THE POTENTIAL FOR ELECTRICITY CONSERVATION IN NEW YORK STATE

Final Report

Prepared for

NEW YORK STATE
ENERGY RESEARCH AND DEVELOPMENT AUTHORITY
Albany, N.Y.

Project Manager
David R. Wolcott

and

NIAGARA MOHAWK POWER CORPORATION

Project Manager
James J. Cook

and

NEW YORK STATE ENERGY OFFICE

Project Manager
Peter Smith

Prepared by

AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY
Washington, D.C.

Principal Investigators
Peter M. Miller
Joseph H. Eto
Howard S. Geller

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Neither the individuals nor the organizations acknowledged here necessarily endorse the analysis or the conclusions expressed in this report. The authors assume full responsibility for all information presented herein.

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Executive Summary

This report presents an analysis of the potential for electricity savings and peak demand reductions in the current equipment and building stock in New York State. The objective is to identify and characterize the electricity conservation resource that currently exists in New York as well as in the service areas of the seven major private utilities (Central Hudson Gas & Electric Corp., Consolidated Edison Co., Long Island Lighting Co., New York State Electric & Gas Corp., Niagara Mohawk Power Corp., Orange and Rockland Utilities, and Rochester Gas & Electric Corp.). Consequently, conservation and load management measures are analyzed without considering utility program costs, implementation rates, limits to full adoption, or application in equipment or buildings installed after 1986.

The report should be of use to utilities, energy policymakers, and energy analysts within New York and elsewhere. The results concerning the most cost-effective technologies for saving electricity and peak demand could help to guide utility and/or state-sponsored demand-side management programs. Also, the results could be of use to those who are developing or reviewing utility resource acquisition plans.

Methodology

The analysis is based on electricity consumption and peak demand in the state (excluding New York Power Authority customers) as of 1986, the most recent year for which comprehensive end-use data are available. First, electricity use, summer peak demand, and winter peak demand are disaggregated by sector, building type, and end use for the entire state as well as for each of the major private utilities. Second, end-use technologies are defined which are representative of the building and equipment stock as of 1986.

The conservation analysis then evaluates the savings of electricity and peak demand that would result from the implementation of 62 efficiency measures. Most of the measures are commercially available; a few are expected to become available by the early 1990's. For the most part, the conservation measures affect electricity consumption and/or peak demand without adversely affecting non-energy performance or utility.

The conservation measures are directed at end uses representing approximately 84% of residential electricity use, 85% of industrial electricity use, and building types representing 91% of commercial building electricity use. Thus, a small fraction of electricity use is not analyzed in each sector. No savings potential is assumed for the end uses that are not analyzed.

Each efficiency or load management measure is evaluated with respect to: 1) the total electricity and peak demand savings potential from the measure in the state or utility service area, and 2) the "cost of saved energy" (CSE) and "cost of reduced peak demand" (CRD) for each measure. CSE is the cost of reducing electricity consumption over the lifetime of the efficiency measure. CRD is the capital cost for saving a kW of peak demand over a standard 20-year time period. Both CSE and CRD are based only on the equipment and installation costs of the measures. Thus, they represent estimates of end-user costs and not the full costs of achieving these savings through utility-sponsored or other types of programs.

Cost effectiveness is evaluated from the perspective of the utility, consumer, and society by varying the discount rate used in the calculation of CSE and CRD. We assume a 10% real discount rate for the utility perspective, 6% for the consumer perspective, and 3% for the societal perspective. It is important to note that these values are explicit, rather than implicit, discount rates. Explicit discount rates represent external conditions (e.g. interest rates), while implicit discount rates represent actual behavior in the marketplace (e.g. the implicit trade-off between initial cost and energy costs). Implicit discount rates are typically much higher than explicit discount rates because of inadequate information, limited product choices, third party purchases, and other imperfections in the marketplace.

The conservation analyses for individual end uses and building types are combined into "conservation supply curves." To produce the curves, all of the conservation measures in a particular sector are ranked according to cost effectiveness. The curves show savings potential as a function of cost effectiveness, thereby indicating the total amount of savings available up to any particular CSE or CRD.

Separate conservation supply curves are developed for: 1) the residential, commercial, and industrial sectors, 2) electricity use, summer and winter peak demand, and 3) the state and each major utility. Also, statewide curves are presented from each of the three perspectives (consumer, utility, and societal). Utility-specific curves are presented only from the consumer perspective due to the large number of tables and data already being included. However, overall cost-effectiveness results are compared for each of the three perspectives by utility.

In order to present estimates of the overall cost-effective potential for electricity savings and peak demand reductions, cost-effectiveness thresholds are needed. For the consumer perspective, the thresholds are the average electricity rates in 1986. For the utility and societal perspectives, the thresholds are based on long-range marginal costs for each utility as developed by the New York Public Service Commission. Because the cost-effectiveness analysis is based only on the technical costs (equipment and installation) of the conservation measures, the total savings potential below the cost-effectiveness thresholds is referred to as the "technology-cost potential savings". In order to estimate achievable savings potential, conservation program costs and any limitations preventing full adoption need to be taken into account.

Since the analysis applies to the building and equipment stock as of 1986, no attempt is made to evaluate new sources of electricity demand that have been added since then or that might be added in the future. Also, the analysis does not address the issues of fuel switching or increasing electrification through technologies such as heat pumps. It is reasonable to ignore these issues because the objective is to determine the technical and economic potential for electricity and peak demand savings in the current equipment and building stock, not to forecast future electricity demand.

Results

Tables S-1, S-2, and S-3 present the ranking of conservation measures by CSE along with the electricity savings potential in each sector. The tables apply to the entire state (excluding the NYPA) and are based on analysis from the consumer perspective (i.e., assuming a 6% real discount rate). From these tables, it is seen that the overall technical potential for electricity savings (ignoring cost-effectiveness) is 37% in the residential sector, 50% in the commercial sector, and 22% in the industrial sector. Overall, full adoption of the measures analyzed in this study would reduce state wide electricity consumption by 38%.

Table S-1
ELECTRICITY CONSERVATION ASSESSMENT
RESIDENTIAL SECTOR
New York State
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
FRE	Current sales average (1986)	0.004	373	373	1.08%
REF	Current sales average (1986)	0.010	1,876	2,249	6.50%
REF	Best current (1988)	0.011	1,865	4,114	11.90%
REF	Near-term advanced	0.013	781	4,895	14.16%
EWH	Traps & blanket (EF=0.9)	0.013	265	5,160	14.92%
FRE	Best current (1988)	0.014	259	5,419	15.67%
FRE	Near-term advanced	0.015	129	5,548	16.05%
ESH1	Infiltration reduction	0.017	593	6,141	17.76%
RAN	Improved oven	0.022	212	6,353	18.37%
ESH2	Storm windows	0.022	112	6,465	18.70%
ESH2	Low-emissivity film	0.024	35	6,500	18.80%
RAN	Improved cooktop	0.025	74	6,574	19.01%
LTG	Tungsten halogen lamps-300 h/y	0.027	697	7,271	21.03%
LTG	Energy saving lamps-620 hr/yr	0.030	82	7,353	21.26%
LTG	Energy saving lamps-1,240 h/y	0.030	98	7,451	21.55%
EWH	Front loading clothes washer	0.034	447	7,898	22.84%
LTG	Compact fluorescents-1240 h/y	0.036	1,102	8,999	26.03%
ESH1	Heat pump #1 (HSPF=7)*	0.042	236	9,235	26.71%
LTG	IRF lamps - 300 hr/yr	0.044	813	10,048	29.06%
LTG	Compact fluorescents-620 h/y	0.045	918	10,966	31.71%
ESH1	Heat pump #2 (HSPF=8)*	0.055	23	10,989	31.78%
ECD	Heat pump clothes dryer	0.065	858	11,847	34.26%
ESH1	Low-emissivity film	0.079	163	12,010	34.73%
RAC	RAC: 8.5 EER	0.093	144	12,153	35.15%
CAC	Window film	0.137	76	12,230	35.37%
RAC	RAC: 10.0 EER	0.152	87	12,317	35.62%
CAC	CAC: 10.0 SEER	0.161	79	12,396	35.85%
RAC	RAC: 12 .0 EER	0.195	91	12,487	36.11%
CAC	Variable speed drive	0.221	55	12,542	36.27%
CAC	CAC: 12.0 SEER	0.316	47	12,589	36.41%
ESH1	Add 3" fiberglass in roof/ceiling	0.455	25	12,614	36.48%
CAC	CAC: 14.0 SEER	0.463	37	12,651	36.59%

Notes:
1. 1986 residential electricity consumption: 34,577 GWh
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family and small (2-4 units) multi-family homes; ESH2: electric space heating in large (5+ units) multi-family homes.

Table S-2
ELECTRICITY CONSERVATION ASSESSMENT
COMMERCIAL SECTOR
New York State
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
LTG	Delamping	0.001	141	141	0.35%
REF	Floating head press. control	0.001	172	312	0.78%
REF	Refrig. compressor eff.	0.003	214	526	1.31%
HVAC	Reset supply air temperature	0.005	1,182	1,708	4.26%
LTG	Reflectors	0.010	4,142	5,850	14.59%
HVAC	Fan motor efficiency	0.010	309	6,159	15.37%
LTG	High-efficiency ballast	0.011	513	6,672	16.64%
HVAC	VAV conversion	0.013	2,776	9,448	23.57%
HVAC	Economizer	0.017	301	9,749	24.32%
LTG	Energy-saving fluorescents	0.017	593	10,342	25.80%
HVAC	Pump motor efficiency	0.018	23	10,365	25.86%
HVAC	VSD on fan motor	0.021	3,261	13,626	33.99%
LTG	Occupancy sensors	0.033	500	14,126	35.24%
HVAC	Re-size chillers	0.038	2,260	16,386	40.88%
REF	Refrigerated case covers	0.044	54	16,440	41.01%
LTG	Daylighting controls	0.047	1,660	18,100	45.15%
LTG	VHE bulbs and ballasts	0.058	1,085	19,185	47.86%
HVAC	VSD on pump motor	0.063	212	19,397	48.39%
Shell	Window films (S&W)	0.134	196	19,593	48.88%
Shell	Low-E windows (N)	0.215	85	19,678	49.09%
Shell	Low-E windows (all)	0.236	319	19,997	49.89%
Shell	Roof insulation	0.603	16	20,013	49.92%

Notes:
1. 1986 commercial electricity consumption: 40,087 GWh
2. HVAC: heating, ventilation and air conditioning; LTNG: lighting; Shell: building shell; REF: refrigeration

Table S-3
ELECTRICITY CONSERVATION ASSESSMENT
INDUSTRIAL SECTOR
New York State
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
MOT	21 - 50 HP: retire	0.008	25.3	25.3	0.1%
MOT	>125 HP: retire	0.008	7.5	32.8	0.2%
MOT	51-125 HP: retire	0.008	10.1	42.9	0.2%
LTG	Energy saving lamp	0.009	184.0	226.9	1.1%
MOT	5.1-20 HP: retire	0.012	63.7	290.6	1.4%
LTG	Metal halide lamp	0.020	65.8	356.4	1.7%
LTG	High-efficiency ballast	0.027	57.0	413.4	2.0%
MOT	>125 HP: VSD	0.036	1,472.2	1,885.6	9.3%
MOT	1-5 HP: retire	0.037	7.0	1,892.6	9.3%
LTG	High-pressure sodium	0.043	216.6	2,109.3	10.4%
MOT	21-50 HP: rebuild	0.044	72.0	2,181.3	10.7%
MOT	51-125 HP: VSD	0.045	1,077.9	3,259.2	16.0%
MOT	5.1-20 HP: rebuild	0.051	34.3	3,293.5	16.2%
MOT	51-125 HP: rebuild	0.064	122.4	3,415.9	16.8%
MOT	21-50 HP: VSD	0.087	556.8	3,972.7	19.5%
MOT	>125 HP: rebuild	0.090	111.1	4,083.8	20.1%
MOT	<1 HP: retire	0.103	0.8	4,084.6	20.1%
MOT	5.1-20 HP: VSD	0.129	374.6	4,459.2	21.9%
MOT	1-5 HP: VSD	0.373	25.4	4,484.6	22.0%

Notes:
1. 1986 industrial electricity sales: 20,365 GWh
2. MOT: Motor efficiency measure; LTG: Lighting efficiency measure

The overall technical potential for reducing summer peak demand is 44% in the residential sector, 53% in the commercial sector, 22% in the industrial sector, and 45% statewide. The overall technical potential for reducing winter peak demand is 35%.

Figures S-1 and S-2 present the statewide conservation supply curves evaluated at a 6% discount rate (i.e., from the consumer perspective). Figure S-1 shows that over 20,000 GWH/yr of electricity savings are potentially available at a cost of up to three cents per kWh saved. Figure S-2 shows that 5,000 MW of peak demand reduction are available at costs of up to $1000 per kW saved.

Table S-4 presents the total electricity and peak demand savings potential below the cost-effectiveness thresholds. From the consumer perspective, the technology-cost potential electricity savings are 34,300 GWh/yr or 35% of statewide consumption in 1986 (excluding sales by the NYPA). The technology-cost potential reduction in summer peak demand is 6,850 MW (33% of the 1986 summer peak), while the same value with respect to the winter peak is 4,800 MW (27% of the 1986 winter peak). The commercial sector offers the largest amount of cost-effective electricity and peak demand savings, followed by the residential and industrial sectors.

The technology-cost potential for electricity savings from the utility perspective is considerably lower than from the consumer perspective. Technology-cost potential savings decline to 28% of 1986 usage, and technology-cost potential reduction in peak demand declines to 30% and 22% in the summer and winter, respectively. This result is due to an average CSE threshold of approximately 5 cents/kWh from the utility perspective compared to 5-10 cents/kWh from the consumer perspective. Also, the CSE values are higher from

Figure S-1

ELECTRICITY CONSERVATION SUPPLY CURVE
New York State – 6% Discount Rate

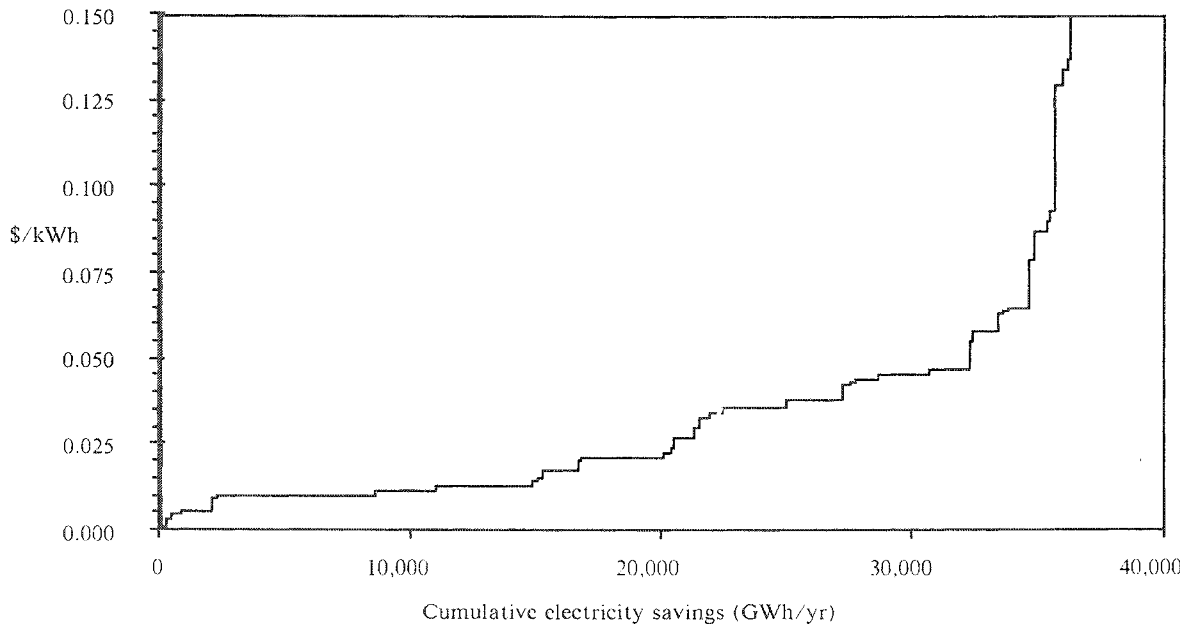


Figure S-2

SUMMER PEAK DEMAND REDUCTION SUPPLY CURVE
New York State - 6% Discount Rate

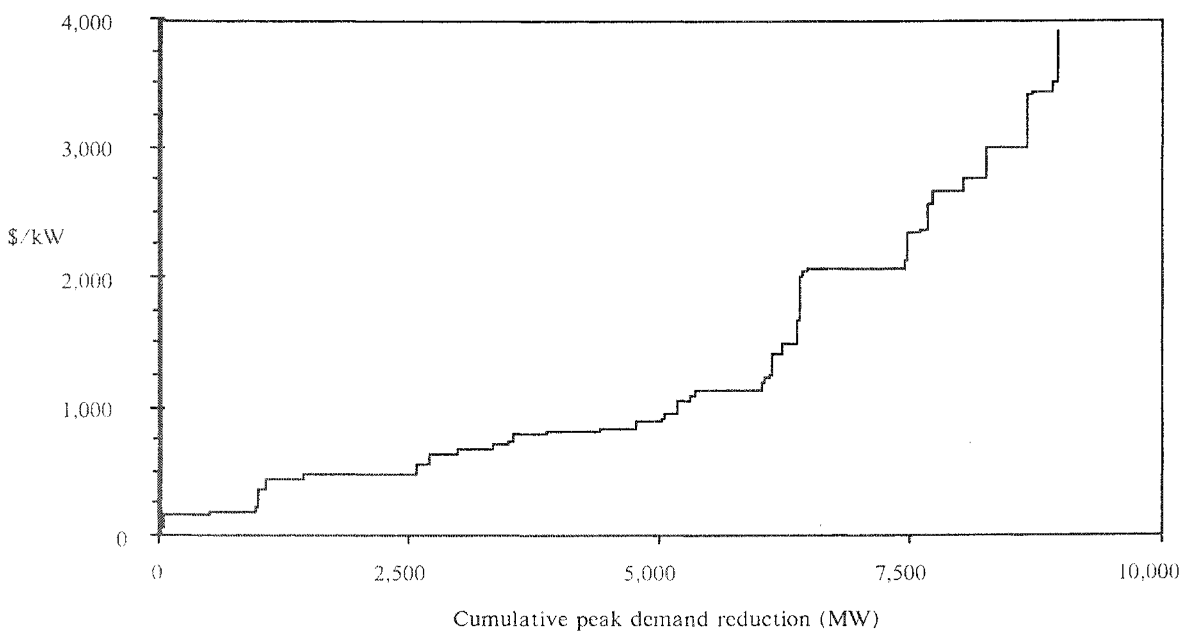


Table S-4
TECHNOLOGY-COST POTENTIAL
ELECTRICITY AND PEAK DEMAND SAVINGS
NEW YORK STATE
Savings and percent of total

CONSUMER PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	12,297	35.6%	1,951	27.0%	1,859	27.6%
Commercial	19,399	48.4%	4,463	44.3%	2,517	31.8%
Industrial	2,646	13.0%	438	13.4%	411	13.2%
Total	34,342	34.7%	6,852	33.3%	4,787	26.9%

UTILITY PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	9,823	28.4%	2,442	33.8%	1,604	23.8%
Commercial	15,606	38.9%	3,450	34.3%	1,970	24.9%
Industrial	1,859	9.1%	293	9.0%	290	9.3%
Total	27,288	27.6%	6,185	30.1%	3,864	21.7%

SOCIETAL PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	11,856	34.3%	3,083	42.6%	2,998	44.5%
Commercial	18,901	47.1%	5,062	50.3%	2,506	31.6%
Industrial	3,303	16.2%	529	16.2%	507	16.2%
Total	34,060	34.4%	8,674	42.2%	6,011	33.8%

*Discount rates for each perspective are: 6% - consumer, 10% - utility, 3% - societal

the utility perspective because of the higher discount rate assumption.

The technology-cost potential for electricity savings from the societal perspective is similar to that from the consumer perspective. However, the technology-cost potential reduction in demand is greater from the societal perspective compared to the consumer perspective. This result arises because from the societal perspective, conservation and load management measures are deemed cost-effective if they exhibit a CRD of less than approximately $1200/kW. No CRD threshold is applied when evaluating cost-effectiveness from the consumer perspective.

From the consumer perspective, the measures which offer a particularly large potential for cost-effective electricity savings include more-efficient residential refrigerators and freezers (5,280 GWh/yr), the installation of reflectors in fluorescent light fixtures (4,140 GWh/yr), and the installation of variable-speed drives on fan and pump motors in commercial buildings (3,470 GWh/yr). The measures which offer the largest potential for cost-effective reductions in summer peak demand include reflectors (1,130 MW), more-efficient refrigerators and freezers (880 MW), and conversion to variable air volume systems in commercial buildings (550 MW). These same measures offer the largest potential for cost-effective reductions in winter peak demand. In addition, residential load controllers, more-efficient air conditioning, and commercial cool storage offer substantial cost-effective peak demand reductions from the societal perspective.

Part of the cost-effective savings potential will be realized as a result of state or federal efficiency standards. In particular, standards on residential refrigerators and freezers will have a significant impact on future electricity use. If we exclude efficiency measures that will be adopted in response to these efficiency standards, the technology-cost potential savings from the consumer perspective drops to 28,050 GWh/yr, 5,650 MW of summer peak demand, and 4,300 MW of winter peak demand. Thus, existing efficiency standards will induce about 15% of the total technology-cost savings potential in the state (based on the consumer perspective).

Table S-5 shows the disaggregation of technology-cost savings potential from the consumer perspective by utility. Considering the fraction of electricity use and peak demand that can be saved in each utility area, only Consolidated Edison shows higher savings potentials (37-45%) than the state as a whole. This is due to the prevalence of commercial buildings and the high electricity rates in Consolidated Edison's service area. For the six other utilities, the technology-cost savings potentials are in the range of 20-34% of total electricity use or peak demand in 1986.

In terms of contribution to the statewide technology-cost electricity savings potential from the consumer perspective, Consolidated Edison provides 39% of the total, Niagara Mohawk provides 26%, LILCO provides 13%, and the other four utilities provide the remaining 21%. Con Ed, NMPC, and LILCO contribute 81% of the statewide technology-cost potential for summer peak demand reduction, and 79% of the statewide technology-cost potential for winter peak demand reduction.

Conclusion

This study shows that there is an enormous potential for electricity savings and peak demand reductions within New York's existing stock of buildings and equipment. Developing a significant portion of this resource could save households and businesses in the state billions of dollars

Table S-5
TECHNOLOGY-COST POTENTIAL
ELECTRICITY AND PEAK DEMAND SAVINGS
CONSUMER PERSPECTIVE

Utility	Cost-effective electricity savings potential (GWh/yr)	Fraction of statewide potential	Fraction of utility consumption
Central Hudson Gas & Electric	1,230	3.6%	29.6%
Consolidated Edison	13,546	39.4%	44.9%
Long Island Lighting Co.	4,575	13.3%	31.8%
New York State Electric & Gas	3,380	9.8%	28.6%
Niagara Mohawk Power Co.	9,115	26.5%	30.0%
Orange & Rockland	792	2.3%	33.7%
Rochester Gas & Electric	1,704	5.0%	29.5%
Total	34,342	100.0%	34.7%

Utility	Cost-effective summer peak demand savings potential (MW)	Fraction of statewide potential	Fraction of utility summer peak demand
Central Hudson Gas & Electric	220	3.2%	28.6%
Consolidated Edison	2,963	43.2%	38.8%
Long Island Lighting Co.	982	14.3%	29.7%
New York State Electric & Gas	568	8.3%	30.2%
Niagara Mohawk Power Co.	1,636	23.9%	31.9%
Orange & Rockland	172	2.5%	22.1%
Rochester Gas & Electric	312	4.6%	29.2%
Total	6,853	100.0%	33.3%

Utility	Cost-effective winter peak demand savings potential (MW)	Fraction of statewide potential	Fraction of utility winter peak demand
Central Hudson Gas & Electric	165	3.4%	23.1%
Consolidated Edison	1,898	39.6%	36.8%
Long Island Lighting Co.	620	13.0%	24.3%
New York State Electric & Gas	491	10.3%	21.9%
Niagara Mohawk Power Co.	1,264	26.4%	22.8%
Orange & Rockland	112	2.3%	19.7%
Rochester Gas & Electric	237	5.0%	23.6%
Total	4,787	100.0%	26.9%

and eliminate the need to build a number of new power plants.

To put the total technology-cost savings potential in perspective, a recent forecast prepared by the New York State Energy Office predicts electricity demand growth of 1.75%/yr during 1985-2002. This implies that electricity demand in the service areas of the seven major private utilities will increase by about 27,000 GWh/yr between 1986 and 2000. Based on our analysis, all of this new demand could be displaced if approximately 80% of the technology-cost electricity savings potential in existing buildings and equipment (based on the consumer or societal perspective is realized. Very little of the savings potential in existing buildings and equipment is incorporated into the Energy Office's forecast.

It is important to reiterate that the estimates of savings potential in this study do not take into account any of the limitations on implementation. In reality, only a portion of the full technical and economic savings potential can be achieved. Also, utilities will incur costs for the promotion of conservation measures in addition to the purchase and installation costs considered in this study. On the other hand, adoption of conservation measures provides other benefits besides reducing electricity use and peak demand (e.g., air pollution and greenhouse warming are reduced).

As a suggestion for follow-up work, we recommend that this study be combined with analyses of implementation experience in New York and elsewhere in order to develop estimates of achievable savings potential. Also, it would be useful to evaluate the environmental and social impacts of electricity conservation measures as well as electricity supply options. This information could be used to estimate the broader costs and benefits of electricity conservation in New York.

Chapter 1

END-USE BREAKDOWN OF ELECTRICITY CONSUMPTION AND DEMAND IN NEW YORK STATE

I. INTRODUCTION

A. Methodology

This chapter presents a breakdown of how electricity is divided among the various end uses in New York as of 1986. This is the most recent year for which comprehensive end-use data are available. "End uses" of electricity are the appliances, machines and tasks which use electricity to provide services. Examples of end uses of electricity are industrial motors, residential water heaters and lighting in commercial buildings.

The analysis covers electricity sold by the seven major private utilities serving New York State, namely Consolidated Edison Company of New York, Inc. (Con Ed), Niagara Mohawk Power Corporation (NMPC), Long Island Lighting Company (LILCO), New York State Electric & Gas Corporation (NYSEG), Rochester Gas and Electric Corporation (RG&E), Orange and Rockland Utilities, Inc. (O&R), and Central Hudson Gas & Electric Corporation (CHG&E). Electricity sales by the New York Power Authority are excluded from this analysis.

The data supporting this analysis are drawn from a number of sources. We base our analysis primarily on New York State sources, particularly on research reports and regulatory filings from the seven major private electric utilities and data and analysis provided by the New York State Energy Office. In some instances, in-state sources are supplemented with regional or national data.

B. Outline

This chapter begins with an analysis of electricity use statewide, presenting first, the fraction of electricity going to each of the three major sectors (i.e., industrial, residential and commercial), and second, how electricity is allocated among the various end uses within each sector (e.g., lighting, air conditioning, etc.). The following chapter evaluates the technical potential for cost-effective electricity conservation. The characterization of current electricity use presented in this chapter is critical to the conservation analysis which follows.

Following the statewide analysis are utility-specific analyses, in which each of the seven major private electric utilities is profiled and conservation potential is evaluated. Both the statewide and utility-specific analyses contain energy use and peak demand (both winter and summer peak) breakdowns.

II. STATEWIDE END-USE BREAKDOWN

A. Sectoral Breakdown

1. Energy

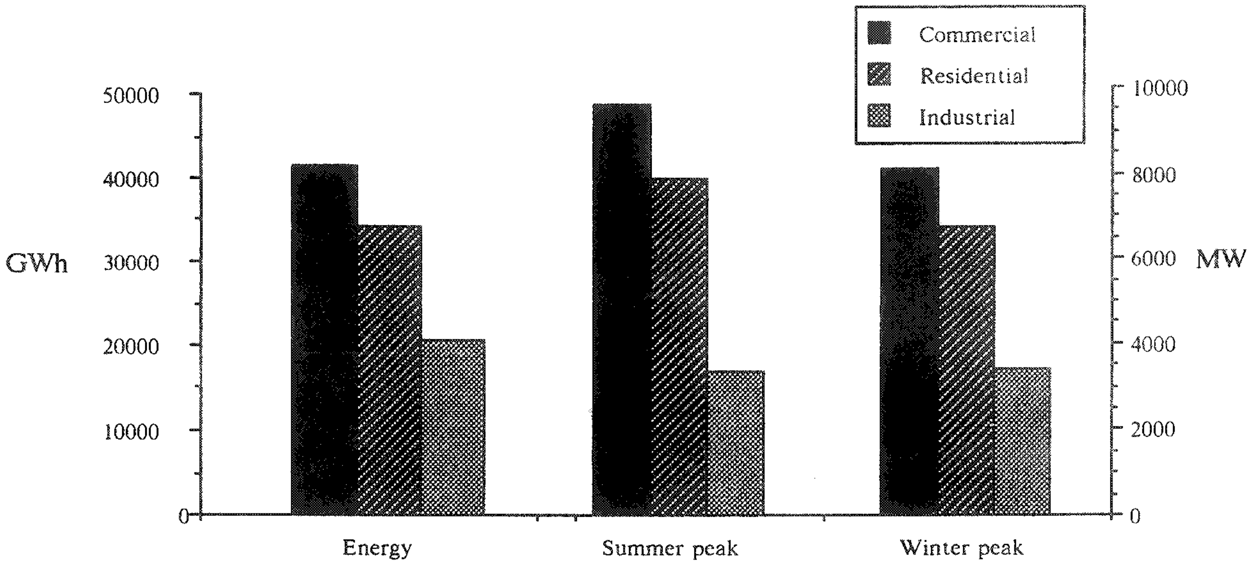
Total electricity sales by the seven major private utilities in New York State in 1986 were 99,035 GWh[1]. Figure 1-1 illustrates how this total was distributed among the major end-use sectors. The commercial sector accounts for the largest fraction of electricity consumption at 40% of the total. The residential sector is the second largest consumer of electricity at 35%. The industrial sector follows with 21% of total electricity consumption. Other end use sectors -- primarily street lighting and transportation -- account for the remaining 4% of total statewide consumption.

2. Demand

The state as a whole experiences its peak demand during the summer, as do five of the seven utilities. The two exceptions are NMPC and NYSEG which are winter-peaking. The annual load factor for the state -- defined as the ratio of average annual load to peak load -- was 55%.

The 1986 statewide peak demand of 20,558 MW occurred at approximately 3:00 P.M. on July 7[2]. The commercial sector

Figure 1-1
ENERGY CONSUMPTION AND PEAK DEMAND
NEW YORK STATE -- 1986



Source: Form EIA 286: Electric Utility Co. Monthly Statement to the Energy Information Administration accounted for approximately 49% of peak summer demand, or 10,070 MW[3]. The residential sector followed with 35% (7,230 MW). As can be seen in Figure 1-2, electricity demand on the peak summer day is at its low at around 6:00 A.M. From that point, demand climbs sharply to its peak between 2:00 and 4:00 P.M. All seven of New York's major private utilities have approximately the same load shape, with downstate utilities tending toward slightly later peaks and upstate utilities toward slightly earlier peaks.

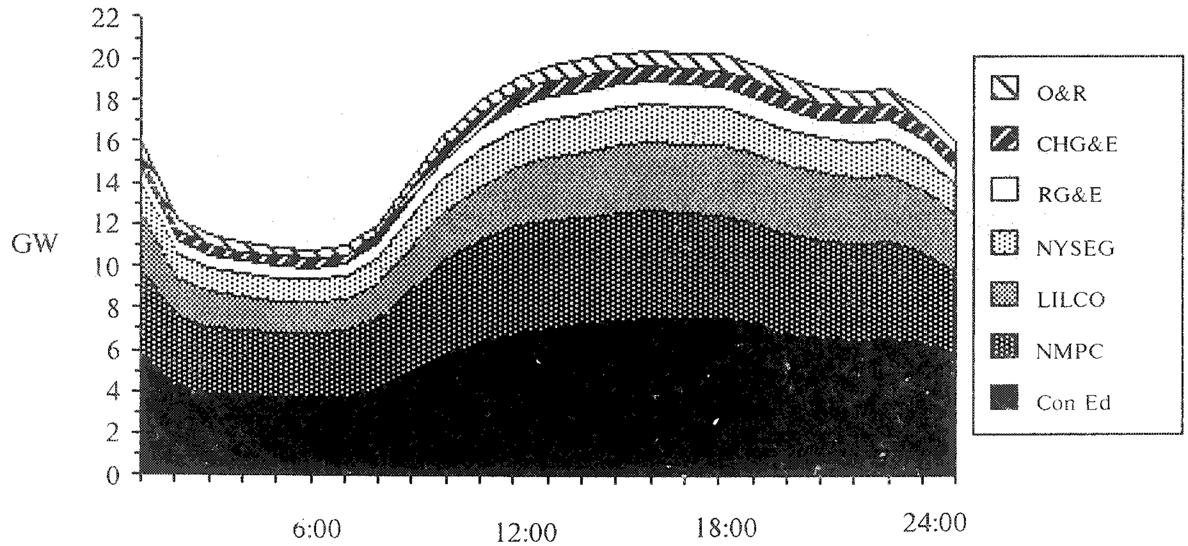
The 1986 winter peak was 15% lower than the summer peak at 17,786 MW on January 14 at 6:00 P.M[4]. The load shape on the peak winter day, as shown in Figure 1-3, is at its low around 4:00 A.M. Demand rapidly climbs from that point to its midday level from 9:00 A.M. to 5:00 P.M. At that time demand rises a further 10% to its peak between 6:00 P.M. and 8:00 P.M. This load shape is quite similar for each of the seven utilities except for Con Ed, for which the early evening peak is less pronounced.

B. <u>Residential Sector</u>

The residential sector in New York in 1986 was composed of approximately 5.9 million households, of which 50% were single-family dwellings. The remainder of the housing stock consists of small multi-family buildings (2-4 units) at 18%, large multi-family buildings (5+ units) at 29%, and mobile homes at 3%. A breakdown of residential housing types, drawn from utility surveys, is presented in Table 1-1. More than 40% of all households are in Con Ed's service territory, including 75% of all multi-family units. Single-family dwellings predominate in the service territories of the other six utilities. The number of residential customers statewide grew at an average rate of 1.1%[5] over the period 1983-87.

