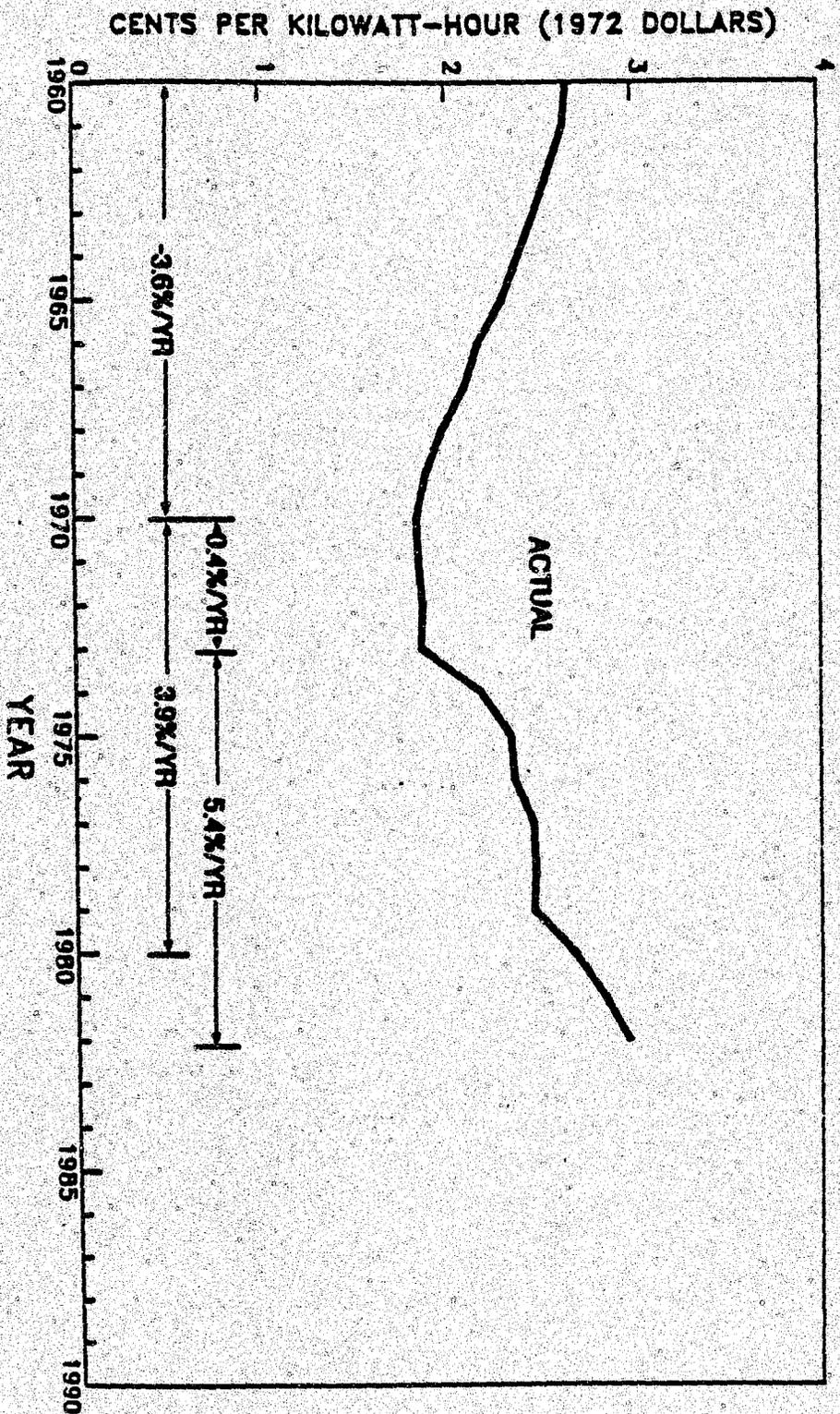
Source: Robert G. Uhler and Charles R. Nelson, "The NERC Summary Load Forecasts: A Retrospective Appraisal and Technical Analysis," May 31, 1985.

DELIVERED PRICE OF NATURAL GAS AND GROWTH RATES 1967-1982



Source: Robert G. Uhler and Charles R. Nelson, "The NERC Summary Load Forecasts: A Retrospective Appraisal and Technical Analysis," May 31, 1985.

PRICE OF ELECTRICITY: WEIGHTED AVERAGE 1960-1982



Source: Robert G. Uhler and Charles R. Nelson, "The NERC Summary Load Forecasts: A Retrospective Appraisal and Technical Analysis," May 31, 1985.

