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%).

APPENDIX A

PHILADELPHIA ELECTRIC COMPANY

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

	1978-79	1977-82	1982-87	1977-87
GNP - Base	2.0%	3.7%	3.2%	3.4%
GRP - Base	1.5%	2.3%	1.8%	2.1%
GNP - Low	1.5%	3.4%	3.0%	3.2%
GRP - Low	1.0%	2.2%	1.3%	1.8%
GNP - High	4.1%	4.2%	3.2%	3.7%
GRP - High	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.

	Real Annual Increase	1988/1978 Costs - 1972 $
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.

EXHIBIT WCH - I

ELECTRIC

<u>1978 - 88 BUDGET FORECAST</u>

With 1988 - 98 Projections

Research and Forecasting Department

December 1978

PREFACE

This forecast in three levels -- high, base and low -- comprises the standard forecast for the Philadelphia Electric Company System. It is mainly an end-use or engineering based forecast and thus provides many details on appliances and applications particularly for the residential class.

In addition, the Company separately obtained a forecast from its econometric model developed for it by Wharton Econometric Forecasting Associates (WEFA) which provides a second independent method of analysis. The base econometric forecast prepared by WEFA in September 1978 projects an average annual growth rate of 3.9 percent from 1978 to 1988, compared to our base forecast growth of 2.9 percent.

Some of the WEFA projections by class are given in the sections of this report. This book contains more details on the forecasting methodology and more historical data than recent forecast books -- except for the long-range forecasts which were prepared in 1974 and 1975. This greater exposition is given because the forecast is now receiving expanded use and interest outside the company and is no longer only an internal tool. As an example of expanded data, the industrial forecast is shown in 2-digit SIC classes which had not been provided since the 1974-75 long-term forecasts.

References used in the forecast preparation are also listed at the end, again because of the expressed interest of reviewers outside the department or company.

Finally, this forecast represents a reduced growth rate for the base case from previous annual forecasts akin to the national trend. Quoting Electrical World (forecast issue, September 15, 1978, the introductory paragraph on Kilowatthour Sales): "Predicting energy growth during the past five years has been a particularly tricky and difficult task. Each year appears to be worse than the year before and 1978 is no different. Each year we believe some signs will appear to guide us in our deliberations so specific and clear-cut trends can be discerned. While there are trends, they are also filled with ambiguities and pitfalls, not unlike the Delphic pronouncements."

SUMMARY OF GROWTH RATES

COMPOUND GROWTH RATES FOR THE FORECAST PERIOD

1978-1988

PERCENT

	1978-83			1983-88			1978-88		
	Low	Base	High	Low	Base	High	Low	Base	High
Residential	(0.7)	1.0	2.8	(0.5)	1.8	2.9	(0.6)	1.5	2.8
House Heating	5.4	13.2	19.7	4.9	10.6	15.9	5.1	11.9	17.8
Small Com. & Ind.	0.8	1.9	3.1	0.6	2.1	2.2	0.7	2.0	2.7
Large Com. & Ind.	1.0	2.7	4.3	3.0	3.4	3.8	2.0	3.0	4.1
Street Lighting	0.4	0.9	1.4	0.4	1.0	1.5	0.4	1.0	1.4
Other Public Auth.	0.7	1.2	1.9	0.7	1.0	1.7	0.7	1.1	1.8
Railroads & Railways	1.1	2.0	2.8	0.8	2.5	3.5	0.9	2.2	3.1
Sales For Resale	(0.6)	1.1	1.8	0.0	0.8	1.1	(0.3)	1.0	1.4
Interdepartmental	0.7	1.3	2.0	2.2	2.1	2.1	1.4	1.7	2.0
TOTAL	0.7	2.6	4.4	2.0	3.2	4.4	1.3	2.9	4.4

R & F Dept.
December 1978

INDEX

SECTION 2 RESIDENTIAL - Continued

SECTION 2 RESIDENTIAL - Continued

SECTION 2 RESIDENTIAL - Continued

SECTION 3 COMMERCIAL AND INDUSTRIAL

SECTION 3 COMMERCIAL AND INDUSTRIAL - Continued | Page No.

SECTION 4 1988-98 FORECAST

1978-88 BUDGET FORECAST

This forecast, which is updated annually, projects kilowatthour sales for the system and companies. The front sections cover the ten year period from 1978 to 1988. The forecast is developed from authoritative data covering housing requirements, population, commercial and industrial construction plans, appliance and application saturations and equipment characteristics, and the economic growth expectation of various recognized authorities.

The methods and data used in its preparation are covered in the subsequent sections in which the ten year forecast is segmented by major classes of customers and uses.

In a following section, a projection is provided for the ensuing decade from 1988 to 1998 as a guide in long range planning. Details of the assumptions applied to the preparation of this second-decade forecast are included in the accompanying discussion.

Because of the growing uncertainties as the forecast time is extended, greater reliance is made on time-series projection, adjusted by demographics. Projection data is given by year and rate class to 1998, but the details shown for the earlier ten years are not completely provided.

The final section prepared by System Planning provides peak demand projections developed by them.

RANGES

Outcomes will vary from forecasts for many reasons. It is most unlikely that results in each year of the ten or twenty year forecasts will approximate the projected values because the forecasts beyond two years do not attempt to predict cyclical economic swings which are almost certain to occur.

The forecast in a given year can vary around the normal trend based on whether the economy at the time is in a recession or is growing at an above average rate. These deviations will tend to counterbalance each other over the long span.

The degree of probable deviations from the trend of normal economic activity was determined by reviewing GNP figures for the period 1952 to 1972 inclusive. The analysis was not carried beyond 1972 because of the extremely unusual effects of the oil crisis and ensuing recession starting in 1973. Linear and polynomial regression and a constant growth percentage were evaluated to see which most correctly described historic economic activity.

Because all methods gave extremely good results, a constant growth percentage was chosen because of its added simplicity. The plus or minus deviations of actual GNP from normal GNP, as estimated by the trend line, were examined, and high (1966) and low (1961) years were selected which occurred with approximately 1 in 10 probability. These selected years determined bands about the normal economic trend line of -7.4% and +5.3%.

Beyond deviations based on the business cycle, broader ranges are established when consideration is given to probable errors in judgment concerning the probable growth of the economy. The base forecasts will vary among recognized economists even though they are based on the same general outlook for the national economy as a whole. Recasting the forecast to allow for the condition that economists predicting growth over or below the central projections will turn out to be correct provides a wider margin of deviation than consideration of business cycles alone. The high and low values established by these combined conditions are given in Table II.

The above two conditions provide a range in which kilowatthour sales results could swing and still be consistent with the assumed probable scenario assumptions. These two factors indicated a range in total sales of -13% and +8% after the first few years.

It is also all but inevitable that not only business-cycle swings and a difference from the mean economic forecast based on a band of economists' predictions will occur, but that the economy will be influenced by factors not now considered probable by most economists. Such could include the effects of government policy changes; OPEC actions; unanticipated technological changes or lack of improvements in appliances; 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.

While the discontinuities in growth caused by the events of the early seventies--the oil embargo, the severe recession, the job and population outflow from the Northeast--were extreme, seldom can the future be counted on to reflect the past when a ten-year planning horizon is required. In this century 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; Viet-Nam; and the energy crisis were all major economic events not foreseen even a few years prior to their occurrence. Political actions cannot be forecast with any degree of confidence.

Thus the need for planning for alternative futures.

The wider ranges forming the high and low forecasts are based on sets of assumptions which are supported by local economic history but are considered to have a probability of occurrence on the order of 10%. The assumptions for these high and low scenarios are given following the normal forecast assumptions below. Table III shows the high and low ranges by year and class of service, and Table V shows growth rates for the pessimistic and optimistic ranges.

These high and low ranges are for the assumptions as described and are not further modified to show the effects of cycles on these smooth projections.

GROWTH

Kilowatthour sales dropped two years in a row in 1974 and 1975, the only such drop since the early Depression years of 1931-32, but in 1976 sales turned up and were about four percent over 1975. Nationally, power sales were up about six percent while Mid-Atlantic sales were up five percent, showing again the economic lag endemic to Southeastern Pennsylvania.

In 1977, national electricity output rose 4.9 percent, Mid-Atlantic 1.5 percent, and PECO output 1.4 percent in spite of warmer than normal weather. Without the unusual number of plant and store closings in 1977 including Alan Wood Steel and Lit Brothers, output would have been up 2 percent.

In the first half of 1978, national output was only up 3.1 percent while PECO output was up 4 percent.

Not only has the local economy experienced strong conservation efforts and a slower than expected recovery from the recent deep recession but other factors were obviously at work. These are identified as the interdependent forces of the physical loss of manufacturing jobs and loads as many older plants closed; high unemployment; and continuous migration to the sun-belt. The U. S. Census Bureau estimated our area lost 156,000 net emigrants from 1970 to 1976.

Having considered the negative factors and all the programs designed to conserve energy -- the effects of which are treated in this forecast as well as the previous five -- it still appears that moderate growth in electric use will occur.

Our expectation of growth is supported in part by the need for housing and jobs for the younger people growing up in this area who will enter the work force during the ten-year forecast period and whose numbers greatly exceed those leaving the work force. Families still lacking many work-saving and comfort conditioning appliances are still adding such devices now commonly enjoyed by the more affluent. It is also expected that the gradual shift from scarce fossil fuels to electricity for space and process heating will continue.

The baseline forecast from 1978 to 1988 has a compound growth rate of three percent which is half the six-percent rate of the Sixties despite the favorable population changes, the recent rapid growth of electric space heat, and the predicted increase in electricity's share of the energy market. The lower rate is due to the effort to conserve all energy resources; the increased cost of energy which further stimulates saving; and the adverse conditions in the regional economy relative to the national economy which became manifest earlier in the seventies. Most of the latest national forecasts project a four to five percent annual growth rate (e.g. McGraw-Hill - 4.1%; NERC - 5.2%; GE - 5%; DOE - 4.8%).

This forecast contemplates a reasonably successful local and national economy with adequate energy supplies. If the region and its people are to prosper, increases in local productivity and the Gross Regional Product (GRP) in line with the Gross National Product (GNP) must take place. Without higher output of goods and services, a standard of living reasonably related to people's expectations, including the increasing mass of jobholders, is not possible.

The forecast assumptions listed in each section show that a modest turn-around in the local economy is anticipated so that it should not continue to lag the national growth as severely as it did in the Seventies to date. This is supported by such expectations as new Federal aid formulas which would recognize the problems of the Northeast; an ebbing of the relocation of factories and people as relative costs, including energy and labor costs, rise in the South; on a growing awareness by local governments and workers of the importance of holding down costs; on recognition of the basic attributes of the area as a market center; a rail center; a cultural, educational, and medical center; an important port; and on a satisfactory supply of skilled and unskilled labor, land, energy and water.

If the factory and population outmigration continues unabated, growth would approximate the low-growth scenario rate of about two-percent. However, every decade in this country (see RANGES) has brought considerable change from the preceding decade so that none could be predicted well by mirroring the past.

This forecast in covering three growth conditions -- high, base and low -- for twenty years, details in the following sections the power needed for jobs and housing for the postwar-baby-boom offspring now establishing households; for further saturation of appliances by present non-owners as city dwellers tend to catch up with suburbanites in these comforts and conveniences; and for industrial power to support the growth in GRP and GNP estimated by a consensus of economists.

ECONOMY

Beginning with 1972, changes made in the overall forecast were gradually but consistently downward. This has been largely due to drastic changes in the energy field, accentuated by the Arab oil embargo in late 1973, but really traceable to a longer trend toward energy conservation with increasing scarcity and rising prices of energy. The other major factor causing the projections to be reduced is the lower economic growth now generally anticipated and the extended lag in the Philadelphia economy compared with the national economy experienced since the two recessions of the early seventies.

Early in 1973, based on the average forecasts of leading economists, the real GNP for 1985 (in terms of 1972 dollars) was estimated to be $2,016 billion. The latest estimate included in this forecast is for a real GNP in 1985 of $1,761 billion, 12.6% less than predicted at the time of the 1973-83 forecast. This reduction is equivalent to three to four years normal growth in the output of goods and services.

Much of this reduced expectation in the economic outlook is attributed to the effects of energy and environmental problems on production costs, productivity and capital investment plans.

Sales for 1979, the company's budget year, are lower than the projected trend due to the expectation of a moderate recession during that year.

Econcmic projections are listed in the assumption sections and the GNP/GRP table.

CONSERVATION/CURTAILMENT/ELASTICITY

Our forecast prepared prior to the 1973 oil embargo stated that it "allowed for substantial estimated reductions in energy requirements due to conservation efforts in this period . . . brought about in large measure by our own programs to treat electricity as a valuable resource to be used wisely." The effects of various conservation techniques, including in particular the expected results of our pioneering high efficiency air conditioning programs (high EER's), were detailed and included in reducing the forecast sales from prior expectations.

At the time the 1974-84 forecast was prepared in the spring of 1974, the oil embargo was in effect and early curtailment efforts (no Christmas lighting, curtailed floodlighting, closed gas stations) were in evidence, but only fragmentary data was available as a basis for estimating what the total lasting effect might be, so a moderate reduction in the forecast was made.

It became evident since the embargo was lifted that with energy costs predicted to remain relatively high customers can be expected to continue to conserve energy at a high rate. This forecast reflects reductions made since 1972 attributable to such factors as the development of more efficient appliances, curtailed use of some applications such as air conditioning and the general adoption of rigid construction standards.

A discussion on elasticity is at the end of this section.

ASSUMPTIONS

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

	1978-79	1977-82	1982-87	1977-87
GNP - Base	2.0%	3.7%	3.2%	3.4%
GRP - Base	1.5%	2.3%	1.8%	2.1%
GNP - Low	1.5%	3.4%	3.0%	3.2%
GRP - Low	1.0%	2.2%	1.3%	1.8%
GNP - High	4.1%	4.2%	3.2%	3.7%
GRP - High	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.

	Real Annual Increase	1988/1978 Costs - 1972 $
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.

References

1. Foster Associates, Inc., "Fuel and Energy Price Forecasts," EPRI, EA 411, 1977.

2. SRI International, "Fuel and Energy Price Forecasts," EPRI, EA 433, 1977.

3. Electric Power Research Institute, "Supply 77," EPRI, EA 634-SR.

PHILADELPHIA ELECTRIC COMPANY SYSTEM

BASE CASE

ELECTRIC

MILLION KWH

	ACTUAL 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
RESIDENTIAL	7297.0*	6995.0	7040.0	7120.0	7200.0	7290.0	7400.0	7530.0	7660.0	7810.0	7960.0	8090.0
PERCENT CHANGE		-4.1	0.6	1.1	1.1	1.3	1.5	1.8	1.7	2.0	1.9	1.6
HOUSE HEATING	813.0*	880.0	980.0	1110.0	1270.0	1450.0	1640.0	1830.0	2020.0	2240.0	2470.0	2720.0
PERCENT CHANGE		8.2	11.4	13.3	14.4	14.2	13.1	11.6	10.4	10.9	10.3	10.1
SMALL COM. & IND.	2825.0*	2893.0	2910.0	2970.0	3040.0	3110.0	3180.0	3250.0	3330.0	3390.0	3460.0	3520.0
PERCENT CHANGE		2.4	0.6	2.1	2.4	2.3	2.3	2.2	2.5	1.8	2.1	1.7
LARGE COM. & IND.	14912.0	15314.0	15350.0	15920.0	16390.0	16910.0	17460.0	18040.0	18640.0	19290.0	19980.0	20610.0
PERCENT CHANGE		2.7	0.2	3.7	3.0	3.2	3.3	3.3	3.3	3.5	3.6	3.2
STREET LIGHTING	162.0	167.0	169.0	171.0	172.0	174.0	175.0	177.0	179.0	181.0	183.0	184.0
PERCENT CHANGE		3.1	1.2	1.2	0.6	1.2	0.6	1.1	1.1	1.1	1.1	0.5
OTHER PUBLIC AUTH.	142.0	144.0	147.0	148.0	150.0	151.0	153.0	154.0	156.0	158.0	160.0	161.0
PERCENT CHANGE		1.4	2.1	0.7	1.4	0.7	1.3	0.7	1.3	1.3	1.3	0.6
RAILROADS & RAILWAYS	878.0	844.0	865.0	880.0	895.0	910.0	934.0	959.0	982.0	1006.0	1030.0	1055.0
PERCENT CHANGE		-3.9	2.5	1.7	1.7	1.7	2.6	2.7	2.4	2.4	2.4	2.4
SALES FOR RESALE	108.0	109.0	109.0	111.0	112.0	113.0	115.0	116.0	117.0	118.0	119.0	120.0
PERCENT CHANGE		0.9	0.0	1.8	0.9	0.9	1.8	0.9	0.9	0.9	0.8	0.8
INTERDEPARTMENTAL	60.0	59.0	60.0	60.0	61.0	62.0	63.0	64.0	66.0	67.0	68.0	70.0
PERCENT CHANGE		-1.7	1.7	0.0	1.7	1.6	1.6	1.6	3.1	1.5	1.5	2.9
TOTAL	27197(C)	27405	27630	28470	29290	30170	31120	32130	33150	34260	35430	36530
PERCENT CHANGE		0.8	0.8	3.1	2.8	3.0	3.1	3.2	3.2	3.3	3.4	3.1

BREAKDOWN OF SEASONAL AND ENVIRONMENTAL LOADS

	ACTUAL 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
SPACE HEATING	1364(A)	1465	1454	1573	1715	1861	2012	2160	2306	2457	4611	2767
AIR CONDITIONING	2669(B)	2690	2535	2589	2640	2709	2774	2830	2902	2965	3031	3092
ENVIRONMENTAL**	3059	3183	3324	3470	3567	3687	3809	3935	4078	4240	4427	4622
ALL OTHER LOAD	20105	20067	20317	20858	21360	21913	22525	23187	23864	24598	23361	26049
**ENVIRONMENTAL LOAD W/O ELECTRIC STEEL MELTING	2359	2433	2549	2670	2742	2827	2907	3005	3108	3240	3387	3542

(A) TO CORRECT FOR MORE DEGREE DAYS THAN NORMAL DEDUCT 63.0 MMKWH. (C) WEATHER NORMALIZED TOTAL 26914.

(B) TO CORRECT FOR MORE EFFECTIVE DEGREE HOURS THAN NORMAL DEDUCT 220.0 MMKWH.

* 1977 INCLUDES AN ABNORMAL INCREASE OF 340 MMKWH DUE TO THE CHANGE FROM QUARTERLY TO MONTHLY BILLING (278 MMKWH IS RESIDENTIAL, 55 MMKWH IS HOUSE HEATING, AND 7 MMKWH IS SM. C&I).

R & F DEPT.
DECEMBER 1978

13

TABLE I

PHILADELPHIA ELECTRIC COMPANY SYSTEM

EFFECTS OF BUSINESS CYCLES AND GNP ESTIMATE VARIATIONS

ON BASE CASE

MILLION KWH

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
RESIDENTIAL										
HIGH	7329	7412	7495	7589	7703	7839	7974	8130	8286	8422
LOW	6125	6194	6264	6342	6438	6551	6664	6795	6925	7038
HOUSE HEATING										
HIGH	982	1112	1272	1453	1643	1834	2024	2244	2475	2725
LOW	979	1109	1269	1448	1638	1829	2018	2238	2467	2717
SMALL COM. & IND.										
HIGH	3172	3237	3314	3390	3466	3542	3630	3695	3771	3837
LOW	2636	2671	2754	2818	2881	2944	3017	3071	3135	3189
LARGE COM. & IND.										
HIGH	16946	17576	18024	18669	19276	19916	20570	21396	22058	22753
LOW	12793	13268	13659	14093	14551	15034	15535	16076	16651	17176
STREET LIGHTING										
HIGH	167	171	172	174	175	177	179	181	183	184
LOW	167	171	172	174	175	177	179	181	183	184
OTHER PUBLIC AUTHORITIES										
HIGH	147	148	150	151	153	154	156	158	160	161
LOW	147	148	150	151	153	154	156	158	160	161
RAILROADS & RAILWAYS										
HIGH	867	882	897	912	936	961	984	1008	1032	1057
LOW	863	878	893	908	932	957	980	1004	1028	1053
SALES FOR RESALE										
HIGH	118	120	121	122	124	125	126	127	129	130
LOW	95	96	97	98	100	101	102	103	104	104
INTERDEPARTMENTAL										
HIGH	60	60	61	62	63	64	66	67	68	70
LOW	60	60	61	62	63	64	66	67	68	70
TOTAL										
HIGH	29790	30718	31576	32522	33539	34612	35717	36906	38162	39339
LOW	23867	24615	25319	26074	26931	27816	28717	29693	30721	31672

TABLE II

R & D DEPT.
DECEMBER 1978

BASE FORECAST

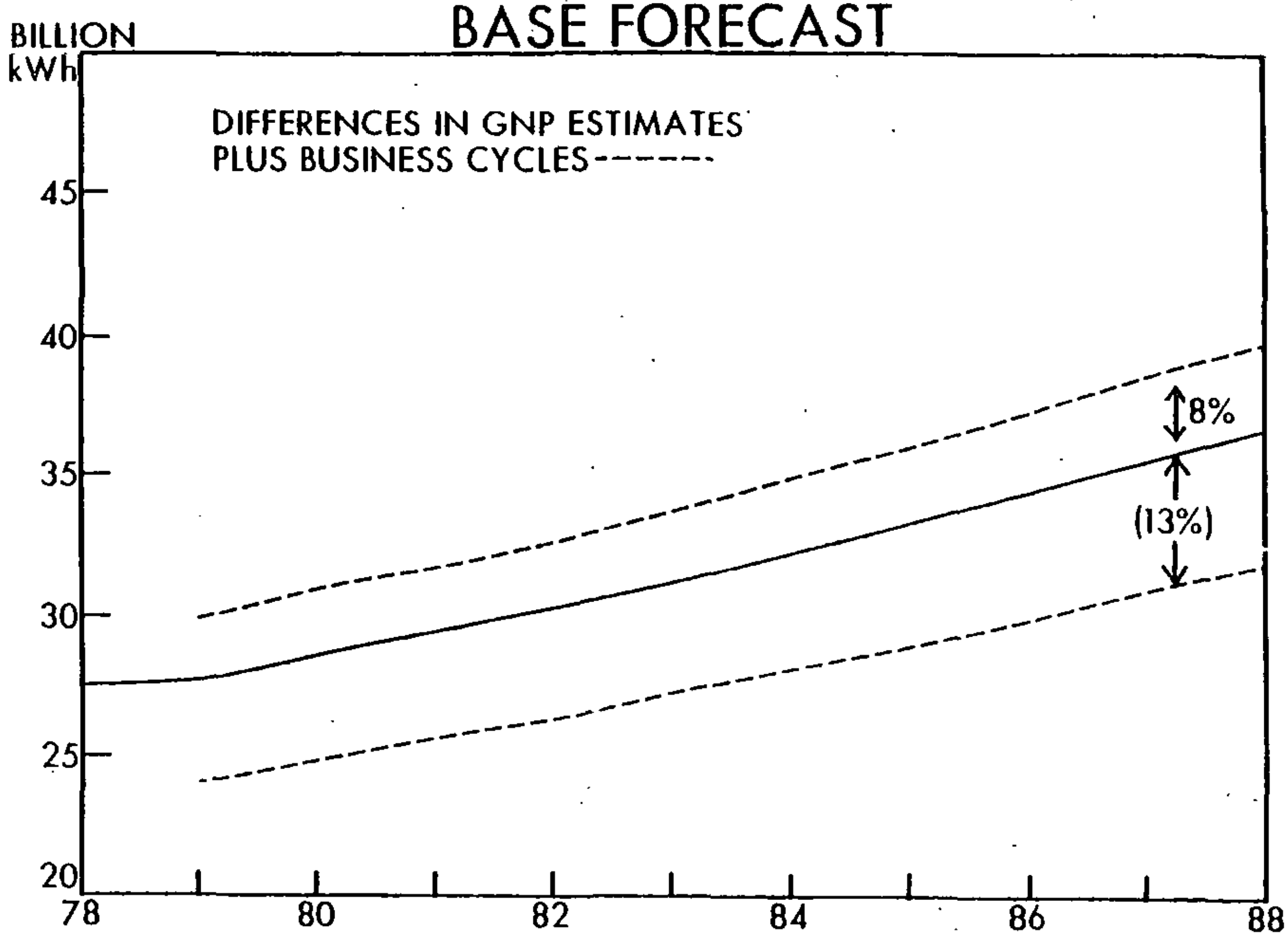


CHART I

PHILADELPHIA ELECTRIC COMPANY SYSTEM

ELECTRIC

HIGH AND LOW RANGES

MILLION KWH

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
RESIDENTIAL										
HIGH	7192	7361	7546	7783	8023	8245	8476	8737	9000	9246
LOW	6730	6904	6864	6819	6770	6728	6687	6657	6635	6613
HOUSE HEATING										
HIGH	1054	1270	1531	1815	2165	2567	3015	3478	4005	4537
LOW	884	952	1012	1080	1143	1206	1268	1330	1391	1451
SMALL COM. & IND.										
HIGH	2960	3070	3182	3282	3367	3453	3533	3614	3690	3763
LOW	2905	2959	2970	2996	3014	3032	3049	3067	3084	3102
LARGE COM. & IND.										
HIGH	16390	17050	17620	18240	18930	19610	20350	21160	22020	22840
LOW	14320	14820	15220	15660	16130	16600	17110	17650	18220	18730
STREET LIGHTING										
HIGH	169	171	174	176	179	182	185	187	190	193
LOW	167	168	168	169	170	170	171	172	172	173
OTHER PUBLIC AUTHORITIES										
HIGH	147	150	153	155	158	160	163	166	169	172
LOW	146	147	148	148	149	150	151	152	153	154
RAILROADS & RAILWAYS										
HIGH	875	895	905	935	970	1000	1040	1070	1110	1150
LOW	855	875	880	885	890	895	900	910	920	925
SALES FOR RESALE										
HIGH	114	116	117	118	119	121	123	124	125	126
LOW	104	105	105	105	106	106	106	106	106	106
INTERDEPARTMENTAL										
HIGH	61	61	63	64	65	66	68	67	70	72
LOW	59	59	59	60	61	62	64	65	66	68
TOTAL										
HIGH	28962	30144	31281	32568	33976	35402	36953	38625	40379	42093
PERCENT CHANGE	5.7	4.1	3.8	4.1	4.3	4.2	4.4	4.5	4.5	4.2
LOW	26470	26909	27439	27922	28423	28947	29506	30109	30747	31322
PERCENT CHANGE	-3.8	2.3	1.7	1.8	1.8	1.8	1.9	2.0	2.1	1.9
BREAKDOWN OF SEASONAL LOADS										
SPACE HEATING										
HIGH	1492	1657	1866	2052	2270	2506	2742	2996	3294	3517
LOW	1390	1480	1554	1620	1687	1758	1826	1895	1951	2035
AIR CONDITIONING										
HIGH	2580	2685	2804	2931	3065	3203	3344	3471	3642	3790
LOW	2437	2422	2413	2403	2394	2397	2397	2397	2400	2402

TABLE III

R & F DEPT.
DECEMBER 1978

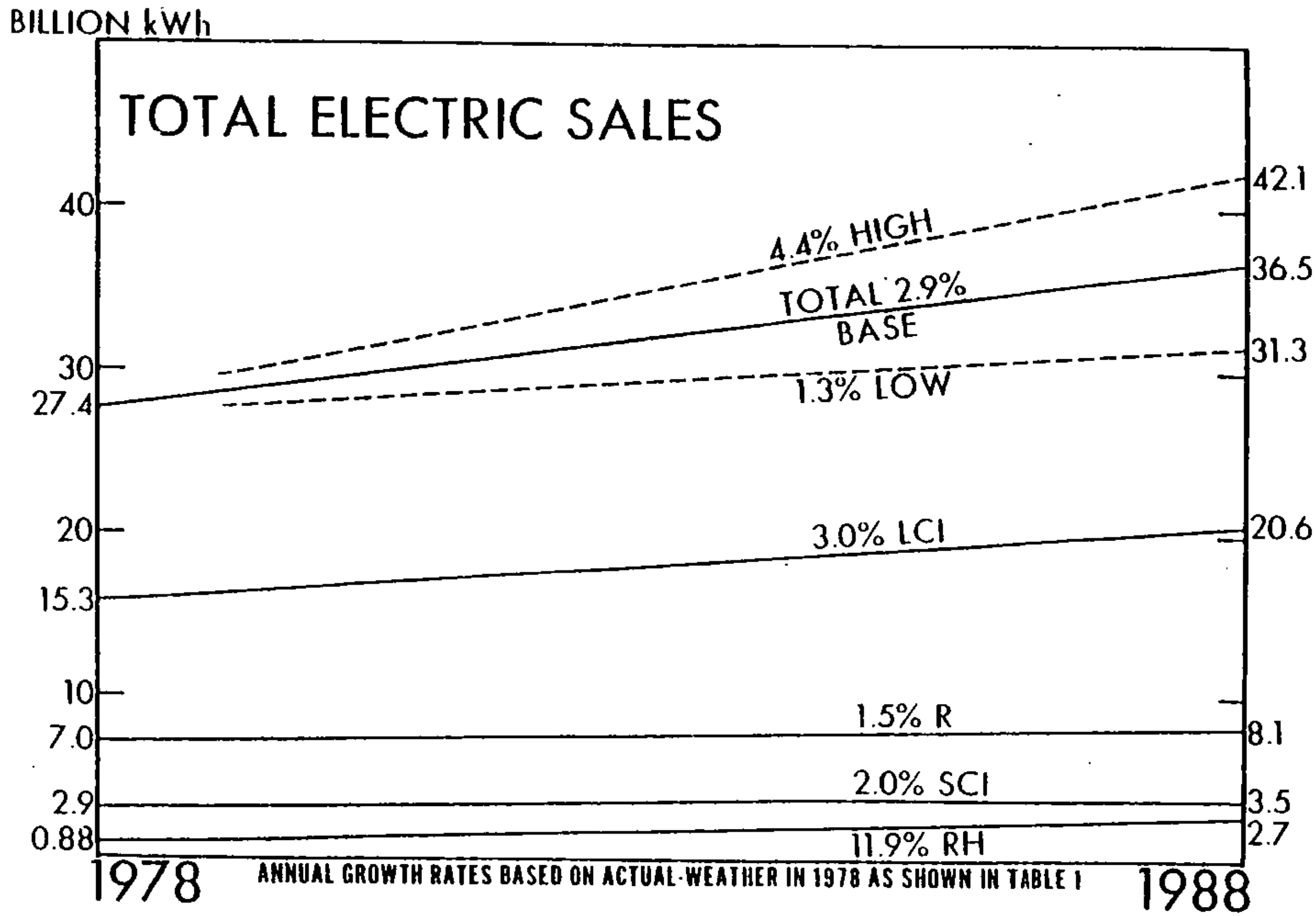
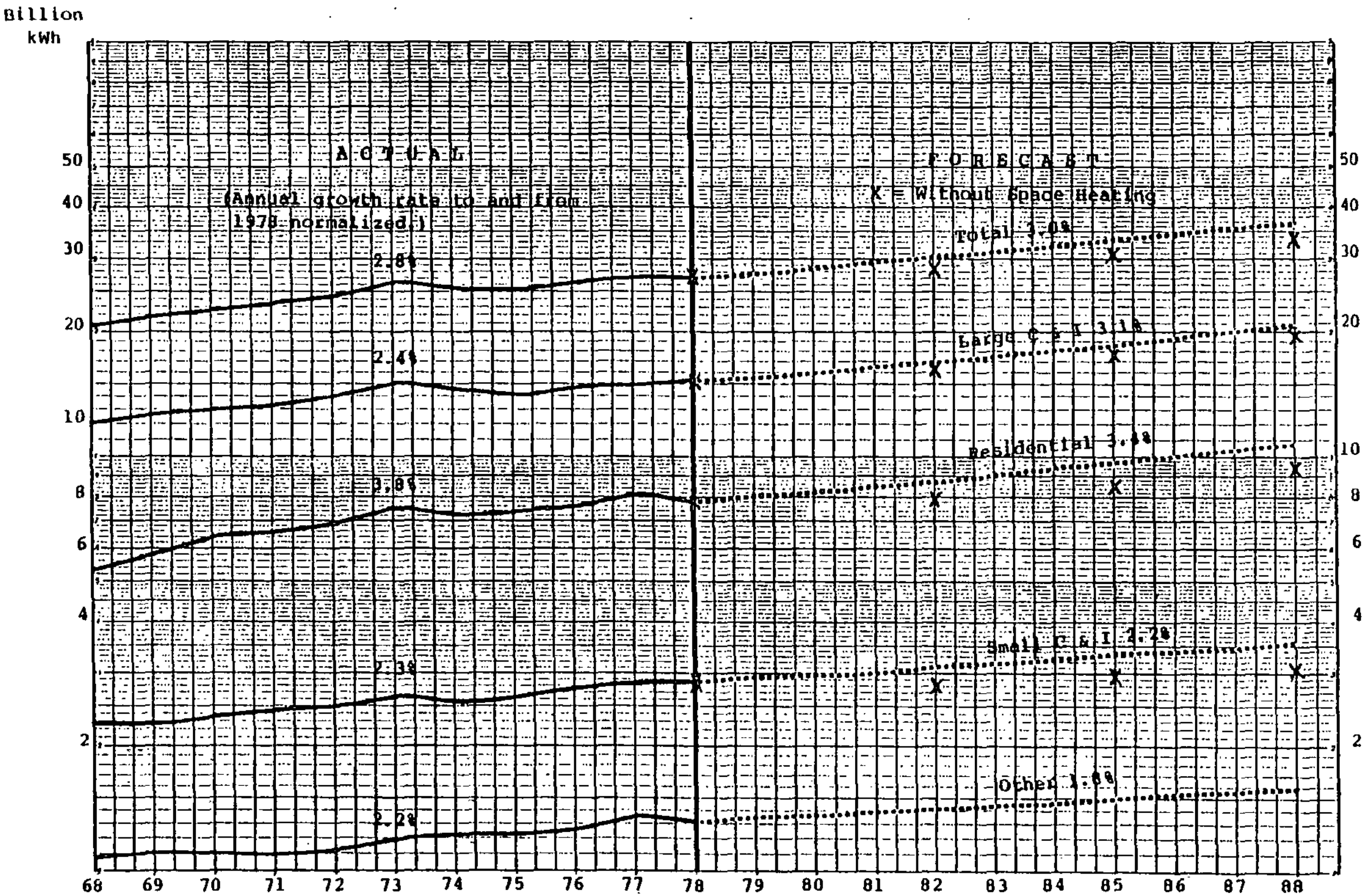

BILLION kWh
TOTAL ELECTRIC SALES
40
30
27.4
20
15.3
10
7.0
2.9
0.88
4.4% HIGH
TOTAL 2.9%
BASE
1.3% LOW
3.0% LCI
1.5% R
2.0% SCI
11.9% RH
42.1
36.5
31.3
20.6
8.1
3.5
2.7
1978
1988
ANNUAL GROWTH RATES BASED ON ACTUAL-WEATHER IN 1978 AS SHOWN IN TABLE 1

CHART 2

PHILADELPHIA ELECTRIC COMPANY SYSTEM
1978-1988 FORECAST
ELECTRIC

Base Case



NOTE: Semilog scale
Curves are noncumulative

CHART 3

R & F Dept.
December 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM
1978-88 FORECAST
ELECTRIC

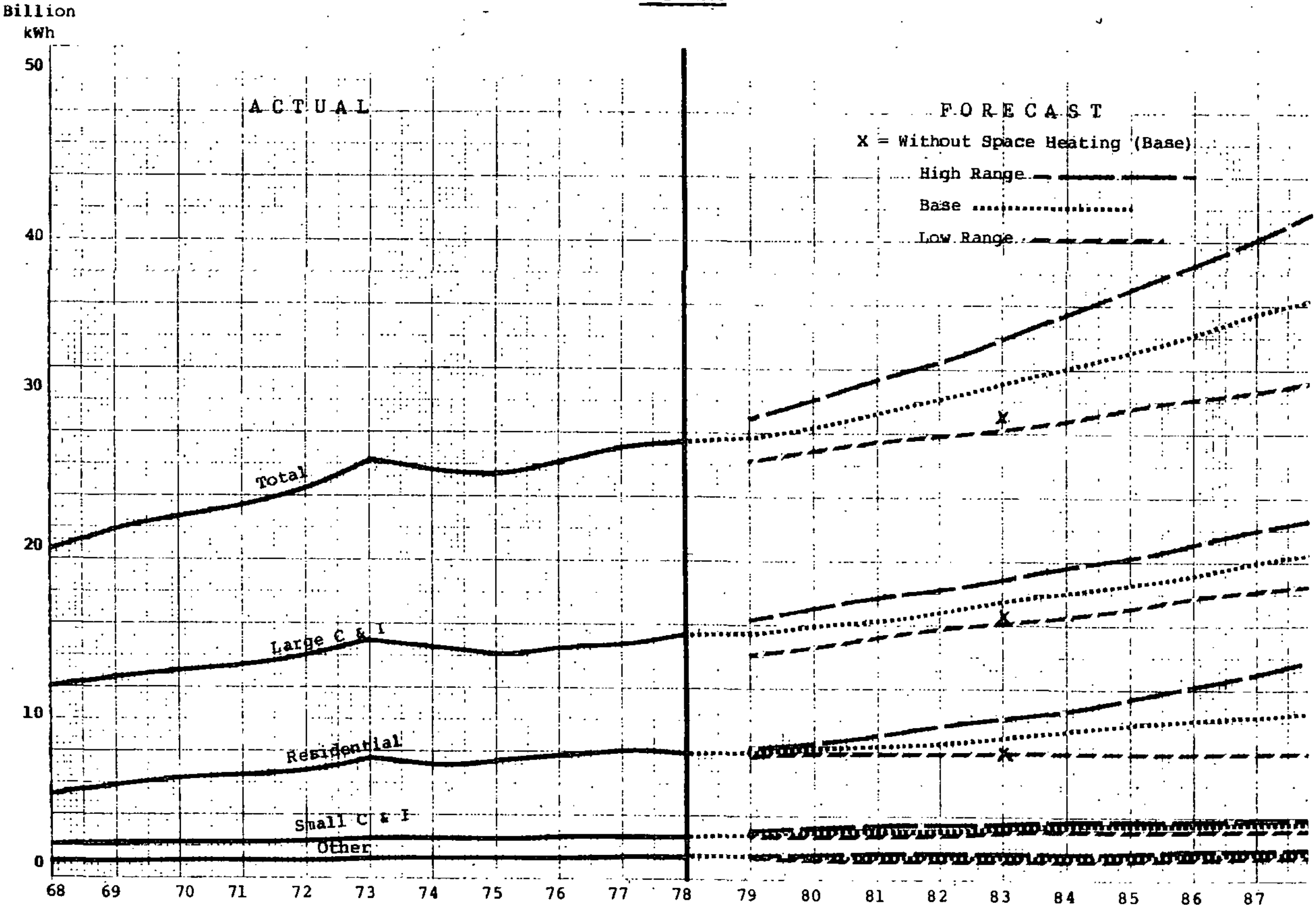


Chart 3-A

R & F Dept.
December 1978

BASE CASE

PHILADELPHIA ELECTRIC COMPANY SYSTEM
COMPOUND ANNUAL RATES OF GROWTH*
BY CLASS OF SERVICE

PERCENT

	FORECAST				FORECAST Without Increase in Space Heating			
	5 Year 1978-83	10 Year 1978-88	15 Year 1978-93	20 Year 1978-98	5 Year 1978-83	10 Year 1978-88	15 Year 1978-93	20 Year 1978-98
Residential - kWh	1.0	1.5	1.1	0.7	2.6	2.7	2.4	2.0
Growth of Number of Customers (Year End)	0.4	0.3	0.0	(0.2)	1.9	[illegible]	1.2	1.0
Growth of Sales per Customer	0.8	1.2	1.1	0.9	0.8	1.2	1.1	0.9
House Heating - kWh	13.2	11.9	10.9	9.8	0.0	0.0	0.0	0.0
Growth of Number of Customers (Year End)	14.4	12.8	11.5	10.3	0.0	0.0	0.0	0.0
Growth of Sales per Customer	(0.9)	(0.8)	(0.6)	(0.5)	0.0	0.0	0.0	0.0
Total Residential - kWh	2.8	3.2	3.1	2.8	0.2	1.4	1.6	1.4
Growth of Number of Customers (Year End)	1.1	1.1	1.0	0.9	1.1	1.1	1.0	0.9
Growth of Sales per Customer	1.8	2.1	2.1	2.0	(0.9)	0.4	0.6	0.5
Small Commercial and Industrial - kWh	1.9	2.0	1.7	1.4	1.2	1.4	1.2	1.0
Growth of Number of Customers (Year End)	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.4
Growth of Sales per Customer	1.4	1.5	1.2	1.0	0.7	0.8	0.7	0.6
Large Commercial and Industrial - kWh	2.7	3.0	2.8	2.6	2.6	2.9	2.6	2.5
Large Commercial	3.2	3.4	3.1	2.9	3.0	3.2	2.8	2.7
Large Industrial	2.1	2.7	2.5	2.4	2.1	2.7	2.5	2.4
Street Lighting - kWh	0.9	1.0	1.0	0.9	0.9	1.0	1.0	0.9
Other Public Authorities - kWh	1.2	1.1	1.1	1.0	1.1	1.1	1.1	1.0
Railroads and Railways - kWh	2.0	2.2	1.9	1.8	2.0	2.2	1.9	1.8
Sales for Resale - kWh	1.1	1.0	0.9	0.9	0.9	0.7	0.7	0.8
Interdepartmental - kWh	1.3	1.7	1.6	1.5	1.3	1.7	1.6	1.5
TOTAL	2.6	2.9	2.7	2.5	1.7	2.3	2.2	2.0

*Annual growth rates based on actual weather in 1978 as shown in Table I

Table IV

R & F Dept.
December 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM
LOW AND HIGH FORECAST RANGES
COMPOUND ANNUAL RATES OF GROWTH
BY CLASS OF SERVICE

(PERCENT)

	Five Year 1978-83				Ten Year 1978-88			
			Without Electric Space Heating				Without Electric Space Heating	
	Low Range	High Range	Low Range	High Range	Low Range	High Range	Low Range	High Range
Residential - kWh	(0.6)	2.9	(0.2)	4.6	(0.5)	2.9	(0.1)	5.0
Growth of Number of Customers (Avg.)	(0.4)	0.5	(0.1)	1.4	(0.4)	0.1	(0.1)	1.4
Growth of Sales per Customer	(0.2)	2.4	(0.1)	3.0	(0.1)	2.7	0.0	3.5
House Heating - kWh	5.8	20.2	0.0	0.0	5.3	18.1	0.0	0.0
Growth in Number of Customers (Avg.)	7.3	19.9	0.0	0.0	6.6	17.5	0.0	0.0
Growth of Sales per Customer	(1.4)	0.9	0.0	0.0	(1.2)	0.5	0.0	0.0
Total Residential - kWh	0.2	5.4	(0.2)	4.1	0.3	5.8	(0.1)	4.6
Growth in Number of Customers (Avg.)	(0.1)	1.4	(0.1)	1.4	(0.1)	1.4	(0.1)	1.4
Growth of Sales per Customer	0.3	3.9	(0.1)	2.6	0.4	4.3	0.0	3.1
Small Commercial and Industrial - kWh	0.8	3.1	0.5	2.2	0.7	2.7	0.4	1.9
Large Commercial and Industrial - kWh	1.0	4.3	0.9	4.2	2.0	4.1	1.9	3.9
Large Commercial	1.6	5.0	1.5	4.7	2.4	4.5	2.2	4.2
Large Industrial	0.5	3.7	0.4	3.7	1.7	3.6	1.7	3.6
Street Lighting - kWh	0.4	1.4	0.4	1.4	0.4	1.4	0.4	1.4
Other Public Authorities - kWh	0.7	1.9	0.7	1.7	0.7	1.8	0.6	1.7
Railroads and Railways - kWh	1.1	2.8	1.1	2.8	0.9	3.1	0.9	3.1
Sales for Resale - kWh	(0.6)	1.8	(0.7)	1.2	(0.3)	1.4	(0.5)	1.0
Interdepartmental - kWh	0.7	2.0	0.7	2.0	1.4	2.0	1.4	2.0
Total - kWh	0.7	4.4	0.6	3.9	1.3	4.4	1.2	3.9

	Fifteen Year 1978-93				[illegible]			
			Without Electric Space Heating				Without Electric Space Heating	
	Low Range	High Range	Low Range	High Range	Low Range	High Range	Low Range	Heating
Residential - kWh	(0.4)	2.3	0.0	4.7	(0.3)	1.6	0.1	4.2
Growth of Number of Customers (Avg.)	(0.5)	(0.3)	(0.1)	1.2	(0.5)	[illegible]	[illegible]	1.1
Growth of Sales per Customer	0.1	2.7	0.2	3.3	0.2	[illegible]	0.3	3.0
House Heating - kWh	4.8	15.4	0.0	0.0	4.3	13.1	0.0	0.0
Growth in Number of Customers (Avg.)	5.8	14.9	0.0	0.0	5.1	12.9	0.0	0.0
Growth of Sales per Customer	(0.9)	0.4	0.0	0.0	(0.7)	0.2	0.0	0.0
Total Residential - kWh	0.4	5.4	0.0	4.3	0.5	4.8	0.1	3.8
Growth in Number of Customers (Avg.)	(0.1)	1.2	(0.1)	1.2	[illegible]	1.1	[illegible]	1.1
Growth of Sales per Customer	0.5	4.1	0.2	3.0	0.7	3.7	[illegible]	2.7
Small Commercial and Industrial - kWh	0.7	2.3	0.4	1.7	[illegible]	[illegible]	0.4	1.4
Large Commercial and Industrial - kWh	1.7	4.1	1.6	3.9	1.5	4.0	1.4	3.9
Large Commercial	2.3	4.3	2.1	4.1	2.2	[illegible]	[illegible]	4.0
Large Industrial	1.1	3.8	1.1	3.8	0.7	3.9	0.7	3.9
Street Lighting - kWh	0.4	1.5	0.4	1.5	0.3	1.3	0.3	1.3
Other Public Authorities - kWh	0.7	1.8	0.6	1.6	0.5	1.5	0.4	1.4
Railroads and Railways - kWh	0.8	3.8	0.8	3.8	0.7	4.7	0.7	4.7
Sales for Resale - kWh	(0.1)	1.3	(0.2)	1.0	0.0	1.2	(0.1)	1.0
Interdepartmental - kWh	1.0	2.0	1.0	2.0	0.8	2.1	0.6	2.1
Total - kWh	1.1	4.2	1.0	3.8	1.1	4.1	1.0	3.7

NOTE: Growth rates are calculated with 1978 as the base year.

Table V

PHILADELPHIA ELECTRIC COMPANY SYSTEM

ALL CLASSES OF SERVICE - MMKWH

COMPOUND GROWTH RATES - %

BASE CASE

TO \ FROM	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
78	0.6																				
79	1.3	2.0																			
80	1.9	2.6	3.1																		
81	2.1	2.6	3.0	2.8																	
82	2.3	2.7	3.0	2.9	3.0																
83	2.4	2.8	3.0	3.0	3.1	3.1															
84	2.6	2.9	3.1	3.0	3.1	3.2	3.2														
85	2.6	2.9	3.1	3.1	3.1	3.2	3.2	3.2													
86	2.7	3.0	3.1	3.1	3.2	3.2	3.3	3.3	3.3												
87	2.8	3.0	3.2	3.2	3.2	3.3	3.3	3.3	3.4	3.4											
88	2.8	3.0	3.2	3.2	3.2	3.2	3.3	3.3	3.3	3.3	3.1										
89	2.8	3.0	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.0	2.8	2.5									
90	2.7	2.9	3.0	3.0	3.0	3.0	3.0	3.0	2.9	2.8	2.6	2.4	2.3								
91	2.7	2.9	3.0	2.9	3.0	2.9	2.9	2.9	2.8	2.7	2.5	2.4	2.3	2.3							
92	2.7	2.8	2.9	2.9	2.9	2.9	2.8	2.8	2.7	2.6	2.5	2.3	2.3	2.3	2.2						
93	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.7	2.7	2.6	2.4	2.3	2.3	2.2	2.2	2.2					
94	2.6	2.8	2.8	2.8	2.8	2.8	2.7	2.7	2.6	2.5	2.4	2.3	2.2	2.2	2.2	2.2	2.2				
95	2.6	2.7	2.8	2.7	2.7	2.7	2.7	2.6	2.6	2.5	2.3	2.2	2.2	2.2	2.1	2.1	2.1	2.0			
96	2.6	2.7	2.7	2.7	2.7	2.7	2.6	2.6	2.5	2.4	2.3	2.2	2.2	2.2	2.1	2.1	2.1	2.0	2.1		
97	2.5	2.6	2.7	2.6	2.6	2.6	2.6	2.5	2.5	2.4	2.3	2.2	2.2	2.1	2.1	2.1	2.1	2.0	2.0	2.0	
98	2.5	2.6	2.6	2.6	2.6	2.6	2.5	2.5	2.4	2.3	2.3	2.2	2.1	2.1	2.1	2.1	2.0	2.0	2.0	2.0	1.9

WHEN USING THIS TABLE, CHOOSE THE STARTING YEAR FROM THE TOP MARGIN, SELECT THE ENDING YEAR FROM THE LEFT MARGIN, WHERE THEY INTERSECT YOU WILL FIND THE COMPOUND GROWTH RATE FOR THAT PERIOD.
EXAMPLE: FROM 1978 TO 1988 THE COMPOUND GROWTH RATE IS 3.0%.

TOTAL MMKWH

1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
26915	27081	27630	28490	29290	30170	31120	32120	33150	34260	35430	36530	37426	38292	39184	40038	40928	41823	42657	43544	44415	45268

NOTE: TOTAL MMKWH FOR 1977 AND 1978 HAVE BEEN NORMALIZED.

Table VI

R & F DEPT.
DECEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

ALL CLASSES OF SERVICE - MMKWH

COMPOUND GROWTH RATES - %

HIGH CASE

TO	FROM 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
78	0.6																				
79	3.7	6.9																			
80	3.8	5.5	4.1																		
81	3.8	4.9	3.9	3.8																	
82	3.9	4.7	4.0	3.9	4.1																
83	4.0	4.6	4.1	4.1	4.2	4.3															
84	4.0	4.6	4.1	4.1	4.2	4.3	4.2														
85	4.0	4.5	4.1	4.2	4.3	4.3	4.3	4.4													
86	4.1	4.5	4.2	4.2	4.3	4.4	4.4	4.5	4.5												
87	4.1	4.5	4.2	4.3	4.3	4.4	4.4	4.5	4.5	4.5											
88	4.1	4.5	4.2	4.3	4.3	4.4	4.4	4.4	4.4	4.4	4.2										
89	4.2	4.5	4.2	4.3	4.3	4.3	4.4	4.4	4.4	4.3	4.2	4.2									
90	4.1	4.4	4.2	4.2	4.3	4.3	4.3	4.3	4.3	4.3	4.2	4.1	4.0								
91	4.1	4.4	4.2	4.2	4.3	4.3	4.3	4.3	4.3	4.2	4.1	4.1	4.0	4.0							
92	4.1	4.4	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.1	4.1	4.0	4.0	3.9	3.9						
93	4.1	4.3	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.1	4.0	4.0	3.9	3.9	3.9	3.8					
94	4.1	4.3	4.1	4.1	4.2	4.2	4.1	4.1	4.1	4.1	4.0	3.9	3.9	3.8	3.8	3.8	3.7				
95	4.0	4.3	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.0	3.9	3.9	3.8	3.8	3.8	3.7	3.7	3.6			
96	4.0	4.2	4.1	4.1	4.1	4.1	4.1	4.0	4.0	4.0	3.9	3.9	3.8	3.8	3.7	3.7	3.6	3.6	3.5		
97	4.0	4.2	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.9	3.9	3.8	3.8	3.7	3.7	3.7	3.6	3.6	3.6	3.6	
98	4.0	4.1	4.0	4.0	4.0	4.0	4.0	4.0	3.9	3.9	3.8	3.8	3.7	3.7	3.7	3.6	3.6	3.6	3.5	3.6	3.5

WHEN USING THIS TABLE, CHOOSE THE STARTING YEAR FROM THE TOP MARGIN, SELECT THE ENDING YEAR FROM THE LEFT MARGIN, WHERE THEY INTERSECT YOU WILL FIND THE COMPOUND GROWTH RATE FOR THAT PERIOD.
EXAMPLE: FROM 1978 TO 1988 THE COMPOUND GROWTH RATE IS 4.5%.

TOTAL MMKWH

1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
26915	27081	28962	30144	31281	32572	33976	35402	36953	38625	40379	42093	43877	45651	47458	49297	51186	53078	54998	56948	58980	61064

NOTE: TOTAL MMKWH FOR 1977 AND 1978 HAVE BEEN NORMALIZED.

TABLE VII

R & F DEPT.
DECEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

LOW CASE

ALL CLASSES OF SERVICE - MMKWH

COMPOUND GROWTH RATES - %

TO \ FROM	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
78	0.6																				
79	-1.0	-2.6																			
80	0.1	-0.2	2.3																		
81	0.5	0.4	2.0	1.7																	
82	0.7	0.8	1.9	1.7	1.8																
83	0.9	1.0	1.9	1.7	1.8	1.8															
84	1.0	1.1	1.9	1.8	1.8	1.8	1.8														
85	1.2	1.2	1.9	1.8	1.8	1.9	1.9	1.9													
86	1.3	1.3	1.9	1.8	1.9	1.9	1.9	2.0	2.0												
87	1.3	1.4	1.9	1.9	1.9	1.9	2.0	2.0	2.1	2.1											
88	1.4	1.5	1.9	1.9	1.9	1.9	2.0	2.0	2.0	2.0	1.9										
89	1.3	1.4	1.8	1.8	1.8	1.8	1.8	1.8	1.7	1.6	1.4	0.8									
90	1.3	1.4	1.7	1.7	1.7	1.7	1.6	1.6	1.5	1.4	1.2	0.8	0.8								
91	1.3	1.3	1.7	1.6	1.6	1.6	1.5	1.5	1.4	1.3	1.1	0.8	0.8	0.8							
92	1.2	1.3	1.6	1.5	1.5	1.5	1.4	1.4	1.3	1.2	1.0	0.8	0.8	0.8	0.8						
93	1.2	1.2	1.5	1.5	1.5	1.4	1.4	1.3	1.3	1.2	1.0	0.8	0.8	0.8	0.8	0.8					
94	1.2	1.2	1.5	1.4	1.4	1.4	1.3	1.3	1.2	1.1	1.0	0.8	0.8	0.8	0.8	0.8	0.8				
95	1.2	1.2	1.4	1.4	1.4	1.3	1.3	1.2	1.2	1.1	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.9			
96	1.1	1.2	1.4	1.3	1.3	1.3	1.3	1.2	1.1	1.1	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8		
97	1.1	1.2	1.4	1.3	1.3	1.3	1.2	1.2	1.1	1.0	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
98	1.1	1.1	1.3	1.3	1.3	1.2	1.2	1.2	1.1	1.0	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.9	0.9

WHEN USING THIS TABLE, CHOOSE THE STARTING YEAR FROM THE TOP MARGIN, SELECT THE ENDING YEAR FROM THE LEFT MARGIN, WHERE THEY INTERSECT YOU WILL FIND THE COMPOUND GROWTH RATE FOR THAT PERIOD.
EXAMPLE: FROM 1978 TO 1988 THE COMPOUND GROWTH RATE IS 1.5%.

TOTAL MMKWH

1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
26915	27081	26370	26989	27439	27922	28423	28947	29506	30109	30747	31332	31585	31838	32093	32354	32623	32871	33165	33438	33712	34009

NOTE: TOTAL MMKWH FOR 1977 AND 1978 HAVE BEEN NORMALIZED.

TABLE VIII

R & F DEPT.
DECEMBER 1978

PHILADELPHIA ELECTRIC COMPANY

ELECTRIC

BASE CASE

MILLION KWH

	ACTUAL 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
RESIDENTIAL	7155.0	6846.0	6890.0	6967.0	7048.0	7142.0	7252.0	7377.0	7513.0	7662.0	7804.0	7930.0
HOUSE HEATING	754.0	813.0	909.0	1029.0	1181.0	1352.0	1529.0	1711.0	1899.0	2106.0	2329.0	2571.0
SMALL COM. & IND.	2751.0	2814.0	2826.0	2885.0	2948.0	3014.0	3081.0	3151.0	3218.0	3283.0	3344.0	3408.0
LARGE COM. & IND.	14769.0	15161.0	15202.0	15761.0	16231.0	16745.0	17285.0	17869.0	18454.0	19097.0	19780.0	20494.0
STREET LIGHTING	160.0	166.0	168.0	170.0	171.0	173.0	174.0	176.0	178.0	180.0	182.0	184.0
OTHER PUBLIC AUTH.	142.0	145.0	147.0	148.0	150.0	152.0	153.0	155.0	156.0	158.0	160.0	161.0
RAILROADS & RAILWAYS	878.0	844.0	865.0	880.0	895.0	910.0	934.0	959.0	982.0	1006.0	1030.0	1055.0
SALES FOR RESALE -												
IN PENNSYLVANIA	107.6	109.0	109.0	111.0	111.9	112.6	114.5	116.4	117.0	118.0	119.0	120.0
TO CONOWINGO POWER	380.8	408.4	419.4	434.4	448.1	461.6	475.8	490.4	505.5	521.1	537.1	553.6
INTERDEPARTMENTAL	60.0	57.0	59.0	60.0	61.0	62.0	64.0	65.0	66.0	67.0	68.0	70.0
TOTAL *	26774.6	26957.0	27175.0	28011.0	28796.9	29662.6	30586.5	31570.4	32583.0	33677.0	34816.0	35895.0

* SALES FOR RESALE TO CONOWINGO POWER HAVE BEEN EXCLUDED FROM THE TOTAL TO AVOID COUNTING THESE SALES TWICE WHEN P.E. CO. SALES AND CONOWINGO POWER SALES ARE ADDED TOGETHER TO OBTAIN SYSTEM SALES.
NOTE: TOTALS MAY NOT EQUAL THE SUM OF INDIVIDUAL CATEGORIES DUE TO ROUNDING.

TABLE IX

R & E DEPT.
DECEMBER 1978

CONOWINGO POWER COMPANY

ELECTRIC

THOUSAND KWH

BASE CASE

	ACTUAL 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
RESIDENTIAL	142357	147800	150300	151300	151000	150500	149800	149300	150000	151900	154900	158000
HOUSE HEATING	59100	65500	73700	81700	90000	98500	107200	115700	124000	132100	140100	148000
SMALL COM. & IND.	74051	79900	81100	84700	89000	93000	97300	102100	107200	112400	118000	123900
LARGE COM. & IND.	143448	153000	154000	159000	164000	169000	175000	180000	196000	193000	200000	205000
PUB. ST. & HWY. LTG.	941	974	985	995	1005	1015	1025	1035	1045	1055	1065	1075
SALES FOR RESALE	22	22	24	24	24	24	24	24	24	24	24	24
TOTAL	419949	447956	460109	477919	495029	512037	530349	540159	570369	570479	614089	636999

TABLE X

E & F DEPT.
DECEMBER 1978

ELECTRIC CUSTOMERS

MONTH OF DECEMBER

BASE CASE

	ACTUAL 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
PHILADELPHIA ELECTRIC COMPANY SYSTEM												
RESIDENTIAL 1,000'S	1111.0	1114.8	1118.6	1123.2	1128.7	1135.0	1140.6	1145.1	1148.2	1149.8	1149.4	1147.1
HOUSE HEATING 1,000'S	37.2	43.4	48.8	55.9	64.7	74.7	85.0	95.4	106.2	118.1	131.0	144.7
SMALL COM. & IND. 1,000'S	115.9	116.2	116.6	117.1	117.7	118.3	119.0	119.7	120.5	121.2	121.8	122.4
LARGE COM. & IND.	5772	5798	5826	5857	5888	5919	5950	5981	6012	6043	6074	6105
STREET LIGHTING	441	434	435	438	440	442	444	446	448	450	452	454
OTHER PUBLIC AUTH.	1931	1954	1974	1993	2013	2033	2054	2074	2095	2115	2137	2148
R.R. & RWYS.	3	3	3	3	3	3	3	3	3	3	3	3
SALES FOR RESALE	6	6	6	6	6	6	6	6	6	6	6	6
TOTAL 1,000'S	1272.3	1282.6	1292.2	1304.5	1319.5	1336.4	1353.1	1368.7	1383.5	1397.7	1410.9	1422.9
UNRESTRICTED WATER HTG. 1,000'S*	9.6	10.9	12.0	13.1	14.1	15.0	15.8	16.4	16.8	17.2	17.5	17.6
RESTRICTED WATER HTG. 1,000'S*	100.8	101.3	101.3	101.4	101.4	101.3	101.1	100.8	100.4	99.9	99.4	98.8
POL **	4828	4775	4725	4675	4625	4600	4600	4600	4600	4600	4600	4600
PHILADELPHIA ELECTRIC COMPANY												
RESIDENTIAL 1,000'S	1092.7	1096.2	1099.9	1104.3	1109.7	1115.9	1121.4	1125.8	1128.9	1130.4	1130.1	1127.9
HOUSE HEATING 1,000'S	34.4	40.3	45.4	52.3	60.8	70.5	80.5	90.6	101.0	112.6	125.0	138.3
SMALL COM. & IND. 1,000'S	113.7	114.0	114.3	114.8	115.3	115.9	116.6	117.2	117.9	118.6	119.2	119.7
LARGE COM. & IND.	5692	5720	5746	5775	5805	5835	5865	5895	5925	5955	5985	6015
STREET LIGHTING	427	420	421	423	425	427	429	431	433	435	437	439
OTHER PUBLIC AUTH.	1931	1954	1974	1993	2013	2033	2054	2074	2095	2115	2137	2148
R.R. & RWYS.	3	3	3	3	3	3	3	3	3	3	3	3
SALES FOR RESALE	6	6	6	6	6	6	6	6	6	6	6	6
TOTAL	1248.9	1250.6	1267.8	1279.6	1294.1	1310.6	1326.9	1342.0	1356.3	1370.1	1382.9	1394.5
ELIMINATIONS	3	3	3	3	3	3	3	3	3	3	3	3
CONOWINGO POWER COMPANY												
RESIDENTIAL	18440	18720	18880	19020	19160	19300	19370	19440	19470	19500	19470	19530
HOUSE HEATING	2800	3120	3360	3620	3880	4160	4470	4860	5150	5540	5970	6410
SMALL COM. & IND.	2210	2340	2270	2310	2350	2390	2440	2490	2540	2600	2660	2720
LARGE COM. & IND.	80	78	80	82	83	84	85	86	87	88	89	90
STREET LIGHTING	14	14	14	15	15	15	15	15	15	15	15	15
SALES FOR RESALE	3	3	3	3	3	3	3	3	3	3	3	3
TOTAL	23547	24275	24607	25056	25491	25932	26303	26834	27205	27746	28207	28660

* INCLUDED IN THE RESIDENTIAL CLASS.
** INCLUDED IN THE SMALL COM. & IND. CLASS.
NOTE: TOTALS MAY NOT EQUAL THE SUM OF INDIVIDUAL CATEGORIES WHICH ARE ROUNDED NUMBERS.

R & F DEPT.
DECEMBER 1978

TABLE XI

PHILADELPHIA ELECTRIC COMPANY SYSTEM

ENVIRONMENTAL USAGE FORECAST

BASE CASE

MILLION KWH

ENVIRONMENTAL CATEGORY	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
POLLUTION CONTROL EQUIPMENT*	874.0	910.0	943.0	988.0	1014.0	1047.0	1080.0	1107.0	1139.0	1176.0	1218.0	1258.0
ELECTRIC STEEL MELTING	700.0	750.0	775.0	800.0	825.0	860.0	900.0	930.0	970.0	1000.0	1040.0	1080.0
RECYCLING	62.0	67.0	71.0	74.0	77.0	81.0	85.0	97.0	103.0	107.0	110.0	113.0
SEWAGE & REFUSE TREATMENT	240.0	300.0	350.0	400.0	420.0	435.0	450.0	465.0	480.0	495.0	505.0	510.0
WATER PURIFICATION	305.0	313.0	320.0	328.0	336.0	345.0	353.0	362.0	371.0	380.0	390.0	400.0
MASS TRANSIT	878.0	843.0	865.0	880.0	895.0	915.0	936.0	958.0	980.0	1004.0	1029.0	1055.0
ELECTRIC VEHICLES	0.0	0.0	0.0	0.0	0.2	2.0	5.0	12.0	35.0	78.0	135.0	206.0
TOTAL ENVIRONMENTAL LOAD	3059.0	3183.0	3324.0	3470.0	3567.2	3685.0	3809.0	3931.0	4078.0	4240.0	4427.0	4622.0
% OF SYSTEM USAGE	11.2	11.6	12.0	12.2	12.2	12.2	12.2	12.2	12.3	12.3	12.5	12.6
% NOT INCLUDING ELECTRIC STEEL MELTING	8.7	8.9	9.2	9.4	9.4	9.4	9.3	9.3	9.4	9.4	9.5	9.6

* INCLUDES POWER USED FOR LIGHTING, AIR AND SOLIDS POLLUTION CONTROL APPLICATIONS IN THE PRIVATE BUSINESS SECTOR, ALSO PRODUCTION ENERGY REQUIRED TO MANUFACTURE LESS POLLUTING PRODUCTS SUCH AS NONLEADED GASOLINE.

TABLE XII

R & F DEPT.
NOVEMBER 1978

PRICE ELASTICITY OF ELECTRICITY

The price elasticity of the demand for electricity for small price changes is defined as the

$$\frac{\%\ \text{Change in kWh}}{\%\ \text{Change in Price}} = - \frac{P}{Q} \cdot \frac{dQ}{dP} = \text{Point Elasticity}$$

Where P = real price of an average or marginal kWh of electricity

Q = quantity demanded in kWh

dQ = change in quantity

dP = change in real price

Price elasticity measures the degree to which a change in price will affect the change in quantity demanded. Elasticities between 0 and 1 are considered inelastic, while those greater than 1 are considered elastic. Total revenues accruing to goods whose demands are elastic will expand as the real price of the goods declines. Conversely, total revenues accruing to inelastic goods will decrease as the real price of the goods declines. Changes in real price will not have an appreciable influence on commodities whose demands are inelastic, while for an elastic commodity, changes in price will have a stronger impact on the quantity used.

For large changes in price, arc elasticity is used. Arc elasticity is measured over an arc of the demand curve rather than at a specific point on the curve. To do this, one can use the average of the two price figures and the average of the two quantity figures.

$$\frac{-dQ}{dP} \times \frac{\frac{P_2 + P_1}{2}}{\frac{Q_2 + Q_1}{2}} = - \frac{dQ}{dP} \frac{(P_2 + P_1)}{(Q_2 + Q_1)} = \text{Arc Elasticity}$$

Sometimes the prices and quantities are first converted into log form. If the elasticity were estimated to be -.5 and the <u>point</u> elasticity formula were used, a 50% price increase would result in a 25% reduction in quantity demanded. If the elasticity were estimated to be -.5 and the <u>arc</u> formula were used, a 50% price increase would result in an 18% quantity decrease.

Many elasticity studies analyze the influence of substitute fuel prices on the demand for electric energy. Defined as the cross-elasticity of demand, it measures the degree to which a 1% change in the real price of a fuel substitute (coal, natural gas, residual oil, or distillate oil) will affect the percent change in kWh demanded.

$$\text{Cross elasticity of electricity in (kWh)} \; - \frac{dQ\ (\text{kWh})}{dP\ (\text{substitute fuel})} \cdot \frac{P\ (\text{Substitute fuel})}{Q\ (\text{kWh})}$$

The price elasticity of any good or service is a function of:

(a) the price and availability of substitutes,

(b) the degree of necessity attached to the commodity or service,

(c) the proportion of the household or business budget that is devoted to the commodity or service.

In other words, high price elasticity is associated with the availability of substitutes at a reasonable price, nonnecessities, and goods or services which represent a large proportion of the budget of a household or business. Low price elasticity is associated with goods that have no substitute at a reasonable price, are necessities, and represent a trivial proportion of the family or business budget.