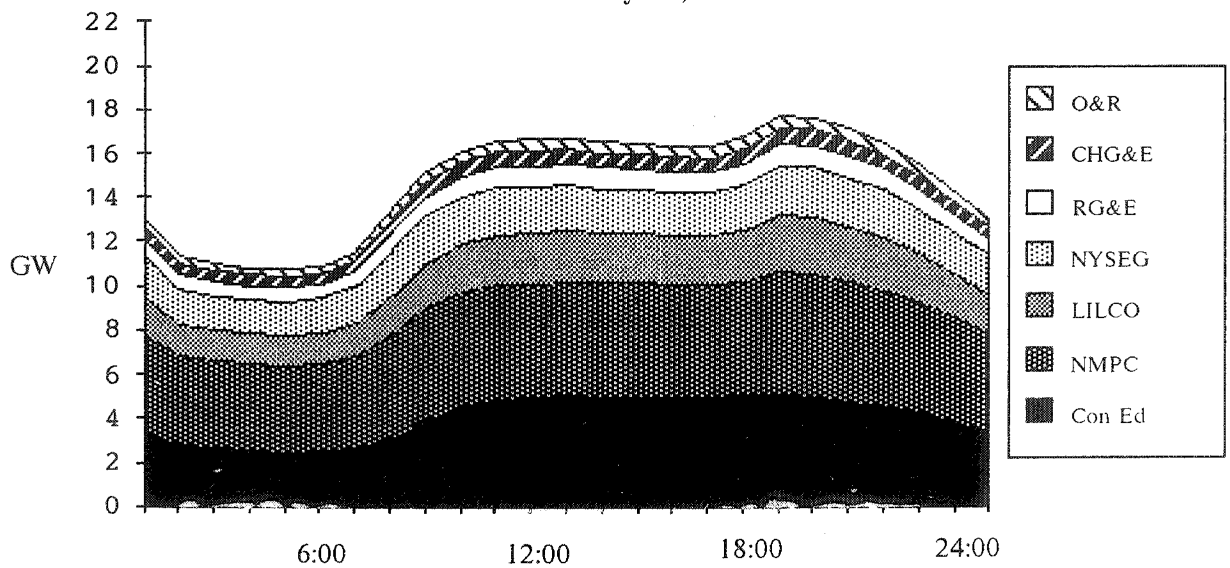
The typical single-family house has about 1,500-2,000 sq.ft. of floorspace[6,7]. Typical levels of insulation include 6" of fiberglass insulation (R18) in the ceiling and double-pane windows or single-pane windows with attached

Figure 1-2
SUMMER PEAK DAY LOADS
July 7, 1986



Source: 1986 NYPP System Load Data

Figure 1-3
WINTER PEAK DAY LOADS
January 14, 1986



Source: 1986 NYPP System Load Data

Table I-1
BREAKDOWN OF HOUSING TYPES IN NEW YORK STATE in 1986

Housing type	Con Edison	Niagara Mohawk	Long Island Lighting	NY State Electric & Gas	Central Hudson G & E	Orange and Rockland	Rochester Gas and Electric	Statewide average
Single-family	15%	65%	88%	74%	80%	79%	71%	50%
Multi-family								
2-4 units	23%	24%	5%	11%	6%	5%	8%	18%
5+ units	61%	6%	4%	3%	4%	10%	15%	29%
Mobile homes	---	5%	1%	9%	6%	4%	---	3%
Condominiums	---	---	2%	1%	2%	---	2%	1%
Other	---	---	---	2%	2%	2%	5%	1%
Fraction of houses in state	42%	22%	15%	11%	3%	3%	5%	100%

Sources:
1. Cambridge Reports; "Evening Survey of Appliance Ownership: July 1986"; Con Edison; 1986
2. Hudson, J.; "1986 Mail Survey of Residential Customers" (Submitted to Economic Research Dept. of NMPC); Urban Systems Research & Engineering, Inc.; Cambridge, MA; Dec. 1986
3. "Appliance Saturations Survey 1986"; Long Island Lighting Company; November 1986
4. "1985 Residential Appliance Saturation Survey"; New York State Electric & Gas; July 1986
5. "1987 Appliance Saturation Survey"; Central Hudson Gas & Electric Corporation; Feb. 1988
6. "Appliance Saturation Survey: Summer 1986"; Orange and Rockland Utilities, Inc.; August 1986
7. "1986 Residential Customer Market Survey"; Rochester Gas and Electric Corporation; Dec. 1987

storm windows[8,9]. Homes with electric space heating typically are substantially better insulated than homes heated with either gas or oil[10].

Our estimate of electricity use for the average residential customer is calculated as the average electricity consumption per appliance multiplied by the saturation for each appliance per customer. The average electricity consumption per appliance is known as the "unit energy consumption" or "UEC" for that appliance. The saturation is the percentage of customers with a particular appliance. The saturation can be greater than 100% when some households have more than one of a particular appliance.

We developed estimates of energy consumption per appliance (UEC) in a number of different ways, depending on the appliance. Many of our UEC estimates were developed by comparing estimates from NY utility studies[11,12,13], studies from neighboring regions[14,15,16], and a national survey of residential energy use[17]. Table 1-2 presents these estimates alongside our UEC estimates for this study.

Our estimates of electricity consumption for space heating and cooling were produced using a building simulation model developed by Lawrence Berkeley Laboratory for the U.S. Department of Energy[18]. The model, known as DOE-2, simulates the operation of a specified prototype building, taking into account climate and usage patterns. We developed a single-family and a multi-family prototype building and calculated electricity consumption for both a typical upstate climate (Syracuse) and a downstate climate (New York City).

Our single family prototype is a two-story, brick house with 2,200 sq.ft. of floorspace and an unfinished basement. It is heated with electric resistance baseboards and cooled with a central air conditioner. Our multi-family prototype is an average apartment in a 80-unit, 10-floor high-rise building. The unit has 675 sq.ft. of floorspace, electric

Table 1-2
ESTIMATES OF RESIDENTIAL ELECTRICAL APPLIANCE
AVERAGE ANNUAL ELECTRICITY CONSUMPTION
(kWh/yr)

	ESTIMATES							Current
Appliance	NMPC(1)	NMPC(2)	NMPC(3)	LILCO	Midwest	Ontario	Michigan	Study
Space heating	11,513	13,232	13,367	---	10,500	16,352	5,348	9,961
- Single-family	---	---	---	---	12,100	19,907	6,587	12,899
- Multi-family	---	---	---	---	6,400	7,645	3,228	3,692
Water heater	4,425	2,938	3,086	4,412	3,800	5,300	3,674	3,200
Refrigerator	1,448	1,938	1,573	1,147	1,400	1,200	1,311	1,340
Freezer	1,085	2,595	1,308	1,041	1,100	900	1,242	1,000
Central A/C	1,312	979	1,282	2,709	2,500	---	1,419	1,341
Room A/C	455	467	263	263	---	---	446	428
Cooking range	776	1,278	617	745	700	950	---	700
Lighting	1,004	---	---	938	1,000	800	748	900
Clothes dryer	308	1,157	970	---	880	1,000	---	880
TV (Color)	72	548	602	---	---	---	---	320
TV (B&W)	---	365	214	---	---	---	---	100

Sources:

1. NMPC(1): "Market Analysis: 1987-2007"; Niagara Mohawk Power Corporation; Syracuse, NY; Sept. 1987
2. NMPC(2): "Demand Side Management Plan 1988"; Niagara Mohawk Power Corp.; Syracuse, NY; April 1988
3. NMPC(3): Lawrence, A.; "Residential Energy Utilization Indexes for Niagara Mohawk: Mixed Estimation Combining Niagara Mohawk and National Data"; Angel Economic Reports; Lake Placid, NY; Feb. 1988
4. LILCO: Barakat, Howard and Chamberlin, Inc.; "Demand-side Management Program Analysis"; Long Island Lighting Co.; Berkeley, CA; April 1988
5. Midwest: Geller, H. et.al.; "Acid Rain and Electricity Conservation"; American Council for an Energy-Efficient Economy; Wash., D.C.; June 1987
6. Ontario: Brooks, D. and Torrie, R.; "Electricity Conservation Supply Curves for Ontario"; Marbek Resource Consultants; Ottawa, Canada; Aug. 1987
7. Michigan: Krause, F. et.al.; "Analysis of Michigan's Demand-Side Electricity Resources in the Residential Sector"; Lawrence Berkeley Laboratory; Berkeley, CA; Feb. 1987

resistance heating and room air conditioners for cooling. The thermal characteristics of our prototypes are presented in Table 1-3.

Our estimates of refrigerator and freezer unit energy consumption were developed from manufacturers' data of average electricity consumption and sales volume back to 1972[19].

Our estimates of statewide appliance saturations are based on appliance surveys conducted by the seven utilities[20,21,22,23,24,25,26]. The results of these surveys are presented in Table 1-4 alongside our estimates of average statewide saturations. Electric space heating saturations are broken out for multi-family and single-family residences. The single-family space heating saturation is a weighted average which includes small multi-family (2-4 units) and condominiums. We have grouped housing types in this way because both small multi-family buildings and condominiums more closely resemble our single-family prototype in terms of conservation measures, costs and savings. Neither mobile homes nor the "other" category of homes are included in the analysis.

A detailed breakdown of electricity use in the residential sector is presented in Table 1-5. The first column presents our UEC estimates. The second column lists our estimates of the saturation of each of the appliance types. The third column is the average UEC per customer, which is calculated as the product of the UEC per appliance and the saturation for each appliance type. The estimates of statewide average space conditioning UECs are population- and saturation-weighted averages of the results of the DOE-2 simulations for upstate and downstate climate zones.

Our analysis shows that refrigerators are the largest residential end use of electricity, accounting for 1,611 kWh/yr, or 27% of total residential consumption. Their large share is due to their moderately large UEC combined with a very high saturation. Lighting is the second largest

Table 1-3
RESIDENTIAL BUILDING PROTOTYPES

	Single family	**Multi-family**
Description:	Two-story w/basement	High rise apt. bldg.
Floorspace:	2,240 $ft.^2$	275 $ft.^2$/unit
Fraction of wall area w/glazing:	12%	12%
Roof R-value:	37	Uninsulated concrete
Wall R-value:	11	Uninsulated brick
Floor R-value:	18	No insulation
Glazings:	2 (R-1.9)	1 (R-0.7)
Basement:	No insulation	No insulation
Heating temperature:	68 F	68 F
(night setback)	64 F	64 F
Cooling temperature:	78 F	78 F
Heating system:	Electric resistance	Electric resistance
Heating efficiency:	100%	100%
Cooling system:	Central A/C	Room A/C
Cooling COP:	2.35	2.05

Table 1-4
RESIDENTIAL ELECTRIC APPLIANCE SATURATIONS

Appliance	Con Ed	NMPC	LILCO	NYSEG	CHG&E	O&R	RG&E	Weighted statewide average
Space heating	5.2%	10.8%	5.0%	10.0%	10.5%	5.8%	6.2%	7.2%
Single-family*	3.8%	10.4%	4.8%	9.5%	9.7%	4.3%	5.8%	7.3%
Multi-family	6.0%	16.0%	10.0%	12.8%	27.5%	18.6%	10.4%	7.1%
Water heating	5.5%	32.4%	7.0%	33.0%	26.0%	12.0%	14.7%	15.9%
Refrigerator	107.6%	141.8%	125.0%	122.0%	121.6%	109.0%	119.3%	120.2%
Freezer	9.3%	39.0%	26.0%	51.0%	43.1%	36.0%	36.5%	25.9%
Central A/C	5.8%	6.7%	14.0%	4.0%	7.0%	15.0%	14.9%	7.7%
Room A/C	88.6%	22.0%	111.0%	27.5%	63.4%	88.5%	29.8%	67.1%
Cooking range	18.3%	45.6%	50.0%	53.0%	59.0%	23.0%	58.0%	36.1%
Lighting	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Clothes dryer	11.4%	51.9%	55.0%	52.0%	64.0%	30.0%	46.9%	35.0%
Color TV	158.3%	131.0%	185.0%	123.5%	159.6%	179.3%	150.7%	152.7%
B&W TV	65.3%	48.0%	53.0%	53.5%	63.1%	48.7%	51.1%	57.3%

* Single-family saturation includes 2-4 unit multi-family buildings and condominiums.

Sources:
1. "Niagara Mohawk Power Corporation 1988 Demand Side Management Plan"; NMPC; April 1988
2. "Appliance Saturations Survey 1986"; Long Island Lighting Company; November 1986
3. Cambridge Reports; "Evening Survey of Appliance Ownership: July 1986"; Con Edison; 1986
4. "1986 Residential Customer Market Survey"; Rochester Gas and Electric Corporation; Dec. 1987
5. "1985 Residential Appliance Saturation Survey"; New York State Electric & Gas; July 1986
6. "Appliance Saturation Survey: Summer 1986"; Orange and Rockland Utilities, Inc.; August 1986
7. "1987 Appliance Saturation Survey"; Central Hudson Gas & Electric Corporation; Feb. 1988

Table 1-5
RESIDENTIAL ELECTRICITY CONSUMPTION
NEW YORK STATE - 1986

End use	UEC per appliance (kWh/yr)	Saturation	UEC per customer (kWh/yr)	Fraction of total
Refrigerator	1,340	120.2%	1,611	27.3%
Lighting	900	100.0%	900	15.3%
Space heating	9,961	7.2%	717	12.2%
Single-family	12,899	7.3%		
Multi-family	3,692	7.1%		
Water heating	3,200	15.9%	509	8.6%
Color television	320	152.5%	488	8.3%
Miscellaneous	403	100.0%	403	6.8%
Clothes dryer	880	35.0%	308	5.2%
Room air conditioner	428	67.0%	287	4.9%
Freezer	1,000	25.9%	259	4.4%
Cooking range	700	36.1%	253	4.3%
Central air conditioner	1,341	7.7%	103	1.8%
B&W television	100	57.7%	58	1.0%
Total			5,895	100.0%

residential end use of electricity at 900 kWh/yr, or 15% of residential consumption. Space heating, water heating and television viewing (color and black & white combined) each account for 488 - 717 kWh/yr, or 9 - 13% of total residential use. The remaining end uses each account for 7% or less of total residential use. Miscellaneous end uses account for 403 kWh/yr, or 7% of total residential use. Air conditioners (room and central combined) account for 390 kWh/yr (7%), electric clothes dryers account for an average of 308 kWh/yr (5%), freezers account for 259 kWh/yr (4%) and electric ranges add another 253 kWh/yr (4%).

We have assumed that electricity use by the remaining unanalyzed, or "miscellaneous", end-uses -- which includes VCRs, microwave ovens, stereo equipment, and small kitchen appliances -- is based on the difference between the sum of all other end uses and the actual 1986 statewide average residential sales per customer of 5,895 kWh/yr[27].

Tables 1-6 and 1-7 present our breakdown of peak demand for the residential sector in summer and winter, respectively. The first column in these tables contains our estimates of average demand per appliance. This is typically calculated as the annual consumption divided by the the number of hours in a year. For space conditioning appliances, the peak demand is drawn from the DOE-2 simulation. For air conditioners the average demand is calculated as the annual consumption (determined in the DOE-2 simulation) averaged over the three summer months only.

The second column in Tables 1-6 and 1-7 lists estimates of the ratio of peak-to-average demand for each of the appliance types during system peaks. These estimates were derived from a statistical analysis of NMPC sales data[28]. By their statistical nature, these estimates are necessarily approximate. Further, because these estimates are based on homes within Niagara Mohawk's service territory, they may not reflect perfectly conditions at other utilities in the state. These considerations are counterbalanced by the fact

Table 1-6
RESIDENTIAL PEAK SUMMER DEMAND
NEW YORK STATE - 1986

Appliance	Avg. demand per appliance* (W)	Peak/average demand ratio	Coincident demand per appliance (W)	Saturation	Coincident demand per customer (W)	Fraction of total
Room A/C**	195	3.29	643	67.0%	430	36.6%
Refrigerator	153	1.51	231	120.2%	278	23.6%
Central A/C**	612	4.42	2,704	7.7%	208	17.7%
Cooking range	80	2.15	172	36.1%	62	5.3%
Clothes dryer	100	1.46	147	35.0%	51	4.4%
Lighting	103	0.42	43	100.0%	43	3.7%
Water heating	365	0.69	252	15.9%	40	3.4%
Freezer	114	1.28	146	25.9%	38	3.2%
Color television	37	0.42	15	152.5%	23	2.0%
B&W television	11	0.42	5	57.7%	3	0.2%
Miscellaneous	1	0.42	0	100.0%	0	0.0%
Total					1,177	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.
** The demand for air conditioners is averaged over the three summer months only.

Table 1-7
RESIDENTIAL PEAK WINTER DEMAND
NEW YORK STATE - 1986

End use	Avg. demand per appliance* (W)	Peak/average demand ratio	Coincident demand per appliance (W)	Saturation	Coincident demand per customer (W)	Fraction of total
Space heating	1,125	3.88	4,363	7.2%	314	30.1%
Lighting	103	1.93	199	100.0%	199	19.0%
Refrigerator	153	0.76	116	120.2%	140	13.4%
Color television	37	1.93	71	152.5%	108	10.3%
Water heating	365	1.78	651	15.9%	104	9.9%
Clothes dryer	100	2.54	255	35.0%	89	8.5%
Cooking range	80	1.46	117	36.1%	42	4.0%
Freezer	114	1.18	135	25.9%	35	3.4%
B&W television	11	1.93	22	57.7%	13	1.2%
Miscellaneous	1	1.93	2	100.0%	2	0.2%
Total					1,045	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.

that NMPC accounts for the second-largest fraction of houses of any utility. Since the NMPC peak-to-average demand analysis provides the best available New York-specific data, it is relied upon.

The third column in Tables 1-6 and 1-7 is the coincident demand per appliance, which is calculated as the product of the average demand per appliance and the peak-to-average ratio (except for space conditioning equipment as explained earlier). The fourth column contains our saturation estimates, as presented in Table 4. The coincident demand per customer, presented in the fifth column, is calculated as the product of the coincident demand per appliance and the saturation for each appliance type. The final column presents the fraction of residential demand from each appliance type.

Average peak summer demand per household is 1,177 W. The peak winter demand is somewhat lower at 1,045 W. As shown in Table 1-6, air conditioning accounts for 638 W per household, or almost half of residential peak summer demand. Refrigerators and freezers together account for 318 W or 27% of peak demand. The remaining 221 W is divided between cooking, water heating, lighting, clothes drying and television viewing. Table 1-7 presents the breakdown of residential peak demand in the winter. As expected, air conditioning is replaced by space heating, which accounts for 314 W per household, or 30.1% of peak demand. Lighting accounts for 199 W (19%) of peak demand, almost five times higher than in the summer due to the later hour at which winter peak occurs and the shorter days during this season. The remaining 532 W is allocated among refrigerators and freezers (175 W), televisions (121 W), water heating (104 W), clothes drying (89 W), cooking (42 W), and miscellaneous end uses (2 W).

C. Commercial Sector

The commercial sector accounted for over 40,000 GWh of electricity sales in 1986, over 40% of total statewide sales[29]. Nearly half of the total commercial sales occurred in Con Ed's service territory. Peak demand in 1986 for the commercial sector was approximately 10,100 MW in the summer and 7,900 MW in the winter. Again, nearly half of the total peak demand occurred in Con Ed's service territory.

Our analysis of commercial sector buildings is based primarily on simulations of seven different building types -- offices, retail stores, hotels, hospitals, supermarkets, schools and small commercial buildings. The DOE-2 model is used for the commercial sector simulations as it was for the residential space conditioning analysis. The building prototypes are drawn from a 1986 study of commercial buildings in Con Ed's service territory[30]. This study involved an extensive survey of commercial buildings and the specification of seven prototype buildings for DOE-2 analysis. Our study uses these prototypes to evaluate statewide conservation potential. Table 1-8 contains descriptions of the prototype buildings. The only significant change made in the prototype buildings from the Con Ed base case was to increase the minimum outside air ventilation requirements to conform with the proposed new ASHRAE standard of 20 cubic feet per minute (cfm) per person[31]. The minimum outside air ventilation requirements in the Con Ed base case prototypes ranged from 5 to 20 cfm.

It is important to note that the prototype buildings do not resemble actual buildings. Their hypothetical construction is an amalgam of various equipment types with the fraction of floorspace served by each type equal to that found in the building population at large. For example, while real buildings are typically served by a single cooling system type, our prototype retail store (with a total of seven floors) has one floor with a single-zone reheat system, one floor with a dual duct system, two floors with a multi-zone system, and three floors with a package, single-zone system. In effect, we have accounted for the

Table 1-8
COMMERCIAL BUILDING PROTOTYPES

Office Building
- Floorspace: 205,000 $ft.^2$
- Floors: 27
- Fraction of wall area w/glazing: 42%
- Peak lighting demand: 1.71 $W/ft.^2$
- Peak equipment demand: 0.25 $W/ft.^2$

Retail Store
- Floorspace: 149,000 $ft.^2$
- Floors: 7
- Fraction of wall area w/glazing: 15%
- Peak lighting demand: 1.59 $W/ft.^2$
- Peak equipment demand: 0.15 $W/ft.^2$

Hotel
- Floorspace: 250,500 $ft.^2$
- Floors: 22
- Fraction of wall area w/glazing: 30%
- Peak lighting demand: 1.01 $W/ft.^2$
- Peak equipment demand: 0.54 $W/ft.^2$

Hospital
- Floorspace: 320,500 ft.2
- Floors: 11
- Fraction of wall area w/glazing: 35%
- Peak lighting demand: 1.08 W/ft.2
- Peak equipment demand: 0.6 W/ft.2

Supermarket
- Floorspace: 19,500 $ft.^2$
- Floors: 1
- Fraction of wall area w/glazing: 10%
- Peak lighting demand: 1.87 $W/ft.^2$
- Peak equipment demand: 0.5 $W/ft.^2$

School
- Floorspace: 237,100 $ft.^2$
- Floors: 6
- Fraction of wall area w/glazing: 20%
- Peak lighting demand: 2.41 $W/ft.^2$
- Peak equipment demand: 1.15 $W/ft.^2$

Small Building
- Floorspace: 3,500 $ft.^2$
- Floors: 2
- Fraction of wall area w/glazing: 17%
- Peak lighting demand: 1.28 $W/ft.^2$
- Peak equipment demand: 0.16 $W/ft.^2$

varying saturation of different equipment types prior to the conservation analysis.

Another noteworthy aspect to the prototypes is the very low lighting power densities, ranging from 1.01 to 2.41 W/sq.ft. We attribute this to a number of factors. First, the New York State Lighting Standards require compliance with a fairly strict energy budget for all buildings using more than 5,000 kWh/month, which includes all of the prototypes except for the small building[32]. Second, high commercial electricity prices in Con Ed's service territory would increase the cost-effectiveness of conservation retrofits and increase their penetration. The prototypes indicate that these two factors have already led to the adoption of a number of lighting efficiency measures. This indication is born out by a recent national survey of the penetration of lighting efficiency measures[33]. This survey found that for the Northeast census region, 48% of fluorescent bulbs and 46% of fluorescent lamp ballasts were energy-efficient types. Following this survey, we assume that these fractions of high-efficiency lighting equipment have been installed in all commercial buildings and that substantial delamping has occurred in all but the small building. There is evidence that this assumption may overstate the amount of high-efficiency lighting equipment that has been installed in the state. A recent survey of commercial buildings in NMPC's service territory found only 7% of fluorescent lamps and 15% of fluorescent lamp ballasts to be of high-efficiency types[34].

Use of the Con Ed building prototypes may introduce some biases into our analysis. First, the Con Ed survey focused primarily on large accounts, with usage above 450,000 kWh/yr. Electricity use in these buildings may not be representative of all commercial buildings, the majority of which are much smaller. Second, the survey covered only Con Ed's service territory; buildings in the rest of the State may have somewhat different characteristics.

There are countervailing factors which tend to offset the potential biases introduced by using the Con Ed prototypes. First, although very large buildings are in the minority numerically, they account for a disproportionately large fraction of consumption. For example, NMPC found in a recent survey of commercial buildings that the largest 10% of commercial customers account for 69% of total sectoral electricity consumption[35]. Also, the inclusion of a small building prototype tends to offset the reliance on large buildings. Second, while the characteristics of commercial buildings in the rest of the state may differ, the commercial sector in Con Ed's service territory accounts for nearly 50% of commercial sales statewide.

Finally, in order to provide a check on the validity of using the Con Ed prototypes, we have compared the results of our analysis to other estimates of commercial building electricity intensity. Table 1-9 presents a comparison of the estimates of average electricity intensity in commercial buildings from the DOE-2 simulations carried out for this report and four other sets of estimates. The other estimates include: (1) The CEDMS model developed for NYSEO -- a statistical model of commercial sector energy demand used by the New York State Energy Office (NYSEO) and many of the utilities for forecasting and analysis[36]; (2) Two analyses done for Con Ed and NMPC by Xenergy Inc.[37,38] (The Con Ed study is the source for our own building prototypes. The difference between our simulation and Xenergy's appears to be caused by a "calibration" procedure carried out by Xenergy. See below.); (3) Estimates from Massachusetts Electric Co. based on a survey of commercial buildings in their service territory[39].

Our analysis is in reasonably close agreement with the other estimates for five of the seven buildings analyzed, the hotel, hospital, education building, small building and the supermarket. For the remaining two buildings -- offices and retail stores -- our estimates of electricity intensity

Table 1-9
COMMERCIAL ELECTRICITY INTENSITIES
(saturation-weighted average kWh/sq.ft.)

		HVAC*	Lighting	Misc.*	Total
Office bldg.	ACEEE	16.5	6.6	1.0	24.1
	CEDMS	6.8	8.9	0.3	16.2
	NMPC	5.1	5.2	4.3	14.5
	Con Ed	1.9	6.2	7.6	16.0
	Mass. Elec.	4.2	3.3	3.2	10.7
Retail store	ACEEE	12.8	6.2	0.5	19.4
	CEDMS	4.8	6.1	0.2	11.1
	NMPC	1.9	5.1	2.0	9.0
	Con Ed	2.0	6.4	5.1	13.5
	Mass. Elec.	1.3	4.4	1.5	7.2
Hotel	ACEEE	7.7	3.3	1.9	12.9
	CEDMS	8.5	4.7	2.3	16.8
	NMPC	5.7	4.0	4.4	14.2
	Con Ed	2.8	3.4	4.9	11.1
	Mass. Elec.	5.2	3.9	4.6	13.7
Health facility	ACEEE	8.3	6.0	3.9	18.2
	CEDMS	5.9	7.3	2.3	16.2
	NMPC	4.7	5.0	8.9	18.6
	Con Ed	1.9	4.4	8.1	14.4
	Mass. Elec.	6.4	6.8	10.8	24.0
Supermarket	ACEEE	6.1	12.4	34.5	52.9
	CEDMS	5.7	12.7	32.5	51.1
	NMPC	5.8	15.7	27.1	48.6
	Con Ed	4.6	12.4	39.8	56.7
	Mass. Elec.	5.6	8.0	13.3	26.9
Education bldg.	ACEEE	6.6	5.0	2.5	14.1
	CEDMS	1.7	5.5	1.2	8.9
	NMPC	---	---	---	---
	Con Ed	1.2	5.9	6.0	13.1
	Mass. Elec.	1.7	2.2	2.2	6.2

Table 1-9 (continued)
COMMERCIAL ELECTRICITY INTENSITIES
(saturation-weighted average kWh/sq.ft.)

		HVAC*	Lighting	Misc.*	Total
Small building**	ACEEE	2.1	4.7	0.6	7.3
	CEDMS	2.0	4.6	0.2	7.0
	NMPC	1.9	5.8	4.0	11.8
	Con Ed	0.2	0.9	0.7	1.7
	Mass. Elec.	1.4	1.7	2.5	5.6

* The definitions of end use categories may differ between sources.
** Corresponds to "miscellaneous" building types for CEDMS, NMPC, and Mass. Elec.

Sources:
1. CEDMS-PC, Jerry Jackson Assoc., 1986
2. "Characterization of Niagara Mohawk Power Corporation's Commercial Class", Xenergy Inc., 1988 (preapred for Niagara Mohawk Power Corp.)
3. "Study of Energy End Uses and Conservation Potential in Selected Segments of the Commercial Class", Xenergy Inc., 1987 (prepared for Consolidated Edison Co.)
4. "Supplement 3B to Long Range Forecast 3 for the Twin Year Period 1988-1997", Filing Companies: Massachusetts Electric, New England Power Co., Yankee Atomic Electric Co., New England Hydro-Transmission Electric Co.; 1988

are significantly higher than the other estimates. It can be seen that the discrepancy is primarily due to differences in estimates of HVAC energy use. There are a number of possible reasons for this difference.

One possible reason is our change in the minimum outside air ventilation rates to conform with the proposed new ASHRAE standard. A recent study estimated that an increase in minimum outside air requirement from 5 cfm to 20 cfm should typically lead to an increase in HVAC energy consumption amounting to 7% of building cooling energy and 2% of energy used for ventilation for a typical office building in New York City's climate zone[40].

A second possible reason is that in analyses of the prototype buildings, we were careful to insure that building loads were met nearly all the time (i.e., more than 99.9% of operating hours). This requirement guided our sizing and operation of HVAC systems and therefore determined to a large extent HVAC electricity consumption. In contrast, in many real buildings, loads are not met for many hours during the hottest summer days and coldest winter days. As a result, these buildings will use less HVAC energy. On the other hand, there are also buildings that are over-conditioned and are too hot in the winter and too cold in the summer, thereby using more HVAC energy. Unfortunately, we have no evidence quantifying this effect and therefore are unable to estimate whether it might explain the discrepancy. It does appear that this is part of the reason for the difference between our EUI estimates and those of Xenergy using the same prototypes. After constructing their initial prototypes, Xenergy "calibrated" their buildings. This process "involved fine tuning some building characteristics, such as temperature set points and ventilation rates, until the annual end-use consumption per square foot (EUI) of the typical building was equal to the corresponding estimate for the [building type] population as a whole."[41]

A third possible reason for the differences in HVAC electricity consumption is that our prototype buildings have 100% saturations of air conditioning and ventilation, while the saturations of these end uses in the building stock as a whole are somewhat lower. This is particularly relevant when extending our estimates outside of Con Ed's service territory to the rest of New York State where air conditioning would appear to be less prevalent. Xenergy estimates cooling saturations of 100% for office buildings and 98.1% for retail stores in Con Ed's service territory, and 75% for office buildings and 42% for retail stores in NMPC's service territory[42]. The inclusion of less than 100% saturation of cooling and ventilation would significantly reduce our estimates of HVAC electricity consumption. Incorporation of Xenergy estimates of cooling and ventilation saturations in NMPC's service territory would reduce our estimates of HVAC elelctricity use in offices and retail buildings by approximately 3 kWh/ft^2 and 6 kWh/ft^2, respectively.

Finally, the fourth possible reason for the difference in estimates of HVAC electricity consumption is that our estimates are based on large buildings, while some of the other estimates include all building sizes within a particular building type. In particular, the CEDMS, NMPC and Massachusetts estimates all include a full range of building sizes in their estimates. Because small buildings tend to be less electricity intensive (see the EUIs for the small building prototype), the inclusion of smaller buildings would tend to lower the estimate of average EUI.

In conclusion, there are a number of factors that, in combination, might well account for the difference in EUI estimates. However, given that the discrepancy exists, the important question is how might our potentially overstated EUI estimates bias our conservation analysis, if at all. Generally, any overestimation of HVAC electricity use will have a number of impacts. First, total savings from conservation measures directed at HVAC equipment will be larger and total savings from measures directed at lighting and miscellaneous end uses will be smaller than expected. This is because, as our estimate of consumption per building increases, the corresponding estimate of floorspace decreases, so that the product remains consistent with total consumption. The result is that as floorspace decreases, a lighting measure which saves a given amount per square foot will save less statewide. Second, the cost-effectiveness of lighting and refrigeration measures should be affected only to a small degree or not at all. This is because the majority of savings -- and all of the costs -- from these measures are independent of HVAC interactions. Even large changes in HVAC electricity use will affect total savings from lighting and refrigeration measures only marginally. Third, to the extent that the potential overestimation of HVAC electricity use is due to oversized equipment, the cost-effectiveness of HVAC measures will be unaffected because the measure costs (which are based on equipment size) will increase along with savings. Finally, to the extent that the potential overestimation of HVAC electricity use is due to increased operation of HVAC equipment, the cost-effectiveness of HVAC measures will be improved as efficiency improvements are applied over more hours.

Referring back to Table 1-9, our analysis finds that supermarkets are by far the most electricity intensive building type at approximately 53 $kWh/ft^2/yr$. Office buildings are the second most electricity intensive at 24 $kWh/ft^2/yr$. Retail buildings, health facilities, hotels and education buildings all consume between 12 and 19 $kWh/ft^2/yr$. The small building type has the lowest electricity intensity at 7 $kWh/ft^2/yr$. Energy use for lighting remains fairly constant among buildings at 3-7 $kWh/ft^2/yr$ except for supermarkets for which longer hours and higher lighting levels lead to an electricity intensity of over 12 $kWh/ft^2/yr$.

In order to develop estimates of the fraction of electricity used by each building type, we have relied on the CEDMS model for its breakdown of commercial floorspace. Because the electricity consumption of our prototype buildings differ from the CEDMS estimates, we would overestimate total statewide electricity consumption if we were to use the CEDMS floorspace estimates. Instead, we use the estimates of fraction of total commercial floorspace for each building type and calculate the floorspace totals necessary to make total consumption equal to statewide consumption.

In assigning the CEDMS floorspace estimates to our modeled building types we have assumed that the CEDMS categories of: a) primary and secondary schools, and b) universities and colleges, are all represented by our education building. Further, we have assigned the CEDMS miscellaneous building type to our small building prototype. Finally, the CEDMS restaurant and warehouse building types were not assigned to any modeled building because their characteristics and energy use patterns are substantially different from any of the building types modeled. The conservation potential of these building types was not estimated.

Our final estimates of commercial floorspace show a total of approximately 3,672 million ft^2. Office buildings account for the largest fraction of this total at 28%. The next largest fractions of total floorspace are from small buildings (21%), educational buildings (14%), retail stores (12%), hospitals (5%), hotels (3%) and supermarkets (2%). The remaining, unanalyzed building types together account for 16% of total commercial floorspace.

Using the CEDMS floorspace fractions we have compiled a breakdown of electricity consumption by building type and by end use. This breakdown is presented in Table 1-10. Office buildings account for 39.5% of electricity consumption, by far the largest fraction. The next largest fraction of

Table 1-10
COMMERCIAL ELECTRICITY CONSUMPTION
NEW YORK STATE - 1986
(GWh/year)

	HVAC	Lighting	Miscellaneous	Total	Fraction
Office building	10,833	4,333	636	15,815	39.5%
Retail store	3,694	1,793	132	5,622	14.0%
Hotel	517	224	132	872	2.2%
Health facility	955	684	448	2,085	5.2%
Supermarket	379	772	2,147	3,297	8.2%
Education bldg.	2,268	1,725	853	4,846	12.1%
Small building	1,051	2,394	308	3,752	9.4%
Other buildings*	---	---	---	3,798	9.5%
Total	19,696	11,925	4,654	40,087	
Fraction**	54.3%	32.9%	12.8%		

* There is no end-use breakdown for "other buildings" because they were not modeled.
** End use fractions are based only on modeled buildings.

electricity consumption is due to retail stores (14%), educational buildings (12%), small buildings (9%), supermarkets (8%), health facilities (5%), and hotels (2%). Unanalyzed building types account for the remaining 9% of commercial electricity use.