Residential New Construction

PECO System Service Area

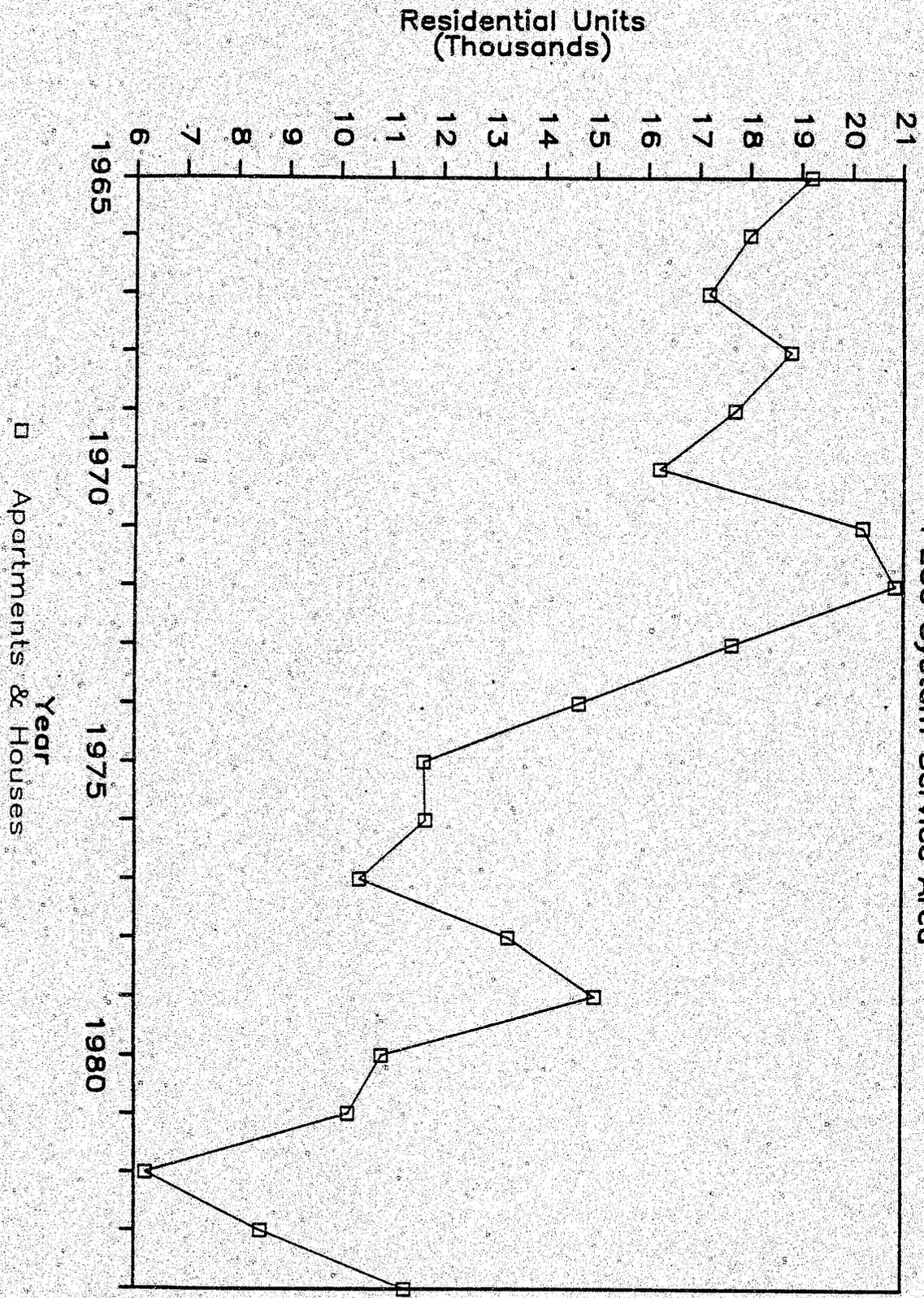


Chart 1 of 4

Manufacturing Employment of Philadelphia SMSA