With these principles in mind, an examination of electric demand should provide some tentative ideas regarding the degree of elasticity for electric service.

In the residential sector, gas is a reasonable substitute for water heating, space heating, clothes drying and cooking, and oil is a reasonable substitute for water and space heating. However, over the near future both gas and oil are expected to be in short supply, if available at all, and the price of these fuels is expected to increase at least as fast as that of electricity. For most home uses of electricity, it is considered in the nature of a necessity. In the typical American home in 1977, electricity represented only 2.1% of total personal consumption expenditures compared with items such as:

	Percent of Total Personal Consumption Expenditures
Food	18.0
Clothing	7.9
Housing	15.3
Medical Care	9.8
Personal Business	5.0
Transportation	14.3
Recreation	6.7
Tobacco	1.4
Alcoholic Beverages	2.3
Gas, fuel oil and coal	2.1
Electricity	2.1

In the Philadelphia Electric Company area in 1972, 2.2% of average employee earnings was spent on electricity. By 1977, this proportion had increased to 3.0%.

The shortage of substitute products, the expectation that their prices will rise as fast as electricity, the necessity characteristics of electricity and the relative unimportance in the family budget all point toward low price elasticity in the residential market.

In the industrial sector, gas and oil are expected to be in short supply in the near future, and electricity is considered in the nature of a necessity also. In the typical manufacturing industry, the cost of electricity represents only 2.1% of total product value, and in no standard industrial classification two-digit industry does it represent more than 5.3% of product value. This indicates that industry could pass on any increase in the price of electricity with only a slight rise in the price of its product. A 100% increase in the price of electricity, if this increased cost is passed directly to the consumer, should produce about a 2% increase in price for the typical manufactured good. The calculations in this paragraph are based on the 1976 Pennsylvania Industrial Census, and 1976 P.E. revenue from manufacturing customers. Even if gas and oil are available, their price will be rising as fast as electricity, so the possible advantage in shifting fuels should be eliminated.

A number of economists have attempted to estimate the price elasticity of electric demand; however, there is little consensus in any of the three sectors. The following summary gives the general ranges:

Class	Short Run	Long Run
Residential	-.09 to - .99	-.326 to -2.00
Commercial	-.16 to -1.16	-.538 to -1.42
Industrial	-.21 to -2.71	-.429 to -2.40

it is important to note that none of the elasticity studies measure the extent of a change in real electricity price on a customer's peak load requirement as measured in kW. The economist's definition of demand is used in the context of electric consumption (energy), not power (kW). Therefore, the important analysis of determining relationships between changes in real electric price and the commensurate changes in both system and class-diversified load characteristics cannot be quantified at this time. In the long run however, a real price change in electricity will be followed by a lagged response in consumption. Consumers will tend to purchase appliances which utilize fuels whose real price per Btu equivalent is lower relative to electricity. Long run elasticity estimates the percentage change in kWh, allowing for the lag response to have had time to work itself out. The lag response is the time it takes for the consumer to purchase substitute appliances in response to the initial electric price change.

Many criticisms have been leveled at the elasticity studies including the following:

1. The relevant variables may not be included. Most of the studies take into account the role of competing fuels. However, a large portion of electricity consumption is utilized by appliances which have no practical fuel alternatives to speak of. Therefore, this portion of kWh consumption is certainly price inelastic, while the heating requirements are definitely more elastic. None of the listed studies have attempted to differentiate between those demands which have viable fuel substitutes and those that do not. Until these markets are separated out, the effects of competitive fuel costs on electricity demand will not be clearly distinguished from the noncompetitive markets.

2. The empirical research of the late sixties and very early seventies is no longer valid with today's energy shortages and the ensuing real rises in electricity prices.

3. Due to the declining rate block structure, average revenue per customer is as much determined by levels of consumption as consumption is determined by average revenue. Electric rates and consumption become dependent on each other which refutes conventional demand studies which treat price as an exogenous variable, independent of the quantity consumed. While the use of typical monthly electric bills avoids the dependence problem by assuming fixed levels of consumption of electricity, it still does not give an adequate measure of marginal electric price. The price of the incremental kWh of consumption is theoretically the best measure of price in doing a demand study. Very few studies have been able to incorporate an incremental price variable in their demand analyses.

4. An important question to which very few elasticity studies address themselves is the assessment of the effects of changes in rate structure on electric consumption. To what extent will a 1% bill increase at the 100 kWh per customer level lead to a significantly different price elasticity than at the 1,000 kWh per customer level? The majority of the models, which use a constant elasticity coefficient, cannot provide adequate answers.

5. While the studies do indicate some degree of price sensitivity, there is no indication that peak loads either at the system or class-diversified levels will respond to large increases of electric spaces. There is no reason to assume that kW demand will decrease especially in summer peaking companies. This stems from Wilson's findings that air conditioning saturation is not electric price sensitive. Since summer peak loads will remain at least constant over time while energy use decreases by virtue of electric price rises, the load factor will decline. As the load factor decreases, costs per kWh will rise, leading to higher rates, which would trigger a new use/price reaction cycle over again. However, winter peaking loads might exhibit an opposite use/price reaction cycle although it would be less pronounced than summer peaking loads. Gujarati has found that residential electric house heating saturation is extremely sensitive to electric price. In fact the long run elasticity is -5.00.

   Increases in the electric heating rate would tend to decrease the amount of new space heating added each year. This would have the effect of lowering the consumption and peak in the winter months. This would result in a lower annual load factor which would tend to raise the costs per kilowatthour and cause the company to seek rate relief to cover the revenue lost. A vicious cycle would result whereby rate increases caused the need for further rate increases. Any rate increases for electric space heating are contrary to national policy because they would force builders to install oil which is already in short supply, particularly in the long run. Gas is already in such short supply that only limited connections can be made by the company.

One of the best tests of the estimated elasticity coefficients is whether they have been an accurate estimator of the effect of price increases which have already taken place. The present average estimate of short run residential price elasticity is -0.5.

This estimate can be tested against PECO sales or average use. From 1968 to 1977, the residential rate per kilowatthour excluding Rate RH increased 133%. At the same time, the Consumer Price Index increased 74%, so the relative increase in PECO rates was 64%. If the above mentioned elasticity applied in this period, average use should have fallen 23%. If fact, average use excluding Rate RH increased 28%. Based on the experience of this company, the elasticity estimate of -0.5 is much too large in the short run.

While the coefficient of elasticity cited in many studies seems much too large, it is reasonable to conclude that some elasticity does exist primarily as a result of the long run impact of rising prices over many years during which time consumers have an opportunity to buy more efficient appliances and businessmen have had time to plan and construct more efficient buildings.

D. F. King
December 1978

PRICE ELASTICITY OF ELECTRICITY: SUMMARY OF ECONOMETRIC ESTIMATES

RESIDENTIAL SECTOR STUDIES	TYPE OF PRICE	SHORT - RUN ELASTICITY	LONG-RUN ELASTICITY	TYPE OF DATA
Anderson	A1	NE	-1.12	CS: States
Cicchetti & Smith	A	NE	-0.53 to -2.33	TS: Utility Service Territory
FEA-National Energy Outlook	A	-0.15 to -0.20	-0.77	PTS: Regions
Fisher & Kaysen	A	-0.22 to -0.99	NE	PTS: States
Griffin	A	-0.06	-0.52	TS: Aggregate U.S.
Halvorsen	A	-0.2 to -0.3	-.97	PTS: States
Houthakker	M	-0.89	NE	CS: Cities
Houthakker & Taylor	A	-0.13	-1.89	TS: Aggregate U.S.
Houthakker, Verleger & Sheehan	M	-.03 to -.09	-0.44 to -1.19	PTS: States
Mount, Chapman & Tyrell	A	-0.14 to -0.31	-1.20	PTS: States
Taylor, et al	M	-0.07	-0.78	PTS: States
Uri	A	-0.61	-1.66	TS: Aggregate U.S.
Wilson	A1	NE	-1.33	CS: SMSA

Source: Office of Conservation
FEA - 9/30/77
"Elec. Utility Rate Demonstration Project" - Exhibit (CRJ-2)

PRICE ELASTICITY OF ELECTRICITY: SUMMARY OF ECONOMETRIC ESTIMATES (Cont'd.)

COMMERCIAL SECTOR STUDIES	TYPE OF PRICE	SHORT-RUN ELASTICITY	LONG-RUN ELASTICITY	TYPE OF DATA
FEA-National Energy Outlook	A	-0.2	-0.87	PTS: Regions
Griffin	A	-0.04	-0.51	TS: Aggregate U.S.
Halvorsen	M	NE	-0.92 to -1.21	PTS: States
Mount, et al	A	-0.17	-1.36	PTS: States
Uri 12/	A	-0.34	-0.85	TS: Aggregate U.S.
INDUSTRIAL SECTOR STUDIES				
FEA-National Energy Outlook	A	-0.13	-0.33	PTS: Regions
Griffin	A	-0.04	-0.51	TS: Aggregate U.S.
Halvorsen	M	NE	-1.40 to -1.75	CS: States
Mount, et al	A	-0.22	-1.82	PTS: States
Uri	A	-0.35	-0.51	TS: Aggregate U.S.
Chern	A	-0.25	-0.90	PTS: SIC Industries

Notes:

A: Average price
A1: Average price paid for fixed amount of consumption per month.
CS: Cross Section
PTS: Pooled time series
M: Marginal price
NE: Not estimated
TS: Time series

SOURCES

Anderson, K.P., "Residential Energy Use: An Econometric Analysis." The Rand Corporation (R-1297-NSF), October 1973.

Baughman, M.L. and P.L. Joskow, Interfuel Substitution in the Consumption of Energy in the United States, Draft. Massachusetts Institute of Technology, May 10, 1974.

Chern, W.S., Industrial Demand for Electricity. Oak Ridge National Laboratory. Draft Report, 1976.

Electric Power Research Institute, Draft Final Report, Topic 2: Electric Utility Rate Design Study. Prepared by National Economic Research Associates: "Considerations of the Price Elasticity of Demand for Electricity." Palo Alto, CA., June 30, 1976.

Federal Energy Administration, National Energy Outlook (FEA-N-75/713), February 1976.

Fisher, F.M. and Kaysen, C., The Demand for Electricity in the United States. Amsterdam, Holland: North-Holland Publishing Company, 1962.

Griffin, J.W., "The Effects of Higher Prices on Electricity Consumption," The Bell Journal of Economics and Management Science, Vol. 5, No. 2, (Autumn 1974), pp. 515-539.

Guth, L.A., Report on Forecasted Sales and Peak-Load Growth of Member Companies of the New York Power Pool. New York, New York, National Economics Research Associates, Inc., December 10, 1975. See also EPRI Draft Final Report, Topic 2, prepared by NERA, cited above.

Halvorsen, R. "Demand for Electric Energy in the United States," Southern Economic Journal, Vol. 42, No. 4, (April 1976), pp 610-625.

Houthakker, H.S., "Electricity Tariffs in Theory and Practice." Electricity in the United States. Amsterdam: North Holland Publishing Company, 1962.

Houthakker, H.S. and Taylor, L.D., Consumer Demand in the United States, 2nd ed. Cambridge: Harvard University Press, 1970.

Houthakker, H.S., Verleger, P.K., and Sheehan, D.P., "Dynamic Demand Analysis for Gasoline and Residential Electricity." Lexington, Massachusetts: Data Resources, Inc., 1973.

Mount, T.D., Chapman, L.D., and Tyrell, T.J., "Electricity Demand in the United States: An Econometric Analysis." Oak Ridge National Laboratory (ORNL-NSF-49). Oak Ridge, Tennessee, June 1973.

Taylor, L.D. "The Demand for Electricity: A Survey." The Bell Journal of Economics, Vol. 6, No. 1, (Spring 1975), pp. 74-110.

Taylor, L.D. et al., "The Residential Demand for Energy: Report to the Electric Power Research Institute." (June 1976).

Uri, N.D., "A Dynamic Demand Analysis for Electrical Energy by Class of Consumer." Working Paper 34, Bureau of Labor Statistics. January 1975.

Wilson, J.W., "Residential Demand for Electricity." Quarterly Review of Economics and Business, Vol. 11, No. 1 (Spring 1971), pp. 7-22.

Wilson, J.W. & Associates, Draft Final Report, Sub Topics 2.1 and 2.2: Electric Utility Rate Design Study. Prepared for the Electric Power Research Institute. Washington, D.C. September 23, 1976.

Wilson, J.W., Douglas Point Site Projected Electric Power Demand for the Potomac Electric Power Company. Maryland Department of State Planning for the Maryland Power Plant Siting Program, PPSE 4-2, Vol. 3, July 1975.

RESIDENTIAL DISCUSSION
1978-1988

The residential forecast is comprised of electric energy use associated with Rates R, RM, RH and WH for single family detached houses (HSE), single family attached houses (TWHSE) and individually metered apartments (IMA).

Rates GS, PD and HT new single point metered apartments are also developed in this section, but the energy sales associated with them is included in the commercial and industrial forecast section.

The forecast was formulated through an analysis of existing customers and their use of electricity; projections of dwelling units as they correlate to changes in population patterns; review of regional and national appliance sales figures; projections of expected energy savings due to the implementation of the Department of Energy's efficiency improvement targets; and changes in design of both housing and appliances as well as patterns of use.

The usage of existing customers is obtained from various Company records, while surveys, Census data, sales records and industry related publications used to project appliance saturations and energy use are included in the listing of reference materials found at the end of this section.

The assumptions relied on for the residential forecast specifically, as well as demographic assumptions also used in other classes of service, are described in the headings after the following summary.

RESIDENTIAL FORECAST SUMMARY

For the forecast period 1978 to 1988, the annual growth rate for the total residential market is 3.3%. For Rate RH, the annual growth rate is 12.2% compared to 1.5% for the nonelectric heating customers.

A major component supporting the forecasted growth of 3 billion kWh is the growth of new customers. By 1988, 172,000 new construction customers are projected to be added, of which 75,000 will be electric heating customers, contributing 50% of the forecasted growth of electric sales. An additional 97,000 nonelectric heating customers will be connected adding another 800 million kWh, or another 25% of the projected increase. The remaining 750 million kWh of growth will be from the existing 1.2 million customers. Of this increase, about one-third or 250 million kWh will be heating kWh obtained from the conversion of Rate R customers to Rate RH.

With increased appliance efficiencies, the refrigerator market segment will decline from 30% of total 1978 sales to 25% by 1988. The other market segments are relatively unchanged with the exception of electric heating which increases from 5% of 1978 sales to 12% by 1988. In-depth appliance forecasts are described in the following text and summarized by their respective tables and charts.

For comparison, in October 1978 the Applied Business Research Institute (ABRI), under a subcontract to Wharton Econometric Forecasting Associates (WEFA), completed a ten year electric energy sales forecast for the period 1977 to 1987. For the electric heating market, ABRI's middle economic forecast projects a 14.7% annual growth rate compared to PECO's like period forecast of 13.0%. For the nonelectric heating customers, ABRI projects a 2.2% growth rate compared to PECO's 1.4% growth rate. For the total residential market, ABRI projects a 4.3% annual growth rate compared to PECO's 3.1% growth rate.

For the period 1978 to 1990, the Oak Ridge National Laboratory (ORNL) projects for the Mid Atlantic States (Pennsylvania, New Jersey, Maryland, Delaware, Virginia and West Virginia) a growth rate of 3.5%. This projection includes their estimation of the affects of an "appliance efficiency program, thermal standards for new residential construction, a retrofit program, and the combination of these three programs". For the same period, PECO's forecasted growth is 3.3%. For the longer run 1978-1995, ORNL projects 3.1% compared to PECO's forecast of 3.0%.

COMPARISON OF THE BASE FORECAST TO THE LOW AND HIGH RANGES FOR 1988

	1988		
	Low Range	Base	High Range
Total Electric Sales (Million kWh)	8,064	10,807	13,777
kWh Difference (Million kWh)	(2,743)	-	2,970
Percent Difference	(25%)	-	27%
Average R Rate Living Units (Thousands)	1,157	1,299	1,340
kWh/Living Unit	6,970	8,319	10,281

Major Areas of Deviation - (Million kWh)

Electric Heat		(544)		+577
Air Conditioning				
Room Coolers	(89)		+178	
Central Plant	(308)		+195	
Total A/C		(397)		+373
Transportation		(170)		+292
Water Heating		(176)		+579
Lighting		(126)		+122
All Other Appliances		(1,330)		+1,027
		(2,743)		+2,970

Of the above deviations from the base forecast, the change in the number of living units in the low range accounts for 1,181 million kWh or 43% of the decreased usage 2,743, while in the high range the increased living units account for only 341 million kWh or 11% of the increased usage 2,970.

POPULATION MODEL

An abridged form of the cohort - component method of demographic population projections, was used to simulate changes which occur in area population from 1970 to 2000. Estimates and projections consider the natural increase of births, natural decrease from deaths and the effect of net migration applied to a 1970 base population as extracted from the U.S. Census.(1,2)*

The cohort method is used to produce anticipated changes in population by age, sex and race classifications caused by the factors of fertility, mortality and migration, while maintaining the integrity of the individual cohort; the cohorts being defined as a group of individuals born in a specifically defined time interval.(3,4)

There are thirty-four cohorts defined in the population model. They are by single year classification up to age 19-20 and by five year age groups to the 85 plus cohort. To each age cohort, based on race and sex differences, the appropriate survival rates are applied. To those females ages 10 to 49 years old, the race and age specific fertility rates are applied to determine the expected births. Birth sex proportions are applied to determine the male to female ratio of births in a given year. Finally, net migration estimates were applied to all age cohorts to determine the net change in the area population from year to year.

The attributes of the cohorts are as follows:

1. Age - The base population, on which all estimates and projections are made, was extracted from the 1970 Census of Population.(1,2)

   The population is advanced from 1970 to the year 2000 by the cohorts previously defined. This is done by a stepwise procedure, the steps synonomous to the time interval of the cohort definition. The intervening time periods are extrapolations of the interval calculations.

2. Race - Each cohort is segregated into white and non-white races. This is essential for the application of the appropriate race-specific fertility, mortality and migration rates. The ratio of white to non-white portions of the population has a definite effect on the growth rate of the total population.

3. Sex - Each cohort is further segmented into male and female categories. This allows the application of the appropriate death and fertility rates. It is also necessary for the proper apportionment of new births to each sex category.

*A list of references can be found at the end of the residential section.

All forecast scenarios use the Bureau of Census revised Series II fertility rates.(5,6) This Series ultimately leads to replacement level fertility by the year 2015, approximately equal to 2,100 births per thousand females. Present fertility rates are lower for white than non-white races although the difference is projected to disappear. The race-specific fertility rates are applied to the individual female cohorts ages 10 to 49 years of age.(7)

Mortality is considered through the use of survival rates by each cohort sub-category. Survival rates represent that portion of a cohort that progresses from one specific time interval to another. The rates used were obtained from the Survival Tables published in the U.S. Bureau of Census' Current Population series.(5,6)

Migration from the 1970-1976 period has taken into consideration the Census Bureau's P-26 Series estimates of net migration.(8,9,10) From 1976, three scenarios are offered using varying migration assumptions. The base case shows a decline in net out-migration over a ten year period after 1976 to the 1965-1970 rates.(11,12) The low range considers migration to remain at its present rate through 2000. The high range assumes net migration to be neutral after that estimated for the initial period.(13,14)

Data is collected for the five county Pennsylvania area of the Philadelphia SMSA, for portions of York County, Pennsylvania and for portions of Cecil and Hartford Counties in Maryland.(2,15) This area is reduced to conform with the PECO and Conowingo Power Company service areas. Separate projections are made for the five county area, the PECO service area and Conowingo Power Company service area. The latter two are combined to yield a PECO system population projection. The five county (Bucks, Chester, Delaware, Montgomery, Philadelphia) area projections are used strictly for comparative analysis to existing estimates and projections.

The following table summarizes the population forecasts developed by various government and academic groups compared to PECO's in-house forecast for the five county Philadelphia area.

POPULATION ESTIMATES AND PROJECTIONS

FIVE COUNTY PHILADELPHIA SMSA (PENNSYLVANIA PORTION)
(BUCKS, CHESTER, DELAWARE, MONTGOMERY, PHILADELPHIA)

SOURCE	1976 ESTIMATE*	2000 PROJECTION
Federal State Cooperative Program(16)	3,802,000	-
Office of State Planning and Development(17)	3,802,000	3,965,000
Pennsylvania Department of Education(18)	3,984,000**	4,385,000
U.S. Bureau of the Census(8,9,10)	3,802,000 (Provisional)	-
Delaware Valley Regional Planning Commission(16,19)	3,802,000	4,292,000
Applied Business Research Institute(20)	3,802,000	4,131,000
Philadelphia Electric Company	3,791,000	4,104,000

*County estimates and projections(21,22,23,24)
**Extrapolation from five year figures.

HOUSEHOLD FORMATION

On a national basis, the Department of Commerce reports that the number of people per household decreased from 3.37 in 1950 to 3.14 in 1970 for a 20 year annual rate of -0.35%.(25,26) From 1970, the rate of decrease advanced to -1.33% per year to a level of 2.86 people per household in 1977. For the forecast period 1977 to 1990, the Department projects another decline at an annual rate of -0.88% down to 2.55 people per household by 1990(27,28).

For the Philadelphia area, the number of people per household decreased from 3.60 in 1950 to 3.21 in 1970 for an annual rate of -0.57%. From 1970, the Philadelphia area declined at an annual rate of -1.39% which was slightly greater than the national level.(1,2,29,30) For the forecast period 1977 to 1988, PECO projects another decline at an annual rate of -0.55%, which is three-fifths of the Department of Commerce's national rate. If PECO accepted the Department of Commerce's projection for the Philadelphia area, the PECO forecast would project another 50,000 households on line by 1988.

For many years, the Department of Economics at McGraw Hill has developed an annual forecast for energy sales. As part of this forecast, they prepare both a national population and household formation projection. For the forecast period 1977 to 1990, they project the number of people per household to decline from 2.91 in 1977 (compared to the Department of Commerce's estimation of 2.86) to 2.62 people per household in 1990 (compared to 2.55 by the Department of Commerce). For 1988, McGraw Hill projects a ratio of 2.65 as compared to PECO's ratio of 2.74.(31)

Since household formations are relatively independent of the number of children in the population, a validity check compares the total number of adults per household. The Department of Commerce projects a decline from 1.99 adults per household (18 years and over) in 1977 to 1.84 in 1990.(25) The PECO forecast projects a decline from 2.07 in 1977 to 2.04 in 1990.

The relationship between total households and females over 19 years of age is also monitored. PECO's forecast projects the number of households per female over 19 to increase from 0.952 in 1975 to 0.960 in 1988. From 1960 to 1975, this ratio increased at an annual rate of 0.75%. For the forecast period to 1988, the annual growth rate is only 0.06% - virtually stabilized.

For the Philadelphia area several local forecasts have been made, ranging from particular areas or specific counties to a projection for the entire Delaware Valley. The city of Philadelphia's Planning Commission projects the number of people per household to decline from 3.0 in 1970 to 2.50 in 1990 for an annual rate of -0.91% compared to PECO's rate of -0.88% for PECO's entire system.(32)

For the five county area, the Delaware Valley Regional Planning Commission(16,19), based on data obtained from the Planning Commissions of each county, projects a five county twenty-five year (1975-2000) population growth of 420,000 as compared to PECO's five county service area projected growth of 283,000. For the year 2000, DVRPC projects a five county people per household rate of 2.50 compared to PECO's forecast of 2.68. For the year 2000, the DVRPC projection of 2.5 people per household, in conjunction with PECO's service area population, would lead to another 100,000 households on line by the turn of the century.

The Pennsylvania Office of State Planning and Development(17), projects a five county twenty-five year (1975-2000) population growth of 165,000. Using their population projection and the DVRPC's projection of 2.5 people per household, results in a twenty-five year growth in households of 300,000 living units as compared to PECO's service area projected growth of 260,000 living units.

Finally, in an independent study prepared by Applied Business Research Institute(20), as a subcontractor to Wharton Econometric Forecasting Associates, ABRI projected a 1987 population for the Pennsylvania PECO service area of 3,805,000 as compared to PECO's in-house projection of 3,825,000. For the year 2000, ABRI preliminarily projects a population of 4,002,000 compared to PECO's projection of 4,001,000.

For the period 1979 to 1988, PECO projects an increase of 173,000 houseolds for the high range and a loss of 3,000 households for the low range. For the base case, a 133,000 household increase is projected.

NEW CONSTRUCTION

Since World War II, the United States has experienced a multitude of changes. Many of today's life styles and buying patterns, rooted in the events of the mid-1940's, are having major impacts on today's economy.

In 1945 veterans began to return home and start families. The "baby boom" lasted until the early 1960's. In the mid-to-late 1960's, as women born in the post-war "boom" grew into the marrying age (20 to 24 years), they outnumbered potential mates in the "suitable" age group*. Many of these women postponed their marriages and many continued on to higher education and then went into the labor market. With larger incomes, these women set up single households or joint households with unrelated individuals. Thus began a marked evolution in American life styles that has expanded in scope during the 1970's.

A recent analysis by the U.S. Census indicated the following changing life styles:

1. More young adults are remaining single or postponing marriage. The proportion of all women 20 to 24 years old who had never married soared from 28% to 45% between 1960 to 1977. The never-married women in the age group 25 to 29 increased from 10.5% to 16% in the same period with the entire gain occurring since 1970.

2. The number of non-family households is growing sharply and much of this increase seems to be directly associated with the postponement of marriage and also the growth of the "senior citizen's cohort". In 1977, there were 18 million non-family households and 90% of these households were "primary individuals" living alone, an increase of 50% between 1970 and 1977 compared to only a 10% increase for family households.

3. The divorce rate and the ratio of divorces to intact marriages have both been increasing. Partly as a result of this trend, 35% more families were maintained by persons without a spouse in 1977 than 1970 and over 80% of these families were headed by women. About one-third of all children now live in a family where divorce has been experienced.

Of all the above factors, the most significant development of the past ten years, for its impact on spending patterns, is the great increase in the number of working women. In 1977, over 53% of women participated in the labor market compared to less than 41% in 1960. Other changes in consumer demand have resulted from the earlier retirement age of men, the increase in part-time jobs, the smaller size of families, changing value judgments and the growing ratio of young adults and older citizens.

---

*"Suitable" age is defined as a median of three years older than the woman.

These demographic, cultural and sociological changes have had an increasing impact on the housing industry. Housing demand has been boosted not only by the effect of the post-war-boom babies reaching the home buying age but also by the increase in the number of families with two incomes and by the increasing number of new one person households. In the future (1977 to 1982), the 20 to 39 age group will increase by 13% compared with an estimated total population increase of 4%. This single factor supports a strong housing demand for new homes and apartments.

The above analysis was extracted from a research paper prepared by the Argus Research Corporation.(25,33)

A recent article in the Wall Street Journal reaffirms these findings and further points out that the major portion of the "baby boom" is between 20 and 30 years of age, the usual period of household formations, and that this group is just beginning to dominate the housing market. They also state that the members of this generation, both single or childless couples, are not as worried about poor schools, crime and crowding and are thus moving into cities, where their purchase and rehabilitation of blocks of deteriorating housing is raising some officials' hopes for an urban resurgence. This latter factor can be seen in the Society Hill area of Philadelphia.

The Wall Street Journal article further quotes Stuart Davis, Chairman of Great Western Savings and Loan Association, that by the end of this decade 32 million Americans will have hit the age 30 milestone, up a whopping 39% from the total during the 1960's. And during the 1980's, about 42 million will reach 30. Based on this factor alone, he sees no significant drop in the housing demand until the 1990's when the 'baby-bust' generation of the 1960's enters the market.

In the same article, Dwight Jaffee, Princeton University Economics Professor, states that he expects an average of slightly more than 2 million housing starts a year over the next 10 years compared with an average of about 1.7 million over the past 10 years. In his words, "The (housing) industry is ratcheted up a whole notch. The 1980's are going to be glorious."

Kenneth Rosen, Assistant Professor of Economics and Public Affairs at Princeton, estimates that current demand is running 25% above that of the 1960's and even high interest rates aren't likely to kill this boom because it's demographically based.

The Journal article continues with Michael Sumichrast, Chief Economist of the National Association of Home Builders, who forecasts that within five years 70% of all U.S. households will own their own dwellings, up from the 64% level maintained since 1970. That prediction indicates a low level of apartment construction. Mr. Sumichrast states "If it weren't for government subsidized buildings, we would actually be losing rental inventory."

In the past most young couples lived in apartments for several years until they could save a sufficient "nest egg" for a down payment on a home. As the above data indicates, this is no longer true. Again, the Wall Street Journal indicates that a recent study by the U.S. League of Savings Associations found that 35% of all home buyers are under 30 years old and 63% of all first time home buyers are under 30. The Home Builders Association says 10% of the homes sold last year were bought by people under 25 years old. For these people, the economics of home ownership were compelling.(34)

In another Argus Research paper, they state "A house is not just a home these days. It is also an investment...The median purchase price of a new home in April 1978 was a record high $53,000, just about twice what it was in April 1973." Argus says, "Federal tax rate structures...have long favored construction of single family homes and have assumed increasing significance as inflation pushes more families into higher nominal tax brackets. Home ownership is now a prime inflation hedge...."(35)

In recent months, interest rates on mortgages have increased at an alarming rate. In July 1978, a Business Week article on mortgages stated, "With savings inflows off 20% from last year, the first signs of tight mortgage money are cropping up...(some) savings and loan associations and saving banks around the country are beginning to ration credit by demanding higher down payments and shorter maturities. Some have cut out mortgages with less than 10% down."(36)

In the August 28 issue of Business Week, it is stated that housing forecasters worried that a restrictive monetary policy, high mortgage interest rates and dwindling savings at mortgage lending associations would slow housing by at least 15%, and some saw it beginning a sharper decline by early next year (1979), following the contracyclical patterns that has plagued the industry since the mid-1960's. A Federal Reserve Board insider is quoted as saying, "housing is now seen as playing a role in preventing an economic slow down and keeping consumer spending alive."(37)

The Business Week article quotes Allen Sinai, financial economist for Data Resources Incorporated, who predicts, "Unless you get a full blown credit crunch, housing and housing-support organizations will get their money." Michael Sumichrast of the Home Builders feels that home buyers were still willing to accept 10% interest rates. Jay Janis, Under Secretary of the Housing and Urban Development Department, says while inflation may average 8% this year, houses will go up 10% to 12%. In his opinion, "The purchase of a new single family home is the best investment available to a young family or anyone else in this country."(37)

In PECO's budget forecast for 1978, 13,000 new construction living units* were forecasted to be completed and occupied. With eight months of actual data recorded for 1978, it appears that about 13,500 units will be connected with about 12,000 units individually metered. In view of the increasing potential of a credit crunch, PECO projects an 8% decline for individually metered new construction units in 1979, down to the 11,000 unit level.

*Includes both individually metered and single point metered living units.

For the overall forecast period 1978 to 1988, PECO projects 183,000 living units to be built in the Company's five county Pennsylvania territory as compared to 171,000 units constructed in the period 1967-1977. The average annual increase for the forecasted period is about 7% compared to Dwight Jaffee's national prediction of 19%.(34) (PECO includes intercity rehabilitated housing as new construction.)

As stated previously, housing needs are population related. In the period 1965 to 1977, 27.7 housing connections were made in the Philadelphia area for every 100 people reaching the age 22. For the forecasted period 1979 to 1988, PECO's projected ratio is 26.9, about 3% less than the historical average.

Abating the effect of new construction on housing supply is the removal of housing units through demolitions and abandonments. For the period 1979 to 1988, PECO has estimated the net effect of demolitions, abandonments, reintroduction of services and separations of wiring to average an annual loss of 4,100 units.

While five county regional all-inclusive data is not available on the number of dwelling units demolished and abandoned each year, localized data has been accumulated primarily from the city of Philadelphia and Delaware County permit records.(38,39) Because of the age characteristics of the residential neighborhoods in these two localities, it is believed that this data accounts for a vast majority of the living units removed from the system. In Philadelphia, where about one-half of all PECO customers reside, there has been approximately 1,500 to 3,000 units demolished each year. In recent years, after examining Company records, new construction housing data and demolition records, it would appear that demolitions on a five county basis are for the most part being offset by decreasing vacancy rates, reintroduction of services and separations of wiring. The latter is evident by examining the large number of older "mansion-type homes" that are being subdivided into apartments. In addition, Bureau of the Census data on vacant housing indicates that national trends may be moving in a similar direction.(40,41,42) On the local level, there are also some cases of large commercial buildings being converted into single point metered apartments, notably the conversion of the Adelphia and Warwick hotels into condominiums and the Botany 500 and Westminster Arch buildings into SPM apartments.

In the projection of housing needs, the PECO model segments new construction into four categories - single point metered apartments (SPM) on Rates GS, PD and HT, and individually metered apartments (IMA), row/townhouses (TWHSE), and single detached houses (HSE) all on Rates R or RH.

In the period 1970 to 1977, 47% of all new construction living units were apartments - SPM or IMA. In the years of 1970 to 1973, when the average annual units connected approached 19,000, 53% were apartments. For the period 1979 to 1988, PECO forecasts new construction apartment additions of 78,500 units which is about 45% of all new construction units. Based on the previously discussed housing analyses of national forecasters, PECO's apartment estimations may seem high; however, PECO maintains that for the present a conservative estimation is warranted for the Philadelphia area. In the city of Philadelphia, the average household size for 1970 was 3.0 persons. The Philadelphia Planning Commission estimates the household size to decline to 2.5 persons by 1990.(32) As household size declines, the need for single family homes may decrease. As the cost of housing increases, the ability of marginal income residents to purchase new homes declines and results in an increased demand for apartments. The Department of Commerce indicated that for 1977, 24% of total new construction was apartments as compared to the peak rate of 50% with over one million apartment units in 1972. For 1978, the Commerce Department projects a 7% increase over 1977 to a 31% level. The Commerce Department further states, "Despite the relatively slow pace of recovery for multi-unit housing compared to single units, there is a basis for improvement in the investment climate for the apartment market. Demographic and social factors (i.e. many new young families, more single person households and a rise in the elderly population) have been favorable in recent years and will become even more so as we approach the 1980's".(43) If a higher percentage of single family units are constructed than is included in the PECO forecast, the PECO energy forecast may be on the low side since single family units have more appliances and use more energy than apartments.

For the forecast period 1979 to 1988, 3,000 SPM units will be added. Because of anticipated restrictions by either the Department of Energy or the Pennsylvania PUC(44), increased utility charges to HT customers and the desire of many developers to transfer utility costs to apartment renters, no further construction growth is anticipated above presently committed SPM units.

For single family living units, PECO forecasts 43,000 additional townhouses and 53,000 new detached units for a forecasted market segment of 25% and 30% respectively. For the period 1975 to 1977 (the only years where historical townhouse data is available), 19% of new units connected were townhouses and 47% were single detached units.

For the high range from 1979 to 1988, the forecast projects 29.7 new construction housing connections for every 100 people reaching the age 22. For the low range, the ratio is 13.5. Under the high range, 200,000 living units will be connected as compared to 90,000 units for the low range and 175,000 for the base forecast. The high range projects that 70% of the new construction units will be houses while the low range projects only 47% houses and 53% apartments.

RATE RH

To determine the penetration of electric heat, each housing sector (single point metered apartments, individually metered apartments, townhouses and single detached houses) was separated geographically - City of Philadelphia, Suburban Divisions and Conowingo Power. Heating costs were calculated for a typical single detached house comparing PECO gas rates, fuel oil costs and three types of electric heat systems - baseboard, furnace and heat pump.

Based on a space heating cost analysis for 1978, a newly constructed suburban single detached house with 1,500 square feet of heated living area with an electric heating baseboard system would have a heating cost about 47% higher than a gas heated house and about 21% higher than one using fuel oil. If the customer desired a central air conditioning system*, an electric heat pump would have a heating cost about 6% less than a gas system and 23% less than a fuel oil system. These cost estimates are based on present PECO electric and gas rate tariffs and fuel oil at 50 cents per gallon.(45,46) Heating system seasonal efficiencies (combustion and duct loss included) are 100% for electric baseboard, 90% for the heat pump, 72% for gas and 63% for fuel oil. The estimated seasonal coefficient of performance (COP) for the heat pump is 1.9**.(47) Insulation characteristics for all heating energies are equivalent to three inches in the floor and walls, six inches in the roof and storm windows and doors.

For 1988, the heating cost comparison results in the electric baseboard system being 27% higher than gas and 17% higher than oil with the electric heat pump 30% less than gas and 36% less than oil. These cost estimates are based on 1978 constant dollars with no increase in the cost of electricity and an annual increase of 1.5% for fuel oil and 2.7% for natural gas***. Heating system seasonal efficiencies are 100% for electric baseboard, 90% for the heat pump, 81% for gas (up 9% from 1978) and 70% for fuel oil (up 7% from 1978). The increases in efficiencies for gas and oil are based on DOE targets for 1980.(50) The estimated seasonal COP for the heat pump is 2.2.(47,51)

---

*In 1976 and 1977, 65% of all housing development units installed central air conditioning. (See Air Conditioning section of this forecast.)

**PECO's comparative heat pump efficiency is 171% (0.90 X 1.9). Arthur D. Little's study assumed the following efficiencies - heat pump 167%, existing gas and oil systems 60% and 50% respectively and for new construction 70% for gas and 60% for oil.(48)

***For comparison, the Oak Ridge National Laboratory has projected residential fuel prices for the Middle Atlantic States (1975 $\$/10^6$ Btu) to increase in the following manner - electric 0.43%, oil 2.12% and gas 3.70%.(49)

Based on the projected increases in heating system efficiencies and the projected prices of heating energies, the following constant-dollar cost relationships were assumed based on PECO gas at an index of 100 in 1978. These values apply to a suburban single detached new constructed house.

	PECO Gas	Oil	Electric Space Heating: Baseboard*	Electric Space Heating: Central	Electric Space Heating: Heat Pump
1978	100	121	147	173	94
1988	116	126	147	173	81

The above heating cost comparisons are not based on life-cycle cost studies; they exclude the cost components of equipment, maintenance and building modifications like chimneys. An in-depth life-cycle cost study conducted by Northeast Utilities(52) concludes the following for systems installed in 1977 assuming energy prices escalate at equal rates.

The differences in the present value costs, on a life-cycle basis, of all the systems analyzed (except solar-assisted) fall within a narrow range...each alternative being generally competitive with the other.

The electrically heated house with standard insulation is less expensive on a life-cycle cost basis than oil. The principal reasons are that the combination of the lower initial cost of the electric system and its higher efficiency at the point of use outweighs the operating cost disadvantage. If fuel oil prices rise faster than the cost of electricity, as expected, then the life-cycle advantage of electric systems is greater.

The electric heat pump is competitive with the electric baseboard system and is lower in cost than oil.

The gas heating system has the lowest total life-cycle cost of all systems. If gas costs increase faster than other energy sources, gas space heating systems will lose their competitive position.

Solar-assisted systems have the most expensive life-cycle costs of all systems analyzed. The solar systems would be more expensive if government subsidies in the form of tax credits and property tax exemptions were not included in the analysis.

The relative energy price escalation rate is a very significant variable. The comparison of present value costs of systems under the assumption of different energy price escalation rates produces greater differences among them in total cost than any other variable.

---

*The energy consumption for baseboard heating has been reduced about 4% to account for energy savings available from individual room controls. Other heating systems have been increased about 1.5% to account for furnace fan loads.

For systems installed in 1985 assuming energy prices escalating at equal rates, the Northeast Study concluded:

The electric baseboard system becomes somewhat more expensive than the oil system, although the 25 year total difference is very slight.

The heat pump installed in 1985 has the lowest life-cycle costs of all systems except gas. This results principally from the assumption that improved equipment design will raise the heat pump seasonal COP for Connecticut from the present 1.5 to 2.0 (a 33% improvement)*.

The gas hydronic system continues to have the lowest life-cycle costs. However, the difference is much less than for 1977 installations when compared to the heat pump**.

The solar-assisted electric system on the TOD rate becomes more competitive than in 1977, being lower in current dollar cost than electric baseboard but higher than the heat pump, oil, or gas systems.

The solar-assisted electric system*** billed on a conventional electric rate proves to be the most expensive of all the space heating alternatives analyzed for 1985.

The solar-assisted oil-fired warm air system also proved to be a more costly alternative than the conventional systems.

It is noted that the Northeast Study was based on equal energy price escalations and that this assumption is the most significant variable in their study.

Based on the Northeast Study, the Fuhrman's testimony and private conversations with Pennsylvania Power and Light personnel who are monitoring a test solar house with solar energy, it is PECO's conclusion that solar heated homes will have an insignificant impact on the Philadelphia area for the term of this ten year forecast.

---

*In Richard E. Fuhrman's testimony, he concluded that heat pumps in downstate New York would achieve a seasonal COP of 2.0 by 1985.(53)

**The Northeast Utilities Study excluded both oil and gas warm air systems. In the Philadelphia area, gas warm air systems (which are more prevalent than gas hydronic systems) would have a lower life-cycle cost.

***The solar-assisted electric system was defined as a liquid solar collection system using 300 square feet of collectors, a 750 gallon storage tank, a conventional electric warm air furnace, and all the associated duct work, piping, pumps, etc.

I. SATURATION GROWTH

Short Term (1978 to 1980)

In the short term, electric heating connections are based on an analysis of field data supplied by the Business Services Department from personal contacts with local builders and heating contractors. This data, in the form of builder commitments, is reviewed monthly to determine customer desires and changing trends.(54) As of August, the 1978 penetration of electric heating connections in the new construction market was 38% compared to the year-to-date commitments of 62%. Based on this data, the present connection penetration forecast for 1978 is 45%, about 1½% higher than was projected last year. For 1979 and 1980, PECO forecasts an electric heating penetration of 42% and 43% respectively. The decline from the 1978 penetration is due to the expected resumption of suburban gas heating sales.

Long Term (1979 to 1988)

For the long term, PECO projects an electric heating penetration in the new construction market of 43%. Table XXVIII displays the annual electric heating penetration by housing category. It is noted that the historical electric heating penetration from 1970 to 1977 was 26% and the penetration since the oil embargo (1974 to 1977) was 41%.

By 1988, PECO's total electric heating forecast projects a saturation of 10.9% as compared to 3% in 1977. ADL's study(48), for their base case, projects a 1990 saturation for Northeastern United States of 10% for single family detached units as compared to PECO's projection of 8% by year end 1988.

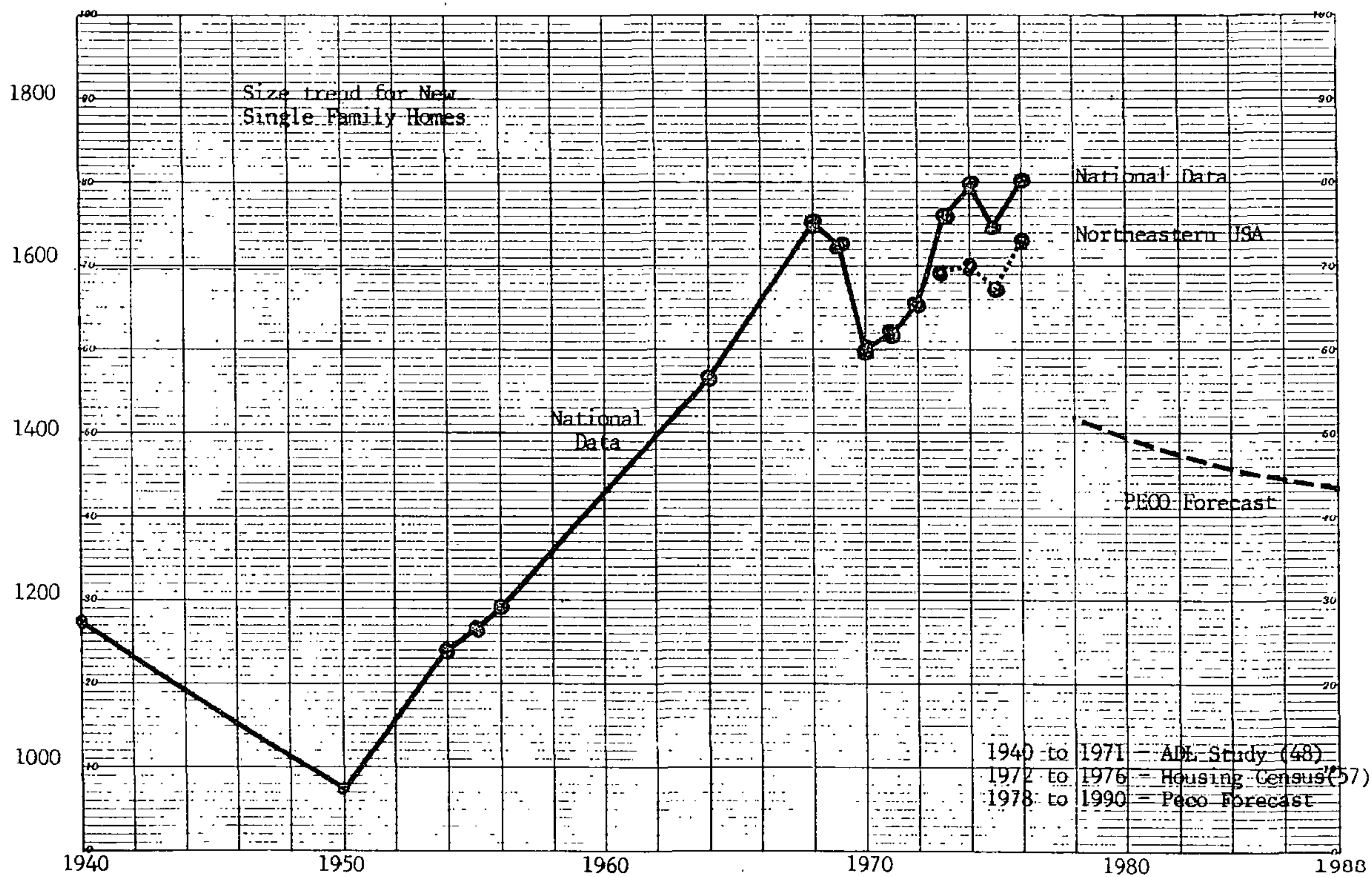
II. ENERGY USAGE

As indicated in the general section, the electric space heating model is segmented geographically by housing category (single detached house, townhouse and apartment) and by type of heating equipment (baseboard, furnace/boiler and heat pump).

Energy usage for electrically heated new construction living units is based on the following living areas - 1,500 square feet for single family detached houses, 1,200 square feet for single family attached homes (townhouse) and 900 square feet for multi-family apartments. In the ADL Study, they assume 1,560 square feet for detached houses, 1,100 square feet for single family attached-duplex units and 900 square feet for multi-family low rise garden apartments. ADL further states that based on their assumptions, "The average square footage of a residential unit (weighted by the number of different units in the inventory) rises from 1,196 square feet in 1970 - (compared to PECO's estimated 1977 value of 1,120 square feet and Dr. Williams(55) 1973 national value of 1,185 square feet) - to 1,240 square feet in 1990." PECO's 1988 weighted average is 1,130 square feet. ADL further states that "Despite this increase, some economists feel that (ADL's) estimate of stabilization in average living area may be conservative. We (ADL)...tested the effect of more liberal assumptions...(with) the average single family home built over the twenty year period...(of)...approximately 2,100 square feet." With "similar increase in the size of other type units, the average square footage for all residential units in 1990 would be 1,472 square feet." This area would be 30% larger than PECO's 1988 projection.

Chart R-1 displays the average size of new single family homes from 1940 to 1976(48,56,57) and PECO's forecasted size for the Philadelphia area. The historical trend is based on national data. From 1972 to 1976, both national and Northeastern United States data is shown. All data points exclude multi-unit projects.

PECO estimates a 1978 heat loss of 45,000 Btuh (30 Btuh per square foot) for the single detached house reducing to 39,000 Btuh (26 Btuh per square foot) in 1988 for a 13% reduction. For townhouses, the 1978 heat loss was estimated at 31,000 Btuh (26 Btuh per square foot) reduced by 11.5% to 27,600 Btuh by 1988. For apartments, a 1978 heat loss was estimated at 23,400 Btuh (26 Btuh per square foot) reduced by 11.5% to 21,900 Btuh (23 Btuh per square foot) by 1988. These reductions are based on the assumption that greater amounts of insulation will be used combined with more energy-efficient building designs like less glass area. ADL's study assumed new homes built in 1990 will consume 5% less energy than in 1970 due to improved design and more efficient use of the structure. For 1970, ADL's electric heating usage values adjusted to Philadelphia degree days are 17,960 kWh for single detached houses compared to PECO's 1978 estimate of 17,400 for baseboard units and 13,400 for the weighted average of all equipment types. For attached living units, ADL assumes 11,200 kWh/unit compared to PECO's 12,100 for baseboard units and 8,400 kWh for a weighted average. For apartments, ADL assumes 6,450 kWh while PECO uses a weighted average of 8,300 kWh.



1800
1600
1400
1200
1000
1940
1950
1960
1970
1980
1988
Size trend for New Single Family Homes
National Data
National Data
Northeastern USA
PECO Forecast
1940 to 1971 = ADL Study (48)
1972 to 1976 = Housing Census (57)
1978 to 1990 = Peco Forecast

CHART R-1

Based on seasonal heating system efficiencies of 100% for baseboard heat, 90% for warm air systems in single family houses (attached and detached) and 95% for apartments, the average heating usage for units connected in 1978 was estimated to be 10,500 kWh reducing to 6,700 kWh in 1988 for a reduction of 36%. Dr. Williams' study for New York City assumed a constant value of 11,500 kWh/unit.

A major factor that affected the PECO reduction was the shift to more townhouses and apartments, and an increase in the penetration and efficiency of heat pumps. From 1977 to 1988, the PECO forecast projects the penetration of electrically heated living units with heat pumps to increase from 60% to 72% with the heat pump's seasonal COP increasing from 1.8 to 2.2.

In the high range forecast, the 1988 total electric heating penetration was increased to 15.1% (compared to the base forecast projection of 10.9%) while the low range penetration is 6.6%. Since most electric heating installations come from the new construction market, the total projected change of new construction is the major factor in the range penetration projections. Also of importance is the effect of the conversion market. For the period 1979 to 1988, the high range projects 61,600 additions compared to 7,200 units projected for the low range and 26,600 units in the base forecast.

Kilowatthour usage values for the two ranges were developed from increased heat pump sales which generated a 1988 average heating value of 9,150 kWh for the high range and 9,570 kWh for the low range.

SOCIAL FACTORS

According to The Conference Board: "The great post-war birth-boom generation is coming of age. Over the past three decades babies of the late Forties and Fifties have been passing through the population structure and at each juncture defining a unique, if brief, era, ranging from the great migration to suburbia as the size of families expanded, to the go-go years of blue jeans, to pop and pot, to the trauma on the campuses and the proliferation of causes ranging from women's lib to ecology to Buddhism. In the next years there will be a sturdy growth in the total number of families and an extraordinary growth in the number of young families. For example, in 1985 there will be roughly 9 million more families than now (1976). Of that number, slightly more than 7.5 million will be in the 25-44 age bracket."

"While the U.S. market is...in continous flux, the changes in the years ahead will be quite exceptional. In demographic terms, certainly, the difference between past and future will be greater than in any prior era...For instance, the age group 35-44, which was the slowest-growing segment of the market during the past ten years, will be the most rapidly growing segment in the next ten.

The implications of all this for marketers are quite obvious. Each age group...has its own particular needs for products and services."(58)

The April 1978 issue of the Appliance Manufacturer makes the following statements: "Perhaps the most important age group for the entire (appliance) industry is the 35 to 54 year old segment. This group will make the biggest overall percentage gain between now and the year 2000. From about 47 million people, it will grow to 77 million or 30% of the total U.S. population. Their economic situation should be improving during these years. That represents strong growth potential for the (appliance) industry because these consumers will spend the most for all types of appliances."

"During the growth years, (these) consumers upgrade their housing...appliances also are the subject of upgrading. Larger capacities will be the better sellers for this group in major appliances...."

"Laundry appliances are no longer something to do without. A dishwasher has now become more of a need. The refrigerator...will be big in both size and features. Separate freezers become a significant convenience for this group."

"This age group also will be the biggest target for home computers...prompted by a growing desire to spend less of their off work hours in (personal financial management affairs)."

In comments regarding single individual households, the Appliance Manufacturer study says, "Single individuals represent a growing market for appliances...they will spend more for comfort appliances." The study notes that it is these households which, "...will be good prospects for fast cooking appliances, dishwashers, disposals and hot water dispensers."(59)

In the ADL study, they state: "It is impossible to quantify the life-style changes taking place in our society...one must conclude that society is changing, that it is becoming more leisure-oriented...(and)...will lead the growing middle and upper middle classes to purchase houses the same size as at present or even smaller houses albeit with more labor-saving devices and comforts."

"Over the past few decades, the increasing affluence of the American consumer has led to increased penetration of major appliances...and a proliferation of minor convenience items."(48)

The March 1978 issue of Appliance Manufacturer quotes the Department of Commerce's U.S. Industrial Outlook for 1978 as seeing a favorable market for appliances into 1982 based on the likelihood of large increases in consumer spending for durable products, especially home furnishings. New household formations in the next few years are expected to bolster the market for appliances, with the number of new households expected to increase much faster than the total population.(60)

From the April 1978 issue of Appliance Manufacturer, according to the Department of Commerce, family income will almost double between 1975 and 1990 and more than 60% of all households will have an annual income (in constant dollars) in excess of $15,000 by 1990 compared to less than 30% of the households in 1975.

Based on these facts, Appliance Manufacturer makes the following statements: "For appliance makers, the overall income picture means that people can buy appliances and more of them in the future."

"So as consumers upgrade housing, they will upgrade appliances, specifically kitchen appliances. Upgraded housing, especially when it is new construction, will have more comfort products, such as central air conditioning and central humidifiers."

"A couple of years ago there were predictions of smaller, no-frill homes as one answer to the cost spiral. But it hasn't happened; average home size has been increasing and more luxury features have gone in, features like fireplaces and central air conditioning."(59)

In light of the prevailing opinions that demand will increase, PECO has been experimenting with econometric models to project saturation curves for appliances. Efforts to date have not produced output which is considered reliable, but the preliminary model for central and room air conditioners provided input to the preparation of the air conditioning forecast.

APPLIANCE EFFICIENCY

In the development of the PECO forecast, the appliance efficiency targets, as adopted by the Department of Energy, have been utilized in the base forecast. However, it is important to realize that these DOE targets are just what the title calls them - "targets". The Department of Energy states, "The targets for products...1 through 10...are required...to be designed so that, if met*, the aggregate energy efficiency of all such products which are manufactured in 1980 will exceed the aggregate energy efficiency of all such products manufactured in 1972 by the maximum percentage improvement which DOE determines to be economically and technologically feasible, but which in any case is not less than 20 percent."(61) Based on the actual appliance efficiency targets, as established by the DOE, the aggregate improvement of all individual targets, if met, is 28% - eight percent greater than DOE's minimum standard.

It is important to realize, that according to the Energy Policy and Conservation Act, "...the appliance program is responsible for encouraging manufacturers to produce, and consumers to purchase, significantly more efficient appliances by 1980. The Act sets forth two interrelated strategies for accomplishing this objective. The first is to establish voluntary efficiency improvement targets...the second strategy entails development of a labeling program to require that manufacturers label each product with energy information to allow consumer comparisons...intended to encourage comparison shopping and to enhance consumer demand for the more efficient products."(61)

The question is, what will be the real affect of these government goals?

In 1974, at the peak of the energy crisis, Aeronutronic Ford introduced its Philco brand Cold Guard high efficiency refrigerator. This refrigerator exceeded the preliminary guidelines established by the Federal Energy Administration. By 1976, when prices were increased to offset the increased cost of the unit, sales decreased and the Cold Guard was taken off the market.(62)

Infodyne Systems Corporation, under contract to the FEA, has prepared a preliminary report of its, "Economic Impact Study of the Appliance Efficiency Program", that states, "Unfortunately, awareness of the energy crisis has not radically changed consumer life styles or the ways they buy and use appliances. The public has not been sold on the benefits of life-cycle costs."(63)

Appliance Manufacturer, in March 1977, remarks, "Consumers have not demanded more efficient appliances. In fact, what little evidence exists, indicates the opposite." Regarding consumer acceptance the article says, "It often appears that government is trying to force more efficient use by making sure there are fewer use options. The last time this was tried in an overt way, it failed." This statement was made in reference to the mandatory wearing of seat belts in cars before automobile engines could be started. The article continues, "If consumers were willing to reject a program designed to save lives, how can we assume they'll accept one created to save energy?"(64)

*Underlining emphasis added by PECO.

In ADL's study, they comment that, "Builders and the occupant tend to be far more sensitive to first costs than to operating costs, and thus resist making investments in energy-saving devices and materials, regardless of the future benefits of these investments." ADL further states, "The consensus of the (appliance) industry is that the consumer will accept an energy-saving device with a one-year payback and might accept one with a two-year payback. Longer payback periods are not attractive under current market conditions."

Based on these conditions, ADL's forecast includes the following statement: "Under these circumstances, we have estimated that the economic advantages offered by energy conservation will be accepted slowly, if at all. Thus, even energy conservation measures that offer payback periods as short as one year will be implemented by only 15% of residential energy consumers."(48)

In spite of these uncertainties in what will happen in the market place, PECO's forecast assumes that all the DOE targets will be met by 1980.

APPLIANCE LIFE SPANS

In determining the effect of increased appliance efficiencies on the PECO forecast, three market segments were considered. These markets are the new construction market, the appliance addition market and the replacement market. In the ten year forecast, the appliance life span does not affect either the new construction or the addition markets; however, it does affect the replacement market.

In the replacement market, the PECO model assumes that working appliances will not be removed from the system solely for the purpose of installing a more efficient appliance.

The following table summarizes appliance life spans used by the PECO model. In general, these values were the approximate average of the studies that are referenced.

Appliance	PECO Life Spans (Years)	References
Refrigerator	15	48, 55, 64, 65, 68
Freezer	20	48, 55, 64, 65, 68
Electric Range	15	48, 55, 64, 65, 68
Electric Dryer	13	48, 55, 64, 65, 68
Automatic Washer	12	48, 55, 64, 65, 68
Dishwasher	12	48, 55, 64, 65, 68
Water Heater	20	48, 55, 64
B/W TV	12	48, 55, 64, 65, 68
Color TV	12	48, 55, 64, 65, 68
Room Air Conditioner	10-13	53, 55, 66, 67, 69, 70
Central Air Conditioning	15	55, 66, 67

In some instances, notably the "optional use appliances", such as electric dryers, dishwashers, televisions, room and central air conditioners and dehumidifiers, the future life spans may be longer than past studies have assumed. This caution is based on several interrelated factors such as:

1. With the conservation movement, consumers reduced their usage of the "optional use appliances". If an appliance usage is decreased, its life span should increase. This has been preliminarily documented for room coolers in the Philadelphia area.

2. If thermostatic settings on refrigerators and central air conditioners have been turned up (less cooling required), both of these appliances could last somewhat longer than past records indicate. Also, with less children and more working wives, the refrigerator's use could be further reduced.

3. For appliances like televisions and room coolers, where multi-unit ownership is a reality, the additional units decrease the average use of the total units in a household.(55)

4. If new appliances like clothes washers and dishwashers use less hot water, and if the temperature settings are reduced, water heater life spans may be longer. Also, smaller families may require less hot water which could also extend the useful life span.

5. Finally, consumers are increasingly more "consumer wise" in the buying of appliances.(59) This astute awareness may cause manufacturers to build in more quality resulting in a longer appliance life span.(71)

Additional research is required in this area to insure that future energy sales are not incorrectly estimated due to the useful lives of appliances being either too short or too long.

APPLIANCE USAGE

The general equation for calculating energy usage for appliances is:

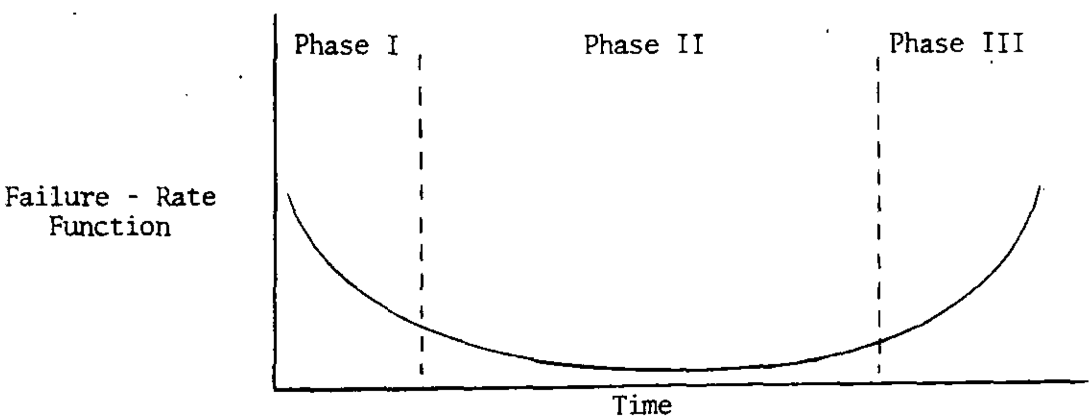
$$kWh_n = kWh_{n-1} - (UR_n \times kWh/UR_n) + (URP_n \times kWh/URP_n) + (AU_n \times kWh/AU_n)$$

where kWh_n = Forecasted Year's kWh Sales
kWh_{n-1} = Prior Year's Forecasted kWh Sales
UR = Units Removed
kWh/UR = kWh per Removed Unit
URP = Units Replaced
kWh/URP = kWh per Replaced Unit
AU = Additional Units Sold
kWh/AU = kWh per Additional Unit

$UR_n = URP_{n-LS} + AU_{n-LS}$ where LS = Appliance Life Span

Removal Units and Energy Usage

At present, no material effort has been made to determine the failure distribution of residential appliances. It is believed that appliances follow a normal life-mortality type curve as exhibited by the "Bathtub Curve".(71).



It can be properly assumed that early (burn in) failures in Phase I of the curve are repaired or replaced under appliance manufacturers' warranties and that Phase II failures are small compared to the wear out failures of Phase III.

In Dr. Williams' study of energy usage of New York City, the Werbull distribution was utilized to determine Phase III failures of individual appliances. For this distribution, Dr. Williams stated, "In the absence of data we assumed a standard deviation of approximately one-third the mean life".(55) Until more research is completed, PECO believes that the discrete integer life span method utilized in its model has provided adequate results.

The energy usage of the removal units for the Philadelphia area is normally not available. In its absence, national values have been determined and assumed to be equal to local energy values. For the detailed method of how this value is calculated, refer to the Energy Calculation Section of each appliance.

Replacement Units and Energy Usage

The PECO model assumes that when appliances wear out they are replaced with new units having the energy consumption values of new additional units sold, and are therefore at the efficiency level projected to be reached in the replacement year. In general, this will be at a higher efficiency level than that of the unit replaced.

New Additional Units and Energy

The total number of units added each year is computed by adding the number of units needed to account for the increased saturation as described by the change in residential living units on line, the projected new construction market, short term economic conditions and changing population patterns of age cohorts. The energy usage value is calculated based on the changing size and configuration and projected energy efficiency targets established by the Department of Energy.(50,61,72,73) For detailed energy calculations refer to the Energy Usage Section for each appliance.

AIR CONDITIONING

Air conditioning is segmented into two options: first, central plant (whole house) air conditioning and secondly, room coolers (windows/through the wall) air conditioning. Generally, a household will not select both options. However, both the 1976 and 1977 PECO Appliance Surveys indicate that 5% of individually metered central air conditioning customers, representing about 8,000 central plant customers, do in fact also have at least one room cooler.(74,75) It is believed that the purpose of the multiple ownership is to reduce energy usage during periods when whole house cooling is deemed not necessary by the household occupants. Future surveys should monitor this abnormality to determine if a new trend is occurring. The significance of a growing trend may well increase the connected air conditioning load while decreasing the energy usage and load factor. The effect on peak demand is questionable, due to the fact that when peak cooling days occur the usage factor of the available cooling equipment is unknown. For forecasting purposes, it is assumed that joint ownership will be minimal.

To determine the ultimate potential market for air conditioning, it was necessary to develop a means to compare room cooler saturation to central plant saturation. Local surveys of air conditioning dealers indicate the average size of a central air conditioner sold during the period 1971 to 1977 had a range between 30,000 Btu/hour and 35,000 Btu/hour.(76) Most national studies assume an average size of 36,000 Btu/hour*. For the period 1970 to 1977, the local dealer surveys also indicated an average room cooler size with a range of 8,600 Btu/hour to 10,500 Btu/hour. Based on an average room cooler size of 9,600 Btu/hour** and an average central plant size of 32,500 Btu/hour, it would require the cooling capacity of 3.4 room coolers to equal one central plant air conditioner.

Using local PECO customer survey data, it was also determined that customers without central air conditioning indicated that 3.20 room coolers per single family household and 2.22 room coolers per apartment household were required for full cooling.(80,81) For 1988, based on the mix of houses and apartments, the weighted average is 3 room coolers per household.

---

*The SRI Study assumed a national average of 36,000 Btu/hour.(77) The Williams Report for New York City stated an average of 36,000 Btu/hour for single family dwellings(55), which was indicated to be consistent with the Lawrence Berkeley Laboratory's Appliance Study.

**The SRI Study assumed an approximate average of 12,000 Btu/hour for 1969. The EEI 1977 Guide indicates an approximate value of 7,000 Btu/hour.(78) Dr. Williams, using Lawrence Berkeley Laboratory data, estimated an average cooling capacity figure of 9,000 Btu/hour. A PECO calculated value based on data from Merchandising indicated a national value of 1977 for approximately 11,000 Btu/hour.(79)

To determine the ultimate saturation of households with air conditioning, customer surveys were conducted to ascertain the percentage of customers who never wanted air conditioning. In 1972, 21.5% indicated a negative preference towards air conditioning.(80) In 1973, two surveys were conducted which indicated 23.3% and 22.6% of the responding households had a negative preference.(81) The average of these three surveys (all conducted prior to the oil embargo) was 22.5%. In PECO's 1978 Conservation Survey, the negative preference declined to 18.7%.(82) In other words, the preference for air conditioning (the potential ultimate saturation) has grown from 77.5% in 1973 to 81.3% in 1978 for a five year gain of 3.8%. The PECO forecast projects a 1988 saturation of 65% and a 1998 saturation of 70%, 15% and 10% less than the ultimate potential of 80%.

Chart R-2 graphically displays the historical and projected growth of air conditioning.

To develop an energy forecast, the total air conditioning saturation was segmented into room coolers and central plant units with their associated EER's*, BTU sizings and full load operating hours. The following sections deal with each air conditioning category.

ROOM COOLERS (RATES R AND RH)

I. SATURATION GROWTH**

According to U.S. Census data, room cooler saturation for the Philadelphia area grew rapidly from 10.6% in 1960 to 29.9% in 1970.(29,90) In the PECO end use model it appears that room cooler saturation peaked in 1974 at 33.5% and declined to 30.6% in 1977. The model further projects that the room cooler saturation will not exceed the 31% level until 1982 and will only reach the 34.7% level by 1988 which is only one percent over the 1974 level.

The PECO end use model utilizes annual dealer sales data obtained from the Electrical Association of Philadelphia.(83) It calculated the replacement market, for units replaced prior to 1978, using an average life span of 10 years. For units replaced after 1977, the average life span was increased from 11 years to 13 years. This life span is questionable since there is a minimal amount of information available to support any assumption. Private discussion with Carrier Corporation indicates a life span of 9 years.(67) Dr. Williams' New York City forecast uses a 12 year life while information from a DRI study for Duquesne Light Company based on data taken from the FEA indicates a 15 year life span.(66)

---

*Energy Efficiency Ratio = Btu/Hour ÷ Total Wattage
**Based on 3 Room Coolers/Household

With decreasing usage (a full discussion regarding this aspect may be found in the Energy Usage Section), it should be expected that the life span of room coolers may be significantly longer than the PECO model utilizes. With a longer life span, the PECO model would project a higher near term saturation. This increasing saturation may in fact be true since the last two air conditioning surveys actually reported an increasing room cooler saturation.