HVAC accounts for over half of the electricity consumed in the commercial building types analyzed. Lighting accounts for a third while the remainder is due to miscellaneous end uses.

D. Industrial Sector

The industrial sector is extremely diverse and therefore difficult to characterize in detail in terms of energy consumption. Our analysis consists of a breakdown of electricity consumption by SIC code and by major end use.

The seven major private utilities sold almost 20,400 GWh of electricity to the industrial sector in New York in 1986[43]. Table 1-11 presents a breakdown of electricity use by industry type. The data presented in this table are drawn from reports submitted by the utilities to the Federal Energy Regulatory Commission[44]. Chemicals and allied products (SIC 28) and electric and electronic machinery (SIC 36) each accounted for just over 3,000 GWh in 1986, or 15% of electric sales to the industrial sector. Primary metals (SIC 33), machinery except electrical (SIC 35), transportation equipment (SIC 37), stone, clay, glass, and concrete (SIC 32), paper and allied products (SIC 26), and food and kindred products (SIC 20) all accounted for 6 to 10% of industrial sales. Mining industries accounted for 1% of total industrial sales.

Motors are estimated to account for about 75% of industrial electricity use nationwide[45,46,47]. We estimate that motors account for 78% of industrial electricity use in New York state, as shown in Table 1-11. This estimate is based on a breakdown of the fraction of electricity used by motors according to SIC category[48].

Table 1-11
INDUSTRIAL ELECTRICITY CONSUMPTION
NEW YORK STATE - 1986

SIC	Industry	Electricity Consumption (GWh)	Fraction of total	Electricity consumption by motors (GWh)	Fraction by motors
28	Chemicals & Allied Products	3,029.9	14.9%	1,908.8	63%
36	Electric & Electronic Machinery	3,011.4	14.8%	2,499.5	83%
33	Primary Metal Industries	2,051.6	10.1%	1,579.8	77%
35	Machinery except Electrical	1,740.7	8.5%	1,410.0	81%
37	Transportation Equipment	1,451.6	7.1%	1,103.2	76%
32	Stone, Clay, Glass & Concrete Products	1,393.2	6.8%	1,281.8	92%
26	Paper & Alled Products	1,370.9	6.7%	1,110.4	81%
20	Food and Kindred Products	1,206.7	5.9%	977.4	81%
	Other Industrial	855.6	4.2%	N/A	N/A
38	Measuring, Analyzing & Controlling Instruments	800.7	3.9%	560.5	70%
34	Fabricated Metal Products	740.4	3.6%	629.4	85%
30	Rubber & Misc. Plastics Products	731.2	3.6%	636.1	87%
39	Miscellaneous Manufacturing	713.4	3.5%	499.4	70%
27	Printing, Publishing & Allied Products	503.0	2.5%	367.2	73%
14	Mining, Quarrying & Oil and Gas Extraction	207.7	1.0%	N/A	N/A
29	Petroleum Refining and Related Industries	128.5	0.6%	106.6	83%
22	Textile Mill Products	123.4	0.6%	97.4	79%
23	Apparel & Other Finished Products	111.9	0.5%	81.7	73%
24	Lumber & Wood Products Except Furniture	103.8	0.5%	76.8	74%
31	Leather & Leather Products	45.2	0.2%	33.0	73%
25	Furniture & Fixtures	44.0	0.2%	32.6	74%
21	Tobacco Manufacturers	0.1	0.0%	0.1	73%
	Total	20,364.9	100%	15,817.5	78%

Sources:
1. Schedule XV, Uniform Statistical Report; Submitted to the NY State Energy Office
2. "Classification and Evaluation of Electric Motors and Pumps"; U.S. Dept. of Energy; Feb. 1980

Table 1-12 lists our assumptions regarding the base case characteristics of the motors stock, where motors are divided into six categories by size. The characteristics for the six categories are based on a major national study of electrical consumption by motors[49]. The efficiency assumptions are drawn from two recent reviews of motor technologies[50,51]. We assume that all motors are of standard efficiency in the base case. Table 1-12 shows that while small motors dominate in terms of numbers, large motors account for the large majority of electricity consumption. The final column in Table 1-12 contains estimates of the fraction of motors in each size category that are rebuilt rather than replaced when they wear out. Rebuilding of a motor (essentially rewinding the iron core) costs significantly less than full replacement. Consequently, the cost-effectiveness of motor efficiency measures depends on whether a motor would be rebuilt or replaced.

Estimates of how electricity is further divided among the remaining end uses vary widely depending on industry type and region, among other factors. For example, estimates of the fraction of industrial electricity use due to lighting range from less than 5% to 11%[52]. We conservatively estimate that lighting accounts for 7% of total industrial consumption. Thus, industrial processes (electrolysis, heat, etc.) account for most of the remaining 15% of industrial electricity consumption.

Very little data are available regarding typical peak demands of industrial equipment. The ratio of peak to average demand will depend on a number of factors including industry-type, number of shifts, and particular industrial processes. Following a number of recent studies, we make the simplifying assumption that the peak-to-average ratio for both industrial motors and lights is equal to the ratio for the industrial sector as a whole[53]. This ratio is calculated as the ratio of peak demand to the annual consumption divided by the number of hours in a year (8,760

Table 1-12
BASE CASE INDUSTRIAL MOTOR ASSUMPTIONS
NEW YORK STATE - 1986

Size range (HP)	Average size (HP)	Number (x1000)	Average usage (hrs/yr)	Average cost (1986$)	Average demand (Kwh/yr)	Total demand (GWh/yr)	Avg. eff.	Avg. life (yrs)	Fraction rebuilt
< 1	0.28	105.46	400	40	120	13	70.0%	20	0%
1-5	1.34	104.28	921	165	1,150	120	80.5%	20	0%
5 - 20	8.61	113.19	2,050	655	15,574	1,763	85.0%	30	35%
21 - 50	25.86	37.60	3,139	1,500	68,406	2,572	89.0%	17	74%
51 - 125	80.55	19.78	3,656	4,500	242,712	4,801	91.0%	12	94%
> 125	195.00	10.68	3,913	10,500	613,372	6,549	93.3%	11	95%
Total	---	391	---	---	---	15,817	---	---	---

Notes:
1. Average usage, cost and efficiency apply to the average size unit in any particular size range.
2. The total demand by industrial motors is equal to 77.7% of the 1986 statewide industrial demand of 20,364.9 GWh.

Sources:
1. "Classification and Evaluation of Electric Motors and Pumps"; U.S. Department of Energy; February 1980 (DOE/CS-0147)
2. W.J. McDonald and H.N. Hickok; "Energy Losses in Electric Power Systems"; IEEE Transactions on Industry Applications, Vol. IA-21, No.4, pp.803-19; May/June 1985
3. "Energy Efficient Motors in Canada: Technologies, Market Factors and Penetration Rates"; Marbek Resource Consultants; Ottawa, Canada; Nov. 1987

hours). The industrial peak-to-average demand ratios for the state and for each of the seven utilities for both summer and winter are presented in Table 1-13.

III. UTILITY-SPECIFIC END-USE BREAKDOWNS

A. Central Hudson Gas & Electric

1. Sectoral Breakdown

Total electricity sales for Central Hudson Gas & Electric in 1986 were 4,159 GWh[54]. The industrial sector accounted for the largest fraction of electricity consumption at 39% of the total. The residential sector was the second largest consumer of electricity at 32%. The commercial sector followed with 22% of total electricity consumption.

CHG&E experiences its peak demand during the summer. The annual load factor for the utility -- defined as the ratio of average annual load to peak load -- was 62%. The 1986 utility peak demand of 770 MW occurred at approximately 3:00 P.M. on July 7[55]. The industrial sector accounted for approximately 37% of peak summer demand, or 285 MW[56]. The commercial sector followed with 231 MW. The 1986 winter peak of 720 MW which occurred on January 15 at approximately 6:00 P.M was 7% lower than the summer peak[57].

2. Residential Sector

The residential sector in CHG&E's service territory in 1986 was composed of approximately 202,000 households, of which 80% were single-family dwellings[58,59]. The remainder of the housing stock consists of small multi-family buildings (2-4 units) at 6%, large multi-family buildings (5+ units) at 4%, mobile homes at 6% and condominiums and other housing types at 4%[60].

A detailed breakdown of electricity use in CHG&E's residential sector is presented in Table 1-14. The UEC estimates in Table 1-14 are taken from a variety of sources, as described in the statewide analysis. The estimates of

Table 1-13
INDUSTRIAL PEAK-TO-AVERAGE DEMAND RATIOS
NEW YORK STATE

Utility	Annual Consumption (GWh)	Peak demand Summer (MW)	Peak demand Winter (MW)	Peak to Average Ratio* Summer	Peak to Average Ratio* Winter
Consolidated Edison	1,436	305	207	1.86	1.26
Niagara Mohawk Power Co.	10,676	1,536	1,551	1.26	1.27
Long Island Lighting Company	1,482	199	255	1.18	1.51
New York State Electric & Gas	2,899	489	516	1.48	1.56
Rochester Gas and Electric	1,781	321	272	1.58	1.34
Orange and Rockland	461	125	108	2.38	2.05
Central Hudson Gas & Electric	1,631	285	215	1.53	1.15
New York State	20,366	3,336	3,071	1.43	1.32

*Peak-to-Average Ratio is defined as the ratio of the peak demand to the average annual demand.

Sources:
1. Schedule XV, Uniform Statistical Report; Submitted to the NY State Energy Office
2. Peak demand values are based on New York State Energy Office estimates.

Table 1-14

RESIDENTIAL ELECTRICITY CONSUMPTION
CENTRAL HUDSON GAS & ELECTRIC - 1986

End use	UEC per appliance (kWh/yr)	Saturation (%)	UEC per customer (kWh/yr)	Fraction of total (%)
Refrigerator	1,340	121.6%	1,629	24.0%
Space heating	10,150	10.5%	1,066	15.7%
Single-family	11,354	9.7%		
Multi-family	3,512	27.5%		
Lighting	900	100.0%	900	13.2%
Water heating	3,200	26.0%	832	12.2%
Clothes dryer	880	64.0%	563	8.3%
Color television	320	159.6%	511	7.5%
Freezer	1,000	43.1%	431	6.3%
Cooking range	700	59.0%	413	6.1%
Room air conditioner	453	63.4%	287	4.2%
Central air conditioner	1,516	7.0%	106	1.6%
B&W television	100	63.1%	63	0.9%
Total			6,801	100.0%

Notes:

1. Reported 1986 average consumption per household was 6,492 kWh/yr.
   Source: "Financial Statistics of the Major Privately Owned Utilities Within New York State"; NY State Dept. of Public Service; 1986

space conditioning UECs are drawn from DOE-2 simulations (also as described in the statewide analysis) and are based on a downstate climate zone. The saturation estimates are from a 1987 CHG&E residential appliance saturation survey[61].

Our analysis shows that refrigerators are the largest residential end use of electricity, accounting for 1,629 kWh/yr, or 24% of total residential consumption. The large share is due to a moderately large UEC combined with a very high saturation. Electric space heating is the second largest residential end use of electricity at 1,066 kWh/yr, or 15.7% of residential consumption. Lighting is the third largest residential end use of electricity at 900 kWh/yr, or 13.2% of residential consumption. Water heating follows at 832 kWh/yr (12.2%). The remaining end uses each account for less than 10% of total residential use.

For the statewide analysis and utility-specific analyses, we have typically assumed that electricity use by the remaining unanalyzed, or "miscellaneous," end-uses -- which includes VCRs, microwave ovens, stereo equipment, and small kitchen appliances -- is based on the difference between the sum of all other end uses and the actual 1986 average residential sales per customer. However, for CHG&E our estimated consumption of the analyzed end-uses is 309 kWh/yr over the reported average residential consumption of 6,492 kWh/yr[62]. Clearly, we have overestimated the consumption of one or more of the end-uses. However, the best available evidence indicates that each of the estimates is reasonable and accurate. Absent compelling evidence to the contrary, we have decided to let this minor discrepancy stand.

Tables 1-15 and 1-16 present our breakdown of peak demand for CHG&E's residential sector in summer and winter, respectively. Average peak summer demand per household is 1,334 W. The peak winter demand is somewhat higher at 1,418 W. Air conditioning accounts for 659 W per household, or almost half of residential peak summer demand.

Table 1-15
RESIDENTIAL PEAK SUMMER DEMAND
CENTRAL HUDSON GAS & ELECTRIC - 1986

Appliance	Avg. demand per appliance* (W)	Peak/average demand ratio (%)	Coincident demand per appliance (W)	Saturation (%)	Coincident demand per customer (W)	Fraction of total (%)
Room A/C**	207	3.38	699	63.4%	443	33.2%
Refrigerator	153	1.51	231	121.6%	281	21.1%
Central A/C**	692	4.45	3,083	7.0%	216	16.2%
Cooking range	80	2.15	172	59.0%	101	7.6%
Clothes dryer	100	1.46	147	64.0%	94	7.0%
Water heating	365	0.69	252	26.0%	66	4.9%
Freezer	114	1.28	146	43.1%	63	4.7%
Lighting	103	0.42	43	100.0%	43	3.2%
Color television	37	0.42	15	159.6%	24	1.8%
B&W television	11	0.42	5	63.1%	3	0.2%
Miscellaneous	0	0.42	0	100.0%	0	0.0%
Total					1,334	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.
** The demand for air conditioners is averaged over the three summer months only.

Table 1-16
RESIDENTIAL PEAK WINTER DEMAND
CENTRAL HUDSON GAS & ELECTRIC - 1986

End use	Avg. demand per appliance* (W)	Peak/average demand ratio (%)	Coincident demand per appliance (W)	Saturation (%)	Coincident demand per customer (W)	Fraction of total (%)
Space heating	1,187	3.95	4,684	10.5%	492	34.7%
Lighting	103	1.93	199	100.0%	199	14.0%
Water heating	365	1.78	651	26.0%	169	11.9%
Clothes dryer	100	2.54	255	64.0%	163	11.5%
Refrigerator	153	0.76	116	121.6%	142	10.0%
Color television	37	1.93	71	159.6%	113	8.0%
Cooking range	80	1.46	117	59.0%	69	4.8%
Freezer	114	1.18	135	43.1%	58	4.1%
B&W television	11	1.93	22	63.1%	14	1.0%
Total					1,418	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.

Refrigerators and freezers together account for 344 W or 26% of peak demand. The remaining 331 W is divided between the other end uses.

Table 1-16 presents the breakdown of residential peak demand in the winter. As expected, air conditioning is replaced by space heating, which accounts for 492 W per household, or 35% of peak demand. Lighting accounts for 199 W (14%) of peak demand, almost five times higher than in the summer due to the later hour and shorter days at which the winter peak occurs. The remaining 726 W is divided between the other end uses.

3. Commercial Sector

As described earlier, our analysis of commercial sector buildings is based on a simulation of seven different building types -- offices, retail stores, hotels, hospitals, supermarkets, schools and small commercial buildings. The DOE-2 model is used for the commercial sector simulations as it was for the residential space conditioning analysis. For CHG&E's service territory, we have used the modeling results based on the downstate climate zone.

Our estimate of the distribution of floorspace among the various building types is taken from the CEDMS model as described earlier. We estimate total commercial floorspace in CHG&E's service territory at approximately 100 million ft^2. Small buildings account for the largest fraction of this total at 28%. The next largest fractions of total floorspace are from educational buildings (18%), office buildings (16%), and retail stores (12%). Unanalyzed building types account for 10% of total commercial floorspace.

Using our floorspace estimates and the DOE-2 modeling results for the downstate climate zone, we have compiled a breakdown of electricity consumption by building type and by end use in CHG&E's service territory. This breakdown is presented in Table 1-17. Office buildings account for 25% of electricity consumption. The next largest fractions of

Table I-17
COMMERCIAL ELECTRICITY CONSUMPTION
CENTRAL HUDSON GAS & ELECTRIC - 1986
(GWh/year)

	HVAC	Lighting	Miscellaneous	Total	Fraction
Office building	157	63	9	229	24.6%
Retail store	94	44	3	142	15.2%
Hotel	24	10	6	40	4.3%
Health facility	38	26	17	80	8.6%
Supermarket	12	22	61	95	10.2%
Education bldg.	73	54	26	153	16.4%
Small building	36	78	10	124	13.3%
Other buildings*	---	---	---	68	7.3%
Total	434	296	133	931	
Fraction**	50.3%	34.3%	15.4%		

* There is no end-use breakdown for "other buildings" because they were not modeled.
** End use fractions are based only on modeled buildings.

electricity consumption are due to educational buildings (16%), retail stores (15%), small buildings (13%), and supermarkets (10%). The remaining building types account for less than 10% each. Unanalyzed building types account for 7% of commercial electricity consumption. In terms of end use, HVAC accounts for 50% of the electricity consumed in CHG&E's commercial sector while lighting accounts for a third.

4. Industrial Sector

Table 1-18 presents a breakdown of electricity use by industry type. The data presented in this table is drawn from reports submitted by the utilities to the New York State Energy Office[63]. Chemicals and allied products (SIC 28) and electric and electronic machinery (SIC 36) each accounted for just over 3,000 GWh in 1986 or 15% of electric sales to the industrial sector. Primary metals (SIC 33), machinery except electrical (SIC 35), transportation equipment (SIC 37), stone, clay, glass, and concrete (SIC 32), paper and allied products (SIC 26), and food and kindred products (SIC 20) all accounted for 6 to 10% of industrial sales.

We estimate that motors account for 84% of industrial electricity use in CHG&E's service territory, as shown in Table 1-18. This estimate is based on a breakdown of fraction of electricity used by motors by SIC code nationwide[64]. We further estimate that lighting accounts for 7% of total industrial consumption and that processing (electrolysis, heat, etc.) accounts for most of the remaining 15% of industrial electricity consumption.

B. Consolidated Edison Company of New York, Inc.

1. Sectoral Breakdown

Total electricity sales for Consolidated Edison in 1986 were 30,167 GWh[65]. The commercial sector accounted for the largest fraction of electricity consumption at 67% of the

Table 1-18
INDUSTRIAL ELECTRICITY CONSUMPTION
CENTRAL HUDSON GAS & ELECTRIC - 1986

SIC	Industry	Electricity Consumption (GWh)	Fraction of total	Electricity consumption by motors (GWh)	Fraction by motors
36	Electric & Electronic Machinery	1,214.1	74.5%	1,007.7	83%
32	Stone, Clay, Glass & Concrete Products	190.5	11.7%	175.3	92%
34	Fabricated Metal Products	52.6	3.2%	44.7	85%
26	Paper & Alled Products	33.1	2.0%	26.8	81%
27	Printing, Publishing & Allied Products	25.2	1.5%	18.4	73%
39	Miscellaneous Manufacturing	21.0	1.3%	14.7	70%
35	Machinery except Electrical	18.6	1.1%	15.0	81%
	Mining, Quarrying & Oil and Gas Extraction	16.6	1.0%	---	N/A
30	Rubber & Misc. Plastics Products	14.1	0.9%	12.3	87%
28	Chemicals & Allied Products	13.8	0.8%	8.7	63%
20	Food and Kindred Products	10.9	0.7%	8.8	81%
22	Textile Mill Products	7.1	0.4%	5.6	79%
33	Primary Metal Industries	5.2	0.3%	4.0	77%
25	Furniture & Fixtures	2.5	0.2%	1.8	74%
29	Petroleum Refining and Related Industries	1.9	0.1%	1.6	83%
23	Apparel & Other Finished Products	1.5	0.1%	1.1	73%
24	Lumber & Wood Products Except Furniture	1.1	0.1%	0.8	74%
31	Leather & Leather Products	0.5	0.0%	0.3	73%
38	Measuring, Analyzing & Controlling Instruments	0.3	0.0%	0.2	70%
21	Tobacco Manufacturers	0.1	0.0%	0.0	73%
37	Transportation Equipment	0.0	0.0%	0.0	76%
	Other Industrial	0.0	0.0%	---	N/A
	Total	1,630.6	100.0%	1,361.8	84%

Sources:
1. Schedule XV, Uniform Statistical Report; Submitted to the NY State Energy Office
2. "Classification and Evaluation of Electric Motors and Pumps"; U.S. Dept. of Energy; Feb. 1980

total. The residential sector was the second largest consumer of electricity at 27%.

Con Ed experiences its peak demand during the summer. The annual load factor for the utility -- defined as the ratio of average annual load to peak load -- was 45%. The 1986 utility peak demand of 7,641 MW occurred at approximately 4:00 P.M. on July 7[66]. The commercial sector accounted for approximately 61% of peak summer demand, or 4,653 MW[67]. The residential sector followed with 2,670 MW. The 1986 winter peak of 5,164 MW which occurred on January 14 at approximately 6:00 P.M was 32% lower than the summer peak[68].

2. Residential Sector

The residential sector in Con Ed's service territory in 1986 was composed of approximately 2,475,000 households, of which 84% were multi-family buildings[69,70]. The remainder of the housing stock consists of single-family dwellings at 15% and other housing types (<1%).

A detailed breakdown of electricity use in Con Ed's residential sector is presented in Table 1-19. The UEC estimates in Table 1-19 are taken from a variety of sources, as described in the statewide analysis. The estimates of space conditioning UECs are drawn from DOE-2 simulations (also as described in the statewide analysis) and are based on a downstate climate zone. The saturation estimates are from a 1986 Con Ed residential appliance saturation survey[71].

Our analysis shows that refrigerators are the largest residential end use of electricity, accounting for 1,442 kWh/yr, or 34% of total residential consumption. The large share is due to a moderately large UEC combined with a very high saturation. Lighting is the second largest residential end use of electricity at 900 kWh/yr, or 21.5% of residential consumption. Television viewing (color and black & white combined) is the third largest residential end use of electricity at 572 kWh/yr, or 13.7% of residential

Table 1-19
RESIDENTIAL ELECTRICITY CONSUMPTION
CONSOLIDATED EDISON - 1986

End use	UEC per appliance (kWh/yr)	Saturation	UEC per customer (kWh/yr)	Fraction of total
Refrigerator	1,340	107.6%	1,442	34.4%
Lighting	900	100.0%	900	21.5%
Color television	320	158.3%	507	12.1%
Room air conditioner	450	88.6%	399	9.5%
Space heating	5,672	5.2%	292	7.0%
Single-family	11,354	3.8%		
Multi-family	3,512	6.0%		
Water heating	3,200	5.5%	176	4.2%
Cooking range	700	18.3%	128	3.1%
Clothes dryer	880	11.4%	100	2.4%
Freezer	1,000	9.3%	93	2.2%
Central air conditioner	1,516	5.8%	88	2.1%
B&W television	100	65.3%	65	1.6%
Total			4,190	100.0%

Notes:
1. Reported 1986 average consumption per household was 4,179 kWh/yr.
   Source: "Financial Statistics of the Major Privately Owned Utilities Within New York State"; NY State Dept. of Public Service; 1986

consumption. The remaining end uses each account for 2-10% of total residential use.

For the statewide analysis and utility-specific analyses, we have assumed that typical electricity use by the remaining unanalyzed, or "miscellaneous", end-uses -- which includes VCRs, microwave ovens, stereo equipment, and small kitchen appliances -- is based on the difference between the sum of all other end uses and the actual 1986 average residential sales per customer. However, for Con Ed, our estimated consumption of the analyzed end-uses is 11 kWh/yr over the reported average residential consumption of 4,179 kWh/yr[72]. Clearly, we have overestimated the consumption of one or more of the end-uses. However, the best available evidence indicates that each of the estimates is reasonable and accurate. Absent compelling evidence to the contrary, we have decided to let this minor discrepancy stand.

Tables 1-20 and 1-21 present our breakdown of peak demand for Con Ed's residential sector in summer and winter, respectively. Average peak summer demand per household is 1,193 W. The peak winter demand is significantly lower at 695 W. Air conditioning accounts for 798 W per household, or two-thirds of residential peak summer demand. Refrigerators and freezers together account for 263 W or 22% of peak demand. The remaining 132 W is divided between the other end uses.

Table 1-21 presents the breakdown of residential peak demand in the winter. Lighting accounts for 199 W, or 29% of peak demand, almost five times higher than in the summer due to the later hour and shorter days at which the winter peak occurs. Space heating accounts for 146 W per household, or 21% of peak demand.

3. Commercial Sector

As described earlier, our analysis of commercial sector buildings is based on a simulation of seven different building types -- offices, retail stores, hotels, hospitals,

Table 1-20
RESIDENTIAL PEAK SUMMER DEMAND
CONSOLIDATED EDISON - 1986

Appliance	Avg. demand per appliance* (W)	Peak/average demand ratio (%)	Coincident demand per appliance (W)	Saturation (%)	Coincident demand per customer (W)	Fraction of total (%)
Room A/C**	207	3.38	699	88.6%	619	51.9%
Refrigerator	153	1.51	231	107.6%	249	20.8%
Central A/C**	692	4.45	3,083	5.8%	179	15.0%
Lighting	103	0.42	43	100.0%	43	3.6%
Cooking range	80	2.15	172	18.3%	31	2.6%
Color television	37	0.42	15	158.3%	24	2.0%
Clothes dryer	100	1.46	147	11.4%	17	1.4%
Water heating	365	0.69	252	5.5%	14	1.2%
Freezer	114	1.28	146	9.3%	14	1.1%
B&W television	11	0.42	5	65.3%	3	0.3%
Miscellaneous	0	0.42	0	100.0%	0	0.0%
Total					1,193	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.
** The demand for air conditioners is averaged over the three summer months only.

Table 1-21

RESIDENTIAL PEAK WINTER DEMAND
CONSOLIDATED EDISON - 1986

End use	Avg. demand per appliance* (W)	Peak/average demand ratio (%)	Coincident demand per appliance (W)	Saturation (%)	Coincident demand per customer (W)	Fraction of total (%)
Lighting	103	1.93	199	100.0%	199	28.6%
Space heating	750	3.74	2,806	5.2%	146	21.0%
Refrigerator	153	0.76	116	107.6%	125	18.0%
Color television	37	1.93	71	158.3%	112	16.1%
Water heating	365	1.78	651	5.5%	36	5.2%
Clothes dryer	100	2.54	255	11.4%	29	4.2%
Cooking range	80	1.46	117	18.3%	21	3.1%
B&W television	11	1.93	22	65.3%	14	2.1%
Freezer	114	1.18	135	9.3%	13	1.8%
Total					695	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.

supermarkets, schools and small commercial buildings. The DOE-2 model is used for the commercial sector simulations as it was for the residential space conditioning analysis. For Con Ed's service territory, we have used the modeling results based on the downstate climate zone.

We estimate a total of approximately 1,752 million ft^2 of commercial floorspace in Con Ed's service territory. Office buildings account for the largest fraction of this total at 37%. Small buildings and retail stores account for 17% and 10% of commercial floorspace, respectively. Unanalyzed building types account for 18%. The remaining building types each account for less than 10% of total commercial floorspace.

Our breakdown of electricity consumption by building type and by end use in Con Ed's service territory is presented in Table 1-22. Office buildings account for 52% of electricity consumption, by far the largest fraction. The next largest fraction of electricity consumption is due to retail stores (12%). Unanalyzed building types account for 9% of commercial electricity consumption while the other analyzed building types each account for less than 8% of commercial electricity consumption. In terms of end use, HVAC accounts for almost 60% of the electricity consumed in Con Ed's commercial sector. Lighting accounts for almost a third.

4. Industrial Sector

Table 1-23 presents a breakdown of electricity use by industry type. The data presented in this table is drawn from reports submitted by the utilities to the New York State Energy Office[73]. Miscellaneous manufacturing (SIC 39) accounted for 230 GWh in 1986, or 16% of electric sales to the industrial sector. Printing, publishing and allied products (SIC 27) accounted for 12% of industrial sales. Food and kindred products accounted for a further 11% of total industrial sales. The remaining industries each accounted for less than 10% of industrial consumption.

Table 1-22
COMMERCIAL ELECTRICITY CONSUMPTION
CONSOLIDATED EDISON - 1986
(GWh/year)

	HVAC	Lighting	Miscellaneous	Total	Fraction
Office building	6,528	2,605	382	9,514	51.9%
Retail store	1,412	661	48	2,121	11.6%
Hotel	260	106	62	428	2.3%
Health facility	337	232	152	721	3.9%
Supermarket	139	264	734	1,137	6.2%
Education bldg.	656	481	237	1,373	7.5%
Small building	395	847	109	1,350	7.4%
Other buildings*	---	---	---	1,686	9.2%
Total	9,725	5,196	1,725	18,332	
Fraction**	58.4%	31.2%	10.4%		

* There is no end-use breakdown for "other buildings" because they were not modeled.
** End use fractions are based only on modeled buildings.

Table 1-23
INDUSTRIAL ELECTRICITY CONSUMPTION
CONSOLIDATED EDISON - 1986

SIC	Industry	Electricity consumption (GWh)	Fraction of total	Electricity consumption by motors (GWh)	Fraction by motors
39	Miscellaneous Manufacturing	228.6	15.9%	160.0	70%
27	Printing, Publishing & Allied Products	175.3	12.2%	127.9	73%
20	Food and Kindred Products	153.1	10.7%	124.0	81%
28	Chemicals & Allied Products	142.1	9.9%	89.5	63%
36	Electric & Electronic Machinery	137.5	9.6%	114.1	83%
35	Machinery except Electrical	114.9	8.0%	93.1	81%
30	Rubber & Misc. Plastics Products	94.1	6.6%	81.8	87%
23	Apparel & Other Finished Products	83.9	5.8%	61.3	73%
34	Fabricated Metal Products	65.2	4.5%	55.4	85%
37	Transportation Equipment	52.9	3.7%	40.2	76%
26	Paper & Alled Products	40.7	2.8%	33.0	81%
38	Measuring, Analyzing & Controlling Instruments	40.3	2.8%	28.2	70%
33	Primary Metal Industries	39.9	2.8%	30.8	77%
22	Textile Mill Products	21.8	1.5%	17.2	79%
32	Stone, Clay, Glass & Concrete Products	21.1	1.5%	19.4	92%
29	Petroleum Refining and Related Industries	9.3	0.6%	7.7	83%
31	Leather & Leather Products	6.4	0.4%	4.6	73%
24	Lumber & Wood Products Except Furniture	4.3	0.3%	3.2	74%
25	Furniture & Fixtures	4.3	0.3%	3.2	74%
	Mining, Quarrying & Oil and Gas Extraction	0.0	0.0%	---	N/A
21	Tobacco Manufacturers	0.0	0.0%	0.0	73%
	Other Industrial	0.0	0.0%	---	N/A
	Total	1,435.5	100.0%	1,094.6	76%

Sources:
1. Schedule XV, Uniform Statistical Report; Submitted to the NY State Energy Office
2. "Classification and Evaluation of Electric Motors and Pumps"; U.S. Dept. of Energy; Feb. 1980

We estimate that motors account for 76% of industrial electricity use in Con Ed's service territory, as shown in Table 1-23. This estimate is based on a breakdown of fraction of electricity used by motors by SIC code nationwide[74]. We further estimate that lighting accounts for 7% of total industrial consumption and that processing (electrolysis, heat, etc.) accounts for most of the remaining 17% of industrial electricity consumption.

C. Long Island Lighting Company

1. Sectoral Breakdown

Total electricity sales for Long Island Lighting Company in 1986 were 14,394 GWh[75]. The residential sector accounted for the largest fraction of electricity consumption at 43% of the total. The commercial sector was the second largest consumer of electricity at 36%. The industrial sector followed with 10% of total electricity consumption.

LILCO experiences its peak demand during the summer. The annual load factor for the utility -- defined as the ratio of average annual load to peak load -- was 50%. The 1986 utility peak demand of 3,387 MW occurred at approximately 6:00 P.M. on July 7[76]. The residential sector accounted for approximately 56% of peak summer demand, or 1,853 MW[77]. The commercial sector followed with 1,257 MW. The 1986 winter peak of 2,577 MW which occurred on January 28 at approximately 7:00 P.M was 24% lower than the summer peak[78].

2. Residential Sector

The residential sector in LILCO's service territory in 1986 was composed of approximately 861,000 households, of which 88% were single-family dwellings[79,80]. The remainder of the housing stock consists of small multi-family buildings (2-4 units) at 5%, large multi-family buildings (5+ units) at 4%, mobile homes at 1% and condominiums at 2%.

A detailed breakdown of electricity use in LILCO's residential sector is presented in Table 1-24. The UEC

Table 1-24
RESIDENTIAL ELECTRICITY CONSUMPTION
LONG ISLAND LIGHTING COMPANY - 1986

End use	UEC per appliance (kWh/yr)	Saturation (%)	UEC per customer (kWh/yr)	Fraction of total (%)
Refrigerator	1,340	125.0%	1,675	23.1%
Miscellaneous	1,482	100.0%	1,482	20.4%
Lighting	900	100.0%	900	12.4%
Color television	320	185.0%	592	8.2%
Space heating	10,538	5.0%	529	7.3%
Single-family	11,354	4.8%		
Multi-family	3,512	10.0%		
Room air conditioner	450	111.0%	500	6.9%
Clothes dryer	880	55.0%	484	6.7%
Cooking range	700	50.0%	350	4.8%
Freezer	1,000	26.0%	260	3.6%
Water heating	3,200	7.0%	224	3.1%
Central air conditioner	1,516	14.0%	212	2.9%
B&W television	100	53.0%	53	0.7%
Total			7,260	100.0%

Notes:

1. Reported 1986 average consumption per household was 7,260 kWh/yr.
   Source: "Financial Statistics of the Major Privately Owned Utilities Within New York State"; NY State Dept. of Public Service; 1986

estimates in Table 1-24 are taken from a variety of sources, as described in the statewide analysis. The estimates of space conditioning UECs are drawn from DOE-2 simulations (also as described in the statewide analysis) and are based on a downstate climate zone. The saturation estimates are from a 1986 LILCO residential appliance saturation survey[81].

Our analysis shows that refrigerators are the largest residential end use of electricity, accounting for 1,675 kWh/yr, or 23% of total residential consumption. The large share is due to a moderately large UEC combined with a very high saturation. Miscellaneous uses are the second largest residential end use of electricity at 1,482 kWh/yr, or 20% of residential consumption. Lighting is the third largest residential end use of electricity at 900 kWh/yr, or 12% of residential consumption. The remaining end uses each account for less than 10% of total residential use.

Tables 1-25 and 1-26 present our breakdown of peak demand for LILCO's residential sector in summer and winter, respectively. Average peak summer demand per household is 1,864 W. The peak winter demand is 28% lower at 1,336 W. Air conditioning accounts for 1,208 W per household, or almost two-thirds of residential peak summer demand. Refrigerators and freezers together account for 327 W or 17% of peak demand. The remaining end uses each account for less than 5% of peak summer demand.