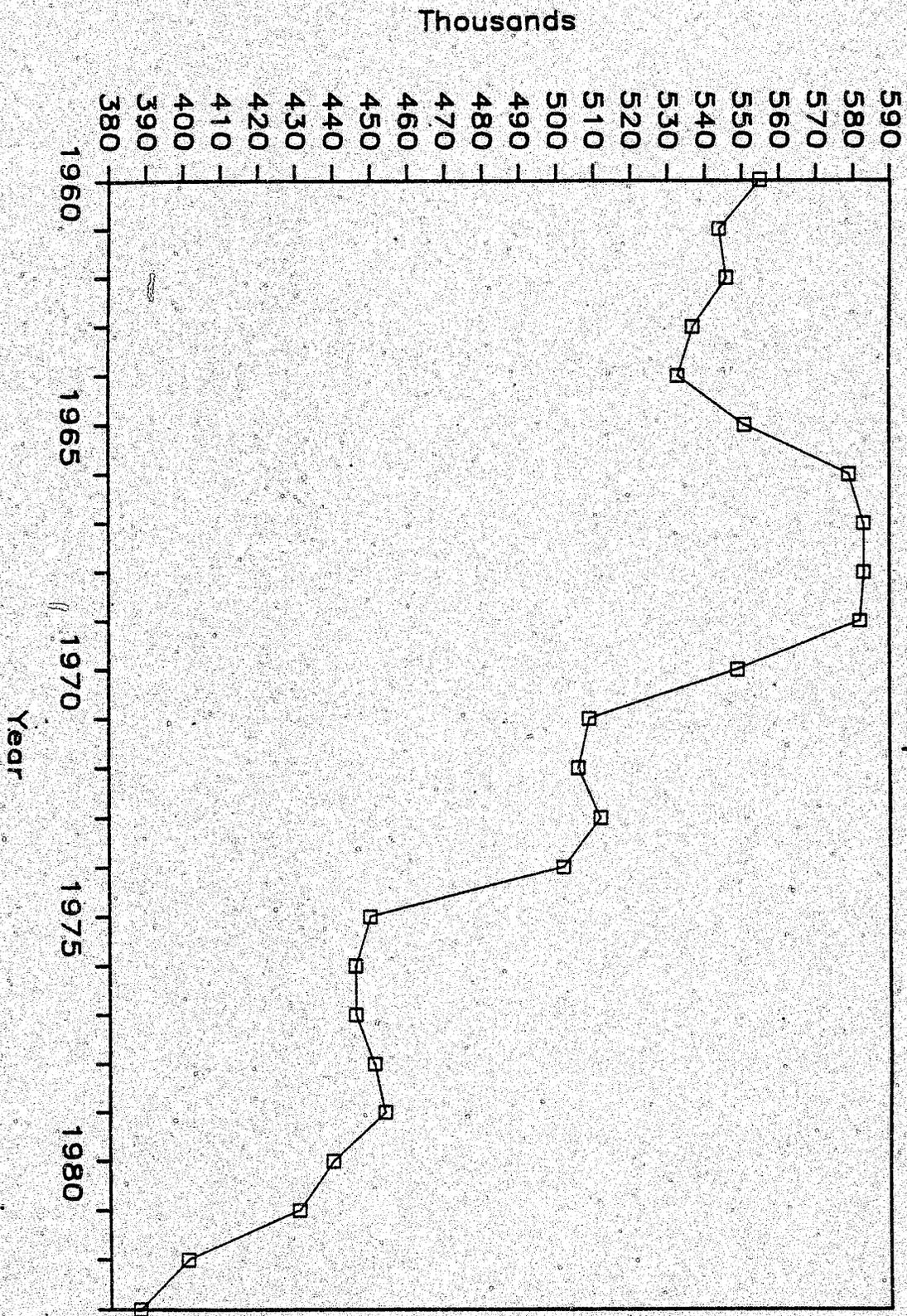


Chart 2 of 4

PECCO Total Residential Customers

1970-1983

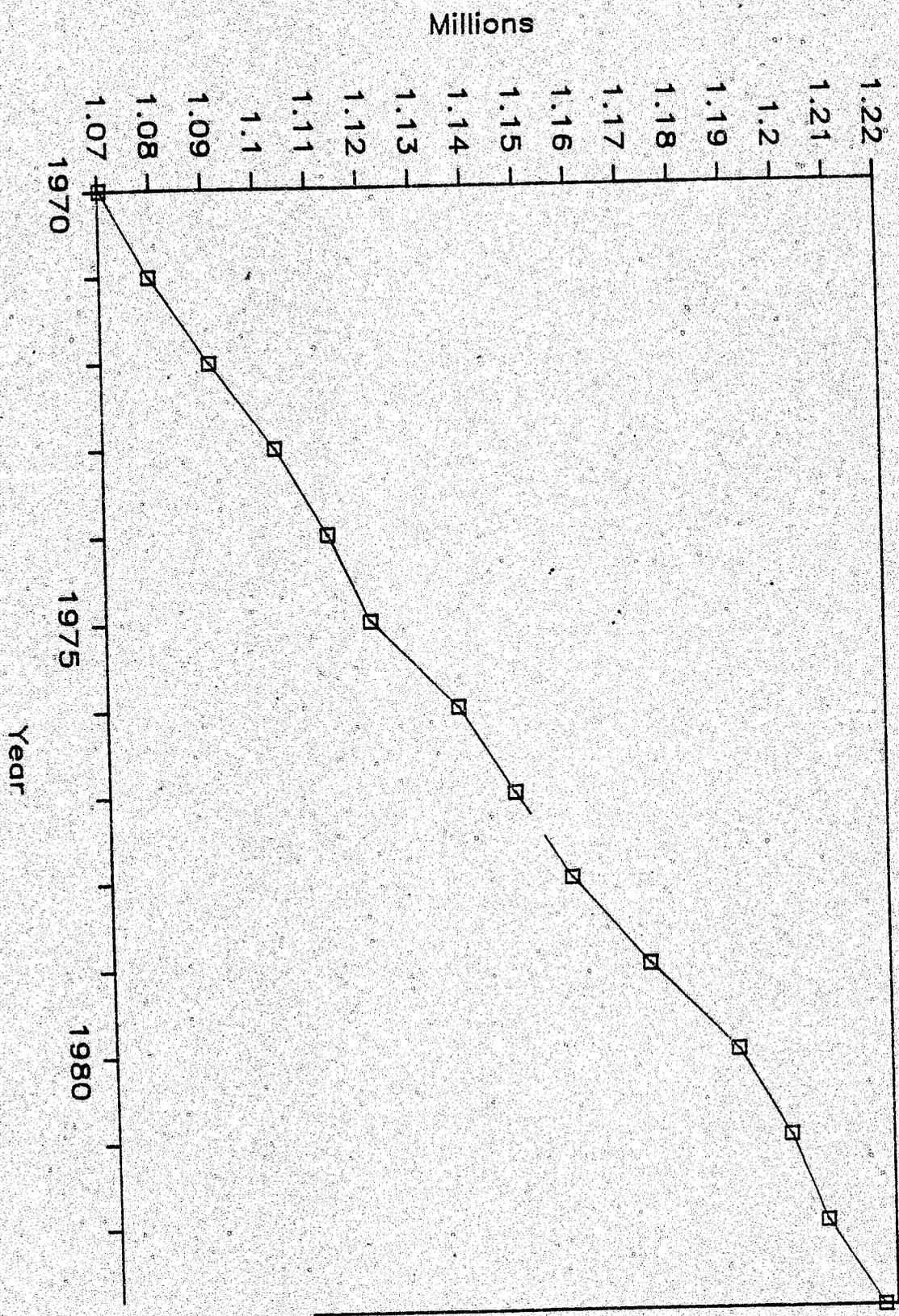
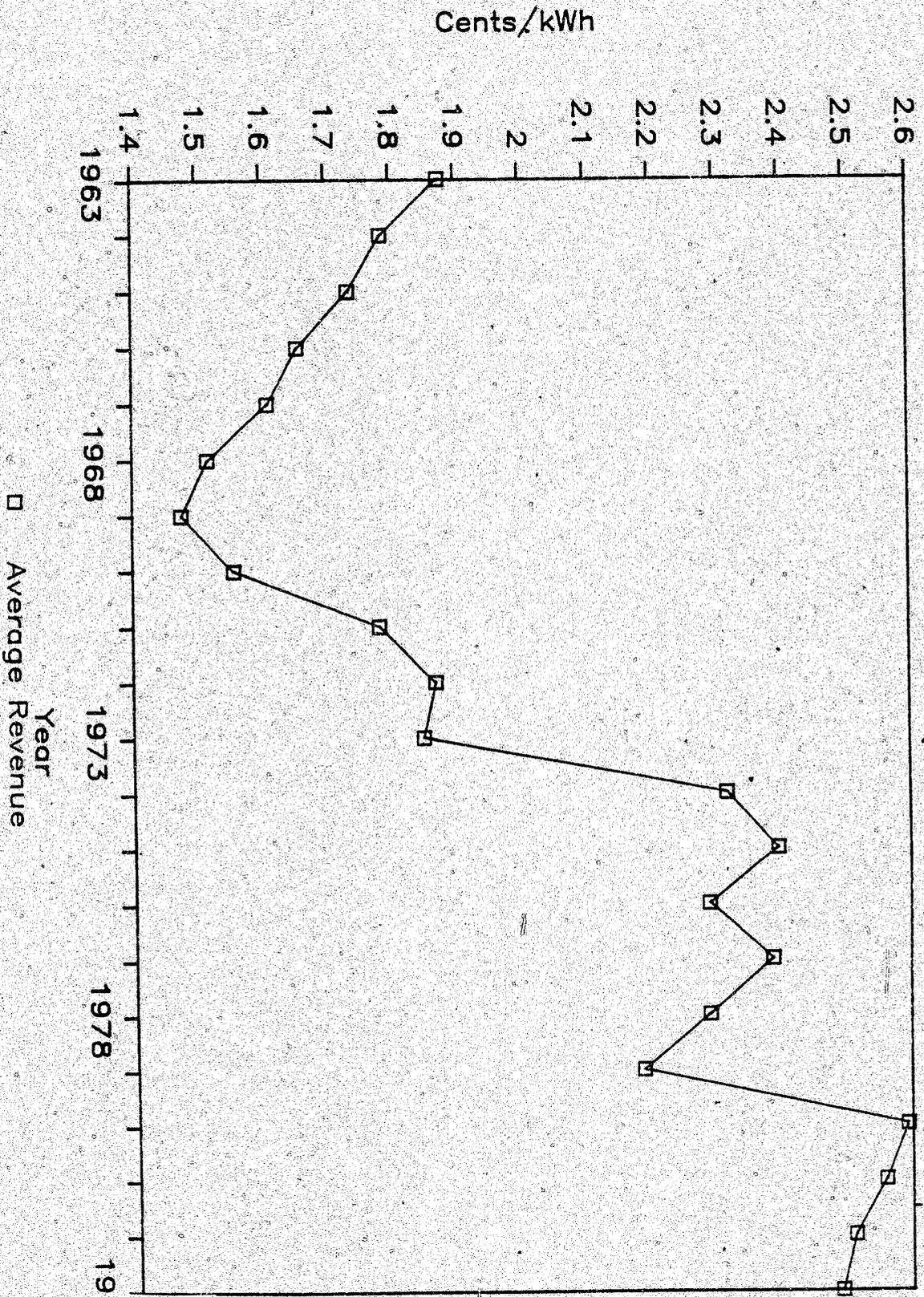