January 1976 Survey reports 29.8% (PECO model projects 32.5%)
Fall 1976 Survey reports 30.6% (PECO model projects 31.3%)
Fall 1977 Survey reports 32.2% (PECO model projects 30.6%)

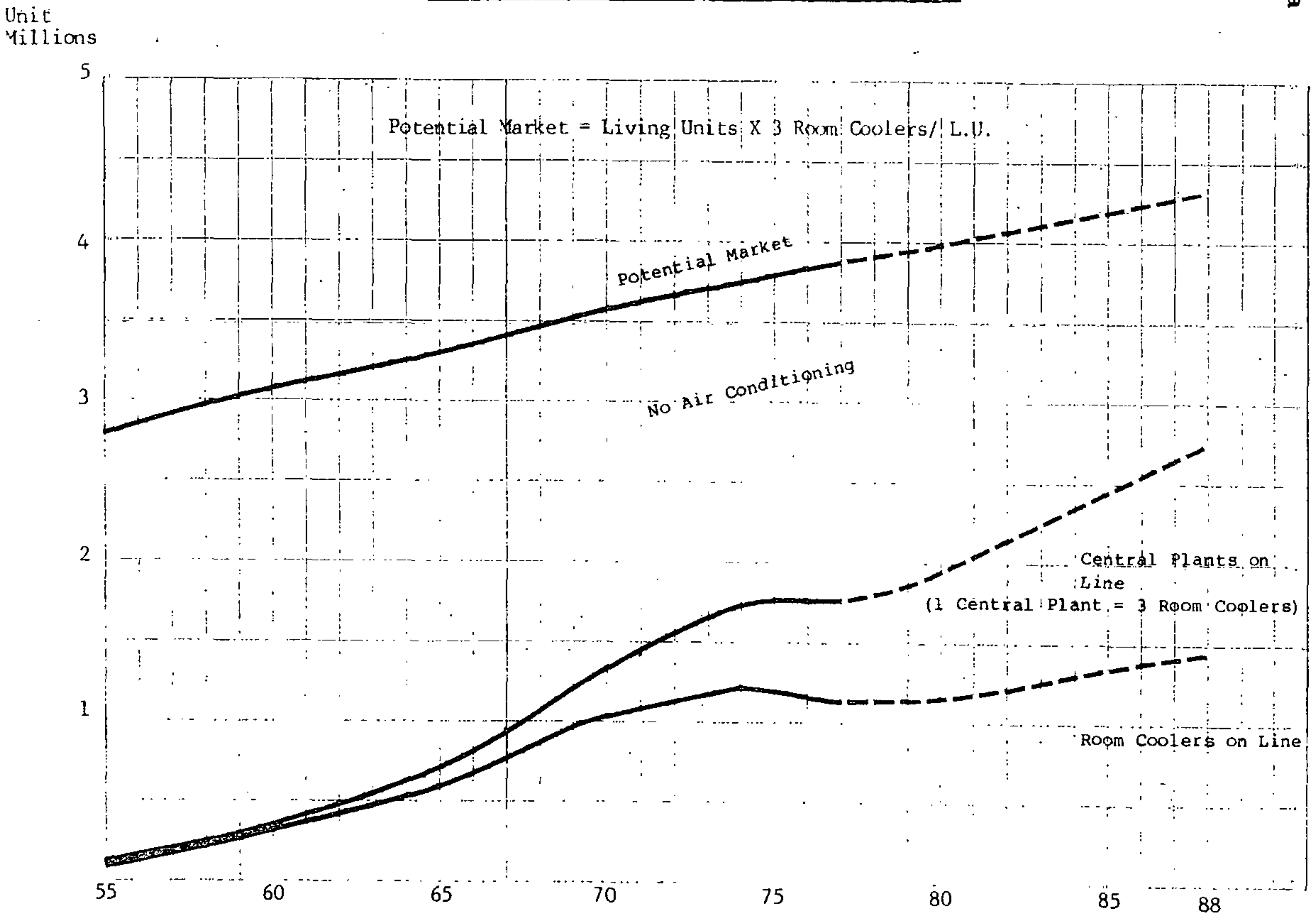
This year, to support the end use model, PECO has developed a new econometric model to forecast air conditioning saturations. For all markets, the econometric model(84) preliminarily projects a 31.4% saturation for 1983 (the last year projected) as compared to our end use model's projection of 30.9%.

As a comparison to other forecasts, Dr. Williams projects a New York City household saturation growth from 53% in 1970 to 82% in 1975 to 92% in 1988. Based on the three room cooler concept, the saturation growth would be 27.3% in 1975 as compared to 30.7% in 1988 for a growth of 3.4% as compared to PECO's forecasted growth of 2.2%.

The ADL study projects a household saturation growth, for the Northeastern United States, from 27% in 1970 to 53% in 1990. This projection is based on households with at least one room cooler. Of importance is the doubling of the household saturation. On a national basis, ADL projects a saturation growth (based on the three room cooler concept) from 13% in 1970 to 21.0% in 1990 for a 8% growth. PECO's growth for the same period is only 5%.

For the PECO <u>high range</u>, a room cooler saturation of 41% is projected for 1988 compared to 31% for the <u>low range</u> and 35% for the base forecast.

RESIDENTIAL AIR CONDITIONING UNITS - SYSTEM - ALL RATES
COMPARISON OF FORECASTED AIR CONDITIONING MARKET



Note: Room Cooler and Central Plant Curves are Cumulative

CHART R-2

R & F Dept.
December 1978

II. ENERGY USAGE

To calculate air conditioning usage, three basic factors are required; cooling capacity (Btu/hour), hours of use and the Energy Efficiency Ratio (EER). The PECO model has been supplied with historical data obtained from various company and industry sources.

Since 1970, surveys of local air conditioning distributors have produced annual sales statistics on unit sales, unit sizes and EER ratings. The weighted average cooling capacity for the survey respondents was 9,475 Btu/hour which is about 1.4% less than the estimated average of all room coolers on line in 1977.(85) The PECO model projects the average size for units on line to continue to decrease to 9,550 Btu/hour level by 1988. From 1970 to 1972, the EER ratings decreased from 6.47 to 6.24*. From 1972 to 1977, the EER ratings increased to 6.84. The PECO model projects this trend to continue to an EER rating of 8.4 in 1988 as compared to DOE's EER target of 7.94.

The final aspect is the hourly use component. Based on a load study for the summer of 1971, Baltimore Gas and Electric calculated an annual usage factor of 310 hours of full load operation.(86) Dr. Williams, using 1972 data from PSE&G, developed for New York City an estimated annual usage of 330 hours. Using additional data from the Whirlpool Corporation and AHAM, Dr. Williams also calculated an annual operating usage of 348 hours.

In the last few years, the usage of air conditioning has declined due to the increasing efforts of customers to decrease their energy consumption. As early as 1973, PECO's surveys indicated that customers were curtailing their air conditioning usage. This conservation trend has steadily increased as more customers realize that the energy crisis is real. In PECO's 1976 and 1977 air conditioning surveys, respondents indicated that one-seventh of all the room coolers on line were never used during these two cooling seasons.

In an attempt to quantify this changing customer habit, the results of three PECO studies were compared. A PECO air conditioning study conducted for the summer of 1972 indicated an average room cooler usage of 308 kWh/unit.(87) A similar study conducted for the summer of 1973** indicated an average of 381 kWh.(88) Another PECO study conducted on load data gathered for the summers of 1975 and 1976 indicated an average usage of 143 kWh/unit.(89) Since all three studies were bill analysis type studies and not true load studies, the above usage values may tend to underestimate actual cooling loads; therefore the absolute values were not used. Of value, however, is the net change from the 1972-1973 period to the 1975-1976 period. This change represents about a 50% decline in the use of room coolers. For 1977, the PECO forecast model uses 200 full load operating hours per room cooler, which is about 40% less than Dr. Williams' 1972 value and 35% less than Baltimore Gas and Electric's 1971 value.

---

*For comparison, the DOE's 1972 EER base point is 6.2.

**The summer of 1973 was the hottest summer on record and weather correction factors may not have been sufficient to adequately adjust the usage data to normal weather conditions.

By 1988, the model further reduces the hourly usage to 150 full load hours. This reduction accounts for the greater use of insulation in both the existing market and the new construction market and the greater number of multiple room coolers*.

With all factors considered, the PECO model forecasts the average room cooler usage to decrease from 293 kWh/unit in 1977 to 181 kWh/unit in 1988 for a 38% reduction per unit.

For the high range, PECO projects for 1988 a per unit usage value of 259 kWh compared to 146 kWh/unit for the low range.

CENTRAL PLANT (RATES R AND RH)

I. SATURATION GROWTH

According to U.S. Census data** for the Philadelphia area, the saturation of central air conditioning grew from 1.1% in 1960 to 7.5% in 1970.(29,90) PECO's 1977 survey indicated a total household saturation (including SPM apartments) of 15.2%, more than double the 1970 Census figure. Unlike room coolers, the saturation growth of central air conditioning has continued to increase. This is due to two factors; the replacement market is much smaller, and there was a major impact from the new construction market, which has a majority of its units cooled centrally. Both the 1976 and 1977 new construction surveys (for individually metered living units) indicated that 65% of the new construction development market was built with central air conditioning installed. In the apartment and townhouse market, 75% were connected with central plant units.(91,92) All factors indicate that this trend will continue into the future and as the apartment and townhouse segments of the new construction market grow, the total saturation figure will climb even higher.

For the forecast period ending in 1988, the PECO end use model projects about 132,000 additional central plant air conditioners in the new construction market. This calculation is based on the application of the saturation rates indicated on Table R-I.

In the existing market where less data is available, PECO projects an average of 8,000 annual additions. Of this number, about 25% are conversion heat pumps. Respondents in the 1977 PECO Appliance Survey indicated that about 12,000 central air conditioners would be added to the existing market in 1978.

---

*Further study is necessary to isolate the actual usage of multiple owned room coolers; however, it is believed that as a household adds additional room coolers, the usage per unit decreases.(55)

**This includes single point metered apartments which have a higher saturation of central plant air conditioning than individually metered customers.

UNITS AND BTU ADDITIONS TO CENTRAL PLANT AIR CONDITIONING

NEW CONSTRUCTION

	DETACHED HOUSES				TOWNHOUSES				IMA				RATES R-RH				SPM			ALL RATES			
	TOTAL	%SAT	UNITS	BTU	TOTAL	%SAT	UNITS	BTU	TOTAL	%SAT	UNITS	BTU	TOTAL	%SAT	UNITS	BTU	TOTAL	%SAT	BTU	TOTAL	%SAT	UNITS	BTU
1977																							
Electric	2460	68.0	1673	38.0	1900	95.0	1805	30.0	1040	56.0	582	24.0	5400	75.2	4060	32.4	1500	100.0	24.0	6900	80.6	5560	30.16
Gas	590	97.0	572	38.0	300	71.0	213	30.0	620	90.0	558	24.0	1510	89.0	1343	30.9	0	100.0	24.0	1510	89.0	1343	30.92
Oil	4350	35.0	1523	38.0	450	72.0	324	30.0	290	25.0	73	24.0	5090	37.7	1919	36.1	0	100.0	24.0	5090	37.7	1919	36.13
1978																							
Electric	1860	68.0	1265	38.0	1550	95.0	1473	30.0	1160	57.0	661	24.0	4570	74.4	3399	31.8	1000	100.0	24.0	5570	79.0	4399	30.05
Gas	940	85.0	799	38.0	540	55.0	297	30.0	1060	90.0	954	24.0	2540	80.7	2050	30.3	0	100.0	24.0	2540	80.7	2050	30.33
Oil	3200	35.0	1120	38.0	360	72.0	259	30.0	330	26.0	86	24.0	3890	37.7	1465	35.8	0	100.0	24.0	3890	37.7	1465	35.76
1979																							
Electric	2040	69.0	1408	38.0	2150	95.0	2043	30.0	1770	57.0	1009	24.0	5960	74.8	4459	31.2	1000	100.0	24.0	6960	78.4	5459	29.85
Gas	1440	85.0	1224	38.0	770	55.0	424	30.0	1860	90.0	1674	24.0	4070	81.6	3322	29.9	0	100.0	24.0	4070	81.6	3322	29.92
Oil	2920	36.0	1051	38.0	530	72.0	382	30.0	520	27.0	140	24.0	3970	39.6	1573	34.8	0	100.0	24.0	3970	39.6	1573	34.81
1980																							
Electric	2190	69.0	1511	38.0	2650	95.0	2518	30.0	2510	58.0	1456	24.0	7350	74.6	5484	30.6	1000	100.0	24.0	8350	77.7	6484	29.57
Gas	1980	85.0	1683	38.0	890	56.0	498	30.0	2810	90.0	2529	24.0	5680	82.9	4710	29.6	0	100.0	24.0	5680	82.9	4710	29.64
Oil	2530	36.0	911	38.0	710	72.0	511	30.0	730	28.0	204	24.0	3970	41.0	1626	33.7	0	100.0	24.0	3970	41.0	1626	33.74
1981																							
Electric	2090	70.0	1463	38.0	2810	95.0	2670	30.0	3330	58.0	1931	24.0	8230	73.7	6064	30.0	0	100.0	24.0	8230	73.7	6064	30.02
Gas	2060	85.0	1751	38.0	1060	56.0	594	30.0	4310	90.0	3879	24.0	7430	83.8	6224	28.5	0	100.0	24.0	7430	83.8	6224	28.51
Oil	2050	37.0	759	38.0	780	72.0	562	30.0	1010	29.0	293	24.0	3840	42.0	1613	32.7	0	100.0	24.0	3840	42.0	1613	32.[illegible]
1982																							
Electric	1860	70.0	1302	38.0	2670	95.0	2537	30.0	3580	59.0	2112	24.0	8110	73.4	5951	29.6	0	100.0	24.0	8110	73.4	5951	29.62
Gas	2020	85.0	1717	38.0	1080	57.0	616	30.0	4870	90.0	4383	24.0	7970	84.3	6716	28.1	0	100.0	24.0	7970	84.3	6716	28.1[illegible]
Oil	1520	37.0	562	38.0	800	72.0	576	30.0	1100	30.0	330	24.0	3420	42.9	1468	31.7	0	100.0	24.0	3420	42.9	1468	31.72
1983																							
Electric	1800	71.0	1278	38.0	2670	95.0	2537	30.0	3350	59.0	1977	24.0	7820	74.1	5791	29.7	0	100.0	24.0	7820	74.1	5791	29.7[illegible]
Gas	1950	85.0	1658	38.0	1200	57.0	684	30.0	5050	90.0	4545	24.0	8200	84.0	6887	28.0	0	100.0	24.0	8200	84.0	6887	27.[illegible]
Oil	1250	38.0	475	38.0	780	72.0	562	30.0	950	31.0	295	24.0	2980	44.7	1331	31.5	0	100.0	24.0	2980	44.7	1331	31.5[illegible]
1984																							
Electric	1730	71.0	1228	38.0	2790	95.0	2651	30.0	3250	60.0	1950	24.0	7770	75.0	5829	29.7	0	100.0	24.0	7770	75.0	5829	29.68
Gas	1910	85.0	1624	38.0	1270	58.0	737	30.0	4980	90.0	4482	24.0	8160	83.8	6842	28.0	0	100.0	24.0	8160	83.8	6842	27.97
Oil	1060	38.0	403	38.0	690	72.0	497	30.0	820	32.0	262	24.0	2570	45.2	1162	31.4	0	100.0	24.0	2570	45.2	1162	31.[illegible]
1985																							
Electric	1710	72.0	1231	38.0	3010	95.0	2860	30.0	3430	60.0	2058	24.0	8150	75.4	6149	29.6	0	100.0	24.0	8150	75.4	6149	29.5[illegible]
Gas	1860	85.0	1581	38.0	1330	58.0	771	30.0	5020	90.0	4518	24.0	8210	83.7	6870	27.9	0	100.0	24.0	8210	83.7	6870	27.90
Oil	930	39.0	363	38.0	610	72.0	439	30.0	600	33.0	198	24.0	2140	46.7	1000	31.7	0	100.0	24.0	2140	46.7	1000	31.71
1986																							
Electric	1710	72.0	1231	38.0	3090	95.0	2936	30.0	3620	61.0	2208	24.0	8420	75.7	6375	29.5	0	100.0	24.0	8420	75.7	6375	29.4[illegible]
Gas	1800	85.0	1530	38.0	1330	59.0	785	30.0	4770	90.0	4293	24.0	7900	83.6	6608	28.0	0	100.0	24.0	7900	83.6	6608	27.95
Oil	770	39.0	300	38.0	500	72.0	360	30.0	410	34.0	139	24.0	1680	47.6	800	32.0	0	100.0	24.0	1680	47.6	800	31.[illegible]
1987																							
Electric	1590	73.0	1161	38.0	3130	95.0	2974	30.0	3590	61.0	2190	24.0	8310	76.1	6324	29.4	0	100.0	24.0	8310	76.1	6324	29.3[illegible]
Gas	1580	85.0	1343	38.0	1310	59.0	773	30.0	4440	90.0	3996	24.0	7330	83.4	6112	27.8	0	100.0	24.0	7330	83.4	6112	27.84
Oil	610	40.0	244	38.0	380	72.0	274	30.0	270	35.0	95	24.0	1260	48.6	612	32.3	0	100.0	24.0	1260	48.6	612	32.[illegible]
1988																							
Electric	1390	73.0	1015	38.0	2980	95.0	2831	30.0	3300	62.0	2046	24.0	7670	76.8	5892	29.3	0	100.0	24.0	7670	76.8	5892	29.[illegible]
Gas	1320	85.0	1122	38.0	1200	60.0	720	30.0	3970	90.0	3573	24.0	6490	83.4	5415	27.7	0	100.0	24.0	6490	83.4	5415	27.[illegible]
Oil	470	40.0	188	38.0	240	72.0	173	30.0	30	35.0	11	24.0	740	50.2	371	33.9	0	100.0	24.0	740	50.2	371	33.88

Table R-1

R & P Dept.
August 1978

By 1988, the PECO end use model projects a central air conditioning saturation of 30%. The ADL study projects a 1990 saturation of 28% for Northeastern United States as compared to 4% for 1970 (PECO's 1970 saturation was 7.5%). The two independent projections appear to support each other.

Another method used to project PECO's central air conditioning saturation was a newly developed econometric saturation model. This model, coupled with the utilization of the Gompertz curve, projected a saturation of 30.2% for 1988 compared to 29.5% in PECO's end use model. The forecasted variables for the econometric model were generally obtained from WEFA's Philadelphia regional model.

For the high range, PECO's end use model projects a 33% saturation for 1988 compared to 22% for the low range.

II. ENERGY USAGE

As with room coolers, three basic factors are required to calculate the energy usage of central air conditioning; cooling capacity, hours of use and the energy efficiency ratio (EER). Again, the PECO model has been supplied with historical data obtained from various company and industry sources.

Since 1971, surveys of local central air conditioning distributors have produced annual sales statistics on unit sales, unit size and EER ratings. The weighted average cooling capacity for the survey respondents was 32,700 Btuh which is about 3% less than the estimated average of all central air conditioners on line in 1977.(76) The PECO model, which calculates the average size of new units coming on line (see Table R-II), projects a declining size to the point that the average unit on line in 1988 will be 31,400 Btuh, 7% less than the average unit on line in 1977.

From 1972 to 1975, the EER ratings for the distributors' surveys decreased from 7.05* to 6.88. By 1977, the EER increased to 7.22. The PECO model projects this increasing trend to continue to an EER rating of 8.5 in 1988 as compared to DOE's EER target of 8.1 for a split system central air conditioner.

The last variable is the hourly use element. From local studies of five similar utilities**, conducted from 1963 to 1973, the range of usage (adjusted to normal PECO weather) varied from 210 hours to 800 hours per unit. In ADL's study, they estimate 300 full load hours for Northeastern United States and 500 hours for North Central United States. Dr. Williams' forecast for New York City estimates a seasonal use of 600 hours. On the high side is ASHRAE's estimate of 1,000 hours for the Southeastern Pennsylvania area.(98,99)

---

*For comparison, the DOE's 1972 EER base point is 6.6.

**Actual metered usage of central air conditioning equipment.(93,94,95,96,97)

PHILADELPHIA ELECTRIC COMPANY SYSTEM

CENTRAL PLANT - RESIDENTIAL - ALL RATES

BASE CASE

YR	TOTAL C/P SALES	TOTAL RESID SALES	LIFE	REPLACEMENT MARKET C/P UNITS	AVG BTU	AVG EER	AVG KW	*REPLACEMENTS %	C/P UNITS	AVG KW	ADDITIONS C/P UNITS	AVG MBTU	AVG EER	AVG KW	AVERAGE C/P ON LN	MW	PER CENTRAL PLANT BTU	EER	KW	TE C/P UNITS	AVG RESD L.U.	C/P PENE	YR
55	0.7	0.7	15	0.0	0	0.00	0.00	99	0.0	0.00	0.7	36.0	7.00	5.14	1.4	7.4	36000	7.00	5.14	1.8	934.0	0.2	55
56	2.2	2.2	15	0.0	0	0.00	0.00	99	0.0	0.00	2.2	36.0	7.00	5.14	2.9	14.9	36000	7.00	5.14	4.0	962.0	0.3	56
57	2.2	2.2	15	0.0	0	0.00	0.00	99	0.0	0.00	2.2	36.0	7.00	5.14	5.1	26.2	36000	7.00	5.14	6.2	985.0	0.5	57
58	1.4	1.4	15	0.0	0	0.00	0.00	99	0.0	0.00	1.4	36.0	7.00	5.14	6.9	35.5	36000	7.00	5.14	7.6	997.0	0.7	58
59	2.4	2.4	15	0.0	.0	0.00	0.00	99	0.0	0.00	2.4	36.0	7.00	5.14	8.8	45.3	36000	7.00	5.14	10.0	1012.0	0.9	59
60	2.8	2.8	15	0.0	36000	7.00	5.14	99	0.0	5.14	2.8	36.0	7.00	5.14	11.4	58.7	36000	7.00	5.14	12.8	1028.1	1.1	60
61	3.2	3.2	15	0.0	36000	7.00	5.14	99	0.0	5.14	3.2	36.0	7.00	5.14	14.4	74.1	36000	7.00	5.14	16.0	1041.6	1.4	61
62	4.0	4.0	15	0.0	36000	7.00	5.14	99	0.0	5.14	4.0	36.0	7.00	5.14	18.0	92.6	36000	7.00	5.14	20.0	1060.7	1.7	62
63	4.6	4.6	15	0.0	36000	7.00	5.14	99	0.0	5.14	4.6	36.0	7.00	5.14	22.3	114.7	36000	7.00	5.14	24.6	1070.0	2.1	63
64	5.9	5.9	15	0.0	36000	7.00	5.14	99	0.0	5.14	5.9	36.0	7.00	5.14	27.5	141.7	36000	7.00	5.14	30.5	1084.6	2.5	64
65	9.0	9.0	15	0.0	36000	7.00	5.14	99	0.0	5.14	9.0	36.0	7.00	5.14	35.0	180.0	36000	7.00	5.14	39.5	1101.5	3.2	65
66	11.1	11.1	15	0.1	36000	7.00	5.14	99	0.1	5.14	11.0	36.0	7.00	5.14	45.0	231.4	36000	7.00	5.14	50.5	1121.0	4.0	66
67	11.1	11.1	15	0.2	36000	7.00	5.14	99	0.2	5.22	10.9	36.0	6.90	5.22	55.9	288.5	36000	6.98	5.16	61.4	1137.0	4.9	67
68	11.1	11.1	15	0.4	36000	7.00	5.14	99	0.4	5.29	10.7	35.0	6.80	5.15	66.7	344.1	35852	6.95	5.16	72.1	1154.0	5.8	68
69	15.1	15.1	15	0.7	36000	7.00	5.14	99	0.7	5.37	14.4	34.0	6.70	5.07	79.3	407.9	35543	6.91	5.14	86.5	1174.0	6.8	69
70	18.1	18.1	15	1.1	36000	7.00	5.14	99	1.1	5.41	17.0	33.5	6.66	5.03	95.0	487.1	35208	6.86	5.13	103.5	1194.5	8.0	70
71	18.0	18.0	15	1.6	36000	7.00	5.14	99	1.6	5.41	16.4	32.8	6.66	4.92	111.7	570.1	34878	6.83	5.10	119.9	1207.5	9.2	71
72	22.1	22.1	15	1.9	36000	7.00	5.14	99	1.9	5.11	20.2	34.4	7.05	4.88	129.9	659.0	34809	6.86	5.07	140.0	1226.6	10.6	72
73	26.0	26.0	15	2.0	36000	7.00	5.14	99	2.0	5.14	24.0	32.5	7.00	4.64	152.0	761.3	34471	6.88	5.01	164.0	1240.2	12.3	73
74	20.4	20.4	15	2.3	36000	7.00	5.14	99	2.3	5.20	18.1	29.4	6.92	4.25	173.1	853.6	33967	6.89	4.93	182.1	1253.8	13.8	74
75	12.0	12.0	15	2.8	36000	7.00	5.14	99	2.7	5.23	9.3	31.7	6.88	4.61	186.7	918.3	33856	6.88	4.92	171.4	1265.9	14.8	75
76	13.0	13.0	15	3.4	36000	7.00	5.14	99	3.3	4.95	9.7	32.0	7.28	4.40	196.2	959.0	33766	6.91	4.89	201.0	1280.5	15.3	76
77	16.7	16.7	15	4.0	36000	7.00	5.14	99	4.0	4.99	12.7	32.2	7.22	4.46	207.4	1007.5	33673	6.95	4.86	215.7	1294.1	15.0	77
78	19.5	19.5	15	5.1	36000	7.00	5.14	99	5.0	4.80	14.5	31.7	7.50	4.23	220.9	1062.1	33547	6.98	4.81	228.1	1304.9	16.9	78
79	22.6	22.6	15	6.7	36000	7.00	5.14	99	6.6	4.62	16.0	30.2	7.80	3.87	236.1	1115.6	33327	7.05	4.72	244.1	1315.2	17.9	79
80	26.5	26.5	15	8.5	36000	6.99	5.15	99	8.5	4.50	18.0	29.0	8.00	3.63	253.0	1168.6	33019	7.15	4.62	262.0	1326.9	19.1	80
81	30.0	30.0	15	10.1	35883	6.95	5.16	99	10.0	4.43	20.0	29.0	8.10	3.58	271.9	1226.5	32742	7.26	4.51	281.9	1340.7	20.3	81
82	33.2	33.2	15	11.3	35511	6.88	5.16	99	11.2	4.33	22.0	29.0	8.20	3.54	292.8	1289.1	32470	7.38	4.40	303.8	1355.2	21.6	82
83	35.6	35.6	15	12.7	34849	6.79	5.13	99	12.6	4.22	23.0	29.0	8.25	3.52	315.2	1355.4	32225	7.49	4.30	326.7	1371.9	23.0	83
84	38.6	38.6	15	14.7	34150	6.72	5.08	99	14.6	4.11	24.0	29.0	8.30	3.49	338.6	1422.0	32003	7.62	4.20	350.5	1386.9	24.4	84
85	39.9	39.9	15	17.1	33829	6.73	5.02	99	16.9	4.05	23.0	29.0	8.35	3.47	361.9	1488.8	31817	7.73	4.11	373.3	1400.7	25.8	85
86	42.3	42.3	15	19.5	33601	6.81	4.93	99	19.3	4.00	23.0	29.0	8.40	3.45	384.7	1551.1	31653	7.85	4.03	395.1	1414.2	27.2	86
87	42.2	42.2	15	21.4	33254	6.91	4.81	99	21.2	3.94	21.0	29.0	8.45	3.43	406.5	1609.8	31518	7.96	3.96	416.9	1426.7	28.5	87
88	39.3	39.3	15	21.5	32645	6.96	4.69	99	21.3	3.84	18.0	29.0	8.50	3.41	425.8	1660.0	31413	8.06	3.90	434.7	1438.1	29.6	88

* REPLACEMENT KTU/UNIT IS THE SAME AS REPLACEMENT MARKET KTU/UNIT.
* REPLACEMENT EER/UNIT IS THE SAME AS ADDITIONS EER/UNIT.

Table R-II

R & F Dept.
August 1978

As with room coolers, the use of central air conditioning has declined especially since the oil embargo of late 1973 and 1974. For the summer of 1975, PECO conducted a bill analysis study (100,101) of suburban central air conditioning customers. This study determined an average cooling use of 2,645 kWh. Assuming an average size of 34,000 Btu/hour and an EER of 6.9*, the resultant hours of use equaled 540 hours, which is slightly higher than the average of the above noted utility load studies and the ADL's projected use for the North Central States. For the cooling season of 1976, PECO, in conjunction with EPRI, conducted a load study of ten heat pump customers. Their cooling use averaged 2,100 kWh with an annual usage factor of 320 hours.(47) Another PECO study, conducted on twenty-five residential customers for the summer of 1976, indicated an average energy usage of 1,160 kWh/unit with an hourly usage of only 230 hours/season.(89)

Based on the above data, the PECO model projects the energy consumption using 450 hours per year per unit. This value is kept constant throughout the forecast period.

All factors considered, PECO estimates its normalized usage for 1977 as 2,187 kWh decreasing to 1,754 kWh/year by 1988. For comparison, PECO's estimated energy usage for new central plant additions in 1980 and 1988 is 1,635 kWh and 1,535 kWh respectively. Dr. Williams' forecast for New York City, for units sold after 1979, is 1,550 kWh.

For the <u>high range</u> forecast for 1988, central air conditioning usage is projected to be 1,975 kWh/unit compared to 1,500 kWh/unit for the <u>low range</u>.

---

*Obtained from PECO's air conditioning model.

REFRIGERATORS

I. SATURATION GROWTH

It is accepted that virtually all households have at least one refrigerator.(102) Regarding the ownership of the second refrigerator, no definitive data is presently available to determine its historical growth pattern. Neither the 1960 or 1970 U.S. Census sought data on refrigerator ownership. A 1972 study conducted by Stanford Research Institute indicated a total national saturation for 1960 of 87% growing to 96% by 1968.(77) PECO's sales records, as reported in Merchandising, indicates the growth of households with electric refrigerators grew from 88% in 1959 to the 99% level by 1967.(103) (See Chart R-3). It is not known how many of these households already had a second refrigerator; however, Dr. Williams states in his analysis that according to, ..."discussions with several utility people...many of the second refrigerators resulted from the purchase of a frost-free model and the retention of the old but still functioning manual defrost model".(55) Since frost-free models were first introduced in the early 1960's, it can be assumed that the total saturation (i.e. the number of refrigerators per 100 households) is greater than that shown by Chart R-3.

From 1968 to 1975, the Electrical Association of Philadelphia reports refrigerator sales for the five county area of 810,000 units.(83) Assuming a constant life span of fifteen years, the replacement market for the same period is estimated at 560,000 units (the number of refrigerators sold from 1953 to 1960) resulting in an increased ownership of a quarter of a million units. The calculated saturation for year-end 1975 is 112.5%. Customer data is taken from PECO annual reports.(104,105)

$$\frac{\text{(December 1967 Customers X 1967 Refrig. Sat.) + Refrig. Sales Net Gain}}{\text{December 1975 Customers}}$$

$$\frac{(1{,}021{,}200 \text{ X } 99\%) + 250{,}000}{1{,}121{,}000} = 112.5\%$$

In January 1976, PECO's income versus usage study indicated a refrigerator saturation of 112.4%(106), which verifies the above "calculated saturation". The September 1976 PECO appliance survey indicated a saturation of 115%(74) and the September 1977 appliance survey indicated a continued growth to 117.3%.(75)

Using the forecasting methodology of Dr. Williams, the annual compound growth factor from 1967's 99% to 1975's 112.4% was 1.6%. Applying this growth factor from 1975 to 1988, results in a forecasted year-end saturation of 116% for 1977 and 138% for 1988. With the increasing number of apartments that are projected to be connected* and with the decreasing family size, it was believed that this projection was too high and was therefore reduced to 130%; which is equal to an annual compound growth of 1.1% as compared to the historical growth of 1.6%.

---

*Multiple refrigerator ownership for apartments in the 1977 Appliance Survey was determined to be 4.4% compared to 19.8% for single and row homes.

ELECTRIC REFRIGERATORS

SATURATION GROWTH

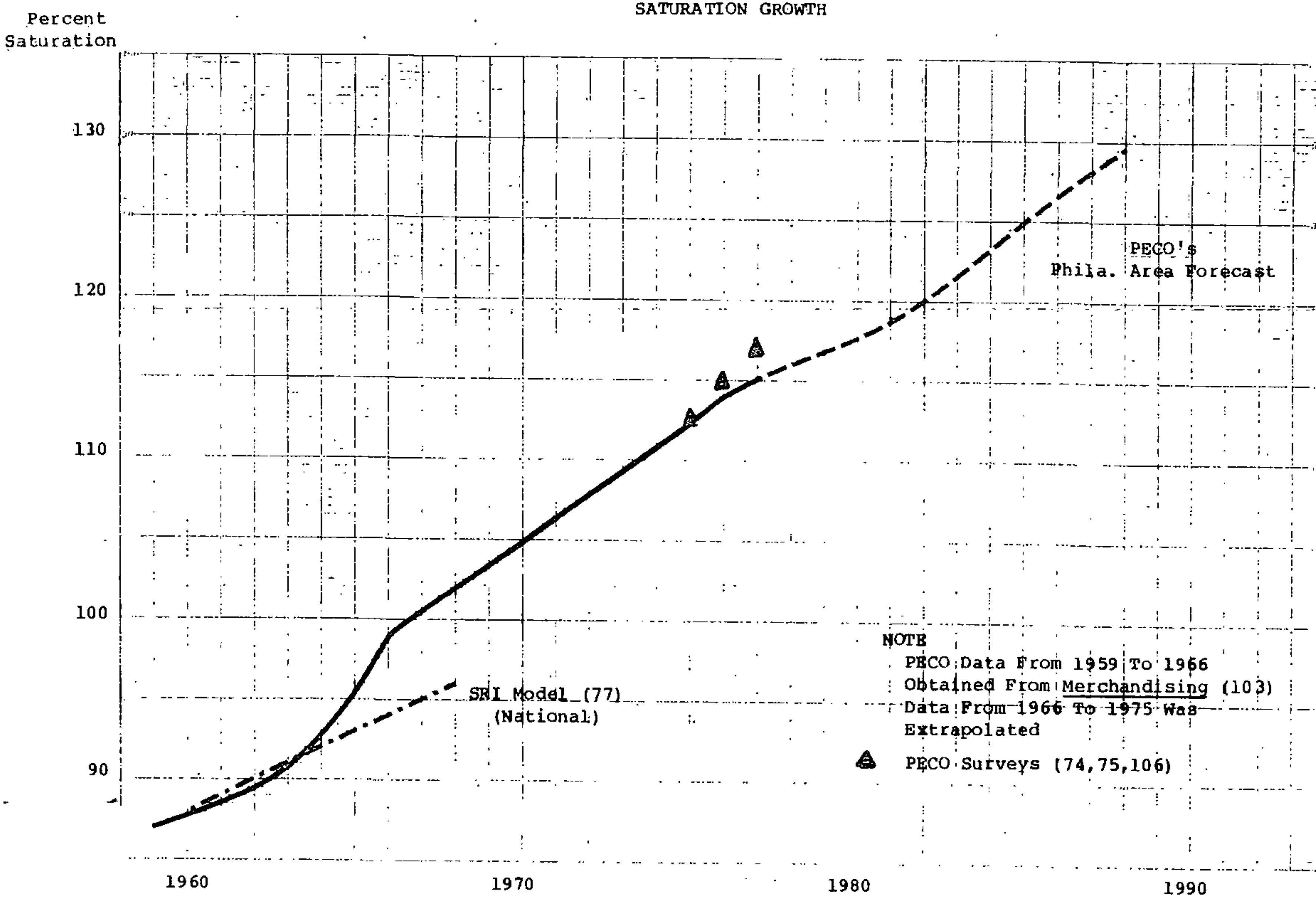


CHART R-3

A second method used to determine the suitableness of the 1988 projection of 130% was to compare the required saturation growths of the second refrigerator for each type of living unit, i.e. apartments versus houses. The current forecast projects the apartment market to increase to about 21% by 1988 with the remaining 79% being town or single homes. Should the saturation of two refrigerators in apartments increase to 7% from the existing 4.4% and the multiple saturation for houses increase to 36% from its existing saturation of 20%, a total weighted saturation of 130%* would result. These assumptions seem reasonable when compared to the historically calculated growth seen in the last ten years and especially the measured growth of the last two years.

A third method to check the validity of PECO's 1988 projection is to compare our future estimations to existing saturations of nearby utilities and utilities with similar metropolitan service areas. The following is a compilation of refrigerator saturations as reported by each respective utility.

Refrigerator Saturation by Housing Type
Comparison of Utility Surveys

Utility	Total Saturation	Apartment Saturation	Single & Row Home Saturation
Public Service E & G, 1976(107)	134%	127%	139%
Pennsylvania Power & Light, 1975(108)	124%	114%	127%
Baltimore G & E, 1976(109)	121%	104%	125%
Detroit Edison, 1976(110)	119%	103%	123%
Consumer Power, 1975(111)	116%	112%	117%
Composite 1974 Total for Pacific G & E, Southern California Edison and San Diego G & E(55)	N/A	116% Duplex 104% Multiple Apts.	120%

*Saturation calculation for 1988:

21% X 1,298,700 X 1.07 = 291,800 Refrigerators in Apartment Market
79% X 1,298,700 X 1.36 = <u>1,395,300</u> Refrigerators in House Market

1,687,100 ÷ 1,298,700 = 130%

For the <u>high range</u>, PECO projects a 1988 saturation of 133% compared to 122% for the <u>low range</u> and 130% for the base forecast.

II. REFRIGERATOR CHARACTERISTICS - HISTORY AND FUTURE PROJECTION

Insufficient local data exists on the size (refrigerated volume) or configurations of refrigerator sales. The PECO model therefore assumes that national refrigerator characteristics can be used for the PECO service area.

Historically, the refrigerator was introduced in the early 1920's. Over the years its size has continued to grow, as indicated by Chart R-4, from 99.6% of those units sold in 1937 being less than 9 cu.ft., to 1977 when 40% of the units sold were 18 cu.ft. or larger.(103)

Chart R-5 represents the historic growth for the average cubic foot of new refrigerators sold for 1950 to 1977. To verify PECO's calculation, the 1970 value was compared to the Arthur D. Little study(48) and the Oak Ridge National Laboratory 1977 Refrigerator Study.(112) PECO's 1970 calculated value is 15.2 cu.ft. compared to the ADL value of 14 cu.ft. and the Oak Ridge value of 15.2 cu.ft. For 1960, PECO's value is 12.4 cu.ft. compared to Oak Ridge 12.5 cu.ft. PECO's projections to 1988 are based on an increase of one-eighth cu.ft. per year as compared to the one-sixth cu.ft. projection of the ADL refrigerator forecast.

Chart R-5 represents PECO's calculated average volume for the total number of refrigerators on line from 1965 to 1977 and PECO's projection to 1988. As a point of interest, PECO's calculated value of 13.5 cu.ft. for 1970 is compared to the ADL calculated value of 13 cu.ft. and the ORNL calculated value of 13.5 cu.ft.

In addition to the increasing volume, the refrigerator configuration has also changed from the simple small single door manual defrost unit to the two door frost-free combination refrigerator/freezer; some of which are side by side models with automatic ice and ice water dispensers. Chart R-6 graphically displays these changes.

As these changes occur, the energy consumption has continued to increase to the point where current deluxe conventional side by side models used more than half of the total average customer's usage in the mid-1960's.

Charts R-5 and R-6 extrapolate historic trends into the future. However, social factors do not always support trend projections. In examining PECO's demographic forecast, it is projected that the family size will continue to decrease (as is true for all national projections - see section on Population), and a larger percent of new housing contruction will be apartments. These demographic changes should signal an end to the continuing growth of the size of the refrigerator. On the other hand, a greater customer desire to upgrade existing smaller units (units sold in the late 1960's averaged about 15 cu.ft. as compared to units sold in the mid-1970's of 16 cu.ft.); an increasing personal income (see Social Factors section); a decreasing real price for refrigerators(112) and the continuing desire to do away with manual defrosting; all point to a growth trend of larger refrigerators and more frost-free units.

REFRIGERATORS

COMPARISON OF UNTIS SOLD BY SIZE

SOURCE - <u>MERCHANDISING</u> (103)

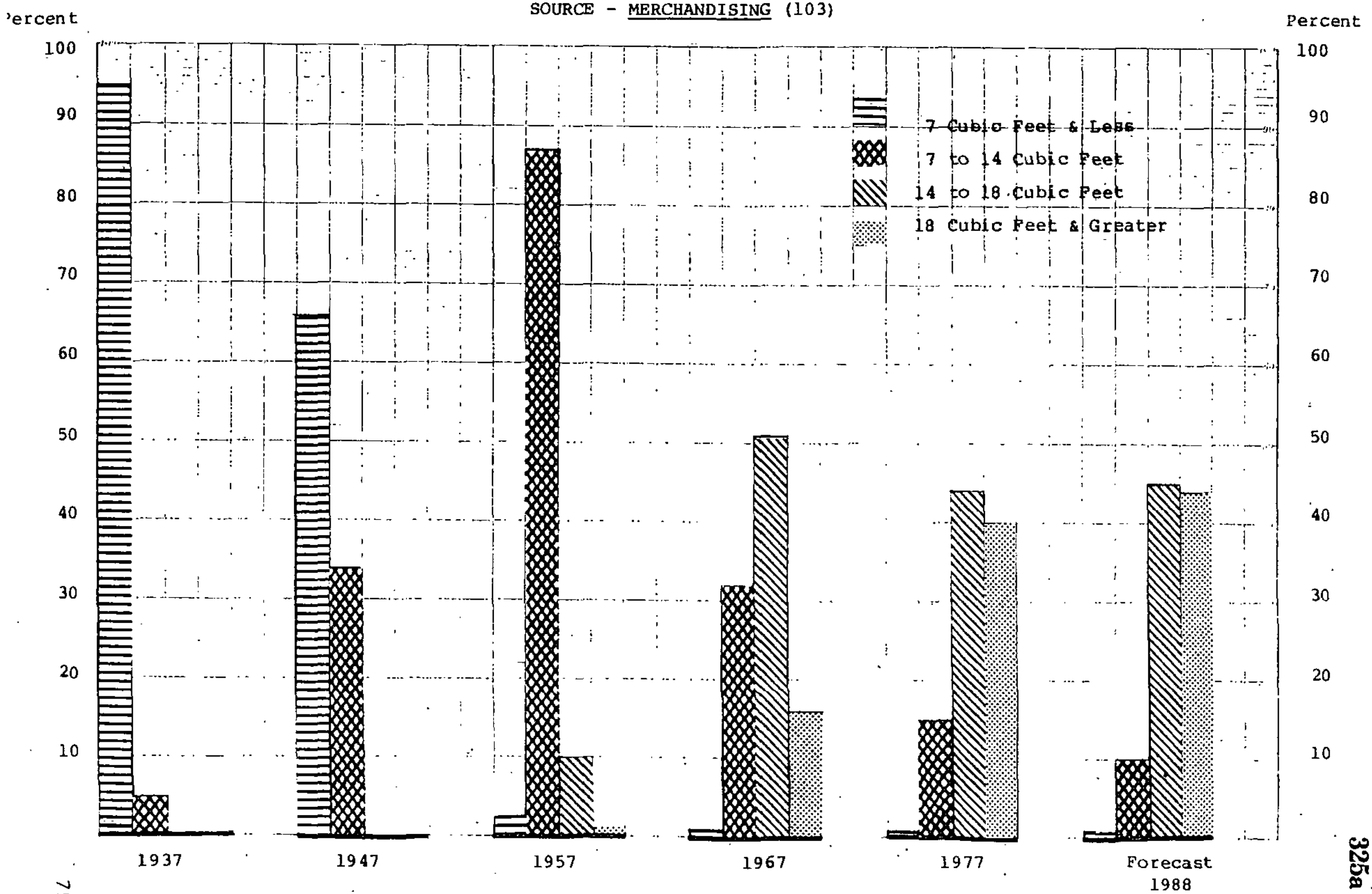


CHART R-4

REFRIGERATORS

AVERAGE SIZE SOLD

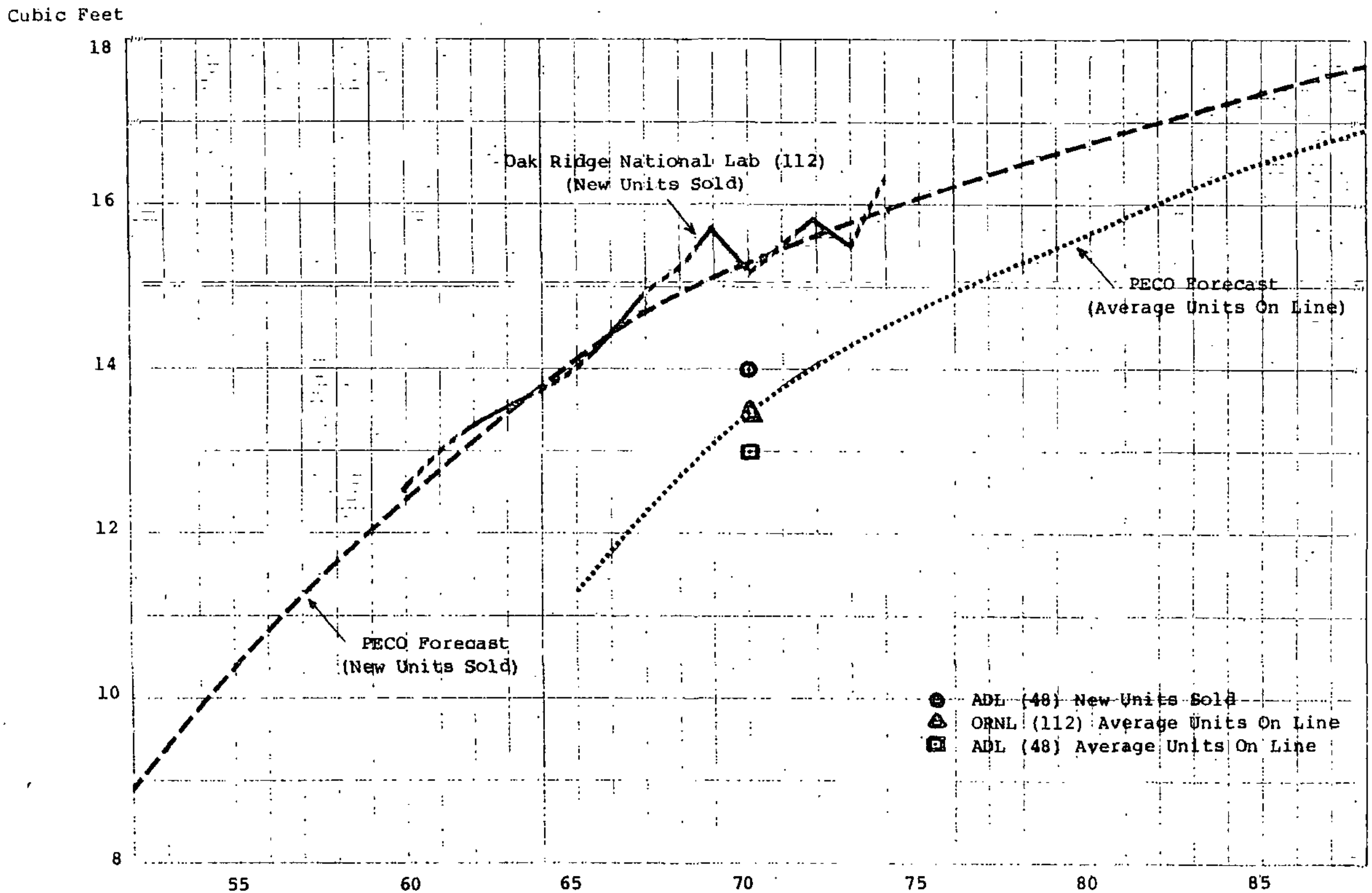


CHART R-5

COMBINATION REFRIGERATOR/FREEZERS

PERCENT SALES TO FROST FREE

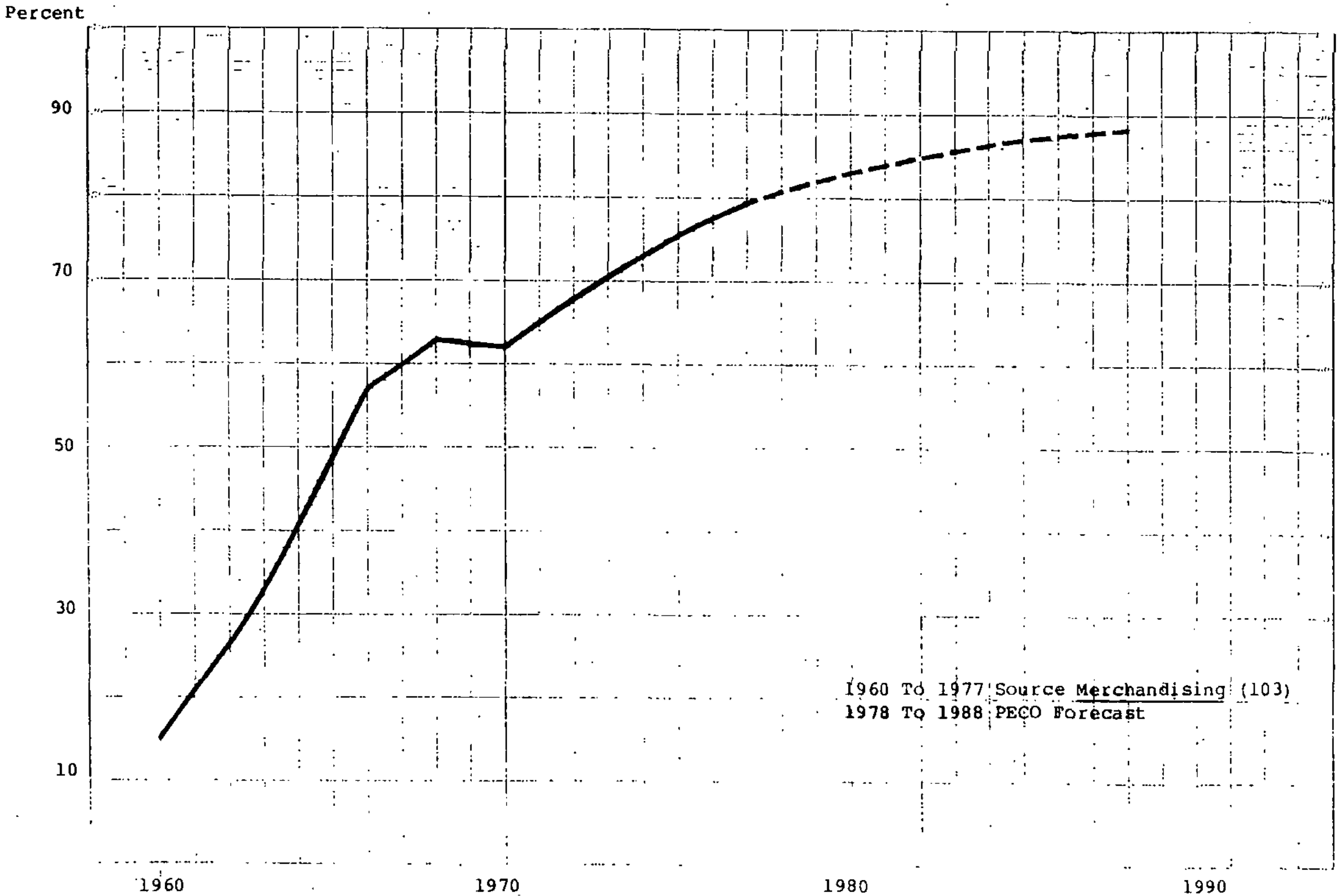


CHART R-6

For 1978, Merchandising forecasts 81% (up 3% from 1977) of all refrigerator factory shipments will be frost-free.(113) ADL projects that by 1980 no-frost units will account for about 70% of all refrigerators in place compared to only 40% in 1974. PECO's 1977 survey indicates that 63.4% of all in place units in the Philadelphia area are frost-free.

III. REFRIGERATOR ENERGY CALCULATION

Energy usage is directly related to the refrigerator size; the presence of a freezer compartment and its location (i.e. top mount, bottom mount or side by side); the size of the freezer compartment as related to the total refrigerator capacity; the presence of an automatic ice maker and the defrosting function (manual, partial defrosting, frost-free); the presence of an energy saver switch and the demographic and housing characteristics; the location of the refrigerator, in relationship to the cooking range and the space heating system (ducts, outlets, etc.); and the presence of air conditioning.

As much of this data is not available, national data, localized where possible, is used to derive energy use by specific category. These categories are a manual defrost single door refrigerator; two door combination partial defrost refrigerator/freezer; and two door combination frost-free units. For each category, data has been sought to determine the kWh/cu.ft./day ratio which is applied to the calculated size of the refrigerator within that group. Since sales data does not exist on frost-free single door units, the kWh/cu.ft./day value of manual defrost units have been estimated about 5% higher to account for the omission of frost-free sales data.

The energy usage of replacement units (refrigerators that wear out and are replaced with new units), are assumed to be of the same size and energy consumption values as new additional units. This assumption may put a low bias on the forecast, as replacement units over the near term would come from a higher percentage of houses than the future (added units) market mix of houses and apartments.

The average kWh/cu.ft./day values were obtained from test data of various utility companies and published data by Edison Electric Institute (EEI), Association of Home Appliance Manufacturers (AHAM), Oak Ridge National Laboratory and various consumer research publications.

A summary of these findings is indicated on the following page.

	Method of Findings	KWh/Cubic Foot/Day: Manual Defrost Single Door	Frost-Free Single Door	Top Mount Combination Partial Defrost	Top and Side/Side Combination Frost-Free
1966 Baltimore G & E Study(114)	Test				.342
1969 EEI Guide(115)	Test	.166	.278	.223	.358
1970 Consumers Bulletin(116)	Test	.181			.343
1972 National Utility Study(117)	Test				.349
1972 Localized Utility Study(117)	Test				.357
1972 Consumers Bulletin(118)	Test	.164			.377
1973 EEA Guide(119)	Test	.166	.278	.223	.358
1973 Oak Ridge/TANSIL(112)	Estimate				.354
1975 AHAM Directory(120)	Mfg. Test			.254 (13 cu.ft.)	.331 (15.6 cu.ft.)
1976 Consumer's Research(121)	Test*				.348 (Top Mount Old Units)
1976 Consumer's Research(122)	Test				.263**(Top Mount New Units) .275**(Side/Side New Units)
1977 EEI Guide(78)	Test			.329	.352
1977 Oak Ridge/Hoskins & Hirst(112)	Model***			.290****	.336 (Top Mount)
1977 Consumer's Research(123)	Test				.292 (Top Mount) .284 (Side/Side)
1977 California Minimum Standards(124)	N/A	.192		.261	.305
1979 California Minimum Standards(125)	N/A	.192		.229	.240

*Based on Consumer's Research's adjusted "cubic foot" calculation.
**Excludes use of anti-sweat heaters.
***Includes use of anti-sweat heaters.
****Oak Ridge's model predicts a savings of 14% with the elimination of the defrost cycle of the freezer in a top mount combination refrigerator freezer. Consumer's Research's test results indicate "a difference of only about 10%".(125)

Chart R-7 graphically represents the kWh/cu.ft./day data points from 1966 to 1978 for frost-free combination refrigerator/freezers. The accepted values used by the PECO model are:

0.35 kWh/cu.ft./day for the composite of top and bottom mount and side by side frost-free combination refrigerator/freezers decreased to 0.252 in 1980 and thereafter to 1988.

0.30 kWh/cu.ft./day for partial defrost combination refrigerator/freezers decreased to 0.216 in 1970 and thereafter to 1988. The original value was determined based on the statements of Oak Ridge National Laboratory and Consumer's Research that this type of refrigerator uses about 10% to 14% less than a frost-free model of the same size. The PECO model used a reduction factor of 14%.

Projected values for 1980 were based on the DOE appliance efficiency improvement target of 39% (28% energy reduction), as compared to 1972 energy use values.(61)

To test the validity of the PECO model, the calculated energy usage per average refrigerator on line and new units sold were compared to the Stanford Research Institute Study, the ADL Study and Dr. Williams' Study for New York City. Chart R-8 displays the comparisons.

Also, when compared to a report prepared by the National Bureau of Standards for the FEA(126), PECO's calculated value for new units sold in 1972 was only 5% higher than from the NBS's value.

Table R-III summarizes the PECO refrigerator forecast for the years 1977-1988.

For the high range, the forecast projects a 39% energy efficiency improvement accomplished by 1988 as compared to 1980 for the base forecast. The low range projects a 43% improvement by 1980 and 67% improvement by 1988. For 1988, the high range estimates a per unit usage of 1,660 kWh/year compared to an annual usage of 1,535 kWh for the low range and 1,600 kWh for the base forecast.

REFRIGERATORS - FROST FREE COMBINATIONS

ENERGY USE - KWH PER CU.FT. PER DAY

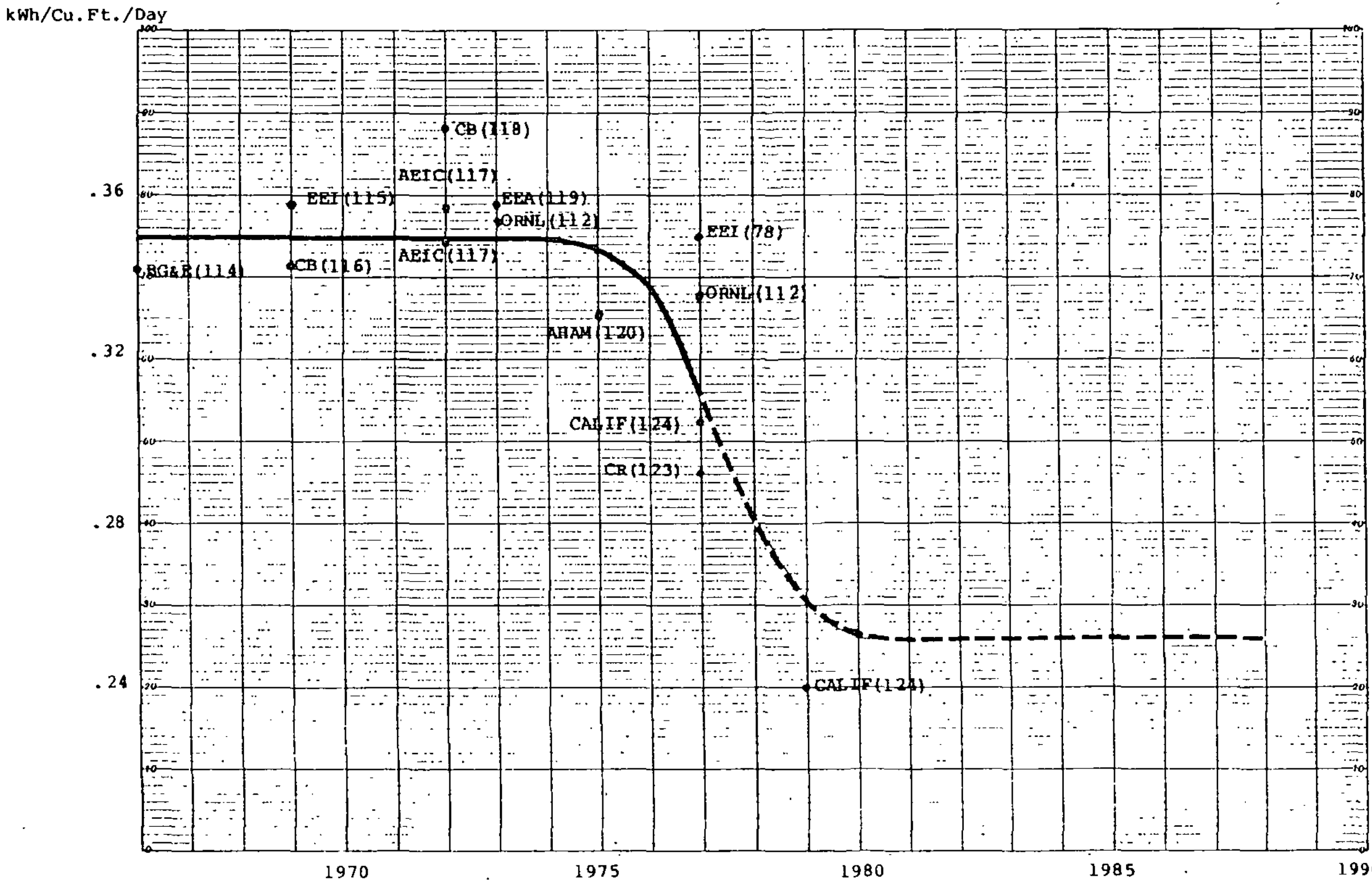
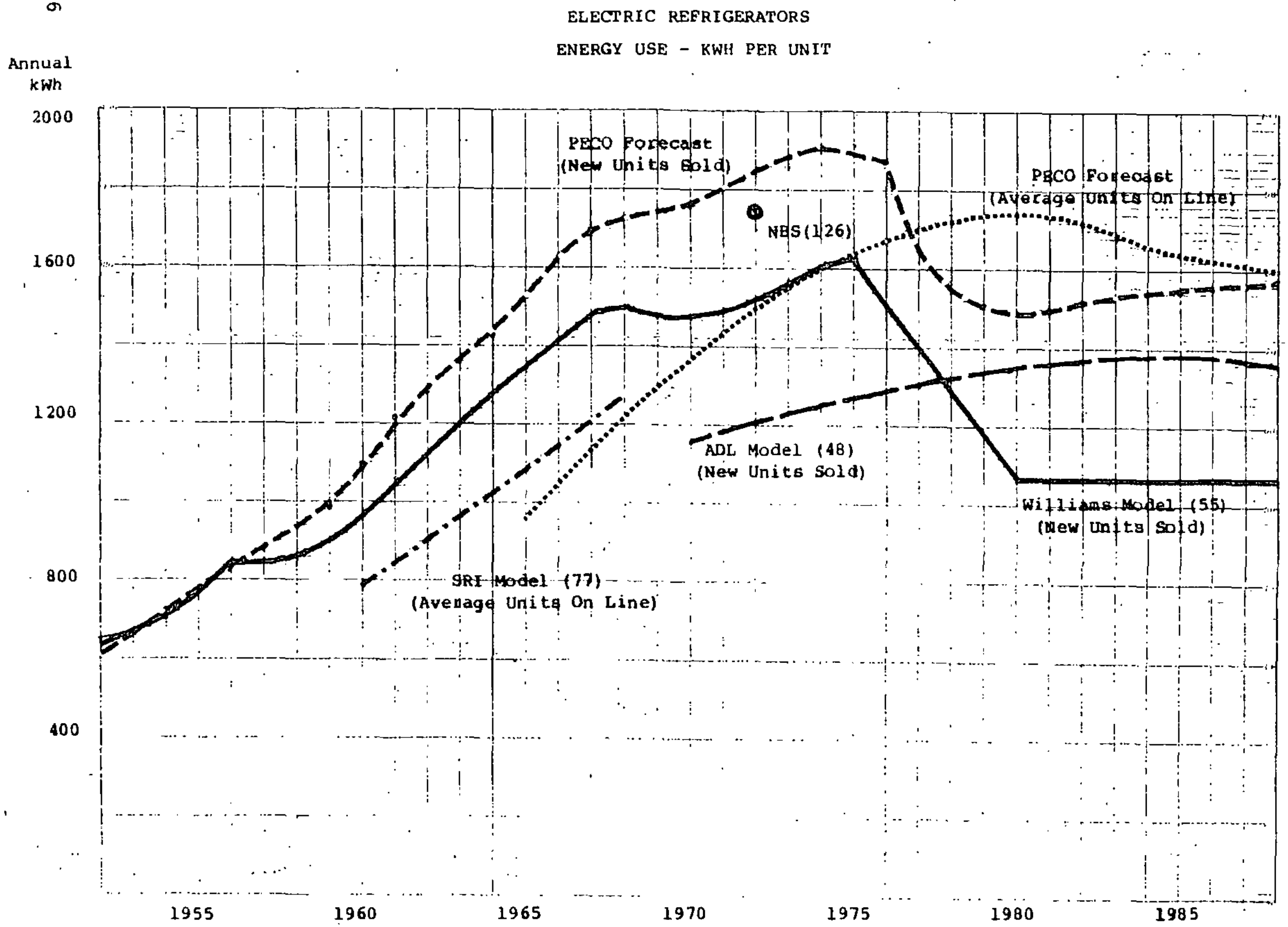


CHART R-7



ELECTRIC REFRIGERATORS
ENERGY USE - KWH PER UNIT
Annual kWh
2000
1600
1200
800
400
1955
1960
1965
1970
1975
1980
1985
PECO Forecast (New Units Sold)
PECO Forecast (Average Units On Line)
NBS(126)
ADL Model (48) (New Units Sold)
Williams Model (55) (New Units Sold)
SRI Model (77) (Average Units On Line)

CHART R-8

REFRIGERATOR ANALYSIS

YR	YR END UNITS	AVG UNITS ON LN	NEW UNITS	REPLC MKT	REPLC UNITS	TOTAL UNITS SOLD	KWH AVG UNIT SOLD	TOTAL ADDL MMKWH	MMKWH REMOVED	KWH/UNIT REMOVED	TOTAL MMKWH	AVG KWH ON LN	AVG D.U.	% SAT
77	1344.6	1340.3	8.7	69.1	69.1	77.8	1647	128.1	88.5	1281	2284.1	1704	1156	115.96
78	1360.6	1352.6	16.0	78.6	78.6	94.6	1574	147.6	106.7	1358	2325.0	1719	1166	116.02
79	1383.6	1372.1	23.0	78.8	78.8	101.8	1507	154.2	112.9	1433	2366.3	1725	1175	116.74
80	1411.6	1397.6	28.0	87.1	87.1	115.1	1486	171.9	132.4	1521	2405.8	1721	1186	117.86
81	1443.6	1427.6	32.0	102.1	102.1	134.1	1502	203.4	166.8	1633	2442.4	1711	1199	119.08
82	1478.6	1461.1	35	102.6	102.6	137.6	1520	208.9	174.0	1696	2477.3	1695	1214	120.34
83	1515.6	1497.1	37.0	108.7	108.7	145.7	1532	222.9	187.5	1725	2512.7	1678	1230	121.69
84	1554.6	1535.1	39.0	111.8	111.8	150.8	1544	231.3	194.1	1736	2549.9	1661	1246	123.24
85	1594.6	1574.6	40.0	104.8	104.8	144.8	1556	224.2	184.4	1759	2587.7	1645	1260	124.96
86	163[illegible]	[illegible]3.6	38.0	99.4	99.4	137.4	1568	217.6	178.8	1799	2628.5	1629	1274	126.68
87	1667.6	16[illegible].1	35.0	93.7	93.7	128.7	1579	206.7	173.4	1850	2661.8	1613	1287	128.24
88	1698.6	1683.1	31.0	99.9	99.9	130.9	1591	212.1	186.1	1863	2687.8	1597	1299	129.60

87

333a

R & E DEPT.
SEPTEMBER 1978

TABLE R-III

FREEZERS

I. SATURATION GROWTH

Freezer saturation for the Philadelphia area (five county) as reported from U.S. Census survey material for 1960(90) and 1970(29) are 12.9% and 17.7%. This is a ten year growth of 37%. In the city of Philadelphia, where income levels are less than the area's average, the ten year freezer saturation growth was 58%. Three of the four suburban counties had ten year growths in the twenty to thirty percent range.

Projecting 1977 freezer saturation based on the annual growth rate from 1960 to 1970 would yield a saturation of 22.0%. PECO's 1977 appliance survey, however, reports a saturation of 25.3% indicating an increasing growth rate during a period when economic conditions were depressed.(75)

Projecting the freezer saturation for 1988, based on the annual growth rate experienced from 1960 to 1977, would yield a saturation of 39.1%; while using the most recent seven year annual growth rate would yield a saturation of 44.4%. The PECO model projects 40.0% which is at the lower end of the projection range.

Chart R-9 displays the historical saturation growth for the Philadelphia area and PECO's projected growth for the forecast period. In addition, this figure indicates historical and projected saturation from other reports and studies.