Table 1-26 presents the breakdown of residential peak demand in the winter. Air conditioning is replaced by miscellaneous end-uses which accounted for 327 W (24%), space heating at 243 W (18%) and lighting at 199 W (15%). The remaining 567 W is divided between the other end uses.

3. Commercial Sector

As described earlier, our analysis of commercial sector buildings is based on a simulation of seven different building types -- offices, retail stores, hotels, hospitals, supermarkets, schools and small commercial buildings. The DOE-2 model is used for the commercial sector simulations as

Table 1-25
RESIDENTIAL PEAK SUMMER DEMAND
LONG ISLAND LIGHTING CO. - 1986

Appliance	Avg. demand per appliance* (W)	Peak/average demand ratio (%)	Coincident demand per appliance (W)	Saturation (%)	Coincident demand per customer (W)	Fraction of total (%)
Room A/C**	207	3.38	699	111.0%	776	41.6%
Central A/C**	692	4.45	3,083	14.0%	432	23.2%
Refrigerator	153	1.51	231	125.0%	289	15.5%
Cooking range	80	2.15	172	50.0%	86	4.6%
Clothes dryer	100	1.46	147	55.0%	81	4.3%
Miscellaneous	169	0.42	71	100.0%	71	3.8%
Lighting	103	0.42	43	100.0%	43	2.3%
Freezer	114	1.28	146	26.0%	38	2.0%
Color television	37	0.42	15	185.0%	28	1.5%
Water heating	365	0.69	252	7.0%	18	0.9%
B&W television	11	0.42	5	53.0%	3	0.1%
Total					1,864	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.
** The demand for air conditioners is averaged over the three summer months only.

Table 1-26

RESIDENTIAL PEAK WINTER DEMAND
LONG ISLAND LIGHTING CO. - 1986

End use	Avg. demand per appliance* (W)	Peak/average demand ratio (%)	Coincident demand per appliance (W)	Saturation (%)	Coincident demand per customer (W)	Fraction of total (%)
Miscellaneous	169	1.93	327	100.0%	327	24.5%
Space heating	1,233	3.94	4,863	5.0%	243	18.2%
Lighting	103	1.93	199	100.0%	199	14.9%
Refrigerator	153	0.76	116	125.0%	146	10.9%
Clothes dryer	100	2.54	255	55.0%	140	10.5%
Color television	37	1.93	71	185.0%	131	9.8%
Cooking range	80	1.46	117	50.0%	58	4.4%
Water heating	365	1.78	651	7.0%	46	3.4%
Freezer	114	1.18	135	26.0%	35	2.6%
B&W television	11	1.93	22	53.0%	12	0.9%
Total					1,336	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.

it was for the residential space conditioning analysis. For LILCO's service territory, we have used the modeling results based on the downstate climate zone.

We estimate that total commercial floorspace in LILCO's service territory is approximately 554 million ft^2. Small buildings account for the largest fraction of this total at 16%. Office buildings, educational buildings and retail stores follow at 21%, 16%, and 14%, respectively. Unanalyzed building types account for 16% of total commercial floorspace.

Using our floorspace estimates and the DOE-2 modeling results we have compiled a breakdown of electricity consumption by building type and by end use in LILCO's service territory. This breakdown is presented in Table 1-27. Office buildings account for 31% of electricity consumption, by far the largest fraction. The next largest fractions of electricity consumption are due to retail stores (17%), educational buildings (11%), small buildings (11%) and supermarkets (10%). Unanalyzed building types account for 10% of commercial electricity consumption. HVAC accounts for over 50% of commercial electricity consumption when broken down by end use, while lighting accounts for just over a third.

4. Industrial Sector

Table 1-28 presents a breakdown of electricity use by industry type. The data presented in this table is drawn from reports submitted by the utilities to the New York State Energy Office[82]. Transportation equipment (SIC 37) and electric and electronic machinery (SIC 36) each accounted for just over 300 GWh in 1986 or 21-22% of electric sales to the industrial sector. The remaining SIC sectors each accounted for less than 10% of industrial sales.

We estimate that motors account for 78% of industrial electricity use in LILCO's service territory, as shown in Table 1-28. This estimate is based on a breakdown of fraction of electricity used by motors by SIC code

Table 1-27
COMMERCIAL ELECTRICITY CONSUMPTION
LONG ISLAND LIGHTING CO. - 1986
(GWh/year)

	HVAC	Lighting	Miscellaneous	Total	Fraction
Office building	1,093	436	64	1,593	30.9%
Retail store	583	273	20	876	17.0%
Hotel	26	10	6	42	0.8%
Health facility	149	103	67	319	6.2%
Supermarket	62	117	325	503	9.8%
Education bldg.	344	252	124	720	14.0%
Small building	164	353	45	563	10.9%
Other buildings*	---	---	---	536	10.4%
Total	2,421	1,544	652	5,154	
Fraction**	52.4%	33.4%	14.1%		

* There is no end-use breakdown for "other buildings" because they were not modeled.
** End use fractions are based only on modeled buildings.

Table I-28
INDUSTRIAL ELECTRICITY CONSUMPTION
LONG ISLAND LIGHTING CO. - 1986

SIC	Industry	Electricity Consumption (GWh)	Fraction of total	Electricity consumption by motors (GWh)	Fraction by motors
37	Transportation Equipment	328.2	22.2%	249.5	76%
36	Electric & Electronic Machinery	316.3	21.3%	262.5	83%
35	Machinery except Electrical	139.7	9.4%	113.2	81%
38	Measuring, Analyzing & Controlling Instruments	132.6	9.0%	92.8	70%
	Other Industrial	102.6	6.9%	---	N/A
27	Printing, Publishing & Allied Products	98.5	6.6%	71.9	73%
34	Fabricated Metal Products	84.6	5.7%	71.9	85%
28	Chemicals & Allied Products	68.3	4.6%	43.0	63%
20	Food and Kindred Products	68.2	4.6%	55.3	81%
30	Rubber & Misc. Plastics Products	61.6	4.2%	51.2	83%
26	Paper & Alled Products	48.7	3.3%	39.5	81%
33	Primary Metal Industries	32.1	2.2%	24.7	77%
	Mining, Quarrying & Oil and Gas Extraction	---	---	---	N/A
21	Tobacco Manufacturers	0.0	0.0%	0.0	73%
22	Textile Mill Products	0.0	0.0%	0.0	79%
23	Apparel & Other Finished Products	0.0	0.0%	0.0	73%
24	Lumber & Wood Products Except Furniture	0.0	0.0%	0.0	74%
25	Furniture & Fixtures	0.0	0.0%	0.0	74%
29	Petroleum Refining and Related Industries	0.0	0.0%	0.0	87%
31	Leather & Leather Products	0.0	0.0%	0.0	73%
32	Stone, Clay, Glass & Concrete Products	0.0	0.0%	0.0	92%
39	Miscellaneous Manufacturing	0.0	0.0%	0.0	70%
	Total	1,481.5	100.0%	1,155.4	78%

Sources:
1. Schedule XV, Uniform Statistical Report; Submitted to the NY State Energy Office
2. "Classification and Evaluation of Electric Motors and Pumps"; U.S. Dept. of Energy; Feb. 1980

nationwide[83]. We further estimate that lighting accounts for 7% of total industrial consumption and that processing (electrolysis, heat, etc.) accounts for most of the remaining 15% of industrial electricity consumption.

D. New York State Electric & Gas Corporation

1. Sectoral Breakdown

Total electricity sales for New York State Electric & Gas in 1986 were 11,807 GWh[84]. The residential sector accounted for the largest fraction of electricity consumption at 41% of the total. The industrial sector was the second largest consumer of electricity at 25%. The commercial sector followed with 23% of total electricity consumption.

NYSEG experiences its peak demand during the winter. The annual load factor for the utility -- defined as the ratio of average annual load to peak load -- was 72%. The 1986 utility peak demand of 2,268 MW occurred at approximately January 14 at 7:00 P.M[85]. The residential sector accounted for approximately 42% of peak winter demand, or 942 MW[86]. The commercial sector followed with 785 MW. The 1986 summer peak of 1,894 MW which occurred at approximately 1:00 P.M. on July 7 was 16% lower than the winter peak[87].

2. Residential Sector

The residential sector in NYSEG's service territory in 1986 was composed of approximately 635,000 households, of which 74% were single-family dwellings[88,89]. The remainder of the housing stock consists of small multi-family buildings (2-4 units) at 11%, large multi-family buildings (5+ units) at 3%, mobile homes at 9% and condominiums and other housing types at 3%.

A detailed breakdown of electricity use in NYSEG's residential sector is presented in Table 1-29. The UEC estimates in Table 1-29 are taken from a variety of sources, as described in the statewide analysis. The estimates of

Table 1-29
RESIDENTIAL ELECTRICITY CONSUMPTION
NEW YORK STATE ELECTRIC & GAS - 1986

End use	UEC per appliance (kWh/yr)	Saturation (%)	UEC per customer (kWh/yr)	Fraction of total (%)
Refrigerator	1,340	122.0%	1,635	21.7%
Space heating	12,641	10.0%	1,260	16.7%
Single-family	14,569	9.5%		
Multi-family	4,770	12.8%		
Water heating	3,200	33.0%	1,056	14.0%
Lighting	900	100.0%	900	11.9%
Miscellaneous	784	100.0%	784	10.4%
Freezer	1,000	51.0%	510	6.8%
Clothes dryer	880	52.0%	458	6.1%
Color television	320	123.5%	395	5.2%
Cooking range	700	53.0%	371	4.9%
Room air conditioner	278	27.5%	76	1.0%
B&W television	100	53.5%	54	0.7%
Central air conditioner	989	4.0%	40	0.5%
Total			7,538	100.0%

Notes:
1. Reported 1986 average consumption per household was 7,538 kWh/yr.
Source: "Financial Statistics of the Major Privately Owned Utilities Within New York State"; NY State Dept. of Public Service; 1986

space conditioning UECs are drawn from DOE-2 simulations (also as described in the statewide analysis) and are based on an upstate climate zone. The saturation estimates are from a 1985 NYSEG residential appliance saturation survey[90].

Our analysis shows that refrigerators are the largest residential end use of electricity, accounting for 1,635 kWh/yr, or 22% of total residential consumption. The large share is due to a moderately large UEC combined with a very high saturation. Electric space heating is the second largest residential end use of electricity at 1,260 kWh/yr, or 17% of residential consumption. Water heating is the third largest residential end use of electricity at 1,056 kWh/yr, or 14% of residential consumption.

Tables 1-30 and 1-31 present our breakdown of peak demand for NYSEG's residential sector in summer and winter, respectively. Average peak summer demand per household is 868 W. The peak winter demand is almost twice as high at 1,686 W. Refrigerators and freezers together account for 357 W or 41% of peak demand. Air conditioning accounts for 164 W per household, or 20% of residential peak summer demand. The remaining end uses each account for less than 10% of residential peak summer demand.

Table 1-31 presents the breakdown of residential peak demand in the winter. Space heating accounts for 595 W per household, or 35% of peak demand. Water heating, lighting, refrigerators and freezers and miscellaneous end-uses each account for 10-13% of peak demand. The remaining 293 W is divided between the other end uses.

3. Commercial Sector

As described earlier, our analysis of commercial sector buildings is based on a simulation of seven different building types -- offices, retail stores, hotels, hospitals, supermarkets, schools and small commercial buildings. The DOE-2 model is used for the commercial sector simulations as it was for the residential space conditioning analysis. For

Table 1-30
RESIDENTIAL PEAK SUMMER DEMAND
NEW YORK STATE ELECTRIC & GAS - 1986

Appliance	Avg. demand per appliance* (W)	Peak/average demand ratio (%)	Coincident demand per appliance (W)	Saturation (%)	Coincident demand per customer (W)	Fraction of total (%)
Refrigerator	153	1.51	231	122.0%	282	32.5%
Cooking range	80	2.15	172	53.0%	91	10.5%
Water heating	365	0.69	252	33.0%	83	9.6%
Room A/C**	127	2.33	296	27.5%	81	9.4%
Central A/C**	452	4.31	1,945	4.0%	78	9.0%
Clothes dryer	100	1.46	147	52.0%	76	8.8%
Freezer	114	1.28	146	51.0%	75	8.6%
Lighting	103	0.42	43	100.0%	43	5.0%
Miscellaneous	89	0.42	38	100.0%	38	4.3%
Color television	37	0.42	15	123.5%	19	2.2%
B&W television	11	0.42	5	53.5%	3	0.3%
Total					868	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.
** The demand for air conditioners is averaged over the three summer months only.

Table 1-31

RESIDENTIAL PEAK WINTER DEMAND

NEW YORK STATE ELECTRIC & GAS - 1986

End use	Avg. demand per appliance* (W)	Peak/average demand ratio (%)	Coincident demand per appliance (W)	Saturation (%)	Coincident demand per customer (W)	Fraction of total (%)
Space heating	1,515	3.93	5,947	10.0%	595	35.3%
Water heating	365	1.78	651	33.0%	215	12.7%
Lighting	103	1.93	199	100.0%	199	11.8%
Miscellaneous	89	1.93	173	100.0%	173	10.3%
Refrigerator	153	0.76	116	122.0%	142	8.4%
Clothes dryer	100	2.54	255	52.0%	132	7.9%
Color television	37	1.93	71	123.5%	87	5.2%
Freezer	114	1.18	135	51.0%	69	4.1%
Cooking range	80	1.46	117	53.0%	62	3.7%
B&W television	11	1.93	22	53.5%	12	0.7%
Total					1,686	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.

NYSEG's service territory, we have used the modeling results based on the upstate climate zone.

Our estimates of commercial floorspace are derived from the CEDMS model as described earlier. We estimate total commercial floorspace in NYSEG's service territory at approximately 281 million ft^2. Small buildings account for the largest fraction of this total at 26%. Educational buildings follow at 22%. Unanalyzed building types account for 11% of total commercial floorspace.

Using our floorspace estimates and the DOE-2 modeling results we have compiled a breakdown of electricity consumption by building type and by end use in NYSEG's service territory. This breakdown is presented in Table 1-32. Electricity use is fairly evenly distributed between office buildings, which account for 23% of electricity consumption, educational building types (20%), retail stores (17%). Small buildings and supermarkets account for 12% and 10% of commercial electricity consumption, respectively. Unanalyzed building types account for 9% of commercial electricity consumption. In terms of end use, HVAC accounts for just under half of the electricity consumed in NYSEG's commercial sector. Lighting accounts for 36% while miscellaneous end uses account for the remaining 16% of commercial electricity consumption.

4. Industrial Sector

Table 1-33 presents a breakdown of electricity use by industry type. The data presented in this table is drawn from reports submitted by the utilities to the New York State Energy Office[91]. Machinery (except electrical) (SIC 35) accounted for 18% of of electric sales to the industrial sector. Other industrial and stone, clay, glass, and concrete (SIC 32) each accounted for 11% of industrial electric sales. The remaining industrial sectors each accounted for less than 10% of industrial sales.

We estimate that motors account for 80% of industrial electricity use in NYSEG's service territory, as shown in

Table 1-32
COMMERCIAL ELECTRICITY CONSUMPTION
NEW YORK STATE ELECTRIC & GAS - 1986
(GWh/year)

	HVAC	Lighting	Miscellaneous	Total	Fraction
Office building	443	179	26	648	23.4%
Retail store	302	157	12	471	17.0%
Hotel	49	24	14	87	3.1%
Health facility	64	49	32	145	5.2%
Supermarket	29	67	187	284	10.2%
Education bldg.	249	200	98	547	19.7%
Small building	87	220	28	335	12.1%
Other buildings*	---	---	---	255	9.2%
Total	1,223	896	398	2,772	
Fraction**	48.6%	35.6%	15.8%		

* There is no end-use breakdown for "other buildings" because they were not modeled.
** End use fractions are based only on modeled buildings.

Table 1-33

INDUSTRIAL ELECTRICITY CONSUMPTION
NEW YORK STATE ELECTRIC & GAS - 1986

SIC	Industry	Electricity Consumption (GWh)	Fraction of total	Electricity consumption by motors (GWh)	Fraction by motors
35	Machinery except Electrical	529.3	18.3%	428.7	81%
	Other Industrial	330.4	11.4%	---	N/A
32	Stone, Clay, Glass & Concrete Products	306.7	10.6%	282.1	92%
37	Transportation Equipment	266.9	9.2%	202.8	76%
20	Food and Kindred Products	236.3	8.1%	191.4	81%
36	Electric & Electronic Machinery	230.6	8.0%	191.4	83%
28	Chemicals & Allied Products	177.3	6.1%	111.7	63%
34	Fabricated Metal Products	165.5	5.7%	140.7	85%
30	Rubber & Misc. Plastics Products	143.4	4.9%	124.8	87%
38	Measuring, Analyzing & Controlling Instruments	75.5	2.6%	52.9	70%
26	Paper & Alled Products	72.0	2.5%	58.3	81%
	Mining, Quarrying & Oil and Gas Extraction	67.4	2.3%	---	N/A
27	Printing, Publishing & Allied Products	65.2	2.2%	47.6	73%
33	Primary Metal Industries	61.2	2.1%	47.1	77%
29	Petroleum Refining and Related Industries	41.5	1.4%	34.4	83%
24	Lumber & Wood Products Except Furniture	32.9	1.1%	24.3	74%
25	Furniture & Fixtures	26.6	0.9%	19.7	74%
39	Miscellaneous Manufacturing	25.2	0.9%	17.6	70%
31	Leather & Leather Products	22.0	0.8%	16.1	73%
22	Textile Mill Products	16.2	0.6%	12.8	79%
23	Apparel & Other Finished Products	7.3	0.3%	5.3	73%
21	Tobacco Manufacturers	0.0	0.0%	0.0	73%
	Total	2,899.4	100.0%	2,329.4	80%

Sources:
1. Schedule XV, Uniform Statistical Report; Submitted to the New York State Energy Office
2. "Classification and Evaluation of Electric Motors and Pumps"; U.S. Dept. of Energy; Feb. 1980

Table 1-33. This estimate is based on a breakdown of fraction of electricity used by motors by SIC code nationwide[92]. We further estimate that lighting accounts for 7% of total industrial consumption and that processing (electrolysis, heat, etc.) account for most of the remaining 13% of industrial electricity consumption.

E. Niagara Mohawk Power Corporation

1. Sectoral Breakdown

Total electricity sales for the Niagara Mohawk Power Corporation in 1986 were 30,374 GWh[93]. The industrial sector accounted for the largest fraction of electricity consumption at 35% of the total. The commercial sector was the second largest consumer of electricity at 34%. The residential sector followed with 30% of total electricity consumption.

NMPC experiences its peak demand during the winter. The annual load factor for the utility -- defined as the ratio of average annual load to peak load -- was 68%. The 1986 utility peak demand of 5,563 MW occurred on January 14 at approximately 7:00 P.M[94]. The residential sector accounted for approximately 40% of peak summer demand, or 2,216 MW[95]. The commercial sector followed with 1,772 MW. The 1986 summer peak of 5,171 MW which occurred at approximately 2:00 P.M. on July 7 was 7% lower than the winter peak[96].

2. Residential Sector

The residential sector in NMPC's service territory in 1986 was composed of approximately 1,276,000 households, of which 65% were single-family dwellings[97,98]. The remainder of the housing stock consists of small multi-family buildings (2-4 units) at 24%, large multi-family buildings (5+ units) at 6%, and mobile homes at 5%.

A detailed breakdown of electricity use in NMPC's residential sector is presented in Table 1-34. The UEC estimates in Table 1-34 are taken from a variety of sources, as described in the statewide analysis. The estimates of

Table 1-34
RESIDENTIAL ELECTRICITY CONSUMPTION
NIAGARA MOHAWK POWER CORPORATION- 1986

End use	UEC per appliance (kWh/yr)	Saturation (%)	UEC per customer (kWh/yr)	Fraction of total (%)
Refrigerator	1,340	141.8%	1,900	26.3%
Space heating	13,322	10.8%	1,438	19.9%
Single-family	14,569	10.4%		
Multi-family	4,770	16.0%		
Water heating	3,200	32.4%	1,037	14.4%
Lighting	900	100.0%	900	12.5%
Clothes dryer	880	55.0%	484	6.7%
Color television	320	130.0%	416	5.8%
Freezer	1,000	39.0%	390	5.4%
Cooking range	700	45.6%	319	4.4%
Miscellaneous	153	100.0%	153	2.1%
Central air conditioner	989	6.7%	66	0.9%
Room air conditioner	278	22.0%	61	0.8%
B&W television	100	50.0%	50	0.7%
Total			7,215	100.0%

Notes:

1. Reported 1986 average consumption per household was 7,215 kWh/yr.
   Source: "Financial Statistics of the Major Privately Owned Utilities Within New York State"; NY State Dept. of Public Service; 1986

space conditioning UECs are drawn from DOE-2 simulations (also as described in the statewide analysis) and are based on an upstate climate zone. The saturation estimates are from a 1986 NMPC residential appliance saturation survey[99].

Our analysis shows that refrigerators are the largest residential end use of electricity, accounting for 1,900 kWh/yr, or 26% of total residential consumption. The large share is due to a moderately large UEC combined with a very high saturation. Electric space heating is the second largest residential end use of electricity at 1,438 kWh/yr, or 20% of residential consumption. Water heating is the third largest residential end use of electricity at 1,037 kWh/yr, or 14.4% of residential consumption.

Tables 1-35 and 1-36 present our breakdown of peak demand for NMPC's residential sector in summer and winter, respectively. Average peak summer demand per household is 889 W. The peak winter demand is almost twice as high at 1,604 W. Refrigerators and freezers together account for 385 W or 43% of peak summer demand. Air conditioning accounts for a further 195 W per household, or 22% of residential peak summer demand. The remaining end uses each account for less than 10% of peak residential summer demand.

Table 1-36 presents the breakdown of residential peak demand in the winter. Space heating accounts for 654 W per household, or 41% of peak demand. Water heating, lighting and refrigerators and freezers each account for 10-13% of peak demand.

3. Commercial Sector

As described earlier, our analysis of commercial sector buildings is based on a simulation of seven different building types -- offices, retail stores, hotels, hospitals, supermarkets, schools and small commercial buildings. The DOE-2 model is used for the commercial sector simulations as it was for the residential space conditioning analysis. For NMPC's service territory, we have used the modeling results based on the upstate climate zone.

Table 1-35

RESIDENTIAL PEAK SUMMER DEMAND

NIAGARA MOHAWK POWER CORP. - 1986

Appliance	Avg. demand per appliance* (W)	Peak/average demand ratio (%)	Coincident demand per appliance (W)	Saturation (%)	Coincident demand per customer (W)	Fraction of total (%)
Refrigerator	153	1.51	231	141.8%	328	36.8%
Central A/C**	452	4.31	1,945	6.7%	130	14.7%
Water heating	365	0.69	252	32.4%	82	9.2%
Cooking range	80	2.15	172	45.6%	78	8.8%
Clothes dryer	100	1.46	147	51.9%	76	8.6%
Room A/C**	127	2.33	296	22.0%	65	7.3%
Freezer	114	1.28	146	39.0%	57	6.4%
Lighting	103	0.42	43	100.0%	43	4.9%
Color television	37	0.42	15	131.0%	20	2.3%
Miscellaneous	17	0.42	7	100.0%	7	0.8%
B&W television	11	0.42	5	48.0%	2	0.3%
Total					889	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.
** The demand for air conditioners is averaged over the three summer months only.

Table 1-36
RESIDENTIAL PEAK WINTER DEMAND
NIAGARA MOHAWK POWER CORP. - 1986

End use	Avg. demand per appliance* (W)	Peak/average demand ratio (%)	Coincident demand per appliance (W)	Saturation (%)	Coincident demand per customer (W)	Fraction of total (%)
Space heating	1,540	3.93	6,055	10.8%	654	40.8%
Water heating	365	1.78	651	32.4%	211	13.2%
Lighting	103	1.93	199	100.0%	199	12.4%
Refrigerator	153	0.76	116	141.8%	165	10.3%
Clothes dryer	100	2.54	255	51.9%	132	8.2%
Color television	37	1.93	71	131.0%	93	5.8%
Cooking range	80	1.46	117	45.6%	53	3.3%
Freezer	114	1.18	135	39.0%	53	3.3%
Miscellaneous	17	1.93	34	100.0%	34	2.1%
B&W television	11	1.93	22	48.0%	11	0.7%
Total					1,604	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.

We estimate total commercial floorspace in NMPC's service territory at approximately 700 million ft^2. Small buildings account for the largest fraction of this total at 24%. The next largest fractions of total floorspace are from offices (20%) and educational buildings (19%). Unanalyzed building types and retail stores account for 14% and 13% of total commercial floorspace, respectively.

Using our floorspace estimates and the DOE-2 modeling results we have compiled a breakdown of electricity consumption by building type and by end use in NMPC's service territory. This breakdown is presented in Table 1-37. Office buildings account for 30% of electricity consumption, by far the largest fraction. The next largest fractions of electricity consumption are due to educational buildings (16%), retail stores (15%), and small buildings (11%). Each of the remaining building types, including unanalyzed building types, each accounts for less than 10% of commercial electricity consumption. When broken down by end use, HVAC accounts for 50% of the electricity consumed in NMPC's commercial sector.

4. Industrial Sector

Table 1-38 presents a breakdown of electricity use by industry type. The data presented in this table is drawn from reports submitted by the utilities to the New York State Energy Office[100]. Chemicals and allied products (SIC 28) accounted for 2,500 GWh in 1986 or 23% of electric sales to the industrial sector. Primary metals (SIC 33) and paper and allied products (SIC 26) accounted for 18% and 11% of industrial sales, respectively. The remaining industries each accounted for less than 10% of total industrial sales.

We estimate that motors account for 76% of industrial electricity use in NMPC's service territory, as shown in Table 1-38. This estimate is based on a breakdown of fraction of electricity used by motors by SIC code nationwide[101]. We further estimate that lighting accounts for 7% of total industrial consumption and that processing

Table 1-37
COMMERCIAL ELECTRICITY CONSUMPTION
NIAGARA MOHAWK POWER CORP. - 1986
(GWh/year)

	HVAC	Lighting	Miscellaneous	Total	Fraction
Office building	2,099	850	124	3,073	30.0%
Retail store	998	519	38	1,554	15.1%
Hotel	131	64	38	232	2.3%
Health facility	272	210	138	618	6.0%
Supermarket	105	239	665	1,008	9.8%
Education bldg.	765	612	302	1,680	16.4%
Small building	284	723	93	1,098	10.7%
Other buildings*	---	---	---	996	9.7%
Total	4,653	3,216	1,397	10,260	
Fraction**	50.2%	34.7%	15.1%		

* There is no end-use breakdown for "other buildings" because they were not modeled.
** End use fractions are based only on modeled buildings.

Table 1-38
INDUSTRIAL ELECTRICITY CONSUMPTION
NIAGARA MOHAWK POWER CORP. - 1986

SIC	Industry	Electricity Consumption (GWh)	Fraction of total	Electricity consumption by motors (GWh)	Fraction by motors
28	Chemicals & Allied Products	2,488.5	23.3%	1,567.8	63%
33	Primary Metal Industries	1,896.0	17.8%	1,459.9	77%
26	Paper & Alled Products	1,146.7	10.7%	928.8	81%
36	Electric & Electronic Machinery	956.1	9.0%	793.6	83%
32	Stone, Clay, Glass & Concrete Products	816.5	7.6%	751.2	92%
37	Transportation Equipment	778.8	7.3%	591.9	76%
20	Food and Kindred Products	651.9	6.1%	528.0	81%
39	Miscellaneous Manufacturing	436.4	4.1%	305.5	70%
35	Machinery except Electrical	413.2	3.9%	334.7	81%
30	Rubber & Misc. Plastics Products	345.1	3.2%	300.2	87%
34	Fabricated Metal Products	273.2	2.6%	232.2	85%
	Mining, Quarrying & Oil and Gas Extraction	110.8	1.0%	---	N/A
27	Printing, Publishing & Allied Products	103.7	1.0%	75.7	73%
38	Measuring, Analyzing & Controlling Instruments	78.8	0.7%	55.2	70%
24	Lumber & Wood Products Except Furniture	65.0	0.6%	48.1	74%
22	Textile Mill Products	61.3	0.6%	48.4	79%
31	Leather & Leather Products	16.4	0.2%	12.0	73%
23	Apparel & Other Finished Products	15.6	0.1%	11.4	73%
29	Petroleum Refining and Related Industries	12.6	0.1%	10.5	83%
25	Furniture & Fixtures	9.0	0.1%	6.7	74%
21	Tobacco Manufacturers	0.0	0.0%	0.0	73%
	Other Industrial	0.0	0.0%	---	N/A
	Total	10,675.6	100%	8,146.2	76%

Sources:
1. Schedule XV, Uniform Statistical Report; Submitted to the NY State Energy Office
2. "Classification and Evaluation of Electric Motors and Pumps"; U.S. Dept. of Energy; Feb. 1980

(electrolysis, heat, etc.) accounts for most of the remaining 17% of industrial electricity consumption.

F. Orange and Rockland Utilities, Inc.

1. Sectoral Breakdown

Total electricity sales for Orange and Rockland's New York service territory in 1986 were 2,352 GWh[102]. The commercial sector accounted for the largest fraction of electricity consumption at 42% of the total. The residential sector was the second largest consumer of electricity at 35%. The industrial sector followed with 20% of total electricity consumption.

O&R experiences its peak demand during the summer. The annual load factor for the utility -- defined as the ratio of average annual load to peak load -- was 34%. The 1986 utility peak demand of 813 MW occurred at approximately 5:00 P.M. on July 7[103]. The residential sector accounted for approximately 54% of peak summer demand, or 421 MW[104]. The commercial sector followed with 234 MW. The 1986 winter peak of 569 MW which occurred on January 14 at 6:00 P.M was 30% lower than the summer peak[105].

2. Residential Sector

The residential sector in O&R's service territory in 1986 was composed of approximately 148,000 households, of which 79% were single-family dwellings[106,107]. The remainder of the housing stock consists of small multi-family buildings (2-4 units) at 5%, large multi-family buildings (5+ units) at 10%, mobile homes at 4% and other housing types at 2%.

A detailed breakdown of electricity use in O&R's residential sector is presented in Table 1-39. The UEC estimates in Table 1-39 are taken from a variety of sources, as described in the statewide analysis. The estimates of space conditioning UECs are drawn from DOE-2 simulations (also as described in the statewide analysis) and are based

Table 1-39

RESIDENTIAL ELECTRICITY CONSUMPTION
ORANGE AND ROCKLAND - 1986

End use	UEC per appliance (kWh/yr)	Saturation (%)	UEC per customer (kWh/yr)	Fraction of total (%)
Refrigerator	1,340	109.0%	1,461	26.7%
Lighting	900	100.0%	900	16.5%
Color television	320	179.3%	574	10.5%
Space heating	9,000	5.8%	482	8.8%
Single-family	11,354	4.3%		
Multi-family	3,512	18.6%		
Room air conditioner	450	88.5%	398	7.3%
Water heating	3,200	12.0%	384	7.0%
Freezer	1,000	36.0%	360	6.6%
Clothes dryer	880	30.0%	264	4.8%
Central air conditioner	1,516	15.0%	227	4.2%
Miscellaneous	208	100.0%	208	3.8%
Cooking range	700	23.0%	161	2.9%
B&W television	100	48.7%	49	0.9%
Total			5,468	100.0%

Notes:

1. Reported 1986 average consumption per household was 5,468 kWh/yr.
   Source: "Financial Statistics of the Major Privately Owned Utilities Within New York State"; NY State Dept. of Public Service; 1986

on a downstate climate zone. The saturation estimates are from a 1986 O&R residential appliance saturation survey[108].

Our analysis shows that refrigerators are the largest residential end use of electricity, accounting for 1,461 kWh/yr, or 27% of total residential consumption. The large share is due to a moderately large UEC combined with a very high saturation. Lighting is the second largest residential end use of electricity at 900 kWh/yr, or 16% of residential consumption. Television viewing (color and black & white combined) is the third largest end use, accounting for 623 kWh/yr, or 11% of total residential use. The remaining end uses each account for less than 10% of total residential use.

Tables 1-40 and 1-41 present our breakdown of peak demand for O&R's residential sector in summer and winter, respectively. Average peak summer demand per household is 1,582 W. The peak winter demand is one-third lower at 1,005 W. Air conditioning accounts for 1,081 W per household, or almost 60% of residential peak summer demand. Refrigerators and freezers together account for 305 W or 19% of peak demand. The remaining end uses each account for less than 4% of summer residential peak demand.

Table 1-41 presents the breakdown of residential peak demand in the winter. Space heating is the largest component of peak demand at 266 W per household, or 27% of peak demand. Lighting accounts for 199 W (20%) of peak demand, almost five times higher than in the summer due to the later hour and shorter days at which the winter peak occurs. Refrigerators and freezers and television viewing account for 17% and 14% of peak winter demand, respectively.

3. Commercial Sector

As described earlier, our analysis of commercial sector buildings is based on a simulation of seven different building types -- offices, retail stores, hotels, hospitals, supermarkets, schools and small commercial buildings. The DOE-2 model is used for the commercial sector simulations as

Table 1-40

RESIDENTIAL PEAK SUMMER DEMAND
ORANGE AND ROCKLAND - 1986

Appliance	Avg. demand per appliance* (W)	Peak/average demand ratio (%)	Coincident demand per appliance (W)	Saturation (%)	Coincident demand per customer (W)	Fraction of total (%)
Room A/C**	207	3.38	699	88.5%	619	39.1%
Central A/C**	692	4.45	3,083	15.0%	462	29.2%
Refrigerator	153	1.51	231	109.0%	252	15.9%
Freezer	114	1.28	146	36.0%	53	3.3%
Clothes dryer	100	1.46	147	30.0%	44	2.8%
Lighting	103	0.42	43	100.0%	43	2.7%
Cooking range	80	2.15	172	23.0%	40	2.5%
Water heating	365	0.69	252	12.0%	30	1.9%
Color television	37	0.42	15	179.3%	28	1.7%
Miscellaneous	24	0.42	10	100.0%	10	0.6%
B&W television	11	0.42	5	48.7%	2	0.1%
Total					1,582	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.
** The demand for air conditioners is averaged over the three summer months only.

Table 1-41
RESIDENTIAL PEAK WINTER DEMAND
ORANGE AND ROCKLAND - 1986

End use	Avg. demand per appliance* (W)	Peak/average demand ratio (%)	Coincident demand per appliance (W)	Saturation (%)	Coincident demand per customer (W)	Fraction of total (%)
Space heating	1,168	3.93	4,586	5.8%	266	26.5%
Lighting	103	1.93	199	100.0%	199	19.8%
Refrigerator	153	0.76	116	109.0%	127	12.6%
Color television	37	1.93	71	179.3%	127	12.6%
Water heating	365	1.78	651	12.0%	78	7.8%
Clothes dryer	100	2.54	255	30.0%	76	7.6%
Freezer	114	1.18	135	36.0%	49	4.8%
Miscellaneous	24	1.93	46	100.0%	46	4.6%
Cooking range	80	1.46	117	23.0%	27	2.7%
B&W television	11	1.93	22	48.7%	11	1.1%
Total					1,005	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.

it was for the residential space conditioning analysis. For O&R's service territory, we have used the modeling results based on the downstate climate zone.