Chart 3 of 4

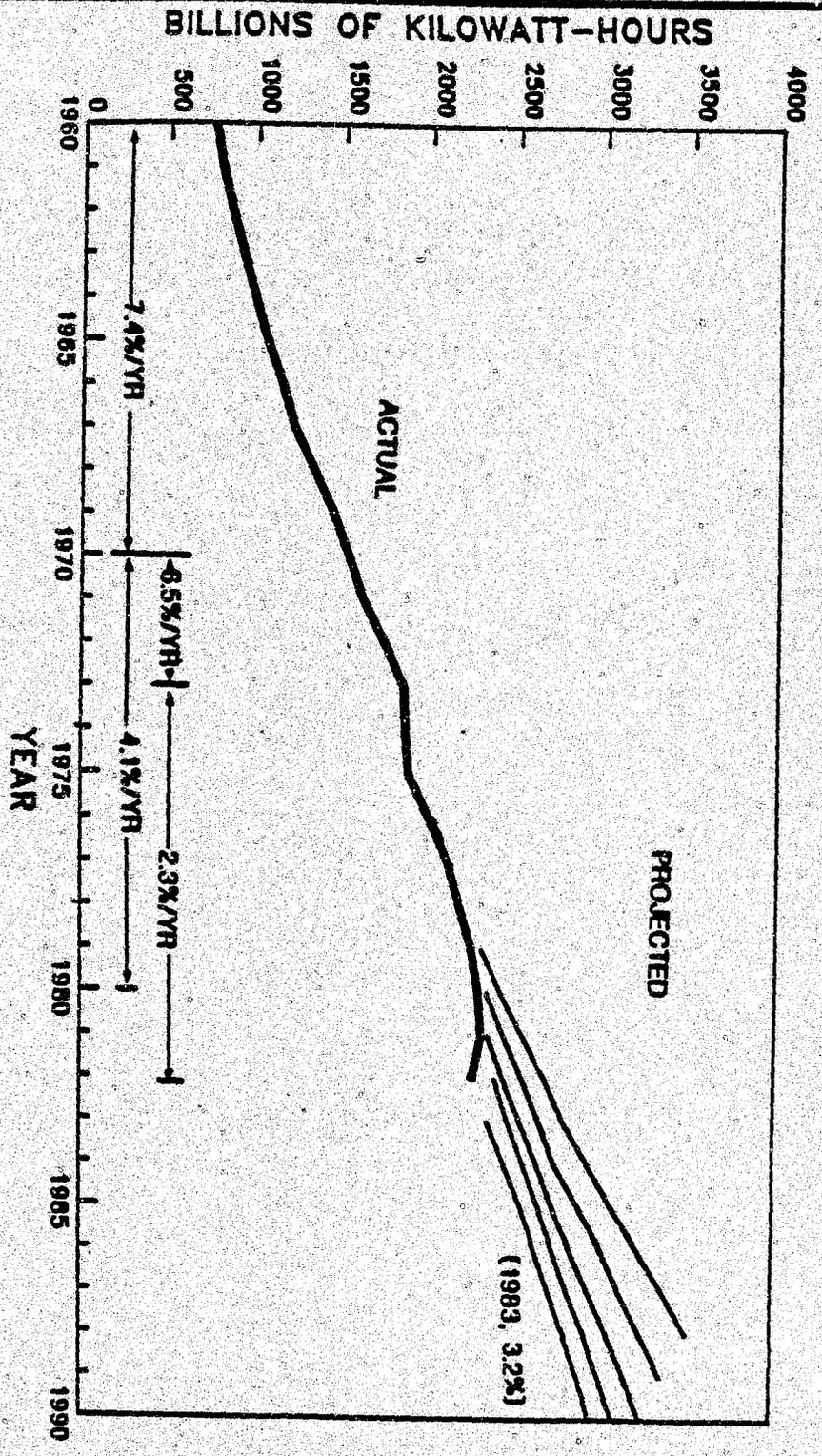
PECO Price of Electricity

Real Dollars (1967=100)