Merchandising reports that freezer saturation grew, on a national basis, from 21% in 1958 to 44.8% in 1977 for an annual growth rate of 4.1% as compared to the Philadelphia area's rate of 4.0% for the period 1960 to 1977.(103) Stanford Research Institute also reports the annual growth rate from 1960 to 1968 of 4.2%.(71)

Arthur D. Little in their report for the FEA states, "Current sales and saturation are increasing rapidly because of escalating food costs and the scarcity of certain foods".(48) ADL's forecast projects a total national saturation of 46% by 1990, 6% higher than PECO's projection for 1988. For 1977, ADL's saturation projection was 35% which is 10% less than Merchandising's measured saturation of 45%. If this difference is extended to 1990, the ADL projection would be 56% compared to PECO's area projection of 40%.

Also shown on Chart R-9 is Dr. Williams' saturation projection for New York City.(55) From 1970 to 1988, Dr. Williams' annual growth rate is 8.4%, which is more than double PECO's projected rate.

Another method to substantiate PECO's 1988 projection is to compare the required saturation growths of freezers for each type of living unit, i.e. apartments versus houses. The current forecast projects the apartment market to increase to about 21% by 1988, with the remaining 79% being town or single houses. Should the saturation of freezers in apartments increase to 13% from the existing 8.8% and the saturation for houses increase to 47% from its existing saturation of 28.4%, a total weighted saturation of 40% would result.* These assumptions seem reasonable when compared to growth experienced in the last seven years and especially the growth during the last four years.

A third method to check the validity of PECO's 1988 projection is to compare PECO's future freezer estimations with existing saturations of nearby utilities and to compare other utilities' historical growth rates with PECO's forecasted rate.

Public Service Electric and Gas reports a 1976 saturation of 20.6% with an annual growth rate of 4.3% since 1962.(107)

Baltimore Gas and Electric's 1976 survey records a saturation of 38.3% compared to their 1966 saturation of 24.7%. This is a 4.5% annual growth rate. Their survey reports that, "Nearly one in two single-family homes have a freezer, with saturation in apartments also on the increase".(109) Further, their survey found that one-fourth of all freezers on their lines were frost-free.

Pennsylvania Power and Light's 1975 survey states, "Freezer saturation (now at 42%) has increased 18 points since 1970 after remaining level between 20-25% in the previous five year period".(108) Their annual growth rate from 1970 to 1975 was 11.8% compared to 5.8% for the period 1958 to 1975.

Potomac Edison's 1977 survey records a freezer saturation of 55.1% as compared to 40.6% in 1967 and 31.6% in 1963. Their annual growth rate from 1963 to 1977 was 4.1%; reaching 5.7% for the last ten years.(127)

Other utility surveys indicate present freezer saturations in the 30% to 40% range. Detroit Edison's 1976 survey reports a freezer saturation of 32.8%(110), Atlantic Electric's 1977 survey records a freezer saturation of 36.3%(128) and Consumers Power's 1975 survey indicates a saturation of 46.3%.(111)

PECO's forecasted annual growth from 1977 to 1988 is 4.3% compared to 5.3% for the <u>high range</u> and 2.3% for the <u>low range</u>.

---

*Apartments:	21% X 1,298,700 X .13 =	35,500
Houses:	79% X 1,298,700 X .47 =	482,200
		516,700 ÷ 1,298,700 = 40%

SATURATION GROWTH - FREEZERS

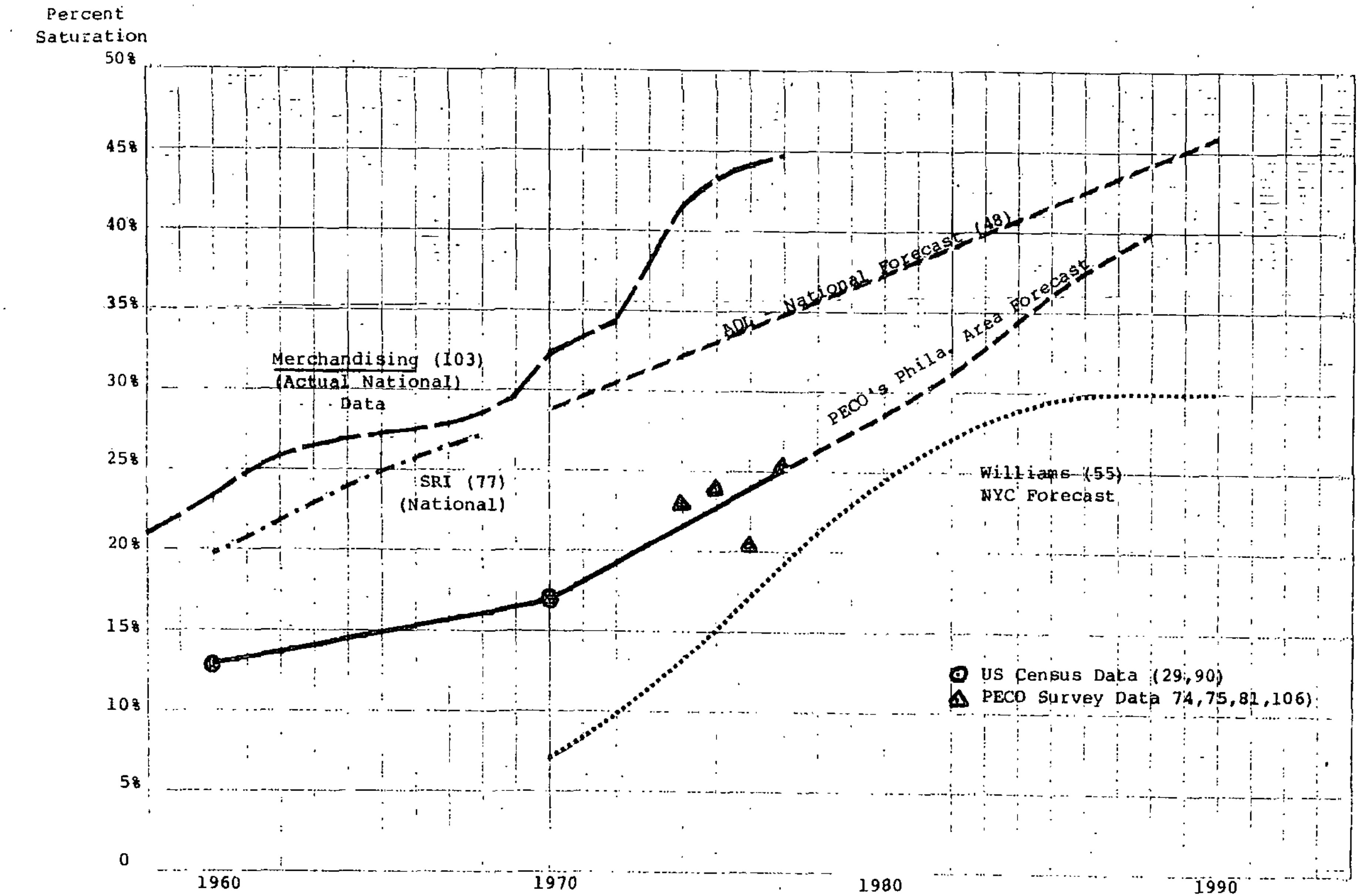


CHART R-9

II. FREEZER CHARACTERISTICS

Local sales data on freezer size or configuration is not available. PECO's 1977 survey indicates that 31% of all freezers on line are frost free. Recent national sales data as reported by Merchandising indicates that frost-free sales have declined during the last three years. This decline has resulted from an increased trend to chest-type freezers, which cost less to buy and operate than upright models since they are more efficient and manually defrosted. Also, manual defrost upright models are selling better than their no-frost counterpart, because they are less expensive to purchase and use less energy. For these reasons, PECO's forecast projects that local frost-free sales of new units and replacements will decline from 20% of new unit sales in 1977 (a decrease of 11% from the measured 1977 average saturation of 31%), to 10% in 1987 and hold constant thereafter. This decreasing trend will decrease the average saturation of frost-free units on line from 31% in 1977 to 22% in 1988. Should the frost free models regain their popularity, PECO's freezer projection would be on the low side since a comparative size frost free freezer uses 50% more electricity.(78)

The ADL study, by contrast, based their most probable forecast on the projection that, "About 30% of freezers are no frost. This percentage is expected to hold despite the higher energy utilization of this type of freezer".(48)

In the past 20 years, the size of freezers has steadily increased from an approximate 11½ cu.ft.* to 16½ cu.ft. in 1977. AEIC's 1975 study of food freezers reported an average volume of 16.5 cu.ft.(129). EEI's 1977 guide estimates an average size of 16 cu.ft. for manual defrost units and 16.5 cu.ft. for no-frost units(78), while EEI's 1969 guide had suggested 15 cu.ft. for all units sold. Unlike refrigerators, the growth in sales of the largest category of freezers (over 20 cu.ft.) has shown very little change for the past six years.(103) Similarly, sales of the smallest category (under 14 cu.ft.) have also stabilized. Therefore, the PECO model estimates the average size for future freezer sales will be identical to the 1977 EEI guide recommendation.

The freezer characteristics are identical for all three forecasts; high, low and base.

---

*SRI reports 1961 freezer usage at 915 kWh per year divided by EEI's 1969 estimate of 79.7 kWh/cu.ft. equals 11½ cu.ft. for 1961.

III. FREEZER ENERGY USAGE

As with refrigerators, energy usage for freezers is directly related to a variety of conditions: the total volume, the defrosting function, the configuration (upright or chest), the presence of an energy saver switch, demographic and housing characteristics, the location (kitchen, basement or garage), and in some instances the type and availability of a heating and cooling environmental system.

Since much of this data is not available for local sales, the PECO model reverted to national data. Chart R-10 graphically represents the kWh/cu.ft./day data points taken from the following table.

		Chest Manual	Upright Manual	Average for Manual	Upright No Frost
1969 EEI Guide(115)	Test			.218	.322
1973 EEA Guide(119)	Test			.218	.322
1975 National Utility Study(129)	Test	.19	.21	.20	.30
1977 EEI Guide(78)	Test			.204	.302
1977 AHAM(130)	Mfg. Test	.117	.216	.20	.322

The PECO model used a 1972 value of .322 kWh/cu.ft./day for frost-free freezers decreasing to .250 in 1980 and thereafter to 1988. For manual defrost freezers, the model used a 1972 value of .218 kWh/cu.ft./day as a composite for upright and chest freezers decreasing to .170 in 1980 and thereafter to 1988. Projected values for 1980 were based on the DOE appliance efficiency improvement target of 28% (22% energy reduction), as compared to 1972 energy use values.(61)

To test the validity of the PECO model, the calculated energy usage per average freezer on line and new units sold was compared to the 1972 Stanford Research Institute Study, Dr. Williams' study of energy use for New York and the ADL study. Chart R-11 displays the comparison. Table R-IV summarizes the PECO freezer forecast.

The PECO model projects, for new freezers sold in 1980, an average usage of 1,024 kWh as compared to Dr. Williams' 1980 projection of 990 kWh. PECO's average usage for total units on line in 1988 is 1,145 kWh compared to ADL's 1990 value of 1,170 kWh.

For the high range, PECO forecasts an energy reduction of 11% for an average usage for new units sold in 1988 of 1,115 kWh/year. PECO's 1988 average on line usage is 1,223 kWh/year. For the low range, PECO projects an energy reduction of 22% for an average usage for new units sold in 1988 of 977 kWh/year. PECO's 1988 low range average on line usage is 1,195 kWh/unit. The low range usage is higher than base forecast usage (1,195 versus 1,145) due to the limited number of additional freezer sales and the effect this has on the present stock of freezers on line.

FREEZERS

ENERGY USE - KWH/CU.FT./DAY

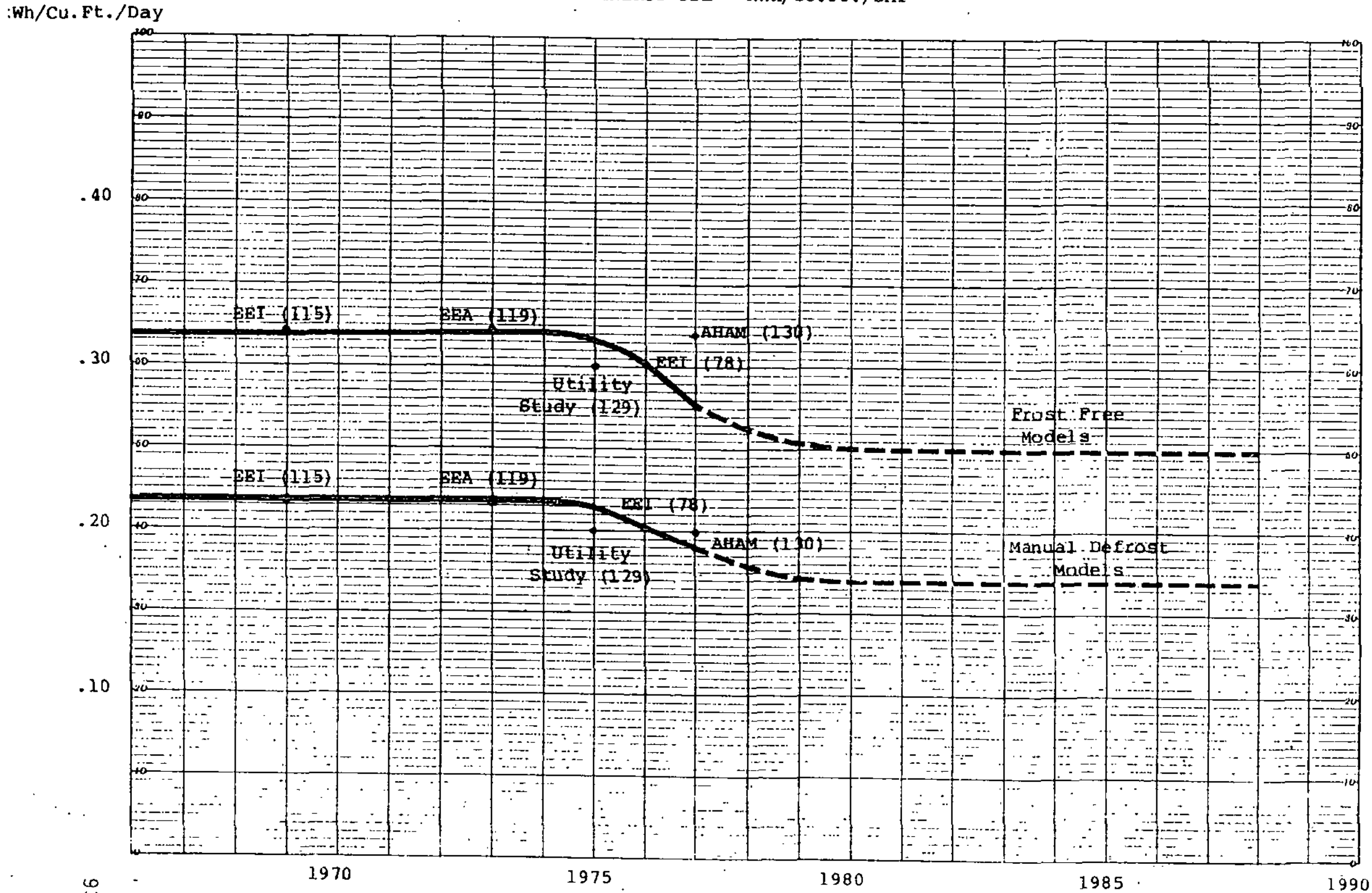


CHART R-10

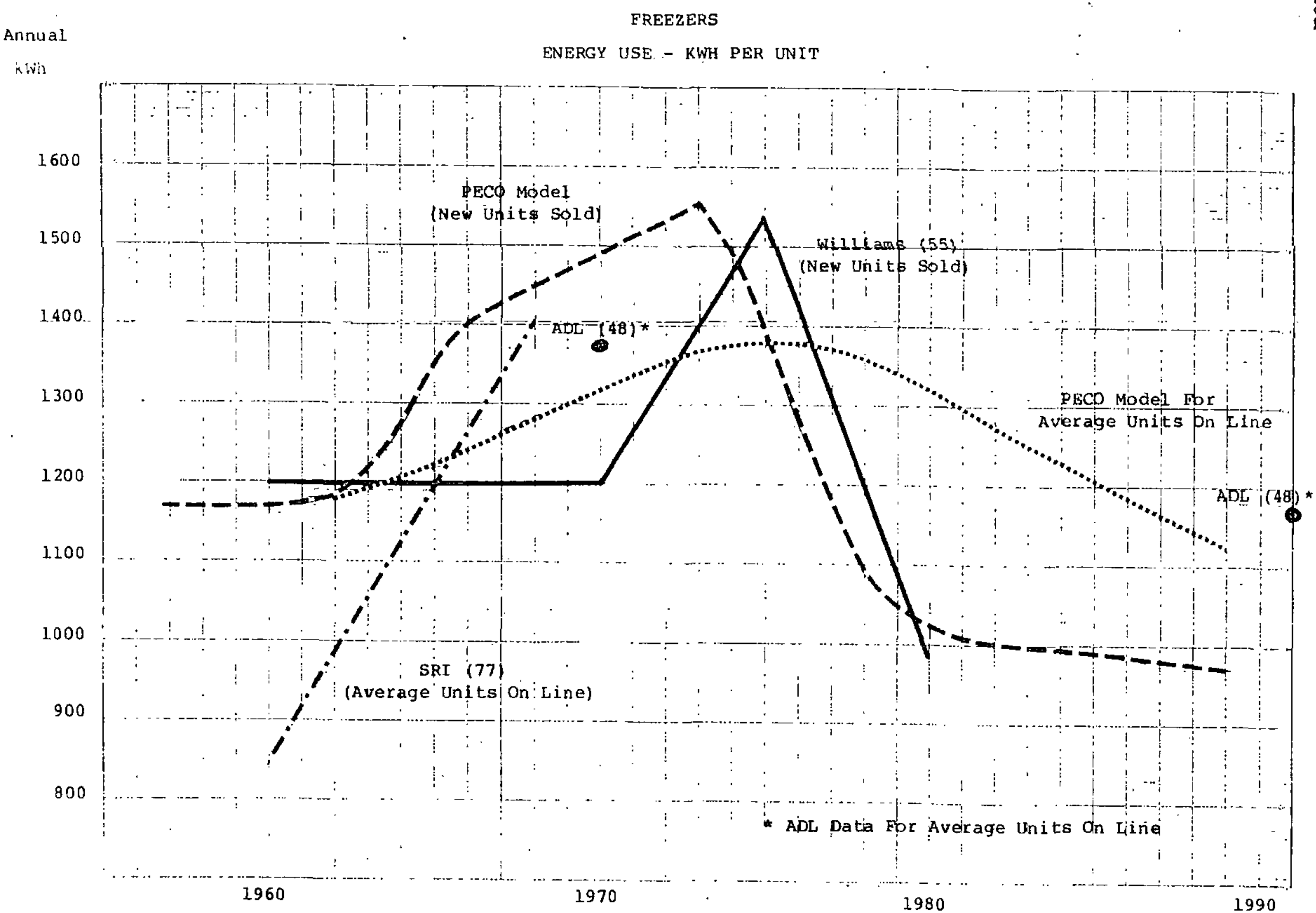

FREEZERS
ENERGY USE - KWH PER UNIT
Annual
kWh
1600
1500
1400
1300
1200
1100
1000
900
800
1960
1970
1980
1990
PECO Model
(New Units Sold)
Williams (55)
(New Units Sold)
ADL (48)*
PECO Model For
Average Units On Line
ADL (48)*
SRI (77)
(Average Units On Line)
* ADL Data For Average Units On Line

CHART R-11

FREEZER ANALYSIS

YR	YR END UNITS	AVG UNITS ON LN	NEW UNITS	REPLC MKT	REPLC UNITS	TOTAL UNITS SOLD	KWH AVG UNIT SOLD	TOTAL ADDL MMKWH	MMKWH REMOVED	KWH/UNIT REMOVED	TOTAL MMKWH	AVG KWH ON LN	AVG U.U.	% SAT
77	293.7	288.4	10.7	9.6	9.6	20.3	1182	21.5	11.2	1167	395.6	1372	1156	24.95
78	305.7	299.7	12.0	9.6	9.6	21.6	1086	22.8	11.2	1167	407.1	1358	1166	25.71
79	321.7	313.7	16.0	9.6	9.6	25.6	1051	24.8	11.3	1172	420.7	1341	1175	26.69
80	340.7	331.2	19.0	9.1	9.1	28.1	1024	27.5	11.0	1171	437.2	1320	1186	27.93
81	363.7	352.2	23.0	11.5	11.5	34.5	1009	31.6	12.1	1170	456.7	1297	1199	29.38
82	388.7	376.2	25.0	9.6	9.6	34.6	1004	34.7	12.4	1175	479.0	1273	1214	30.98
83	415.7	402.2	27.0	10.6	10.6	37.6	999	36.1	12.1	1193	503.1	1251	1230	32.69
84	441.7	428.7	26.0	11.5	11.5	37.5	995	37.3	13.7	1240	526.7	1229	1246	34.42
85	466.7	454.2	25.0	13.3	13.3	38.3	990	37.5	16.3	1315	547.9	1206	1260	36.05
86	489.7	478.2	23.0	13.5	13.5	36.5	985	36.8	18.5	1381	566.3	1184	1274	37.54
87	509.7	499.7	20.0	13.4	13.4	33.4	980	34.2	19.0	1409	581.5	1164	1287	38.83
88	526.7	518.2	17.0	13.5	13.5	30.5	977	31.2	19.3	1431	573.5	1145	1299	39.99

95

Table R-IV

R & F Dept.
September 1978

I. SATURATION GROWTH

Cooking ranges are classified as pivotal appliances since the energy used (electric versus gas) is in many cases determined by the type of energy used to heat the home. In the new construction market, the "pivotal appliance rule" is usually always true; a gas heated home will normally have a gas range and an electrically heated home will normally have an electric range. The basic question is what type of range will an oil heated home install? If a gas main is nearby, as is true in the city of Philadelphia, then a gas range may be installed; however, if a gas main is not locally available, as is true in many areas of the suburbs, then an electric range is the most likely option. At this point other economic conditions are applicable, i.e. electric ranges normally cost less to buy but cost more to operate.* Other factors, such as availability of gas supply, customer preferences and ease of installation, all affect a consumer's choice.**

From 1960 to 1970, the saturation of electric ranges in the Philadelphia area grew from 23.0%(90) to 29.5%(29), an annual growth rate of 2.5%. PECO's 1977 survey measured an electric range saturation of 38.0% for a 17 year annual growth rate of 3.0%.(75) Applying this historical growth rate to 1988 yields a saturation of 52.6% as compared to PECO's forecasted value of 46.5%, which represents an annual growth rate of only 1.9%. The historical growth rate from 1970 to 1977 was 3.7%.

Chart R-12 displays the historical saturation growth for the Philadelphia area and PECO's projected growth for the forecasted period. In addition, this figure indicates historical and projected saturation from other reports and studies.

Merchandising reports the national saturation of electric ranges grew from 33% in 1958 to nearly 72% by 1977, for an annual growth rate of 2.7%(103) compared to PECO's comparative value of 3.0%.

Arthur D. Little reports that electric range saturation in 1970 was 41% compared to PECO's value of 29.5%. For 1990, ADL projects an electric range saturation of 75% compared to PECO's estimation of 48%. For the period 1970 to 1990, ADL's annual growth factor is 3.1% compared to PECO's value of 2.5%. ADL attributes their growth to, "...continuing recent trends in consumer and contractor preference". ADL also states, "The shift to electric (ranges) has the effect of significantly decreasing on-site energy consumption for cooking purposes".(48)

---

*The operating cost differential in the future will lessen as the price of gas rises faster than electricity. See energy price projections.

**A recent opinion poll indicated that younger women prefer electric ranges while older women prefer gas ranges. As the number of younger women increase (see Population Section) there should be a favorable impact on electric range sales.

Also shown on Chart R-12 is Dr. Williams saturation projection for New York City. From 1970 to 1990, Dr. Williams' annual growth rate is 5.5%(55) which is about double PECO's Philadelphia area projection.

As an indication of the movement towards electric ranges, the 1977 PECO survey determined that 107,000 gas space heating customers have electric ranges for a saturation of 18.2%, while only 1,600 electric space heating customers have gas ranges for a saturation of only 4.8%. The primary source of gas ranges in the electric heating market is electric space heating conversions from gas space heating customers who maintained their old gas ranges.

Based on this data, the following summarizes the electric range forecast.

1977	year end electric ranges on line	425,000
1978-1988	Rate RH new construction with electric ranges	80,000
	Oil heated new construction with electric ranges	30,000
	Gas heated new construction with electric ranges	5,000
	Rate RH conversions	8,000
	Electric range conversions from gas ranges	33,000
	Loss due to demolitions and abandonments	-4,000
1988	year end electric ranges on line	577,000

The high range forecast projects a 1988 saturation of 47% compared to 40% for the low range and 44% for the base case.

SATURATION GROWTH - ELECTRIC RANGE

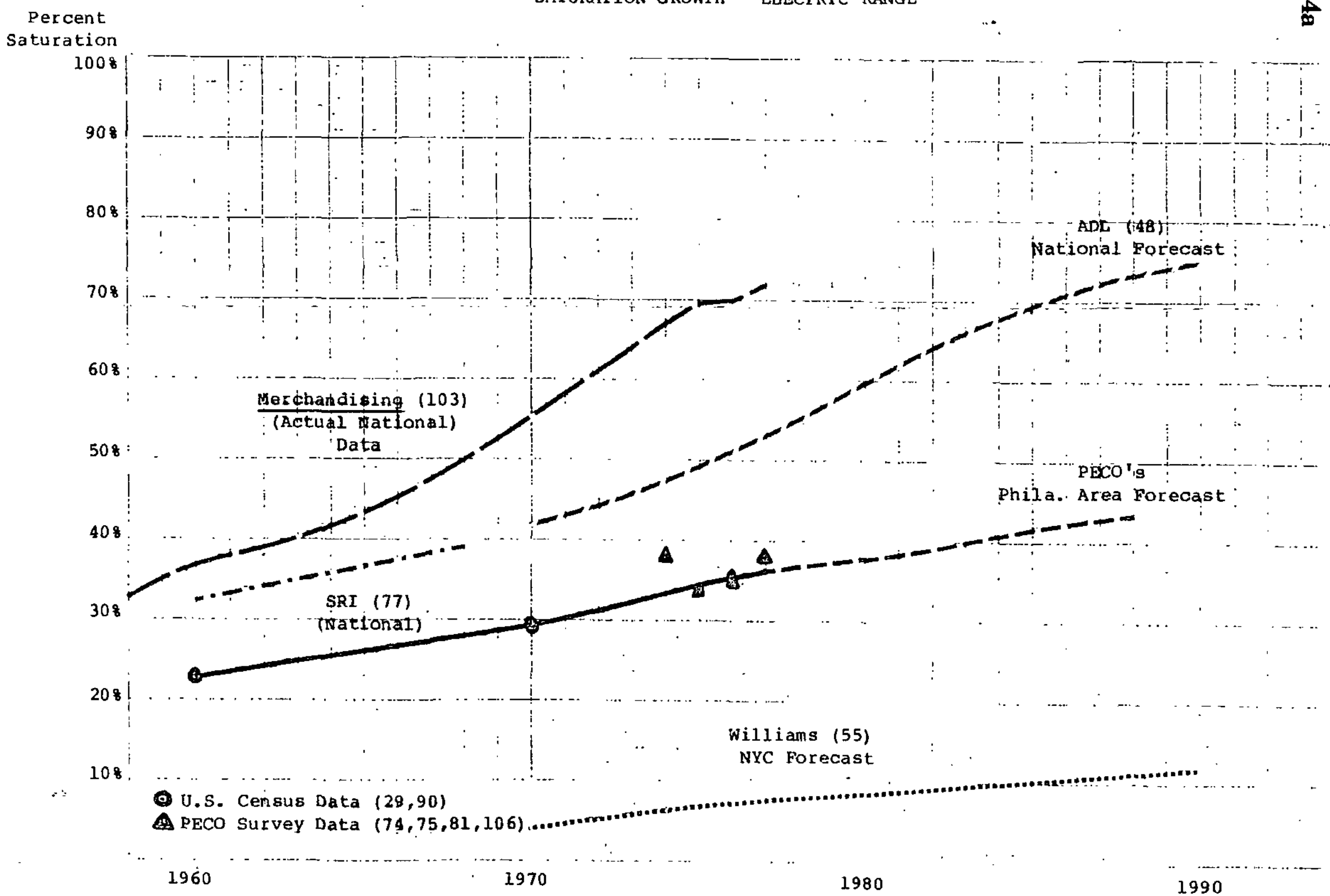


CHART R-12

II. ENERGY USAGE

In contrast to appliances such as refrigerators and freezers, where the energy usage is controlled more by automatic controls (thermostats) than by the customer's living habits or desires, use of electric ranges depends largely on customer motivation. They may choose to use a conventional cooking range or any of several counter top appliances like toaster ovens, hot dog cookers or microwave ovens.

In recent years, changing living habits and the energy conservation ethic have substantially changed the usage of electric ranges. Stanford Research Institute reports the average usage of electric ranges decreased from 1,225 kWh/unit in 1960 to 1,180 kWh/unit in 1968.(77) The ADL model projects a constant average usage of 1,170 kWh/unit for the entire forecast period, 1970-1990. ADL states, "An increasing percentage of ranges will be self cleaning. They use only slightly more energy than conventional ranges; however, because the energy used for self cleaning is mostly offset by operational savings which accrue from the increased insulation needed in such units....Under our base case assumption, electric ranges will reflect...(no)...savings."(48)

EEA's 1973 guide recommended 1,175 kWh/year for electric ranges.(119)

The EEI's 1977 Appliance Usage Guide indicates that a conventional electric range and oven uses 700 kWh/year and a self cleaning unit uses 730 kWh/year.(73) An article in Electrical World, August 1977, discusses findings by EEI which indicate that a large number of studies undertaken in recent years point to a trending down of range use. The article includes another study conducted by the Association of Home Appliance Manufacturers (AHAM) indicating that electricity consumption by the toaster oven, broiler, slow cooking pot, fry pan and roaster total 477 kWh per year. The article points out that although this consumption seems to offset the decline recorded in range use, the data are not yet sufficient to attribute the range decline to the increased use of the individual small cooking appliances noted.(131)

To calculate the projected usage for electric ranges, the PECO model utilizes the following values:

1. Self cleaning ovens increasing from 37% of new units sold in 1977 to 70% of the units sold in 1988.(102)

2. Smooth top ranges increasing from 8% of new units sold in 1977(102) to 50% of the units sold in 1988.(65,132)

3. Microwave oven saturation increasing from 2.5%(75) in 1977 to 6.5% in 1988 for an annual growth rate of 8%.

4. Microwave oven saturation for customers with electric ranges increasing from 2.5% in 1977(75) to 7.5% in 1988 for an annual growth rate of 10.5%.

5. Additional energy use for self cleaning oven option - 30 kWh.(78,133)

6. Additional energy use for smooth top range option - 1%.(65,132)

7. Energy use for microwave ovens - 190 kWh.(78)

8. Electric range energy reduction for customers with microwave ovens is estimated at 35%.(65)

9. 3% energy reduction for electric ranges based on the DOE's efficiency improvement target.(50)

10. All removal units up to 1988 at 700 kWh.

Table R-V summarizes the electric range forecast.

The high range projects an average usage in 1988 of 710 kWh/unit compared to 688 kWh/unit for the low range and 700 kWh for the base case.

RANGE ANALYSIS

YR	YR END UNITS	AVG UNITS ON LN	NEW UNITS	REPLC MKT	REPLC UNITS	TOTAL UNITS SOLD	KWH AVG UNIT SOLD	TOTAL ADDL MMKWH	MMKWH REMOVED	KWH/UNIT REMOVED	TOTAL MMKWH	AVG KWH ON LN	AVG D.U.	% SAT
77	424.7	421.0	7.5	20.8	20.8	28.3	699	19.0	13.5	702	294.6	700	1156	36.42
78	432.7	428.7	8.0	24.8	24.8	32.8	700	21.4	16.0	702	300.0	700	1166	36.77
79	441.7	437.2	9.0	24.3	24.3	33.3	700	23.1	17.2	701	305.9	700	1175	37.20
80	452.7	447.2	11.0	26.3	26.3	37.3	700	24.7	17.7	700	312.9	700	1186	37.71
81	465.7	459.2	13.0	29.8	29.8	42.8	700	28.0	19.7	701	321.3	700	1199	38.30
82	481.7	473.7	16.0	26.4	26.4	42.4	700	29.8	19.7	701	331.4	700	1214	39.02
83	497.7	489.7	16.0	30.4	30.4	46.4	700	31.1	19.9	701	342.6	700	1230	39.81
84	513.7	505.7	16.0	30.4	30.4	46.4	700	32.5	21.3	701	353.8	700	1246	40.60
85	529.7	521.7	16.0	27.6	27.6	43.6	700	31.5	20.3	700	365.0	700	1260	41.40
86	545.7	537.7	16.0	29.9	29.9	45.9	700	31.3	20.1	699	376.2	700	1274	[illegible]
87	561.7	553.7	16.0	32.6	32.6	48.6	700	33.1	21.9	699	387.5	700	1287	43.03
88	576.7	569.2	15.0	35.4	35.4	50.4	700	34.7	23.8	700	398.3	700	1299	43.83

Table R-V

R & F Dept.
September 1978

ELECTRIC DRYERS

I. SATURATION GROWTH

Clothes dryers are classified as pivotal appliances since the energy used to dry the clothes (electric versus gas) is in many cases determined by the type of energy used to heat the home. In the new construction market, the "pivotal appliance rule" is normally always true; a gas heated home will normally have a gas dryer and an electrically heated home will normally have an electric dryer. The question remains, what type of dryer would an oil heated home install? If a gas main is nearby, as is true in the city of Philadelphia, then a gas dryer can be easily installed; however, if a gas main is not locally available, as is true in many areas of the suburbs, then an electric dryer is the most likely option. At this point, other economic conditions are applicable, i.e. electric dryers normally cost less to buy but cost more to operate. Other factors such as availability of gas supply, customer preferences and ease of installation all affect a consumer's choice.

From 1960 to 1970, the saturation of electric dryers for the Philadelphia area grew from 13.2%(90) to 25.8%(29), an annual growth rate of 6.9%. PECO's 1977 survey measured an electric dryer saturation of 34.5% for a 17 year annual growth rate of 5.8%.(75) Applying this historical growth rate to 1988 yields a saturation of 64.1% as compared to PECO's forecasted value of 47.8%, which represents an annual growth rate of only 3.0%. The historical growth rate from 1970 to 1977 was 4.2%.

Chart R-13 displays the historical saturation growth for the Philadelphia area and PECO's projected growth for the forecasted period. In addition, this figure indicates historical and projected saturation from other reports and studies.

Merchandising reports the national growth of electric and gas dryers grew from 15% in 1958 to nearly 60% by 1977. Electric dryers grew from 13% in 1958 to 40% in 1977(103) for an annual growth rate of 6.1% compared to PECO's comparative value of 5.8%. Stanford Research Institute reports an annual growth rate from 1960 to 1969 of 8.5%(77) which is significantly higher than Merchandising's statistics would support.

Arthur D. Little reports that electric dryer saturation in 1970 was 30%(48) compared to the calculated value of 27.5% taken from Merchandising's data and PECO's area value of 25.8%. For 1990, ADL projects an electric dryer saturation of 60% compared to PECO's estimation of 49%. For the period 1970 to 1990, ADL's annual growth factor is 3.5% compared to PECO's value of 3.3%.

Also shown on Chart R-13 is Dr. Williams saturation projection for New York City. From 1970 to 1990, Dr. Williams' annual growth rate is 4.5%(55), which is about one-third higher than PECO's Philadelphia area projection.

As with other appliances, a further check to substantiate the 1988 projection is to compare the saturation growth of electric dryers to each type of living unit, i.e. apartments versus houses. PECO's 1977 survey indicates the existing saturation of all dryers (gas and electric) by housing type to be:

	Total	Electric	Gas
Apartments	21.6%	15.9%	5.7%
Houses	64.5%	37.9%	26.6%
Total	58.1%	34.5%	23.6%

By 1988, the PECO forecast projects the saturation of apartments with electric dryers to grow to 19%. For houses, 55% are expected to have electric dryers yielding a total saturation of 47.5%.*

The high range for 1988 projects a saturation of 54% compared to 43% for the low range.

---

*Apartments: 21% X 1,298,700 X .19 = 51,800
Houses: 79% X 1,298,700 X .55 = 564,300
616,100 ÷ 1,298,700 = 47.4%

SATURATION GROWTH - ELECTRIC DRYERS

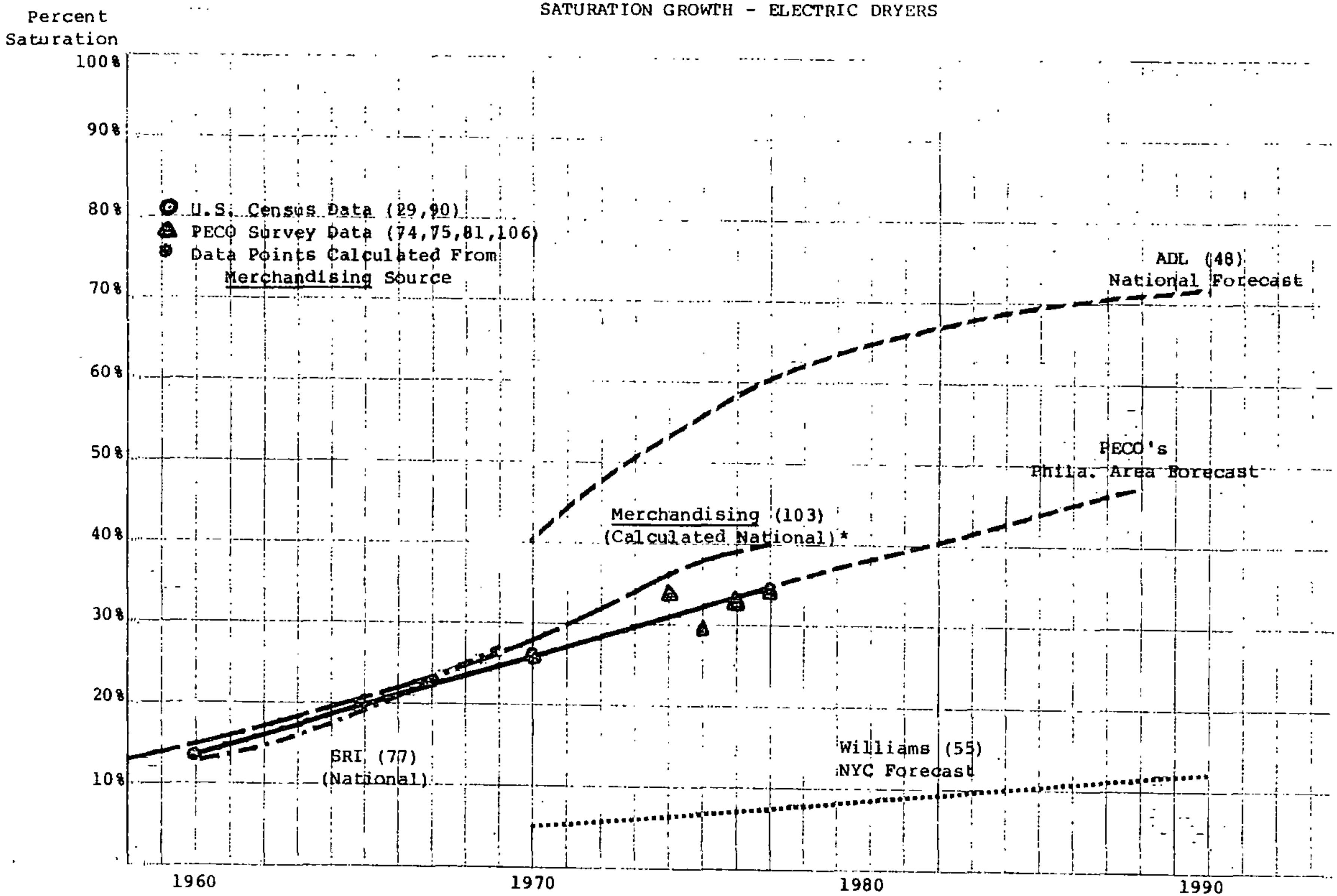


CHART R-13

II. ENERGY USAGE

Unlike appliances, such as refrigerators and freezers where the energy usage is controlled more by automatic controls (thermostats) than by the customer's living habits or desires, use of the electric dryer often depends on customer motivation toward saving energy and reducing energy costs. In recent years (post 1973), the energy conservation ethic has increased substantially but, due to the absence of extensive individual appliance load studies, it is uncertain what effect conservation has had on the electric dryer. Conversely, there are changing employment patterns, in which the labor participation rate is steadily increasing and is expected to further increase in the future as more women enter the work force. It could be expected that increased usage by this class of customer could cancel the conservation efforts of the more cost conscious customer. Because of the uncertainty of the various possibilities, the PECO model does not project reduced use but does assume the use of more efficient dryers as projected by the DOE.(61)

Stanford Research Institute estimated the average usage of electric dryers to have increased from 960 kWh/year in 1960 to 990 kWh/unit in 1968. ADL projects new electric dryer usage to be 996 kWh/unit for the entire period 1970 to 1990. ADL states, "No net efficiency increase is projected for electric dryers."(48) Because of this assumption, ADL's average usage is increased from 938 kWh/year in 1970 to 967 kWh/unit by 1990. Dr. Williams' study estimates electric dryer usage for new units to be 1,000 kWh/year for all units sold up to 1975 decreasing to 940 kWh by 1980 for a 6% reduction due to increased dryer efficiency.

PECO's forecast projects an historical usage factor of 990 kWh/unit (for new units and average units alike), up to 1977. Starting in 1978, PECO estimates that new dryer usage will decline to the 950 kWh level by 1981 and thereafter hold constant. This reduction is based on DOE's appliance efficiency improvement target which is equivalent to a 4% energy reduction as compared to 1972 energy use values.

Chart R-14 displays all the above estimations. Table R-VI summarizes the PECO electric dryer forecast.

For the high range, the average usage for units on line in 1988 is 975 kWh compared to 960 kWh for both the low range and base case.

ELECTRIC DRYERS

ENERGY USE - KWH PER UNIT

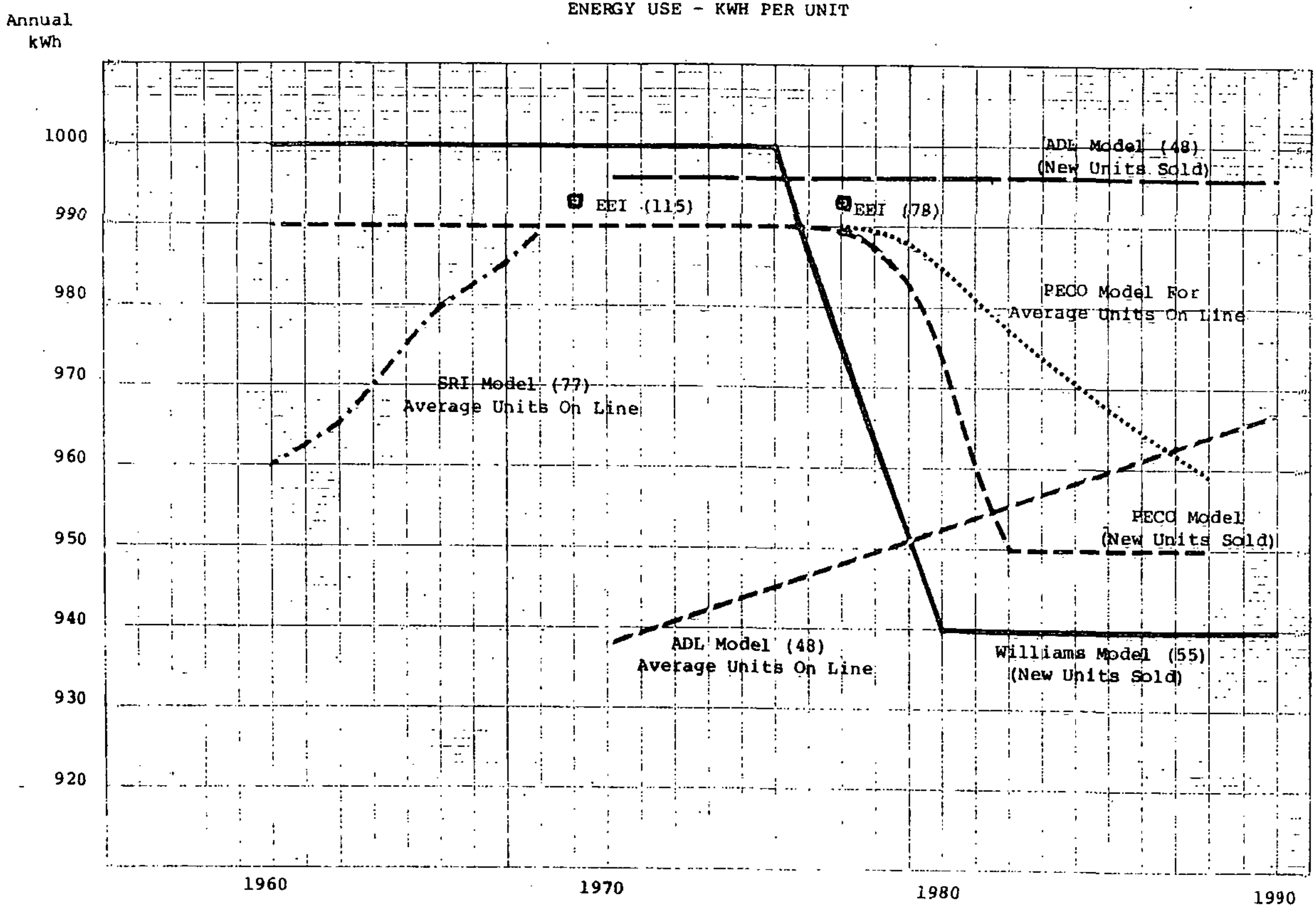


CHART R-14

DRYER ANALYSIS

YR	YR END UNITS	AVG UNITS ON LN	NEW UNITS	REPLC MKT	REPLC UNITS	TOTAL UNITS SOLD	KWH AVG UNIT SOLD	TOTAL ADDL MMKWH	MMKWH REMOVED	KWH/UNIT REMOVED	TOTAL MMKWH	AVG KWH ON LN	AVG U.U.	% SAT
77	412.4	397.3	30.2	16.0	16.0	46.2	988	39.6	15.8	987	393.3	990	1156	34.37
78	427.4	419.9	15.0	21.0	21.0	36.0	983	40.4	18.3	989	415.4	989	1166	36.02
79	444.4	435.9	17.0	24.9	24.9	41.9	974	37.9	22.8	991	430.6	988	1175	37.09
80	462.4	453.4	18.0	25.9	25.9	43.9	960	41.2	25.2	990	446.6	985	1186	38.23
81	481.4	471.9	19.0	32.9	32.9	51.9	950	45.5	29.1	990	463.1	981	1199	39.36
82	501.4	491.4	20.0	32.6	32.6	52.6	950	49.7	32.5	991	480.3	977	1214	40.47
83	522.4	511.9	21.0	27.7	27.7	48.7	950	48.1	29.9	990	498.6	974	1230	41.61
84	543.4	532.9	21.0	32.1	32.1	53.1	950	48.4	29.6	990	517.3	971	1246	42.78
85	564.4	553.9	21.0	36.1	36.1	57.1	950	52.4	33.8	990	535.9	968	1260	43.96
86	585.4	574.9	21.0	38.2	38.2	59.2	950	55.3	36.8	989	554.5	964	1273	45.13
87	605.4	595.4	20.0	33.2	33.2	53.2	950	53.4	35.4	990	572.5	962	1287	46.27
88	623.7	614.7	18.5	27.7	27.7	46.2	950	47.2	30.2	990	587.6	959	1299	[illegible]

107

Table R-VI

R & F Dept.
September 1978

TELEVISION

I. SATURATION GROWTH

Nearly every household in the Philadelphia area has at least one television set. The 1977 PECO Survey measured a total saturation of 180% (i.e. 180 TV sets per 100 households).(75) Assuming the saturation of TV sets is relatively constant, the average number on line in 1976 was 2,060,000. From 1965 to 1976, the Electrical Association of Philadelphia reports that 45.2% of the TV sets sold were color resulting in a calculated number of color sets on line of 932,500* and 1,127,500 black and white sets.(83) Merchandising reports that 72.3% of households in the Mid-Atlantic states have at least one color set. Assuming the Philadelphia area to have a similar saturation would result in 830,000 households with color sets and 102,500 households with two color sets (assuming negligible households have more than two color sets). Therefore, for 1976, the saturation of households with one color set is 63.4% and 8.9% with two color sets. With 99% of Philadelphia households having televisions, 26.7% have only black and white sets (99% less 72.3%).

The PECO model projects the saturation of households with at least one color set will increase from 75% in 1977 to 91% by 1988 for an annual growth rate of 1.8%. This is in comparison to the 12.0% growth rate measured by Merchandising, for the Mid-Atlantic region, for the period 1970-1977 (36% to 75%). The PECO model also projects the saturation of households with black and white TV sets will decline from 71% in 1976 to 46% by 1988.

The ADL study forecasts the national saturation of households with color TV will increase to 98% by 1990 while black and white sets will decline to 85%. ADL also projects the total saturation of TV sets will increase from 150% in 1970 to 183% (98% plus 85%) by 1990(48) compared to PECO's model projection of no growth.

Dr. Williams in his forecast for New York City forecasts a 1990 color TV saturation of 89% from a base of 35% in 1970.

All three forecasts, high, low and base, all project a saturation of 180%.

---

*Calculation based on a twelve year life span for color and black and white sets.

II. ENERGY USE

Energy use for televisions, unlike other major appliances, cannot be directly calculated by taking the number of units on line multiplied by a "standard" energy consumption value per unit. The PECO model determines the number of primary and secondary - color and black and white TV sets. After determining the average wattage for each type of set, the energy consumption is calculated by multiplying the primary set's wattage value by 1,850 hours per year and the secondary set's wattage by 364 hours. Hours of use were based on the following data:

The Television Bureau of Advertising shows that A. C. Nielsen data for the first ten months of 1977 indicates the average household watched six hours and four minutes of TV per day (2,214 hours per year), only seven minutes less per day than in 1976.(134)

In a study by AEIC, conducted in 1973, the average annual viewing time was calculated at 2,097 hours(135), which would indicate a four year growth, when compared to the Nielsen report, of 117 hours - 1.4% per year. The PECO model only increases the hours of use for the primary color set from 1,850 hours in 1977 to 1,900 hours in 1988 for an annual growth rate of 0.7%, half the measured growth rate of the last four years. All other sets are maintained at the 1977 viewing hours.

The AEIC data indicates the viewing hours for the primary color TV set at 1,850 hours and about 400 hours for the second black and white set.

EEA's 1973 and EEI's 1977 guides indicate the average TV set is used 2,200 hours per year.(119,78)

The PECO model based its "primary" TV set use on the AEIC figure of 1,850 hours while the "secondary" set's usage was calculated at 364 hours, based on the difference between the Nielsen's report and the AEIC study (2,214 less 1,850).

The total energy consumption for televisions for the year 1976 was determined to be 550 million kWh, 265 kWh per set based on 2,060,000 sets. The average use per household based on a saturation of 180% was 477 kWh.

Dr. Williams in quoting values established by the Lawrence Berkeley Laboratory Appliance Study, calculated his energy forecast for new units sold using 150 watts for color sets and 75 watts for black and white sets.(55) Dr. Williams, using A. C. Nielsen data for New York City, used 2,370 hours of TV use for households with color sets and 2,000 hours for black and white TV households.

The PECO model assumes that all TV sets sold after 1976 are solid state. This assumption may slightly underestimate TV usage, since some TV hybrid units are still being sold in the retail market. Based on EEI's 1977 guide for solid state units, the average wattage used is 145 watts for color and 45 watts for black and white.

The DOE energy efficiency targets project an energy saving of 65% for black and white sets and 35% for color sets based on 1972 usage.(61) Excluding changing household TV viewing habits, if the DOE targets are applied to EEI's 1973 wattage guides for conventional TV units, the DOE's 1980 targets would be 195 watts for color sets and 56 watts for black and white sets.

Chart R-15 graphically displays the energy usage of the various color TV forecasts.

For the high range, the average usage per TV set in 1988 is 177 kWh compared to 167 kWh for the base case and 160 kWh for the low range.

COLOR TELEVISION

ENERGY USE - kWh PER UNIT

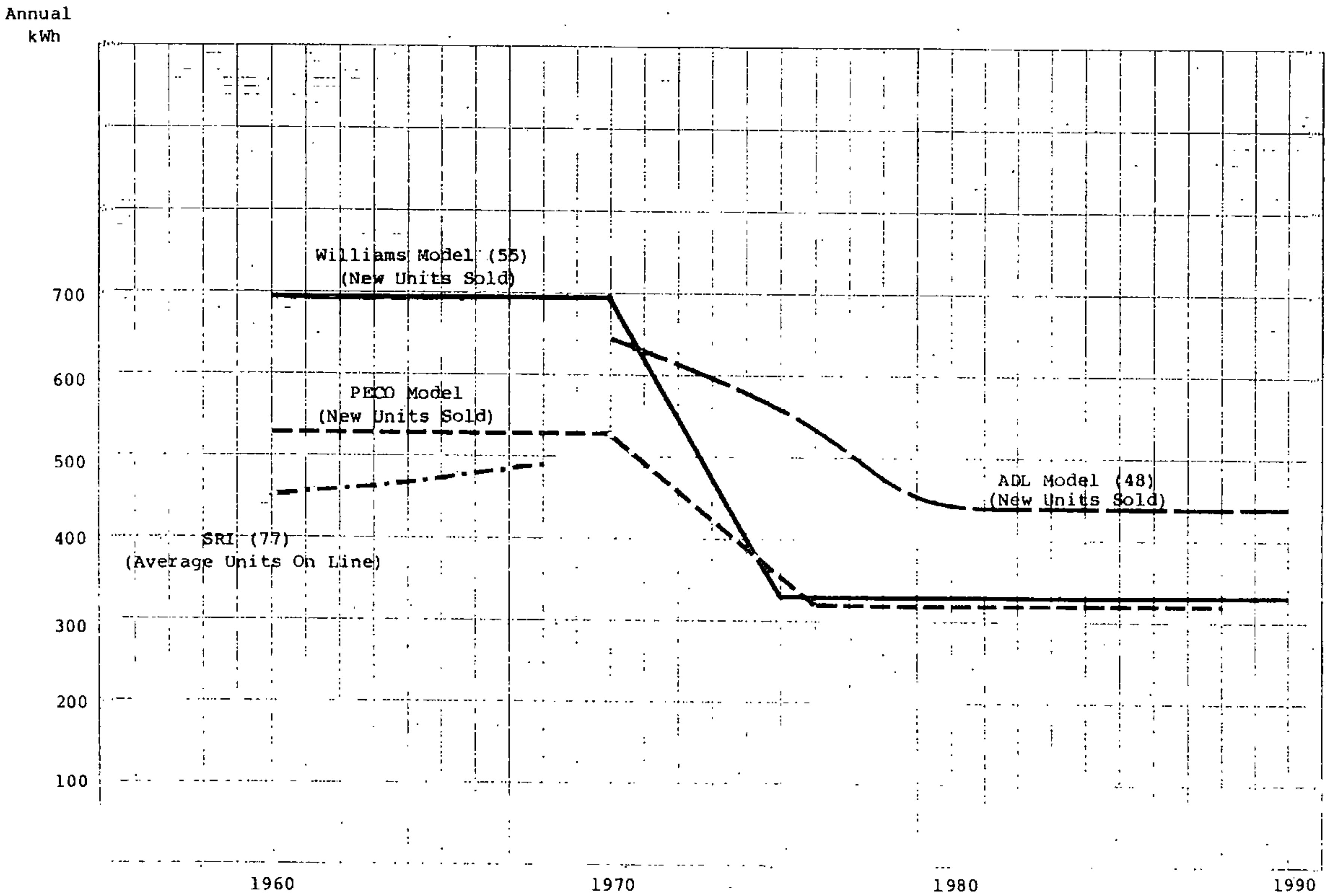


CHART R-15

DISHWASHERS

I. SATURATION GROWTH

Dishwasher saturation for the Philadelphia area, as reported by the U.S. Census, was 20.3% in 1970.(29) No census data is available for 1960. PECO's 1977 survey reports a saturation of 35.0% for a seven year annual growth rate of 8.1%. Merchandising reports the saturation on a national basis increased from 12% in 1960 to 41% in 1977 for a 17 year annual growth rate of 7.5% and an annual growth rate of 6.9% for the period 1970-1977. The Stanford Research Institute reports the historical growth rate from 1960 to 1969 was 5.8%.(77)

Arthur D. Little in their report states, "The saturation of dishwashers is expected to increase from 19% in 1970 to 80% in 1990. Virtually all new housing units will have dishwashers".(48) ADL's forecasted annual growth rate is 7.5%.

Dr. Williams projects that the saturation in New York City will increase from 14% in 1970 to 40% by 1990 for an annual growth rate of 5.4%.(55)

Applying Dr. Williams' and ADL's projected growth rates to PECO's 1977 measured saturation yields a 1988 saturation range of 62% to 78%. PECO's model projects a 1988 saturation of 49%; rather conservative when compared to ADL and Dr. Williams.

PECO's model calculates its forecasted saturation by adding 178,000 dishwashers in the new construction market and 50,000 additions in the existing housing market to the 404,000 existing units on line in 1977, for a total number of dishwashers on line in 1988 of 632,000; which equates to a 1988 saturation of 48.8%.

Chart R-16 displays the saturation growth projection of the various models.

The high range projects a 1988 saturation of 55% compared to 46% for the low range and 49% for the base case.

II. ENERGY USE

Dishwashers are classified as "discretionary use appliances". The use of a dishwasher can range from consistent use to save time and labor to spasmodic use for special occasions. As the cost of energy has increased, it is believed that use of this appliance may decrease or at least be modified so that less energy is consumed. The consumer has the option of using the dishwasher every other day instead of daily, or changing the usage pattern from the normal wash cycle to the short cycle, or eliminating the drying cycle by opening the dishwasher for air drying.

Stanford Research Institute estimated that the average energy consumption for dishwashers increased from 338 kWh in 1960 to 360 kWh in 1968. Dr. Williams projected the usage for new dishwashers to be a constant 275 kWh from 1960 to 1975 and then decreasing to 225 kWh by 1980 for a 18% reduction. ADL projects the average use will decline from 360 kWh in 1970 to 325 kWh by 1980 for a 10% reduction. ADL indicates, "The primary opportunity to save energy is to eliminate (or make optional) the heating/drying cycle, which accounts for about 30% of the energy used in a dishwasher". ADL further states that with the optional use of the drying cycle, "A 10% reduction in per unit energy consumption (can be accomplished) by 1990".(48)

Data Resources Incorporated (DRI) states the energy use for dishwashers will be reduced by 20% from 363 kWh in 1977 to 290 kWh by 1980.(68) DRI based this projection on FEA's appliance efficiency targets listed in the July 15, 1977 Federal Register.(50)

The PECO model projects a 16% reduction which is the average of the above three projections. Based on an initial usage value of 363 kWh(119), the 1981 value is 305 kWh; 20 kWh lower than ADL and 15 kWh higher than the DRI projection.

Chart R-17 displays the energy usage values of the various forecasts and Table R-VII represents the PECO dishwasher forecast.

The low range and base case both project a 1988 average on line usage of 311 kWh compared to 334 kWh for the high range.

DISHWASHERS

SATURATION GROWTH

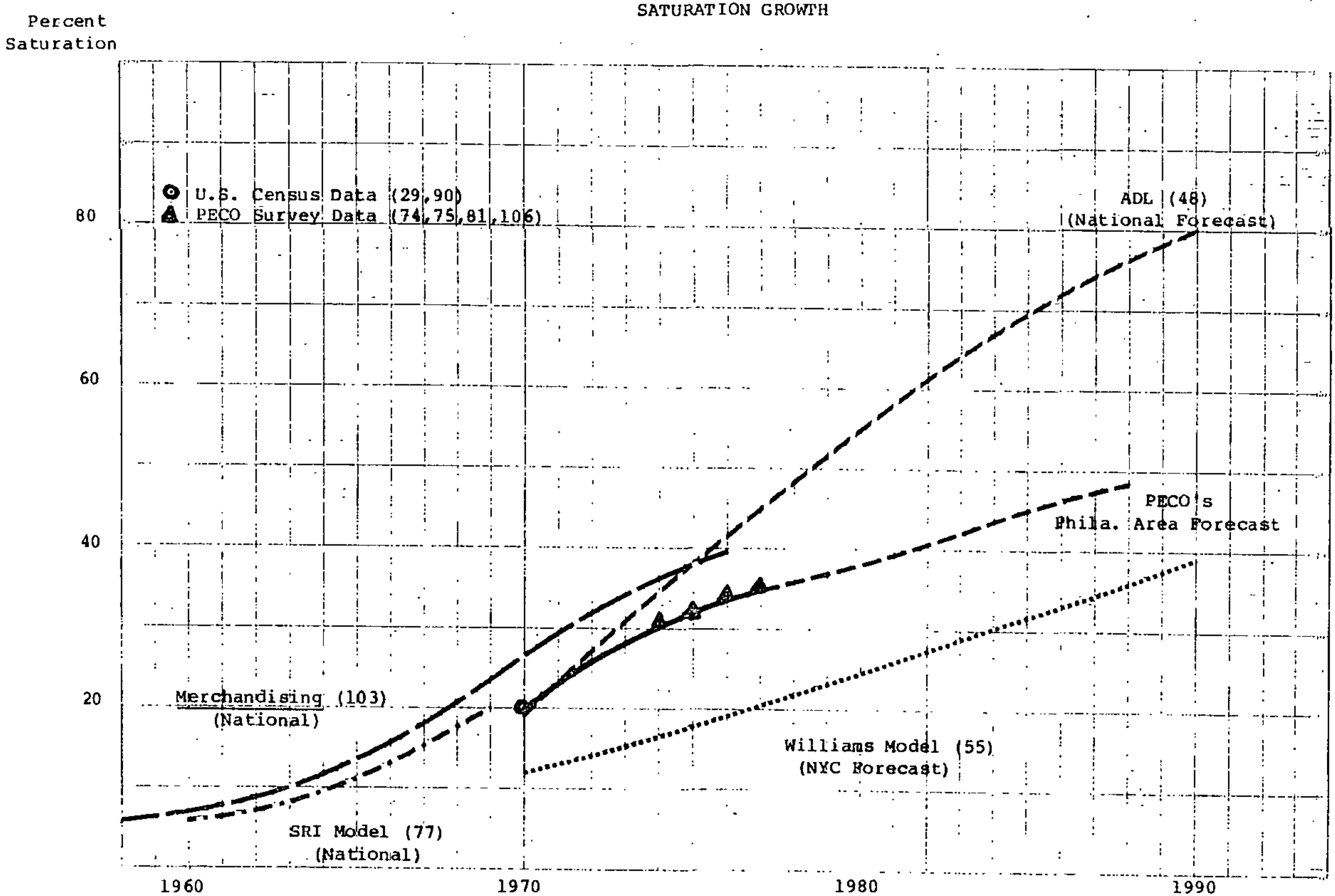


CHART R-16

DISHWASHERS

ENERGY USE - KWH PER UNIT

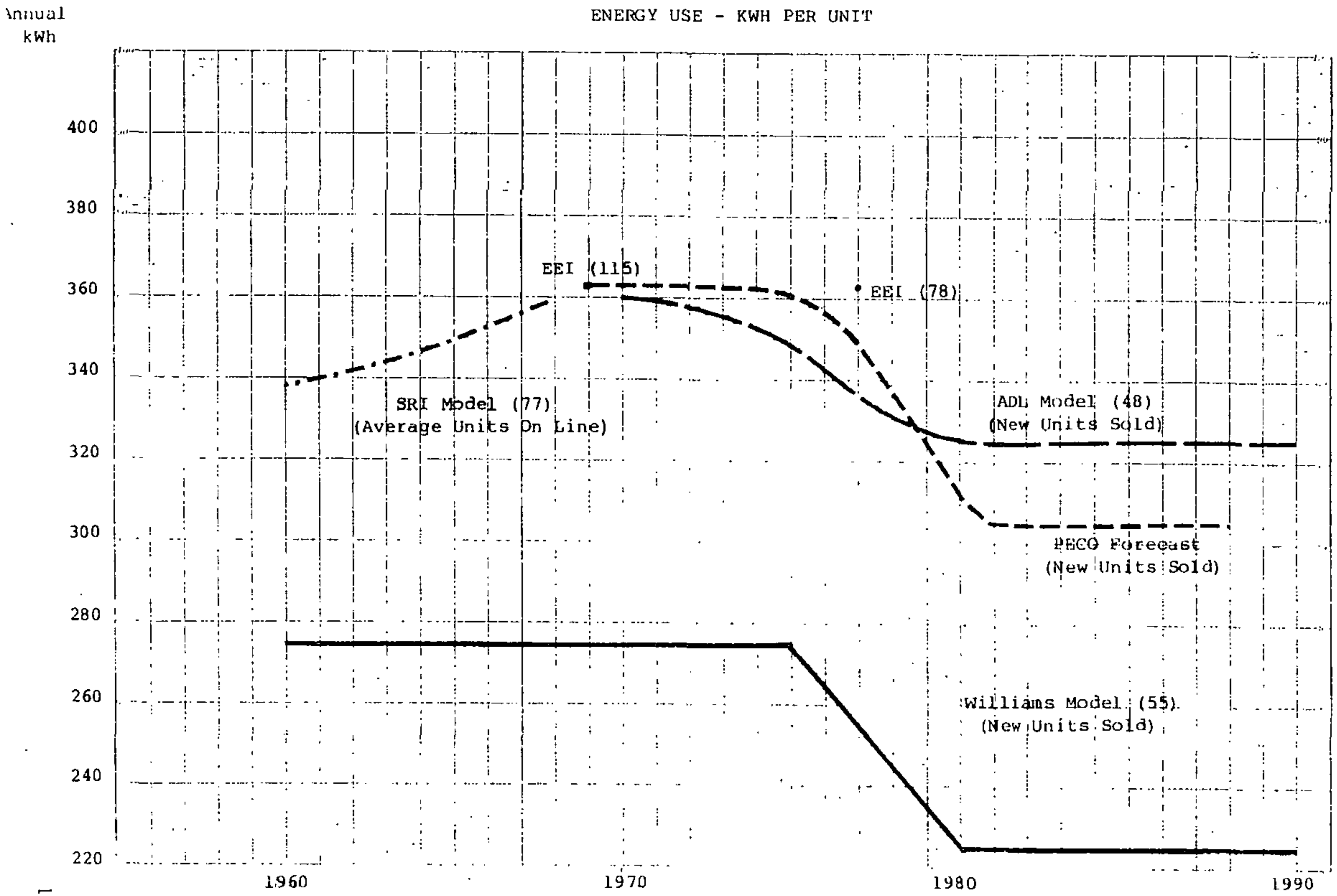


CHART R-17

DISHWASHER ANALYSIS

YR	YR END UNITS	AVG UNITS ON LN	NEW UNITS	REPLC MKT	REPLC UNITS	TOTAL UNITS SOLD	KWH AVG UNIT SOLD	TOTAL ADDL MMKWH	MMKWH REMOVED	KWH/UNIT REMOVED	TOTAL MMKWH	AVG KWH ON LN	AVG D.U.	% SAT
77	410.8	404.0	13.7	22.8	22,8	36.5	350	12.3	7.6	349	145.2	359	1156	34.95
78	425.3	418.1	14.5	30.1	30.1	44.6	339	13.8	9.4	353	149.6	358	1166	35.86
79	441.3	433.3	16.0	28.5	28.5	44.5	326	14.5	10.5	357	153.7	355	1175	36.86
80	460.3	450.8	19.0	32.1	32.1	51.1	311	14.9	10.9	360	157.7	350	1186	38.02
81	482.3	471.3	22.0	34.3	34.3	56.3	305	16.4	12.1	363	162.0	344	1199	39.31
82	506.3	494.3	24.0	34.1	34.1	58.1	305	17.4	12.5	364	167.0	338	1214	40.71
83	530.3	518.3	24.0	34.9	34.9	58.9	305	17.8	12.6	364	172.3	332	1230	42.13
84	554.3	542.3	24.0	39.6	39.6	63.6	305	18.7	13.6	364	177.4	327	1246	43.54
85	577.3	565.8	23.0	41.6	41.6	64.6	305	19.5	14.8	363	182.2	322	1260	44.90
86	599.3	588.3	22.0	35.4	35.4	57.4	305	18.6	14.0	364	186.8	317	1274	46.19
87	621.3	610.3	22.0	29.8	29.8	51.8	305	16.6	11.8	360	191.7	314	1287	47.43
88	642.3	631.8	21.0	33.9	33.9	54.9	305	16.3	11.3	355	196.6	311	1299	48.65

Table R-VII

R & F Dept.
September 1978

WATER HEATING

I. SATURATION GROWTH

Water heating customers are made up of households on Rates WH-Restricted (WHR), WH-Unrestricted (WHU), R and RH. Rates WHR and WHU are for individually metered water heating customers and comprised about 70% of all water heating customers on line in 1977. Rate RH water heating customers added another 20%. These customers are identified for rate schedule purposes, but their actual water heating usage is not separately metered. Rate R water heating customers make up less than 10%* of all water heating customers. There is no identification code for these customers because all water heating usage is metered as base load.