We estimate a total of approximately 113 million ft^2 of commercial floorspace in O&R's service territory. Unanalyzed building types account for the largest fraction of this total at 22%. Floorspace fractions for analyzed building types include small buildings (21%), offices (16%), educational buildings (15%), retail stores (11%), and health facilities (9%). Supermarkets and hotels each account for 3% or less of total commercial floorspace.

Our breakdown of electricity consumption by building type and by end use in O&R's service territory is presented in Table 1-42. Office buildings account for 26% of electricity consumption. Health facilities, small buildings, retail stores, supermarkets, educational buildings, and unanalyzed building types each account for 10-14% of commercial electricity consumption. In terms of end use, HVAC accounts for 51% of the electricity consumed in O&R's commercial sector while lighting accounts for one third.

4. <u>Industrial Sector</u>

Table 1-43 presents a breakdown of electricity use by industry type. The data presented in this table is drawn from reports submitted by the utilities to the New York State Energy Office[109]. Chemicals and allied products (SIC 28) accounted for 111 GWh in 1986 or 24% of electric sales to the industrial sector. Other industrial sectors and fabricated metal products (SIC 34) accounted for a further 21% and 13% of industrial sales, respectively. The remaining industrial sectors each accounted for less than 10% of total industrial sales.

We estimate that motors account for 78% of industrial electricity use in O&R's service territory, as shown in Table 1-43. This estimate is based on a breakdown of fraction of electricity used by motors by SIC code

Table 1-42
COMMERCIAL ELECTRICITY CONSUMPTION
ORANGE AND ROCKLAND - 1986
(GWh/year)

	HVAC	Lighting	Miscellaneous	Total	Fraction
Office building	171	68	10	250	25.5%
Retail store	94	44	3	142	14.4%
Hotel	11	4	3	17	1.8%
Health facility	46	32	21	99	10.1%
Supermarket	13	24	67	104	10.6%
Education bldg.	66	49	24	139	14.2%
Small building	30	64	8	101	10.3%
Other buildings*	---	---	---	129	13.2%
Total	431	285	136	980	
Fraction**	50.6%	33.5%	15.9%		

* There is no end-use breakdown for "other buildings" because they were not modeled.
** End use fractions are based only on modeled buildings.

Table 1-43
INDUSTRIAL ELECTRICITY CONSUMPTION
ORANGE AND ROCKLAND - 1986

SIC	Industry	Electricity Consumption (GWh)	Fraction of total	Electricity consumption by motors (GWh)	Fraction by motors
28	Chemicals & Allied Products	111.2	24.1%	70.1	63%
	Other Industrial	95.5	20.7%	---	N/A
34	Fabricated Metal Products	59.7	12.9%	50.7	85%
32	Stone, Clay, Glass & Concrete Products	43.7	9.5%	40.2	92%
30	Rubber & Misc. Plastics Products	39.5	8.6%	34.4	87%
37	Transportation Equipment	24.8	5.4%	18.9	76%
36	Electric & Electronic Machinery	23.2	5.0%	19.2	83%
26	Paper & Alled Products	18.7	4.0%	15.1	81%
	Mining, Quarrying & Oil and Gas Extraction	12.9	2.8%	---	N/A
35	Machinery except Electrical	12.5	2.7%	10.1	81%
22	Textile Mill Products	9.2	2.0%	7.3	79%
33	Primary Metal Industries	4.1	0.9%	3.1	77%
20	Food and Kindred Products	1.8	0.4%	1.4	81%
25	Furniture & Fixtures	1.6	0.4%	1.2	74%
29	Petroleum Refining and Related Industries	1.5	0.3%	1.2	83%
27	Printing, Publishing & Allied Products	1.0	0.2%	0.7	73%
24	Lumber & Wood Products Except Furniture	0.5	0.1%	0.4	74%
38	Measuring, Analyzing & Controlling Instruments	0.2	0.0%	0.1	70%
21	Tobacco Manufacturers	0.0	0.0%	0.0	73%
23	Apparel & Other Finished Products	0.0	0.0%	0.0	73%
31	Leather & Leather Products	0.0	0.0%	0.0	73%
39	Miscellaneous Manufacturing	0.0	0.0%	0.0	70%
	Total	461.4	100%	358.3	78%

Sources:
1. Schedule XV, Uniform Statistical Report; Submitted to the New York State Energy Office
2. "Classification and Evaluation of Electric Motors and Pumps"; U.S. Dept. of Energy; Feb. 1980

nationwide[110]. We further estimate that lighting accounts for 7% of total industrial consumption and that processing (electrolysis, heat, etc.) accounts for most of the remaining 15% of industrial electricity consumption.

G. Rochester Gas and Electric Corporation

1. Sectoral Breakdown

Total electricity sales for Rochester Gas and Electric in 1986 were 5,782 GWh[111]. The residential sector accounted for the largest fraction of electricity consumption at 33% of the total. The industrial sector was the second largest consumer of electricity at 31%. The commercial sector followed with 29% of total electricity consumption.

RG&E experiences its peak demand during the summer. The annual load factor for the utility -- defined as the ratio of average annual load to peak load -- was 62%. The 1986 utility peak demand of 1,100 MW occurred at approximately 2:00 P.M. on July 25[112]. The commercial sector accounted for approximately 36% of peak summer demand, or 385 MW[113]. The residential sector followed with 363 MW. The 1986 winter peak of 1,026 MW which occurred on January 17 at 6:00 P.M was 7% lower than the summer peak[114].

2. Residential Sector

The residential sector in RG&E's service territory in 1986 was composed of approximately 280,000 households, of which 71% were single-family dwellings[115,116]. The remainder of the housing stock consists of small multi-family buildings (2-4 units) at 8%, large multi-family buildings (5+ units) at 15%, condominiums at 2%, and other housing types at 5%.

A detailed breakdown of electricity use in RG&E's residential sector is presented in Table 1-44. The UEC estimates in Table 1-44 are taken from a variety of sources, as described in the statewide analysis. The estimates of space conditioning UECs are drawn from DOE-2 simulations (also as described in the statewide analysis) and are based

Table 1-44

RESIDENTIAL ELECTRICITY CONSUMPTION

ROCHESTER GAS AND ELECTRIC - 1986

End use	UEC per appliance (kWh/yr)	Saturation (%)	UEC per customer (kWh/yr)	Fraction of total (%)
Refrigerator	1,340	119.3%	1,599	23.7%
Miscellaneous	1,074	100.0%	1,074	15.9%
Lighting	900	100.0%	900	13.3%
Space heating	12,359	6.2%	769	11.4%
Single-family	14,569	5.8%		
Multi-family	4,770	10.4%		
Color television	320	150.7%	482	7.1%
Water heating	3,200	14.7%	470	7.0%
Clothes dryer	880	46.9%	413	6.1%
Cooking range	700	58.0%	406	6.0%
Freezer	1,000	36.5%	365	5.4%
Central air conditioner	989	14.9%	147	2.2%
Room air conditioner	278	29.8%	83	1.2%
B&W television	100	51.1%	51	0.8%
Total			6,759	100.0%

Notes:

1. Reported 1986 average consumption per household was 6,759 kWh/yr.
   Source: "Financial Statistics of the Major Privately Owned Utilities Within New York State"; NY State Dept. of Public Service; 1986

on an upstate climate zone. The saturation estimates are from a 1986 RG&E residential appliance saturation survey[117].

Our analysis shows that refrigerators are the largest residential end use of electricity, accounting for 1,599 kWh/yr, or 24% of total residential consumption. The large share is due to a moderately large UEC combined with a very high saturation. Miscellaneous end uses are the second largest residential end use of electricity at 1,074 kWh/yr, or 16% of residential consumption. Lighting is the third largest residential end use of electricity at 900 kWh/yr, or 13% of residential consumption. Space heating follows at 769 kWh/yr (11%). The remaining end uses each account for less than 10% of total residential use.

Tables 1-45 and 1-46 present our breakdown of peak demand for RG&E's residential sector in summer and winter, respectively. Average peak summer demand per household is 1,033 W. The peak winter demand is 30% higher at 1,380 W. Air conditioning accounts for 378 W per household, or 37% of residential peak summer demand. Refrigerators and freezers together account for 329 W or 32% of peak demand. The remaining end uses each account for less than 10% of peak residential summer demand.

Table 1-46 presents the breakdown of residential peak demand in the winter. Space heating accounts for 356 W per household, or 26% of peak demand. Miscellaneous end uses, refrigerators and freezers, and lighting account for 17%, 15% and 14% of peak demand, respectively. The remaining end uses each account for less than 7% of peak residential winter demand.

3. Commercial Sector

As described earlier, our analysis of commercial sector buildings is based on a simulation of seven different building types -- offices, retail stores, hotels, hospitals, supermarkets, schools and small commercial buildings. The DOE-2 model is used for the commercial sector simulations as it was for the residential space conditioning analysis. For

Table 1-45
RESIDENTIAL PEAK SUMMER DEMAND
ROCHESTER GAS AND ELECTRIC - 1986

Appliance	Avg. demand per appliance* (W)	Peak/average demand ratio (%)	Coincident demand per appliance (W)	Saturation (%)	Coincident demand per customer (W)	Fraction of total (%)
Central A/C**	452	4.31	1,945	14.9%	290	28.1%
Refrigerator	153	1.51	231	119.3%	276	26.7%
Cooking range	80	2.15	172	58.0%	100	9.7%
Room A/C**	127	2.33	296	29.8%	88	8.5%
Clothes dryer	100	1.46	147	46.9%	69	6.7%
Freezer	114	1.28	146	36.5%	53	5.2%
Miscellaneous	123	0.42	51	100.0%	51	5.0%
Lighting	103	0.42	43	100.0%	43	4.2%
Water heating	365	0.69	252	14.7%	37	3.6%
Color television	37	0.42	15	150.7%	23	2.2%
B&W television	11	0.42	5	51.1%	2	0.2%
Total					1,033	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.
** The demand for air conditioners is averaged over the three summer months only.

Table 1-46
RESIDENTIAL PEAK WINTER DEMAND
ROCHESTER GAS AND ELECTRIC - 1986

End use	Avg. demand per appliance* (W)	Peak/average demand ratio (%)	Coincident demand per appliance (W)	Saturation (%)	Coincident demand per customer (W)	Fraction of total (%)
Space heating	1,465	3.91	5,735	6.2%	356	25.8%
Miscellaneous	123	1.93	237	100.0%	237	17.2%
Lighting	103	1.93	199	100.0%	199	14.4%
Refrigerator	153	0.76	116	119.3%	139	10.1%
Clothes dryer	100	2.54	255	46.9%	119	8.7%
Color television	37	1.93	71	150.7%	106	7.7%
Water heating	365	1.78	651	14.7%	96	6.9%
Cooking range	80	1.46	117	58.0%	68	4.9%
Freezer	114	1.18	135	36.5%	49	3.6%
B&W television	11	1.93	22	51.1%	11	0.8%
Total					1,380	100%

* The average demand is equal to the annual consumption divided by 8,760 hours per year.

RG&E's service territory, we have used the modeling results based on the upstate climate zone.

We estimate that total commercial floorspace in RG&E's service territory is approximately 170 million ft^2. Small buildings account for the largest fraction of this total at 24%. The next largest fractions of total floorspace are from office buildings (20%), retail stores (16%), and educational buildings (16%). Unanalyzed building types account for 14% or less of total commercial floorspace.

Our breakdown of electricity consumption by building type and by end use in RG&E's service territory is presented in Table 1-47. The largest fraction of commercial electricity consumption is due to office buildings, which account for 31% of electricity consumption. The next largest fraction of electricity consumption is due to retail stores (19%). Unanalyzed building types account for 8% of commercial electricity consumption. HVAC end uses account for 51% of the electricity consumed in RG&E's commercial sector when broken down by end use, while lighting accounts for a further 35%.

4. Industrial Sector

Table 1-48 presents a breakdown of electricity use by industry type. The data presented in this table is drawn from reports submitted by the utilities to the New York State Energy Office[118]. Machinery except electrical (SIC 35) and measuring, analyzing and controlling instruments (SIC 38) dominated industrial electric sales with 29% and 27% of total sales, respectively. "Other" industrial sectors accounted for a further 18% while the remaining sectors each accounted for 7.5% of sales or less.

We estimate that motors account for 78% of industrial electricity use in RG&E's service territory, as shown in Table 48. This estimate is based on a breakdown of fraction of electricity used by motors by SIC code nationwide[119]. We further estimate that lighting accounts for 7% of total industrial consumption and that processing (electrolysis,

Table I-47
COMMERCIAL ELECTRICITY CONSUMPTION
ROCHESTER GAS AND ELECTRIC - 1986
(GWh/year)

	HVAC	Lighting	Miscellaneous	Total	Fraction
Office building	346	140	21	507	30.6%
Retail store	202	105	8	315	19.0%
Hotel	14	7	4	26	1.5%
Health facility	45	35	23	102	6.1%
Supermarket	17	39	110	166	10.0%
Education bldg.	106	85	42	233	14.1%
Small building	47	119	15	181	10.9%
Other buildings*	---	---	---	128	7.7%
Total	778	531	222	1,658	
Fraction**	50.9%	34.7%	14.5%		

* There is no end-use breakdown for "other buildings" because they were not modeled.
** End use fractions are based only on modeled buildings.

Table 1-48
INDUSTRIAL ELECTRICITY CONSUMPTION
ROCHESTER GAS AND ELECTRIC - 1986

SIC	Industry	Electricity Consumption (GWh)	Fraction of total	Electricity consumption by motors (GWh)	Fraction by motors
35	Machinery except Electrical	512.5	28.8%	415.2	81%
38	Measuring, Analyzing & Controlling Instruments	472.9	26.6%	331.0	70%
	Other Industrial	327.1	18.4%	---	N/A
36	Electric & Electronic Machinery	133.8	7.5%	111.0	83%
30	Rubber & Misc. Plastics Products	95.0	5.3%	82.7	87%
20	Food and Kindred Products	84.5	4.7%	68.5	81%
34	Fabricated Metal Products	39.6	2.2%	33.7	85%
27	Printing, Publishing & Allied Products	34.1	1.9%	24.9	73%
28	Chemicals & Allied Products	28.6	1.6%	18.0	63%
32	Stone, Clay, Glass & Concrete Products	14.8	0.8%	13.6	92%
33	Primary Metal Industries	13.2	0.7%	10.2	77%
26	Paper & Alled Products	11.1	0.6%	9.0	81%
22	Textile Mill Products	7.8	0.4%	6.2	79%
23	Apparel & Other Finished Products	3.7	0.2%	2.7	73%
39	Miscellaneous Manufacturing	2.3	0.1%	1.6	70%
	Mining, Quarrying & Oil and Gas Extraction	0.0	0.0%	---	N/A
21	Tobacco Manufacturers	0.0	0.0%	0.0	73%
24	Lumber & Wood Products Except Furniture	0.0	0.0%	0.0	74%
25	Furniture & Fixtures	0.0	0.0%	0.0	74%
29	Petroleum Refining and Related Industries	0.0	0.0%	0.0	83%
31	Leather & Leather Products	0.0	0.0%	0.0	73%
37	Transportation Equipment	0.0	0.0%	0.0	76%
	Total	1,781.0	100%	1,381.9	78%

Sources:
1. Schedule XV, Uniform Statistical Report; Submitted to the New York State Energy Office
2. "Classification and Evaluation of Electric Motors and Pumps"; U.S. Dept. of Energy; Feb. 1980

heat, etc.) account for most of the remaining 15% of industrial electricity consumption.

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110. "Classification and Evaluation of Electric Motors and Pumps", U.S. Department of Energy

111. "Financial Statistics of the Major Privately Owned Utilities Within New York State -- Preliminary Survey -- Twelve Largest Companies -- 1987"

112. 1986 New York Power Pool System Load Data: supplied by the New York State Energy Office

113. The estimates of fraction of peak demand due to the commercial and residential sectors are approximate and are drawn from New York State Energy Office estimates.

114. 1986 New York Power Pool System Load Data

115. "Financial Statistics of the Major Privately Owned Utilities Within New York State -- Preliminary Survey -- Twelve Largest Companies -- 1987"

116. "1986 Residential Customer Market Survey", Rochester Gas and Electric Corporation, December 1987

117. ibid.

118. "Schedule XV-Classification of Industrial Energy Sales and Revenues", Uniform Statistical Report, 1986

119. "Classification and Evaluation of Electric Motors and Pumps", U.S. Department of Energy

Chapter 2

ASSESSMENT OF ELECTRICITY CONSERVATION POTENTIAL IN NEW YORK STATE

I. INTRODUCTION

This chapter contains an assessment of the technical and economic potential for reducing electricity consumption and peak demand in New York State through the implementation of a wide range of end-use efficiency measures. The objectives of this chapter are to identify and characterize the electricity conservation resource that is available in New York State as well as in the service area of the seven major private utilities in the state[1]. Consequently, conservation measures are analyzed without considering administrative program costs, implementation rates, or limits to full adoption.

It is worth emphasizing the latter point. The results of this analysis -- in particular, estimates of the potential savings in electricity and reductions in peak demand -- are not necessarily achievable goals. In order to assess the amount of conservation that could realistically be saved in the future, one must also take into account the phased adoption of conservation measures and program costs, among other factors. The evaluation of these factors and estimates of achievable conservation rates and savings will require further study.

II. METHODOLOGY

Our analysis of electricity conservation potential begins with the base case level of technology and associated electricity consumption that was defined in the previous chapter. The base case technology is representative of the equipment and building stock as of 1986.

The conservation analysis then evaluates the savings in electricity consumption and peak demand that would result from the implementation of 62 efficiency measures. The efficiency measures are all either commercially available at present or are expected to be available by the early 1990's. Further, the measures do not decrease performance or utility to consumers (in some cases performance is increased).

The efficiency measures are presented in order of cost-effectiveness, with the most economically promising measures presented first. This enables us to construct "conservation supply curves" -- charts or tables showing the savings potential and cost-effectiveness of different efficiency measures, ranked in order of decreasing economic attractiveness. Conservation supply curves are presented for the state and for each utility in the concluding section of this chapter. The conservation supply curves can be used to estimate the total savings potential below a particular cost threshold.

Our evaluation of the cost-effectiveness of efficiency measures is based on two economic parameters, the "marginal cost of saved energy" (CSE) and the "marginal cost of reduced demand" (CRD). The CSE is a measure of the cost of reducing electricity consumption through the implementation of a particular measure. The CSE is calculated by multiplying the cost for the efficiency measure by the appropriate capital recovery factor and dividing by the incremental annual electricity savings. The term "marginal" indicates that the CSE is based on the cost and savings from each conservation measure as it is applied, rather than on the cumulative total of all measures applied to that point.

The CRD is a measure of the cost of reducing demand during peak periods through the implementation of an efficiency measure. The CRD is calculated as the net present value of the cost of reducing peak demand through a particular conservation measure over a 20-year time period. Our calculation of CRD is standardized over a 20-year horizon in order to permit comparison of measures with different lifetimes and with electricity supply technologies. We calculate reduced peak demand as the average reduction in demand over the peak two-hour period for the system. The peak period is 2-4 P.M. on weekdays during July and August for the summer and 6-8 P.M. on weekdays during January and February for the winter. The season with the largest reduction in peak demand for each measure is used for the calculation of CRD. As with the CSE, the CRD is based on the cost and savings from each conservation measure as it is applied, rather than on the cumulative total of all measures applied to that point.

The type of measure being analyzed determines whether the full or incremental cost of each measure is used in calculating cost-effectiveness. For conservation measures that entail an improvement in efficiency over a less efficient model, the incremental cost for the efficiency measure is used. Examples of this type of measure include high-efficiency air conditioners, lamps and motors. For stand-alone conservation measures such as variable-speed drives, home weatherization, and commercial cool storage systems, the full cost of the conservation measure is used.

Our estimates of CSE and CRD for each of the conservation measures are in units of dollars per kilowatt-hour saved and dollars per peak kilowatt avoided. These indices can be used to evaluate cost-effectiveness through comparison with the marginal cost of electricity supply and new capacity. The marginal costs of electricity supply options represent an estimate of the limit on the economic feasibility of the conservation measures[2].

We evaluate cost-effectiveness from three different viewpoints -- the utility, consumer, and societal -- by varying the assumed discount rate and the cost-effectiveness threshold. For the utility viewpoint we assume a real discount rate of 10%, as suggested by NMPC as an example of the cost of money to NY utilities in recent years. The CSE and CRD will be compared with the marginal cost of energy and capacity supply, also as determined in the NYPSC proceeding[3]. The consumer viewpoint will be based on a discount rate of 6% and the CSE and CRD will be compared to current electricity prices. This rate was chosen because it is a reasonable estimate of the opportunity cost for consumers based on average real interest rates for savings and investment vehicles, as well as loans[4]. Further, a discount rate at or close to 6% is used by other organizations including the California Energy Commission for evaluating conservation measures[5]. The societal viewpoint will incorporate a real discount rate of 3% and the cost-effectiveness threshold will be based on the marginal cost of electricity and capacity supply. The societal discount rate is based on the real interest rate on low-risk, long-term public funds -- i.e., federal or municipal bonds.

It is important to point out that the discount rates selected for our analysis -- 3%, 6% and 10% -- are explicit, rather than implicit, discount rates. Explicit discount rates are intended to be representative of external economic conditions (e.g., interest rates). They represent an estimate of the actual relative time value of money. In contrast, implicit discount rates are determined by calculating the discount rate that would explain measured behaviour. For example, given a range of appliance efficiencies, the purchase of an appliance with a particular efficiency would be interpreted to imply the existence of a discount rate that directed the implicit trade-off between initial cost and energy costs. In the marketplace, various factors often lead to lower efficiencies than would result from an explicit calculation of costs and benefits using explicit discount rates. These factors include inadequate information, limited choices and conflicting decision criteria. As a result, implicit discount rates, calculated in this manner, are typically much higher than explicit discount rates, particularly for residential consumers.

The cost-effectiveness thresholds, presented in Table 2-1, include marginal costs of energy, capacity supply, and total cost in addition to 1987 electricity rates. The long-run total cost figure is the sum of the marginal energy cost and a capitalized capacity cost. It can be seen that long-run avoided costs are relatively low, particularly from the utility perspective. This is because marginal costs over the next few years are quite low primarily due to surpluses among the upstate utilities. While marginal costs do rise significantly in later years, these costs are discounted and so have relatively less impact on the net present value of the cost stream. In comparison, current electricity rates are relatively high, both in comparison to long-run costs and to electricity rates nationwide. This disparity between marginal costs and electricity rates in most cases results in a greater number of conservation measures appearing cost-effective from the consumer perspective than from either the utility or societal perspectives.

The conservation analysis only applies to the building and equipment stock as of 1986. No attempt is made to evaluate new sources of electricity demand that have been added since then or that are anticipated in the future. Also, the conservation analysis does not address the issue of increasing electrification -- through technologies such as heat pumps or industrial induction heating -- or of fuel-switching. It is reasonable to ignore these issues because the objective is not to forecast future demand for electricity. Rather, the goal is to determine the

Table 2-1
MARGINAL COSTS AND ELECTRICITY RATES

	CHG&E	Con Ed	LILCO	NYSEG	NMPC	O&R	RG&E	State
Utility Viewpoint								
Discount rate: 10%								
Long run avoided capacity ($/kW)*:	$415	$609	$872	$650	$578	$537	$624	$634
Long run avoided energy (¢/kWh)*:	3.76¢	3.90¢	4.67¢	3.70¢	3.70¢	3.82¢	3.70¢	3.91¢
Long run total cost (¢/kWh)**:	4.31¢	4.71¢	5.82¢	4.56¢	4.47¢	4.53¢	4.53¢	4.75¢
Consumer Viewpoint								
Discount rate: 6%								
1987 electricity rates (¢/kWh)								
• Commercial	8.15¢	10.73¢	11.33¢	8.25¢	7.28¢	8.79¢	7.80¢	9.58¢
• Residential	9.96¢	14.19¢	11.51¢	9.72¢	7.68¢	10.48¢	9.15¢	10.60¢
• Industrial	6.53¢	10.41¢	7.74¢	6.20¢	3.76¢	5.49¢	6.03¢	5.33¢
Societal Viewpoint								
Discount rate: 3%								
Long run avoided capacity ($/kW)*:	$829	$1,175	$1,557	$1,249	$1,121	$1,047	$1,202	$1,206
Long run avoided energy (¢/kWh)*:	4.08¢	4.25¢	4.87¢	4.03¢	4.03¢	4.17¢	4.03¢	4.23¢
Long run total cost (¢/kWh)**:	4.69¢	5.12¢	6.02¢	4.96¢	4.86¢	4.94¢	4.93¢	5.12¢

* Net present value of 20-year (1988-2008) stream of avoided costs.

** The long run total cost is the sum of the capitalized avoided capacity cost and the avoided energy cost.

Sources:
1. Long run avoided costs are from: "Opinion and Order Adopting Long-Run Avoided Cost Estimates (Opinion No. 88-13)"; State of New York Public Service Commission; Albany, NY; May 1988
2. Electricity rates are from: "Monthly Energy Price Report"; New York State Energy Office; Albany, New York; Feb. 1988

potential for cost-effective reductions in electricity consumption and peak demand within the current building and equipment stock.

III. DESCRIPTION AND EVALUATION OF CONSERVATION MEASURES

A. Residential Sector

The analysis of the residential sector includes conservation measures directed at nine different end uses representing 84% of residential electricity consumption. The electricity and peak demand savings resulting from the installation of the various conservation measures directed at space conditioning are based on a computer simulation of two different housing types -- single-family and multi-family -- representing 95% of residential homes in the state. No estimate of the conservation potential in space conditioning is made for the housing type which was not modeled -- i.e., mobile homes.

All conservation measures directed at end uses other than space conditioning are based on the usage and savings potential for an average of single- and multi-family homes. Therefore costs and savings for these measures are not differentiated between the two housing types.

The conservation analyses by end use for the residential sector are presented in Tables 2-2 to 2-13. The statewide residential summary tables for energy and peak demand for each of the three discount rates analyzed are presented in Tables 2-33, 2-34, 2-39, 2-40, 2-45, and 2-46. The statewide summaries are also presented graphically as supply curves in Figures 2-3, 2-4, 2-5, 2-10, 2-11, 2-12, 2-16, 2-17, and 2-18.

1. Residential Space Heating and Shell Measures

a. Infiltration reduction

This measure involves the reduction of infiltration losses through caulking and weatherstripping of cracks in the walls and ceiling and the remedy of thermal bypasses in the walls, attic, and foundation. Together, these measures reduce overall infiltration losses by 40%[6]. This measure is applied to single-family homes with electric resistance space heating. The residential electric space heating conservation assessment is presented in Tables 2-2 and 2-3 for each of the two climate zones analyzed.

We estimate a cost for this measure of $350 for the single-family residence based on a utility-sponsored pilot program involving house doctoring of 138 homes in New Jersey[7]. Electricity savings from this measure are taken from the DOE-2 simulation. Estimated savings per house are 2,218 kWh/yr of electricity consumption and 600 W of winter peak for the upstate climate zone and 1,948 kWh/yr of electricity consumption and 533 W of winter peak for the downstate climate zone. This measure is quite cost-effective with a maximum CSE of 2¢/kWh at a discount rate of 10%. The total statewide electricity savings potential is estimated to be 593 GWh/yr, with a reduction in winter peak demand of 162 MW.

b. Ceiling insulation

The New York State Energy Conservation Construction Code requires substantial levels of insulation in new homes and for the addition, alteration or substantial renovation of existing homes[8]. However, many older homes have significantly lower levels of insulation[9,10].

This measure entails the addition of three inches of fiberglass batt insulation to existing single-family homes with electric resistance space heating. The cost for this measure of $470 is drawn from a library of retrofit measure costs compiled by the Michigan Public Service Commission[11]. Savings from this measure are taken from the DOE-2 simulation of the single-family home. Estimated savings per house are 80 kWh/yr of electricity consumption and 11 W of winter peak for the upstate climate zone and 88 kWh/yr of electricity consumption and 11 W of winter

Table 2-2

ELECTRIC SPACE HEATING CONSERVATION ASSESSMENT

New York State - Upstate climate zone

Discount rate = 6%

Option	UEC (KWh/yr)	Diversified peak demand Summer (Watts)	Diversified peak demand Winter (Watts)	Extra first cost (1986 $)	Life (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
SINGLE FAMILY										
1986 stock average	14,569	0	6,580	---	---	---	---	---	---	---
Infiltration reduction	12,351	0	5,979	350	15	0.015	711	240	---	65
Heat pump #1 (HSPF=7)*	6,052	0	3,224	2,300	15	0.035	1,020	104	---	45
Electric thermal storage system*	6,052	0	0	6,000	20	---	1,004	0	---	296
Heat pump #2 (HSPF=8)*	5,435	0	2,895	300	15	0.047	1,114	10	---	5
Low-emissivity film	4,867	0	2,728	538	20	0.078	3,221	61	---	18
Add 3" fiberglass in roof/ceiling	4,787	0	2,717	470	20	0.482	40,775	9	---	1
MULTI-FAMILY										
1986 stock average	4,770	0	1,810	---	---	---	---	---	---	---
Storm windows	3,733	0	1,420	252	20	0.020	646	47	---	18
Low-emissivity film	3,395	0	1,280	84	10	0.020	600	15	---	6

* ETS and heat pump are mutually exclusive measures. CSE and CRD values are calculated independently.

Notes:

1. Housing stock fractions are: single family - 68% ; multi-family - 29%
2. Saturation of electric space heating is single-family homes is 7.3%
3. Saturation of electric space heating is multi-family homes is 7.1%
4. Infiltration: instrumented audit and measures to reduce infiltration and eliminate thermal bypasses.
5. Electric thermal storage: Replace baseboard heaters ceramic brick storage room units.
6. Low-emissivity film: Apply low-E film to windows to reduce heat loss.

Table 2-3

ELECTRIC SPACE HEATING CONSERVATION ASSESSMENT

New York State - Downstate climate zone

Discount rate = 6%

Option	UEC (KWh/yr)	Diversified peak demand Summer (Watts)	Diversified peak demand Winter (Watts)	Extra first cost (1986 $)	Life (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
SINGLE FAMILY										
1986 stock average	11,354	0	5,130	---	---	---	---	---	---	---
Infiltration reduction	9,406	0	4,597	350	15	0.017	802	353	---	97
Heat pump #1 (HSPF=7)*	4,609	0	2,514	2,300	15	0.047	1,349	132	---	57
Electric thermal storage system*	4,609	0	0	6,000	20	---	1,305	0	---	386
Heat pump #2 (HSPF=8)*	4,139	0	2,257	300	15	0.062	1,429	13	---	7
Low-emissivity film	3,579	0	2,157	538	20	0.079	5,364	102	---	18
Add 3" fiberglass in roof/ceiling	3,491	0	2,146	470	20	0.439	42,210	16	---	2
MULTI-FAMILY										
1986 stock average	3,512	0	1,320	---	---	---	---	---	---	---
Storm windows	2,646	0	960	252	20	0.024	700	65	---	27
Low-emissivity film	2,381	0	850	84	10	0.026	764	20	---	8

* ETS and heat pump are mutually exclusive measures. CSE and CRD values are calculated independently.

Notes:

1. Housing stock fractions are: single family - 68% ; multi-family and mobile hor - 29%
2. Saturation of electric space heating is single-family homes is 7.3%
3. Saturation of electric space heating is multi-family homes is 7.1%
4. Infiltration: instrumented audit and measures to reduce infiltration and eliminate thermal bypasses.
5. Electric thermal storage: Replace baseboard heaters ceramic brick storage room units.
6. Low-emissivity film: Apply low-E film to windows to reduce heat loss.

peak for the downstate climate zone. The total statewide electricity savings potential is estimated to be 25 GWh/yr, with a reduction in winter peak demand of 3 MW.

The estimated electricity and peak demand savings from this measure are low, primarily because of the high level of insulation that is assumed to exist in the base case electrically space-heated single-family home, as discussed in the preceding chapter. This measure would be significantly more cost-effective in homes with lower levels of insulation.

c. Storm windows

This measure involves the installation of storm windows to multi-family housing units. Storm windows increase the insulating value of the window and thereby reduce heat loss. This measure is applied only to multi-family buildings because single-family homes are assumed to have either double pane windows or storm windows in the base case.

The estimated installed cost of this measure is $6.00/sq.ft based on a broad survey of conservation retrofit experiences in multi-family buildings across the U.S.[12]. Savings from this measure are taken from the DOE-2 simulation. Estimated savings for a multi-family housing unit are 1,047 kWh/yr and 390 watts and 866 kWh/yr and 360 watts for the upstate and downstate climate zones, respectively. The estimated total statewide electricity savings potential is 112 GWh/yr, with a reduction in winter peak demand of 45 MW.

d. Low-emissivity window film

This measure involves the application of low-emissivity, shaded window film to north-facing windows. The film is applied to the interior of the glass in order to reduce heat loss during the heating season. The low-emissivity coating cuts heat transfer through the glass by about 25-45% in comparison to a standard single-pane window and by 8-22% in comparison to a double pane or single pane and storm window[13]. For this measure, we assume that the low-emissivity film is rated R-1.2 and has a shading coefficient of 0.7[14]. This measure is applied to both single-family and multi-family buildings with electric space heating.

The estimated installed cost of this measure is $2.00/sq.ft[15]. Savings from this measure are taken from the DOE-2 simulation. For a single-family home, estimated savings are 568 kWh/yr and 167 watts and 560 kWh/yr and 100 watts for the upstate and downstate climate zones, respectively. For a multi-family housing unit, estimated savings are 338 kWh/yr and 140 watts and 265 kWh/yr and 90 watts for the upstate and downstate climate zones, respectively. The estimated total statewide electricity savings potential is 198 GWh/yr, with a reduction in winter peak demand of 50 MW.

e. <u>Electric thermal storage</u>

Electric thermal storage heating units (ETS) consist of electric resistance heating coils interwoven in a stack of ceramic bricks or rock inside an insulated cabinet. During off-peak hours -- 11:00 P.M. to 7:00 A.M -- the bricks (or rock) are charged by the heating coil. During the day, the heating coil is turned off and the bricks discharge their heat to the home. ETS is used to shift electricity used for space heating into the off-peak hours. ETS systems have been installed in homes in New York State since 1985. They are currently being promoted by NYSEG as part of a full-scale program with the goal of installing ETS in 25% of the new homes that would otherwise have installed electric resistance heating by 1992[16].

This measure entails the replacement of the standard electric resistance heating system with ETS room units. It is applied to single-family homes with electric resistance space heating and without central air conditioning. Single-family homes with air conditioning are assumed to install a heat pump rather than an ETS system (the heat pump measures are described below). To our knowledge, ETS has not been installed in multi-family homes. For this reason we do not assume that ETS systems are applied in multi-family homes.