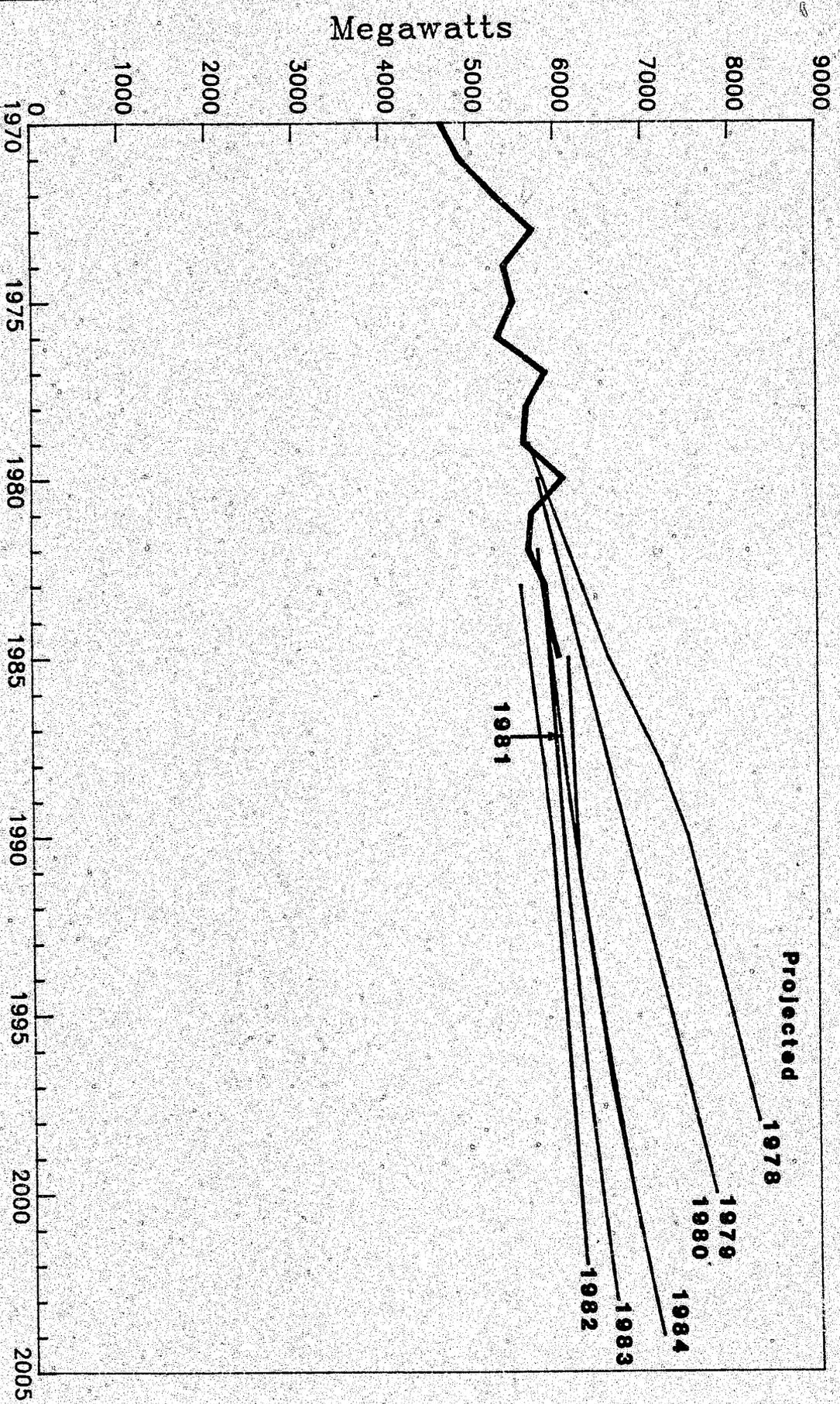
NET ENERGY REQUIREMENTS AND GROWTH RATES

1960-1982: ACTUAL
1983-1990: PROJECTED



Source: Robert G. Uhler and Charles R. Nelson, "The NERC Summary Load Forecasts: A Retrospective Appraisal and Technical Analysis," May 31, 1985.

PECO ACTUAL AND FORECASTED PEAKS 1970 - 2004



CHANGE IN FORECASTS OF ENERGY SALES REQUIREMENTS
FOR PECO, MAAC AND THE UNITED STATES

Region	1979 Forecast for 1988	1984 Forecast for 1988	Percent Change in Forecasts
	(1) (Gigawatt-hours)	(2)	(3) (Percent)
PECO	<1 34622	28389	-18.0030X
MAAC	<2 239579	194020	-19.0162
USA	<2 3542600	2684998	-24.2082

- 1> Forecast of Energy Sales.
- 2> Forecast of Net Annual Energy Requirements.

Source: Column (1): PECO Forecast, table 1, and Edison Electric Institute, 1979 Annual Electric Power Survey, April 1979, pp. 14-15.
 Column (2): PECO Forecast, table 1, and U.S. Department of Energy, Electric Power Supply and Demand for the Contiguous United States 1984-1993, June 1984, p. 6.

Comparison of PECO Forecast Assumptions and Realized Changes
 in Selected Demographic and Economic Statistics
 Average Annual Rates of Growth, 1978-1983
 PECO System Service Area

	As Projected by PECO, December 1978	Actual
	(1)	(2)
Base Case		
-----Percent-----		
Economic Statistics		
(1) GNP	3.62	1.91
(2) GRP 1)	2.28	na
Philadelphia Area Statistics		
(3) Residential Customers	1.09	0.98
(4) Cumulative New Construction 2)	1.22	0.81
(5) Dwelling Units	1.01	0.86
(6) Manufacturing & Non-Manufacturing	1.73	0.40
(7) Manufacturing	-0.76	-2.96
(8) Non-Manufacturing	2.48	1.37
Energy Statistics		
(9) Price of Electricity	0.00	0.71 3)
(10) OII - No. 2	1.50	7.26 4)
(11) Total Sales of Electricity Less Interdept. and Resale 5)	2.28	0.02
(12) Peak(Standard)	2.04	1.30

NOTE:

- 1) Estimated.
- 2) As compared with total units in 1977.
- 3) Average cent per kilowatt-hour.
- 4) In 1967 Dollars.
- 5) Not normalized.

SOURCE:

Row 1, Column 1:	PECO 1978-1988 Electric Budget Forecast, December 1978, p. 8.
Row 1, Column 2:	Economic Report of the President, February 1984, p.222.
Row 2, Column 1:	PECO 1978-1988 Electric Budget Forecast, December 1978, p. 8.
Row 2, Column 2:	-----
Row 3, Column 1:	PECO 1978-1988 Electric Budget Forecast, December 1978, p. 150.
Row 3, Column 2:	PECO Annual Reports 1975-1984.
Row 4, Column 1:	PECO 1978-1988 Electric Budget Forecast, December 1978, p. 170.
Row 4, Column 2:	PECO 1984-1994 Electric Budget Forecast, December 1984, p. 149.
Row 5, Column 1:	PECO 1978-1988 Electric Budget Forecast, December 1978, p. 175.
Row 5, Column 2:	PECO 1978-1988 Electric Budget Forecast, December 1978, p. 175.
Row 6, Column 1:	1980 Bureau of the Census Data provided by PECO.
Row 6, Column 2:	1980 Bureau of the Census Data provided by PECO.
Row 7, Column 1:	1980 Bureau of the Census Data provided by PECO.
Row 7, Column 2:	1980 Bureau of the Census Data provided by PECO.
Row 8, Column 1:	1980 Bureau of the Census Data provided by PECO.
Row 8, Column 2:	1980 Bureau of the Census Data provided by PECO.
Row 9, Column 1:	1980 Bureau of the Census Data provided by PECO.
Row 9, Column 2:	1980 Bureau of the Census Data provided by PECO.
Row 10, Column 1:	PECO 1978-1988 Electric Budget Forecast, December 1978, p. 9.
Row 10, Column 2:	Monthly Energy Review, Energy Information Administration, April 1985, p.98.
Row 11, Column 1:	PECO 1978-1988 Electric Budget Forecast, December 1978, p. 13.
Row 11, Column 2:	PECO System, Quantity Sales and Customers: Electric, Gas and Steam, 1950-1984.
Row 12, Column 1:	PECO 1978-1988 Electric Budget Forecast, December 1978, p. 283.
Row 12, Column 2:	PECO System Actual Peak Load Data, October 22, 1975, provided by PECO System Planning Division