For the eleven year period, 1977 to 1988, PECO forecasts a gain of 108,000 electric water heating customers. Of this number, 94,000 (87%) will be on Rate RH with a vast majority coming from the new construction electric heating market. The other 14,000 will be oil heated living units with electric hot water on one of the other three rates - WHR, WHU or R. No new construction with gas space heating is projected to install electric water heating.

In 1976, 79% or 2,200 new construction development units with oil furnaces installed electric water heating with 37% (800 units) connected on Rate R.(91) In 1977, 86% or 2,000 units with oil furnaces installed electric water heaters with 600 units on Rate R.(92)

In recent years, there has been a steady increase in the number of unrestricted water heating customers. For the five year period ending December 31, 1977, the WHU customers grew by 4,400 customers. For the eleven year forecast period, PECO projects this class of customers to increase by another 7,900 units for an annual increase of 720 units. For the twelve month period ending September 1978, 1,129 unrestricted customers were added.

For the restricted water heating class, PECO projects an increase from the 100,800 customer level in December 1977 to 101,400 level in 1981 and then a decrease to the 98,800 level in 1988. This decrease is due to the conversion of oil heated living units with electric water heaters to Rate RH and a loss of some living units with electric water heating to demolitions.

In the last five years, WHR customers have only increased about 1,600 units.

For the high range, PECO projects a 1988 saturation of 25% compared to 20% for the base case and 19% for the low range.

---

*This estimation is based on customer survey data and there is a high probability of error since some customers on Rate R may identify their gas or oil water heater as electric. Builder contractor surveys conducted in 1976 and 1977 indicate that 12% and 15% of all new construction development units have electric water heating on Rate R.(91,92)

II. ENERGY USAGE

Of all the major appliances, the projection of water heating usage is the most difficult. For example, WHU customers use about 40% more hot water than WHR customers. Why? Are there more people per household, more children, more clothes washers, more dishwashers or do WHU customers have the same number of clothes washers and dishwashers but just use them more? With the introduction of the DOE efficiency targets for 1980, appliances will use less energy but how these targets will affect PECO water heating usage is a matter of conjecture.

ASSUMPTIONS FOR HOT WATER USAGE

Since the DOE is applying its energy efficiency targets to 1972 usage values, the PECO model attempts first to develop water heating usage by appliance application and by rate category. Once this is accomplished, the DOE targets are utilized to estimate water heating usage for new units sold after 1979.

The following assumptions are applicable to all categories:

140°F. water output temperature(136,137,138,139)
55°F. water input temperature(136,137,138)
83% water heater efficiency(136,137,138)

1972 USAGE FOR RESTRICTED WATER HEATING CUSTOMERS - WHR

<u>Domestic Use</u>

3.13 people per household (PECO population model - general population)
72.5 gallons of hot water per person per week(137)

$$\text{kWh Output Usage} = \frac{72.5 \times 3.13 \times 52 \times 8.34^{*} \times (140 - 55)}{3{,}412.8} = 2{,}451 \text{ kWh/Year}$$

kWh Input @ 83% Efficiency = 2,953 kWh/Year

*Pounds/Gallon of Water

Dishwasher Use

15.0 gallons hot water/event(137,140)
6 events/week (PECO assumption)*

$$\text{kWh Output Usage} = \frac{15 \times 6 \times 52 \times 8.34 \times (140 - 55)}{3{,}412.8} = 972 \text{ kWh/Year}$$

kWh Input @ 83% Efficiency = 1,171 kWh/Year

Clothes Washer Usage

4 hot cycle washes per week (PECO assumption)**
2 warm cycle washes per week (PECO assumption)**
Hot cycle uses 24 gallons of hot water(137)
Warm cycle uses 11 gallons of hot water(137)

$$\text{kWh Output Usage} = \frac{(4(24) + 2(11)) \times 52 \times 8.34 \times (140 - 55)}{3{,}412.8} = 1{,}275 \text{ kWh/Year}$$

kWh Input @ 83% Efficiency = 1,536 kWh/Year

Applying PECO's saturation estimate for all electric customers to the Rate WHR class results in the following water heating usage per water heating customer:

Domestic Use	100.0% X 2,953 kWh =	2,953 kWh/Customer
Clothes Washer	75.5% X 1,536 kWh =	1,160 kWh/Customer
Dishwasher	25.5% X 1,171 kWh =	298 kWh/Customer
		4,411 kWh/Customer

Since the actual 1972 usage for this class was 4,405 kWh, the assumptions are believed to be justified pending additional research.

*ADL assumes 7 events/week but this was believed to be too high an average.
**ADL indicates a total of 6 cycles per week (3 hot and 3 warm).(137)

Using the same method, the hot water usage for unrestricted water heating customers is:

$$\text{Domestic} = \frac{72.5 \text{ X } 4.2 \text{ people/household X } 52 \text{ X } 8.34 \text{ X } (150 - 55)}{3,412.8} = 3,676 \text{ kWh/Year}$$

kWh Input @ 83% Efficiency = 4,429 kWh/Year

$$\text{Dishwasher} = \frac{15 \text{ X } 7 \text{ X } 52 \text{ X } 8.34 \text{ X } (150 - 55)}{3,412.8} = 1,268 \text{ kWh/Year}$$

kWh Input @ 83% Efficiency = 1,527 kWh/Year

$$\text{Clothes Washer} = \frac{(5(24) + 3(11)) \text{ X } 52 \text{ X } 8.34 \text{ X } (150 - 55)}{3,412.8} = 1,847 \text{ kWh/Year}$$

kWh Input @ 83% Efficiency = 2,225 kWh/Year

Average use per WHU customer:

Domestic Use	100.0% X 4,429 kWh =	4,429 kWh/Year
Dishwasher	25.3% X 1,527 kWh =	389 kWh/Year
Clothes Washer	75.5% X 2,225 kWh =	1,680 kWh/Year
		6,498 kWh/Year

Actual water heating usage for WHU customers in 1972 was 6,466 kWh which validates the general assumption.

To further test the water heating values, they were applied to the 1976* appliance saturations with the following results:

WHR Customers

Domestic Use	100.0% X 2,953 kWh =	2,953 kWh/Year
Dishwasher	33.4% X 1,171 kWh =	391 kWh/Year
Clothes Washer	78.0% X 1,536 kWh =	1,198 kWh/Year
		4,542 kWh/Year

*1976 was selected as a test year since it was not affected by changes in billing procedures as was true for 1977.

Actual water heating usage for WHR customers for 1976 was 4,461 kWh, or about 1.8% less than the calculated value. This decrease appears to be acceptable considering the conservation efforts our customers have been taking. However, when the change in the number of people per household is considered (down 5.8%), some questions arise as to the real impact this variable has on water heating usage. Of course, the appliance saturation figures that were used for WHR customers might be much lower than the average of all water heating customers (gas, oil and electric). If the saturation of dishwashers and clothes washers were increasing at a faster rate for WHR customers than their household size was decreasing, then more hot water would be used. These unknown factors could affect future forecasted values.

A similar test for WHU customers indicated a calculated value of 6,675 kWh/water heater compared to an actual value of 6,225 kWh* for an error of 7.2%. If the decrease in household size was applied to the calculated value, the error would be reduced to 1.0%.

APPLICATION OF DOE EFFICIENCY TARGETS

Clothes Washers

According to the FEA standards*, the energy use of a clothes washer in 1972 was .198 loads/kWh or 5.05 kWh/load.(50) This value includes both the use of the clothes washer and the energy consumed to heat the water used by the washer. Assuming six loads per week, the FEA annual usage would be 1,576 kWh less 103 kWh** for the washer resulting in a water heating use of 1,473 kWh, compared to PECO's 1,536 kWh value calculated for WHR customers.

FEA's 1980 target is 3.44 kWh/load or 1,073 kWh, less 103 kWh for the clothes washer's motor, which totals 970 kWh for a 34% reduction of hot water usage. This reduction is due to the elimination of the warm rinse cycle and a reduced warm temperature setting. PECO has accepted these targets. However, additional research is necessary to insure customer acceptance and applicability. If PECO customers are already using cold water rinse cycles, or even a higher percentage of total cold water washes than the FEA calculations account for, then it is possible that the PECO water heating forecast has been decreased too much.

---

*As of the date of the preparation of this material, the DOE standard has not been published for clothes washers.

**PECO usage value.

Dishwashers

According to the DOE standards, the energy use of a dishwasher in 1972 was 4.15 kWh/load.(61) This value includes both the use of the dishwasher and the energy consumed to heat the water used by the dishwasher. Assuming six loads per unit, the DOE annual usage would be 1,295 kWh/year less 363 kWh* for the dishwasher motor and drying cycle resulting in a water heating use of 932 kWh, compared to PECO's 1,171 kWh value calculated for WHR customers. For PECO's calculated consumption to equal the DOE value of 921 kWh, it would require a reduction of 3.1 gallons of hot water/wash cycle or a reduction in the temperature of the water from 140°F. to 123°F.

DOE's 1980 target is 3.32 kWh/load or 1,037 kWh/year based on six loads per week. Subtracting the anticipated 1980 dishwasher usage of 305 kWh (for motor and drying), yields a water heating consumption value of 732 kWh or a 21.5% reduction. This reduction is due to an improved fill control (3.9% energy savings), the elimination of one rinse cycle (5.6% savings) and a change in the geometry of the unit, which would reduce the hot water consumption to 12.5 gallons of hot water (savings not identified by DOE). Again, PECO has accepted these targets; however additional research is necessary to insure customer acceptance and applicability.

Domestic Use

No specific technical reductions were listed by DOE; however customers have already been made aware of the savings obtainable from such things as switching from tub baths to showers, and even to using low flow shower heads in place of standard shower heads. The latter modification can reduce the amount of hot water used by as much as 50%.(141,142,143) Since these potential savings are a result of changing customer habits and not merely mandated technological changes, one can only speculate as to their use and effect on energy consumption. By the year 1988, the PECO model projects a 5% reduction for domestic usage. This reduction approximates the percent change in the size of households.

Water Heater Efficiency

According to the FEA targets**, the energy savings for an electric water heater are estimated to be 15%, an increase from 80% in 1972 to 95% in 1980. These savings are due to increased or improved insulation (8%), reduced thermostat settings (6%) and the introduction of a heat trap (2%). Again, one can only speculate as to the acceptance of reduced temperature settings.

---

*PECO usage value.
**As of the date of the preparation of this material, the DOE targets have not been published.

Applying the above potential energy savings to the 1972 PECO appliance values results in the following energy consumptions for units sold in 1980 for customers on Rate WHR.

Rate WHR	1972 Output Water Htg. Usage (kWh)	Energy Reduction	1980 Output Water Htg. Usage (kWh)	1980 Water Htr. Efficiency Factor*	1980 Input Water Htg. Usage (kWh)
Dishwasher	972	21.5%	763	1.024	781
Clothes Washer	1,275	34.0%	842	1.024	862
Domestic	2,451	None	2,451	1.024	2,510
	4,698**				4,153

The maximum potential energy savings, assuming 100% saturation of dishwashers and clothes washers, would equal 4,153/5,660 or 26.6%.

From 1980 to 1988, 125,000 dishwashers are forecasted to be added in the customer categories WHR, WHJ and R. Of the 400,000 dishwashers on line in 1979, 75%*** or 300,000 will be replaced leaving 100,000 pre-1980 units on line. Based on these estimations, the weighted hot water use of a dishwasher for Rate WHR would be:

$$\frac{100{,}000 \text{ X } 972 \text{ kWh/Unit} + 425{,}000 \text{ X } 763 \text{ kWh/Unit}}{525{,}000} = 805 \text{ kWh}$$

For the same period, 80,000 clothes washers are projected to be added. Of the 875,000 clothes washers on line in 1979, 75%*** or 660,000 units will be replaced leaving 215,000 pre-1980 units on line. Based on these estimations, the weighted hot water use of a clothes washer for Rate WHR would be:

$$\frac{215{,}000 \text{ X } 1{,}275 \text{ kWh} + 740{,}000 \text{ (842 kWh)}}{955{,}000} = 939 \text{ kWh}$$

Domestic usage in 1988 is 2,451 kWh X 95% = 2,324 kWh.

*1972 water heater efficiency factor times FEA energy reduction estimate (1/.83) X .85 = 1.024

**1972 input is 4,698/.83 = 5,660 kWh/Year

***This value is based on a twelve year life span. Of the units on line in 1979, approximately 9/12ths will be replaced by 1988.

To determine the effect of increased water heater efficiency on water heater use, a weighted water heater efficiency factor was developed for 1988 between the new high efficient water heaters and the older less efficient units still on line. From 1980 to 1988, it is estimated that 10,000 water heaters would be added to the non-RH customer categories. Of the 126,000 water heaters on line in 1979, 45%* or 57,000 units will be replaced leaving 69,000 pre-1980 units on line. Based on these estimates, the weighted water heater efficiency for Rate WHR would be:

$$\frac{69,000\ (83\%) + 67,000\ (95\%)}{137,000} = 89\%$$

Based on these factors, Rate WHR usage per customer in 1988 (again assuming the same saturation of dishwashers and clothes washers as are forecasted for all Rate R customers) would be:

Dishwasher	45.2% X	803 =	363	kWh
Clothes Washer	81.0% X	939 =	761	kWh
Domestic Use	100.0% X	2,324 =	2,324	kWh
			3,448	kWh Output

kWh Input @ 89% Efficiency = 3,870 kWh/Year

The following is a comparison of water heating usage on a per customer basis for the years 1978 and 1988:

	1978	1988	Percent Change
Rate WHR*	4,548 kWh	3,870 kWh	-14.9%
Rate WHU	6,280 kWh	5,346 kWh	-14.9%
Rate R**	4,548 kWh	3,870 kWh	-14.9%
Rate RH	5,110 kWh	4,048 kWh	-20.8%
Total All Rates	4,790 kWh	4,057 kWh	-15.3%

For the high range, PECO projects the average usage for all rate classes at 4,905 kWh/water heater compared to 4,040 kWh/unit for the low range.

*This value is based on a 20 year life span. Of the units on line in 1979, 9/20ths will be replaced by 1988.

**The PECO model estimates the hot water usage for customers on Rate R to equal customers' usage on Rate WHR. Should the usage characteristics of Rate R customers be closer to Rate WHU customers, future PECO energy projections would be too low.

OTHER MAJOR APPLIANCES

Dehumidifiers, clothes washers, supplementary heating and heating auxiliaries are classified as "other major appliances". These appliances do not contribute significantly, if at all, to summer demand peaks. For that reason, the PECO model does not attempt to develop historical data which was necessary for the major appliances.

DEHUMIDIFIERS

I. SATURATION GROWTH

This appliance, used primarily in basements (76.5%), is normally found in the suburban single home as compared to the row home or apartment. In the 1977 PECO survey, dehumidifier saturation was measured at the 15% level with a 23% saturation in single homes and 5% in row and multi-family living units. The PECO model projects a 1988 saturation of 19% with a 29% saturation in single homes and 7% in the other building types. The low growth is due to the characteristics involved in the ownership of this appliance, namely the desire to increase the comfort of a recreational room or to protect family items that are stored in basements. Also, some forecasters believe that as central air conditioning expands, the summertime usage of basements will decline negating the use of dehumidifiers. Also, some environmental engineers believe that central air conditioning assists in maintaining a low humidity level in basements again negating the need to use a dehumidifier.

The high range projects a 1988 saturation of 24% compared to 19% for the base case and 18% for the low range.

II. ENERGY USAGE

The 1977 EEI Appliance Usage Guide indicates a dehumidifier use of 337 kWh/year(78), identical to EEA's 1969's value.(119) The PECO model accepts this recommendation for 1977 and applies the DOE's efficiency improvement target of 16%(61) to be applicable for new and replacement units sold in 1980 and thereafter. Table R-VIII indicates the PECO forecast for dehumidifiers.

All three forecast ranges project a 1988 usage of 335 kWh.

DEHUMIDIFIER ANALYSIS

YR	YR END UNITS	AVG UNITS ON LN	NEW UNITS	REPLC MKT	REPLC UNITS	TOTAL UNITS SOLD	KWH AVG UNIT SOLD	TOTAL ADDL MMKWH	MMKWH REMOVED	KWH/UNIT REMOVED	TOTAL MMKWH	AVG KWH ON LN	AVG D.U.	% SAT
77	165.0	163.5	3.1	9.8	9.8	12.9	374	5.4	4.4	378	61.6	377	1156	14.14
78	170.0	167.5	5.0	6.1	6.1	11.1	363	4.4	3.0	377	62.9	376	1166	14.37
79	176.5	173.3	6.5	4.2	4.2	10.7	341	3.7	2.0	379	64.7	373	1175	14.74
80	184.0	180.3	7.5	4.4	4.4	11.9	322	3.6	1.7	384	66.7	370	1186	15.20
81	192.5	188.3	8.5	4.0	4.0	12.5	317	3.9	1.6	381	68.9	366	1199	15.70
82	201.5	197.0	9.0	6.2	6.2	15.2	317	4.4	1.9	373	71.4	363	1214	16.25
83	211.0	206.3	9.5	10.7	10.7	20.2	317	5.6	3.2	373	73.9	358	1230	16.77
84	220.5	215.8	9.5	11.1	11.1	20.6	317	6.5	4.1	376	76.2	353	1246	17.32
85	229.5	225.0	9.0	11.3	11.3	20.3	317	6.5	4.3	379	78.5	349	1260	17.86
86	237.5	233.5	8.0	12.6	12.6	20.6	317	6.5	4.6	381	80.4	344	1274	18.33
87	244.5	241.0	7.0	21.0	21.0	28.0	317	7.7	6.4	378	81.7	339	1287	18.73
88	250.5	247.5	6.0	12.9	12.9	18.9	317	7.4	6.4	378	82.8	334	1299	19.06

Table R-VIII

R & F Dept.
September 1978

CLOTHES WASHERS

I. SATURATION GROWTH

The saturation of clothes washers declined from 77.4% of all households on line in 1960(90) to 73.7% in 1970.(29) The 1977 PECO Survey measured a saturation of 79.9% for all Rate R and RH customers. The 1988 projection is 83.1% with a saturation of 95% in single and row houses and 39% in apartments, as compared to 88% and 39% respectively for 1977. No growth is projected for the apartment market.

The high range projects a 1988 saturation of 85% compared to 78% for the low range.

II. ENERGY USAGE

The 1969 and 1977 EEI Appliance Guides indicated clothes washer usage at 103 kWh for automatic types and 76 kWh for non-automatic washers. Based on the last eleven years of sales data from the Electrical Association of Philadelphia, 95.7% were automatic washers indicating an average usage value of 102 kWh.(83) All future sales are projected to be automatic clothes washers. Based on the DOE estimations, no efficiency improvements are projected other than that affecting water usage. Table R-IX indicates the PECO forecast for washers. All three forecasts project a 1988 usage of 103 kWh/washer.

SUPPLEMENTARY HEATING (INCLUDES PORTABLE AND AUXILIARY HEATERS)*

I. SATURATION GROWTH AND ENERGY USAGE

Little data is available, nationally or locally, for this appliance. The 1977 PECO Survey indicated the saturation in households on Rate R was 11.5%, with a majority of the units located in bathrooms and bedrooms. The total number of units per household was measured at 1.13 units.(75) Data concerning the average wattage per unit was not sought due to potential survey errors. Also, data concerning the usage habits was not determined.

The PECO forecast accepts the 11.5% saturation rate and assumes for 1977 an average use of 600 kWh per year per household. The latter figure is based on an average wattage of 1,000 and 600 hours use per year, which is slightly less than one-half of the normal hours used for a central heating system. For 1988, the forecast projects a saturation of 19.5% of Rate R households (17.4% of all households), and an average use of 575 kWh per Rate R household. Since a majority of supplemental heaters are already 100% efficient, the energy reduction factor is due to changing customer's habits and curtailments in use due to improved building insulation.

---

*Supplementary heaters are defined as electric heaters which are used to supplement existing fossil fuel heating systems, such as a portable electric heater in a cold bedroom. Auxiliary heaters are defined as units which are used as the sole heating system in a room where no other heating system is available, such as a baseboard unit or a window heat pump in a newly added room.

CLOTHES WASHER ANALYSIS

YR	YR END UNITS	AVG UNITS ON LN	NEW UNITS	REPLC MKT	REPLC UNITS	TOTAL UNITS SOLD	KWH AVG UNIT SOLD	TOTAL ADDL MMKWH	MMKWH REMOVED	KWH/UNIT REMOVED	TOTAL MMKWH	AVG KWH ON LN	AVG B.D.	% SAT
77	902.8	902.7	3.6	84.7	81.3	84.9	103	8.5	8.2	100	92.4	102	1156	78.10
78	909.8	906.3	7.0	87.5	87.5	94.5	103	9.2	8.7	100	92.9	103	1166	77.74
79	919.8	914.8	10.0	83.9	83.9	93.9	103	9.7	8.7	101	94.0	103	1175	77.83
80	932.8	926.3	13.0	86.3	86.3	99.3	103	9.9	8.6	101	95.3	103	1186	78.11
81	947.8	940.3	15.0	81.7	81.7	96.7	103	10.1	8.5	101	96.9	103	1199	78.44
82	965.8	956.8	18.0	81.5	81.5	99.5	103	10.1	8.3	102	98.7	103	1214	78.81
83	985.8	975.8	20.0	77.9	77.9	97.9	103	10.2	9.1	102	100.8	103	1230	79.32
84	1006.8	996.3	21.0	92.1	92.1	113.1	103	10.9	8.7	102	103.0	103	1246	79.98
85	1028.8	1017.8	22.0	85.5	85.5	107.5	103	11.3	9.1	102	105.2	103	1260	80.78
86	1050.3	1039.6	21.5	80.1	80.1	101.6	103	10.8	8.5	103	107.5	103	1274	81.61
87	1070.3	1060.3	20.0	66.4	66.4	86.4	103	9.7	7.5	102	109.7	103	1287	82.40
88	1087.3	1078.8	17.0	79.7	79.7	96.7	103	9.4	7.5	103	111.6	103	1299	83.07

Table R-IX

R & F Dept.
September 1978

HEATING AUXILIARIES

I. SATURATION GROWTH

The PECO model assumes that all households without electric space heating are heated with either a central plant forced air system or a central plant boiler system.

A few systems on line may still be natural draft or gravity systems or even self-ventilating systems. In the future, such gravity systems will be removed as older units are either replaced with forced systems or are completely abandoned. The gain in such sales would be minimal.

II. ENERGY USAGE

The energy usage for 1977 is based on 340 kWh for a gas heating system and 510 kWh for a fuel oil system*. Based on the results of the 1977 PECO Survey, the weighted average for heating auxiliaries is 419 kWh. By 1988 this value is reduced by 5% to account for smaller units coming on line and better insulated homes. For reference, EEI's 1977 Guide estimates a furnace fan usage value of 650 kWh based on 500 watts of connected load.(78) EEI's usage is based on 1,300 hours of operation which is equivalent to the PECO estimate for heating usage.

The low range and base case both project a 1988 usage of 400 kWh/unit while the high range projects 419 kWh/unit.

*These values were obtained from a report prepared by the Applications Department of PECO.(45)

TRANSPORTATION - ELECTRIC

I. SATURATION GROWTH

Of all the appliance applications, the estimated growth of electric vehicles (EV's) is by far the most speculative. The one saving factor is that since battery recharging will be made during the evening hours, the effect of electric vehicles will be to increase PECO's daily load factors and not add additional load to the generating peak.(144)

The Delaware Valley Regional Planning Commission (DVRPC) projects an automobile per capita ownership rate for the year 2000 of .45.(145) Applying this rate to PECO's 2000 population forecast of 4 million, results in an automobile projection of 1.8* million cars. In EPRI's EV study, they project for 2000 an 11.6% EV penetration for both New York and Chicago.(146) Applying this penetration to PECO's total auto projection of 1.8 million yields a PECO EV forecast of 209,000. When compared to EPRI's projection for the following four cities, it would appear that PECO's forecast may be somewhat low.

New York - 1,180,000 electric automobiles; Los Angeles - 1,040,000 electric automobiles; Chicago - 724,000 electric automobiles; Washington, DC - 311,000 electric automobiles. It is noted that the Washington projection is based on an EV penetration of 9.2%.

The major problem (assuming the year 2000 forecast is adequate) is the development of the growth curve necessary to estimate the annual penetration of electric vehicles. For 1978, PECO estimates that there are probably less than fifty electric cars that are charged on Rates R or RH. PECO estimates that no real electric car sales will be realized until 1985, when the zinc-chlorine battery should be available. This assumption is in line with EPRI's pessimistic scenario. By 1988, PECO projects 43,000 electric cars for a household penetration of 3.2%. By 1990, PECO projects 71,000 EV's which is about 3.7% of EPRI's 1.9 million national pessimistic scenario for 1990. A Federal Power Commission survey, published in a 1978 Lead Industries Association paper, reports a 1990 forecast of 38 million electric vehicles(147), substantially larger than EPRI's forecast. On the conservative side, SRI International projects 1990 EV sales at only 60,000 vehicles while annual sales in 2000 will grow to 600,000 EV units for an estimated total on line of 2½ to 3 million units(148), roughly one-quarter of EPRI's estimate.

Finally, in a survey conducted by the EV Council in 1976, it was determined that 42% of the respondents said they would be interested in an electric car.(149) Also, big city residents indicated a higher interest rate than rural areas. This latter factor would add support to PECO's forecast.

---

*DVRPC year 2000 planning program, published in December 1977, confirms this auto ownership projection.

II. ENERGY USAGE

Many estimates have been made regarding the eventual total electric usage of electric cars. Long Island Lighting Company is presently using two $3,000 electric citicars, which are sub-compact, two seaters. Both of these 1,200 pound cars average .3 kWh/mile. The NCR Company in their test program had similar results.(147) The citicar is described by Mr. William Simmons, the Auto Editor of the Philadelphia Inquirer, as "...little more than an enclosed golf cart"*. Mr. Edward A. Campbell, executive secretary of the Electric Vehicle Council reports the electric usage of an electric car will average about 5,000 kWh/year.(151) Mr. Jalal T. Salihi of EPA suggests an average of .64 kWh/mile or 6,440 kWh/year.(152) In a recent advertisement by EVA/Chloride Corporation of Cleveland, they state an average energy consumption of .6 kWh/mile for their two-door "Change of Pace" electric car.(153)

The 1978 EPRI study projects, for the year 2000, an annual usage in the range of 4,330 kWh for electric cars in Los Angeles to 4,575 kWh for Washington, DC. New York and Chicago are both estimated to use 4,480 kWh/year. These estimations were based on the size of vehicles presently being used in these cities. EPRI's average kWh/mile ratio decreased from .52 in 1980 to .47 in 2000 with the average annual mileage in the 9,500 range.(146)

PECO's forecast projects an annual use in 1981 of 2,000 kWh/car increasing to 4,500 kWh/vehicle in 1989 and kept constant thereafter. These values were based on assumptions that early electric cars would be of the two seater "Citicar" type using about 7,000 miles/year (19 miles/day) at 0.3 kWh/mile. Later models would be using about 9,000 miles/year at 0.5 kWh/mile. This latter figure is equivalent to EPRI's study.

---

*This description was repeated by the Wall Street Journal.(150)

LIGHTING

I. SATURATION GROWTH

All living units are projected to have lighting load.

II. ENERGY USAGE

In Dr. Williams' study for New York City, he states, "Acquiring lighting usage data requires rewiring houses to place all lighting on special monitored circuits and is thus very expensive. Since we are unaware of any more recent information, we have relied on ... 1959 data." Dr. Williams projects that from 1959 to 1970, lighting usage per household grew by 1.8% per year for a 1970 lighting load of 661 kWh/year/household.* Based on data obtained from General Electric, Dr. Williams states that GE's estimated lighting use for 1973 is 1,130 kWh per household.(55)

For 1968, the Stanford Research Institute estimates 730 kWh/year of lighting load. This was based on assuming an average household used five 100 watt bulbs burning four hours per day. The ADL study estimates that the average lighting consumption per household in 1970 was 760 kWh.(77)

In PECO's view, these estimates are no longer valid. In fact, Dr. Williams in his study strongly suggests that lighting usage was substantially reduced in 1974 and 1975. PECO survey data also supports Dr. Williams' conclusion. It appears that as a conservation measure, lighting curtailments have been those most used and most visible.(75,82,154) The following lighting estimates were made by PECO for 1977.

Standard Time	Lighting Wattage and Daily Use		
Months - 183 Days	Single Homes	Row Homes	Apartments
Living Room	250 Watts @ 5 Hrs.	200 Watts @ 5 Hrs.	150 Watts @ 5 Hrs.
Kitchen	100 Watts @ 2 Hrs.	100 Watts @ 2 Hrs.	75 Watts @ 2 Hrs.
Master Bedroom	200 Watts @ 1 Hr.	175 Watts @ 1 Hr.	150 Watts @ 1 Hr.
Additional Bedrooms	200 Watts @ 1 Hr.	150 Watts @ 1 Hr.	100 Watts @ 1 Hr.
Miscellaneous	100 Watts @ 1 Hr.	100 Watts @ 1 Hr.	50 Watts @ 1 Hr.
Exterior Lighting	75 Watts @ 2 Hrs.	50 Watts @ 2 Hrs.	None
Daylight Saving Time Months - 182 Days (assumes about a 50% reduction)			
Estimated Energy Use Per Year	575 kWh	464 kWh	330 kWh

---

*Based on an average size household of 891 square feet and 2.77 people per household.

Based on the estimated breakdown of the housing mix on line, the average lighting kWh/household in 1977 would be:

(.519 X 575) + (.309 X 465) + (.172 X 330) = 500 kWh/household

Based on the assumption that the average existing single home is 1,300 square feet, a row home is 1,000 square feet and an apartment is 800 square feet; the average living unit size would be 1,120 square feet.

(.519 X 1,300) + (.309 X 1,000) + (.172 X 800) = 1,120 square feet

This estimate compares favorably to Dr. Williams' 1973 national estimate of 1,185 square feet*. PECO's 1977 total lighting use per square foot is .446 kWh/square foot (500/1,120), compared to Dr. Williams' value of .74 kWh/square feet for 1970.

Based on conversations with our field personnel and local building contractors, the PECO model projects new construction at the following rates: single homes 1,500 square feet, townhouses 1,200 square feet and apartments 900 square feet. These are conservatively low estimates and additional study is needed to adequately measure actual home sizes (see the Residential New Construction Section).

Based on new construction additions and losses due to abandonments, the average size home in 1988 is 1,130 square feet compared to 1,120 square feet in 1977. Based on a constant interior lighting load of .421 kWh/square foot**, the interior lighting forecast for 1988 is 476 kWh compared to 472 kWh for 1977.

1,130 square feet X .421 kWh/square foot = 476 kWh/household

Because of the growing awareness of security lighting and the positive effect increased lighting has in decreasing crime, the PECO forecast estimates that by 1988 the use of exterior lighting will grow from 28 kWh/year to 49 kWh/year.

Based on these factors, the 1988 PECO forecast for lighting is 525 kWh/household. The total kWh/household per square foot value is .465 which is 4% higher than our 1977 estimate and 37% below Dr. Williams' forecasted value. ADL's forecast for 1990 is 760 kWh per household, which is 45% higher than PECO's forecasted value.

---

*ADL estimates for 1970 a national household average of 1,196 square feet increasing to 1,240 square feet in 1990.

**500 kWh/household of total lighting less 28 kWh/household of exterior lighting. Interior lighting load equals 472/1,120 = .421 kWh/square foot.

One factor not considered in PECO's forecast is the potential effect of increased lighting efficiency due to the introduction of one or more of the high efficiency lighting sources. The PECO model does not believe that any significant advances will be made in this area for the following reasons:

The Duro-Test Corporation has indicated that their energy-saving bulb should be available in 1979. Mr. Lawrence Johnson, Duro-Test vice president, is quoted by the Philadelphia Bulletin, "A 100-watt bulb with the new coating would consume approximately 40 watts of electricity while still maintaining the light output of a conventional 100-watt bulb".(155) Duro-Test indicated the cost of the bulb would be ten times the cost of an ordinary bulb.

Without any data on the life span of Duro-Test's bulb, it is impossible to calculate the cost effectiveness of their claims; however the Killer Watt Corporation of Los Angeles has recently introduced their Killer Watt fluorescent bulb which, with an adapter, can be used in any incandescent lamp*. Killer Watt's 125-watt bulb, which uses only 44 watts of power (as per their advertising literature), costs $32.88.(156) Killer Watt claims an eight year bulb life as compared to a six month life of a conventional bulb. It is difficult to believe that many people will be willing to spend $33 for a single 125-watt light bulb. PECO's cost analysis indicates a payback period of six years and three months assuming the cost of money is zero. If the cost of money is included, there is no payback.

Finally, there has been much discussion regarding the Holister Litek bulb. This bulb is still being developed in the laboratory and is not projected to be in the marketplace before 1982. Again, this bulb is projected to cost about $10.

Based on the facts at hand, PECO does not believe that any significant number of low energy bulbs will be in the market during the forecast period ending in 1988. It is also noted that the DOE standards also omits any mention of a high efficiency incandescent bulb.

---

*Assuming there is sufficient physical room for the circular type bulb.

MISCELLANEOUS APPLIANCES

This category includes all those appliances not specifically described in the other categories and those future appliances not yet invented or introduced to the public.

ENERGY GROWTH

In 1968, Stanford Research Institute had estimated an annual consumption of 320 kWh/household.(77) The ADL study indicated a 1970 miscellaneous usage of 469 kWh/household.(48) For 1977, PECO's model estimates a miscellaneous usage of 480 kWh.

For the future, PECO projects a growth rate of 4.8% per year per household. When calculated on the same basis as the ADL study, both projections equal a growth rate of 3.5% per year.

This "appliance category" includes the multitude of small appliances from electric clocks to all the various kitchen and general use appliances such as food mixers, hedge trimers and hair dryers. Reginald H. Jones, Chairman of General Electric, stated that 45% of GE's houseware sales in 1976 came from products that were not offered ten years ago. By 1987, Mr. Jones projected that as much as 60% of GE sales will come from products not now in production.(102)

Some of these "potential growth products" are: Electronic TV games, TV video recorders, ultra-wide TV home theaters, home computer centers, microwave ranges, an ever expanding number of new kitchen appliances and a host of new personal comfort and entertainment items.(157,158) Also included in this category are those appliances not yet invented or introduced to the public.

SINGLE-POINT METERED APARTMENTS

For the period 1979 to 1981, this market segment was projected to produce an additional 3,000 living units, all in the electric heat new construction category. Because of possible future DOE or PUC restrictions, the increased utility charges to HT customers and desire by developers to transfer utility costs to apartment renters, no further construction growth was anticipated in this market.

CONOWINGO POWER COMPANY

New construction for the 1979-88 period is estimated to average 500 units with the electric heat market averaging approximately 400 units per year. These judgments are based on an analysis of Conowingo Power Company records, opinions supplied by representatives of that district and a review of Cecil County Community Economics Report. No specific range forecasts were made for this PECO subsidiary.

The following is a summary of the tables and charts in the residential section. The tables are in reverse numerical order so as to better portray the actual preparation sequence of the forecasts from the development of population projections through new construction and the development of appliance saturations and usage parameters.

TABLE SUMMARY

Table R-XXXVI shows the relationship of dwelling units on system to total population and female population.

Table R-XXXV shows the population statistics on which Philadelphia Electric Company housing totals are based.

Table R-XXXIV is a summary of the housing activity through the forecast period.

Table R-XXXIII lists total housing anticipated to be on system during each forecast year.

Table R-XXVIII, R-XXIX, R-XXX, R-XXXI and R-XXXII show the estimated new construction and electric space heating breakdown of apartments, detached houses and townhouses by Philadelphia, suburbs and Conowingo.

Table R-XXVII segments the electric heating connections between heat pumps and resistance type heating systems.

Table R-XXVI shows details of the projected electric space heating market for conversion from other fuels, including the estimated number of heating units due for replacement each year based on past construction data.

Table R-XXV combines electric heat new construction and conversion data for annual units added along with heat pump projections, as the basis for developing kWh values. Heat pumps are treated separately because the kWh values are lower than those for units with resistance heat.

Table R-XXIV indicates a comparison of housing starts, demolitions and abandonments, electric heating penetration for new construction and the number of electric heat conversions for the forecast periods of 1979-1988 and 1989-1998 for the base, low and high ranges.

Table R-XXIII provides single-point metered apartment projections from material furnished by Business Services. The load associated with these living units is included in the Commercial and Industrial sales category. Living unit projections are subtracted from total dwelling unit requirements to obtain Rate R customers (R, RM, RH and WH).

Table R-XXII shows residential air conditioning data and projections for residences on R rates (R, RH, RM).

Table R-XXI provides room cooler projections for all rates.

Table R-XX gives central plant projections for all rates as well as the total connected air conditioning load on the system. The material on the above three tables is described more fully in the separate "Air Conditioning" material covered earlier in this section.

Table R-XIX indicates for R rates for 1978, 1988 and 1998 the comparison of air conditioning data (average kW/unit and average hours use for room coolers and central units) for the three forecasts - base, low and high.

Table R-XVIII shows use projections by appliances and applications for R rates (R, RH, RM) for the system. This forms the main basis for the residential forecast. The data and estimates establishing each use are described previously.

Table R-XVII indicates the penetration for each appliance for 1978, and the low, base and high ranges for 1988 and 1998.

Tables R-X, R-XI, R-XII, R-XIII, R-XV and R-XVI sum up the total use for R, RH, RM and WH for System, Company and Conowingo. Table R-XIV summarizes the high and low ranges for System. These tables also show numbers of customers and average use. Space heating and air conditioning components of consumption are shown on Tables R-X and R-XIV for System.

SUMMARY CHARTS

Chart R-18 indicates the electric use of the residential markets from 1968 to 1977 and projects the forecast to 1988 for base case.

Chart R-19 graphs residential electric usage by appliance class for base case.

Charts R-20 and R-21 display the population pyramids for males and females by age groups for 1977 and 1998 as developed from the Census Bureau's 1970 data projected to 1976.

Chart R-22 shows the historical change in natural birth rates from 1925 to present and the projection of the three current Census Bureau's birth rates. All three forecasts use Series II birth rates.

LIST OF REFERENCES

1. U.S. Department of Commerce, Bureau of the Census, General Population Characteristics, Pennsylvania: 1970 Census of Population. PC(1)-B40, October 1971.

2. U.S. Department of Commerce, Bureau of the Census, General Population Characteristics, Maryland: 1970 Census of Population. PC(1)-B22, October 1971.

3. U.S. Department of Commerce, Bureau of the Census, Guide for Local Area Population Projections, by Richard Irwin, Technical Paper No. 39, July 1977.

4. Oak Ridge Associated Universities, Population Forecasting for Small Areas, Conf-7505142, Oak Ridge, Tennessee, May 5-6, 1975.

5. U.S. Department of Commerce, Bureau of the Census, Population Estimates and Projections. Series P-25, No. 704, July 1977.

6. U.S. Department of Commerce, Bureau of the Census, Population Estimates and Projections. Series P-25, No. 601, October 1975.

7. U.S. Department of Health, Education and Welfare, Trends in Fertility in the United States. DHEW Publication No. (HRA) 78-1906, September 1977.

8. U.S. Department of Commerce, Bureau of the Census, Current Population Reports. Series P-26, 1976.

9. U.S. Department of Commerce, Bureau of the Census, Current Population Reports. Series P-26, 1975.

10. U.S. Department of Commerce, Bureau of the Census, Current Population Reports. Series P-26, 1974.

11. U.S. Department of Agriculture, Economic Research Service, Net Migration of the Population, 1960-70 by Age, Sex and Color, by Gladys K. Bowles, Calvin L. Beale and Everett S. Lee. University of Georgia Printing Department, December 1975.

12. U.S. Department of Commerce, Bureau of the Census, Current Population Reports. Series P-25, Table No. 1, p. 105.

13. U.S. Department of Commerce, Bureau of the Census, Current Population Reports. Series P-20, p. 21.

14. U.S. Department of Labor, Employment and Training Administration, Why Families Move, by Julie Davanzo of the Rand Corporation, 1977.

15. Maryland Center for Health Statistics, Department of Health and Mental Hygiene, Maryland Population Estimates. Baltimore, Maryland, June 1977.

16. Delaware Valley Data Bulletin, "1976 Population Estimates for the Delaware Valley Region," Table No. 1, June 1978. (Mimeographed.)

17. Commonwealth of Pennsylvania, Office of State Planning and Development, Summary Report. Report No. 78 PPS-1, June 1978.

18. Pennsylvania Department of Education, Bureau of Information Systems, Population Projection for Pennsylvania and Counties 1970-2000. By John Senier, Division of Research, September 1975.

19. Delaware Valley Regional Planning Commission, "Year 2000 Land Use and Open Space Plan." (Typewritten), Chapters 2, 3 and 4, October 1978.

20. Applied Business Research Institute, PECO/WEFA Residential Consumption Model. Wyndmoor, Pennsylvania, October 1978.

21. Bucks County Planning Commission, "Bucks County Population Projections," revised January 1978. (Mimeographed.)

22. Chester County Planning Commission, "Population Estimates," 1977. (Mimeographed.)

23. Delaware County Planning Commission, "Population Projections," November 1976. (Mimeographed.)

24. Philadelphia City Planning Commission, "Population Projections," August 1978. (Mimeographed.)

25. U.S. Department of Commerce, Bureau of the Census, Current Population Reports. Series P-20, No. 313, September 1977.

26. The Conference Board, A Guide to Consumer Markets 1976/1977. New York, 1976, p. 63.

27. U.S. Department of Commerce, Bureau of the Census, Annual Housing Survey. Series H-170-75-33, August 1977.

28. U.S. Department of Commerce, Bureau of the Census, Social Indicators 1976. Federal Statistical System, December 1977.

29. U.S. Department of Commerce, Bureau of the Census, 1970 Census of Housing: General Housing Characteristics Pennsylvania. HC(1)-A40 Pa., September 1971.

30. U.S. Department of Commerce, Bureau of the Census, 1970 Census of Housing: Detailed Housing Characteristics Maryland. HC(1)-B22 Md., April 1972.

31. Electrical World, "29th Annual Electrical Industry Forecast." Electrical World, September 15, 1978, pp. 61-76.

32. Business Fortnight, "More Households, Fewer People." Business Fortnight, May 31, 1978, p. 16.

33. Argus Research Corporation, "The American Evolution - Implications for Investment." Weekly Staff Report, Vol. 45, No. 44, October 30, 1978.

34. William M. Bulkeley, "Raising the Roof," Wall Street Journal, July 27, 1978.

35. Argus Research Corporation, "Let the Builder be Wary," Weekly Staff Report, Vol. 45, No. 26, June 26, 1978.

36. Business Week, "Mortgage Money is Drying Up," Business Week, July 3, 1978, p. 19.

37. Business Week, "The Building Slump that hasn't Happened." Business Week, August 28, 1978, pp. 29-30.

38. Department of Licenses and Inspections, Philadelphia, "Annual Building Construction Reports," 1960-1977. (Mimeographed.)

39. Delaware County Planning Commission, "Housing Tenure," 1978. (Mimeographed.)

40. U.S. Department of Commerce, Bureau of the Census, Housing Units Authorized for Demolition in Permit-Issuing Places: 1975, Construction Reports C45-1975, April 1976.

41. U.S. Department of Commerce, Economic Development Administration, Bridges to the Future: Forces Impacting Urban Economics. Research Report, 1978, pp. 2-31.

42. U.S. Department of Commerce, Bureau of the Census, Current Housing Reports. Series H-111-76-4, February 1977.

43. Aaron Sabghir, "The New Construction Outlook for 1978." U.S. Department of Commerce, Construction Report, February 1978, pp. 4-5.

44. Pennsylvania Public Utility Commission, "Final Report - Generic Rate Structure Investigation," Harrisburg, Pa., December 1977. (Mimeographed.)

45. Philadelphia Electric Company, "Residential Space Heating Comparison." Applications Department Report, January 1978. (Typewritten.)

46. Philadelphia Electric Company, "Residential #2 Oil - Average Price." Applications Department Report, March 1978. (Typewritten.)

47. Philadelphia Electric Company, "Residential Heat Pump Study in Conjunction with Electric Power Research Institute." Applications Department Report, October 6, 1977. (Mimeographed.)

48. Federal Energy Adminstration, Council on Environmental Quality, Project Independence. Task Force Report - Energy Conservation, Vol. 1, November 1974.

49. Eric Hirst and James B. Kurish, Residential Energy Use to the Year 2000: A Regional Analysis. Oak Ridge National Laboratory, November 1977.

50. Federal Energy Adminstration, "Energy Conservation Program for Appliances." Federal Register, Vol. 42, No. 136, July 15, 1977.

51. Electric Power Research Institute, Load and Use Characteristics of Electric Heat Pumps in Single-Family Residences. EA-793, Vol. I, Research Project 432-1, June 1978.

52. Northeast Utilities, Consumer Research Section, "Residential Heating System Alternatives." Hartford, Ct., March 1978. (Mimeographed.)

53. Richard E. Fuhrman, prepared testimony given before the State of New York Public Service Commission, in the matter of CASE 80003, New York City, 1977. (Mimeographed.)

54. Philadelphia Electric Company, "Residential Market Summary." Sales Analysis Report, August 1978. (Mimeographed.)

55. R. Williams, report prepared for the New York Public Service Commission by the Center for Environmental Studies, Princeton, N.J., Vol. 4, 1977. (Mimeographed.)

56. Appliance Manufacturer, "Better Economic Times." Appliance Manufacturer, April 1978, pp. 67-101.

57. U.S. Department of Commerce, Bureau of the Census, Characteristics of New Housing: 1976. Construction Report, C25-76-13, July 1977.

58. Fabian Linden, "The Postwar Generation Comes of Age." The Conference Board Record, September 1976, pp. 10-13.

59. Appliance Manufacturer, "Who Are 'We', the American Consumer?" Appliance Manufacturer, April 1978, pp. 46-61.

60. A. N. and J. B. Wecksler, "Continued Growth for Appliances Seen by 'Outlook.'" Appliance Manufacturer, March 1978, p. 19.

61. Federal Energy Administration, "Energy Conservation Program for Appliances." Federal Register, Vol. 43, No. 70, April 11, 1978.

62. William Wingstedt, "In Memoriam." Appliance Manufacturer, Editorial, October 1976.

63. William Wingstedt, "No Easy." Appliance Manufacturer, September 1975, pp. 52-55.

64. Arnold P. Consdorf and Charles W. Behrens, "Appliance Energy Efficiency: The Trials of a Test." Appliance Manufacturer, March 1977, pp. 40-59.

65. Marilyn Doss Ruffin and Katherine S. Tippett, "Service Life Expectancy of Household Appliances: New Estimates from the USDA." Home Economics Research Journal, Vol. 3, No. 3, March 1975, pp. 159-170.

66. Duquesne Light Company, "The Expected Impact of FEA Appliance Efficiency Standards Upon Residential Electricity Sales and Peak Load." Study dated March 1978. (Mimeographed.)

67. Correspondence with Dr. L. Gunlogson of Carrier Corporation regarding air conditioning trends, August 30, 1977. (Typewritten.)

68. Consumer and Food Economics Institute Survey, July 1972, cited by the 1975 Handbook of Agricultural Charts, No. 491, Figure 93, p. 69.

69. Electric Power Research Institute, Efficient Electricity Use. Edited by Craig B. Smith, Pergamon Press, New York, 1976.

70. Merchandising, "Trendings." Merchandising, June 1977.

71. Robert T. Lund, "Making Products Live Longer." Technology Review, January 1977, pp. 49-55.

72. Federal Energy Administration, "Energy Conservation Program for Appliances." Federal Register, Vol. 42, No. 155, August 11, 1977.

73. Department of Energy, "Energy Conservation Program for Appliances." Federal Register, Vol. 43, No. 175, September 8, 1978.

74. Philadelphia Electric Company, "1977 Residential Appliance Saturation Survey." Research and Forecasting Department, April 1978. (Mimeographed.)

75. Philadelphia Electric Company, "Residential Appliance and Air Conditioning Survey Analysis September 1976 - Individually Metered Rates." Research and Forecasting Department, January 1977. (Mimeographed.)

76. The Electrical Association of Philadelphia, "Central Air Conditioner Sales Analysis 1977." March 1978. (Mimeographed.)

77. Stanford Research Institute, Patterns of Energy Consumption in the United States. Office of Science and Technology, U.S. Government Printing Office, Washington, DC, January 1972, pp. 33-62.

78. Edison Electric Institute, "Annual Energy Requirements of Electric Household Appliances." EEI-Pub., No. 75-61 rev. (Mimeographed.)

79. Merchandising, "The 10-Year Tables: Major Appliance Analysis." Merchandising, March 1978, p. 106.

80. Philadelphia Electric Company, "1972 Residential Air Conditioning Survey Analysis." Research and Forecasting Department, October 1972. (Mimeographed.)

81. Philadelphia Electric Company, "Residential Air Conditioning Survey Analysis." 1973 Spring and Fall Surveys by Research and Forecasting Department, November 1973. (Mimeographed.)

82. Philadelphia Electric Company, "1978 Residential Conservation Survey." Research and Forecasting Department, December 1978. (Mimeographed.)

83. The Electrical Association of Philadelphia, "Appliance Sales." Reports from 1968 to 1978. (Mimeographed.)

84. Philadelphia Electric Company, "An Econometric Model for Appliance Saturation." Research and Forecasting Department, October 1978. (Mimeographed.)

85. The Electrical Association of Philadelphia, "Room Air Conditioner Sales Analysis." March 1977. (Mimeographed.)

86. Association of Edison Illuminating Companies, "Report Of The Load Research Committee 1972-1973." May 1974, pp. L215, 245. (Mimeographed.)

87. Philadelphia Electric Company, "Residential Air Conditioning Room Cooler Usage Study." Research and Forecasting Department, November 1973. (Mimeographed.)

88. Philadelphia Electric Company, "Residential Air Conditioning Room Cooler Usage Study." Research and Forecasting Department, July 16, 1974. (Mimeographed.)

89. Philadelphia Electric Company, "1975 Residential Electric Service Load Study Air Conditioning Analysis." Research and Forecasting Department, December 1978. (Typewritten.)

90. U.S. Department of Commerce, Bureau of the Census, 1960 Census of Housing: Characteristics Pennsylvania. HC(1)-40B, April 1962.

91. Philadelphia Electric Company, "Residential New Construction Central Air Conditioning and Water Heating Analysis 1976." Research and Forecasting Department, July 1977. (Typewritten.)

92. Philadelphia Electric Company, "Residential New Construction Central Air Conditioning and Water Heating Analysis 1977." Research and Forecasting Department, August 1978. (Mimeographed.)

93. Association of Edison Illuminating Companies, "Report of the Load Research Committee 1965-1966." March 1967, p. L-186. (Mimeographed.)

94. Association of Edison Illuminating Companies, "Report of the Load Research Committee 1965-1966." March 1967, p. L-65. (Mimeographed.)

95. Association of Edison Illuminating Companies, "Report of the Load Research Committee 1966-1967." January 1968, p. L-95. (Mimeographed.)

96. Association of Edison Illuminating Companies, "Report of the Load Research Committee 1969-1970." January 1971, p. L-131. (Mimeographed.)

97. Association of Edison Illuminating Companies, "Report of the Load Research Committee 1974-1975." January 1976, p. L-7. (Mimeographed.)

98. Edison Electric Institute, "Air Conditioning Usage Study." Edison Electric Institute, Pub. No. 76-2, 1976.

99. R. R. McConnell, J. R. Tobias and L. W. Nelson, "Reducing Energy Consumption During the Cooling Season." ASHRAE Journal, June 1976, pp. 61-65.

100. Philadelphia Electric Company, "Residential Central Air Conditioning Usage August 1975 Versus August 1974." Research and Forecasting Department, September 1975. (Typewritten.)

101. Philadelphia Electric Company, "Residential Central Air Conditioning Study." Research and Forecasting Department, February 1976. (Typewritten.)

102. Merchandising, "10-Year Saturation Levels." Merchandising, March 1978, p. 58.

103. Merchandising, "Statistical and Marketing Report." Merchandising, March 1977, pp. 31-113.

104. Philadelphia Electric Company, Annual Report 1967. Philadelphia, PA, March 1968.

105. Philadelphia Electric Company, Annual Report 1975. Philadelphia, PA, March 1976.

106. National Analysts, "Study of Relationship between Electrical Usage and Household Income." Report for Philadelphia Electric Company, March 1976. (Mimeographed.)

107. Public Service Electric and Gas Company, "1976 Residential Electric and Gas Appliance Survey." Rates Department, July 1977. (Mimeographed.)

108. Pennsylvania Power and Light Company, "1975 Appliance Saturation Survey." Market Research Department, May 1977. (Mimeographed.)

109. Baltimore Gas and Electric Company, "1976 Appliance Survey." Consumer Research, March 1977. (Mimeographed.)

110. The Detroit Edison Company, "1976 Appliance Saturation Survey." Customer and Marketing Research, May 7, 1977. (Mimeographed.)

111. Consumers Power Company, "1975 Appliance Saturation Survey." Rate Research Department, June 1976. (Mimeographed.)

112. Robert A. Hoskins and Eric Hirst, Energy and Cost Analysis of Residential Refrigerators. Oak Ridge National Laboratory, January 1977.

113. Merchandising, "Forecast." Merchandising, May 1978, pp. 33-54.

114. Baltimore Gas and Electric Company, "Residential Customer Load Study Homes with Frost-Free Combination Refrigerator-Freezers." Consumer Research, July 1967. (Mimeographed.)

115. Edison Electric Institute, "Approximate Wattage Rating of Electrical Appliances." June 1969. (Typewritten.)

116. Consumer Bulletin, "Dishwashers, Refrigerators, Ranges." Consumer Bulletin Annual 1970, pp. 107-207.

117. Association of Edison Illuminating Companies, "Report Of The Load Research Committee 1972-73." May 1974. (Mimeographed.)

118. Consumer Bulletin, "Dishwashers, Refrigerators, Trash Disposers, Ranges." Consumer Bulletin Annual 1972, pp. 3-6.

119. Electric Energy Association, "Annual Energy Requirements of Electric Household Appliances." New York, 1973. (Mimeographed.)

120. Association of Home Appliance Manufacturers, 1975 Directory of Certified Refrigerator/Freezers. Chicago, IL, September 1975.

121. Consumers' Research Magazine, "Combination Refrigerator-Freezers with Top-Mounted Freezers." Consumers' Research Magazine, August 1976, pp. 7-14.

122. Consumers' Research Magazine, "Refrigerator-Freezer Combinations, Side-By-Side Models." Consumers' Research Magazine, September 1976, pp. 29-34.

123. Consumers' Research Magazine, "Major Kitchen Appliances." Consumers' Research Magazine, October 1977, pp. 201-205.

124. California Energy Resources Conservation and Development Commission, "Regulations for Appliance Efficiency Standards." Adopted November 3, 1976. (Mimeographed.)

125. Consumers' Research Magazine, "The Real Cost of Automatic Defrosting of Combination Refrigerator-Freezers." Consumers' Research Magazine, January 1977, p. 34.

126. U.S. Department of Energy, Office of Consumer Products, "Appliance Energy Efficiency." Correspondence with James A. Smith on H.R. 5037, April 1978. (Mimeographed.)

127. The Potomac Edison Company, "1977 Residential Load Survey." Customer Service Department, March 1978. (Mimeographed.)

128. Atlantic Electric, "1977 Residential Appliance Saturation and Market Study." Market Research Department, March 1978. (Mimeographed.)

129. Association of Edison Illuminating Companies, "Report Of The Load Research Committee 1976-1977." March 1978, p. L-297. (Mimeographed.)

130. Association of Home Appliance Manufacturers, 1977 Directory of Certified Refrigerator/Freezers. Edition No. 1, January 1977. (Mimeographed.)

131. Walter Blumst, "Appliance Use Figures Need Revision." Electrical World, August 1, 1977, pp. 50-51.

132. Rosemary Carucci Goss and Rebecca P. Lovingood, "Energy Consumption of a Smooth-Top and Conventional Electric Range in Family Meal Preparation." Home Economics Research Journal, Vol. 6, No. 4, June 1978, pp. 262-268.

133. Consumers' Research Magazine, "30-Inch Electric Ranges." Consumers' Research Magazine, May 1977, pp. 27-31.

134. Peter W. Bernstein, "The TV Networkers - Get Some Bad News from Dunedin." Fortune, January 16, 1978, pp. 107-108.

135. Association of Edison Illuminating Companies, "Report Of The Load Research Committee 1973-1974." July 1975, p. L-101. (Mimeographed.)

136. U.S. Department of Commerce, National Technical Information Service, "Energy and Cost Analysis of Residential Water Heaters." By Robert A. Hoskins, et al., Oak Ridge National Laboratory, June 1977. (Mimeographed.)

137. R. P. Wilson, Jr., "Energy Conservation Options for Residential Water Heaters." Energy, Vol. 3, Pergamon Press, New York, pp. 149-172.

138. Richard A. Grot, "Field Performance of Gas and Electric Water Heaters." An abstract prepared for the National Bureau of Standards, February 1978. (Mimeographed.)

139. Consumers' Research Magazine, "What [illegible] a Safe Domestic Hot-Water Temperature?" Consumers' Research Magazine, [illegible] 1978, pp. 24-25.

140. Consumers' Research Magazine. "Automatic Dishwashers." Consumers' Research Magazine, November 1974, pp. 15-21.

141. Electrical World, "Energy Management Series." Electrical World, October 1, 1978, p. 59.

142. Consumers' Research Magazine. "[illegible] Heads and Water Saving Devices." Consumers' Research Magazine, [illegible] 1978, p. 19.

143. Consumers' Research Magazine, "[illegible] Heads." Consumers' Research Magazine, November 1977, pp. 17-20.

144. Electrical Week, "Electrical [illegible] 'Just Another Appliance' but with Load Implications." Electrical [illegible], October 9, 1978, p. 3.

145. Delaware Valley Regional Planning Commission, "Alternative Futures for the Delaware Valley." Year 2000 Report No. 4, September 1976. (Mimeographed.)

146. Electric Power Research Institute, The Impact of Electric Passenger Automobiles on Utility System Loads, 1985-2000. EPRI, Project 758-1, EA-623, July 1978.

147. Lead Industries Association Inc., "Battery Powered Electrical Vehicles State-of-the-Art 1978." A printed brochure, New York, July 1978.

148. Edward M. Dickson and Barry L. Walton, "A Scenario of Battery Electric Vehicle Market Evolution." Electric Vehicle News, May 1978.

149. Electric Vehicle Council, "Questions and Answers on Electric Vehicles." A news release issued at Exposition, April 26/29, 1977. (Typewritten.)

150. Leonard M. Apcar, "Oil & 'Glorified Golf Cart'." Wall Street Journal, June 21, 1978.

151. Electric Light & Power, "Electric Vehicles: Next Major Appliance and Load Management Tool?" Electric Light & Power, Vol. 54, No. 11, November 1976.

152. Jalal T. Salihi, "The Electric Car - Fact and Fancy." Spectrum, June 1972, pp. 44-48.

153. Electric Vehicle Associates Inc., "Change of Pace." Brochure, July 1978.

154. Detroit Edison Company, "1977 Energy Conservation Survey." Customer and Marketing Research Department, February 1978. (Mimeographed.)

155. Associated Press, "Efficient Light Bulb Developed." Evening Bulletin, August 17, 1977.

156. Killer Watt Corporation, Brochure on adapter to convert incandescent lamp into fluorescent, Los Angeles, CA.

157. Newsweek, "TV of Tomorrow." Newsweek, July 3, 1978, pp. 62-71.

158. General Electric Company, "The GE Widescreen 1000 Home Television Theater." Specifications for model 45YP 9000 W. (Mimeographed.)

PHILADELPHIA ELECTRIC COMPANY SYSTEM

RESIDENTIAL SALES - RATES R,RH,WH

BASE CASE

	ACTUAL 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
ADDITIONS TO RH	4578	6150	5400	7120	8800	10000	10300	10400	10800	11900	12900	13700
RATE RH												
CUSTOMERS - DECEMBER (1,000'S)	37.2	43.4	48.8	55.9	64.7	74.7	85.0	95.4	106.2	118.1	[illegible]	144.7
CUSTOMERS - AVG. (1,000'S)	34.7	40.3	46.1	52.3	60.3	69.7	79.8	90.2	100.8	112.1	124.5	137.8
ANNUAL AVG. USE - KWH	23457	21414	21334	21228	21079	20805	20489	20256	20070	19956	19824	19725
SALES - KWH (MILLIONS)	813	863	983	1111	1271	1450	1636	1827	2023	2238	2469	2719
RATES R AND RM - INCLUDES WH												
NET CHANGE IN CUSTOMERS	6050	3850	3800	4580	5500	6300	5600	4500	3100	1600	-400	-2300
CUSTOMERS - DECEMBER (1,000'S)	1111.0	1114.8	1118.6	1123.2	1128.7	1135.0	1140.6	1145.1	1148.2	1149.8	1149.4	[illegible]
CUSTOMERS - AVG. (1,000'S)	1108.2	1112.9	1116.7	1120.9	1126.0	1131.9	1137.8	1142.9	1146.7	1149.0	1149.6	1148.3
ANNUAL AVG. USE - KWH	6585	6262	6304	6351	6394	6443	6505	6585	6683	6800	6923	7044
ANNUAL AVG. KWH INC.	292	-322	42	47	43	49	63	80	98	117	122	121
SALES - KWH (MILLIONS)	7297	6970	7040	7119	7199	7292	7402	7526	7663	7814	7959	8088
TOTAL RESIDENTIAL												
ADDITIONS - NEW CONSTR.	9913	12000	11000	14000	17000	19500	19500	19000	18500	18500	18000	16900
OTHER CUSTOMER CHANGES(1)	715	-2000	-1800	-2300	-2700	-3200	-3600	-4100	-4600	-5000	-5500	-5500
NET CHANGE IN CUSTOMERS	10628	10000	9200	11700	14300	16300	15900	14900	13900	13500	12500	11400
CUSTOMERS - DECEMBER (1,000'S)	1148.2	1158.2	1167.4	1179.1	1193.4	1209.7	1225.6	1240.5	1254.4	1267.9	1280.4	1291.8
CUSTOMERS - AVG. (1,000'S)	1142.9	1153.2	1162.8	1173.3	1186.3	1201.6	1217.7	1233.1	1247.5	1261.2	1274.2	1286.1
ANNUAL AVG. USE - KWH	7097	6792	6900	7014	7140	7276	7422	7585	7765	7970	8184	8403
ANNUAL AVG. KWH INC.	391	-305	108	115	126	136	146	163	180	205	214	219
SALES - KWH (MILLIONS)	8110	7833	8023	8230	8470	8742	9038	9353	9686	10052	10428	10807
RATE WH - INCLUDED IN R & RM (CUSTOMERS IN 1,000'S)												
UNRESTRICTED CUSTOMERS - AVG.	10.1	10.2	11.5	12.6	13.6	14.6	15.4	16.1	16.6	17.0	17.4	17.6
OFF-PEAK CUSTOMERS - AVG.	100.4	101.1	101.3	101.4	101.4	101.3	101.2	100.9	100.6	100.2	99.7	99.1
SALES - KWH (MILLIONS)	522	524	527	529	525	520	515	508	499	494	487	477
BREAKDOWN OF SEASONAL LOADS - KWH (MILLIONS)												
ELECTRIC SPACE HEATING(2)	441	505	564	629	709	801	898	995	1092	1192	1296	1405
AIR CONDITIONING(3)	686	697	712	726	745	767	793	819	846	873	901	926
ALL OTHER LOAD(4)	6523	6631	6748	6875	7017	7175	7347	7539	7749	7988	8230	8477

(1)OTHER CUSTOMER CHANGES REFLECTS THE NET NUMBER OF REINTRODUCTIONS, DEMOLITIONS AND SEPARATIONS OF WIRING.
(2)INCLUDES BASE AND SUPPLEMENTAL ADJUSTED FOR NORMAL WEATHER. ESTIMATED ACTUAL LOADS 528 MMKWH 1977, 540 MMKWH 1978.
(3)INCLUDES ROOM COOLERS AND CENTRAL AIR ONLY ADJUSTED FOR NORMAL WEATHER. ESTIMATED ACTUAL LOADS 767 MMKWH 1977 AND 783 MMKWH 1978.
(4)ALL LOADS ARE NORMALIZED. ESTIMATED ACTUAL LOAD FOR 1977 IS 6815 MMKWH.
1977 INCLUDES 333 MMKWH FOR CONVERSION FROM BIMONTHLY TO MONTHLY BILLING, AND 127 MMKWH FOR WEATHER CONDITIONS.
1978 TOTALS ARE BASED ON NINE MONTHS ACTUAL SALES DATA ADJUSTED FOR NORMAL WEATHER PLUS THE LAST THREE MONTHS OF 1978 BUDGETED SALES.
TOTALS MAY NOT EQUAL THE SUM OF INDIVIDUAL FIGURES DUE TO ROUNDING.