We estimate an installed cost of $6,000 for the ETS system[17]. Assuming full displacement of the peak space heating load, estimated savings are 5,979 watts per home and 4,597 watts per home in the upstate and downstate climate zones respectively. These values are based on our DOE-2 building simulations. Experience with previous installations provides no clear evidence of impacts on net electricity use and therefore it is assumed there is no net impact on annual energy use. The total statewide potential reduction in winter peak demand is estimated to be 682 MW.

f. Standard heat pump

This measure involves the replacement of the resistance electric heating system with a moderately efficient heat pump (HSPF=7, SEER=10). The New York State Energy Conservation Construction Code requires a minimum efficiency of SEER=8.5[18]; the National Appliance Energy Conservation Act requires a minimum efficiency of 10.0 SEER for all split system heat pumps manufactured after January 1, 1992[19].

This measure is applied to single-family homes with electric resistance space heating and central air conditioning. Because heat pumps are assumed to be installed only in homes that previously had central air conditioning, it is reasonable to assume that the installation of the heat pump will not lead to additional electricity consumption for air conditioning.

We estimate an installed cost for this measure of $2,300[20]. Savings from all heat pump measures are taken from the DOE-2 simulation of the single-family home. Estimated savings per home from this measure are 6,300 kWh/yr and 2.75 kW and 4,800 kWh/yr and 2.08 kW for the upstate and downstate climate zones, respectively. The total statewide electricity savings potential is estimated to be 236 GWh/yr, with a reduction in winter peak demand of 103 MW.

g. High-efficiency heat pump

This measure involves upgrading a standard heat pump to a high-efficiency heat pump (HSPF=8, SEER=12). We estimate an incremental cost (over the previous heat pump measure) of $300[21]. Estimated savings per home from this measure are 617 kWh/yr and 329 watts and 470 kWh/yr and 257 watts for the upstate and downstate climate zones, respectively. The total statewide electricity savings potential is estimated to be 23 GWh/yr, with a reduction in winter peak demand of 12 MW.

2. Residential Water Heating Measures

a. Heat traps and insulation blanket

This measure involves the installation of heat traps and an insulation blanket on electric water heaters. Heat traps reduce convective losses from the hot water inlet and outlet during standby periods while the blanket reduces conductive losses from the tank. The residential water heater conservation assessment is presented in Table 2-4.

We estimate savings of 10% of the electricity used for water heating from this measure at an installed cost of $36[22]. The annual electricity savings from the application of this measure to a typical electric water heater is 284 kWh/yr. This measure is quite cost-effective with a maximum CSE of 1.6¢/kWh. The total statewide electricity savings potential is estimated to be 265 GWh/yr, with peak demand reductions of 21 MW and 54 MW in the summer and winter, respectively.

b. Front-loading clothes washer

Table 2-4

ELECTRIC WATER HEATER CONSERVATION ASSESSMENT

New York State

Discount rate = 6%

Option	UEC (KWh/yr)	Diversified peak demand Summer (Watts)	Diversified peak demand Winter (Watts)	Extra first cost (1986 $)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock avg. (EF=0.82)	3,200	252	650	---	13	---	---	---	---	---
Traps & blanket (EF=0.9)	2,916	230	592	36	13	0.013	837	265	21	54
Load controller/cycler	2,916	144	370	150	15	---	825	0	80	207
Front loading clothes washer	2,436	120	309	155	13	0.034	3,418	447	22	57

Notes:

1. Saturation =16%
2. The peak-to-average demand ratio for electric water heaters is 0.69 in the summer and 1.78 in the winter.
3. Base case includes low-flow showerhead.
4. Thermal traps and blanket reduce demand by 10% for $36.
5. Front loading clothes washer reduces demand by 480 KWh/yr for EF=0.9.
6. EF-Energy Factor: a measure of overall water heater efficiency.

This measure involves the replacement of the standard top-loading clothes washer with a front-loading model. The front-loading clothes washer saves energy by using less hot water to wash the same amount of clothes. We estimate an incremental cost of $150 and electricity savings of 480 kWh/yr[23]. The total statewide electricity savings potential is estimated to be 447 GWh/yr, with peak demand reductions of 22 MW and 57 MW in the summer and winter, respectively.

c. Load controller/cycler

This measure involves the installation of a radio-activated, utility-controlled, shut-off device to reduce water heater operation during peak load periods. When activated, the load controller cuts off electricity to the water heater for a pre-determined amount of time. The fraction of time during which operation is permitted is known as the cycling schedule. For example, under a typical 33% cycling schedule, the load controller will permit operation for five minutes out of every quarter hour. The water heaters being controlled are divided into three groups. The first group operates during the first five minutes out of each quarter hour; the second and the third group each follow in sequence. In this manner the total load is reduced by two-thirds. Common cycling schedules range from 0% to 67% of operation.

We assume a 33% cycling schedule during the peak summer and winter hours. The estimated cost for this measure is $150, based on the economies of a large-scale program[24]. The cost of this measure would be reduced if installed on a number of appliances in the home due to the multiple use of the utility-based control equipment. The estimated reduction in peak demand from this measure is 86 watts and 222 watts during the summer and winter peak periods, respectively. Electricity savings are somewhat dependent on the cycling schedule and are likely to be relatively small. Therefore, we have assumed no electricity savings from this measure. The total potential reduction in statewide peak demand is estimated to be 80 MW and 207 MW in the summer and winter, respectively.

3. Residential Refrigerator and Freezer Measures

a. Current sales average

This measure involves replacing the 1986 stock average refrigerator or freezer with a model whose efficiency is equal to the sales-weighted average of models sold in 1986[25]. The new refrigerator model includes an increase in compressor efficiency to 4.5 EER and replacement of the fiberglass door insulation with polyurethane foam. The new freezer model includes an increase in compressor efficiency to 3.65 EER and replacement of the fiberglass door insulation with polyurethane foam. Obviously, refrigerators and freezers are being upgraded to these efficiency levels through routine replacement of the current stock. Therefore, this measure requires no further policies for implementation unless there is an interest in increasing the rate at which it is implemented.

The refrigerator and freezer conservation assessments are presented in Tables 2-5 and 2-6, respectively. We estimate an incremental cost of the more efficient refrigerator due to the efficiency measures at $31 and an incremental cost for the freezer of $13[26]. Estimated savings are 266 kWh/yr for the refrigerator and 246 kWh/yr for the freezer. The costs and savings estimated for these measures -- and the following two refrigerator and freezer measures -- are consistent with the recent analysis completed for the DOE rulemaking on revisions to the federal minimum efficiency standards for refrigerators and freezers[27]. All of the refrigerator and freezer measures are quite cost-effective with a maximum CSE of less than 2¢/kWh.

Table 2-5

REFRIGERATOR/FREEZER CONSERVATION ASSESSMENT

New York State

Discount rate = 6%

Option	UEC (KWh/yr)	Diversified peak demand Summer (Watts)	Diversified peak demand Winter (Watts)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	1,340	229	116	---	20	---	---	---	---	---
Current sales average (1986)	1,074	184	93	31	20	0.010	681	1,876	321	163
Best current (1988)	810	139	70	36	20	0.011	795	1,865	319	162
Near-term advanced	699	120	61	18	20	0.013	949	781	134	68

Notes:

1. Saturation =120%
2. Peak-to-average demand ratio is 1.50 in the summer and 0.76 in the winter.
3. Current sales average includes 4.5 EER compressor and foam doors.
4. Best current includes 5.0 EER compressor and additional insulation.
5. Near-term advanced includes more efficient fans and motors and 5.3 EER compressor.

Table 2-6

FREEZER CONSERVATION ASSESSMENT

New York State

Discount rate = 6%

Option	UEC (KWh/yr)	Diversified peak demand Summer (Watts)	Diversified peak demand Winter (Watts)	Extra first cost (1986 $)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	1,000	146	135	---	20	---	---	---	---	---
Current sales average (1986)	754	110	102	13	20	0.004	358	373	54	50
Best current (1988)	583	85	79	30	20	0.014	1,183	259	38	35
Near-term advanced	498	73	67	15	20	0.015	1,224	129	19	17

Notes:

1. Saturation =26%
2. The peak-to-average demand ratio for freezers is 1.28 in the summer and 1.18 in the winter.
3. Current sales average includes 3.65 EER compressor and foam door.
4. Best current includes 4.5 EER compressor and additional insulation.
5. Near-term advanced includes 5.0 EER compressor and additional insulation

The total statewide electricity savings potential for the refrigerator is estimated to be 1,876 GWh/yr, with peak demand reductions of 321 MW and 163 MW in the summer and winter, respectively. The total statewide electricity savings potential for the freezer is estimated to be 373 GWh/yr, with peak demand reductions of 54 MW and 50 MW in the summer and winter, respectively.

b. Best new model

This measure involves replacing the 1986 stock of refrigerators or freezers with models whose efficiency is equal to that of the best models currently available in their class[28]. This level of efficiency complies with the national minimum efficiency standard that becomes effective in 1990[29].

The new refrigerator model includes an increase in compressor efficiency to 5.0 EER and an increase in the thickness of wall and door insulation. The incremental cost for these measures is $36. The new freezer model includes an increase in compressor efficiency to 4.5 EER and an increase in the thickness of wall and door insulation. The incremental cost for these measures is $30[30].

We estimate savings of 264 kWh/yr for the refrigerator and 171 kWh/yr for the freezer. The total statewide electricity savings potential for the refrigerator is estimated to be 1,865 GWh/yr, with peak demand reductions of 319 MW and 162 MW in the summer and winter, respectively. The total statewide electricity savings potential for the freezer is estimated to be 259 GWh/yr, with peak demand reductions of 38 MW and 35 MW in the summer and winter, respectively.

c. Near-term advanced model

This measure involves replacing the 1986 stock average refrigerator or freezer with a model that substantially exceeds the national minimum efficiency standard that becomes effective in 1990. While not currently commercially available, such models are judged technically feasible and likely to become available by the early 1990's.

The new refrigerator model includes an increase in compressor efficiency to 5.3 EER and the use of more efficient fans and fan motors. We estimate savings of 111 kWh/yr at an incremental cost of $18[31]. The new freezer model includes an increase in compressor efficiency to 5.0 EER and a further increase in the thickness of wall and door insulation. We estimate savings of 85 kWh/yr at an incremental cost of $15[32].

The total statewide electricity savings potential for the refrigerator is estimated to be 781 GWh/yr, with peak demand reductions of 134 MW and 68 MW in the summer and winter, respectively. The total statewide electricity savings potential for the freezer is estimated to be 129 GWh/yr, with peak demand reductions of 19 MW and 17 MW in the summer and winter, respectively.

4. Residential Air Conditioning Measures

a. Central air conditioner efficiency upgrades

This measure consists of the replacement of the base case central air conditioner (SEER=8.0) with models of three successively higher efficiencies -- SEERs of 10, 12, and 14. The New York State Energy Conservation Construction Code requires a minimum efficiency of SEER 9.5[33]. The National Appliance Energy Conservation Act requires a minimum efficiency of 10.0 SEER for all split system central air conditioners manufactured after January 1, 1992 and 9.7 SEER for all package units manufactured after January 1, 1993[34]. Central air conditioners of SEER=14 are not currently available in all size classes but are expected to be generally available within a few years.

We estimate incremental costs of $250, $290, and $340 for the three measures, respectively[35]. Savings from this measure are taken from the DOE-2 simulation of the single-family home. For the 10.0 SEER upgrade, savings are estimated to be 109 kWh/yr and 179 watts and 214 kWh/yr and 293 watts for the upstate and downstate climate zones, respectively. For the 12.0 SEER upgrade, savings are estimated to be 64 kWh/yr and 122 watts and 127 kWh/yr and 205 watts for the upstate and downstate climate zones, respectively. For the 14.0 SEER upgrade, savings are estimated to be 63 kWh/yr and 104 watts and 93 kWh/yr and 158 watts for the upstate and downstate climate zones, respectively. These results are presented in the central air conditioning conservation assessments in Tables 2-7 and 2-8, for each of the two climate zones analyzed. The statewide average CRD for this measure at a 6% discount rate ranges from $1,416/kW for the 10.0 SEER upgrade to $3,500/kW for the 14.0 SEER upgrade.

The total statewide electricity savings potential for the 10.0 SEER upgrade is estimated to be 79 GWh/yr, with a reduction in summer peak demand of 113 MW. The total statewide electricity savings potential for the 12.0 SEER upgrade is estimated to be 47 GWh/yr, with a reduction in summer peak demand of 79 MW. The total statewide electricity savings potential for the 14.0 SEER upgrade is estimated to be 38 GWh/yr, with a reduction in summer peak demand of 62 MW.

b. Room air conditioner efficiency upgrade

This measure consists of the replacement of the base case room air conditioners (EER=7.0) with models of three successively higher efficiencies -- EER of 8.5, 10, and 12. The New York State Appliance Standards require a minimum EER of 8.5 for room air conditioners with a capacity of 6,000 Btu/hr or greater[36]. The National Appliance Energy Conservation Act requires a minimum efficiency of 8.0 to 9.0 EER (the minimum efficiency varies depending on product class and capacity) for all room air conditioners manufactured after January 1, 1990[37].

Table 2-7

CENTRAL AIR CONDITIONING CONSERVATION ASSESSMENT

New York State - Upstate climate zone

Discount rate = 6%

Option	UEC	Diversified peak demand Summer	Diversified peak demand Winter	Extra first cost	Lifetime	Marginal CSE	Marginal CRD(20)	Savings potential Energy	Savings potential Peak demand Summer	Savings potential Peak demand Winter
	(KWh/yr)	(Watts)	(Watts)	(1986 $)	(years)	($/KWh)	($/kW)	(GWh/yr)	(MW)	(MW)
1986 Stock avg. (8.0 SEER)	989	1,945	0	---	15	---	---	---	---	---
Load controller/cycler	989	1,216	0	150	15	---	251	---	123	---
Window film	839	991	0	180	10	0.154	1,274	25	38	---
CAC: 10.0 SEER	730	812	0	250	12	0.258	1,986	18	30	---
Variable speed drive	639	812	0	240	12	0.296	---	15	---	---
CAC: 12.0 SEER	575	690	0	290	12	0.511	3,349	11	21	---
CAC: 14.0 SEER	512	586	0	340	12	0.605	4,656	11	17	---

Notes:

1. SEER: Seasonal energy efficiency ratio = Seasonal average Btu output per Wh of electricity consumed.
2. Saturation =8%
3. Load controller/cycler allows 33% operation during peak hours.

Table 2-8

CENTRAL AIR CONDITIONING CONSERVATION ASSESSMENT

New York State - Downstate climate zone

Discount rate = 6%

Option	UEC	Diversified peak demand		Extra first cost	Lifetime	Marginal CSE	Marginal CRD(20)	Savings potential		
		Summer	Winter					Energy	Peak demand Summer	Peak demand Winter
	(KWh/yr)	(Watts)	(Watts)	(1986 $)	(years)	($/KWh)	($/kW)	(GWh/yr)	(MW)	(MW)
1986 Stock avg. (8.0 SEER)	1,516	3,083	0	---	15	---	---	---	---	---
Load controller/cycler	1,516	1,927	0	150	15	---	159	---	327	---
Window film	1,336	1,627	0	180	10	0.128	955	51	85	---
CAC: 10.0 SEER	1,122	1,334	0	250	12	0.132	1,209	61	83	---
Variable speed drive	982	1,334	0	240	12	0.192	---	40	---	---
CAC: 12.0 SEER	855	1,129	0	290	12	0.258	2,000	36	58	---
CAC: 14.0 SEER	761	971	0	340	12	0.407	3,048	27	45	---

Notes:

1. SEER: Seasonal energy efficiency ratio = Seasonal average Btu output per Wh of electricity consumed.
2. Saturation =8%
3. Load controller/cycler allows 33% operation during peak hours.

We estimate incremental costs of $30, $30, and $40 for the three measures, respectively[38]. Savings from this measure are taken from the DOE-2 simulation of the multi-family home. For the 8.5 EER upgrade, savings are estimated to be 19 kWh/yr and 52 watts and 47 kWh/yr and 123 watts for the upstate and downstate climate zones, respectively. For the 10.0 EER upgrade, savings are estimated to be 10 kWh/yr and 37 watts and 29 kWh/yr and 87 watts for the upstate and downstate climate zones, respectively. For the 12.0 EER upgrade, savings are estimated to be 11 kWh/yr and 34 watts and 31 kWh/yr and 81 watts for the upstate and downstate climate zones, respectively. These results are presented in the room air conditioning conservation assessments in Tables 2-9 and 2-10, for each of the two climate zones analyzed. The statewide average CRD for this measure at a 6% discount rate ranges from $439/kW for the 8.5 EER upgrade to $886/kW for the 12 SEER upgrade.

The total statewide electricity savings potential for the 8.5 SEER upgrade is estimated to be 144 GWh/yr, with a reduction in summer peak demand of 381 MW. The total statewide electricity savings potential for the 10.0 SEER upgrade is estimated to be 87 GWh/yr, with a reduction in summer peak demand of 267 MW. The total statewide electricity savings potential for the 12.0 SEER upgrade is estimated to be 91 GWh/yr, with a reduction in summer peak demand of 252 MW.

c. Window films

This measure involves the application of low-emissivity, shaded window film to south-facing windows to reduce heat gain during the cooling season. We assume that the film is rated R-1.2 and has a shading coefficient of 0.7[39]. The estimated installed cost of this measure is $2.00/sq.ft. Estimated savings from this measure are 150 kWh/yr and 225 watts and 150 kWh/yr and 300 watts for the upstate and downstate climate zones, respectively. The

Table 2-9

ROOM AIR CONDITIONING CONSERVATION ASSESSMENT

New York State - Upstate climate zone

Discount rate = 6%

Option	UEC (KWh/yr)	Diversified peak demand Summer (Watts)	Diversified peak demand Winter (Watts)	Extra first cost (1986 $)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock avg. (7.0 EER)	278	296	0	---	12	---	---	---	---	---
RAC: 8.5 EER	259	244	0	30	12	0.177	814	28	77	---
RAC: 10.0 EER	249	207	0	30	12	0.329	1,162	15	54	---
RAC: 12 .0 EER	238	173	0	40	12	0.439	1,641	15	51	---

Notes:
1. EER: Energy efficiency ratio = Average Btu output per Wh of electricity consumed.
2. Saturation =67%

Table 2-10

ROOM AIR CONDITIONING CONSERVATION ASSESSMENT

New York State - Downstate climate zone

Discount rate = 6%

Option	UEC	Diversified peak demand		Extra first cost	Lifetime	Marginal CSE	Marginal CRD(20)	Savings potential		
		Summer	Winter					Energy	Peak demand Summer	Peak demand Winter
	(KWh/yr)	(Watts)	(Watts)	(1986 $)	(years)	($/KWh)	($/kW)	(GWh/yr)	(MW)	(MW)
1986 Stock avg. (7.0 EER)	453	699	0	---	12	---	---	---	---	---
RAC: 8.5 EER	406	576	0	30	12	0.072	345	116	304	---
RAC: 10.0 EER	377	489	0	30	12	0.115	492	72	213	---
RAC: 12 .0 EER	346	408	0	40	12	0.146	695	76	201	---

Notes:

1. EER: Energy efficiency ratio = Average Btu output per Wh of electricity consumed.
2. Saturation =67%

total statewide electricity savings potential is estimated to be 76 GWh/yr, with a reduction in summer peak demand of 123 MW.

d. Load controller/cycler

This measure involves the installation of a radio-activated, utility-controlled, shut-off device to reduce central air conditioner operation during peak periods. When activated, the load controller cuts off electricity to the air conditioner for a pre-determined fraction of the time. The fraction of time during which operation is permitted is known as the cycling schedule. (The residential water heater section contains a more detailed description of load controls.)

We assume a 33% cycling schedule during the peak summer hours. The estimated cost for this measure is $150, based on the economies of a large-scale program[40]. The cost of this measure would be reduced if a number of appliances in the home are controlled. The estimated reduction in the summer peak demand per house is 729 watts and 1,156 watts for the upstate and downstate climate zones, respectively. The statewide average CRD for this measure at a 6% discount rate is $184/kW. The potential reduction in statewide summer peak demand is estimated to be 450 MW.

e. Variable-speed drive

This measure involves the replacement of the standard central air conditioner with a model incorporating a variable-speed drive (VSD) on the fan and compressor motors. The use of a VSD reduces losses from cycling and part-load operation. A residential heat pump incorporating variable-speed drives on both fan and compressor motors was recently introduced by Carrier Corporation[41]. This heat pump was developed through a cooperative effort between Carrier and the Electric Power Research Institute and is being marketed for the high-end of the residential market. In general, variable-speed heat pumps and air conditioners are expected to become more widely available in the U.S. in the near future[42].

Based on computer modeling of air conditioner efficiency improvements, we estimate electricity savings of 12.5% and an incremental cost of $240[43]. Because of inadequate analysis of the impact on peak demand we assume there is no peak demand savings. Total estimated savings per house are 90 kWh/yr and 144 kWh/yr for the upstate and downstate climate zones, respectively. The total statewide electricity savings potential is estimated to be 55 GWh/yr.

5. Residential Lighting Measures

a. Energy-saving incandescents

This measure involves the replacement of standard incandescent lamps with energy-saving-type incandescent lamps. Electricity use is reduced by 5-10% depending on lamp wattage with little or no reduction in light output. The estimated incremental cost for the energy-saving lamps is 10¢/lamp. Total electricity savings from replacement of the 8 most commonly used lamps in a typical house is 30 kWh/yr. The CSE for this measure is 3¢/kWh at a 6% discount rate. Total statewide electricity savings are estimated to be 180 GWh/yr, with peak demand reductions of 9 MW and 40 MW in the summer and winter, respectively. The residential lighting conservation assessment is presented in Table 2-11.

b. Tungsten halogen lamps

This measure involves the replacement of standard incandescent lamps with halogen-filled incandescent lamps. Tungsten halogen lamps contain an inner bulb filled with halogen and a tungsten filament that together increase both efficacy and filament life. The outer bulb is approximately the same size as a standard incandescent lamp, although somewhat heavier. The rated lamp life of tungsten halogen bulbs is approximately 2,750 hours[44].

Table 2-11

LIGHTING CONSERVATION ASSESSMENT

New York State

Discount rate = 6%

Option	UEC (KWh/yr)	Diversified peak demand Summer (Watts)	Diversified peak demand Winter (Watts)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	900	43	198	---	---	---	---	---	---	---
Tungsten halogen lamps-300 h/y	781	37	172	23.32	9	0.027	1,239	697	33	154
Energy saving lamps-620 hr/yr	767	37	169	0.50	1.2	0.030	1,603	82	4	18
Energy saving lamps-1,240 h/y	751	36	165	0.30	0.6	0.030	1,659	98	5	22
Compact fluorescents-1240 h/y	563	27	124	35.01	6	0.036	2,044	1,102	53	243
IRF lamps - 300 hr/yr	424	20	93	44.00	9	0.044	2,004	813	39	179
Compact fluorescents-620 h/y	268	13	59	62.55	12	0.045	2,561	918	44	202

Notes:

1. Base case scenario: 3 bulbs @ 75 W & 1240 hrs/yr; 5 bulbs @ 75W & 620 hrs/yr; 22 bulbs @ 60 W & 300 hrs/yr
   Standard bulbs are assumed to cost 60¢ and have a lifetime of 750 hrs
2. Watt-miser/Supersaver: save 6% at 70¢/bulb, lifetime of 750 hrs
3. Compact fluorescents: 75W to 20W at $18, 60W to 18W at $15, lifetime of 7,500 hours
4. Tungsten halogen lamps: 60W to 42W at $2.50, lifetime of 2,750 hours
4. Infrared reflecting film (IRF) lamps: 42W to 21W at $4.50, lifetime of 2,750 hours .
5. Capital costs are discounted at 6%.
6. The peak-to-average demand ratio for lighting is 0.42 in the summer and 1.93 in the winter.

Light quality is quite close to that of a standard incandescent lamp. Tungsten halogen lamps are marketed by a number of the major manufacturers. A recent survey of electrical equipment retailers in the D.C. area found an average price of $2.50 for 42-watt tungsten halogen lamps[45].

We assume that only the least frequently used lamps in each house are replaced with tungsten halogen lamps. All other lamps are upgraded to compact fluorescent lamps (see below). A total of 22, 60-watt, standard incandescent lamps are replaced with 42-watt tungsten halogen lamps for an electricity savings of 119 kWh/yr per household. The incremental cost for this measure is $23.32. The total statewide electricity savings potential is estimated to be 697 GWh/yr, with peak demand reductions of 33 MW and 154 MW in the summer and winter, respectively.

c. Compact fluorescents

This measure involves the replacement of energy-saving incandescents with compact fluorescent lamps. Replacements are as follows: 20-watt compact fluorescent for 70-watt energy-saving incandescent, 18-watt compact fluorescent for 55-watt energy-saving incandescent. The estimated cost for compact fluorescent lamps is $18 for the 20-watt lamp and $15 for the 18-watt lamp[46].

We assume that only the eight most commonly used lamps in each home are replaced with compact fluorescents due to the relatively high first cost. All other lamps are upgraded to tungsten halogen lamps (see above). The replacement of the eight lamps with compact fluorescents would result in an estimated electricity savings per household of 344 kWh/yr. The CSE for this measure ranges from 3.3 to 5.3¢/kWh depending on annual hours of use and discount rate. The total statewide electricity savings potential is estimated to be 2,020 GWh/yr, with peak demand reductions of 97 MW and 445 MW in the summer and winter, respectively.

c. Infrared reflecting film (IRF) lamps

This measure corresponds to an improvement in incandescent lighting recently developed by General Elelctric Company[47]. The improvement involves placing a quartz tube around the filament in incandescent lamps. The tube has multiple layers of infrared reflecting film (IRF) on its outer surface. The film reflects heat back onto the filament but passes visible light. The IRF is used in conjunction with halogen lamps, resulting in a doubling of efficacy (i.e., 50% less power comnsumption) compared to ordinary halogen lamps[48].

General Electric already uses IRF in some of its very-high-wattage incandescent lamps. Lower wattage reflector lamps with IRF will be introduced in late 1989, and the technology could be applied to ordinary incandescent lamps within a few years. The extra first cost at the retail level for the lower wattage IRF lamps is approximately $2 (relative to ordinary halogen lamps)[49]. Replacing all tungsten halogen lamps with the IRF halogen lamps would result in statewide electricity savings of 813 GWh/yr, with peak demand reductions of 39 MW and 179 MW in the summer and winter, respectively.

6. Residential Clothes Drying Measures

a. Heat pump clothes dryer

This measure involves the replacement of the standard clothes dryer with a heat pump clothes dryer. The heat pump clothes dryer functions as a dehumidifier, removing moisture from the dryer in a closed cycle. A prototype HPCD has been built which shows savings of 50-60% over a conventional dryer. An additional advantage of the HPCD is the replacement of the exhaust vent with a drain pipe, convenient for apartment buildings where exhaust vents are difficult to install. This advanced technology is not commercially available as of 1988, but is expected in the marketplace in the near future[50].

The estimated incremental cost for this measure is $310. Estimated electricity savings per household are 418 kWh/yr[51]. The total statewide electricity savings potential is estimated to be 858 GWh/yr. The heat pump clothes dryer follows the load controller (described below) in our cost curve. Because the load controller reduces peak demand from the clothes dryer to zero, there are no peak savings from this measure. The residential electric clothes dryer conservation assessment is presented in Table 2-13.

b. Load controller/cycler

This measure involves the installation of a radio-activated, utility-controlled, shut-off device to reduce clothes dryer operation during peak periods. When activated, the load controller cuts off electricity to the clothes dryer for a pre-determined period of time. (The residential water heater section contains a more detailed description of load controls.)

We assume a full shut off during the peak summer and winter hours -- i.e., no operation during peak hours. The operation of any dryer turned on during this period would be delayed until after the peak period. Naturally, consumers would need to be compensated for this inconvenience. The estimated cost for this measure is $150, based on the economies of a large-scale program[52]. The cost for compensation is not included in this estimate. The cost of this measure per appliance would be reduced if a number of appliances in the home were controlled. This measure reduces demand during peak periods by 127 watts during the summer and 220 watts during the winter. The potential reduction in statewide peak demand is estimated to be 260 MW and 452 MW in the summer and winter, respectively.

6. Residential Cooking Measures

a. Improved oven

Table 2-12

ELECTRIC COOKING RANGES CONSERVATION ASSESSMENT

New York State

Discount rate = 6%

Option	UEC (KWh/yr)	Diversified peak demand Summer (Watts)	Diversified peak demand Winter (Watts)	Extra first cost (1986 $)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	700	172	117	---	18	---	---	---	---	---
Improved oven	600	147	100	25	18	0.022	1,098	212	52	35
Improved cooktop	565	139	94	10	18	0.025	1,254	74	18	12

Notes:

1. 1986 stock average demand: 325 KWh/yr from oven, 375 KWh/yr from range.
2. Improved oven measures include increased insulation and improved door seals.
3. Improved cooktop measures include reduced burner contact resistance and improved reflectance of burner pans.
1. Saturation =36%
5. The peak-to-average demand ratio for electric cooking ranges is 2.15 in the summer and 1.46 in the winter.

Table 2-13

ELECTRIC CLOTHES DRYER CONSERVATION ASSESSMENT

New York State

Discount rate = 6%

Option	UEC (KWh/yr)	Diversified peak demand Summer (Watts)	Diversified peak demand Winter (Watts)	Extra first cost (1986 $)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	760	127	220	---	18	---	---	---	---	---
Load controller/cycler	760	0	0	150	15	---	832	0	260	452
Heat pump clothes dryer	342	0	0	310	18	0.065	---	858	0	0

Notes:

1. Saturation =35%
2. The peak-to-average demand ratio for electric clothes dryers is 1.46 in the summer and 2.54 in the winter.
3. Load controller/cycler allows 0% operation during peak hours.

This measure involves the replacement of the standard electric oven with a model modified with the following measures: (1) increased insulation; (2) improved door seals; (3) reduced thermal mass; (4) an improved heating element. These measures cut oven electricity use by about 30% at an estimated cost of $25[53]. The estimated savings per household are 100 kWh/yr. The total statewide electricity savings potential is estimated to be 212 GWh/yr, with peak demand reductions of 52 MW and 35 MW in the summer and winter, respectively. The residential electric cooking ranges conservation assessment is presented in Table 2-12.

b. Improved cooktop

This measure involves the replacement of the standard electric cooktop with a model modified with the following measures: (1) heating coil with reduced contact resistance; (2) drip pans with increased reflectance. These measures cut cooktop electricity use by about 10% at an estimated cost of $10[54]. The estimated savings per cooktop are 35 kWh/yr. The total statewide electricity savings potential is estimated to be 74 GWh/yr, with peak demand reductions of 18 MW and 12 MW in the summer and winter, respectively.

B. Commercial Sector

The analysis of the commercial sector includes seven different building types representing 84% of total commercial floorspace and 91% of total electricity consumption in the state[55]. The base case buildings were developed through an extensive survey of commercial buildings in Con Ed's service territory as described in the previous chapter. The electricity and peak demand savings resulting from the installation of the various conservation measures are based on a computer simulation of the seven building types using the DOE-2 model. No estimate of conservation potential is made for the building types which were not modeled -- i.e., warehouses and restaurants.

The efficiency measures described below are applied to each of the appropriate building types. Cost estimates are presented along with the description of each measure. Summary results of the analysis by building type are presented at the end of this section.

The conservation analyses for the commercial sector by climate zone for each of the building types are presented in Tables 2-17 to 2-30. The statewide commercial summary tables for energy and peak demand for each of the three discount rates analyzed are presented in Tables 2-35, 2-36, 2-41, 2-42, 2-47, and 2-48. The statewide summaries are also presented graphically as supply curves in Figures 2-6, 2-7, 2-13, 2-14, 2-20, and 2-21.

1. Commercial Lighting Measures

a. Lighting delamp

Nationwide, many commercial buildings were constructed with excessive lighting levels. The removal of a portion of the lamps in fluorescent fixtures, or "delamping", is a widely employed conservation practice in these buildings.

The majority of the prototype buildings in our analysis begin with relatively low lighting levels, indicating that substantial delamping may have already been implemented. In particular, all of the buildings exhibit peak lighting levels below 2.5 W/ft^2. This may be due to the New York State Lighting Standards which require compliance with a lighting power budget for all buildings using more than 5,000 kWh per month[56]. All of our base case prototype buildings except the small building use more than 5,000 kWh per month. Because it appears likely that substantial delamping has already been implemented, this measure is applied only to the small building prototype.

Our delamping measure entails the removal of only 5% of lamps from fluorescent fixtures. We estimate a cost for this measure of $0.25/fixture[57], under the assumption that it is carried out as an independent task. However if this measure is carried out as a part of normal maintenance procedures, the cost would be much lower. Delamping is an extremely cost-effective measure with a CSE of 0.1¢/kWh at a discount rate of 6%.

Electricity savings from this measure are determined through the DOE-2 building simulation for the small building prototype. The total statewide electricity savings potential is estimated to be 141 GWh/yr, with peak demand reductions of 44 MW and 22 MW in the summer and winter, respectively.

b. <u>Energy-saving fluorescent lamps</u>

This measure entails the replacement of all standard 40-watt fluorescent lamps with 34-watt, energy-saving type, fluorescent lamps. As described in the previous chapter, the base case buildings are assumed to have 48% saturation of energy-saving lamps. This measure brings the saturation up to 100%. This measure reduces average lighting watts per square foot in all commercial building types by 7% relative to the base case[58].

We estimate the incremental cost of the energy-saving lamps at $1.14 for each lamp[59]. Electricity savings from this measure are determined by the DOE-2 model for each of the building prototypes. The total statewide electricity savings potential is estimated to be 593 GWh/yr, with peak demand reductions of 158 MW and 94 MW in the summer and winter, respectively.

c. <u>High-efficiency electromagnetic ballasts</u>

This measure entails the replacement of all remaining standard electromagnetic fluorescent lamp ballasts with high-efficiency electromagnetic (core/coil) ballasts. As described earlier, the base case buildings are assumed to have 46% saturation of high-efficiency electromagnetic ballasts. This measure reduces average lighting watts per square foot by 6% over the previous measure[60].

The sale of standard electromagnetic ballasts has been prohibited in New York State since January 1, 1987 due to Statewide minimum efficiency standards[61]. As ballasts wear out, they will be replaced by high-efficiency electromagnetic ballasts (or electronic ballasts). Therefore, no further policies are required to encourage adoption of this measure, unless there is an interest in accelerating the rate at which implementation occurs.