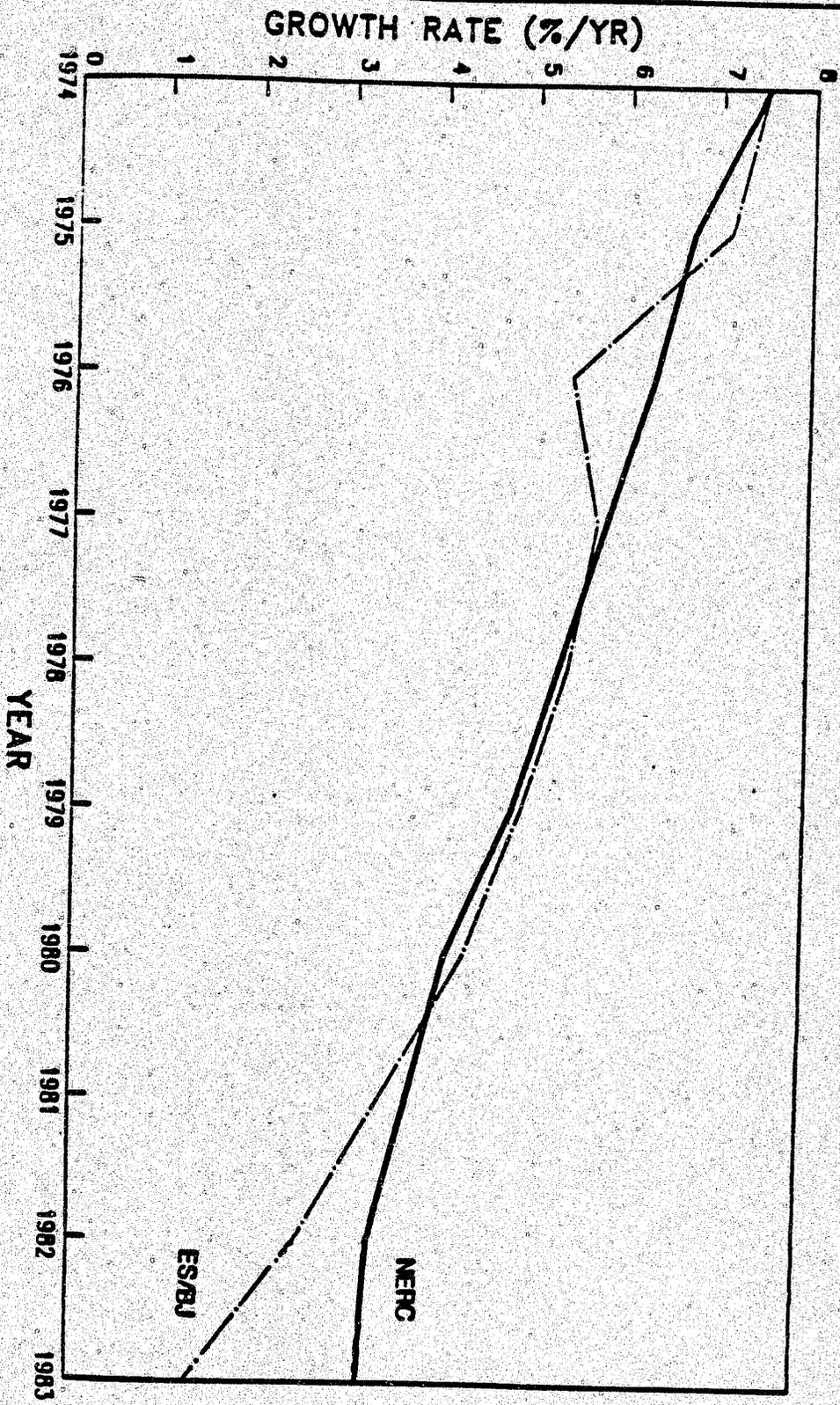
**EXPONENTIAL SMOOTHING/BOX-JENKINS FORECAST
VERSUS NERC SUMMARY FORECAST**

Using Date Through	10-Year Forecast Period	Smoothing Coefficient(θ)	Exponential Smoothing/ Box-Jenkins Forecast ----- (Percent)	NERC Summary Forecast ----- (5)
(1)	(2)	(3)	(4)	(5)
1973	1974-1983	0.971 = 1.0 ¹	7.5%	7.5%
1974	1975-1984	1.0	7.1	6.7
1975	1976-1985	0.84	5.4	6.3
1976	1977-1986	0.86	5.7	5.8
1977	1978-1987	0.85	5.4	5.3
1978	1979-1988	0.82	4.9	4.8
1979	1980-1989	0.79	4.3	4.1
1980	1981-1990	0.76	3.4	3.7
1981	1982-1991	0.73	2.5	3.3
1982	1983-1992	0.69	1.2	3.2

Source: Robert G. Uhler and Charles R. Nelson, "The NERC Summary Load Forecasts: A Retrospective Appraisal and Technical Analysis," May 31, 1985.

¹For 1973 and 1974, the least squares value of the smoothing coefficient was at or near the upper boundary of unity. In this situation, the projected growth rate is the actual average growth rate since 1951.