R & F DEPT.
NOVEMBER 1978

Table R-X

PHILADELPHIA ELECTRIC COMPANY SYSTEM
1978-88 FORECAST

Base Case

INDIVIDUALLY METERED RESIDENTIAL ELECTRIC

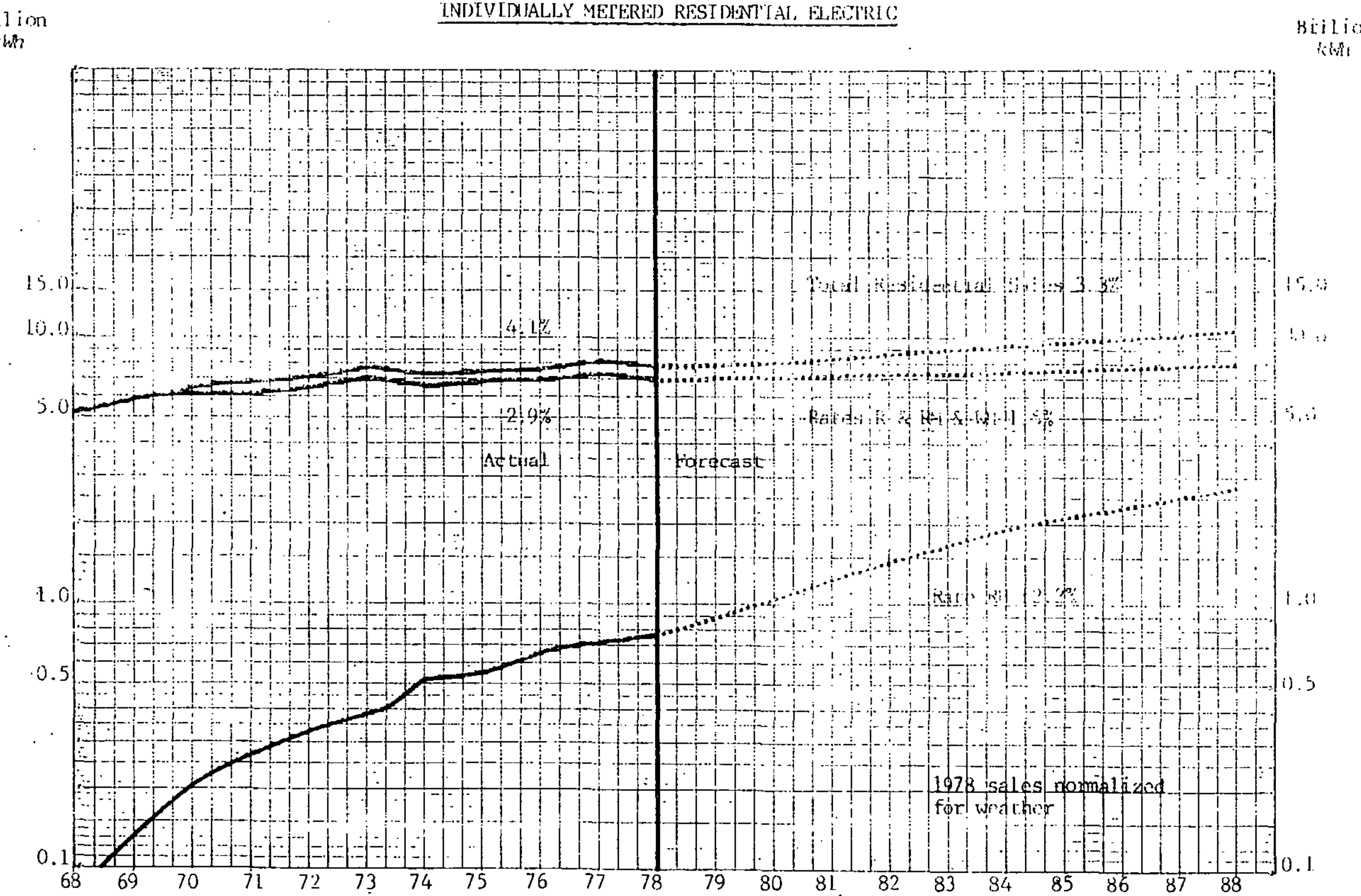


Chart R-18

NOTES: Semilog scale
Curves are noncumulative

R & F Dept.
December 1979

PHILADELPHIA ELECTRIC COMPANY SYSTEM

RESIDENTIAL FORECAST - MMKWH

COMPOUND GROWTH RATES - %

(RATES R,RH,WH)

BASE CASE

TO \ FROM	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
78	2.4																				
79	2.4	2.4																			
80	2.5	2.5	2.6																		
81	2.6	2.6	2.7	2.9																	
82	2.7	2.8	2.9	3.1	3.2																
83	2.8	2.9	3.0	3.2	3.3	3.4															
84	2.9	3.0	3.1	3.2	3.4	3.4	3.5														
85	3.0	3.1	3.2	3.3	3.4	3.5	3.5	3.6													
86	3.1	3.2	3.3	3.4	3.5	3.6	3.6	3.7	3.8												
87	3.1	3.2	3.3	3.4	3.5	3.6	3.6	3.7	3.8	3.7											
88	3.2	3.3	3.4	3.5	3.5	3.6	3.6	3.7	3.7	3.7	3.6										
89	3.2	3.3	3.4	3.5	3.5	3.6	3.6	3.6	3.6	3.6	3.5	3.4									
90	3.2	3.3	3.3	3.4	3.5	3.5	3.5	3.5	3.5	3.4	3.3	3.2	3.0								
91	3.2	3.2	3.3	3.4	3.4	3.4	3.4	3.4	3.4	3.3	3.2	3.0	2.9	2.8							
92	3.1	3.2	3.2	3.3	3.3	3.3	3.3	3.3	3.3	3.2	3.1	2.9	2.8	2.7	2.6						
93	3.1	3.1	3.2	3.2	3.3	3.3	3.2	3.2	3.2	3.1	3.0	2.9	2.7	2.6	2.6	2.5					
94	3.1	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.1	3.0	2.9	2.8	2.7	2.6	2.6	2.5	2.5				
95	3.0	3.0	3.1	3.1	3.1	3.1	3.1	3.1	3.0	2.9	2.8	2.7	2.6	2.5	2.5	2.4	2.3	2.2			
96	3.0	3.0	3.0	3.0	3.1	3.0	3.0	3.0	2.9	2.8	2.7	2.6	2.5	2.5	2.4	2.3	2.3	2.1	2.1		
97	2.9	2.9	3.0	3.0	3.0	3.0	2.9	2.9	2.8	2.8	2.7	2.6	2.5	2.4	2.3	2.2	2.2	2.1	2.0	1.9	
98	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.8	2.8	2.7	2.6	2.5	2.4	2.3	2.2	2.2	2.1	2.0	2.0	1.9	1.8

WHEN USING THIS TABLE, CHOOSE THE STARTING YEAR FROM THE TOP MARGIN, SELECT THE ENDING YEAR FROM THE LEFT MARGIN, WHERE THEY INTERSECT YOU WILL FIND THE COMPOUND GROWTH RATE FOR THAT PERIOD.
EXAMPLE: FROM 1978 TO 1988 THE COMPOUND GROWTH RATE IS 3.3%.

TOTAL MMKWH

1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
7650	7833	8023	8230	8470	8742	9038	9353	9686	10052	10428	10807	11170	11505	11826	12139	12444	12755	13035	13308	13565	13814

TOTAL MMKWH FOR 1977 AND 1978 ARE NORMALIZED.

R & F DEPT.
DECEMBER 1978

Table R-XI

PHILADELPHIA ELECTRIC COMPANY SYSTEM

RESIDENTIAL FORECAST - MMKWH

COMPOUND GROWTH RATES - %

(RATES R,WH)

BASE CASE

TO \ FROM	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
78	0.8																				
79	0.9	1.0																			
80	1.0	1.1	1.1																		
81	1.0	1.1	1.1	1.1																	
82	1.1	1.1	1.2	1.2	1.3																
83	1.1	1.2	1.3	1.3	1.4	1.5															
84	1.2	1.3	1.3	1.4	1.5	1.6	1.7														
85	1.3	1.4	1.4	1.5	1.6	1.7	1.7	1.8													
86	1.4	1.4	1.5	1.6	1.7	1.7	1.8	1.9	2.0												
87	1.4	1.5	1.5	1.6	1.7	1.8	1.8	1.9	1.9	1.9											
88	1.4	1.5	1.6	1.6	1.7	1.7	1.8	1.8	1.8	1.7	1.6										
89	1.4	1.5	1.5	1.6	1.6	1.7	1.7	1.7	1.7	1.6	1.4	1.2									
90	1.4	1.4	1.5	1.5	1.5	1.6	1.6	1.6	1.5	1.4	1.2	1.0	0.8								
91	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.3	1.2	1.0	0.8	0.7	0.5							
92	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.0	0.9	[illegible]	0.5	0.3	0.2						
93	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.0	0.9	0.7	0.5	0.4	0.2	0.1	-0.1					
94	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.0	0.9	0.7	0.6	0.4	0.3	0.1	0.0	-0.1	-0.1				
95	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.8	0.7	0.6	0.5	0.3	0.1	0.0	-0.1	-0.2	-0.3	-0.5			
96	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.7	0.6	0.5	0.3	0.2	0.0	-0.1	-0.2	-0.3	-0.4	-0.5	-0.5		
97	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.6	0.5	0.4	0.2	0.1	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.6	-0.7	
98	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.5	0.4	0.3	0.1	-0.0	-0.1	-0.3	-0.4	-0.5	-0.5	-0.6	-0.7	-0.8	-0.9

WHEN USING THIS TABLE, CHOOSE THE STARTING YEAR FROM THE TOP MARGIN, SELECT THE ENDING YEAR FROM THE LEFT MARGIN, WHERE THEY INTERSECT YOU WILL FIND THE COMPOUND GROWTH RATE FOR THAT PERIOD.
EXAMPLE: FROM 1978 TO 1988 THE COMPOUND GROWTH RATE IS 1.5%.

TOTAL MMKWH

1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
6914	6970	7040	7119	7199	7292	7402	7526	7663	7814	7959	8038	8188	8256	8295	8313	8306	8294	8255	8213	8154	8081

TOTAL MMKWH FOR 1977 AND 1978 ARE NORMALIZED.

Table R-XII

R & F DEPT.
DECEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

BASE CASE

400a

RESIDENTIAL FORECAST - MMKWH

COMPOUND GROWTH RATES - %

(RATE RH)

FROM

TO	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
78	17.3																				
79	15.6	13.9																			
80	14.7	13.5	13.0																		
81	14.6	13.8	13.7	14.4																	
82	14.5	13.9	13.8	14.2	14.1																
83	14.2	13.6	13.6	13.8	13.5	12.8															
84	13.9	13.3	13.2	13.2	12.9	12.2	11.7														
85	13.5	12.9	12.8	12.7	12.3	11.7	11.2	10.7													
86	13.2	12.6	12.5	12.4	12.0	11.5	11.0	10.7	10.6												
87	12.9	12.4	12.2	12.1	11.7	11.2	10.8	10.6	10.5	10.3											
88	12.6	12.2	12.0	11.8	11.5	11.0	10.7	10.5	10.4	10.2	10.1										
89	12.4	11.9	11.7	11.6	11.2	10.8	10.5	10.3	10.2	10.0	9.9	9.7									
90	12.1	11.7	11.5	11.3	11.0	10.6	10.3	10.1	9.9	9.8	9.6	9.3	9.0								
91	11.9	11.4	11.2	11.1	10.8	10.4	10.1	9.9	9.7	9.5	9.4	9.1	8.8	8.7							
92	11.6	11.2	11.0	10.9	10.5	10.2	9.9	9.7	9.5	9.3	9.2	8.9	8.7	8.5	8.4						
93	11.4	11.0	10.8	10.6	10.3	10.0	9.7	9.5	9.4	9.2	9.0	8.8	8.5	8.4	8.3	8.2					
94	11.2	10.8	10.6	10.4	10.1	9.8	9.5	9.3	9.2	9.0	8.8	8.6	8.4	8.2	8.1	8.0	7.8				
95	11.0	10.6	10.4	10.2	9.9	9.6	9.3	9.1	9.0	8.8	8.6	8.4	8.2	8.0	7.9	7.7	7.5	7.2			
96	10.7	10.4	10.2	10.0	9.7	9.4	9.1	8.9	8.8	8.6	8.4	8.2	8.0	7.8	7.6	7.4	7.2	6.9	6.6		
97	10.5	10.1	9.9	9.8	9.5	9.2	8.9	8.7	8.5	8.4	8.2	7.9	7.7	7.6	7.4	7.2	6.9	6.6	6.4	6.2	
98	10.3	9.9	9.7	9.5	9.3	9.0	8.7	8.5	8.3	8.2	8.0	7.7	7.5	7.4	7.2	7.0	6.7	6.5	6.2	6.1	6.0

WHEN USING THIS TABLE, CHOOSE THE STARTING YEAR FROM THE TOP MARGIN, SELECT THE ENDING YEAR FROM THE LEFT MARGIN, WHERE THEY INTERSECT YOU WILL FIND THE COMPOUND GROWTH RATE FOR THAT PERIOD.
EXAMPLE: FROM 1978 TO 1988 THE COMPOUND GROWTH RATE IS 12.2%.

TOTAL MMKWH

1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
736	863	983	1111	1271	1450	1636	1827	2023	2238	2469	2719	2982	3249	3531	3826	4138	4461	4780	5095	5411	5733

TOTAL MMKWH FOR 1977 AND 1978 ARE NORMALIZED.

Table R-XIII

R & F DEPT.
DECEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM
RESIDENTIAL SALES - RATES R, RH, RM, WH
HIGH AND LOW RANGES 1979-88

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
RATE RH										
Customers - Avg. (1,000's) - High	48.3	57.8	69.5	83.7	99.8	117.6	137.1	157.7	179.6	202.5
Customers - Avg. (1,000's) - Low	42.1	45.8	49.4	53.2	57.2	61.2	65.1	69.1	72.9	76.4
Avg. Annual Use (kWh) - High	21,820	21,970	21,880	21,680	21,690	21,830	21,990	22,180	22,300	22,400
Avg. Annual Use (kWh) - Low	21,000	20,790	20,590	20,300	19,980	19,710	19,480	19,250	19,080	18,990
Sales - kWh (millions) - High	1,054	1,270	1,521	1,815	2,165	2,567	3,015	3,498	4,005	4,537
Sales - kWh (millions) - Low	884	952	1,017	1,080	1,143	1,206	1,268	1,330	1,391	1,451
RATES R + RM (INCLUDING WH)										
Customers - Avg. (1,000's) - High	1,119.4	1,124.9	1,130.4	1,135.3	1,139.0	1,140.6	1,140.0	1,137.9	1,133.0	1,125.0
Customers - Avg. (1,000's) - Low	1,103.8	1,100.0	1,096.1	1,093.0	1,089.5	1,086.1	1,082.6	1,078.3	1,073.3	1,067.7
Avg. Annual Use (kWh) - High	6,420	6,540	6,680	6,860	7,040	7,230	7,440	7,680	7,940	8,210
Avg. Annual Use (kWh) - Low	6,280	6,280	6,260	6,240	6,210	6,190	6,180	6,170	6,180	6,190
Sales - kWh (millions) - High	7,192	7,361	7,546	7,783	8,023	8,243	8,476	8,737	9,000	9,240
Sales - kWh (millions) - Low	6,930	6,904	6,864	6,819	6,770	6,726	6,687	6,657	6,635	6,613
TOTAL RESIDENTIAL (R,RH,RM,WH)										
Customers - Avg. (1,000's) - High	1,167.7	1,182.7	1,199.9	1,219.0	1,238.8	1,258.2	1,277.1	1,295.6	1,312.6	1,327.5
Customers - Avg. (1,000's) - Low	1,146.1	1,145.8	1,145.5	1,146.2	1,146.7	1,147.3	1,147.7	1,147.4	1,146.2	1,144.1
Avg. Annual Use (kWh) - High	7,060	7,300	7,560	7,870	8,220	8,590	9,000	9,440	9,910	10,380
Avg. Annual Use (kWh) - Low	6,820	6,860	6,880	6,890	6,900	6,910	6,930	6,960	7,000	7,050
Sales - kWh (millions) - High	8,246	8,631	9,067	9,598	10,188	10,810	11,491	12,235	13,005	13,777
Sales - kWh (millions) - Low	7,814	7,856	7,881	7,899	7,913	7,932	7,955	7,985	8,026	8,064
BREAKDOWN OF SEASONAL LOADS kWh (millions)										
Electric Space Heating - High (1)	593	694	814	951	1,110	1,279	1,460	1,651	1,885	2,040
Electric Space Heating - Low (1)	515	553	590	627	665	703	738	773	805	835
Air Conditioning - High (2)	738	776	822	878	942	1,008	1,077	1,150	1,226	1,299
Air Conditioning - Low (2)	661	641	619	597	575	564	553	543	536	529
All Other Load - High	6,915	7,161	7,431	7,769	8,136	8,523	8,954	9,434	9,894	10,438
All Other Load - Low	6,638	6,662	6,672	6,675	6,673	6,665	6,664	6,671	6,685	6,700

(1) Base and supplemental.

(2) Room coolers and central air conditioning only.

PHILADELPHIA ELECTRIC COMPANY

BASE CASE

RESIDENTIAL SALES

RATES R, RH, WH

	ACTUAL 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
ADDITIONS TO RH	4393	5830	5160	6860	8540	9720	9990	10070	10450	11510	12470	13260
RATE RH												
CUSTOMERS - DECEMBER (1,000'S)	34.4	40.3	45.4	52.3	60.8	70.5	80.5	90.6	101.0	112.6	125.0	138.3
CUSTOMERS - AVG. (1,000'S)	32.0	37.3	42.8	48.8	56.5	65.7	75.5	85.6	95.8	106.8	118.0	131.7
ANNUAL AVG. USE - KWH	23581	21341	21229	21074	20887	20580	20242	20002	19819	19719	19606	19529
SALES - KWH (MILLIONS)	754	797	909	1029	1181	1352	1529	1711	1899	2106	2329	2571
RATES R AND RM - INCLUDES WH												
NET CHANGE IN CUSTOMERS	5673	3570	3640	4440	5360	6180	5510	4430	3050	1590	-370	-2160
CUSTOMERS - DECEMBER (1,000'S)	1092.7	1096.2	1099.9	1104.3	1109.7	1115.9	1121.4	1125.8	1128.9	1130.4	1130.1	1127.9
CUSTOMERS - AVG. (1,000'S)	1089.9	1094.5	1098.1	1102.1	1107.0	1112.8	1118.6	1123.6	1127.3	1129.7	1130.3	1129.0
ANNUAL AVG. USE - KWH	6565	6233	6274	6322	6367	6418	6483	6565	6665	6783	6904	7024
ANNUAL AVG. KWH INC.	293	-332	41	48	45	51	65	82	99	118	122	120
SALES - KWH (MILLIONS)	7155	6822	6890	6967	7048	7142	7252	7377	7513	7662	7804	7930
TOTAL RESIDENTIAL												
ADDITIONS - NEW CONSTR.	9422	11400	10500	13500	16500	19000	19000	18500	18000	18000	17500	16500
OTHER CUSTOMER CHANGES *	644	-2000	-1700	-2200	-2600	-3100	-3500	-4000	-4500	-4900	-5400	-5400
NET CHANGE IN CUSTOMERS	10066	9400	8800	11300	13900	15900	15500	14500	13500	13100	12100	11100
CUSTOMERS - DECEMBER (1,000'S)	1127.1	1136.5	1145.3	1156.6	1170.5	1186.4	1201.9	1216.4	1229.9	1243.0	1255.1	1266.2
CUSTOMERS - AVG. (1,000'S)	1121.9	1131.8	1140.9	1150.9	1163.5	1178.4	1194.1	1209.1	1223.1	1236.4	1249.0	1260.7
ANNUAL AVG. USE - KWH	7050	6731	6836	6948	7072	7207	7353	7516	7695	7900	8112	8330
ANNUAL AVG. KWH INC.	393	-318	105	112	124	135	146	163	179	205	212	218
SALES - KWH (MILLIONS)	7909	7619	7799	7997	8229	8493	8781	9088	9412	9768	10133	10501
RATE WH - INCLUDED IN R & RM (CUSTOMERS IN 1,000'S)												
UNRESTRICTED CUSTOMERS - AVG.	9.7	9.8	11.1	12.2	13.3	14.2	15.0	15.7	16.2	16.6	17.0	17.2
OFF-PEAK CUSTOMERS - AVG.	96.4	97.0	97.2	97.2	97.3	97.2	97.0	96.8	96.4	96.0	95.5	94.9
SALES - KWH (MILLIONS)	504	507	509	512	508	503	498	491	482	477	470	461

* OTHER CUSTOMER CHANGES REFLECTS THE NET NUMBER OF REINTRODUCTIONS, DEMOLITIONS AND SEPARATIONS OF WIRING.
TOTALS MAY NOT EQUAL THE SUM OF INDIVIDUAL FIGURES DUE TO ROUNDING.
1977 INCLUDES 333 MMKWH FOR CONVERSION FROM BIMONTHLY TO MONTHLY BILLING, AND ACTUAL WEATHER.
1978 TOTALS ARE BASED ON NINE MONTHS ACTUAL SALES DATA ADJUSTED FOR NORMAL WEATHER PLUS THE LAST THREE MONTHS OF THE 1978 BUDGETED SALES.

Table R-XV

R & F DEPT.
NOVEMBER 1978

CONOWINGO POWER COMPANY

BASE CASE

RESIDENTIAL SALES

RATES R,RH,WH

	ACTUAL 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
ADDITIONS TO RH	185	320	240	260	260	280	310	330	350	390	430	440
RATE RH												
CUSTOMERS - DECEMBER	2804	3124	3364	3624	3884	4164	4474	4804	5154	5544	5974	6414
CUSTOMERS - AVG.	2689	2964	3244	3494	3754	4024	4319	4637	4979	5349	5759	6194
ANNUAL AVG. USE - KWH	21978	22335	22719	23383	23974	24478	24821	24941	24905	24696	24327	23894
SALES - KWH (1000'S)	59100	66200	73700	81700	90000	98500	107200	115700	124000	132100	140100	148000
RATES R AND RM - INCLUDES WH												
NET CHANGE IN CUSTOMERS	377	280	160	140	140	120	90	70	50	10	-30	-140
CUSTOMERS - DECEMBER	18440	18720	18880	19020	19160	19280	19370	19440	19490	19500	19470	19330
CUSTOMERS - AVG.	18274	18580	18800	18950	19090	19220	19325	19405	19465	19495	19485	19378
ANNUAL AVG. USE - KWH	7792	7955	7995	7984	7910	7830	7752	7694	7706	7792	7950	8154
ANNUAL AVG. KWH INC.	215	162	40	-11	-74	-80	-79	-58	12	86	158	204
SALES - KWH (1000'S)	142400	147800	150300	151300	151000	150500	149800	149300	150000	151900	154900	158000
TOTAL RESIDENTIAL												
ADDITIONS - NEW CONSTR.	491	600	500	500	500	500	500	500	500	500	500	400
OTHER CUSTOMER CHANGES *	71	0	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100
NET CHANGE IN CUSTOMERS	562	600	400	400	400	400	400	400	400	400	400	300
CUSTOMERS - DECEMBER	21244	21844	22244	22644	23044	23444	23844	24244	24644	25044	25444	25744
CUSTOMERS - AVG.	20963	21544	22044	22444	22844	23244	23644	24044	24444	24844	25244	25572
ANNUAL AVG. USE - KWH	9612	9933	10162	10381	10550	10712	10870	11021	11209	11431	11686	11966
ANNUAL AVG. KWH INC.	264	321	228	220	168	163	157	152	188	222	255	280
SALES - KWH (1000'S)	201500	214000	224000	233000	241000	249000	257000	265000	274000	284000	295000	306000
RATE WH - INCLUDED IN R & RM												
UNRESTRICTED CUSTOMERS - AVG.	318	345	360	365	370	375	380	385	390	395	400	405
OFF-PEAK CUSTOMERS - AVG.	4108	4100	4110	4120	4130	4140	4150	4160	4170	4180	4190	4200
SALES - KWH (1000'S)	17200	17300	17500	17400	17300	17200	17000	16900	16900	16800	16800	16800

* OTHER CUSTOMER CHANGES REFLECT THE NET NUMBER OF REINTRODUCTIONS, DEMOLITIONS AND SEPARATIONS OF WIRING.

Table R-XVI

R & F DEPT.
AUGUST 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM
APPLIANCE PENETRATION
RATES R, RH, RM

	1978	1988			1998		
		Low	Base	High	Low	Base	High
Refrigerators	116%	122%	130%	133%	130%	128%	138%
Freezers	26%	32%	40%	44%	37%	43%	51%
Ranges	37%	40%	44%	47%	44%	49%	54%
Clothes Dryers	36%	43%	47%	54%	48%	50%	60%
Clothes Washers	78%	78%	83%	85%	78%	81%	87%
Dishwashers	36%	46%	49%	55%	52%	56%	65%
Water Heaters	14%	19%	20%	25%	23%	27%	36%
TV's	179%	179%	179%	179%	179%	179%	179%
Room Coolers*	30%	31%	35%	41%	31%	35%	47%
Central Air	16%	22%	30%	33%	27%	34%	46%
Dehumidifiers	14%	18%	19%	24%	19%	20%	30%
Electric Heat	3.5%	7%	11%	15%	10%	22%	32%
Heating Auxiliaries	96%	93%	89%	85%	90%	78%	68%
Supplementary Heat	12%	16%	17%	24%	18%	19%	27%
Transportation	0%	0.5%	3%	7%	6%	13%	21%
Lighting - kWh/Cust.	502	480	525	600	460	500	660
Other - kWh/Cust.	483	440	805	990	845	1,100	1,320

*Assumes three room coolers/living unit with air conditioning.

Table R-XVII

R & F Dept.
December 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

BASE CASE

RESIDENTIAL USE BY APPLIANCE CATEGORY (RATES R,RH,WH)

ALL UNITS ARE AVERAGE IN USE IN THOUSANDS - ANNUAL KWH IS IN MILLIONS

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
DWELLING UNITS (R,RH,RM)		1166	1175	1186	1199	1214	1230	1246	1260	1274	1287	1299
REFRIGERATORS	- UNITS	1353	1372	1398	1428	1461	1497	1535	1575	1614	1650	1683
	KWH	2325	2367	2406	2441	2477	2512	2550	2590	2629	2662	2688
FREEZERS	- UNITS	300	314	331	352	376	402	429	454	478	500	518
	KWH	407	421	437	457	479	503	527	548	566	582	593
RANGES	- UNITS	429	437	447	459	474	490	506	522	538	554	569
	KWH	300	306	313	321	332	343	354	365	376	388	398
CLOTHES DRYERS	- UNITS	420	436	453	472	491	512	533	554	575	595	615
	KWH	415	431	447	463	480	499	517	536	554	573	589
CLOTHES WASHERS	- UNITS	906	915	926	940	957	976	996	1018	1040	1060	1079
	KWH	93	94	95	97	99	101	103	105	107	109	111
DISHWASHERS	- UNITS	418	433	451	471	494	518	542	566	588	610	632
	KWH	150	154	158	162	167	172	177	182	187	192	197
WATER HEATERS	- UNITS	160	168	176	185	195	206	216	226	237	247	258
	KWH	765	799	832	864	894	919	943	967	993	1020	1047
TELEVISIONS	- UNITS	2091	2108	2127	2148	2173	2201	2227	2253	2279	2303	2328
	KWH	493	474	451	432	415	403	392	383	381	382	389
ROOM COOLERS	- UNITS	1053	1063	1081	1109	1144	1181	1217	1252	1287	1320	1353
	KWH	298	288	278	269	262	256	251	247	243	244	245
CENTRAL AIR	- UNITS	185	199	216	234	255	277	301	324	347	369	388
	KWH	399	424	448	475	505	537	569	599	630	657	681
DEHUMIDIFIERS	- UNITS	167	173	180	188	197	206	216	225	233	241	247
	KWH	63	65	67	69	72	74	76	79	80	82	83
ELEC. HT. (RH)	- UNITS	40	46	52	60	70	80	90	101	112	124	138
	KWH	422	476	537	613	699	791	883	975	1070	1170	1275
HTG AUXILIARIES	- UNITS	1126	1129	1134	1139	1145	1150	1156	1159	1162	1162	1161
	KWH	470	470	469	469	469	471	471	471	469	467	464
SUPPLEMENTARY HT.	- UNITS	140	147	154	163	172	182	192	201	210	218	226
	KWH	84	87	91	96	101	107	112	117	122	126	130
TRANSPORTATION	- UNITS	0	0	0	0	0	1	3	8	17	29	43
	KWH	0	0	0	0	1	3	9	28	68	122	189
SUB TOTAL	- KWH	6684	6855	7030	7229	7451	7689	7934	8192	8475	8775	9080
LIGHTING	- KWH	585	592	601	611	623	635	647	656	666	674	682
OTHER APPLIANCES	- KWH	563	576	599	629	668	714	772	838	911	978	1045
ANNUAL TOTAL	- KWH	7833	8023	8230	8470	8742	9038	9353	9686	10052	10428	10807

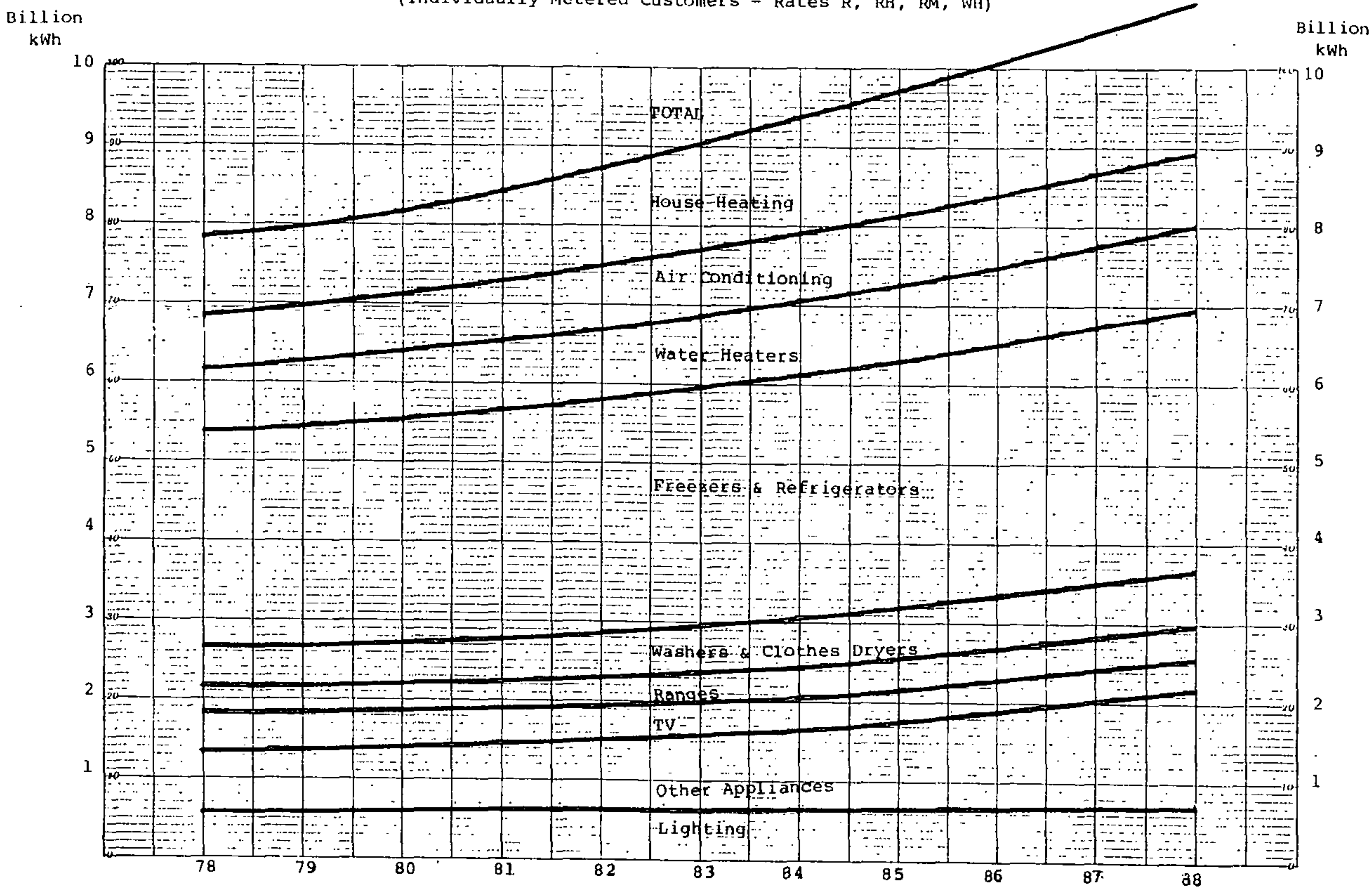
TOTALS MAY NOT EQUAL SUM OF INDIVIDUAL APPLIANCE M-MKWH DUE TO ROUNDING.
1978 - KWH ARE NORMALIZED.

Table R-XVIII

R & F DEPT.
NOVEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM
1978-88 FORECAST
RESIDENTIAL ELECTRIC APPLIANCE USAGE
(Individually Metered Customers - Rates R, RH, RM, WH)

Base Case



NOTES: Curves are cumulative

CHART R-19

R & F Dept.
November 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM
AIR CONDITIONING FACTORS
RATES R, RH, RM

Air Conditioning	1978	1988	1998
Room Cooler			
Average kW/Unit			
High	1.46	1.29	1.15
Base	1.45	1.20	1.11
Low	1.45	1.04	.83
Average Hours Use/Unit			
High	200	200	200
Base	195	150	150
Low	190	140	140

Central Plant	1978	1988	1998
Average kW/Unit			
High	4.82	4.10	3.90
Base	4.81	3.90	3.59
Low	4.81	3.80	3.38
Average Hours Use/Unit			
High	450	480	500
Base	450	450	450
Low	445	395	345

Table R-XIX

R & F Dept.
November 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

CENTRAL PLANT - RESIDENTIAL - ALL RATES

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
CENTRAL PLANT ADDITIONS (1,000'S)	13	15	16	18	20	22	23	24	23	23	21	[illegible]
CENTRAL PLANT REPLACEMENT MARKET (1,000'S)	4	5	7	9	10	11	13	15	17	19	21	21
CENTRAL PLANT REPLACEMENTS (1,000'S)	4	5	7	8	10	11	13	15	17	19	21	21
CENTRAL PLANT NET CHANGE IN UNITS (1,000'S)	13	14	16	18	20	22	23	24	23	23	21	18
CENTRAL PLANT UNITS ON LINE (1,000'S)	193	207	222	239	258	279	301	325	348	371	393	412
TOTAL D.U.'S WITH CENTRAL PLANT OR LARGE TONNAGE SYSTEMS (1,000'S)	207	221	236	253	272	293	315	339	362	385	407	426
E.E.R. - AVERAGE UNIT SOLD	7.22	7.50	7.80	8.00	8.10	8.20	8.25	8.30	8.35	8.40	8.45	8.55
BTU - AVERAGE UNIT ADDED	32200	31700	30200	29000	29000	29000	29000	29000	29000	29000	29000	29000
KW - AVERAGE UNIT ADDED	4.46	4.23	3.87	3.63	3.58	3.54	3.52	3.49	3.47	3.45	3.43	3.41
E.E.R. - AVERAGE UNIT IN USE	6.93	6.98	7.05	7.15	7.26	7.38	7.49	7.62	7.73	7.85	7.96	8.06
BTU - AVERAGE UNIT IN USE	33673	33547	33327	33029	32742	32470	32225	32003	31817	31653	31518	31415
KW - AVERAGE UNIT IN USE	4.86	4.81	4.72	4.62	4.51	4.40	4.30	4.20	4.11	4.03	3.96	3.90
TOTAL MW CONNECTED - CP & LT	1007	1062	1116	1169	1227	1289	1355	1423	1489	1551	1610	1660

TOTAL RESIDENTIAL AIR CONDITIONING MW - ALL RATES

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
CENTRAL PLANT (INCLUDES LARGE TONNAGE)	1007	1062	1116	1169	1227	1289	1355	1423	1489	1551	1610	1660
ROOM COOLERS	1674	1651	1637	1619	1610	1611	1619	1629	1646	1672	1701	1727
TOTAL MW - RESIDENTIAL	2682	2713	2752	2788	2837	2901	2974	3052	3135	3223	3311	3387

NOTES: SPM AND LANSDALE ARE INCLUDED IN ALL FIGURES ON THIS PAGE.
UNITS ARE AVERAGE UNITS IN USE DURING THE YEAR.
TOTALS MAY NOT EQUAL THE SUM OF INDIVIDUAL FIGURES DUE TO ROUNDING.
CENTRAL PLANT -- REFERS TO INDIVIDUAL AIR CONDITIONING UNITS, EACH COOLING ONE DWELLING UNIT.
CENTRAL PLANT -- E.E.R.'S, KW/UNIT AND TOTAL MW HAVE ALL BEEN ESTIMATED TO INCLUDE FAN LOADS IN ACCORDANCE WITH A.R.I. STANDARDS ADOPTED JANUARY 1975.

Table R-XX

R & C DEPT.
AUGUST 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

ROOM COOLERS - RESIDENTIAL - ALL RATES

BASE CASE

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
ROOM COOLER ADDITIONS (1,000'S)	38	45	50	50	48	46	44	42	40	38	36	34
ROOM COOLER REPLACEMENT MARKET (1,000'S)	81	82	118	133	139	132	126	118	89	60	40	47
ROOM COOLER REPLACEMENTS (1,000'S)	23	41	83	106	125	125	120	112	85	57	38	45
ROOM COOLER NET CHANGE IN UNITS (1,000'S)	-19	4	15	23	34	39	38	36	36	35	34	32
ROOM COOLER UNITS ON LINE (1,000'S)	1144	1136	1145	1164	1193	1230	1268	1305	1341	1376	1411	1444
E.E.R. - AVERAGE UNIT SOLD	6.84	7.20	7.50	7.90	8.00	8.10	8.15	8.20	8.25	8.30	8.35	8.40
BTU - AVERAGE UNIT ADDED	9100	9500	9500	9500	9500	9500	9500	9500	9500	9500	9500	9500
KW - AVERAGE UNIT ADDED	1.33	1.32	1.27	1.20	1.19	1.17	1.17	1.16	1.15	1.14	1.14	1.13
E.E.R. - AVERAGE UNIT IN USE	6.57	6.60	6.70	6.88	7.08	7.29	7.49	7.66	7.78	7.87	7.92	7.98
BTU - AVERAGE UNIT IN USE	9613	9595	9578	9564	9557	9554	9554	9555	9555	9554	9552	9551
KW - AVERAGE UNIT IN USE	1.46	1.45	1.43	1.39	1.35	1.31	1.28	1.25	1.23	1.21	1.21	1.20
TOTAL MW CONNECTED - ROOM COOLERS	1674	1651	1637	1619	1610	1611	1619	1629	1646	1672	1701	1727

NOTES: SPM AND LANSDALE ARE INCLUDED IN ALL FIGURES ON THIS PAGE.
UNITS ARE AVERAGE UNITS IN USE DURING THE YEAR.
TOTALS MAY NOT EQUAL THE SUM OF INDIVIDUAL FIGURES DUE TO ROUNDING.

R & F DEPT.
AUGUST 1978

Table R-XXI

PHILADELPHIA ELECTRIC COMPANY SYSTEM

RESIDENTIAL AIR CONDITIONING ON RATES R,RH,RH

BASE CASE

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AVERAGE DWELLING UNITS (1,000'S)	1156	1166	1175	1186	1199	1214	1230	1246	1260	1274	1287	1299
CENTRAL PLANT NET CHANGE IN UNITS (1,000'S)	10	13	15	16	18	21	22	23	23	23	22	19
CENTRAL PLANT UNITS IN USE (1,000'S)	171	184	199	215	234	255	277	300	324	346	368	387
KW - AVERAGE UNIT IN USE	4.86	4.81	4.72	4.62	4.51	4.40	4.30	4.20	4.11	4.05	3.96	3.9[illegible]
HOURS USE - AVERAGE UNIT IN USE	450	450	450	450	450	450	450	450	450	450	450	450
KWH - AVERAGE UNIT IN USE	2186	2163	2126	2078	2030	1981	1935	1891	1851	1814	1782	[illegible]
TOTAL MW CONNECTED - CENTRAL PLANT	833	886	940	995	1055	1120	1191	1262	1331	1396	1458	1519
ROOM COOLER NET CHANGE IN UNITS (1,000'S)	-20	-8	8	18	28	35	37	36	35	35	34	32
ROOM COOLER UNITS IN USE (1,000'S)	1061	1053	1061	1079	1107	1142	1179	1215	1250	1285	1318	1350
KW - AVERAGE UNIT IN USE	1.46	1.45	1.43	1.39	1.35	1.31	1.28	1.25	1.23	1.21	1.21	1.20
HOURS USE - AVERAGE UNIT IN USE	200	195	190	185	180	175	170	165	160	156	153	150
KWH - AVERAGE UNIT IN USE	293	283	272	257	243	229	217	206	196	189	184	179
TOTAL MW CONNECTED - ROOM COOLERS	1553	1529	1516	1501	1494	1496	1504	1516	1535	1560	1587	1616
TOTAL MW CONNECTED - CP & RC	2385	2416	2456	2496	2549	2617	2695	2770	2866	2956	3047	3126

NOTES: SPM AND LANSDALE ARE EXCLUDED FROM ALL FIGURES ON THIS PAGE.
UNITS ARE AVERAGE UNITS IN USE DURING THE YEAR.
TOTALS MAY NOT EQUAL THE SUM OF INDIVIDUAL FIGURES DUE TO ROUNDING.
CENTRAL PLANT -- E.E.R.'S, KW/UNIT AND TOTAL MW HAVE ALL BEEN ESTIMATED TO INCLUDE FAN LOADS IN ACCORDANCE WITH A.R.I. STANDARDS ADOPTED JANUARY 1975.

Table R-XXII

R & F DEPT.
AUGUST 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

BASE CASE

SINGLE POINT METERED APARTMENTS

ANNUAL ADDITIONS - RATES PD & HT

NEW CONSTRUCTION

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
UNITS ELECTRIC HEAT	477	1500	1000	1000	1000	0	0	0	0	0	0	0
AVERAGE USE - KWH	18500	18500	18500	18500	18500	18500	18500	18500	18500	18500	18500	18500
KWH (1,000'S)	4400	13900	9250	9250	9250	0	0	0	0	0	0	0
UNITS NON-ELECTRIC	0	0	0	0	0	0	0	0	0	0	0	0
AVERAGE USE - KWH	7000	7000	7000	7000	7000	7000	7000	7000	7000	7000	7000	7000
KWH (1,000'S)	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL NEW UNITS	477	1500	1000	1000	1000	0	0	0	0	0	0	0
TOTAL NEW KWH(1,000'S)	4400	18300	23150	18500	18500	9250	0	0	0	0	0	0
DEMOLITION UNITS(1)	100	0	200	200	300	300	400	400	400	500	500	500
KWH (1,000'S)	200	200	400	600	1000	1200	1400	1600	1600	1800	2000	2000
SIC 6513 & 6599 KWH (MILLIONS)	780(2)	779(3)	801	819	836	843	841	838	836	833	830	827

(1) DEMOLITIONS INCLUDE CHANGES FROM SINGLE POINT METERED TO INDIVIDUALLY METERED APARTMENTS.
(2) CORRECTED FOR WEATHER.
(3) CORRECTED FOR WEATHER AND MINOR SIC RECLASSIFICATIONS.

R & F DEPT.
NOVEMBER 1978

Table R-XXIII

PHILADELPHIA ELECTRIC COMPANY SYSTEM
RESIDENTIAL SUMMARY
RATES R, RM, RH

Average Annual Number of New Construction Living Units Built

Period	Low Range	Base	High Range
1979-88	8,600	17,200	20,000
1989-98	6,300	13,600	15,800

Average Number of Demolitions and Abandonments Per Year

Period	Low Range	Base	High Range
1979-88	8,900	3,800	2,600
1989-98	9,400	5,400	4,900

Average ESH Penetration in New Construction Market

Period	Low Range	Base	High Range
1979-88	33%	43%	54%
1989-98	38%	57%	75%

Average RH Conversions Per Year

Period	Low Range	Base	High Range
1979-88	600	2,700	6,200
1989-98	1,000	8,600	14,100

Table R-XXIV

R & F Dept.
October 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

BASE CASE

RESISTANCE AND HEAT PUMP ANNUAL ADDITIONS - RATE RH

NEW CONSTRUCTION & CONVERSION UNITS

	ACTUAL 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TOTAL NEW CONSTRUCTION - RH												
RESISTANCE	1612	2090	1690	2180	2730	3110	3070	2810	2610	2590	2510	2370
HEAT PUMP	2452	3310	2880	3780	4620	5120	5040	5010	5160	5560	5910	5940
TOTAL	4064	5400	4570	5960	7350	8230	8110	7820	7770	8150	8420	8310
CONVERSIONS												
RESISTANCE	412	560	580	640	650	710	770	770	760	750	670	590
HEAT PUMP	102	190	250	520	800	1060	1420	1810	2270	3000	3810	4800
TOTAL	514	750	830	1160	1450	1770	2190	2580	3030	3750	4480	5390
TOTAL RATE RH ADDITIONS												
RESISTANCE	2024	2650	2270	2820	3380	3820	3840	3580	3370	3340	3180	2960
HEAT PUMP	2554	3500	3130	4300	5420	6180	6460	6820	7430	8560	9720	10740
TOTAL	4578	6150	5400	7120	8800	10000	10300	10400	10800	11900	12700	13700
ESTIMATED PERCENT OF RH INSTALLING HEAT PUMP	55.8	56.9	58.0	60.4	61.6	61.8	62.7	65.6	68.8	71.9	76.5	78.4
ESTIMATED AVERAGE SEASONAL C.O.P. OF ADDITIONS (HEAT PUMP TO FURNACE)	1.8	1.9	1.9	1.9	1.9	2.0	2.0	2.0	2.1	2.1	2.2	2.2

Table R-XXV

R & F DEPT.
SEPTEMBER 1978

BASE CASE

PHILADELPHIA ELECTRIC COMPANY SYSTEM

RESIDENTIAL ELECTRIC HEAT - RATE RH

CONVERSION MARKET

	PHILADELPHIA			SUBURBAN			CONOWINGO			P.E. CO. SYSTEM				
YEAR	MARKET	% ESH	ESH UNITS	MARKET	% ESH	ESH UNITS	MARKET	% ESH	ESH UNITS	MARKET	% ESH	ESH UNITS	RESISTANCE HEATING	HEAT PUMP
ACTUAL														
1970	28000	0.7	197	24600	2.9	710	800	6.9	55	53400	1.8	962	962	0
1971	28000	0.5	141	25100	2.2	560	800	9.0	72	53900	1.4	773	773	0
1972	27900	0.4	112	25400	0.9	222	800	4.3	34	54100	0.7	368	362	6
1973	27800	0.4	111	25900	1.8	465	900	9.1	82	54600	1.2	658	647	11
1974	27700	0.8	223	26400	1.6	434	900	7.4	67	55000	1.3	724	713	11
1975	27500	0.6	172	26700	1.0	254	900	5.9	53	55100	0.9	479	474	5
1976	27600	0.3	90	26900	1.2	318	900	2.2	20	55400	0.8	428	410	18
1977	27800	0.7	206	27400	1.1	291	900	1.9	17	56100	0.9	514	412	102
FORECAST														
1978	27900	0.5	150	27400	2.0	560	900	4.4	40	56200	1.3	750	560	190
1979	28000	0.6	170	27500	2.3	620	900	4.4	40	56400	1.5	830	580	250
1980	28100	0.8	230	27600	3.2	870	900	6.7	60	56600	2.0	1160	640	520
1981	28200	1.0	290	27700	3.9	1090	900	7.8	70	56800	2.6	1450	650	800
1982	28300	1.2	350	27900	4.8	1330	900	10.0	90	57100	3.1	1770	710	1060
1983	28500	1.5	440	28000	5.9	1640	900	12.2	110	57400	3.8	2190	770	1420
1984	28600	1.8	520	28200	6.8	1930	900	14.4	130	57700	4.5	2580	770	1810
1985	28800	2.1	610	28200	8.0	2270	900	16.7	150	57900	5.2	3030	760	2270
1986	28800	2.6	750	28400	9.9	2810	900	21.1	190	58100	6.5	3750	750	3000
1987	28700	3.1	900	28500	11.8	3360	900	24.4	220	58100	7.7	4480	670	3810
1988	28700	3.8	1080	28500	14.2	4040	900	30.0	270	58100	9.3	5390	590	4800

Table R-XXVI

R & F DEPT.
SEPTEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

RESISTANCE AND HEAT PUMP ANNUAL ADDITIONS - RATE RH

NEW CONSTRUCTION UNITS

BASE CASE

								HOUSES			TWHSES			IMA				
	YEAR	TOTAL UNITS	TOT HSE	IMA APT	HSE	TWHSE	IMA	PHILA	SUB	CON	PHILA	SUB	CON	PHILA	SUB	CON	COP	HP % TOTAL
ACTUAL																		
RESISTANCE	1977	1612	632	980	500	132	980	2	376	122	0	132	0	284	688	8		
HEAT PUMP		2452	2359	93	1268	1091	93	36	1194	38	36	1061	4	62	31	0	1.8	60.3
FORECAST																		
RESISTANCE	1978	2090	1240	850	830	410	850	10	640	180	20	360	30	140	680	30		
HEAT PUMP		3310	3120	190	1630	1490	190	80	1510	40	30	1460	0	40	150	0	1.9	61.3
RESISTANCE	1979	1690	900	790	580	320	790	10	440	130	30	280	10	120	640	30		
HEAT PUMP		2880	2510	370	1280	1230	370	50	1200	30	30	1200	0	30	340	0	1.9	63.0
RESISTANCE	1980	2180	1010	1170	600	410	1170	10	470	120	30	370	10	180	960	30		
HEAT PUMP		3780	3180	600	1440	1740	600	50	1350	40	50	1690	0	60	540	0	1.9	63.4
RESISTANCE	1981	2730	1130	1600	650	480	1600	10	520	120	20	450	10	250	1330	20		
HEAT PUMP		4620	3710	910	1540	2170	910	70	1430	40	40	2130	0	90	820	0	1.9	62.9
RESISTANCE	1982	3110	1040	2070	560	480	2070	10	430	120	30	440	10	370	1680	20		
HEAT PUMP		5120	3860	1260	1530	2330	1260	50	1440	40	40	2290	0	140	1120	0	2.0	62.2
RESISTANCE	1983	3070	940	2130	510	430	2130	10	370	130	30	390	10	350	1760	20		
HEAT PUMP		5040	3590	1450	1350	2240	1450	70	1240	40	50	2190	0	170	1280	0	2.0	62.1
RESISTANCE	1984	2810	880	1930	480	400	1930	10	340	130	30	360	10	340	1570	20		
HEAT PUMP		5010	3590	1420	1320	2270	1420	70	1210	40	70	2200	0	190	1230	0	2.0	64.1
RESISTANCE	1985	2610	830	1780	440	390	1780	10	310	120	30	350	10	280	1480	20		
HEAT PUMP		5160	3690	1470	1290	2400	1470	70	1170	50	80	2320	0	200	1270	0	2.1	66.4
RESISTANCE	1986	2590	800	1790	410	390	1790	10	300	100	30	350	10	280	1500	10		
HEAT PUMP		5560	3920	1640	1300	2620	1640	50	1180	70	90	2530	0	250	1380	10	2.1	68.2
RESISTANCE	1987	2510	710	1800	350	360	1800	10	250	90	30	320	10	230	1560	10		
HEAT PUMP		5910	4090	1820	1360	2730	1820	50	1220	90	100	2630	0	240	1570	10	2.2	70.2
RESISTANCE	1988	2370	620	1750	280	340	1750	10	210	60	30	300	10	230	1510	10		
HEAT PUMP		5940	4100	1840	1310	2790	1840	70	1170	70	110	2670	10	260	1570	10	2.2	71.5

Table R-XXVII

R & F DEPT.
SEPTEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

NEW CONSTRUCTION - TOTAL UNITS - ELECTRIC HEAT UNITS & PENETRATION

BASE CASE

	TOTAL NEW CONSTRUCTION							ELECTRIC HEAT NEW CONSTRUCTION							ELECTRIC HEAT % PENETRATION						
YEAR	TOTAL UNITS	DET* HSES	* TWHSE	TOTAL* HSES	IMA	SPM	TOTAL APTS	TOTAL UNITS	DET* HSES	* TWHSE	TOTAL* HSES	IMA	SPM	TOTAL APTS	TOT UNT	DET* HSE	* TWN	TOT* HSE	IMA	SPM	TOT APT
ACTUAL																					
1970	16234	6909	0	6909	6588	2737	9325	3060	943	0	943	564	1553	2117	19	14	0	14	9	57	23
1971	20199	8872	0	8872	6908	4419	11327	5014	1215	0	1215	1142	2657	3799	25	14	0	14	17	60	34
1972	20839	11522	0	11522	7501	1816	9317	2756	1273	0	1273	526	957	1483	13	11	0	11	7	53	16
1973	17656	7853	0	7853	6806	2997	9803	6066	2342	0	2342	1850	1874	3724	34	30	0	30	27	63	38
1974	14660	7738	0	7738	4051	2871	6922	7903	3660	0	3660	1813	2430	4243	54	47	0	47	45	85	61
1975	11649	4194	2560	6754	2504	2391	4895	6034	1577	1192	2769	1094	2171	3265	52	38	47	41	44	91	67
1976	11678	5387	1965	7352	3129	1197	4326	4292	1212	1094	2306	1399	587	1986	37	22	56	31	45	49	46
1977	10390	6177	1927	8104	1809	477	2286	4541	1768	1223	2991	1073	477	1550	44	29	63	37	59	100	68
FORECAST																					
1978	13500	7400	2650	10050	1950	1500	3450	6900	2460	1900	4360	1040	1500	2540	51	33	72	43	53	100	74
1979	12000	6000	2450	8450	2550	1000	3550	5570	1860	1550	3410	1160	1000	2160	46	31	63	40	45	100	61
1980	15000	6400	3450	9850	4150	1000	5150	6960	2040	2150	4190	1770	1000	2770	46	32	62	43	43	100	54
1981	18000	6700	4250	10950	6050	1000	7050	8350	2190	2650	4840	2510	1000	3510	46	33	62	44	41	100	50
1982	19500	6200	4650	10850	8650	0	8650	8230	2090	2810	4900	3330	0	3330	42	34	60	45	38	0	38
1983	19500	5400	4550	9950	9550	0	9550	8110	1860	2670	4530	3580	0	3580	42	34	59	46	37	0	37
1984	19000	5000	4650	9650	9350	0	9350	7820	1800	2670	4470	3350	0	3350	41	36	57	46	36	0	36
1985	18500	4700	4750	9450	9050	0	9050	7770	1730	2790	4520	3250	0	3250	42	37	59	48	36	0	36
1986	18500	4500	4950	9450	9050	0	9050	8150	1710	3010	4720	3430	0	3430	44	38	61	50	38	0	38
1987	18000	4280	4920	9200	8800	0	8800	8420	1710	3090	4800	3620	0	3620	47	40	63	52	41	0	41
1988	16900	3780	4820	8600	8300	0	8300	8310	1590	3130	4720	3590	0	3590	49	42	65	55	43	0	43
1989	14900	3180	4420	7600	7300	0	7300	7670	1390	2980	4370	3300	0	3300	51	44	67	58	45	0	45
1990	14400	2720	4580	7300	7100	0	7100	7740	1250	3110	4360	3380	0	3380	54	46	68	60	48	0	48
1991	14400	2700	4450	7150	7250	0	7250	7940	1290	3090	4380	3560	0	3560	55	48	69	61	49	0	49
1992	14400	2700	4550	7250	7150	0	7150	8160	1340	3220	4560	3600	0	3600	57	50	71	63	50	0	50
1993	15400	2800	4750	7550	7850	0	7850	8790	1440	3370	4810	3980	0	3980	57	51	71	64	51	0	51
1994	14400	2600	4450	7050	7350	0	7350	8400	1380	3190	4570	3830	0	3830	58	53	72	65	52	0	52
1995	12800	2280	4020	6300	6500	0	6500	7570	1260	2910	4170	3400	0	3400	59	55	72	66	52	0	52
1996	11800	2100	3650	5750	6050	0	6050	7100	1190	2670	3860	3240	0	3240	60	57	73	67	54	0	54
1997	11800	2100	3650	5750	6050	0	6050	7220	1230	2680	3910	3310	0	3310	61	59	73	68	55	0	55
1998	11300	1980	3420	5400	5900	0	5900	7020	1190	2540	3730	3290	0	3290	62	60	74	69	56	0	56

RECORDS ARE NOT AVAILABLE FOR DETACHED HOUSE VERSUS TOWNHOUSE BREAKDOWN PRIOR TO 1975.
* TOWNHOUSES ARE INCLUDED IN THE DETACHED HOUSE CATEGORY PRIOR TO 1975.

Table R-XXVIII

R & F DEPT.
SEPTEMBER 1978

PHILADELPHIA ELECTRIC COMPANY

NEW CONSTRUCTION - TOTAL UNITS - ELECTRIC HEAT UNITS & PENETRATION

BASE CASE

	TOTAL NEW CONSTRUCTION							ELECTRIC HEAT NEW CONSTRUCTION							ELECTRIC HEAT % PENETRATION						
YEAR	TOTAL UNITS	DET* HSES	* TWHSE	TOTAL* HSES	IMA	SPM	TOTAL APTS	TOTAL UNITS	DET* HSES	* TWHSE	TOTAL* HSES	IMA	SPM	TOTAL APTS	TOT UNT	DET* HSE	* TWN	TOT* HSE	IMA	SPM	TOT APT
ACTUAL																					
1970	15649	6353	0	6353	6559	2737	9296	2931	827	0	827	551	1553	2104	19	13	0	13	8	57	23
1971	19474	8165	0	8165	6890	4419	11309	4712	920	0	920	1135	2657	3792	24	11	0	11	16	60	34
1972	19706	10428	0	10428	7462	1816	9278	2476	1010	0	1010	509	957	1466	13	10	0	10	7	53	16
1973	16938	7137	0	7137	6804	2997	9801	5685	1963	0	1963	1848	1874	3722	34	28	0	28	27	63	38
1974	13836	7000	0	7000	3965	2871	6836	7416	3180	0	3180	1806	2430	4236	54	45	0	45	46	85	62
1975	11109	3847	2395	6242	2476	2391	4867	5685	1348	1077	2425	1089	2171	3260	51	35	45	39	44	91	67
1976	11183	4897	1965	6862	3124	1197	4321	4144	1065	1094	2159	1398	587	1985	37	22	56	31	45	49	46
1977	9899	5696	1927	7623	1799	477	2276	4373	1608	1223	2831	1065	477	1542	44	28	63	37	59	100	68
FORECAST																					
1978	12900	6900	2600	9500	1900	1500	3400	6620	2240	1870	4110	1010	1500	2510	51	32	72	43	53	100	74
1979	11500	5600	2400	8000	2500	1000	3500	5370	1700	1540	3240	1130	1000	2130	47	30	64	41	45	100	61
1980	14500	6000	3400	9400	4100	1000	5100	6760	1880	2140	4020	1740	1000	2740	47	31	63	43	42	100	54
1981	17500	6300	4200	10500	6000	1000	7000	8160	2030	2640	4670	2490	1000	3490	47	32	63	44	42	100	50
1982	19000	5800	4600	10400	8600	0	8600	8040	1930	2800	4730	3310	0	3310	42	33	61	45	38	0	38
1983	19000	5000	4500	9500	9500	0	9500	7910	1690	2660	4350	3560	0	3560	42	34	59	46	37	0	37
1984	18500	4600	4600	9200	9300	0	9300	7620	1630	2660	4290	3330	0	3330	41	35	58	47	36	0	36
1985	18000	4300	4700	9000	9000	0	9000	7570	1560	2780	4340	3230	0	3230	42	36	59	48	36	0	36
1986	18000	4100	4900	9000	9000	0	9000	7950	1540	3000	4540	3410	0	3410	44	38	61	50	38	0	38
1987	17500	3880	4870	8750	8750	0	8750	8210	1530	3080	4610	3600	0	3600	47	39	63	53	41	0	41
1988	16500	3480	4770	8250	8250	0	8250	8140	1460	3110	4570	3570	0	3570	49	42	65	55	43	0	43
1989	14500	2880	4370	7250	7250	0	7250	7500	1260	2960	4220	3280	0	3280	52	44	68	58	45	0	45
1990	14000	2420	4530	6950	7050	0	7050	7570	1120	3090	4210	3360	0	3360	54	46	68	61	48	0	48
1991	14000	2400	4400	6800	7200	0	7200	7760	1150	3070	4220	3540	0	3540	55	48	70	62	49	0	49
1992	14000	2400	4500	6900	7100	0	7100	7980	1200	3200	4400	3580	0	3580	57	50	71	64	50	0	50
1993	15000	2500	4700	7200	7800	0	7800	8610	1300	3350	4650	3960	0	3960	57	52	71	65	51	0	51
1994	14000	2300	4400	6700	7300	0	7300	8220	1240	3170	4410	3810	0	3810	59	54	72	66	52	0	52
1995	12500	2080	3970	6050	6450	0	6450	7430	1160	2890	4050	3380	0	3380	59	56	73	67	52	0	52
1996	11500	1900	3600	5500	6000	0	6000	6960	1090	2650	3740	3220	0	3220	61	57	74	68	54	0	54
1997	11500	1900	3600	5500	6000	0	6000	7080	1130	2660	3790	3290	0	3290	62	59	74	69	55	0	55
1998	11000	1780	3370	5150	5850	0	5850	6880	1090	2520	3610	3270	0	3270	63	61	75	70	56	0	56

RECORDS ARE NOT AVAILABLE FOR DETACHED HOUSE VERSUS TOWNHOUSE BREAKDOWN PRIOR TO 1975.
* TOWNHOUSES ARE INCLUDED IN THE DETACHED HOUSE CATEGORY PRIOR TO 1975.

R & F DEPT.
SEPTEMBER 1978

Table R-XXIX

PHILADELPHIA ELECTRIC COMPANY - PHILADELPHIA DIVISION

NEW CONSTRUCTION - TOTAL UNITS - ELECTRIC HEAT UNITS & PENETRATION

BASE CASE

TOTAL NEW CONSTRUCTION

YEAR	TOTAL UNITS	DET* HSES	* TWHSE	TOTAL* HSES	IMA	SPM	TOTAL APTS
ACTUAL							
1970	3444	700	0	700	1581	1163	2744
1971	2994	442	0	442	1638	914	2552
1972	3693	630	0	630	2401	662	3063
1973	3822	774	0	774	2062	986	3048
1974	3299	692	0	692	1334	1273	2607
1975	1928	325	307	632	698	598	1296
1976	2805	234	266	500	1778	527	2305
1977	1480	362	232	594	862	24	886
FORECAST							
1978	2100	400	300	700	800	600	1400
1979	1950	300	400	700	1000	250	1250
1980	2650	300	500	800	1600	250	1850
1981	3150	400	400	800	2100	250	2350
1982	3700	300	400	700	3000	0	3000
1983	3700	400	400	800	2900	0	2900
1984	3500	300	400	700	2800	0	2800
1985	3000	300	400	700	2300	0	2300
1986	2900	200	400	600	2300	0	2300
1987	2390	200	400	600	1790	0	1790
1988	2290	200	400	600	1690	0	1690
1989	1990	200	300	500	1490	0	1490
1990	1910	100	400	500	1410	0	1410
1991	1800	100	300	400	1400	0	1400
1992	1800	100	300	400	1400	0	1400
1993	2100	200	300	500	1600	0	1600
1994	1800	100	300	400	1400	0	1400
1995	1590	100	200	300	1290	0	1290
1996	1500	100	200	300	1200	0	1200
1997	1500	100	200	300	1200	0	1200
1998	1490	100	200	300	1190	0	1190

ELECTRIC HEAT NEW CONSTRUCTION

YEAR	TOTAL UNITS	DET* HSES	* TWHSE	TOTAL* HSES	IMA	SPM	TOTAL APTS
ACTUAL							
1970	466	41	0	41	74	351	425
1971	344	21	0	21	99	224	323
1972	334	14	0	14	158	162	320
1973	745	24	0	24	85	636	721
1974	952	38	0	38	32	882	914
1975	380	6	0	6	2	372	374
1976	427	12	0	12	336	79	415
1977	444	38	36	74	346	24	370
FORECAST							
1978	920	90	50	140	180	600	780
1979	520	60	60	120	150	250	400
1980	630	60	80	140	240	250	490
1981	730	80	60	140	340	250	590
1982	640	60	70	130	510	0	510
1983	680	80	80	160	520	0	520
1984	710	80	100	180	530	0	530
1985	670	80	110	190	480	0	480
1986	710	60	120	180	530	0	530
1987	660	60	130	190	470	0	470
1988	710	80	140	220	490	0	490
1989	650	80	110	190	460	0	460
1990	690	50	160	210	480	0	480
1991	690	50	120	170	520	0	520
1992	740	50	130	180	560	0	560
1993	910	100	140	240	670	0	670
1994	810	50	140	190	620	0	620
1995	740	50	100	150	590	0	590
1996	730	50	100	150	580	0	580
1997	760	50	110	160	600	0	600
1998	770	50	110	160	610	0	610

ELECTRIC HEAT % PENETRATION

YEAR	TOT UNT	DET* HSE	* TWN	TOT* HSE	IMA	SPM	TOT APT
ACTUAL							
1970	14	6	0	6	5	30	15
1971	11	5	0	5	6	25	13
1972	9	2	0	2	7	24	10
1973	19	3	0	3	4	65	24
1974	29	5	0	5	2	69	35
1975	20	2	0	1	0	62	29
1976	15	5	0	2	19	15	18
1977	30	10	16	12	40	100	42
FORECAST							
1978	44	23	17	20	23	100	56
1979	27	20	15	17	15	100	32
1980	24	20	16	18	15	100	26
1981	23	20	15	18	16	100	25
1982	17	20	18	19	17	0	17
1983	18	20	20	20	18	0	18
1984	20	27	25	26	19	0	19
1985	22	27	28	27	21	0	21
1986	24	30	30	30	23	0	23
1987	28	30	33	32	26	0	26
1988	31	40	35	37	29	0	29
1989	33	40	37	38	31	0	31
1990	36	50	40	42	34	0	34
1991	38	50	40	43	37	0	37
1992	41	50	43	45	40	0	40
1993	43	50	47	48	42	0	42
1994	45	50	47	48	44	0	44
1995	47	50	50	50	46	0	46
1996	49	50	50	50	48	0	48
1997	51	50	55	53	50	0	50
1998	52	50	55	53	51	0	51

RECORDS ARE NOT AVAILABLE FOR DETACHED HOUSE VERSUS TOWNHOUSE BREAKDOWN PRIOR TO 1975.

* *TOWNHOUSES ARE INCLUDED IN THE DETACHED HOUSE CATEGORY PRIOR TO 1975.*

R & F DEPT.
SEPTEMBER 1978

Table R-XXX

PHILADELPHIA ELECTRIC COMPANY - SUBURBAN DIVISION

NEW CONSTRUCTION - TOTAL UNITS - ELECTRIC HEAT UNITS & PENETRATION

BASE CASE

YEAR	TOTAL NEW CONSTRUCTION: TOTAL UNITS	DET* HSES	* TWHSE	TOTAL* HSES	IMA	SPM	TOTAL APTS	ELECTRIC HEAT NEW CONSTRUCTION: TOTAL UNITS	DET* HSES	* TWHSE	TOTAL* HSES	IMA	SPM	TOTAL APTS	ELECTRIC HEAT % PENETRATION: TOT UNT	DET* HSE	* TWN	TOT* HSE	IMA	SPM	TOT APT
ACTUAL																					
1970	12205	5653	0	5653	4978	1574	6552	2465	786	0	786	477	1202	1679	20	14	0	14	10	76	26
1971	16480	7723	0	7723	5252	3505	8757	4368	899	0	899	1036	2433	3469	27	12	0	12	20	69	40
1972	16013	9798	0	9798	5061	1154	6215	2142	996	0	996	351	795	1146	13	10	0	10	7	69	18
1973	13116	6363	0	6363	4742	2011	6753	4940	1939	0	1939	1763	1238	3001	38	30	0	30	37	62	44
1974	10537	6308	0	6308	2631	1598	4229	6464	3142	0	3142	1774	1548	3322	61	50	0	50	67	97	79
1975	9181	3522	2088	5610	1778	1793	3571	5305	1342	1077	2419	1087	1799	2886	58	38	52	43	61	100	81
1976	8378	4663	1699	6362	1346	670	2016	3717	1053	1094	2147	1062	508	1570	44	23	64	34	79	76	78
1977	8419	5334	1695	7029	937	453	1390	3929	1570	1187	2757	719	453	1172	47	29	70	39	77	100	84
FORECAST																					
1978	10800	6500	2300	8800	1100	900	2000	5700	2150	1820	3970	830	900	1730	53	33	79	45	75	100	87
1979	9550	5300	2000	7300	1500	750	2250	4850	1640	1480	3120	980	750	1730	51	31	74	43	65	100	77
1980	11850	5700	2900	8600	2500	750	3250	6130	1820	2060	3880	1500	750	2250	52	32	71	45	60	100	69
1981	14350	5900	3800	9700	3900	750	4650	7430	1950	2580	4530	2150	750	2900	52	33	68	47	55	100	62
1982	15300	5500	4200	9700	5600	0	5600	7400	1870	2730	4600	2800	0	2800	48	34	65	47	50	0	50
1983	15300	4600	4100	8700	6600	0	6600	7230	1610	2580	4190	3040	0	3040	47	35	63	48	46	0	46
1984	15000	4300	4200	8500	6500	0	6500	6910	1550	2560	4110	2800	0	2800	46	36	61	48	43	0	43
1985	15000	4000	4300	8300	6700	0	6700	6900	1480	2670	4150	2750	0	2750	46	37	62	50	41	0	41
1986	15100	3900	4500	8400	6700	0	6700	7240	1480	2880	4360	2880	0	2880	48	38	64	52	43	0	43
1987	15110	3680	4470	8150	6960	0	6960	7550	1470	2950	4420	3130	0	3130	50	40	66	54	45	0	45
1988	14210	3280	4370	7650	6560	0	6560	7430	1380	2970	4350	3080	0	3080	52	42	68	57	47	0	47
1989	12510	2680	4070	6750	5760	0	5760	6850	1180	2850	4030	2820	0	2820	55	44	70	60	49	0	49
1990	12090	2320	4130	6450	5640	0	5640	6880	1070	2930	4000	2880	0	2880	57	46	71	62	51	0	51
1991	12200	2300	4100	6400	5800	0	5800	7070	1100	2950	4050	3020	0	3020	58	48	72	63	52	0	52
1992	12200	2300	4200	6500	5700	0	5700	7240	1150	3070	4220	3020	0	3020	59	50	73	65	53	0	53
1993	12900	2300	4400	6700	6200	0	6200	7700	1200	3210	4410	3290	0	3290	60	52	73	66	53	0	55
1994	12200	2200	4100	6300	5900	0	5900	7410	1190	3030	4220	3190	0	3190	61	54	74	67	54	0	54
1995	10910	1980	3770	5750	5160	0	5160	6690	1110	2790	3900	2790	0	2790	61	56	74	68	54	0	54
1996	10000	1800	3400	5200	4800	0	4800	6230	1040	2550	3590	2640	0	2640	62	58	75	69	55	0	55
1997	10000	1800	3400	5200	4800	0	4800	6320	1080	2550	3630	2690	0	2690	63	60	75	70	56	0	56
1998	9510	1680	3170	4850	4660	0	4660	6110	1040	2410	3450	2660	0	2660	64	62	76	71	57	0	57

RECORDS ARE NOT AVAILABLE FOR DETACHED HOUSE VERSUS TOWNHOUSE BREAKDOWN PRIOR TO 1975.
* TOWNHOUSES ARE INCLUDED IN THE DETACHED HOUSE CATEGORY PRIOR TO 1975..