We estimate the incremental cost of the high-efficiency ballasts at $4 per ballast[62]. Electricity savings from this measure are determined by the DOE-2 model for each of the building prototypes. The total statewide electricity savings potential is estimated to be 513 GWh/yr, with peak demand reductions of 132 MW and 85 MW in the summer and winter, respectively.

d. Very high-efficiency fluorescent lamps and electronic ballasts

This measures entails the replacement of high-efficiency electromagnetic ballasts with electronic ballasts and the replacement of energy-saving-type fluorescent lamps with 32-watt very high-efficiency fluorescent lamps (known as T-8 lamps). These lamps have a smaller diameter than ordinary lamps and employ more efficient phosphors. Both the electronic ballasts and the very high-efficiency lamps are readily available and are often installed in combination. Penetration of this measure in existing buildings is still very limited (probably less than 1% of potential applications[63]), so no saturation was assumed in the base case. This combined measure reduces average lighting watts per square foot by 20% over the previous measure[64].

We estimate the incremental cost of the electronic ballasts at $16 per ballast and the incremental cost of each of the 32-watt lamps at $1.03[65]. Therefore, the total installed cost for this measure is $36.12 per fixture[66]. Electricity savings from this measure are determined by the DOE-2 model for each of the building prototypes. This measure is cost-effective in most situations with a statewide average CSE of 6¢/kWh at a discount rate of 6%. The total statewide electricity savings potential from this measure is estimated to be 1,085 GWh/yr, with peak demand reductions of 299 MW and 166 MW in the summer and winter, respectively.

e. Fluorescent lighting fixture reflectors

This measure involves the installation of reflectors in fluorescent fixtures and the removal of some fluorescent lamps in all building types. Reflectors are readily available in anodized aluminum, aluminum film or silver film laminated to an aluminum substrate and are designed to be easily retrofit into existing fixtures. Reflectors are being installed in a growing number of commercial buildings across the country, but their overall use is still very limited[67].

We estimate that installation of a reflector increases useful lumens per watt by 50%, allowing removal of 50% of the lamps while reducing lighting levels by one-fourth[68]. We assume the installation of reflectors (and removal of half the bulbs) in two-thirds of the fixtures in each of the prototype buildings for a net reduction in illuminance of 16%. This measure reduces average lighting watts per square foot by 33% over the previous measure.

Prices for reflectors vary substantially -- from $10-55 per fixture[69] -- depending on manufacturer, quantity and quality. We assume the use of a high-quality, silver-film reflector, purchased in quantity. Our estimate of the installed cost of reflectors is $45 per fixture[70]. The net capital cost associated with each reflector is $12 lower to account for the reduction in lamps used over the life of the reflector[71]. Electricity savings from this measure are determined by the DOE-2 model for each of the building prototypes. This measure is one of the more cost-effective commercial lighting measures with a statewide average CSE of 1¢/kWh at a discount rate of 6%. The estimated statewide electricity savings potential is 4,142 GWh/yr, with peak demand reductions of 1,134 MW and 651 MW in the summer and winter, respectively.

f. Daylighting sensors and controls

This measure involves the installation of a control system which dims the lighting in the building perimeter in response to daylight entering through the windows[72]. The assumed daylighting system provides for a 5-step control, down to a minimum of 70 footcandles of task lighting[73]. The equipment required for the system includes dimmer controls, photosensors and associated wiring. This measure is applied to the prototype hospital, retail store, school, hotel, office and small building.

Electricity savings from daylighting systems will vary among buildings depending on the ratio of window area to wall area and degree of window shading, among other factors. The effective aperture -- calculated as the ratio of glazing area multiplied by the shading coefficient to the total wall area -- provides an overall indicator of the amount of daylight entering. The effective aperture in our prototype buildings ranges from 0.1 to 0.3. We estimate lighting energy savings of 40-55% in the perimeter area, for effective apertures in this range[74]. Considering that daylighting can be used in only a portion of the total floor area of a building, the overall reduction in lighting electricity use from this measure ranges from 13% to 40% depending on building type.

Our estimate of the installed cost of this measure is $60 per fixture with a daylighting control. This cost is based on a price estimate from a large manufacturer and is comparable to other recent price estimates[75,76]. The total statewide electricity savings potential from this measure is estimated to be 1,660 GWh/yr, with peak demand

reductions of 475 MW and 285 MW in the summer and winter, respectively.

g. Occupancy sensors

This measure involves the installation of an occupancy sensor system in rooms with intermittent use, such as conference rooms, bathrooms, etc. The occupancy system automatically turns off lights in these rooms when they are unoccupied for an extended period. The system consists of controls, sensors and associated wiring. It is generally feasible to install sensors in 15% of the total floor space of a typical commercial building[77]. Estimates of lighting energy savings from the installation of an occupancy sensor range from 50 to 60% for the room in which it is installed[78,79]. This measure is applied to all of the prototype buildings except for the supermarket.

Based on manufacturers' literature, we estimate the installed cost of an occupancy sensor to be $65 for a small room (100-150 sq.ft.) and $115 for a large room (300-400 sq.ft.)[80,81]. We assume that the sensors are installed in 15% of the total floor space of each building and that the floor space is equally split between small and large rooms. Electricity savings from this measure are estimated to be 50% of the lighting energy in the rooms in which sensors are installed. The total statewide electricity savings potential from this measure is estimated to be 500 GWh/yr, with peak demand reductions of 136 MW and 80 MW in the summer and winter, respectively.

2. Commercial HVAC measures

a. Re-size chillers

In many buildings, chillers are unnecessarily oversized for building demand. Also, after conservation measures have been installed, the need for chiller capacity is reduced. This measure involves a whole building audit when the existing chillers are to be replaced in order to recalculate cooling load. The audit indicates by how much the new chillers can be downsized to match the reduced load.

The estimated cost of this measure is $0.50/sq.ft. Electricity savings from this measure are determined by the DOE-2 model for each of the building prototypes. Electricity savings from this measure in buildings to which it is applied ranges from 0.3% to 11.7% as a percent of total building electricity use. The total statewide electricity savings potential is estimated to be 2,260 GWh/yr, with peak demand reductions of 499 MW and 250 MW in the summer and winter, respectively.

b. Reset supply air temperature

This measure involves shifting supply air temperature from a constant temperature to a variable temperature based on the needs of the "worst" room. It requires the installation of temperature sensors in a number of rooms and a central processor to monitor temperatures and adjust supply air temperature. This measure is required in the NY State Building Code for new construction and for the addition, alteration or substantial renovation of existing buildings, but is still not employed in many older buildings[82].

The estimated cost of this measure is $1,750 for each constant volume air handling units based on an analysis of 11 prototype commercial buildings for BPA[83]. It is installed on all central HVAC systems with a constant supply air temperature in our prototype buildings. Applications include portions of the floorspace of the prototype hospital, retail store, hotel, office and educational building. Electricity savings from this measure is determined by the DOE-2 model for each of the building prototypes. Electricity savings from this measure in buildings to which it is applied range from 0.6% to 8.8% as a percent of total building electricity use. On a statewide basis, this measure is the most cost-effective commercial HVAC measure with respect to electricity savings with a CSE of 0.5¢/kWh at a discount rate of 6%. The total statewide electricity savings potential is estimated to be 1,182 GWh/yr, with peak demand reductions of 467 MW and 47 MW in the summer and winter, respectively.

c. Economizer

This measure involves the installation of an "economizer" control to the HVAC system. An economizer brings in outside air when it is cool and dry enough, thereby reducing use of chillers. An economizer consists of indoor and outdoor temperature and humidity sensors, dampers, motors, and motor controls. This measure is required in the NY State Building Code for new construction and for the addition, alteration or substantial renovation of existing buildings, but is still not employed in many older buildings[84].

The cost of an economizer control per peak ton of cooling capacity decreases with cooling system size and can vary considerably depending on the cooling system and ease of installation. The estimated installed cost of an economizer control per peak ton of cooling capacity is $65/ton for 15-25 tons, $40/ton for 25-100 tons, and $35/ton for 100+ tons[85]. Electricity savings from this measure are determined by the DOE-2 model for each of the building prototypes to which it could be applied, which includes all of the prototypes except for the small building. The total statewide electricity savings potential is estimated to be 301 GWh/yr, with a summer peak demand reduction of 10 MW.

d. Upgrade fan and pump motor efficiency

This measure involves the replacement of fan and pump motors in HVAC systems with high-efficiency models. High-efficiency motors in the 20-50 HP range are available that are about 2-5% more efficient than standard motors[86]. This measure is applied to all boiler and chiller pumps and supply and return fans in central HVAC systems in our prototype buildings.

Table 2-14 presents our estimates of the cost and efficiency improvement available by motor size. Electricity savings from this measure is determined by the DOE-2 model for each of the building prototypes. The total statewide electricity savings potential from increasing fan motor efficiency is estimated to be 309 GWh/yr, with peak demand reductions of 55 MW and 54 MW in the summer and winter, respectively. The total statewide electricity savings potential from increasing pump motor efficiency is estimated to be 23 GWh/yr, with peak demand reductions of 5 MW and 3 MW in the summer and winter, respectively.

e. Variable air volume

In a central, forced-air HVAC system, the supply air volume can be varied continuously to meet minimum space conditioning load and air quality requirements. This saves electricity by reducing air flow rates during most of the year. In our prototype buildings the supply air volume is varied through the installation of inlet vanes in supply air terminals and temperature sensors. Multi-zone systems are converted to VAV through the installation of a variable-speed drive on the fan motor and are therefore not included in this measure. The potential savings in electricity used for air handling by multi-zone systems appears in the variable-speed drive measure which is described below.

The cost of VAV conversion will vary depending on the pre-existing type of air-handling system. Dual-duct HVAC systems are easier to retrofit and costs typically run $0.25-60/cfm (cfm: cubic feet per minute of air flow capacity). Retrofit costs for other air handling systems are typically $0.65-1.15/cfm[87]. We estimate the cost of VAV conversion at $0.45/cfm for dual-duct systems and $1.00/cfm for other systems. Dual-duct systems are

Table 2-14
HIGH-EFFICIENCY MOTOR OPTIONS

Size range (HP)	Avg. size (HP)	Assumed usage (hrs/yr)	STANDARD MOTOR Efficiency	STANDARD MOTOR Cost (1986$)	HIGH EFF. MOTOR Efficiency	HIGH EFF. MOTOR Cost (1986$)	Annual savings (kWh/yr)
<1	0.28	400	70.0%	$40	74.5%	$50	10
1-5	1.34	921	80.5%	$165	85.5%	$195	84
5.1 - 20	8.61	2,050	85.0%	$655	90.0%	$795	1,018
21 - 50	25.9	3,139	89.0%	$1,500	92.5%	$1,725	2,908
51 - 125	80.6	3,656	91.0%	$4,500	94.3%	$5,100	9,334
>125	195	3,913	93.3%	$10,500	95.5%	$11,400	15,145

Sources:
1. "Classification and Evaluation of Electric Motors and Pumps"; U.S. Department of Energy; Feb. 1980 (DOE/CS-0147)
2. W.J. McDonald and H.N. Hickok; "Energy Losses in Electric Power Systems"; IEEE Transactions on Industry Applications, Vol. IA-21, No.4, pp.803-19; May/June 1985
3. "Adjustable Speed Drives Directory"; Electric Power Research Inst.; Palo Alto, CA; 1985
4. "Energy Efficient Motors in Canada: Technologies, Market Factors and Penetration Rates"; Marbek Resource Consultants; Ottawa, Canada; Nov. 1987

employed for between 0% and 17% of the floorspace in our prototype buildings. Other systems converted to VAV through this measure are employed for between 0% and 27% of the floorspace. The prototype with the largest fraction of floorspace to which this measure is applied is the hotel for which systems converted to VAV through this measure account for 27% of total floorspace.

Electricity savings from this measure is determined by the DOE-2 model for each of the building prototypes. Savings from this measure range from 2.8% to 11.5% as a percentage of total building electricity use. The total statewide electricity savings potential is estimated to be 2,776 GWh/yr, with peak demand reductions of 550 MW and 312 MW in the summer and winter, respectively.

f. Variable-speed drives

This measure entails the installation of variable-speed drives (VSDs) on pump and fan motors. VSDs are electronic devices that enable a motor to vary its speed in order to better match loads and to reduce part-load and cycling losses. The current generation of VSDs function by converting AC current into DC current and then back into AC at varying frequency. VSDs can replace the clutches, valves or vanes which are typically used to regulate air or water flow. Additional benefits include the ability to start and stop the motor gradually, which extends the life of the motor and associated machinery, and precise speed control. This measure is used to provide variable air volume capability in multi-zone air handling systems and for additional savings in systems already converted to VAV (see above).

This measure is applied to all boiler and chiller pumps and to central system supply air fans. Pumps and central system supply air fans susceptible to this measure service between 0 and 57% of the floorspace in our prototype buildings. Estimates of the cost of VSDs are presented in Table 2-15. Electricity savings from this

Table 2-15
VARIABLE-SPEED DRIVE COSTS AND SAVINGS

Motor size range (HP)	Average size (HP)	Assumed usage (hrs/yr)	COST Equipment	COST Installation (1986$/HP)	COST Total cost	Annual savings (kWh/yr)
<1	0.28	400	--	--	--	---
1-5	1.34	921	$515	$310	$825	259
5.1 - 20	8.61	2,050	$415	$255	$670	3,504
21 - 50	25.9	3,139	$310	$205	$515	15,391
51 - 125	80.6	3,656	$155	$155	$310	54,610
>125	195	3,913	$130	$130	$260	138,009

Sources:

1. W.J. McDonald and H.N. Hickok; "Energy Losses in Electric Power Systems"; IEEE Transactions on Industry Applications, Vol. IA-21, No.4, pp.803-19; May/June 1985 May/June 1985
2. "Adjustable Speed Drives Directory"; Electric Power Research Institute; Palo Alto, CA.; 1985

measure is determined by the DOE-2 model for each of the building prototypes. Savings from this measure range from 5.3% to 13.1% as a percentage of total building electricity use for the fan measure and from 0.2% to 2.1% as a percentage of total building electricity use for the pump measure. The total statewide electricity savings potential from the installation of VSDs on fan motors is estimated to be 3,261 GWh/yr, with peak demand reductions of 407 MW and 424 MW in the summer and winter, respectively. The total statewide electricity savings potential from the installation of VSDs on pump motors is estimated to be 212 GWh/yr, with peak demand reductions of 36 MW and 17 MW in the summer and winter, respectively.

g. Cool storage

The use of thermal storage in commercial buildings has grown steadily over the past decade to the point where there are now an estimated 1,000 cool storage systems operating in the U.S.[88]. Cool storage systems can be based on ice, chilled water, or phase change materials, with water and ice being by far the most common of storage media. Systems can be designed for full storage -- in which 100% of the cooling load is moved off-peak -- or partial storage -- in which only a portion of the cooling load is moved off-peak.

Most cool storage systems are installed in buildings during construction. Cool storage systems can be retrofit into existing buildings although the cost is higher than for a new building and the installation may be problematic. Further, chilled water systems, in particular, take up substantial amounts of floorspace. Because of space limitations and possible incompatibility with existing systems, we assume that only 40% of buildings are eligible for installation of a cool storage system. Packaged cool storage systems, which are now being marketed by a number of manufacturers, facilitate installation of cool storage systems in medium-sized and existing buildings (although usually at a reduced efficiency)[89]. This development should serve to expand the potential market for cool storage systems.

Cool storage systems will be most cost-effective in those buildings with an intermittent cooling load that coincides with the system peak, such as offices and retail stores. We apply the cool storage measure to the prototype hospital, retail store, school, hotel and office building. A cool storage system small enough to fit the small building prototype would be difficult to find and install and would suffer from significant dis-economies of scale. The supermarket prototype has particularly long daily operating hours, which provides insufficient off-load hours for charging of the cool storage medium.

This measure entails the installation of a chilled water, partial storage system as the system of choice. Cool storage capacity is chosen to offset 50% of peak cooling needs. The cost of cool storage will vary substantially -- from $25-125 per ton-hr of capacity, according to a recent survey[90]. Installation cost depends on size, the type of HVAC system, and other site-specific factors. On the basis of an analysis of conservation potential in Con Ed's commercial sector, we estimate an installed cost of $75/ton-hr of storage capacity[91].

The impact of cool storage systems on electricity use for cooling will vary from a net increase to a net decrease depending on a number of factors including cool storage system type and efficiency, HVAC system efficiency, and diurnal temperature variations. The available evidence indicates that in general the net impact is unlikely to be large relative to total HVAC electricity use. Therefore, we assume that there is no net impact on building electricity use.

Peak demand savings from this measure ranges from 104 kW for the office building to 66 kW for the hotel in the downstate climate zone. Savings for buildings in the upstate climate zone are approximately 10-20% lower. The potential reduction in statewide summer peak demand is estimated to total 660 MW. The statewide average CRD for this measure is $1,120/kW at a discount rate of 6%.

3. Commercial Shell and Glazing Measures

a. Window films

This measure involves the application of solar control film to south- and west-facing windows in order to reduce solar heat gain and thereby reduce the cooling load. Solar control films are available with a wide range of characteristics, with shading coefficients from 0.2 to 0.8, and optional tints including bronze, silver, smoke and gold. The shading coefficient is a measure of the total solar heat gain through the film normalized to the heat gain through clear, unshaded, vertically placed 1/8 inch glass under the same conditions. A shading coefficient of 1.0 implies no additional shading compared to the reference glass; a coefficient of 0.5 implies 50% less heat gain, etc. This measure is applied to all of the seven prototype buildings.

Installed costs range from $1.25/sq.ft. to $4.50/sq.ft. depending on film type, quality, and quantity of purchase[92]. For this conservation analysis, window film is assumed to reduce the shading coefficient to 0.4 at an installed cost of $2.25/sq.ft. Electricity savings from this measure are determined by the DOE-2 model for each of the building prototypes. The total statewide electricity savings potential is estimated to be 196 GWh/yr, with a reduction in the summer peak demand of 137 MW but an increase in winter peak demand of 14 MW.

b. Insulation

This measure consists of installing four inches of fiberglass batt insulation to the air space below the roof in building prototypes where this is technically feasible. The insulation acts to reduce external heat gains during the cooling season and heat losses during heating season. This measure is applied to the prototype hospital, retail store, school, hotel and small building.

The estimated installed cost of this measure is $0.35/sq.ft. based on a study of retrofit insulation costs in a range of commercial building types in the Pacific Northwest[93]. The cost of this measure would be much lower if it were installed during the construction of a new building. Electricity savings from this measure is determined by the DOE-2 model for each of the building prototypes. The total statewide electricity savings potential is estimated to be 16 GWh/yr, with peak demand reductions of 14 MW and 1 MW in the summer and winter, respectively.

c. <u>Low-emissivity windows</u>

This measure consists of replacing existing windows with new double-pane windows with a low-emissivity coating. The low-emissivity windows cut heat transfer through the window by about 60% in comparison to a standard, single-pane window and by about 30% in comparison to a standard, double-pane window. For this measure, we assume that the low-emissivity window has a thermal resistance of R-2.5 and a shading coefficient of 0.74[94, 95].

The estimated installed cost of this measure is $12.75/sq.ft.[96] The cost of this measure would be much lower if it were installed during construction of the building. Electricity savings from this measure is determined by the DOE-2 model for each of the building prototypes. The total statewide electricity savings potential from the installation of low-emissivity windows on the north side of commercial buildings is estimated to be 85 GWh/yr, with a reduction of winter peak demand reductions of 22 MW. The total statewide electricity savings potential from the installation of low-emissivity windows on the south, east and west sides of commercial buildings is estimated to be 319 GWh/yr, with peak demand reductions of 36 MW and 82 MW in the summer and winter, respectively.

4. Commercial Refrigeration System Measures

Commercial refrigeration system measures are applied only to the supermarket prototype. All of the other building prototypes we analyzed use only small amounts of electricity for refrigeration (restaurants use significant amounts of electricity for refrigeration, but were not analyzed). The refrigeration system in the prototype supermarket accounts for approximately 67,000 kWh/yr, or 44% of total building electricity use in the base case. The supermarket refrigeration system includes refrigeration equipment (compressors, condensers, piping, etc.), display cases and walk-in storage space.

a. High-efficiency compressor and motor

This measure involves the replacement of the existing standard motor and compressor with high-efficiency models. Standard compressors and motors typically operate at approximately 65% overall efficiency[97]. High-efficiency models are available that can improve the efficiency by 10-15%[98,99]. Other measures that are available to increase the efficiency of refrigeration compressors include installation of a variable-speed drive[100] or replacement of the single compressor with a number of smaller compressors of unequal capacity operated in parallel[101]. Each of these measures would provide a level of savings similar to the high-efficiency motor and compressor.

This measure is applied to our prototype supermarket at an estimated incremental cost of $2,000 for each high-efficiency compressor and motor[102]. The estimated savings are 10% of refrigeration system electricity consumption, or 67 MWh/yr per building. Peak refrigeration system demand is also cut by 10% or 12 kW and 7 kW per building for the winter and summer peak loads, respectively. The total statewide electricity savings potential is estimated to be 214 GWh/yr, with peak demand reductions of 37 MW and 21 MW in the summer and winter, respectively.

b. Floating head pressure control

This measure involves the replacement of the minimum-pressure regulator with a floating head pressure control (FHPC) system in the supermarket's refrigeration system. FHPC enables the refrigeration system to take advantage of lower ambient temperatures in order to increase overall system efficiency. A FHPC system consists of a variable pressure control valve, pressure sensors, and associated wiring. The installation of a FHPC system is estimated to cost $800 while reducing refrigeration electricity use by 8% or 53 MWh/yr per building[103]. No peak savings are assumed because of the limited savings produced during the hot summer afternoons when the summer peak occurs. The total statewide electricity savings potential is estimated to be 172 GWh/yr.

c. Refrigerated case covers

This measure consists of the installation of retrofit measures designed to reduce heat gain in refrigerated display cases. Possible measures include glass doors, night covers, strip curtains, and dew point sensors for anti-condensation heaters. The installation of a full set of these measures has been estimated to reduce electricity use for refrigeration by 15-40%[104,105]. However, in many stores, some of these measures will be rejected for aesthetic reasons.

For this conservation analysis, we assume the installation of nighttime covers on refrigeration cases at a cost of $130 per lineal foot of display case installed on 50 lineal feet[106]. We estimate savings at 5% of electricity use for display cases or 17 MWh/yr per building. Peak demand is also cut by 5% or 3 kW and 2 kW per building for the winter and summer peak periods, respectively. The total statewide electricity savings potential is estimated to be 54 GWh/yr, with peak demand reductions of 9 MW and 5 MW in the summer and winter, respectively.

C. Commercial building analyses

1. Education Building

The prototype education building is a 237,000 ft^2, six-floor, private, secondary school. Peak lighting demand is 2.4 W/ft^2. As described earlier, the prototype buildings are divided into a number of distinct areas with regard to HVAC systems. Each area is served by a different HVAC system. The fraction of floorspace served by each system is equal to the saturation of that system type in the general population of that building type. The education building is heated by a steam boiler and cooled in part by a hermetic centrifugal chiller and in part by package single-zone air conditioning units. Air handling system types include multi-zone central systems, package single-zone systems and dual-duct central systems.

The statewide conservation assessment for the education building is presented in Tables 2-16 and 2-17 for each of the climate zones analyzed. A total of 19 different conservation measures are applied to the education building prototype -- nine HVAC measures, six lighting measures, and four shell measures. Twelve of the measures are cost-effective in the downstate climate zone based on a discount rate of six percent and average commercial electricity rates. Only ten of the measures are cost-effective in the upstate climate zone. Installation of all cost-effective measures would reduce electricity consumption by over one-third in both the upstate and downstate climate zones. Summer and winter peak demand would both be reduced by approximately 30%.

The statewide potential for savings from implementation of all cost-effective measures is 1,875 GWh/yr in electricity consumption and 571 MW and 179 MW in

Table 2-16
EDUCATION BUILDING CONSERVATION ASSESSMENT
New York State - Upstate climate zone
Discount rate = 6%

Option	UEC (MWh/yr)	Diversified peak demand Summer (kW)	Diversified peak demand Winter (kW)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	2,727	936	320	---	---	---	---	---	---	---
Reset supply air temp.	2,558	915	306	$7,000	20	0.003	337	153	19	13
VAV conversion	2,482	871	305	$13,199	20	0.014	299	68	40	0
Energy saving fluorescents	2,420	849	299	$6,655	7.2	0.018	615	55	20	6
Reflectors	2,103	729	265	$61,779	15	0.019	629	286	108	31
Economizer	2,054	728	265	$12,332	20	0.020	12,332	45	1	0
High-efficiency ballasts	2,016	715	261	$8,087	15	0.021	763	34	12	4
VSD on fan motor	1,873	682	247	$35,058	15	0.024	1,309	130	30	13
Occupancy sensors	1,828	666	242	$12,621	10	0.036	1,249	40	15	4
Fan motor efficiency	1,822	664	241	$1,881	10	0.038	1,919	6	1	1
VHE bulbs and ballasts	1,712	623	229	$91,209	15	0.080	2,665	100	38	11
Pump motor efficiency	1,711	622	229	$433	10	0.106	1,406	0	0	0
Re-size chillers	1,645	605	221	$99,158	20	0.123	5,689	60	16	8
Window films (S&W)	1,641	597	221	$8,627	20	0.170	1,200	4	6	0
Daylighting controls	1,583	576	215	$50,992	10	0.114	3,732	52	20	6
VSD on pump motor	1,578	572	214	$17,806	15	0.362	6,147	4	3	1
Low-E windows (N)	1,575	575	208	$22,772	20	0.491	4,148	3	-2	5
Low-E windows (All)	1,568	1	0	$68,519	20	0.901	97,884	6	0	1
Roof insulation	1,568	574	208	$7,385	20	3.197	35,167	0	0	0
Cool storage	1,568	516	208	$35,802	20	---	618	0	52	0

Table 2-17

EDUCATION BUILDING CONSERVATION ASSESSMENT

New York State - Downstate climate zone

Discount rate = 6%

Option	UEC (MWh/yr)	Diversified peak demand Summer (kW)	Diversified peak demand Winter (kW)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	2,841	1,030	327	---	---	---	---	---	---	---
Reset supply air temp.	2,644	1,011	296	$7,000	20	0.003	358	166	16	26
VAV conversion	2,563	967	296	$13,977	20	0.014	321	68	37	0
Energy saving fluorescents	2,490	941	288	$6,655	7.2	0.015	532	61	22	6
Reflectors	2,167	818	254	$61,779	15	0.019	613	271	103	28
High-efficiency ballast	2,128	805	250	$8,087	15	0.020	722	33	11	3
Economizer	2,076	802	250	$13,422	20	0.021	4,459	44	3	0
VSD on fan motor	1,925	771	235	$36,495	15	0.023	1,450	127	26	13
Occupancy sensors	1,879	755	230	$12,621	10	0.035	1,249	38	14	4
Fan motor efficiency	1,873	753	229	$1,935	10	0.037	1,856	6	1	1
Pump motor efficiency	1,872	753	229	$434	10	0.074	1,304	1	0	0
Daylighting controls	1,799	725	222	$50,992	10	0.089	2,911	61	23	6
VHE bulbs and ballasts	1,701	687	211	$91,209	15	0.090	2,986	82	31	9
Window films (S&W)	1,695	680	212	$8,627	20	0.115	1,150	5	6	0
Re-size chillers	1,627	662	203	$99,158	20	0.121	5,472	56	15	7
VSD on pump motor	1,621	658	203	$17,864	15	0.273	5,655	5	3	1
Low-E windows (N)	1,619	661	199	$22,772	20	1.050	6,072	1	-2	3
Low-E windows (all)	1,616	658	198	$68,519	20	1.536	31,634	3	2	1
Roof insulation	1,615	657	198	$7,385	20	1.797	5,770	0	1	0
Cool storage	1,615	589	198	$42,214	20	---	618	0	57	0

summer and winter peak demand, respectively. Approximately, one third of the cost-effective savings are from the installation of reflectors in fluorescent fixtures.

2. Hospital

The hospital prototype is a 320,000 ft^2, 11-floor building. Peak lighting demand in the base case is 1.1 W ft^2. The prototype is cooled in part by a hermetic centrifugal chiller and in part by package systems. The building is heated by a steam boiler. Air handling system types include package single-zone and multi-zone, dual-duct and variable air volume.

The hospital building conservation assessment, presented in Tables 2-18 and 2-19, includes a total of 17 different conservation measures -- nine HVAC measures, six lighting measures, and two shell measures. Fifteen of the measures are cost-effective in the downstate climate zone based on a discount rate of six percent and average commercial electricity rates; 14 of the measures are cost-effective in the upstate climate zone. Installation of all cost-effective measures would reduce electricity consumption by approximately 45% in both the upstate and downstate climate zones. Summer and winter peak demand would be reduced by approximately 35% and 49%, respectively.

The statewide potential for savings from the implementation of all cost-effective measures is 954 GWh/yr and 160 MW and 125 MW in summer and winter peak demand, respectively. Approximately, one-fourth of the cost-effective savings are from the installation of reflectors in the fluorescent fixtures. A further 20% of the total savings are from the installation of variable-speed drives on pump and fan motors.

3. Hotel

The prototype hotel is 250,000 ft^2 with 22 floors. Base case peak lighting demand is just over 1 watt/ft^2.

Table 2-18
HOSPITAL CONSERVATION ASSESSMENT
New York State - Upstate climate zone
Discount rate = 6%

Option	UEC (MWh/yr)	Diversified peak demand Summer (kW)	Diversified peak demand Winter (kW)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	6,190	1,344	790	---	---	---	---	---	---	---
VAV conversion	5,592	1,271	732	$23,870	20	0.003	323	84	10	8
Fan motor efficiency	5,533	1,259	723	$3,138	10	0.007	435	8	2	1
Reflectors	4,808	1,120	626	$53,967	15	0.007	473	101	19	14
Pump motor efficiency	4,801	1,119	625	$448	10	0.008	892	1	0	0
High-efficiency ballast	4,733	1,107	615	$7,065	15	0.010	736	9	2	1
Reset supply air temp.	4,687	1,098	614	$10,500	20	0.019	1,193	6	1	0
Energy saving fluorescents	4,598	1,082	601	$3,878	2.7	0.022	1,132	12	2	2
VSD on fan motor	4,108	1,024	515	$113,352	15	0.022	1,609	69	8	12
VSD on pump motor	4,044	1,015	506	$18,458	15	0.028	2,392	9	1	1
Daylighting controls	3,853	979	480	$43,331	10	0.029	1,883	27	5	4
VHE bulbs and ballasts	3,637	937	451	$79,675	15	0.036	2,345	30	6	4
Window films (S&W)	3,573	916	449	$30,411	20	0.039	1,447	9	3	0
Occupancy sensors	3,512	905	440	$24,585	10	0.052	3,492	8	2	1
Re-size chillers	3,291	848	407	$193,147	20	0.072	3,368	31	8	5
Roof insulation	3,285	847	406	$8,225	20	0.108	29,375	1	0	0
Economizer	3,275	847	406	$16,029	20	0.135	94,287	1	0	0
Cool storage	3,275	755	406	$150,275	20	---	1,625	0	13	0

Table 2-19
HOSPITAL CONSERVATION ASSESSMENT
New York State - Downstate climate zone
Discount rate = 6%

Option	UEC (MWh/yr)	Diversified peak demand Summer (kW)	Diversified peak demand Winter (kW)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	6,541	1,475	792	---	---	---	---	---	---	---
VAV conversion	5,927	1,402	731	$24,327	20	0.003	334	115	14	11
Fan efficiency	5,865	1,391	723	$3,197	10	0.007	436	12	2	2
Pump motor efficiency	5,857	1,390	722	$438	10	0.007	766	1	0	0
Reflectors	5,167	1,264	624	$53,967	15	0.008	525	129	23	18
High-efficiency ballast	5,084	1,249	612	$7,065	15	0.008	572	15	3	2
Reset supply air temp.	5,042	1,241	612	$10,500	20	0.021	1,364	8	1	0
Energy saving fluorescents	4,951	1,225	599	$3,878	2.7	0.022	1,132	17	3	2
VSD on fan motor	4,453	1,164	510	$115,467	15	0.023	1,589	93	11	17
VSD on pump motor	4,391	1,159	502	$18,021	15	0.028	2,692	12	1	2
Daylighting controls	4,199	1,122	476	$43,331	10	0.029	1,883	36	7	5
VHE bulbs and ballasts	3,981	1,081	447	$79,675	15	0.036	2,345	41	8	5
Window films (S&W)	3,912	1,058	446	$30,411	20	0.037	1,363	13	4	0
Occupancy sensors	3,851	1,047	437	$24,585	10	0.051	3,492	11	2	2
Re-size chillers	3,612	980	406	$193,147	20	0.066	2,902	45	12	6
Roof insulation	3,603	979	405	$8,225	20	0.079	5,917	2	0	0
Economizer	3,593	976	405	$17,194	20	0.136	4,927	2	1	0
Cool storage	3,593	873	405	$166,962	20	---	1,625	0	19	0

The prototype hotel is cooled in part by a centrifugal chiller and in part by package air conditioning systems. Air handling systems include single-zone reheat, multi-zone systems, and package terminal units. The statewide conservation assessment for the hotel is presented in Tables 2-20 and 2-21.

Nineteen different conservation measures are analyzed with respect to the hotel building -- nine HVAC measures, six lighting measures, and four shell measures. Sixteen of the measures are cost-effective in both climate zones, assuming a discount rate of six percent and average commercial electricity rates. Installation of all cost-effective measures would reduce electricity consumption by approximately 55% in both the upstate and downstate climate zones. Summer and winter peak demand would be reduced by approximately 40% and 50%, respectively.

The statewide potential for savings from implementation of all cost-effective measures is 475 GWh/yr in electricity consumption and 74 MW and 60 MW in summer and winter peak demand, respectively. The installation of variable-speed drives on fan and pump motors account for 22% of the cost-effective electricity savings.

4. Office Building

The office building prototype is a 205,000 ft^2, 27-floor building. Peak lighting demand in the base case is 1.7 W ft^2. The prototype is cooled by a number of different system types, including an open reciprocating chiller, a hermetic centrifugal chiller and package system units. The building is heated by a hot water boiler. Air handling system types include package single-zone and multi-zone, dual-duct and variable air volume.