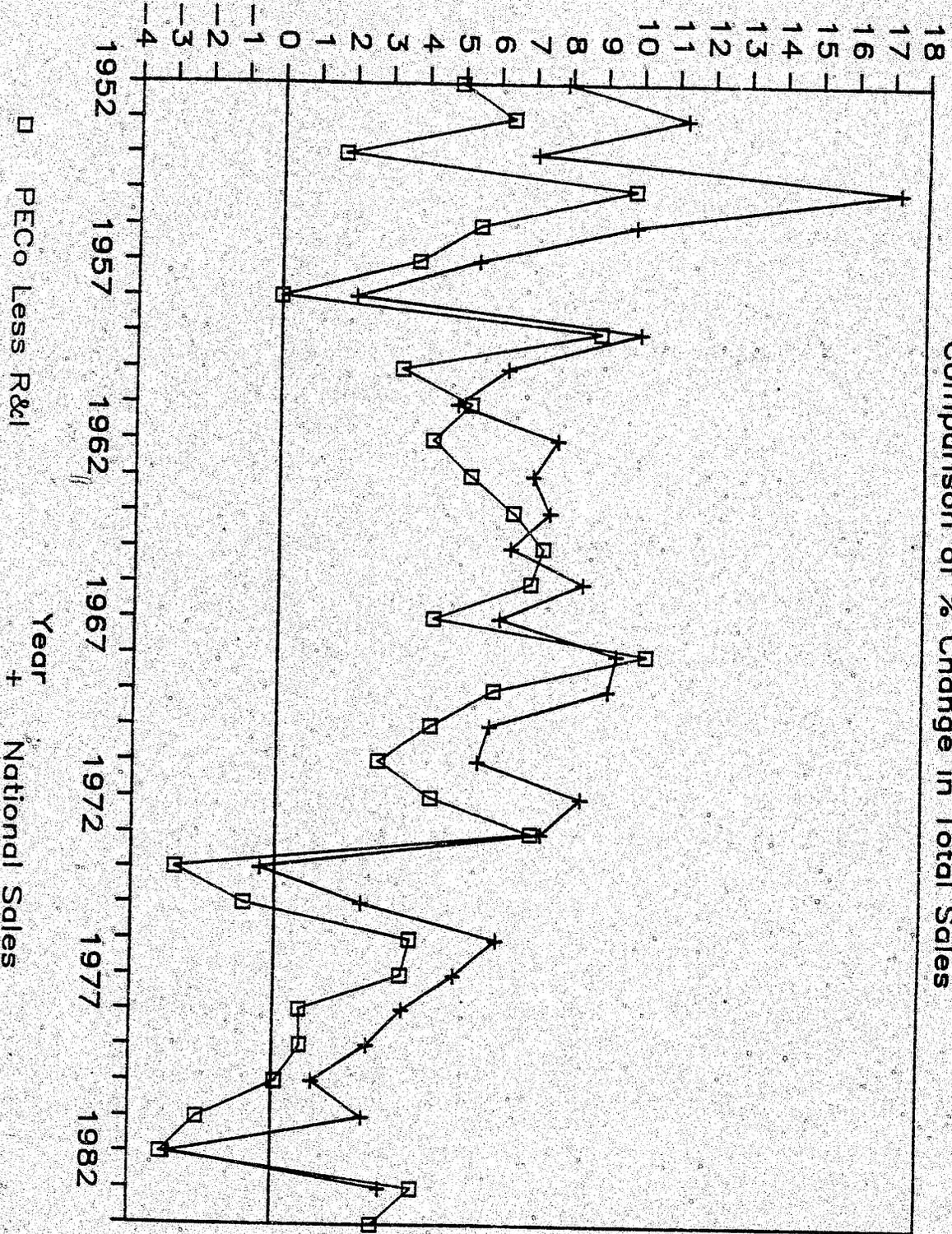
ES/BJ FORECAST VERSUS NERC SUMMARY FORECAST 1974 - 1983



Source: Robert G. Uhler and Charles R. Nelson, "The NERC Summary Load Forecasts: A Retrospective Appraisal and Technical Analysis," May 31, 1985.

Annual % Change in Sales

PECO Sales vs. National Sales Comparison of % Change in Total Sales



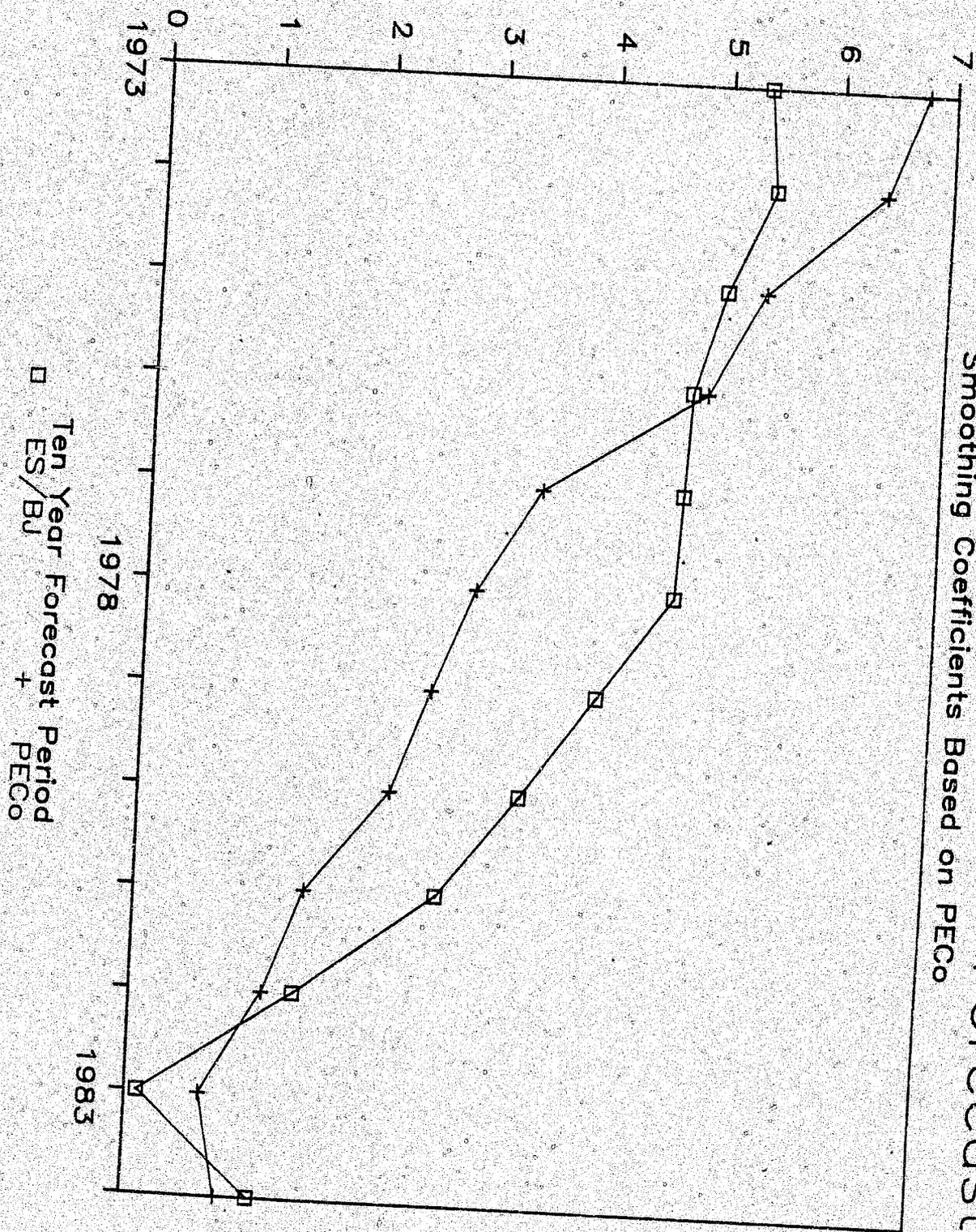
**COMPARISON OF FORECASTS OF GROWTH IN PECO SALES USING
EXPONENTIAL SMOOTHING/BOX-JENKINS TECHNIQUES VERSUS
PECO FORECASTS**