R & F DEPT.
SEPTEMBER 1978

Table R-XXXI

CONOWINGO POWER COMPANY

NEW CONSTRUCTION - TOTAL UNITS - ELECTRIC HEAT UNITS & PENETRATION

BASE CASE

	TOTAL NEW CONSTRUCTION							ELECTRIC HEAT NEW CONSTRUCTION						
YEAR	TOTAL UNITS	DET* HSES	* TWHSE	TOTAL* HSES	IMA	SPM	TOTAL APTS	TOTAL UNITS	DET* HSES	* TWHSE	TOTAL* HSES	IMA	SPM	TOTAL APTS
ACTUAL														
1970	585	556	0	556	29	0	29	129	116	0	116	13	0	13
1971	725	707	0	707	18	0	18	302	295	0	295	7	0	7
1972	1133	1094	0	1094	39	0	39	280	263	0	263	17	0	17
1973	718	716	0	716	2	0	2	381	379	0	379	2	0	2
1974	824	738	0	738	86	0	86	487	480	0	480	7	0	7
1975	540	347	165	512	28	0	28	349	229	115	344	5	0	5
1976	495	490	0	490	5	0	5	148	147	0	147	1	0	1
1977	491	481	0	481	10	0	10	168	160	0	160	8	0	8
FORECAST														
1978	600	500	50	550	50	0	50	280	220	30	250	30	0	30
1979	500	400	50	450	50	0	50	200	160	10	170	30	0	30
1980	500	400	50	450	50	0	50	200	160	10	170	30	0	30
1981	500	400	50	450	50	0	50	190	160	10	170	20	0	20
1982	500	400	50	450	50	0	50	190	160	10	170	20	0	20
1983	500	400	50	450	50	0	50	200	170	10	180	20	0	20
1984	500	400	50	450	50	0	50	200	170	10	180	20	0	20
1985	500	400	50	450	50	0	50	200	170	10	180	20	0	20
1986	500	400	50	450	50	0	50	200	170	10	180	20	0	20
1987	500	400	50	450	50	0	50	210	180	10	190	20	0	20
1988	400	300	50	350	50	0	50	170	130	20	150	20	0	20
1989	400	300	50	350	50	0	50	170	130	20	150	20	0	20
1990	400	300	50	350	50	0	50	170	130	20	150	20	0	20
1991	400	300	50	350	50	0	50	180	140	20	160	20	0	20
1992	400	300	50	350	50	0	50	180	140	20	160	20	0	20
1993	400	300	50	350	50	0	50	180	140	20	160	20	0	20
1994	400	300	50	350	50	0	50	180	140	20	160	20	0	20
1995	300	200	50	250	50	0	50	140	100	20	120	20	0	20
1996	300	200	50	250	50	0	50	140	100	20	120	20	0	20
1997	300	200	50	250	50	0	50	140	100	20	120	20	0	20
1998	300	200	50	250	50	0	50	140	100	20	120	20	0	20

	ELECTRIC HEAT % PENETRATION						
YEAR	TOT UNT	DET* HSE	* TWN	TOT* HSE	IMA	SPM	TOT APT
ACTUAL							
1970	22	21	0	21	45	0	45
1971	42	42	0	42	39	0	39
1972	25	24	0	24	44	0	44
1973	53	53	0	53	100	0	100
1974	59	65	0	65	8	0	8
1975	65	66	70	67	18	0	18
1976	30	30	0	30	20	0	20
1977	34	33	0	33	80	0	80
FORECAST							
1978	47	44	60	45	60	0	60
1979	40	40	20	38	60	0	60
1980	40	40	20	38.	60	0	60
1981	38	40	20	38	40	0	40
1982	38	40	20	38	40	0	40
1983	40	43	20	40	40	0	40
1984	40	43	20	40	40	0	40
1985	40	43	20	40	40	0	40
1986	40	43	20	40	40	0	40
1987	42	45	20	42	40	0	40
1988	43	43	40	43	40	0	40
1989	43	43	40	43	40	0	40
1990	43	43	40	43	40	0	40
1991	45	47	40	46	40	0	40
1992	45	47	40	46	40	0	40
1993	45	47	40	46	40	0	40
1994	45	47	40	46	40	0	40
1995	47	50	40	48	40	0	40
1996	47	50	40	48	40	0	40
1997	47	50	40	48	40	0	40
1998	47	50	40	48	40	0	40

RECORDS ARE NOT AVAILABLE FOR DETACHED HOUSE VERSUS TOWNHOUSE BREAKDOWN PRIOR TO 1975.
* TOWNHOUSES ARE INCLUDED IN THE DETACHED HOUSE CATEGORY PRIOR TO 1975.

R & F DEPT.
SEPTEMBER 1978

Table R-XXXII

PHILADELPHIA ELECTRIC COMPANY SYSTEM

YEAR END DWELLING UNITS (THOUSANDS)

BASE CASE

YEAR		INDIVIDUALLY METERED(1) PECO	S.P.M.(2)	CONOWINGO	TOTAL
	RATES-	R,RH,RM	GS,PD,HT	R,RH,RM	
1977		1139.4	131.4	21.4	1292.2
1978		1148.8	132.9	22.0	1303.7
1979		1157.6	133.7	22.4	1313.7
1980		1168.9	134.5	22.8	1326.2
1981		1182.8	135.2	23.2	1341.2
1982		1198.7	134.9	23.6	1357.2
1983		1214.2	134.5	24.0	1372.7
1984		1228.7	134.1	24.4	1387.2
1985		1242.2	133.7	24.8	1400.7
1986		1255.3	133.2	25.2	1413.7
1987		1267.4	132.7	25.6	1425.7
1988		1278.5	132.2	25.9	1436.6
1989		1287.6	131.7	26.2	1445.5
1990		1296.2	131.2	26.5	1453.9
1991		1304.9	130.6	26.8	1462.3
1992		1313.6	130.0	27.1	1470.7
1993		1323.3	129.4	27.4	1480.1
1994		1332.0	128.8	27.7	1488.5
1995		1339.2	128.2	27.9	1495.3
1996		1345.5	127.5	28.1	1501.1
1997		1351.8	126.8	28.3	1506.9
1998		1357.6	126.1	28.5	1512.2

(1) THIS TOTAL DIFFERS FROM THE RESIDENTIAL AND HOUSE HEATING CUSTOMER TOTALS IN THE SALES AND REVENUE REPORT BECAUSE OF AN ESTIMATED 12,600 ADDITIONAL DWELLING UNITS ON COMBINED METERING (FORMER RATE RM)
(2) INCLUDED IN COMMERCIAL AND INDUSTRIAL.
NOTE: LANSDALE IS EXCLUDED FROM ALL FIGURES ON THIS PAGE.

R & F DEPT.
JULY 1978

Table R-XXXIII

PHILADELPHIA ELECTRIC COMPANY SYSTEM

SUMMARY OF RESIDENTIAL MARKET PROJECTIONS

BASE CASE

			APARTMENTS		
RATES -->	TOTAL DWELLING UNITS (ALL)	HOUSES (R,RH,RM)	INDIVIDUALLY METERED (R,RH,RM)	SINGLE-POINT METERED (GS,PD,HT)	TOTAL (R,RH,RM)
TOTAL					
DECEMBER 31, 1977	1292200	961100	199700	131400	1160800
NEW CONSTRUCTION 1978-88 INCLUSIVE	188400	106450	77450	4500	183900
DEMOLITIONS AND ABANDONMENTS	44000	33300	7000	3700	40300
DECEMBER 31, 1988	1436600	1034250	270150	132200	1304400
NET INCREASE 1977-88 (11 YEARS)	144400	73150	70450	800	143600
ELECTRIC HEAT					
DECEMBER 31, 1977	55200	22600	11800	20800	34400
PERCENT PENETRATION 1977	4.3%	2.4%	5.9%	15.8%	3.0%
NEW CONSTRUCTION 1978-88 INCLUSIVE	84590	49460	30630	4500	80090
PERCENT PENETRATION NEW CONSTRUCTION	44.9%	46.5%	39.5%	100.0%	43.6%
CONVERSIONS FROM OTHER FUELS 1978-88	27380	22340	5040	0	27380
DECEMBER 31, 1988	167170	94400	47470	25300	141870
PERCENT PENETRATION 1988	11.6%	9.1%	17.6%	19.1%	10.9%

NOTE: LANSDALE IS EXCLUDED FROM ALL FIGURES ON THIS PAGE.

R & F DEPT.
DECEMBER 1978

Table R-XXXIV

PHILADELPHIA ELECTRIC COMPANY

RELATIONSHIP OF POPULATION TO NEW CONSTRUCTION

BASE CASE

YEAR	POPULATION REACHING AGE 22*	HOUSING CONNECTIONS	CONNECTIONS PER 100 POPULATION
	(ACTUAL)		
1965	53600	19200	35.8
1966	51100	18000	35.2
1967	48300	17200	35.6
1968	48500	18800	38.8
1969	63100	17700	28.1
1970	61900	15600	25.2
1971	57700	19500	33.8
1972	56700	19700	34.7
1973	56900	16900	29.7
1974	60600	13800	22.8
1975	63700	11100	17.4
1976	64400	11200	17.4
1977	66800	9900	14.8
AVERAGE THROUGH 1977	57950	16050	27.7
	(FORECAST)		
1978	67400	12900	19.1
1979	67200	11500	17.1
1980	67700	14500	21.4
1981	66200	17500	26.4
1982	67500	19000	28.1
1983	64200	19000	29.6
1984	62100	18500	29.8
1985	61600	18000	29.2
1986	61000	18000	29.5
1987	58900	17500	29.7
1988	56200	16500	29.4
1989	52700	14500	27.5
1990	51100	14000	27.4
1991	51100	14000	27.4
1992	50300	14000	27.8
1993	56900	15000	26.4
1994	53900	14000	26.0
1995	49200	12500	25.4
1996	47100	11500	24.4
1997	47100	11500	24.4
1998	46800	11000	23.5
AVERAGE FORECAST (1979 - 1988)	63260	17000	26.9
AVERAGE FORECAST (1989 - 1998)	50620	13200	26.1

* SOURCE: U.S. CENSUS, 1960 AND 1970 AS APPLICABLE.

Table R-XXXV

R & F DEPT.
JULY 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

BASE CASE

RELATIONSHIP OF TOTAL DWELLING UNITS TO POPULATION*

	POPULATION - TOTAL ALL AGES	POPULATION PER DWELLING UNIT	AVERAGE DWELLING UNITS	FEMALES OVER 19	DWELLING UNITS PER FEMALE
1950	3061000	3.60	851.1	1137900	0.75
1960	3489000	3.39	1028.1	1207800	0.85
1970	3830900	3.21	1194.5	1310500	0.91
1975	3754800	2.97	1264.2	1328100	0.95
1978	3740000	2.88	1297.9	1363000	0.95
1983	3793000	2.78	1364.9	1431000	0.95
1988	3916000	2.74	1431.1	1491000	0.96
1993	3999000	2.71	1475.4	1524000	0.97
1998	4051000	2.68	1509.5	1534000	0.98

*Population and dwelling units for PECO's total electric service area (excluding Lansdale).

Table R-XXXVI

R & F DEPT.
JULY 1978

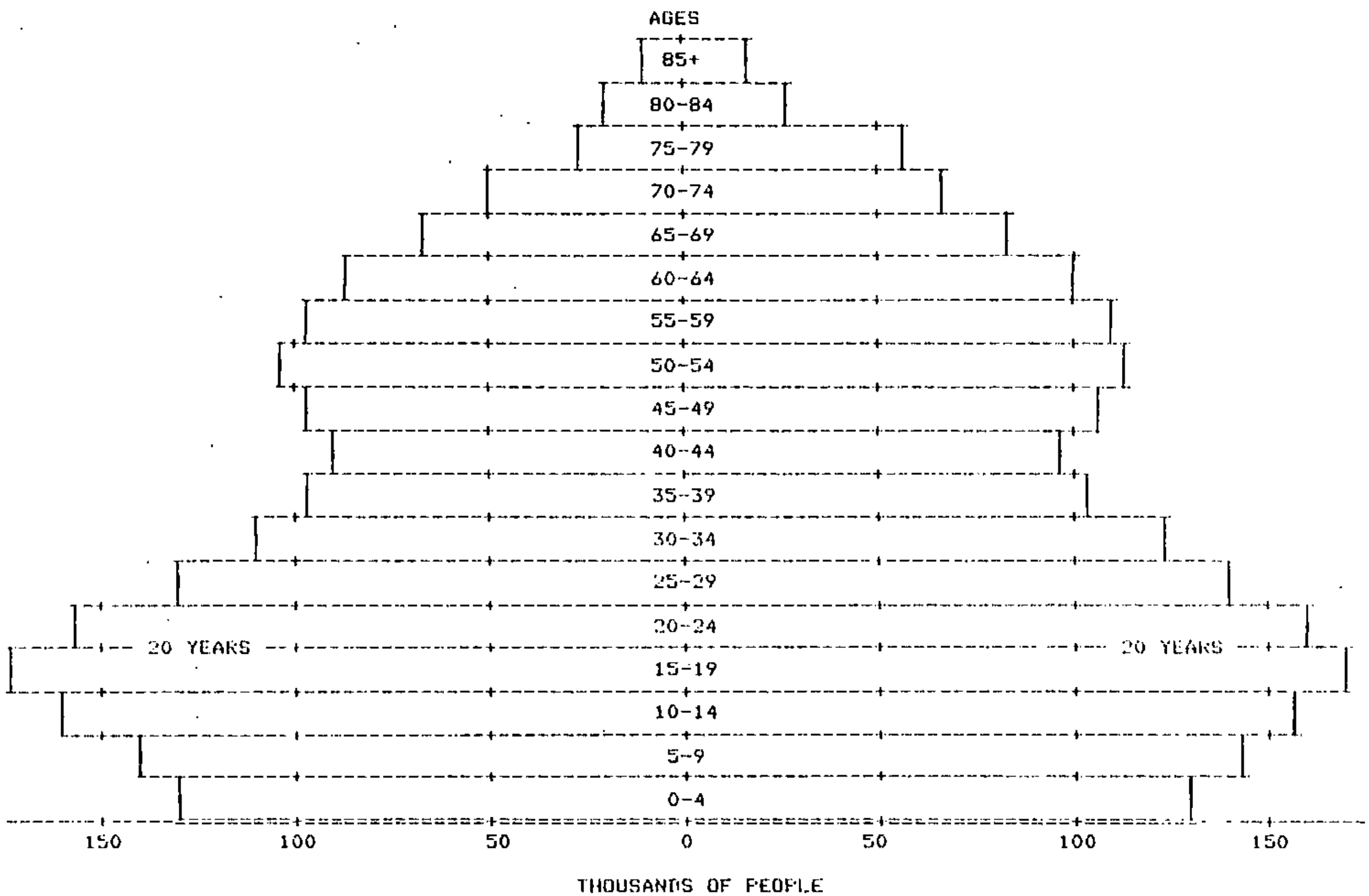
RESIDENTIAL FORECAST

POPULATION BY AGE AND SEX

BASE CASE

1977

MALES FEMALES



R & F DEPT.
DECEMBER 1978

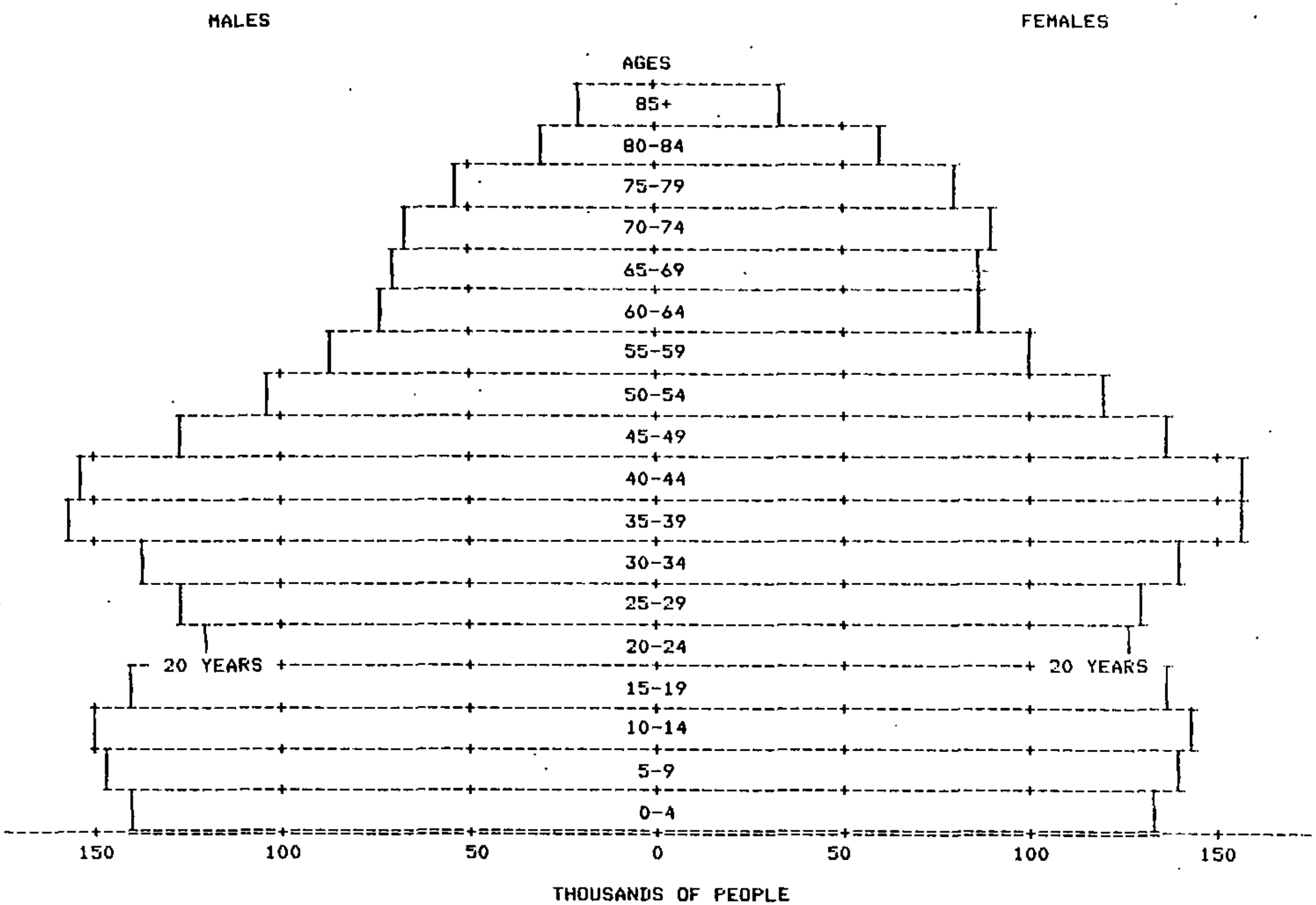
Chart R-20

RESIDENTIAL FORECAST

POPULATION BY AGE AND SEX

BASE CASE

1998



R & F DEPT.
DECEMBER 1978

Chart R-21

NATIONAL BIRTH RATES

1925 to 2000

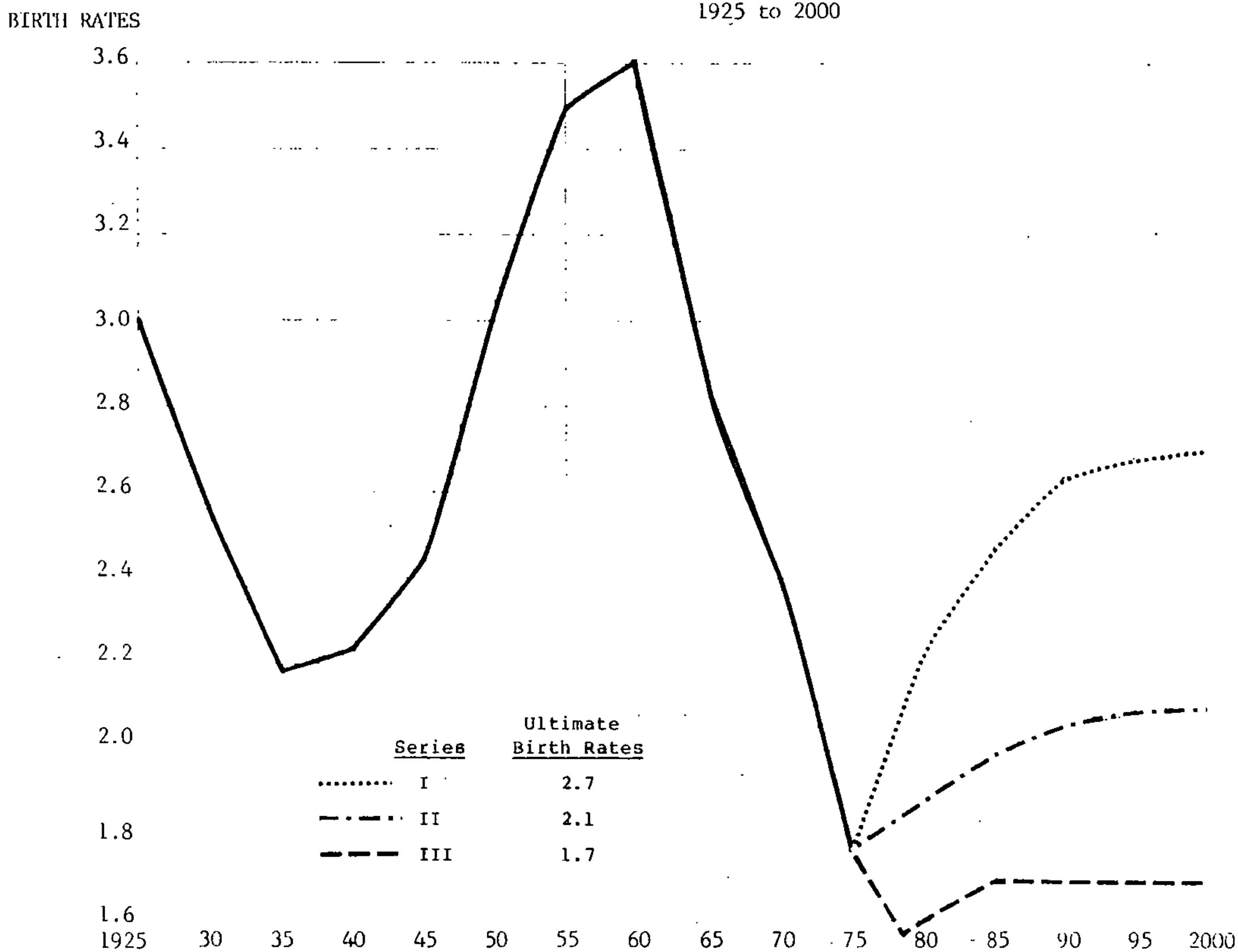


CHART R-22

R & F Dept.
September 1978

COMMERCIAL AND INDUSTRIAL DISCUSSION

The large Commercial and Industrial classification includes all customers served on Rates PD and HT except rail traction services and, therefore, includes the single-point-metered (SPM) apartment complexes served under those rates. The major components of the Large Commercial and Industrial forecast are shown on Table C-I. Included in Other Manufacturing are Standard Industrial Classification numbers (SIC's) 20 through 39 inclusive. Other Nonmanufacturing includes SIC's 1 through 17 and 40 through 99, except for the single-point-metered apartments. The ten largest users among the manufacturing customers of the company were interviewed to arrive at individual growth projections for the forecast period. These ten customers account for over 40% of the total use in the manufacturing class and approximately 12% of total annual consumption by all classes.

Customers served under Rates GS and GLP make up the Small Commercial and Industrial class. Analyses of this group indicate about 90 percent of the load is commercial and 10 percent is small manufacturing.

Base, high and low cases are given for each element of the Commercial and Industrial class, based on the assumptions which follow. Assumptions for other classes of service related to commercial use--such as Railroads and Railways, Other Public Authorities, and Interdepartmental--are also included in this section.

INDUSTRIAL

The number of large manufacturing customers peaked in 1969 and 1970 at the height of the Vietnam war. With the winding down of hostilities and the recession of 1971, the number of customers decreased from 1,773 in 1969 and 1970 to 1,695 at the end of 1973, or a reduction of 78 customers. 1974 saw a slight increase of 5 customers but the severe recession of 1975, the worst since the 1930's, resulted in the loss of an additional 58 customers in the 1975-1977 period. With the war and the 1971 and 1975 recessions behind us, the companies which were sound enough to weather these impacts should now provide a firmer foundation for future growth.

Another factor which influenced the reduction in the number of manufacturing customers was the moving of manufacturing to the sunbelt and the much higher rate at which new plants were started up in the South and West to take advantage of lower labor, tax, and energy costs. This is expected to abate as taxes rise in the sunbelt to provide the necessary services for the increased population, as labor rates rise toward national levels, as fuel costs rise with the conversion of gas fired generating plants to other fuel, and as water supply problems increase because of increased demand. These negative aspects, however, are not the only factors which will encourage business to remain or start up in this area. The Pennsylvania State Department of Commerce is aggressively seeking business by nationally advertising that "Pennsylvania offers a package to business that we challenge any other state to beat". Included in that package is the following "NUCLEAR ENERGY . . . ABUNDANT ELECTRICITY. We are already supplying nuclear power electricity to our industry from six plants. Five more nuclear stations are under construction. By 1980, 25% of Pennsylvania's energy will be coming from nuclear stations. We have so much electricity that we are a net exporter to other states. This helps us hold down the cost of electricity to our own industry".(1) The Philadelphia Industrial Development Corporation is also increasingly active in promoting the area. In 1977, PIDC participated in fifty-nine property transactions including the construction and renovation of 2.6 million square feet of industrial space. This effort retained 2,103 jobs and created 2,164 new jobs for Philadelphians.(2) The City of Philadelphia, in 1978, increased its advertising budget fifteen-fold and has retained an agency to promote Philadelphia aggressively in national media. A large part of this promotion will be directed at industrial managers in an effort to retain existing industry and attract others to Philadelphia. The land-bank program offering low-cost acreage to qualifying industries is an outstanding example of the City's determination.

Other manufacturing sales grew an average of 140 million kWh per year in the pre-embargo period from 1967 to 1973, a period which bracketed the 1970 recession. Annual changes are shown below.

Million-kWH

1966	289	1972	99
1967	139	1973	228
1968	436	1974	(222)
1969	199	1975	(480)
1970	(29)	1976	99
1971	(89)	1977	25

Commitments of new load by other manufacturing customers less cancellations for 1974 through 1978, a five year span following the embargo, average 190 million kWh per year. Assuming that a reasonable recovery from the depressed base will occur over time, the effects of these additions should show up and would support the same three percent growth rate in the near future as was experienced from 1967 to 1973, a period which spanned a recession and many of the customer-loss and out-migration effects of the present times.

Commitments - Million kWh

1974	555	1977	102
1975	185	1978	250 (based on 9 mos. actual)
1976	166		

Five year total new load committed	1258
Plant closing and reductions	300
Annual average increase	190 million kWh

With the financially weak customers weeded out by the recession, the appeal of the sunbelt decreasing as its problems increase, and the state and local governments increasing their promotional efforts, there are prospects for future growth of the industrial market. 1978 is an indication of this. Jackson-Cross, who surveyed the Philadelphia Area's industrial market in mid-1978, found a very high rate of demand for industrial space.(3)

ASSUMPTIONS

(See also general assumptions in the first section)

1. ECONOMY - The Industrial Production Index (IPI) is projected to increase at about 3.6% annually from 1978 to 1988.(4) Based on our analyses which follow, it is indicated that large manufacturing growth will lag the growth in IPI by almost one percent during the forecast period whereas from 1960 to 1973 the average growth rate was 4.7% for both. In the low and high ranges, the IPI is approximately 2.9% and 5.0% respectively. For Gross National Product and Gross Regional Product projections, see the Budget Forecast section assumptions and table.

2. LABOR FORCE - The decreased birthrates of the sixties compared with the babyboom of the fifties will cause a decrease in the growth rate of the potential labor force during the ten year forecast period which should result in a slowing economic growth, and both the supply and demand of many products will be affected. This applies to all three ranges since the birthrates are accomplished facts.

   The table below, based on our projections for the area served, shows the effect of the expected decline in the growth of new labor market entrants on total potential labor force. This table is based on persons of the ages 20 to 65, although government statistics include those 16 and over.

	Number (1,000's)	Change
1970	2,045	
1975	2,056	11
1980	2,127	71
1985	2,207	80
1990	2,237	30
1995	2,273	36

3. FOSSIL FUEL CONVERSION - Some electrification of manufacturing processes--existing or potential--is expected to occur because of real or anticipated gas and oil shortages. If the price of industrial electricity rises in line with the increase in the price of goods generally--as is assumed here--then the cost of fossil fuels will rise at a faster rate and should further stimulate conversion.

   Opportunities for increased power use include metal holding furnaces; electric boilers; induction heaters; high temperature furnaces; high temperature heat pumps and microwave drying. One source of information on the anticipated expansion of these markets is Energy User News.(5)

4. COGENERATION - There are 16 customers on system using private generation. Fifteen of these are connected to the utility system while one major refiner operates independently.

Estimated demand of private generation is 170 MW with approximate annual consumption of one billion kWh. The forecast, being based on factors and growth rates which apply equally to all kWh--purchased or self-generated--allows for an increase in private generation of about 300 million kWh by 1988, consistent with past forecast assumptions.

The company continues to follow these customers closely as well as nongenerating customers concerning future plans for generation through its Committee for Energy Marketing and Purchase (CEMAP).

There are no identified large customers committed to add independent generation although several have been studying the cost-benefits.

Because of the uncertainties existing in the areas of regulation, financing, environmental controls, costs and government incentives, no change in the existing ratio of self-generated to purchased power has been factored into this or previous forecasts. Future forecasts will be adjusted by specific changes, if any.

5. OIL REFINERIES - One refinery is now modernizing its facility to increase production of unleaded gasoline and lube products. The other two refineries, however, do not plan any major expansions during the forecast period. Many observers believe gasoline demand will peak in the United States, perhaps within five years. Price elasticity (oil prices will go higher) and conservation efforts by users coupled with the trend toward smaller and lighter cars are the major factors contributing to modest or no expansion plans of the refineries.

The three oil companies continue to assign a low probability of refining growth in the last half of the forecast period even if oil is discovered off the Atlantic Coast. One refinery is considering replacing three existing hydrocrackers with two modern ones. This additional capacity is included in the base forecast. Also included in the base forecast is an expansion of chemical manufacturing facilities at one of the refineries since ample industrially zoned land is available. In the low range forecast, it is assumed that there will be no expansion or modernizing of refining capacity in our area. If substantial oil is discovered off the coast, additional refining capacity will be built in New England. The low range further assumes that this area has sufficient capacity to meet energy needs because of the expected increase in the efficiency of automobiles and a net loss of population in our area. The high range is based on large quantities of oil being discovered off the coast with additional capacity being built in our area to handle it. It also assumes that there will be no reduction in imports of foreign oil processed at the local plants.

6. STEEL INDUSTRY - For the two large integrated steel mills in our area, growth is projected at an average annual increase of 3.4 percent in the base forecast, which includes added environmental controls, small production increases from changes to existing capacity and a large planned increase in melting and rolling capacity announced by Lukens. This does not include the reactivation of part of the Alan Wood mill by Lukens as it is included in Other Manufacturing. The annual increase to 1988 from the high steel production year of 1974 is only 2.5 percent including the planned Lukens expansion.

   The low range is based on a drop in 1979-80 to the recessionary levels of 1975, then a 2% growth rate due to environmental controls plus part of the Lukens announced changes.

   The high range assumes a 3.5 million ton addition on existing available space and higher steel output based on our high case projections of a stronger economy.

7. OTHER LARGE TEN CUSTOMERS - The other five customers have limited growth plans which are included in the base forecast. The low range assumes this limited growth will not take place, and the high range assumes only a slight expansion over the base, even with an expanding economy. Three of the five customers cannot expand plant facilities materially because of the lack of additional land.

Each of the major two digit SIC's were analyzed to determine past history and future potential for change. Data concerning the future was obtained from the computerized reporting system used by our service representatives as well as by direct communication with them. Discussions of the major two digit SIC's follow.

Four methods were used to forecast large industrial sales. These methods were kilowatt-hours per manhour by SIC, kilowatt-hours per employee by SIC, various regression analyses, and value added by SIC. The discussion of each of these methods follows the discussion of the two digit SIC's.

DISCUSSION OF LARGE INDUSTRIAL TWO DIGIT SIC's

Food and Kindred Products-SIC 20

Δ% kWh from previous year

1967	5.4	1971	2.5	1975	(0.5)
1968	6.4	1972	3.2	1976	2.9
1969	1.6	1973	14.3	1977	1.3
1970	3.6	1974	(1.5)		

For the first ten months of 1978, kWh consumption increased by 2.2% over the same period of 1977. Customers in this class have made substantial commitments to increase their load over the next several years, with ten customers planning to install a total of 18 million kWh in new and existing plants.

Paper and Allied Products (excluding Scott Paper*)-SIC 26

Δ% kWh from previous year

1967	3.9	1971	(5.4)	1975	(21.0)
1968	10.1	1972	4.2	1976	7.6
1969	5.5	1973	4.1	1977	2.8
1970	(2.9)	1974	(4.4)		

*In Large 10

The first ten months of 1978 saw a 4.5% increase in consumption by the paper products group over the same period of 1977. Other than Scott Paper (45 percent of the class) this class is made up mostly of many small processors of cups, bags, packages and paperboard, with no customer accounting for more than 8 percent of the total less Scott. Production of miscellaneous paper goods is expected to grow at a slower pace than the economy as the use of plastics increases at the expense of paper.

Chemicals and Allied Products (Excluding Linde & Merck*)-SIC 28

Δ% kWh from previous year

1967	-	2.5	1971	-	(1.0)	1975	-	(10.6)
1968	-	19.2	1972	-	1.2	1976	-	8.9
1969	-	2.3	1973	-	4.1	1977	-	1.5
1970	-	3.0	1974	-	(3.9)			

*In Large 10

The chemicals were down in 1978 because consumption by Chemetron and Publicker Industries declined. Chemetron's major customer, Alan Wood Steel, ceased operations and this drastically reduced Chemetron's output. Chemetron, however, is relocating its gas compression plant, and operations will resume in late 1979, which will again make it one of our largest customers.

If Chemetron's and Publicker's consumption are removed from both 1977 and 1978, the remaining 143 customers increased their electric consumption by 2.5% for the first ten months of 1978.

Petroleum Refining (excluding ARCO, BP, and Sun Oil*)-SIC 29

Δ% kWh from previous year

1967	-	2.8	1971	-	1.1	1975	-	(2.2)
1968	-	7.9	1972	-	4.7	1976	-	(1.6)
1969	-	(3.9)	1973	-	8.4	1977	-	5.1
1970	-	(2.2)	1974	-	(2.2)			

*In Large 10

Consumption by the SIC group for the first ten months of 1978 was 7.6% over the same period last year. The three large refineries account for 95% of the use of this class. This follows a 5.1% increase last year as the demand of petroleum products remains high.

Rubber and Misc. Products (less Firestone*)-SIC 30

Δ% kWh from previous year

1967	-	2.4	1971	-	10.6	1975	-	(14.4)
1968	-	20.0	1972	-	(0.2)	1976	-	3.4
1969	-	10.0	1973	-	5.3	1977	-	11.2
1970	-	(5.2)	1974	-	0.3			

*In Large 10

After a very substantial increase in consumption of 11.2% in 1977, there was a 3.8% decrease for the first ten months of 1978 vs. the first ten months of 1977. This decrease was primarily the result of decreases in production by B.F. Goodrich and the smaller customers in this class. One of the tire producers, however, has plans to increase its plant capacity by 50% which would add approximately 30 million kWh per year.

Primary Metals (except U.S. Steel*, Lukens* and Alan Wood)-SIC 33

Δ% kWh from previous year

1967	-	2.6	1971	-	(6.4)	1975	-	(19.2)
1968	-	(1.2)	1972	-	1.4	1976	-	(8.7)
1969	-	3.6	1973	-	8.6	1977	-	(6.4)
1970	-	(1.9)	1974	-	9.5			

*In Large 10

When Lukens Steel and U.S. Steel, who are included in the Large 10 customers, are removed from this group and when Alan Wood Steel, which has gone out of business is also excluded, the remaining customers in this SIC increased their consumption by 10.7% during the first ten months of 1978 (U.S. and Lukens dominate this class with over 80 percent of the use). No additional loss of customers is foreseen in this class and the former Alan Wood plant is scheduled to reopen in June, 1979. Also negotiations are presently underway with one of the customers who is seriously considering adding a 6000 kW electric furnace which would consume approximately 20 million kWh annually.

Fabricated Metal Products - SIC 34

Δ% kWh from previous year

1967	-	0.6	1971	-	(5.3)	1975	-	(11.8)
1968	-	10.3	1972	-	0.4	1976	-	4.0
1969	-	5.3	1973	-	5.0	1977	-	(3.5)
1970	-	2.7	1974	-	(1.0)			

For the first ten months of 1978, consumption was 0.8% over the same period of 1977. No major changes are foreseen.

Machinery Except Electrical-SIC 35

Δ% kWh from previous year

1967	-	6.0	1971	-	(1.0)	1975	-	(4.7)
1968	-	5.1	1972	-	5.5	1976	-	3.5
1969	-	5.6	1973	-	10.7	1977	-	(3.1)
1970	-	(3.7)	1974	-	(5.3)			

For the first ten months of 1978, sales were equal to the same period of 1977. In future years, this class is expected to keep pace with the economy.

Electrical and Elec. Mach. Equip. and Supplies-SIC 36

Δ% kWh from previous year

1967	-	12.5	1971	-	(5.1)	1975	-	(12.6)
1968	-	11.8	1972	-	(4.4)	1976	-	(3.0)
1969	-	6.7	1973	-	(0.1)	1977	-	(1.2)
1970	-	3.2	1974	-	(8.3)			

For the first ten months of 1978, consumption by this class was down 1.2%. The reduction was due to Electric Storage Battery and Reynolds Metals phasing out their operations. If these two customers were excluded in both 1977 and 1978, the remaining 124 customers increased their consumption during the first ten months of 1978 by 3.9%. No further reduction in customers is expected.

Transportation Equipment (except Budd Co.*)-SIC 37

Δ% kWh from previous year

1967	-	(12.1)	1971	-	(1.2)	1975	-	(10.6)
1968	-	11.9	1972	-	(5.6)	1976	-	7.9
1969	-	1.6	1973	-	1.0	1977	-	4.2
1970	-	(9.9)	1974	-	(6.3)			

*In Large 10

For the first ten months of 1978, kWh consumption was 1.7% over the first ten months of 1977. Little growth is expected in this class of customers. Sun Ship, however, will be adding new welding and sand blast equipment and they are one of the larger customers in this group.

FORECASTING METHODS

Manhours - This method used historic and forecasted manhours and kilowatt-hours per manhour for the various industrial SIC's. Manhour data was obtained from the Pennsylvania portion of Wharton Econometric Forecasting Associates' (WEFA) model of the Philadelphia SMSA. The manhour data from the model was available from 1969. Using Company sales by SIC and the WEFA manhours, the growth rates in kilowatt-hours per manhour by SIC were calculated for the 1969-77 period. This time period covers a period of slow economic growth and the conservation induced by price-elasticity as well as other efforts to save energy from the time of the 1973 oil crisis.

These kWh growth rates were then applied to WEFA's forecasted manhours to 1988. The product of manhours and kilowatt-hours per manhour produced the forecast of kilowatt-hours for each of the two digit SIC industries. The exceptions to this procedure were SIC's 29 and 33. SIC 29 includes three major oil companies and SIC 33 two major steel producers which are in the Large Ten class of customers and are forecast individually. These customers dominate these two classes. When applying the described method, the forecasted sales of these five companies were subtracted from their respective SIC's and the forecasting method was then applied to the remaining portion of the SIC.

The sales estimate produced by the manhour method is 10,450 million kilowatt-hours for 1988 for total large manufacturing and is shown on Table C-IV.

Industrial Employment - The total population history and the employment history by industrial SIC's 20 through 39 for the five Pennsylvania counties served by PECo. were obtained for the 1965-1976 period.(6) From this data, the ratios of population to employment for the various SIC's were determined for each of the historic twelve years. From Company records, the annual kilowatt-hours consumed by large customers (Rates PD and HT) in each SIC for the 1965-76 period were obtained and the average annual kWh per employee calculated.

Through the use of linear regression, the kilowatt-hours per employee were projected by year through 1988. The variables to determine the low and high cases of large manufacturing sales were the ratios of population to manufacturing employment by SIC. For the low case, regressions of the historic 1965-76 period were run and applied to the Company's population model to determine annual future employment by SIC. For the high case, the regression formulas were applied to the State of Pennsylvania, Department of Commerce's employment forecast for the five county area. With the number of employees for the low and high cases determined for each SIC by year and the average kilowatt-hours per employee by SIC projected, the individual SIC kilowatt-hours were calculated and summed to obtain annual total large manufacturing sales for PECo.

The low and high cases were averaged to obtain the base case for P.E. Co. The low, base and high forecasts for Conowingo's manufacturing sales were then added to obtain P.E. System sales. This method produced total large manufacturing sales of 9,370 million kWh for the low case, 10,620 million kWh for the base case, and 11,560 million kWh for the high case.

MANUFACTURING REGRESSIONS - For the manufacturing sector a number of regression models were estimated using subsets of the following variables as independent variables with kWh sales to manufacturing customers* as the dependent variable:

Industrial Production Index - National (4)
Gross Regional Product 1972$ - Phila. SMSA (7)
Manufacturing Components of Gross National Product 1972$ (7)
Value Added in Manufacturing - Phila. 5 County Area (7)

All plausible models including lags of dependent and independent variables were examined. The following models were statistically significant and reasonable in terms of functional form and dependency. A brief disucssion of the models follows their presentation.

Model 1:

$$\underset{}{KWHMFG} = \underset{(3.43)}{1996.8} + \underset{(8.84)}{46.3}\ IPI$$

$R^2 = 0.857$, $F = 78.1$, RMS Error =332 (4.7% of mean KWHMFG)

Model 2:

$$KWHMFG = \underset{(1.89)}{1386.8} + \underset{(7.82)}{11.7}\ GNP^{**}$$

$R^2 = 0.825$, $F = 61.1$, RMS Error = 368 (5.2% of mean KWHMFG)

Model 3:

$$KWHMFG = \underset{(2.78)}{1345.9} + \underset{(2.39)}{20.9}\ IPI + \underset{(3.25)}{0.5}\ KWHMFG_{-1}$$

$R^2 = 0.924$, $F = 73.1$, RMS Error = 242 (3.4% of mean KWHMFG)

* Sales to Allan Wood Steel were removed from the historic series to remove the discontinuity caused by the closing of this plant in 1977.

** Personal consumption expenditures for durable and nondurable goods plus fixed nonresidential investment.

Model 1

This model assumes that PECO's manufacturing sales are related to the national industrial production index which assumes that Philadelphia based industry is typical of industry in general. Since much of Philadelphia industry provides products for national markets - oil, steel, electrical machinery - it is reasonable that this model provides a good fit to the data.

The behavior of this model over the estimation period is shown in Figure 1. As shown in Figure 1, the model tracks the movements of the dependent variable in that it captures the turning points in the actual data. In addition, the actual data fall within a 95% interval around the regression model for the majority of sample observations.

This model was forecast using McGraw-Hill's forecast for the Industrial Production Index.(4) To provide a more realistic forecast it was observed that the errors in the model are correlated, thus the model was adjusted down by the error in 1977 for each year of the forecast. The resulting forecast is shown in Figure 4.

Model 2

This model relates PECO's manufacturing sales to a subset of the GNP accounts that relate more specifically to manufacturing; that is, personal consumption expenditures for durable and nondurable goods plus fixed nonresidential investment. This model is reasonable in the same sense as Model 1 and provides results that are similar to Model 1 as expected.

The behavior of this model over the estimation period is shown in Figure 2. Figure 2 demonstrates that the model tracks the actual data fairly well by picking up all turning points and encompassing the actual data in a 95% interval for a majority of the sample observations.

This model was forecast using the Wharton National Model. This model also demonstrated highly correlated errors, thus all forecast values were reduced by the error in 1977. The resulting forecast is shown in Figure 4.

Model 3

This model augments Model 1 by including the dynamics of adjustment through the lagged dependent variable in the model. The lagged dependent variable enters the model by assuming that the stock of electrically operated or dependent machinery or processes does not adjust instantaneously to a new equilibrium point. (8) This is entirely plausible given the size and capital costs of manufacturing facilities. The inclusion of the dynamics of adjustment shows an improvement in all aspects over Models 1 & 2, thus corroborating its inclusion in the model.

The behavior of the model over the estimation period is shown in Figure 3. This model tracks the actual data more closely than models 1 & 2 as seen by the reduction in the RMS Error. The model picks up all turning points and captures the actual data in a 95% interval for a majority of the sample observations.

The model was forecast with the same series as Model 1 and each year of the forecast was adjusted by the error in 1977 to take account of the predictable behavior of the errors. The resulting forecast is shown in Figure 4.

The forecasts provided by these models lie in the range 10,420 to 10,840 MMKWH. A calculated prediction interval for the 1988 forecast for Models 1 & 2 is $\pm$ 1300 MMKWH. Such an interval was not calculated for Model 3 but can be expected to be in the same range based on its similarity to the other models.

In summary, the three models presented represent a reasonable estimate of the behavior of kWh sales in manufacturing for the following reasons:

1. The estimation period covers a period where there was movement in dependent and independent variables in both directions,

2. The models are statistically sound in all pertinent areas - RMS Error, R^2, t's, turning points, and

3. The systematic behavior of the errors in each model was incorporated into each forecast.

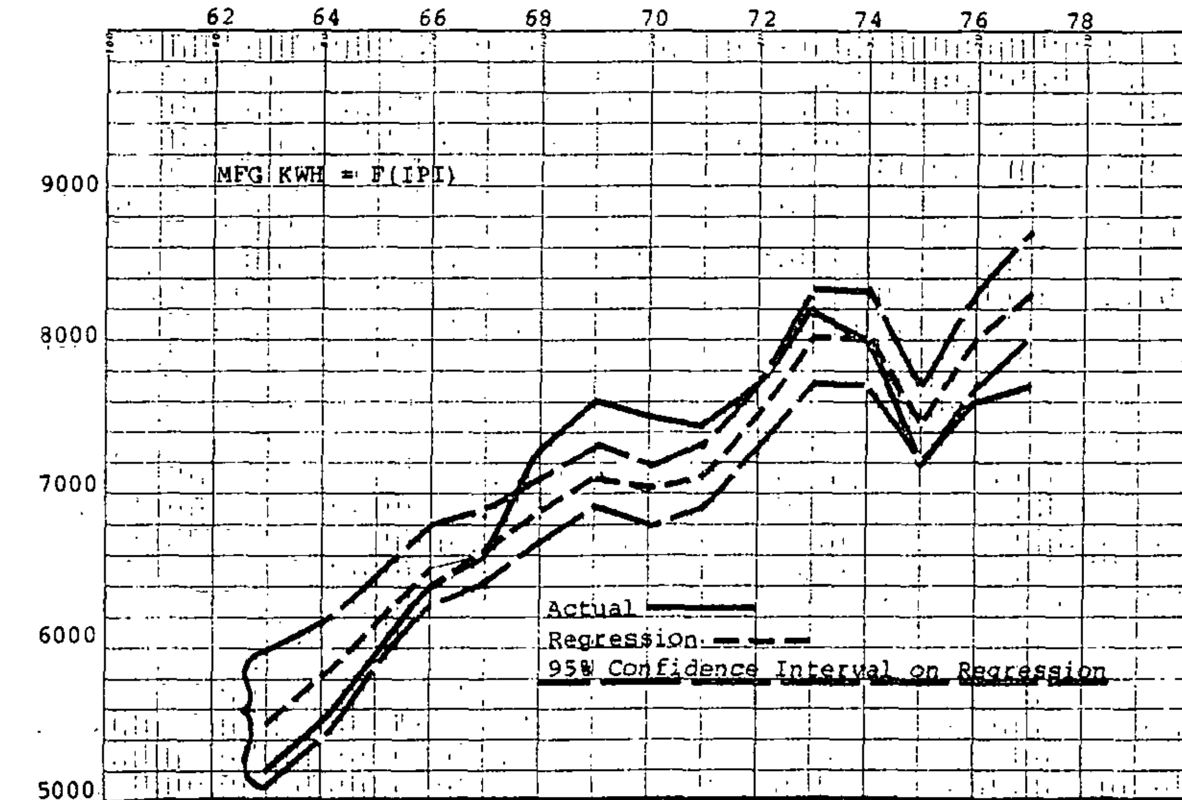


Figure 1

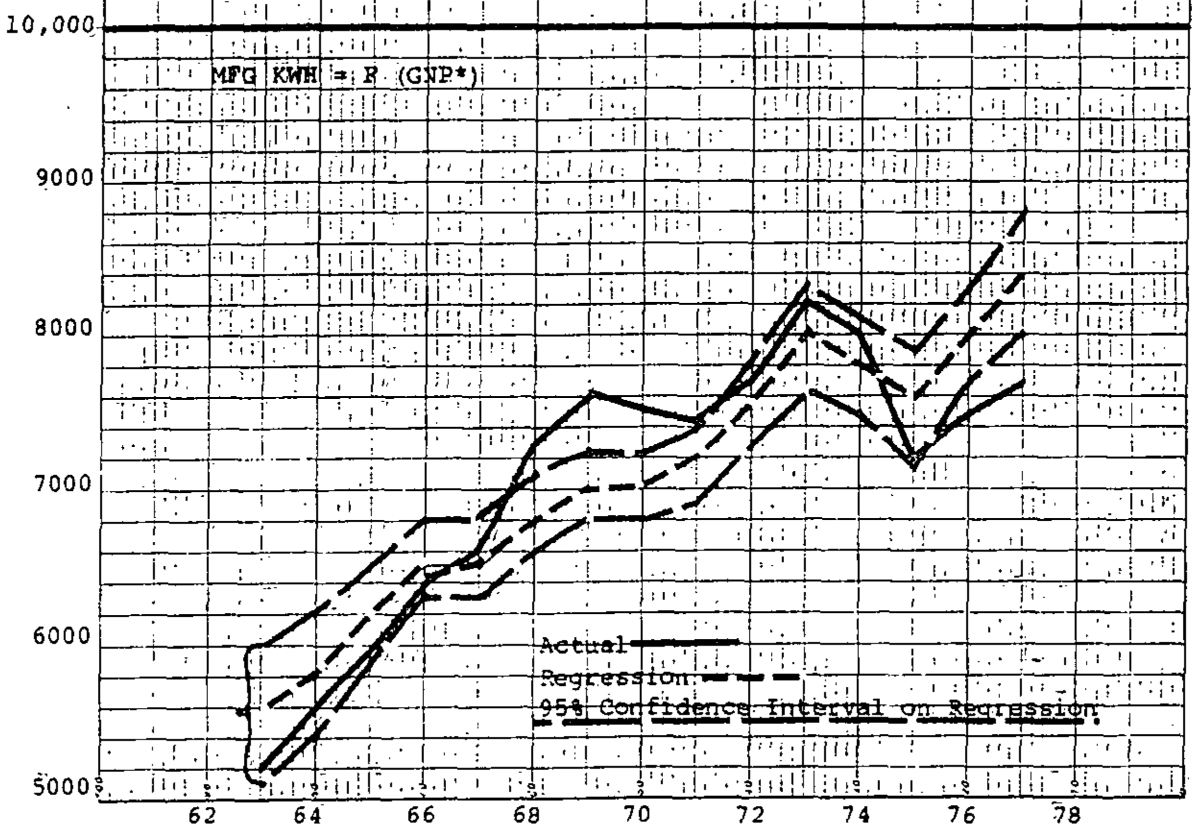


Figure 2

*Durable and nondurable goods plus fixed nonresidential investment.

FIGURE 3

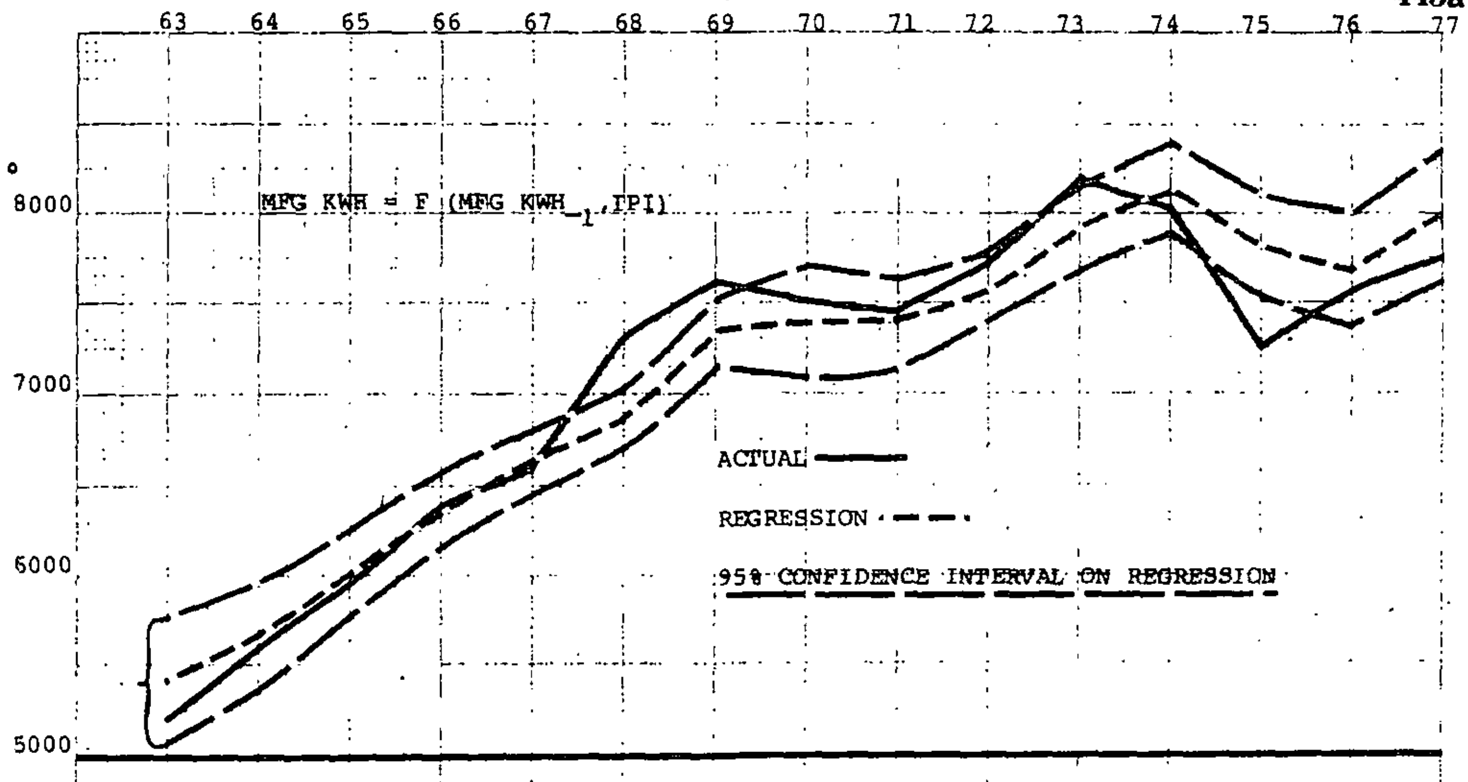
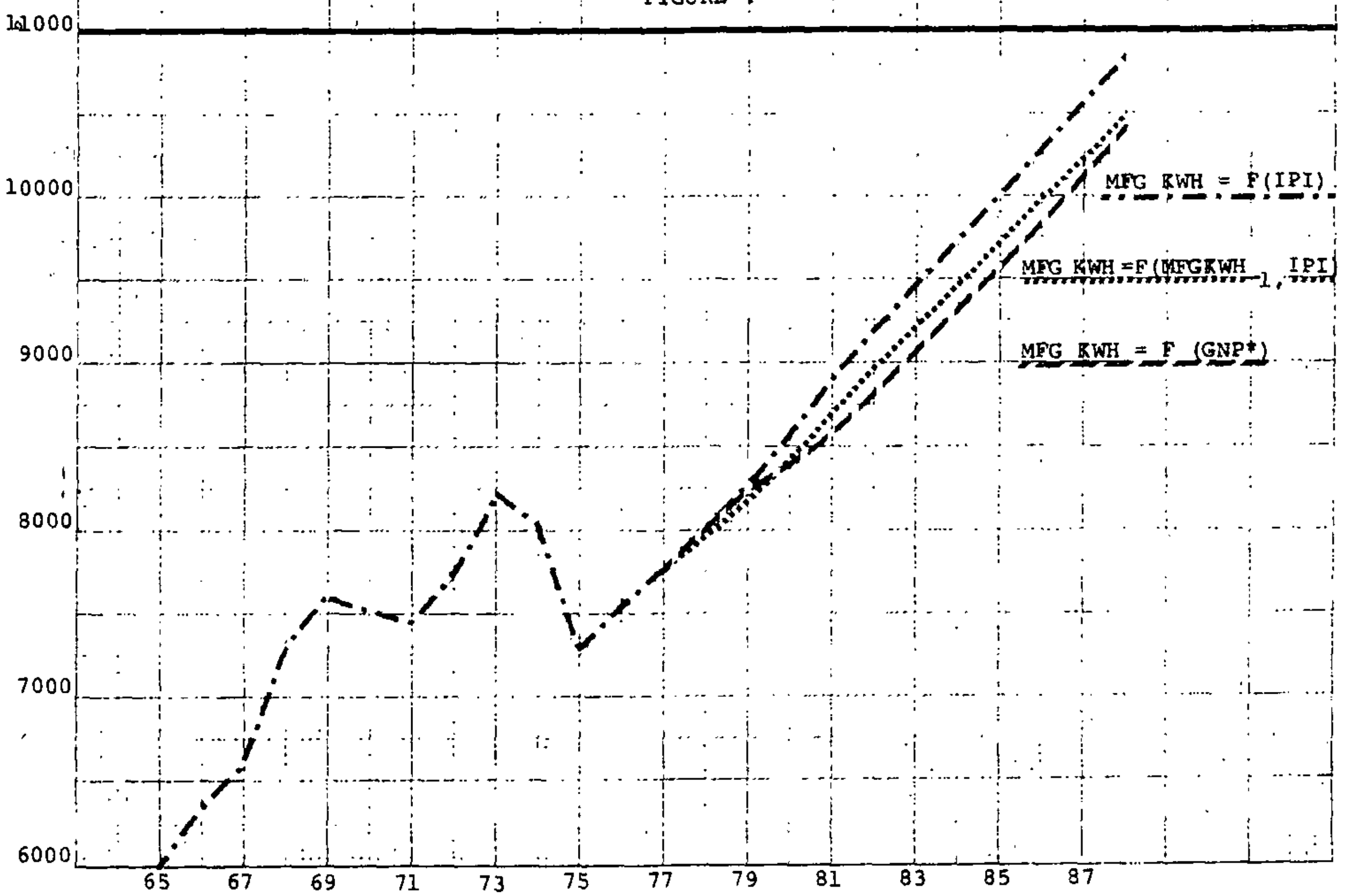


FIGURE 4



*Durable and nondurable goods plus fixed nonresidential investment.

Value Added - The possibility of forecasting by SIC with value added projections was investigated but, after a thorough analysis, was eliminated as a feasible method of forecasting large industrial sales. It was found to have a number of serious problems including the following:

1. Value Added is only available annually with a two or three year lag.

2. It is generally measured with considerable error, especially on a detailed level of industrial disagregation. Errors result from sampling error because, except for the Census of Manufacturing data, value added is obtained from sample surveys. Sampling errors of 5 percent or more are not uncommon, even at the two-digit SIC level.

3. To be useful, the value added data must be converted to "real" terms. The data necessary for this doesn't exist.

4. The correlation between national and local changes in value added is very poor.

Summary - The three methods used to arrive at forecasts of total large manufacturing sales provided comparable base case results. The manhour method produced a ten year growth rate (1978/88) of 2.7% while the industrial employment and regression methods both resulted in ten year growth rates of 2.8%. The Wharton Econometric Forecasting Associates' model, developed independently by them to forecast P.E. Co. sales, also shows a growth rate of 2.8%. A conservative approach was taken, and 2.7% was selected as the base case ten year growth rate which allows for the possibility of an intensified rate of conservation.

The low and high cases were derived by running the three regression models with low and high projections of the IPI and GNP*. The lowest result of 9,800 million kWh was selected for the low case, and this was adjusted downward by 300 million kWh in 1988 after analysis of the Large Ten customers to cover possible exceptional reductions or cancellations of planned increases in that group. The low estimate for 1988 is therefore 9,500 million kWh.

The high figures ranged from 10,640 to 11,950 million kWh and 11,500 was selected for the high case. This is in the center of the results obtained using the higher IPI and GNP values in models 1 & 2 and approximately the same as the results obtained from model 3 with the higher IPI value. The respective low and high ten year growth rates are then 1.7% and 3.7%. The WEFA model's low case is 2.0% and the high case is 3.5%.

*Personal consumption expenditures for durable and nondurable goods plus fixed nonresidential investment.

COMMERCIAL

The Commercial market consists of commercial and service-oriented customers grouped in the Other-Nonmanufacturing sector of the class designated by the Company as Large Commercial and Industrial and also the small commercial customers who make up approximately 90% of the Small Commercial and Industrial class.

Other Nonmanufacturing - is defined as large commercial sales excluding single-point-metered apartments (SPM apartments). It includes all Rate PD and Rate HT customers who are in SIC's 19 and below and 40 and above, except the SPM apartments which are included in SIC 66. This means that certain loads not always thought of as commercial are included in this class. Pipelines, transportation services, and electric, gas, water and sanitary services are among those included. Also included are governmental accounts on Rates PD and HT such as the Navy Yard and the Mint. Billing records indicate that approximately 15% of the total kilowatt-hours in the other nonmanufacturing class are consumed by these "noncommercial" type customers.

It is necessary to consider this "noncommercial" load separately because the physical plant facilities differ drastically from the "commercial" type loads. This is especially important when considering such factors as square feet per employee and conservation measures which apply to physical space. As examples, no square footage is associated with pipeline loads and there are very few employees per square foot for pipelines and water and sewer plants. It is also important when considering the impact of conservation legislation since the criteria applied to commercial uses do not apply to these other types of customers in many cases.

It is expected that the "noncommercial" load in this class will grow at a faster pace than the "commercial" load. During the 1974-77 period, total other nonmanufacturing grew at 3.0%. Oil pumping, however, grew at 4.8% and, based on present commitments, will grow at an above average rate in the future. Water and especially sewer facilities will be expanded to meet stricter environmental requirements such as the prohibition of the City of Philadelphia against dumping sewage waste in the ocean. Suburban areas must also expand or construct new sewage treatment plants to meet new standards. The U.S. Mint is expected to construct a large addition and expand its manufacturing facilities, and the Navy Yard is expected to get contracts to refit aircraft carriers which will also add considerable load.

Other Nonmanufacturing sales grew an average of 333 million kWh per year in the pre-embargo period from 1966 to 1972. The compound growth rate of sales for the same period was 7.9%. If 1973 was included, the figures would be inflated because of the record setting heat during the summer of that year. The annual changes in kilowatt-hours are shown below.

Million kWh

1966 - 324	1972	-	361
1967 - 244	1973	-	500
1968 - 391	1974	-	(181)
1969 - 346	1975	-	223
1970 - 341	1976	-	216
1971 - 324	1977	-	92
	1978	-	182 (10 mos. act. & 2 mos. est.)

In 1974, the oil embargo produced the first decrease in other nonmanufacturing sales since they were recorded separately beginning in 1960. During 1974, the customers in this class complied with the government's request to conserve fuel, and sales declined drastically. After the embargo, however, growth resumed and the average annual kWh increase for 1975 and 1976 returned to two-thirds of the average annual increase for the 1966-72 period. 1977 saw a rash of closings of large department stores, hotels, and supermarkets, but by mid 1978 most of these vacated buildings were occupied or being prepared for reoccupancy. Nevertheless, the fact that so many prime locations became available lessened the need for new construction.

As can be seen from the following table, commitments to construct new space or to add load in existing space hit a low point in 1977.

Commitments - Million kWh

1975 - 498
1976 - 382
1977 - 136
1978 - 270 (10 mos. act. - 2 mos. est.)

These commitments are expected to remain in the 250 million kWh per year range as the economy in the area recovers from the effects of the severe 1974-75 recession. An increase of this magnitude will support the forecasted 3.7% growth rate. One of the factors stimulating the commercial market is the Philadelphia Industrial Development Corporation. In 1977, PIDC assisted 20 commercial property transactions involving the construction or renovation of 508,200 square feet of space. These projects included the retention of 320 jobs and the creation of 1,275 new jobs in Philadelphia.(2) Indications are that the PIDC will be very active in future years in retaining present business and encouraging others to locate here.

Small Commercial & Industrial - is defined as those customers who are billed on Rates GS and GLP. Analysis of Company records reveals that 90% of the class is Commercial and 10% Industrial.

Small Commercial and Industrial sales grew an average of 72 million kWh per year in the pre-embargo period from 1966 to 1972. The compound growth rate of sales for the same period was 3.1%. If 1973 was included, the figures would be inflated because of the record setting heat during the summer of that year. For the 1975-1978 period, sales grew an average of 84 million kWh per year also at a compound growth rate of 3.1%. The annual changes in kilowatt-hours are shown below.

Million kWh

1966	84	1972	76
1967	38	1973	160
1968	131	1974	(105)
1969	37	1975	66
1970	72	1976	131
1971	63	1977	63
		1978	74 (10 mos act. & 2 mos est.)

In 1974, the oil embargo produced a decrease in Small C & I sales. Available records for this class go back to 1945 and 1974 was the only year in which kWh consumption decreased.

The growth rate for the 1978/88 forecast period is expected to decline to 2.2% for several reasons. This class has had and is expected to continue having a high saturation of electric space heating in new construction plus a continuation of several hundred customers converting to electric heat each year. With the increasing rapid acceptance of the heat pump at the expense of resistance type heating, however, total electric heating kilowatt-hours will not increase as rapidly as in the past. Another factor contributing to slower growth will be the effects of ASHRAE 90-75 type standards which will lower heating and air conditioning requirements as well as lowering the requirements for other type loads.