Using Data Through (1)	10-Year Forecast Period (2)	Smoothing Coefficient (3)	Exponential Smoothing/ Box-Jenkins Forecast (4)	PECO Forecast (5)
1972	1973-1983	1.00	5.34	6.75
1973	1974-1984	1.00	5.42	6.41
1974	1975-1985	1.00	5.03	5.38
1975	1976-1986	1.00	4.77	4.90
1976	1977-1987	1.00	4.73	3.48
1977	1978-1988	1.00	4.68	2.93
1978	1979-1989	0.84	4.03	2.57
1979	1980-1990	0.80	3.38	2.24
1980	1981-1991	0.78	2.68	1.52
1981	1982-1992	0.74	1.46	1.18
1982	1983-1993	0.70	0.11	0.66
1983	1984-1994	0.76	1.14	0.66
1984	1985-1995	0.67	1.34	0.85

Note: Smoothing Coefficients Based on PECO Data.

Average Annual Growth Rate(Percent)

ES/BJ Forecast vs. PECCO Forecast Smoothing Coefficients Based on PECCO



COMPARISON OF FORECASTS OF GROWTH IN PECO SALES USING
EXPONENTIAL SMOOTHING/BOX-JENKINS TECHNIQUES VERSUS
PECO FORECASTS

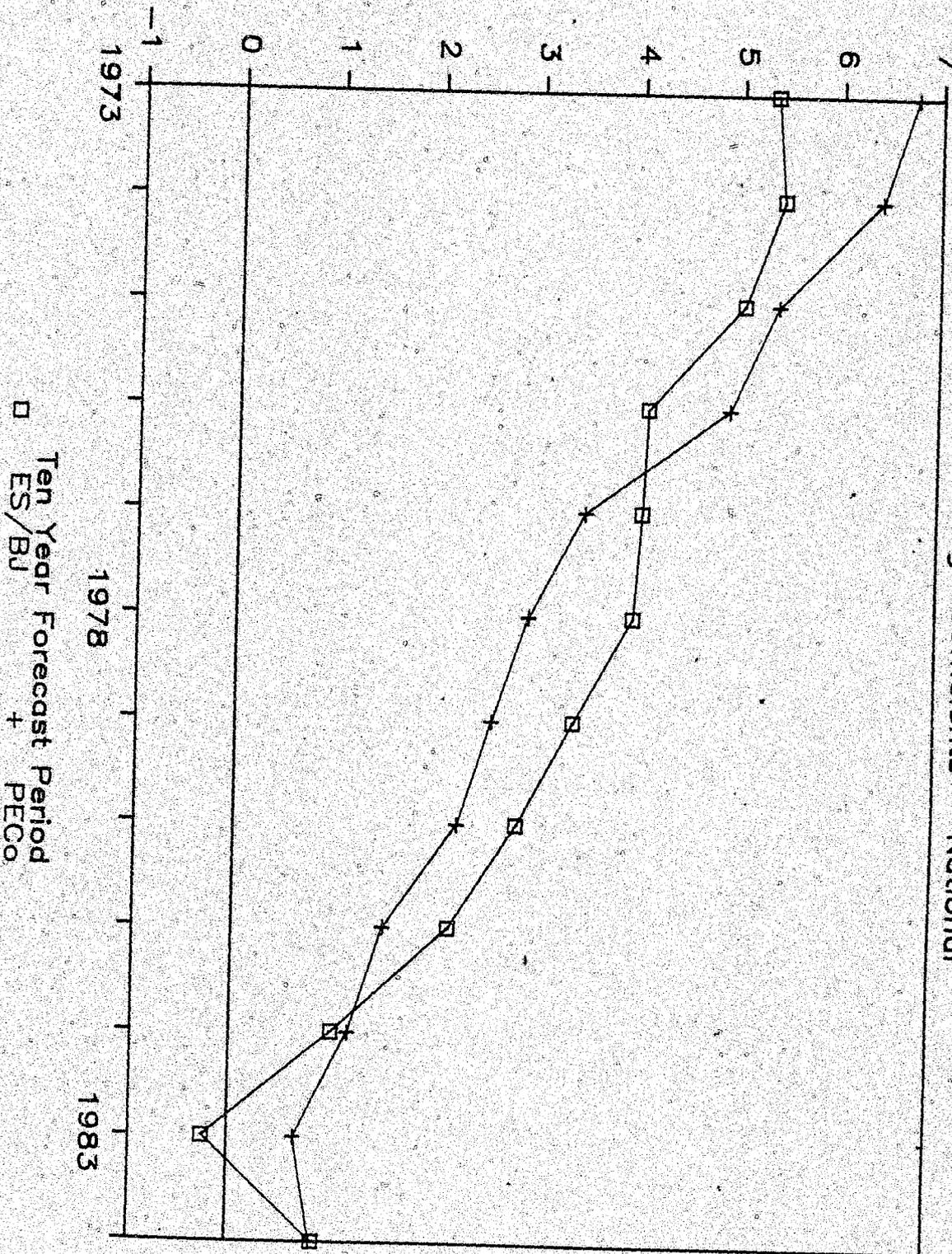
Using Data Through (1)	10-Year Forecast Period (2)	Smoothing Coefficient (3)	Exponential Smoothing/ Box-Jenkins Forecast (4)	PECO Forecast (5)
1972	1973-1983	1.00	5.34%	6.75%
1973	1974-1984	1.00	5.42%	6.41
1974	1975-1985	1.00	5.03%	5.38
1975	1976-1986	0.84	4.09%	4.90
1976	1977-1987	0.86	4.04%	3.48
1977	1978-1988	0.85	3.97%	2.93
1978	1979-1989	0.82	3.38%	2.57
1979	1980-1990	0.79	2.83%	2.24
1980	1981-1991	0.76	2.17%	1.52
1981	1982-1992	0.73	1.02%	1.18
1982	1983-1993	0.69	-0.26%	0.66
1983	1984-1994	0.73	0.87%	0.85
1984	1985-1995	0.67	1.34%	

Note: Smoothing Coefficients Based on National Data.

Average Annual Growth Rate(Percent)

ES/BJ Forecast vs. PECCO Forecast

Smoothing Coefficients = National



□ Ten Year Forecast Period
+ ES/BJ
+ PECCO