ASSUMPTIONS

(See also general assumptions in the first section).

1. CONSERVATION (Existing Buildings) - An analysis of 25 customers in the other nonmanufacturing class who were on system in 1973 and who had made no building structural changes through 1977 revealed that they lowered their electric consumption by 12.9% over the four year period. According to Binswanger/Herman,(9) who manages thirty-two Delaware Valley commercial and industrial buildings, a 15% reduction in energy conservation can be obtained by reviewing the building equipment, good maintenance, and educating personnel. Projecting the findings from the sample to this entire class of customers, existing buildings owned or operated by these customers have apparently reached the point where housekeeping measures to reduce electric consumption have nearly been exhausted. Therefore, future conservation measures will involve engineering and cost analysis studies and capital expenditures.

In the small commercial class, much of the space is rented and the tenants are billed directly by P.E. Co. These customers can conserve by taking limited noncapital involved steps such as using less lighting, reducing the number of air changes, etc. They are reluctant, however, to make capital expenditures because they do not own the building. On the other hand, as was brought out at the New York State Energy Conference(10), landlords are reluctant to install energy efficient equipment or improvements because the tenant is the one who derives the benefits of the energy savings. The only way the landlords can recoup their investment is by raising rents, and this wipes out the energy savings realized by the tenants. In addition, the tenants' business would be interfered with while renovations were being made. Because of these problems, capital investment in energy savings in the small commercial sector is expected to be minimal.

In large commercial buildings such as office buildings and shopping centers, the owners lease much of the space. The owner is billed on either rate PD or HT and includes the utility costs (plus a nominal profit) in the rent charged the tenants. Of the 174 members of the Philadelphia Building Owners and Managers Association, only 25% represent buildings which are totally owner occupied, and this is typical of the Philadelphia area. Under this situation, the owner has little control over how his tenants use electricity. As was also brought out at the New York State Energy Conference (10), "submetering in most commercial and residential buildings would generate energy savings of 10-20 percent". For the owner to submeter a large building, however, would be physically very difficult and also very costly. There is, therefore, little incentive to make capital investments in energy saving equipment or material in these types of buildings.

2. CONSERVATION (New Buildings) - Governmental agencies will continue to encourage energy conservation, and standards based on ASHRAE 90-75 are expected to be promulgated by the State of Pennsylvania in 1979. The Governor vetoed a bill with these provisions in the Fall of 1978 because he considered it too complicated to administer. The legislation will apply to new construction and to structures being renovated. A strict interpretation of ASHRAE 90-75 would reduce electric light and power consumption by 30% (as compared to a structure built prior to the 1973/74 oil embargo) in new office buildings and retail stores.(11) It could also cause average annual electric space heating use to decline from the present 9 kWh per square foot, in new construction, to 7 to 8 kWh per square foot.

A fact which must be borne in mind when assessing the impact of ASHRAE 90-75, however, is that many of its requirements have already been implemented by designers and constructors of buildings. This is evidenced by the reduction of kilowatt-hours per square foot for electric space heating and air conditioning for buildings constructed in P.E. Co's. territory since the oil embargo. The following table illustrates this.

Other Nonmanufacturing Customers
Kilowatt-hours per Square Foot

Year	Electric Space Heating	Air Conditioning
1974	13.5	9.5
1975	11.7	9.2
1976	9.5	7.9
1977	9.5	6.7

3. CONSTRUCTION - For construction in specific SIC's in the other nonmanufacturing class, refer to the individual SIC discussions in the Commercial Forecasting Methodology and Results section. That same section also describes the method used to determine total annual new commercial construction.

4. ELECTRIC SPACE HEATING - Electric space heating is expected to be the preferred source of heat by customers constructing new space during the forecast period. In 1974, 36% of the new large commercial (other-nonmanufacturing) space installed electric heat. The saturation increased to 44% in 1976 (excluding an oil heated warehouse of 1,100,000 square feet), and to 61% in 1977. During the first ten months of 1978, 65% of the newly committed construction will install electric heat. For the base case, it is assumed that 50% of future other-nonmanufacturing space will be heated electrically since gas sales will reopen in 1979. Recent history and the forecasted prices of competitive heating fuels support this level.

In the small commercial and industrial class, the present saturation of electric space heating is expected to continue until gas becomes available for new customers in 1979. Presently 70% of the new small commercial and industrial customers install electric heat. For the base case, it is assumed that 50% of the future new customers will install electric heating after gas becomes available.

Of the new small commercial and industrial space heating customers in 1978, 40% are installing heat pumps. This percentage is expected to increase to 70% by 1988. It has only been in the past few years that residential and commercial heat pumps have been actively promoted by manufacturers, distributors, and electrical contractors. Their acceptance has been quite rapid and, as they become even better recognized as an efficient heating system, it is expected that their saturation will increase.

A plus factor for the heat pump is that it can be installed either on the roof or on the ground next to the building. This is an important consideration for the small commercial customers since interior space is very costly and extremely valuable. Another plus factor for electric space heating in both the large and small commercial markets is that the insulation and fenestration standards required by ASHRAE 90-75 type legislation will provide low heat loss building envelopes which are conducive to the installation of electric heat.

For the low and high cases, the assumptions for both the other nonmanufacturing and small commercial and industrial classes are the same. The low case is based on unexpected reductions in the future relative prices of oil and gas while the high case is based on a continued freeze of new gas sales and higher relative oil prices. In all three cases, the kWh per square foot attributable to electric heat will decline from 9.0 kWh in 1978 to 7.0 kWh per square foot in 1988 to reflect governmental regulations concerning building design.

5. GAS - Under condition's established in an order of the Pennsylvania Public Utility Commission, we could not sign new contracts for gas service after February, 1972. With the recent improvement in the gas situation, it is expected that in the base and low cases gas sales to new and existing customers will be reopened in mid 1979. After 1979, it is expected that 30% of the new customers in this class in our gas franchise area (excludes the City of Philadelphia) will install gas space heating. It is also expected that most of the customers who will install gas heat would have installed oil heat if gas were not available. The Philadelphia Gas Works, which supplies gas in the City of Philadelphia, reopened gas sales in the Spring of 1978. Indications to date also indicate that those customers who are installing or intend to install gas heat are those who would have taken oil if gas were not available. The high case assumes additional gas will not be available during the forecast period.

6. AIR CONDITIONING - In line with actual experiences of the past several years, it is forecast that 65% of new other-nonmanufacturing space and new small commercial space will be air conditioned. The connected watts per square foot for new air conditioned space is expected to decline from 4.4 watts per square foot in 1978 to 3.5 watts by the end of the ten year forecast period. This reduction is expected because of the more energy efficient design of future buildings. Conversion of space from non air conditioned to air conditioned will remain relatively low reflecting the fact that a high degree of air conditioning saturation has already taken place in the commercial market.

   The average estimated equivalent hours of full load operation for small commercial and industrial customers is 760 hours per year for existing cooling equipment, which is a mixture of room coolers and central plant. For new customers, both other-nonmanufacturing and small commercial and industrial, 1,200 equivalent hours of full use is assumed since new customers install central air conditioning.

7. SERVICE EMPLOYMENT - Service employment by SIC was obtained from the Pennsylvania portion of the Wharton Econometric Forecasting Associates' model of the Philadelphia SMSA.

8. RATES - *It is assumed that there will be no major change* in the relationship between Rate GS, the major Small C & I rate, and either Rate PD or HT, the Large C & I rates, during the forecast period.

9. NUMBER OF CUSTOMERS - The total number of small commercial and industrial customers decreased each year from 1955 until 1975. These decreases were mainly the result of "mom and pop" neighborhood stores going out of business and the demolition of older residential and business areas for potential redevelopment. With very few exceptions, the customers lost were nonelectric heat. There were, however, net gains of 526 customers in 1976 and 461 in 1977. This trend is expected to continue for the forecast period with the number of new customers added exceeding the number which go out of business. The net result, therefore, is a moderate annual growth in the total number of customers.

10. SOLAR ENERGY - During the forecast period, solar energy will be used by a small but increasing number of small commercial and industrial customers for water and space heating. As of mid 1978, there were five small commercial and industrial customers with solar heating systems either installed or being installed. By 1988, this number is projected to increase to approximately 250 customers. The impact of solar energy on the class is, therefore, expected to be negligible.

11. ELECTRIC VEHICLES - It is assumed that commercial electric vehicles will contribute little to electric consumption during the 1978-88 forecast period. Although General Motors is a leading proponent of electric vehicles as special purpose cars and trucks and American Telephone & Telegraph will convert its light duty fleet to electric if their present experiment with electric vehicles is successful(12), it is expected that significant acceptance of commercial electric vehicles will not result until after 1988. It is also assumed that electric truck batteries would be recharged at night so that system peaks will not be impacted.

12. SINGLE-POINT-METERED APARTMENTS - The forecast is based on 1,000 units being constructed in 1979, 1,000 units in both 1980 and 1981, and no further construction after 1981. The assumption is that apartments will be built, but individual meters will be installed because single-point-metering is in disfavor due to the difficulty of transferring increased costs to tenants. This assumption applies to all three ranges. The low range assumes that the tenants' conservation efforts will be intensified and that more efficient appliances will be produced and installed. The high range allows for less conservation.

For the Other Nonmanufacturing class, each of the major two digit SIC's were analyzed to determine past history and future potential for change. Data concerning the future for both the Other Nonmanufacturing and Small C & I classes was obtained from the computerized reporting system used by our service representatives as well as by direct communication with them. Discussion of the major two digit SIC's follows.

Four methods were used to forecast Other Nonmanufacturing commercial sales. These methods were kilowatt-hours per manhour by SIC; Other Nonmanufacturing kilowatt-hours per person in the population; various regression analyses; and commercial square footage. The method used to forecast the Small C & I class was square feet per employee to which various end use factors were applied. The discussion of each of these methods follows the discussion of the two digit SIC's.

DISCUSSION OF OTHER NONMANUFACTURING TWO DIGIT SIC's

Office Buildings

Δ % kWh from previous year

1967 - 6.6	1971 - 9.3	1975 - 6.0
1968 - 10.8	1972 - 10.5	1976 - 5.3
1969 - 10.6	1973 - 15.6	1977 - 1.9
1970 - 11.0	1974 - (2.0)	

During the past four years, there has been little new office building construction so that most of the previously over-built space has been filled. The unoccupied rate has now dropped to 11%, which is very close to the trigger point where new office construction starts. There is very little Class A space available. According to the 1978 Plant and Office Location Guide (9) there is a definite lack of space for major users who need a lot of space together. Only one center city building could provide a tenant with 200,000 square feet of contiguous space and only three could come up with 100,000. Construction was started in the summer of 1978 on a large office building, the SmithKline Building. Also an office building of 600,000 square feet is proposed by the Rouse Co. near Ninth and Market Streets in Philadelphia.

The growth in use of computers and data processing equipment is expected to exert a very positive influence on electric consumption by office buildings. A study of energy consumption in 50 office buildings in the City of Philadelphia was made in 1974.(13) The variables examined were building age, condition of building, average occupancy, type of HVAC system, gross square footage, owner occupied or leased, and presence or absence of computers, data processing equipment and support facilities (identified as CDS). Analysis showed that the major factor affecting energy consumption was the presence of CDS. In many of the buildings the systems i.e., HVAC, lighting, elevators, food handling, etc., were operational to support extended data processing operations which, in some instances, were carried on around the clock. Also, the data processing and related activities affects energy consumption in that the HVAC system (often using reheat) consumes more energy to provide the temperature and humidity specified for data processing equipment. With the use of computers growing rapidly(14), this will result in increased electric consumption by office buildings. Exhibit C-I illustrates the difference in electric consumption between buildings located in Philadelphia with and without CDS.(13) The age of the buildings surveyed ranged from two years to 85 years. A similar study was made by the FEA in Baltimore, Maryland and the same results were found. (15)

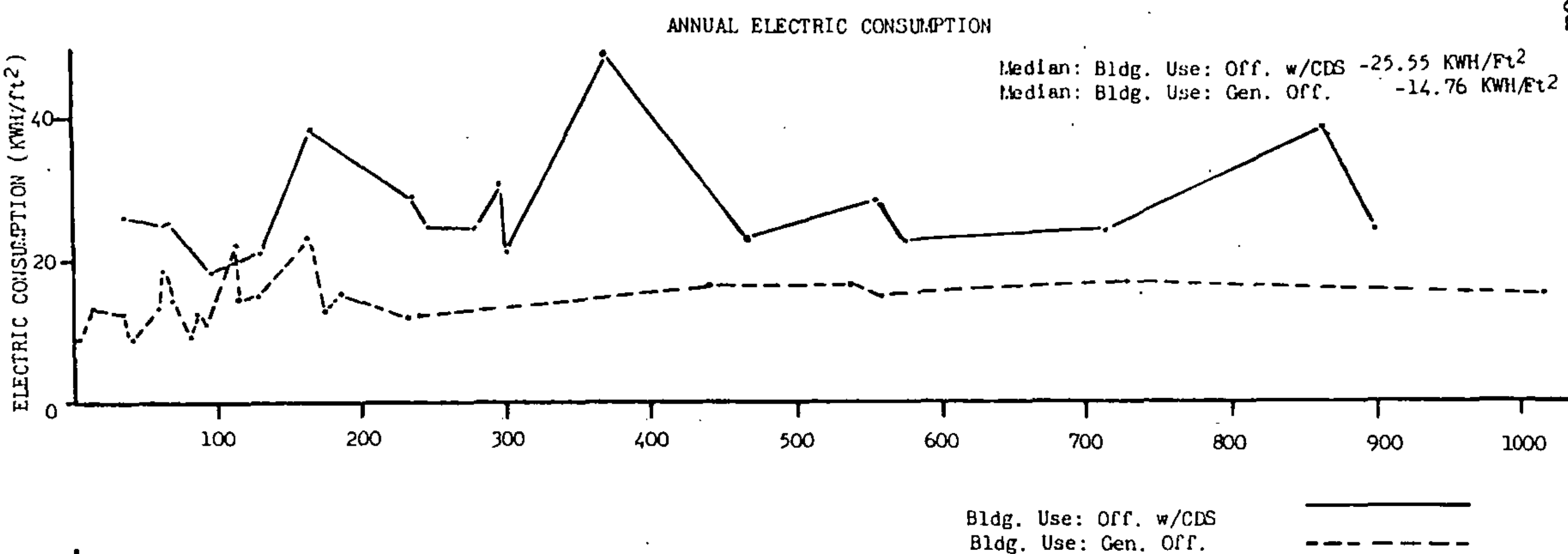
Another factor which will result in greater use of all building facilities is the increasing trend towards flexitime. More and more employers are allowing employees in commercial type jobs to work hours which suit their lifestyle. With workers being in the buildings both before and after "normal" working hours, energy consumption can be expected to increase.

Wholesale and Retail Trade

Δ% kWh from previous year

1967 - 7.9	1971 - 4.9	1975 - 2.6
1968 - 7.4	1972 - 6.7	1976 - 1.7
1969 - 6.7	1973 - 7.8	1977 - 1.9
1970 - 6.2	1974 - (4.0)	

The growth in this group over the past several years has slowed because of the recession and conservation. As a result of poor business conditions in 1974 and 1975, many prime business locations were vacated. As examples, nine Lit Brothers locations, 26 Grants' stores, 3 S. Kleins' department stores, 37 Dales and Penn Fruit stores, and a number of A & P markets were closed. With few exceptions, these locations have now been occupied by other customers. Because these were prime locations, it was advantageous for the new owners to purchase the properties rather than build at less desirable sites. As a result, this had a dampening affect on new construction. Now that these prime locations are occupied, customers desiring to expand or relocate must construct new buildings which should exert a positive influence on consumption by this group of customers.



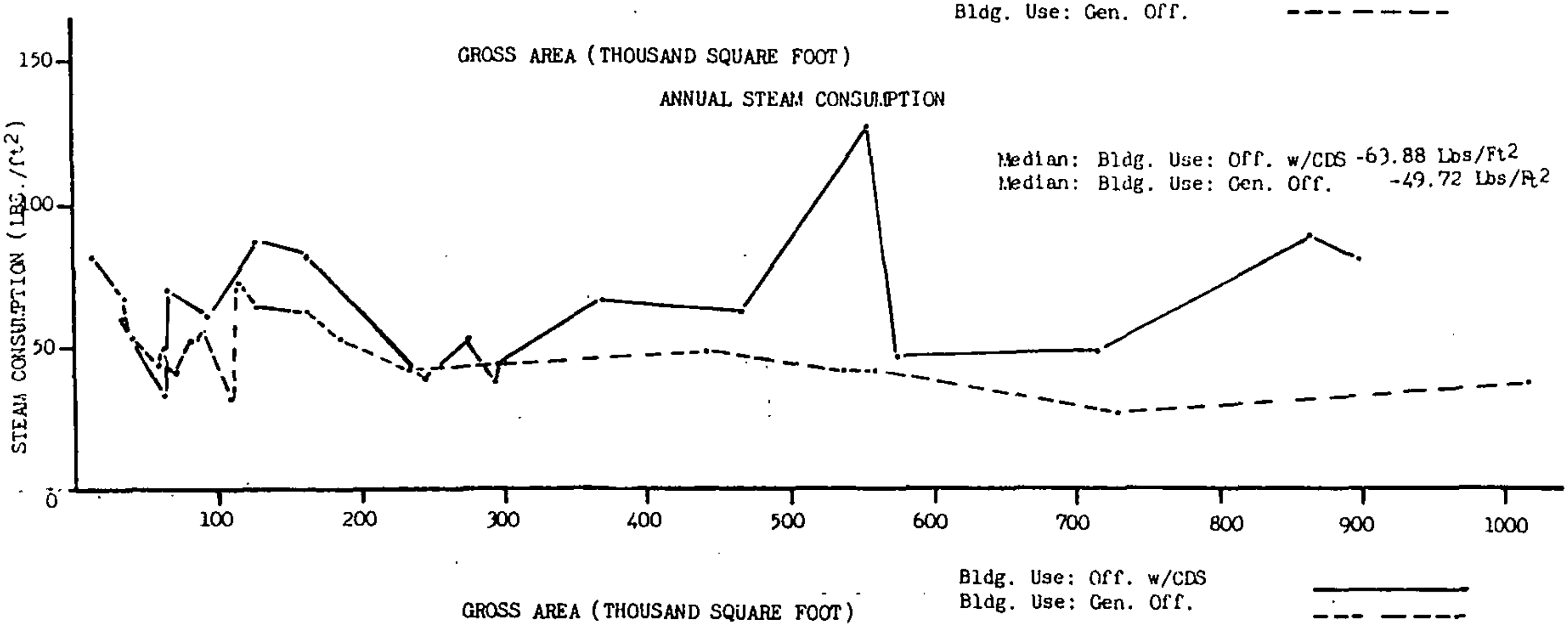


Exhibit C-1

SOURCE: National Electrical Manufacturers Association, "Energy Consumption in Commercial Buildings in Philadelphia", NEMA Study, 1974.

Shopping centers are included in this group and indications are that after two large centers now planned are constructed future shopping centers will be on a smaller scale. Limited availability of suitable building sites and zoning and environmental restrictions are the limiting factors, per the president of the Rouse Co. one of the most prominent developers of shopping areas.(16) They expect, however, to see more small localized shopping centers which should counter-balance the lack of large shopping centers.

Government

Δ % of kWh from previous year

1967 - 5.0	1971 - 6.1	1975 - 5.4
1968 - 9.1	1972 - 4.6	1976 - 3.2
1969 - 7.1	1973 - 4.4	1977 - (1.0)
1970 - 5.3	1974 - (5.7)	

This group includes federal, state, and local government installations on Rates PD and HT. All the Philadelphia public schools on Rates PD and HT are also included. The decline in consumption during 1977 was primarily the result of the Frankford Arsenal closing, the phasing out of Philadelphia General Hospital, and the partial phasing out of Norristown and Philadelphia State Hospitals. There are, however, good growth prospects for this group of customers in the "noncommercial-space" segment. The State Legislature has passed a bill requiring some primary sewage treatment plants to be converted to the secondary level. Also, the City of Philadelphia has been ordered to cease dumping treated sewage in the ocean which means processing equipment will be required. In addition, the Philadelphia Naval Yard is gearing up to handle the reconditioning of the Saratoga and possibly three other aircraft carriers, and this load will peak in the early 1980's and continue for several years. According to a study made by Wharton Econometric Forecasting Associates for the City of Philadelphia, twelve thousand jobs will be created in the Philadelphia area by doing the reconditioning work here.(17)

Utilities

Δ% kWh from the previous year

1967 - 1.3	1971 - (0.3)	1975 - (0.6)
1968 - 7.4	1972 - 5.5	1976 - 0.9
1969 - 6.1	1973 - 6.0	1977 - 2.6
1970 - 6.1	1974 - (2.7)	

Included in this group of customers are telephone companies, suburban water companies, Philadelphia Gas Works, radio and TV stations, and transportation terminal facilities such as the 30th Street Station. Growth in this group is expected at 3% per year as new facilities are added and modernized to meet their customers' needs.

Oil Pumping

Δ% kWh from previous year

1967 - 12.4	1971 - 1.3	1975 - 1.4
1968 - 21.4	1972 - 11.1	1976 - 6.0
1969 - 6.1	1973 - 8.6	1977 - 7.2
1970 - (1.0)	1974 - (4.3)	

Consumption by this class is closely tied into economic conditions. This is evidenced by the decline in consumption in the years of 1970 and 1974 which saw the beginnings of recessions. New pumping stations, of course, also influence consumption. At present, there are two stations under construction which will use a total of 46 million kWh per year, and there are two proposed stations which will consume a total of 25 million kWh per year. This compares to 1977's consumption of 93.2 million kWh for this class of customers.

Schools and Colleges

Δ% kWh from previous year

1967 - 17.3	1971 - 17.2	1975 - 0
1968 - 21.3	1972 - 12.1	1976 - 10.7
1969 - 17.6	1973 - 13.1	1977 - (0.6)
1970 - 13.7	1974 - (2.7)	

Since the birth rate is declining, school construction, once a major source of activity, ostensibly has run its course. It is expected that load from new construction and additions will be offset by school closings.

Hospitals

Δ% kWh from previous year

1967 - 15.1	1971 - 8.7	1975 - 11.3
1968 - 19.0	1972 - 8.4	1976 - (0.7)
1969 - 13.2	1973 - 15.7	1977 - 6.9
1970 - 9.6	1974 - 4.1	

Hospital construction in our service area is proceeding at a rapid rate. The following is a list of hospitals which either have space under construction or in the planning stages.(18)

Hospital Space Under Construction or Planned

Hospital	Square Feet
Coatesville	198,000
Wills Eye	225,000
St. Lukes and Childrens Med. Ctr.	Not yet determined
Graduate	250,000
North Penn	150,000
Pa. Drug & Alcohol Rehab. Ctr.	60,000
Parkview	Not yet determined
Friends	100,000
Crozier Chester Med. Ctr.	3,000
Bryn Mawr	40,000
Lankenau	100,000
Delaware Memorial	50,000
Rolling Hill	120,000
Haverford	63,000
Hahnemann	474,000
Medical College of Penna.	150,000
Jefferson	1,400,000
Germantown	160,000
Total	3,543,000 plus two not as yet determined

In addition to construction normally thought of as hospitals, nursing homes or retirement centers with in-house medical facilities are also included in this group of customers. As of May, 1978, twelve customers of this type either have buildings under construction or in the planning stages with a total capacity of 1,285 beds.

Hotels and Apartments - (Excludes Single-Point-Metered Apartments)

△ % kWh from previous year

1967 - 2.7	1971 - 17.8	1975 - 1.8
1968 - (3.4)	1972 - 6.4	1976 - 8.8
1969 - 30.6	1973 - 9.9	1977 - (5.9)
1970 - 8.2	1974 - 3.1	

1977 saw a negative growth in kilowatt-hours as the Bellevue Stratford closed and the Warwick was remodeled into electrically heated condominiums, which now fall in the residential class. With a severe shortage of hotel space, the Bellevue (Fairmont) is now in the process of being renovated and construction of a large hotel in the Franklintown area has started. Over the next several years this will exert a strong positive influence on kilowatt-hour consumption by this group.

FORECASTING METHODS FOR OTHER NONMANUFACTURING

Manhours - This method used historic and forecasted manhours and kilowatt-hours per manhour for the various commercial SIC's. Manhour data was obtained from the Pennsylvania portion of Wharton Econometric Forecasting Associates' (WEFA) model of the Philadelphia SMSA. The manhour data from the model was available from 1969. Using Company sales by SIC and the WEFA manhours, the growth rates in kilowatt-hours per manhour by SIC were calculated for the 1969-77 period. This time period covers a period of slow economic growth and the conservation induced by price-elasticity as well as other efforts to save energy from the time of the 1973 oil crisis.

These growth rates were then applied to WEFA's forecasted manhours to 1988. The product of manhours and kilowatt-hours per manhour produced the forecast of kilowatt-hours for each of the two digit SIC's. The exception to this procedure was single-point-metered apartments which were excluded from commercial because they are residential and are shown separately in the forecast.

The sales estimate produced by the manhour method is 10,695 *million kilowatt-hours for 1988 for Other Nonmanufacturing.*

Commercial Employment - The total population history for the Philadelphia Electric Company service area was obtained for the 1965-1977 period. The average P.E. Co. nonmanufacturing kilowatt-hours per person in the population was next determined for each of the historic years, after first weather correcting each year's sales. This historic average kilowatt-hour data was then projected on a curve and applied to the Company's population model to obtain estimated sales for each year through 1988. Since single-point-metered apartments are included in total nonmanufacturing, they were deducted. To obtain system sales, other nonmanufacturing sales for Conowingo Power Company were added. This method resulted in 9,355 million kilowatt-hours in 1988 for the base case. The low and high cases are 8,463 million kWh and 9,868 million kWh respectively.

Other Nonmanufacturing Regressions - Sales in the "Other Nonmanufacturing" category were analyzed relative to subsets of the following independent variables:

Gross Regional Product 1972$ - Phila. SMSA (7)
Real Disposable Income 1967$ - Phila. SMSA (7)
Services Component of Gross National Product 1972$ (7)
Value Added in Nonmanufacturing 1972$ - Phila. 5-County Area (7)

All plausible combinations of variables were examined including lags of dependent and independent variables. The following models were selected due to the reasonableness of their structure, their statistical properties and their observed behavior over the estimation period. A brief discussion of each model follows its presentation.

Model 1:

$$\underset{}{\text{KWH NONMFG}} = \underset{(-2.89)}{-1655.9} + \underset{(12.09)}{21.3}\ \text{GNP*}$$

$R^2 = 0.942$, F = 146.1, RMS Error = 205 (3.9% of mean KWH NONMFG)

Model 2:

$$\text{KWH NONMFG} = \underset{(-2.53)}{-2812.1} + \underset{(3.15)}{0.2647}\ \text{YPD} + \underset{(13.18)}{0.7597}\ \text{KWH NONMFG}_{-1}$$

$R^2 = 0.992$, F = 535.1, RMS Error = 73 (1.4% of mean KWH NONMFG)

Model 3:

$$\text{KWH NONMFG} = \underset{(-5.33)}{-6163.2} + \underset{(6.77)}{14.1}\ \text{GNP*} + \underset{(4.08)}{0.4324}\ \text{YPD}_{-1}$$

$R^2 = 0.981$, F = 208.7, RMS Error = 116 (2.2% of mean KWH NONMFG)

* Services component of Gross National Product

Model 1

This model relates nonmanufacturing sales to the services component of the real Gross National Product. Since the majority of sales in nonmanufacturing go to the services industry it is reasonable that such a model would provide a good fit to the kWh consumption in this sector.

The behavior of this model over the estimation period is shown in Figure 1 and confirms the prior expectations about this model:

1. The statistical fit is good,

2. The later years of the model overestimate sales which is logical given the lagging nature of the Philadelphia regional economy.

The model has good forecasting properties in that it picks up most turning points and encompasses the actual data in a 95% confidence interval for a majority of the sample points.

This model was forecast using the Wharton National model. To improve the reasonableness of the forecast, the Model results were adjusted down in each year of the forecast by the forecast error experienced in 1977. The forecast is shown in Figure 4.

Model 2

Real disposable personal income and the lagged value of kWh sales to the nonmanufacturing sector are the determinants of kWh sales in this model. These two variables combine the notion of a partial adjustment process relative to kWh sales and the reasonable assumption that the service industry is responsive to the real income level of consumers. As seen by the statistics for the model, the combination of these variables results in an excellent fit to the data over the sample period.

The behavior of this model over the estimation period is shown in Figure 2 and demonstrates the validity of this formulation. As expected, the inclusion of the lagged dependent variable explains the inertial effect of kWh sales as reflected in a more random error term than that of Model 1.

The model tracks the data well and includes the sample points in a tight 95% confidence interval for nearly every sample point.

The model was forecast using the Philadelphia Regional Economic Model developed by Wharton Econometric Forecasting Associates, Inc. To ensure a more reasonable forecast, the forecast error in 1977 was used to reduce the forecast for kWh sales in each year of the forecast. This forecast is shown in Figure 4.

Model 3

The services component of real Gross National Product and real disposable personal income comprise the last model for nonmanufacturing sales. These variables represent similar determinants of sales in this sector with the addition of a lag on the income variable which attempts to pick up the notion that the services industry does not respond immediately to changes in consumer demand (as represented by the income variable).

The behavior of this model over the estimation period is shown in Figure 3. As can be seen, this model also tracks the data very well and encompasses almost all of the sample points in a 95% confidence interval.

The model was forecast from the same data sources as Models 1 & 2 and was also adjusted in each year of the forecast by the error in 1977. The forecast is shown in Figure 4.

The three forecasts shown provide a range of kWh sales in 1988 from 10,020 MMKWH to 10,750 MMKWH, a spread of approximately 11% of 1977 sales. A calculated prediction interval for Model 1 for the 1988 value is ± 1060 MMKWH. Such an interval was not calculated for Models 2 & 3 but would be expected to be in the same area given the similarity in the nature of all three models.

In summary, the three models presented represent a reasonable estimate of future kWh sales to the "Other Nonmanufacturing" sector. The forecasts of these models can be expected to be slightly above realizable consumption since the models capture only price related conservation, thus any mandated conservation in this sector beyond that related to a rational economic choice on the part of the investor would not be included in the forecasts of these models. The models are sound assessments of existing behavior of this class for several reasons:

FIGURE 1

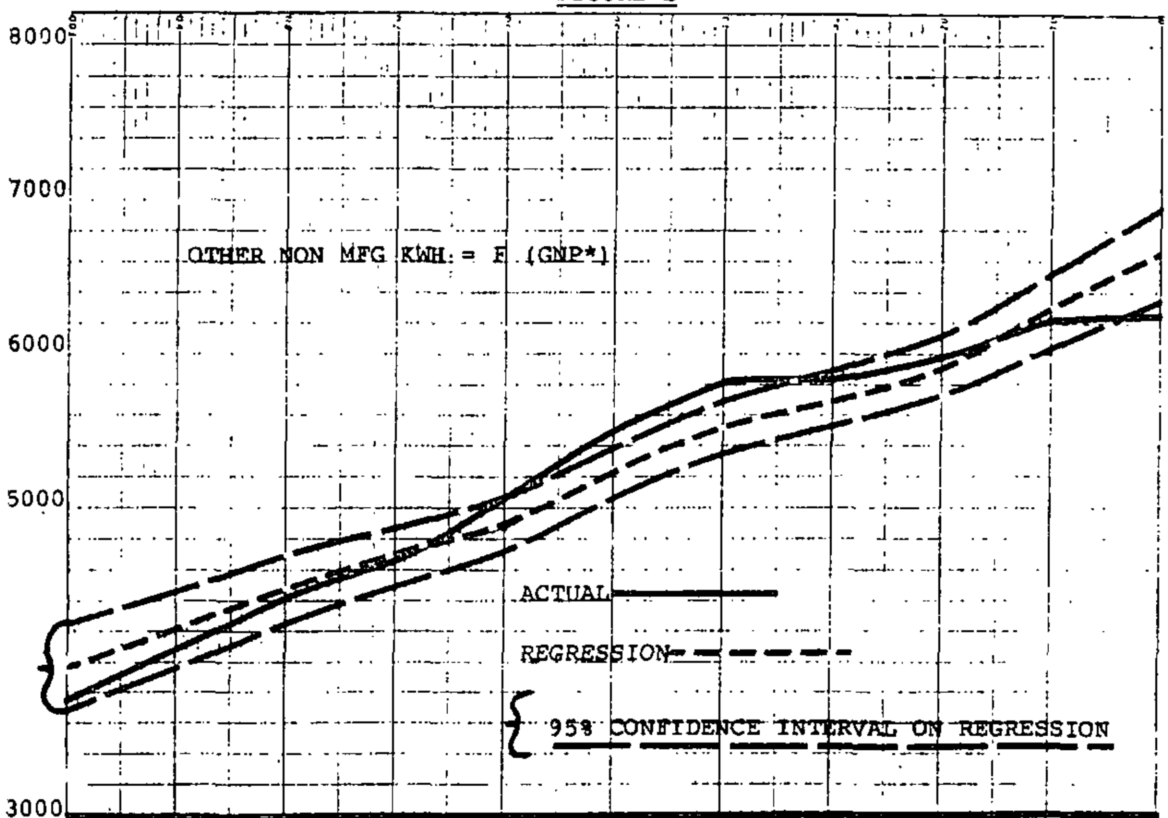
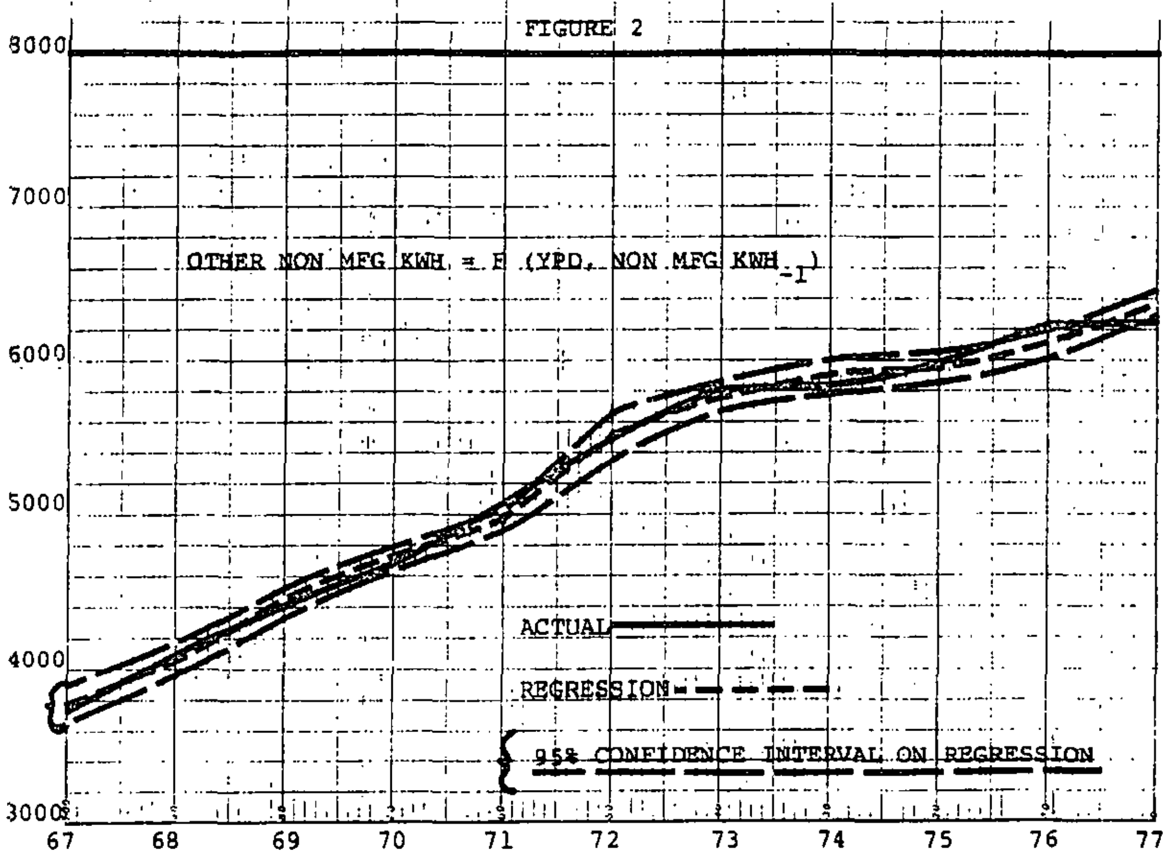


FIGURE 2



*Services component of GNP.

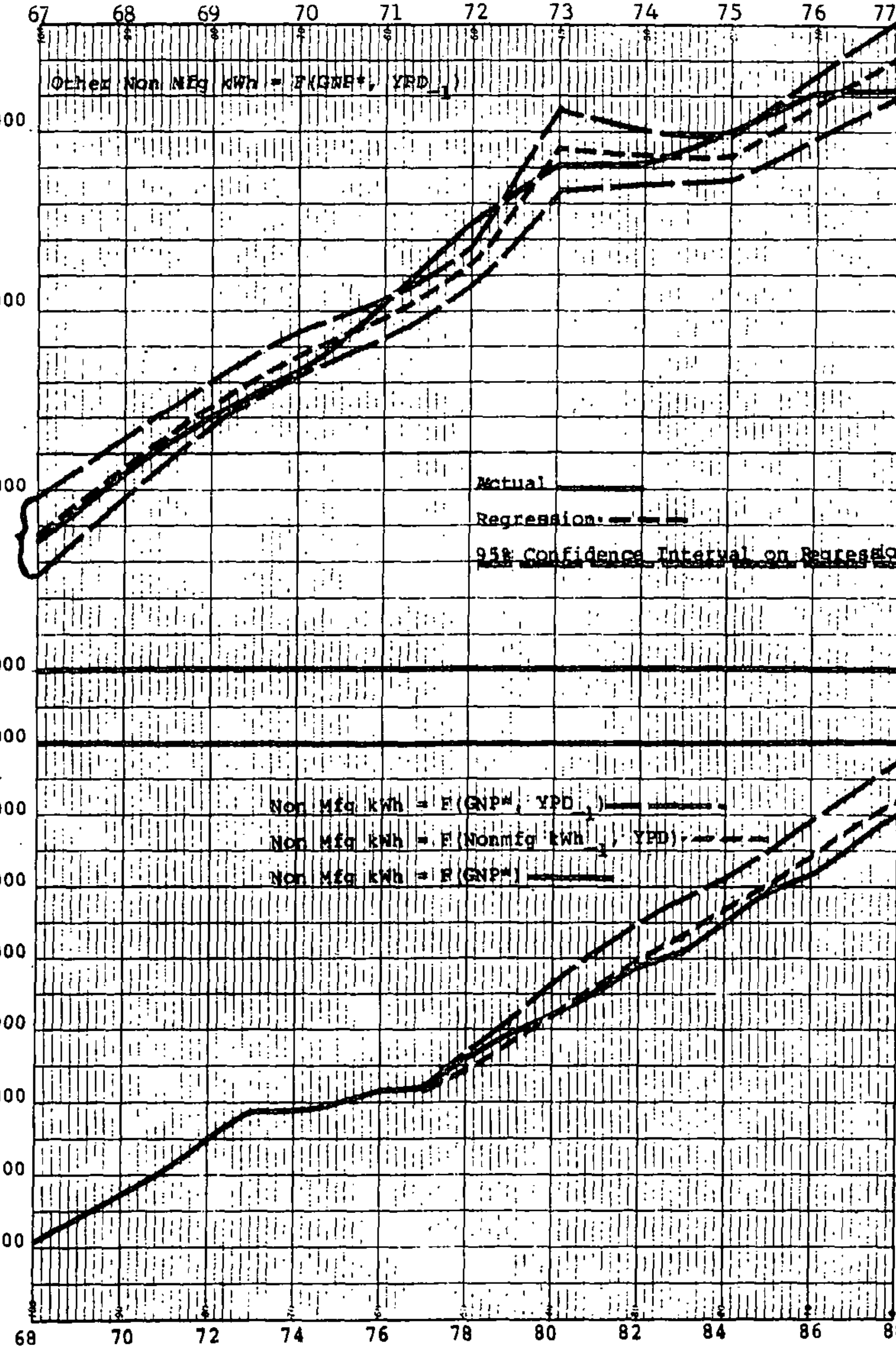


Figure 4

*Services component of GNP.

1. The estimation period includes movements of all variables in both directions and covers a wide range of economic conditions related to this sector.

2. The models have good statistics in all pertinent areas - RMS Error, R^2, t's, and turning points, and

3. The models' forecasts incorporate the respective 1977 forecast error to take account of the low growth in sales from 1976 to 1977.

Commercial Square Footage - This method is based on square feet per commercial employee and the number of nonmanufacturing employees in the labor force. Since there is no adequate and comprehensive estimate of commercial square feet available for our area or region, national data was used to develop it. According to the former FEA's "Project Independence Report", there was an estimated 21.616 billion square feet of commercial space in the United States in 1970.(19) National data for the number of nonagricultural and nonmanufacturing employees in 1970 was obtained from the U.S. Department of Commerce Statistical Abstract of the U.S., 1977. Dividing the 47,413,000 employees into the total number of square feet of commercial space yielded a figure of 456 square feet per employee.

An analysis of the use of electricity by the commercial sector on Long Island prepared by the consulting firm of Dubin, Mindell and Bloom (20) for the County of Suffolk, New York, in 1975, used a similar approach and assumed a factor of 475 square feet per employee.

An analysis of 25 large commercial establishments built in our territory during the 1975-78 period, without warehouse space and most being offices, revealed an average of 401 square feet per employee. These buildings have a much higher population density than do other forms of commercial space which have warehousing or inventory storage space associated with them.

Based on the square footage figure obtained by these various means, it was assumed that there are 465 square feet per "commercial" employee, and that is the figure used in this forecast.

The projections of future commercial employment by year for our service area (excluding Conowingo Power Co.) were obtained from Wharton Econometric Forecasting Associate's Philadelphia Quarterly Model. Applying the 465 square feet per commercial employee to Wharton's projections of commercial employment provided an estimate of 121 million square feet of new commercial space in the 1978/88 period. To determine the kilowatt-hours per square foot to be obtained from new commercial construction, the actual new construction data for our territory from 1974 to 1977 was analyzed. The average for the period was 34 kWh per square foot. Multiplying the 121 million square feet by 34 kWh resulted in 4,100 million kWh in 1988. This was added to P.E. Company's weather corrected small commercial and other nonmanufacturing sales of 8,620 million kWh in 1977 for a total of 12,720 million kWh. To this figure were added known extraordinary future "noncommercial" loads which are included in other nonmanufacturing. Included in the "noncommercial" type loads were known water and sewer plant construction and the refitting of the Saratoga and three other aircraft carriers at the Philadelphia Navy Yard. These add 300 million kWh. Known oil pumping stations already under construction and in the planning stages added another 70 million kWh.

As existing customers can be expected to add equipment, a growth factor of 1% per year was applied to 1977's weather corrected sales less the "noncommercial" type loads. This added 610 million kWh. Much of this growth is expected from the increased use of data processing equipment which is the single most influential element in determining a building's use of electricity.(13),(15)

Reductions are expected from additional conservation by existing customers and from conservation in new construction. Existing customers have already conserved 13%, and it is estimated that they will conserve an additional 7%. This additional 7% conservation was applied to 1977's weather corrected commercial sales except that portion which represents the "noncommercial" type loads. This lowers 1988's sales by 540 million kWh. Conservation in new construction was estimated after reviewing A.D. Little's analysis of the maximum impact of ASHRAE 90-75 on energy consumption in new building design.(11) Actual reductions in comparison to pre-ASHRAE 90-75 standards are expected to be somewhat less. The assumptions used in this forecast reduce electric space heating kilowatt-hours 27%, air conditioning 21%, and other load 20% during the 1978-88 period and amount to 840 million kWh in 1988.

The net effect of these gains and losses produce P.E. Company commercial sales of 12,320 million kWh in 1988. When Conowingo's sales of 185 million are added, total commercial sales for the system are 12,505 million kWh. Deducting 90% of the Small Commercial and Industrial Sales forecast for 1988 (10% is industrial) results in Other nonmanufacturing sales of 9,335 million kWh in 1988.

<u>Summary</u> - The four methods used to determine the forecast of Other Nonmanufacturing sales provided a range of results. This is not unexpected. It is well known in the electric utility industry that the most difficult class to forecast is large commercial sales due to the fact that limited factual data is available. The primary reason for the limited availability of data is the heterogeneity of the class which includes many different types of customers. Included are such diverse types of operations as sewage treatment plants, schools, offices, and shopping areas. In addition, there is great diversity within each type of operation as to size, installed electrical equipment, type of use, etc. For these reasons, judgement is an essential factor in analyzing the sales results forecast by the various methods.

The four methods produced the following base case forecasts of ten year (1978/88) growth rates: manhours - 5.1%; commercial employment - 3.7%; regression methods - 4.8%; and square feet per employee - 3.7%. The Wharton Econometric Forecasting Associate's model, developed independently by them to forecast P.E.Co. sales, shows a growth rate of 4.6%.

A conservative approach was taken, and the square feet per employee method, which produced the lowest ten year growth rate, was selected as the <u>base</u> case. This method was chosen because it was based on national and supportive regional data plus the following: it incorporated known major additional loads coming on system; differences in growth rates between "commercial" and "noncommercial" type loads in the class were recognized; it took cognizance of the fact that existing customers will continue to add load at the same time that they are taking steps to conserve on existing loads; and the effects of ASHRAE 90-75 on new construction were taken into account.

Since the <u>base</u> case had the lowest ten year growth rate, the <u>low</u> case was derived by changing some of the square feet per employee base case assumptions. It was assumed that the 1% growth rate of existing load would not occur, conservation of existing load would increase from 7% to 12% for a total of 25% since 1973, and conservation in new construction would increase from 27% for electric space heating, 21% for air conditioning, and 20% for other load to 30%, 25% and 25% respectively. This produces a <u>low</u> case growth rate of 2.6%. The manhour method did not include low and high projections. The commercial employment method resulted in a 2.7% annual growth rate and the regression methods 4.4% for the low case.

The high case is the result of running the three regression models with the high projections of the services component of real Gross National Product and real disposable personal income. The median of 10,500 million kWh was selected as the high case and produces a ten year growth rate of 4.9%.

Small Commercial & Industrial Method - This class was forecast by a method very similar to that just described in the Other Non-manufacturing 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%. By changing the variables, the growth for the low case forecast is 0.7% while for the high case forecast it is 2.7%.

OTHER CLASSES OF SERVICE

STREET LIGHTING

The base forecast is an annual growth rate of 1.0% for the 1978-88 period. The low and high ranges are 0.4% and 1.5% respectively. Under all three ranges the growth of street lighting sales in the City of Philadelphia will be minimal. Philadelphia now has a high saturation of street lighting and limited undeveloped land. The low range is based mainly on a major portion of the suburban mercury vapor luminaires being converted to the lower wattage high pressure sodium lamps. A contributing factor to a lower growth rate is the requirement that all new residential developments be supplied with underground services. Since underground supply costs more than aerial, there are frequently over-ratio costs which the developers must pay. In communities which do not require street lighting, this deters sales. The high range assumes that pressures will be brought by citizens for better lighted streets and roads and also assumes a minimum conversion to high pressure sodium.

OTHER PUBLIC AUTHORITIES (RATES MLP AND FLP)

The base forecast is based on a stable population in the City of Philadelphia. The low range assumes a continuing decline in population with little need for additional public services. It also assumes that the City of Philadelphia will continue its practice of taking PD or HT services whenever a rate analysis indicates they are warranted. The high range is based on a rejuvenation of city dwelling with improved living conditions which will require more public services.

RAILROADS AND RAILWAYS

During 1978, Amtrak/Conrail and Conrail/SEPTA (the former Penn Central and Reading Systems) experienced considerable electrical equipment problems which required cut-backs in services. Early in 1978, an ice flow severely damaged the Safe Harbor 25 Hz equipment, and normal power was not available until summer. In addition, the Reading's Wayne Junction 25 Hz equipment was plagued with chronic outages but is expected to be back in normal operation by December, 1978. To compound the problem, Amtrak/Conrail has taken one of the four tracks from New York to Washington out of service for repairs which means shunting off freight cars to allow passenger cars to pass. Because of this, there has been a considerable reduction in freight operations on the former Penn Central System.

Because of these problems, 1978's kWh consumption by this class is expected to fall 25 million kWh below 1977, and only one-half of this reduction is expected to be regained during 1979. After 1979, the base case assumes that the 25 Hz electrical stations will operate normally, that track repairs are completed, that the airport feeder (now under construction) will come on system, that SEPTA's entire Broad Street Subway fleet and one-half of the city's trolleys will be replaced by 1981 under an UMTA Grant with an overall increase of 10% in kWh consumption and that railroad freight rates will remain competitive with trucks. The low range assumes that private automobiles (fossil fueled and/or electric) will minimize passenger increases and that there will be little increase in freight loads due to truck competition. The high range assumes existing rail terminals and subway stops will be modernized, that there will be a trend from automobiles to public transportation, and the railroads will compete successfully and improve their freight business.

SALES FOR RESALE - The base forecast growth for this class is minimal because the Borough of Lansdale accounts for 99% plus of the load, and it has little room for new construction due to geographical limitations. The low range is based on conservation and price elasticity keeping residential consumption down and a slower than anticipated economic growth rate placing a damper on industrial and commercial sales. The high range is only slightly higher than the base due to the limited possibility for new construction.

INTERDEPARTMENTAL - The base case and high range are based on all budgeted construction coming on line as planned. The low range assumes additional conservation and all planned construction being cancelled.

PHILADELPHIA ELECTRIC COMPANY SYSTEM

LARGE COMMERCIAL AND INDUSTRIAL

BASE CASE

MILLION KWH

	ACTUAL 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TEN LARGE MANUFACTURING*	3332	3553	3500	3650	3690	3780	3880	4000	4130	4280	4470	4570
OTHER MANUFACTURING	4471	4481	4450	4590	4730	4880	5040	5200	5360	5530	5700	5880
TOTAL MANUFACTURING	7803	8034	7950	8240	8420	8660	8920	9200	9490	9810	10170	10450
SINGLE-POINT METERED APTS.	789	791	800	820	840	840	840	835	830	830	825	820
OTHER NONMANUFACTURING	6320	6489	6600	6860	7130	7410	7700	8005	8320	8650	8985	9340
TOTAL NONMANUFACTURING	7109	7280	7400	7680	7970	8250	8540	8840	9150	9480	9810	10160
TOTAL LARGE C & I	14912	15314	15350	15920	16390	16910	17460	18040	18640	19290	19980	20610
CONOWINGO LARGE C & I	143	153	154	159	164	169	175	180	186	193	200	206
BREAKDOWN OF SEASONAL AND ENVIRONMENTAL LOADS												
SPACE HEATING	612	682	633	663	703	735	765	793	821	849	877	905
AIR CONDITIONING	1572	1568	1501	1528	1555	1580	1604	1627	1649	1672	1695	1719
ENVIRONMENTAL**	2168	2326	2445	2576	2657	2754	2809	2945	3040	3131	3233	3387
ALL OTHER LOAD	10560	10738	10773	11153	11479	11844	12286	12679	13128	13639	14172	14599

*ATLANTIC RICHFIELD, BP OIL, SUN OIL, SCOTT PAPER, LUKENS STEEL, U.S. STEEL, BUDD CO., FIRESTONE, LINDE AIR PRODUCTS, MERCK.
** INCLUDES ELECTRIC STEEL MELTING.

TABLE C-I

R & F DEPT.
NOVEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

BASE CASE

LARGE COMMERCIAL & INDUSTRIAL - MMKWH

COMPOUND GROWTH RATES - %

TO \ FROM	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
78	2.4																				
79	1.9	1.3																			
80	2.5	2.5	3.7																		
81	2.6	2.6	3.3	3.0																	
82	2.7	2.8	3.3	3.1	3.2																
83	2.8	2.9	3.3	3.1	3.2	3.3															
84	2.9	2.9	3.3	3.2	3.2	3.3	3.3														
85	2.9	3.0	3.3	3.2	3.3	3.3	3.3	3.3													
86	3.0	3.1	3.3	3.3	3.3	3.3	3.4	3.4	3.5												
87	3.0	3.1	3.4	3.3	3.4	3.4	3.4	3.5	3.5	3.6											
88	3.1	3.1	3.3	3.3	3.3	3.4	3.4	3.4	3.4	3.4	3.2										
89	3.0	3.0	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.0	2.7	2.3									
90	2.9	3.0	3.1	3.1	3.1	3.1	3.1	3.0	2.9	2.8	2.6	2.3	2.3								
91	2.9	2.9	3.1	3.0	3.0	3.0	3.0	2.9	2.8	2.7	2.5	2.3	2.3	2.3							
92	2.8	2.9	3.0	2.9	2.9	2.9	2.9	2.8	2.8	2.6	2.4	2.3	2.3	2.3	2.2						
93	2.8	2.8	3.0	2.9	2.9	2.9	2.8	2.8	2.7	2.6	2.4	2.3	2.3	2.3	2.3	2.3					
94	2.8	2.8	2.9	2.9	2.8	2.8	2.8	2.7	2.7	2.6	2.4	2.3	2.3	2.3	2.3	2.3	2.3				
95	2.8	2.8	2.9	2.8	2.8	2.8	2.7	2.7	2.6	2.5	2.4	2.3	2.3	2.3	2.3	2.3	2.3	2.2			
96	2.7	2.7	2.8	2.8	2.8	2.7	2.7	2.6	2.6	2.5	2.4	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3		
97	2.7	2.7	2.8	2.8	2.7	2.7	2.7	2.6	2.6	2.5	2.4	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	
98	2.7	2.7	2.8	2.7	2.7	2.7	2.6	2.6	2.5	2.5	2.4	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.2

WHEN USING THIS TABLE, CHOOSE THE STARTING YEAR FROM THE TOP MARGIN, SELECT THE ENDING YEAR FROM THE LEFT MARGIN, WHERE THEY INTERSECT YOU WILL FIND THE COMPOUND GROWTH RATE FOR THAT PERIOD.
EXAMPLE: FROM 1978 TO 1988 THE COMPOUND GROWTH RATE IS 3.1%.

TOTAL MMKWH

1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
14796	15154	15350	15920	16390	16910	17460	18040	18640	19290	19980	20610	21075	21550	22045	22540	23065	23600	24115	24680	25255	25820

NOTE: TOTAL MMKWH FOR 1977 AND 1978 HAVE BEEN NORMALIZED.

Table C-II

R & F DEPT.
DECEMBER 1977

PHILADELPHIA ELECTRIC COMPANY SYSTEM

LARGE COMMERCIAL AND INDUSTRIAL

HIGH AND LOW RANGES

MILLION KWH

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
TOTAL MANUFACTURING										
HIGH	8510	8840	9060	9340	9650	9980	10330	10720	11150	11500
LOW	7390	7650	7800	8000	8220	8450	8700	8970	9270	9500
SINGLE-POINT METERED APTS.										
HIGH	820	840	860	860	860	850	850	850	840	840
LOW	790	810	830	830	830	820	820	820	820	810
OTHER NONMANUFACTURING										
HIGH	7060	7370	7700	8040	8420	8780	9170	9590	10030	10500
LOW	6140	6360	6590	6830	7070	7330	7590	7860	8130	8420
TOTAL NONMANUFACTURING										
HIGH	7880	8210	8560	8900	9280	9630	10020	10440	10870	11340
LOW	6930	7170	7420	7660	7900	8150	8410	8680	8950	9230
TOTAL LARGE C & I										
HIGH	16390	17050	17620	18240	18930	19610	20350	21160	22020	22840
LOW	14320	14820	15220	15660	16120	16600	17110	17650	18220	18730
BREAKDOWN OF SEASONAL LOADS										
SPACE HEATING										
HIGH	638	674	712	744	778	814	852	892	934	979
LOW	628	660	687	707	728	750	773	797	822	848
AIR CONDITIONING										
HIGH	1515	1564	1617	1671	1727	1784	1841	1901	1963	2026
LOW	1444	1458	1471	1482	1494	1506	1516	1526	1535	1544

* ATLANTIC RICHFIELD, BP OIL, SUN OIL, SCOTT PAPER, LUKENS STEEL, U.S. STEEL, BUDD CO., FIRESTONE, LINDE AIR PRODUCTS, MERCK.

Table C-III

R & F DEPT.
DECEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

LARGE INDUSTRIAL - MMKWH

SALES BASED ON HISTORIC KILOWATT-HOURS PER MANHOUR

AND WEFA'S EMPLOYMENT PROJECTIONS BY SIC

BASE CASE

SIC NO.	CLASSIFICATION	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
20	FOOD & KINDRED PRODUCTS	747	784	797	808	820	834	848	861	899	938
22	TEXTILE MILL PRODUCTS	135	137	134	130	127	125	122	119	115	111
23	APPAREL & RELATED PRODUCTS	64	65	65	64	64	64	65	65	66	66
26	PAPER & ALLIED PRODUCTS	589	607	605	590	580	572	564	556	575	594
27	PRINTING & PUBLISHING	199	201	202	203	204	205	206	207	209	210
28	CHEMICAL & ALLIED PRODUCTS	1144	1186	1184	1174	1169	1167	1160	1150	1139	1129
29	PETROLEUM										
	THREE MAJOR OIL COMPANIES	1222	1310	1315	1315	1315	1335	1355	1405	1490	1510
	OTHER SIC 29	67	71	75	79	84	89	94	99	105	111
	TOTAL SIC 29	1289	1381	1390	1394	1399	1424	1449	1504	1595	1621
30	RUBBER	473	485	493	498	514	535	553	572	590	608
	OTHER NON-DURABLES	9	9	10	10	10	11	11	11	12	12
32	STONE, CLAY & GLASS PRODUCTS	179	180	181	180	180	181	182	184	186	187
33	PRIMARY METALS										
	TWO MAJOR STEEL COMPANIES	1519	1570	1600	1675	1770	1865	1960	2055	2150	2230
	OTHER SIC 33	378	441	447	486	529	576	627	682	742	805
	TOTAL SIC 33	1897	2011	2047	2161	2299	2441	2587	2737	2892	3035
34	FABRICATED METALS	369	385	376	362	351	344	343	344	358	366
35	NON-ELECTRICAL MACHINERY	435	450	450	447	454	467	487	517	562	598
36	ELECTRICAL MACHINERY	458	459	442	419	405	396	389	388	386	384
37	TRANSPORTATION EQUIPMENT	452	459	449	415	387	376	378	393	410	427
38	INSTRUMENTS & RELATED PRODUCTS	110	115	116	117	104	105	106	104	101	99
	OTHER DURABLES	85	88	87	82	78	75	71	68	64	61
	TOTAL*	8630	9000	9030	9050	9156	9320	9520	9780	10160	10450

* TOTALS MAY NOT EQUAL THE SUM OF INDIVIDUAL CATAGORIES DUE TO ROUNDING.

R & I DEPT.
NOVEMBER 1978

Table C-IV

PHILADELPHIA ELECTRIC COMPANY SYSTEM

SMALL COMMERCIAL AND INDUSTRIAL

BASE CASE

	ACTUAL 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
CUSTOMERS W/O ELECTRIC HEAT												
CUSTOMERS - ANNUAL AVERAGE	111320	111200	111000	110800	110700	110700	110700	110700	110800	110800	110800	110800
ANNUAL AVERAGE USE - KWH	21837	21931	21830	21988	22196	22407	22634	22873	23095	23303	23505	23683
ANNUAL SALES KWH (MILLIONS)	2430.0	2438.0	2422.0	2436.0	2458.0	2480.0	2505.0	2532.0	2557.0	2581.0	2604.0	2623.0
CUSTOMERS WITH ELECTRIC HEAT												
CUSTOMERS - ANNUAL AVERAGE	4321	4800	5400	6000	6600	7300	7900	8600	9300	10000	10700	11400
ANNUAL AVERAGE USE - KWH	91248	93870	89126	88386	87092	86176	84802	83436	82191	81056	80084	79217
ANNUAL SALES KWH (MILLIONS)	394.0	454.0	483.0	533.0	578.0	626.0	672.0	720.0	767.0	813.0	858.0	900.0
TOTAL ANNUAL SALES KWH (MILLIONS)	2825	2893	2906	2970	3036	3107	3178	3253	3325	3394	3462	3524
BREAKDOWN OF SEASONAL AND ENVIRONMENTAL LOADS												
SPACE HEATING *	210.0	229.0	243.0	267.0	289.0	311.0	334.0	356.0	378.0	401.0	422.0	441.0
AIR CONDITIONING *	304.0	313.0	296.0	309.0	322.0	335.0	350.0	364.0	379.0	393.0	407.0	419.0
ENVIRONMENTAL	13.0	14.0	14.0	14.0	15.0	16.0	19.0	20.0	23.0	27.0	30.0	34.0
ALL OTHER LOAD	2297.0	2337.0	2351.0	2379.0	2410.0	2443.0	2474.0	2511.0	2544.0	2572.0	2601.0	2628.0

* THE FIRST TWO YEAR'S LOAD ESTIMATES REFLECT ACTUAL WEATHER.
NOTE: SUMS MAY NOT EQUAL TOTAL OF INDIVIDUAL CATEGORIES DUE TO ROUNDING.

Table C-V

R & F DEPT.
NOVEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

BASE CASE

SMALL COMMERCIAL & INDUSTRIAL - MMKWH

COMPOUND GROWTH RATES - %

TO \ FROM	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
78	2.0																				
79	2.2	2.3																			
80	2.1	2.2	2.1																		
81	2.2	2.2	2.2	2.4																	
82	2.2	2.3	2.2	2.3	2.3																
83	2.2	2.3	2.2	2.3	2.3	2.3															
84	2.2	2.2	2.2	2.3	2.3	2.2	2.2														
85	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.5													
86	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.1	1.8												
87	2.2	2.2	2.2	2.2	2.2	2.2	2.1	2.1	1.9	2.1											
88	2.1	2.2	2.1	2.1	2.1	2.1	2.1	2.0	1.9	1.9	1.7										
89	2.1	2.1	2.1	2.1	2.0	2.0	1.9	1.9	1.8	1.7	1.6	1.4									
90	2.0	2.0	2.0	2.0	1.9	1.9	1.8	1.8	1.6	1.6	1.4	1.3	1.1								
91	2.0	2.0	1.9	1.9	1.9	1.8	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.4							
92	1.9	1.9	1.8	1.8	1.8	1.7	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	0.8						
93	1.8	1.8	1.8	1.8	1.7	1.7	1.6	1.5	1.4	1.4	1.3	1.2	1.1	1.1	1.0	1.1					
94	1.8	1.8	1.7	1.7	1.6	1.6	1.5	1.5	1.4	1.3	1.2	1.1	1.0	1.0	0.9	0.9	0.8				
95	1.7	1.7	1.6	1.6	1.6	1.5	1.5	1.4	1.3	1.2	1.1	1.0	1.0	0.9	0.8	0.8	0.7	0.5			
96	1.7	1.6	1.6	1.6	1.5	1.5	1.4	1.3	1.2	1.2	1.1	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.8		
97	1.6	1.6	1.5	1.5	1.5	1.4	1.3	1.3	1.2	1.1	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.6	0.7	0.5	
98	1.5	1.5	1.5	1.5	1.4	1.3	1.3	1.2	1.1	1.1	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.5	0.5

WHEN USING THIS TABLE, CHOOSE THE STARTING YEAR FROM THE TOP MARGIN, SELECT THE ENDING YEAR FROM THE LEFT MARGIN, WHERE THEY INTERSECT YOU WILL FIND THE COMPOUND GROWTH RATE FOR THAT PERIOD.
EXAMPLE: FROM 1978 TO 1988 THE COMPOUND GROWTH RATE IS 2.2%.

TOTAL MMKWH

1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2788	2845	2910	2970	3040	3110	3180	3250	3330	3390	3460	3520	3570	3610	3660	3690	3730	3760	3780	3810	3830	3850

NOTE: TOTAL MMKWH FOR 1977 AND 1978 HAVE BEEN NORMALIZED.

Table C-VI

R & F DEPT.
DECEMBER 1978

PHILADELPHIA ELECTRIC COMPANY SYSTEM

SMALL AND LARGE COMMERCIAL AND INDUSTRIAL SALES

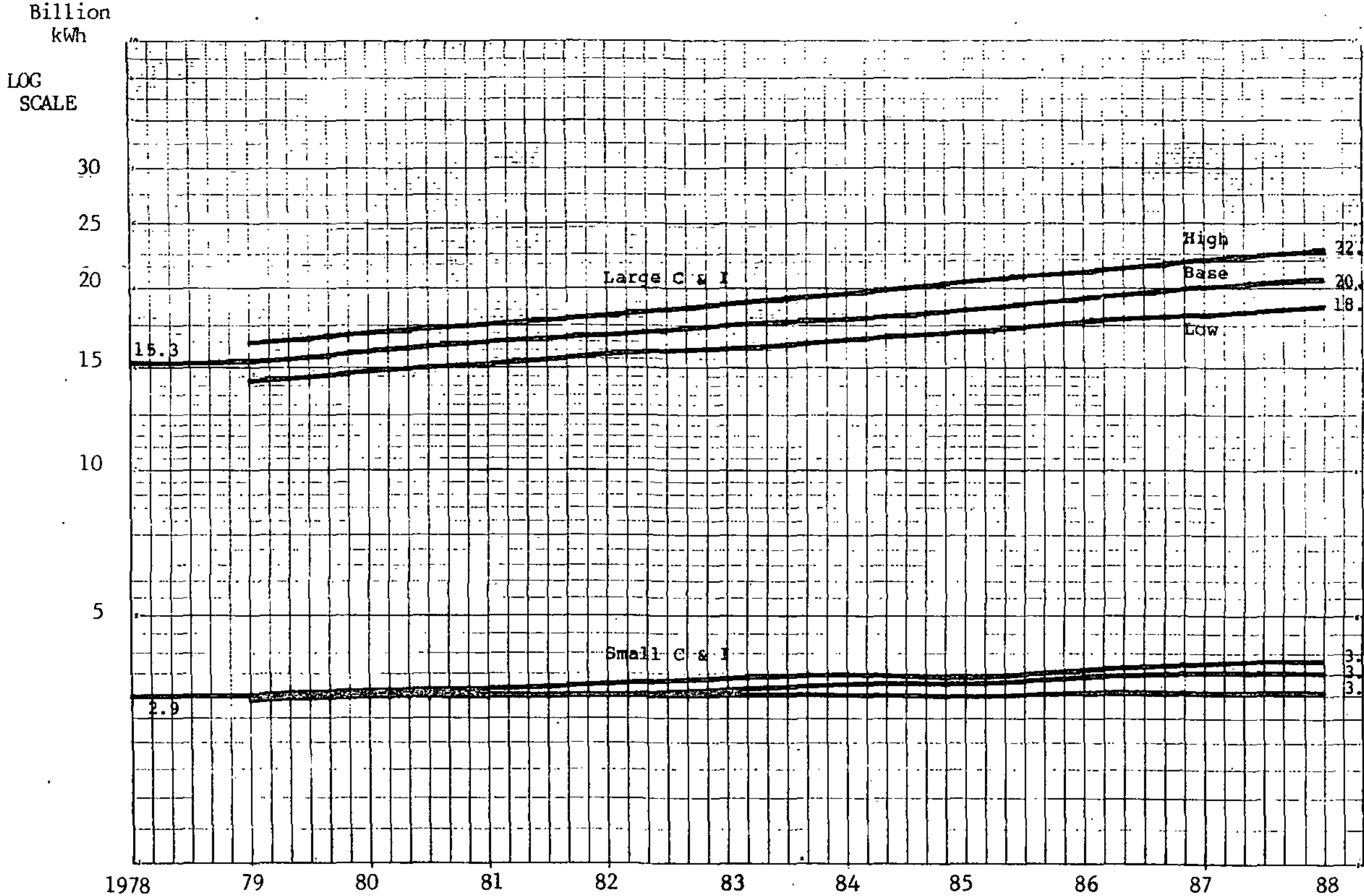


Chart C-1

FILE CONTINUED