Seventeen conservation measures are applied to the office building prototype -- nine HVAC measures, six lighting measures, and two shell measures. The conservation assessment for the office building is

Table 2-20

HOTEL CONSERVATION ASSESSMENT

New York State - Upstate climate zone

Discount rate = 6%

Option	UEC (MWh/yr)	Diversified peak demand Summer (kW)	Diversified peak demand Winter (kW)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	3,013	591	432	---	---	---	---	---	---	---
Reset supply air temp.	2,908	551	432	$7,000	20	0.005	178	12	4	0
Reflectors	2,604	504	394	$32,785	15	0.010	853	35	5	4
Energy saving fluorescents	2,559	498	388	$2,356	4.6	0.014	1,089	5	1	1
High-efficiency ballast	2,530	493	384	$4,292	15	0.014	1,133	3	1	0
Pump motor efficiency	2,526	493	383	$458	10	0.015	1,487	0	0	0
Economizer	2,451	489	383	$17,685	20	0.019	4,982	9	0	0
Fan mototr efficiency	2,432	486	370	$3,407	10	0.024	1,528	2	0	2
VAV conversion	2,201	479	333	$82,719	20	0.029	11,667	26	1	4
VSD on fan motor	1,878	451	254	$100,694	15	0.030	4,387	37	3	9
Daylighting controls	1,750	431	238	$43,190	10	0.043	3,485	15	2	2
VSD on pump motor	1,714	427	232	$18,840	15	0.050	4,275	4	0	1
Re-size chillers	1,521	388	232	$125,229	20	0.053	3,263	22	4	0
Window films (S&W)	1,470	361	232	$33,710	20	0.055	1,206	6	3	0
VHE bulbs and ballasts	1,389	347	222	$48,403	15	0.058	4,470	9	2	1
Occupancy sensors	1,364	344	219	$15,940	10	0.080	6,768	3	0	0
Low-E windows (all)	1,349	326	219	$275,273	20	1.490	15,665	2	2	0
Low-E windows (N)	1,345	320	219	$118,346	20	2.593	20,799	0	1	0
Roof insulation	1,345	320	219	$4,620	20	6.643	57,750	0	0	0
Cool storage	1,345	258	219	$60,354	20	---	975	0	7	0

Table 2-21

HOTEL CONSERVATION ASSESSMENT

New York State - Downstate climate zone

Discount rate = 6%

Option	UEC (MWh/yr)	Diversified peak demand Summer (kW)	Diversified peak demand Winter (kW)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	3,353	681	440	---	---	---	---	---	---	---
Reset supply air temp.	3,201	631	440	$7,000	20	0.004	140	24	8	0
Reflectors	2,878	581	402	$32,785	15	0.010	806	51	8	6
High-efficiency ballast	2,839	575	397	$4,292	15	0.011	878	6	1	1
Pump motor efficiency	2,835	575	393	$461	10	0.015	190	1	0	1
Energy saving fluorescents	2,792	568	388	$2,356	4.6	0.015	1,094	7	1	1
Fan motor efficiency	2,772	565	374	$3,625	10	0.023	1,738	3	1	2
Economizer	2,703	563	374	$19,789	20	0.024	12,291	11	0	0
VSD on fan motor	2,347	534	290	$107,147	15	0.029	4,400	56	5	13
VAV conversion	2,105	525	251	$88,020	20	0.030	10,025	38	1	6
Window films (S&W)	2,034	491	251	$33,710	20	0.039	1,002	11	5	0
Daylighting controls	1,904	470	235	$43,190	10	0.043	3,291	20	3	3
VSD on pump motor	1,867	466	230	$18,971	15	0.050	4,711	6	1	1
Re-size chillers	1,663	431	230	$125,229	20	0.050	3,509	32	6	0
VHE bulbs and ballasts	1,580	417	219	$48,403	15	0.057	4,470	13	2	2
Occupancy sensors	1,554	413	216	$15,940	10	0.079	6,392	4	1	0
Low-E windows (all)	1,527	390	216	$275,273	20	0.837	11,686	4	4	0
Low-E windows (N)	1,518	381	216	$118,346	20	1.075	12,920	1	1	0
Roof insulation	1,518	381	215	$4,620	20	19.791	5,133	0	0	0
Cool storage	1,518	315	215	$63,785	20	---	975	0	10	0

presented in Tables 2-22 and 2-23 for each of the climate zones analyzed. All but four of the measures are cost-effective in both climate zones, based on a discount rate of six percent and average commercial electricity rates. Installation of all 13 cost-effective measures would reduce electricity consumption by approximately 60% in both the upstate and downstate climate zones. Summer and winter peak demand would be reduced by approximately 52% and 60%, respectively.

The statewide potential for savings from the implementation of all cost-effective measures is 9,417 GWh/yr and 1,737 MW and 1,428 MW in summer and winter peak demand, respectively. Each of three measures account for approximately 20% of the total cost-effective savings: (1) installation of variable speed drives on fan motors -- 2,017 GWh/yr; (2) re-sizing of chillers -- 1,846 GWh/yr; (3) conversion to variable air volume -- 1,802 GWh/yr.

5. Retail Store

The prototype retail store is a 149,000 ft^2 building with seven floors. Base case peak lighting demand is 1.6 $watt/ft^2$. The prototype retail store is cooled in part by a hermetic, centrifugal chiller and in part by package air conditioning systems. Air handling systems include single-zone reheat, multi-zone systems, dual-duct systems, and package terminal units.

The retail store conservation assessment, presented in Tables 2-24 and 2-25, includes 19 different conservation measures -- nine HVAC measures, six lighting measures, and four shell measures. Fourteen of the measures are cost-effective in both climate zones, assuming a discount rate of six percent and average commercial electricity rates. Installation of all cost-effective measures would reduce electricity consumption by approximately 61% in both the upstate and downstate climate zones. Summer and winter peak demand would be reduced by approximately 55% and 44%, respectively.

Table 2-22

OFFICE BUILDING CONSERVATION ASSESSMENT

New York State - Upstate climate zone

Discount rate = 6%

Option	UEC (MWh/yr)	Diversified peak demand: Summer (kW)	Diversified peak demand: Winter (kW)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential: Energy (GWh/yr)	Savings potential: Peak demand Summer (MW)	Savings potential: Peak demand Winter (MW)
1986 Stock average	4,912	1,051	737	---	---	---	---	---	---	---
Reflectors	4,455	924	642	$45,407	15	0.010	438	393	109	82
Reset supply air temp.	4,336	915	639	$14,000	20	0.010	1,573	102	8	2
Fan motor efficiency	4,280	905	632	$4,240	10	0.010	649	48	9	6
High-efficiency ballast	4,225	889	620	$5,944	15	0.010	461	48	14	10
VAV conversion	3,674	812	549	$89,921	20	0.013	1,163	474	67	61
Re-size chillers	3,109	712	480	$102,722	20	0.015	1,027	487	86	59
Energy saving fluorescents	3,048	694	467	$3,263	3.9	0.019	666	52	15	11
Pump motor efficiency	3,046	694	467	$353	10	0.020	792	2	1	0
VSD on fan motor	2,438	614	384	$128,699	15	0.021	1,982	523	68	71
Occupancy sensors	2,378	597	371	$13,075	10	0.028	1,208	52	15	11
Daylighting controls	2,148	534	324	$70,497	10	0.039	1,765	198	55	41
VHE bulbs and ballasts	2,046	505	302	$67,037	15	0.064	2,893	88	24	18
VSD on pump motor	2,030	502	301	$14,534	15	0.089	5,193	14	3	1
Low-E windows (N)	1,945	500	285	$130,688	20	0.125	81,680	74	1	14
Low-E windows (All)	1,765	487	252	$343,817	20	0.157	26,266	155	11	29
Window films	1,749	461	256	$44,264	20	0.236	1,688	13	23	-4
Cool storage	1,749	373	256	$96,059	20	---	1,092	0	76	0

Table 2-23
OFFICE BUILDING CONSERVATION ASSESSMENT
New York State - Downstate climate zone
Discount rate = 6%

Option		Diversified peak demand						Savings potential		
				Extra		Marginal	Marginal	Energy	Peak demand	
	UEC	Summer	Winter	first cost	Lifetime	CSE	CRD(20)		Summer	Winter
	(MWh/yr)	(kW)	(kW)	(1986$)	(years)	($/KWh)	($/kW)	(GWh/yr)	(MW)	(MW)
1986 Stock average	4,961	1,022	730	---	---	---	---	---	---	---
Reflectors	4,486	896	630	$45,369	15	0.009	438	1,109	296	232
Fan motor efficiency	4,426	886	623	$4,433	10	0.009	693	141	24	17
High-efficiency ballast	4,368	870	610	$5,939	15	0.010	477	135	36	30
Reset supply air temp.	4,274	869	607	$14,000	20	0.012	14,141	219	2	6
VAV conversion	3,706	795	534	$93,397	20	0.014	1,257	1,328	174	171
Re-size chillers	3,124	694	463	$102,637	20	0.015	1,019	1,359	235	165
Energy saving fluorescents	3,061	678	449	$3,260	3.9	0.018	690	148	39	33
VSD on fan motor	2,421	598	365	$133,407	15	0.020	2,047	1,494	186	197
Pump motor efficiency	2,418	597	365	$431	10	0.020	847	6	2	0
Occupancy sensors	2,356	581	352	$13,064	10	0.027	1,250	146	39	31
Daylighting controls	2,118	517	302	$70,461	10	0.038	1,764	557	149	117
VHE bulbs and ballasts	2,012	487	278	$66,981	15	0.062	2,698	246	71	54
VSD on pump motor	1,992	482	278	$17,747	15	0.084	4,906	48	10	2
Low-E windows (N)	1,933	479	255	$130,688	20	0.184	42,569	137	7	52
Window films	1,917	471	260	$44,264	20	0.229	5,226	37	20	-10
Roof insulation	1,917	470	260	$5,320	20	0.473	19,704	2	1	-1
Cool storage	1,917	366	260	$114,210	20	---	1,092	0	244	0

Table 2-24
RETAIL BUILDING CONSERVATION ASSESSMENT
New York State - Upstate climate zone
Discount rate = 6%

Option	UEC (MWh/yr)	Diversified peak demand Summer (kW)	Diversified peak demand Winter (kW)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (MWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	2,770	875	321	---	---	---	---	---	---	---
Reset supply air temp.	2,528	665	321	$7,000	20	0.002	33	204	178	0
Economizer	2,428	663	321	$5,113	20	0.004	2,955	85	1	0
Reflectors	2,101	586	284	$30,628	15	0.009	486	276	65	31
Fan motor efficiency	2,069	580	274	$2,528	10	0.010	728	27	5	9
Pump motor efficiency	2,064	580	273	$521	10	0.012	1,037	5	1	1
High-efficiency ballast	2,033	577	269	$4,010	15	0.013	1,892	26	2	4
VAV conversion	1,743	460	243	$47,698	20	0.014	409	245	99	21
Energy saving fluorescents	1,700	454	239	$2,201	3.2	0.018	1,415	36	5	4
VSD on fan motor	1,337	418	199	$79,763	15	0.021	2,738	307	30	33
Occupancy sensors	1,294	412	194	$9,481	10	0.028	2,333	36	5	4
VSD on pump motor	1,236	404	190	$21,441	15	0.036	3,629	49	6	4
VHE bulbs and ballasts	1,129	379	178	$45,219	15	0.041	2,216	90	21	10
Window films	1,116	378	178	$6,975	20	0.045	4,500	11	1	0
Daylighting controls	1,052	363	170	$30,809	10	0.062	3,279	54	13	6
Re-size chillers	999	350	170	$74,483	20	0.116	5,630	45	11	0
Roof insulation	995	348	170	$18,095	20	0.356	9,942	4	2	0
Low-E windows (S,W,E)	991	346	170	$54,366	20	1.087	28,811	3	2	0
Low-E windows (N)	990	346	170	$18,972	20	1.090	145,938	1	0	0
Cool storage	990	257	170	$124,883	20	---	1,398	0	76	0

Table 2-25
RETAIL BUILDING CONSERVATION ASSESSMENT
New York State - Downstate climate zone
Discount rate = 6%

Option	UEC (MWh/yr)	Diversified peak demand Summer (kW)	Diversified peak demand Winter (kW)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (MWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	2,967	921	330	---	---	---	---	---	---	---
Reset supply air temp.	2,706	715	330	$7,000	20	0.002	34	288	228	0
Economizer	2,613	711	330	$5,377	20	0.005	1,680	103	4	0
Reflectors	2,281	634	303	$30,628	15	0.009	486	368	85	31
Fan motor efficiency	2,246	628	292	$2,670	10	0.010	630	39	7	12
High-efficiency ballast	2,206	622	289	$4,010	15	0.010	828	44	7	4
Pump motor efficiency	2,201	621	288	$518	10	0.013	1,017	6	1	1
VAV conversion	1,902	523	261	$49,896	20	0.014	507	330	109	29
Energy saving fluorescents	1,859	516	258	$2,201	3.2	0.018	1,415	48	7	4
VSD on fan motor	1,473	480	216	$83,671	15	0.021	2,846	427	40	46
Occupancy sensors	1,430	474	213	$9,481	10	0.028	2,333	48	7	4
VSD on pump motor	1,375	467	208	$21,302	15	0.038	3,974	60	7	5
VHE bulbs and ballasts	1,267	442	199	$45,219	15	0.040	2,216	120	28	10
Window films	1,255	448	199	$6,975	20	0.048	-1,153	13	-7	0
Daylighting controls	1,190	433	194	$30,809	10	0.061	3,279	71	17	6
Re-size chillers	1,137	424	194	$74,483	20	0.116	7,767	58	11	0
Roof insulation	1,132	418	194	$18,095	20	0.272	3,493	6	6	0
Low-E windows (S,W,E)	1,124	412	194	$54,366	20	0.563	8,562	9	7	0
Low-E windows (N)	1,121	412	194	$18,972	20	0.597	105,400	3	0	0
Cool storage	1,121	317	194	$132,703	20	---	1,398	0	105	0

The statewide potential for savings from the implementation of all cost-effective measures is 3,416 GWh/yr in electricity consumption and 972 MW and 279 MW in summer and winter peak demand, respectively. The installation of variable-speed drives on fan and pump motors accounts for 843 GWh/yr, or 25% of the cost-effective electricity savings. The installation of reflectors in the fluorescent fixtures accounts for an additional 644 GWh/yr, or 19% of the cost-effective savings.

6. Small Building

The small building prototype is a 3,500 ft^2, 2-floor building. Peak lighting demand in the base case is 1.3 W ft^2. Cooling is provided by package terminal air conditioners. The conservation assessment for the small building prototype is presented in Tables 2-26 and 2-27.

A total of 10 conservation measures are evaluated with respect to the small building prototype -- seven lighting measures, one HVAC measure, and one shell measure. The small building prototype is the only prototype to which the delamping measure is applied. Seven of the measures are cost-effective in both climate zones, based on a discount rate of six percent and average commercial electricity rates. All seven of the cost-effective measures are lighting measures. Installation of these seven measures would reduce electricity consumption by approximately 56% in both the upstate and downstate climate zones. Summer and winter peak demand would be reduced by approximately 33% and 66%, respectively.

The statewide potential for savings from the implementation of all cost-effective measures is 2,090 GWh/yr in electricity consumption and 671 MW and 331 MW in summer and winter peak demand, respectively. The installation of reflectors accounts for 851 GWh/yr, or 41% of the total cost-effective savings.

7. Supermarket

Table 2-26
SMALL BUILDING CONSERVATION ASSESSMENT
New York State - Uptate climate zone
Discount rate = 6%

Option	UEC (MWh/yr)	Diversified peak demand Summer (kW)	Diversified peak demand Winter (kW)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	24.68	12.94	3.37	---	---	---	---	---	---	---
Delamping	23.75	12.64	3.22	$13	15	0.001	53	61	20	10
High-efficiency ballast	22.69	12.30	3.06	$113	15	0.010	403	70	22	11
Reflectors	17.13	10.51	2.19	$575	15	0.010	394	363	117	57
Energy saving fluorescents	16.36	10.26	2.07	$41	4	0.014	573	51	16	8
Occupancy sensors	15.58	10.01	1.95	$221	10	0.036	1,408	51	16	8
Daylighting controls	11.75	8.78	1.35	$1,445	10	0.048	1,869	250	80	39
VHE bulbs and ballasts	10.61	8.41	1.17	$849	15	0.072	2,810	75	24	12
Window films (S&W)	10.14	7.91	1.17	$860	20	0.151	1,719	31	33	0
Re-size chillers	9.76	7.31	1.17	$1,734	20	0.374	2,890	25	39	0

Table 2-27

SMALL BUILDING CONSERVATION ASSESSMENT

New York State - Downstate climate zone

Discount rate = 6%

Option	UEC (MWh/yr)	Diversified peak demand Summer (kW)	Diversified peak demand Winter (kW)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	25.86	14.00	3.37	---	---	---	---	---	---	---
Delamping	24.90	13.70	3.22	$13	15	0.001	53	80	25	12
Reflectors	18.99	11.80	2.27	$575	15	0.009	370	488	157	79
High-efficiency ballast	18.28	11.57	2.16	$75	15	0.010	403	59	19	9
Energy saving fluorescents	17.50	11.32	2.03	$41	4	0.014	573	65	21	10
Occupancy sensors	16.74	11.07	1.91	$221	10	0.037	1,408	62	21	10
Daylighting controls	12.88	9.84	1.29	$1,445	10	0.048	1,869	319	102	51
VHE bulbs and ballasts	11.72	9.47	1.11	$849	15	0.071	2,810	96	31	15
Window films (S&W)	11.26	9.03	1.11	$860	20	0.151	1,953	39	36	0
Re-size chillers	10.88	8.39	1.11	$1,734	20	0.374	2,709	31	53	0
Roof insulation	10.87	8.34	1.10	$595	20	4.894	11,900	1	4	1

The prototype supermarket is a 19,500 ft^2, single-floor, building. Base case peak lighting demand is 1.6 watt/ft^2. The prototype supermarket is cooled by package air conditioning systems. Refrigeration equipment accounts for over 40% of electricity use in the base case.

The conservation assessment for the prototype supermarket in the upstate climate zone, presented in Table 2-28, contains a total of 11 different conservation measures -- three HVAC measures, four lighting measures, three refrigeration measures and one shell measure. An additional two shell measures -- low-emissivity windows on the north face and on the east, west and south faces -- are analyzed for the supermarket in the downstate climate zone (Table 2-29). These measures are not included in the upstate analysis because they result in a net increase in electricity use in this climate zone.

Nine measures are cost-effective in both climate zones, assuming a discount rate of six percent and average commercial electricity rates. Installation of all cost-effective measures would reduce electricity consumption by approximately 27% in both the upstate and downstate climate zones. Summer and winter peak demand would be reduced by approximately 22% and 23%, respectively. Total cost-effective savings, as a percent of base case electricity use, are lowest for the supermarket of all of the prototype buildings.

The statewide potential for savings from the implementation of all cost-effective measures is 898 GWh/yr and 110 MW and 90 MW in summer and winter peak demand, respectively. The installation of reflectors in the fluorescent fixtures accounts for 272 GWh/yr, or 30% of the cost-effective electricity savings. The installation of the three refrigeration measures (all of which are cost-effective) together account for 440 GWh/yr, or 49% of the cost-effective savings.

Table 2-28

SUPERMARKET CONSERVATION ASSESSMENT

New York State - Upstate climate zone

Discount rate = 6%

Option	UEC (MWh/yr)	Diversified peak demand Summer (kW)	Diversified peak demand Winter (kW)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	1,019	163	123	---	---	---	---	---	---	---
Floating head press. control	966	163	123	$800	15	0.001	---	77	0	0
Refrig. compressor eff.	898	151	116	$2,000	15	0.003	213	96	16	9
Reflectors	815	140	104	$4,708	15	0.005	512	120	16	17
Fan motor efficiency	810	139	104	$249	10	0.006	793	8	1	1
High-efficiency ballast	800	138	102	$616	15	0.006	557	14	2	2
Energy saving fluorescents	789	136	101	$338	2.3	0.016	1,265	16	2	2
VHE bulbs and ballasts	760	133	96	$6,951	15	0.023	2,157	42	6	7
Refrigerated case covers	743	130	94	$6,500	12	0.044	3,208	24	4	2
Window films (S&W)	742	129	94	$896	20	0.051	973	2	1	0
Re-size chillers	739	128	94	$9,749	20	0.265	19,497	4	1	0
Economizer	738	128	94	$5,074	20	0.726	---	1	0	0

Table 2-29
SUPERMARKET CONSERVATION ASSESSMENT
New York State - Downstate climate zone
Discount rate = 6%

Option	UEC (MWh/yr)	Diversified peak demand Summer (kW)	Diversified peak demand Winter (kW)	Extra first cost (1986$)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential Energy (GWh/yr)	Savings potential Peak demand Summer (MW)	Savings potential Peak demand Winter (MW)
1986 Stock average	1,041	170	124	---	---	---	---	---	---	---
Floating head press. control	987	170	124	$800	15	0.001	---	95	0	0
Refrig. compressor eff.	920	159	117	$2,000	15	0.003	213	118	20	11
Reflectors	834	147	105	$4,708	15	0.005	477	152	21	21
Fan motor efficiency	828	146	105	$268	10	0.006	445	10	2	1
High-efficiency ballast	818	144	103	$616	15	0.006	600	18	2	3
Energy saving fluorescents	806	143	102	$338	2.3	0.015	1,041	20	3	3
VHE bulbs and ballasts	776	138	97	$6,951	15	0.022	1,776	53	8	8
Window films (S&W)	775	137	97	$896	20	0.043	1,378	3	1	0
Refrigerated case covers	758	134	96	$6,500	12	0.044	3,208	30	5	3
Re-size chillers	755	133	96	$9,749	20	0.308	8,862	5	2	0
Low-E windows (N)	755	133	96	$179	20	0.501	8,925	0	0	0
Economizer	755	133	96	$5,568	20	1.018	50,620	1	0	0
Low-E windows (all)	755	133	96	$7,943	20	7.433	12,812	0	1	0

D. Industrial Sector

The analysis of the industrial sector includes conservation measures directed at two different end uses representing 85% of industrial electricity consumption. No estimate of conservation potential is made for the end uses which were not analyzed.

The conservation analyses for the industrial sector by end use are presented in Tables 2-30 and 2-31. The statewide industrial summary tables for energy and peak demand for each of the three discount rates analyzed are presented in Tables 2-37, 2-38, 2-43, 2-44, 2-49, and 2-50. The statewide summaries are also presented graphically as supply curves in Figures 2-8, 2-9, 2-15, 2-16, 2-22, and 2-23.

1. Industrial Motor Measures

a. High-efficiency motors

We estimate that motors account for 78% of the electricity consumed in the industrial sector (see Chapter 1). It is assumed that the entire current stock of industrial motors is of standard efficiency. This measure entails the replacement of the current stock of standard motors with high-efficiency models. The replacement is assumed to occur only when the motor either needs to be replaced or rebuilt. Rebuilding a motor (essentially rewinding the iron core) is assumed to cost 30% as much as a new motor. Because the cost-effectiveness differs substantially depending on whether a motor is replaced or rebuilt, the analysis includes separate measures -- weighted by the appropriate fraction -- for each possibility.

Table 2-14 presents our estimates of the cost and efficiency improvement available for motors by size range. The electricity savings potential for this measure is calculated using the base case motor assumptions described in the previous chapter. The statewide conservation assessment for industrial motors is presented in Table 2-30. The CSE for this measure at a 6% discount rate ranges from 0.8¢/kWh to 10.3¢/kWh depending on the size of the motor and whether would have been replaced or rebuilt. The measure is most cost-effective for large and medium motors that would have been retired. The total statewide electricity savings potential from replacement of standard motors with high-efficiency motors is 454 GWh/yr. Potential reductions in statewide peak demand are 73 MW and 70 MW for the summer and winter, respectively.

b. Variable-Speed Drives

This measure involves the installation of variable speed drives (VSDs) on motors to reduce losses from part-load operation. VSDs are electronic devices that enable a motor to vary its speed in order to better match loads and to reduce part-load and cycling losses. The current generation of VSDs function by converting AC current into DC current and then back into AC at varying frequency. VSDs can replace the clutches, valves, or vanes which are typically used to regulate air or fluid flow. Additional benefits include the ability to start and stop the motor gradually, which extends the life of the motor and associated machinery, and precise speed control.

It is assumed that the installation of an VSD on a pump or fan motor will reduce electricity consumption by an average of 22.5%, based on a detailed study which concluded that VSDs will save 20-30% of electricity use in a wide range of applications such as industrial pumps and compressors, blowers and refrigeration equipment[107]. In practice, savings from the installation of an VSD will vary considerably, depending on the amount of variation in the load, fraction of part-load operation, and relative sizing of the motor to the load.

Costs and annual electricity savings from the installation of a VSD from each of our motor size

Table 2-30

INDUSTRIAL MOTORS CONSERVATION ASSESSMENT

New York State

Discount rate = 6%

Option	Measure savings: Energy (KWh/yr)	Measure savings: Summer peak (kW)	Measure savings: Winter peak (kW)	Extra first cost (1986 $)	Lifetime (years)	Marginal CSE ($/KWh)	Marginal CRD(20) ($/kW)	Savings potential: Energy (GWh/yr)	Savings potential: Peak demand Summer (MW)	Savings potential: Peak demand Winter (MW)
21 - 50 HP: retire	2,588	414	397	225	17	0.008	602	25	4	4
>125 HP: retire	14,130	2,262	2,167	900	11	0.008	574	8	1	1
51-125 HP: retire	8,494	1,360	1,303	600	12	0.008	605	10	2	2
5.1-20 HP: retire	865	138	133	140	30	0.012	912	64	10	10
1-5 HP: retire	67	11	10	30	20	0.037	2,787	7	1	1
>125 HP: VSD	137,850	22,066	21,140	50,700	15	0.036	2,752	1,472	236	226
21-50 HP: rebuild	2,588	414	397	1,275	17	0.044	3,410	72	12	11
51-125 HP: VSD	54,496	8,723	8,357	24,986	15	0.045	3,430	1,078	173	165
5.1-20 HP: rebuild	865	138	133	599	30	0.051	3,898	34	5	5
51-125 HP: rebuild	6,583	1,054	1,009	3,750	12	0.064	4,879	122	20	19
21-50 HP: VSD	14,809	2,370	2,271	13,318	15	0.087	6,728	557	89	85
>125 HP: rebuild	10,951	1,753	1,679	8,250	11	0.090	6,794	111	18	17
<1 HP: retire	8	1	1	10	20	0.103	7,809	1	0	0
5.1-20 HP: VSD	3,309	530	508	5,769	30	0.129	9,822	375	60	57
1-5 HP: VSD	244	39	37	1,106	20	0.373	28,349	25	4	4

Notes:

1. "retire" refers to replacement with high-efficiency motor upon retirement of standard motor
2. "rebuild" refers to replacement with high-efficiency motor rather than a rebuild of the current standard efficiency motor
3. VSD: installation of variable speed drive
4. CRD calculations based on peak savings in summer.

categories are presented in Table 2-15. The CSE for this measure climbs from 3.6¢/kWh to 37.3¢/kWh at a discount rate of 6% with decreasing motor size. The total statewide electricity savings potential from the installation of variable-speed drives is estimated to be 3,936 GWh/yr, with peak demand reductions of 561 MW and 538 MW in the summer and winter, respectively.

2. Industrial Lighting Measures

a. Energy-saving fluorescent lamps

This measure involves the replacement of standard 75-watt, 96-inch fluorescent lamps with 60-watt, energy-saving-type fluorescent lamps. The use of these energy-saving lamps leads to a 15% decrease in light output[108]. The statewide conservation assessment for industrial lighting is presented in Table 2-31.

We estimate the incremental cost of the energy-saving lamps at $2.50 per lamp[109]. This measure reduces fixture electricity consumption by 22%, or 148 kWh/yr for our assumed 4,000 hrs/yr of operation[110]. The total statewide electricity savings potential is estimated to be 184 GWh/yr, with peak demand reductions of 29 MW and 28 MW in the summer and winter, respectively.

b. High-efficiency magnetic ballasts

This measure involves the replacement of standard electromagnetic fluorescent lamp ballasts with high-efficiency electromagnetic ballasts. The sale of standard magnetic ballasts has been prohibited in New York State since January 1, 1987[111]. As currently installed ballasts wear out, they will be replaced by high-efficiency electromagnetic ballasts (or electronic ballasts). Therefore, no further policies are required to encourage adoption of this measure, unless there is an interest in accelerating the rate at which implementation occurs.

Table 2-31
INDUSTRIAL LIGHTING CONSERVATION ASSESSMENT
New York State
Discount rate = 6%

Option	UEC	Diversified peak demand Summer	Diversified peak demand Winter	Extra first cost	Lifetime	Marginal CSE	Marginal CRD(20)	Savings potential Energy	Savings potential Peak demand Summer	Savings potential Peak demand Winter
	(KWh/yr)	(Watts)	(Watts)	(1986 $)	(years)	($/KWh)	($/kW)	(GWh/yr)	(MW)	(MW)
FLUORESCENT										
Base case	688	110	106	---	4.5	---	---	---	---	---
Energy saving lamp	540	86	83	5	4.5	0.009	665	184	29	28
High-efficiency ballast	504	81	77	10	15.0	0.027	2,121	57	9	9
MERCURY VAPOR										
Base case	1,820	291	279	---	5.0	---	---	---	---	---
Metal halide lamp	1,540	247	236	25	5.0	0.020	1,576	66	11	10
High-pressure sodium	760	122	117	200	7.0	0.043	3,406	217	35	33

Notes:

1. Base case lighting fractions: 60% fluorescent, 30% mercury vapor, 10% high-pressure sodium, <1% incandescent;
2. Fluorescent base case: Standard 96", 75 watt lamps; 2-lamp shielded fixture; annual use: 4,000 hrs/yr
3. Mercury-vapor base case: 400 W lamps; annual use: 4000 hrs/yr.
4. Energy saving lamp: Install energy saving type lamp; 15% decrease in light output
5. High-efficiency ballast: Install high-efficiency core/coil ballast; 14% increase in light output.
6. Metal halide lamp: Install 325 W, metal halide lamp, 60% increase in light output
7. High-pressure sodium (HPS): Replace mercury luminaires with HPS luminaires, 150W lamps, 38% decrease in light output

Source: General Lighting Cost Analysis: Industrial and Commercial 1985/86; General Electric Company; Cleveland, OH

We estimate the incremental cost of the high-efficiency ballasts at $10 per ballast[112]. This measure reduces fixture electricity consumption by 7%, or 36 kWh/yr, over the previous measure while increasing light output by 14%[113]. The total statewide electricity savings potential is estimated to be 57 GWh/yr, with peak demand reductions of 9 MW in both the summer and winter.

c. Metal halide lamps

This measure involves the replacement of 400-watt mercury vapor lamps with 325-watt metal halide lamps specially designed for use with mercury vapor ballasts. It is assumed that lamps are replaced as they wear out as part of a normal service program. Both types of lamps typically last five years with annual usage of 4,000 hours. The metal halide lamp requires no change in fixture or ballast from the mercury vapor fixture and provides approximately 60% more light output with a 15% decrease in electricity use[114].

The estimated incremental cost for the metal halide lamps is $25[115]. Electricity use per fixture is reduced by 280 kWh/yr, over the mercury vapor lamp. The total statewide electricity savings potential is 66 GWh/yr, with peak demand reductions of 11 MW and 10 MW in the summer and winter, respectively.

d. High-pressure sodium lamps

This measure involves the replacement of the 325-watt metal halide lamp and fixture with 150-watt high-pressure sodium lamps and fixture. High-pressure sodium lamps typically last seven years with annual usage of 4,000 hours. Light output is reduced by 28% relative to the metal halide lamps but is still approximately 15% higher than the mercury vapor base case. Electricity use decreases by 51% relative to the metal halide lamps and by 58% relative to the mercury vapor base case.

The estimated incremental cost for the high-pressure sodium lamp and fixture is $200[116]. Electricity use per fixture is reduced by approximately 780 kWh/yr[117]. The total statewide electricity savings potential is 217 GWh/yr, with peak demand reductions of 35 MW and 33 MW in the summer and winter, respectively.

IV. TOTAL STATEWIDE SAVINGS AND COST-EFFECTIVENESS

A. Statewide savings potential

In this section we present our conclusions regarding the total electricity and peak demand savings available from the conservation measures analyzed. The measures have been grouped into summary tables by sector -- residential, commercial and industrial -- at each of the three discount rates analyzed. These summaries are presented in Tables 2-32 to 2-49.

These results are also depicted graphically, as electricity conservation and demand reduction supply curves, in Figures 2-1 to 2-23. Figures 2-1 and 2-2 are statewide curves which include measures from all three sectors evaluated at a 6% discount rate. The other supply curves are for CSE and CRD for each of the three sectors at each of the three discount rates. The residential sector includes supply curves for both summer and winter peak demand. The commercial and industrial sectors contain only summer peak demand curves. This is because the winter curve differs significantly only for the residential sector (primarily because of space heating measures). The summary tables for all three sectors present both winter and summer peak demand savings.

The 33 measures in the electricity conservation assessment for the residential sector, presented in Tables 2-32, 2-38, and 2-44, together account for potential savings equal to over one-third of residential sector electricity consumption. The six refrigerator and freezer measures stand out in this sector's electricity conservation assessment. These measures constitute six of the top seven measures ranked by cost-effectiveness and

Table 2-32
ELECTRICITY CONSERVATION ASSESSMENT
RESIDENTIAL SECTOR
New York State
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
FRE	Current sales average (1986)	0.004	373	373	1.08%
REF	Current sales average (1986)	0.010	1,876	2,249	6.50%
REF	Best current (1988)	0.011	1,865	4,114	11.90%
REF	Near-term advanced	0.013	781	4,895	14.16%
EWH	Traps & blanket (EF=0.9)	0.013	265	5,160	14.92%
FRE	Best current (1988)	0.014	259	5,419	15.67%
FRE	Near-term advanced	0.015	129	5,548	16.05%
ESH1	Infiltration reduction	0.017	593	6,141	17.76%
RAN	Improved oven	0.022	212	6,353	18.37%
ESH2	Storm windows	0.022	112	6,465	18.70%
ESH2	Low-emissivity film	0.024	35	6,500	18.80%
RAN	Improved cooktop	0.025	74	6,574	19.01%
LTG	Tungsten halogen lamps-300 h/y	0.027	697	7,271	21.03%
LTG	Energy saving lamps-620 hr/yr	0.030	82	7,353	21.26%
LTG	Energy saving lamps-1,240 h/y	0.030	98	7,451	21.55%
EWH	Front loading clothes washer	0.034	447	7,898	22.84%
LTG	Compact fluorescents-1240 h/y	0.036	1,102	8,999	26.03%
ESH1	Heat pump #1 (HSPF=7)*	0.042	236	9,235	26.71%
LTG	IRF lamps - 300 hr/yr	0.044	813	10,048	29.06%
LTG	Compact fluorescents-620 h/y	0.045	918	10,966	31.71%
ESH1	Heat pump #2 (HSPF=8)*	0.055	23	10,989	31.78%
ECD	Heat pump clothes dryer	0.065	858	11,847	34.26%
ESH1	Low-emissivity film	0.079	163	12,010	34.73%
RAC	RAC: 8.5 EER	0.093	144	12,153	35.15%
CAC	Window film	0.137	76	12,230	35.37%
RAC	RAC: 10.0 EER	0.152	87	12,317	35.62%
CAC	CAC: 10.0 SEER	0.161	79	12,396	35.85%
RAC	RAC: 12 .0 EER	0.195	91	12,487	36.11%
CAC	Variable speed drive	0.221	55	12,542	36.27%
CAC	CAC: 12.0 SEER	0.316	47	12,589	36.41%
ESH1	Add 3" fiberglass in roof/ceiling	0.455	25	12,614	36.48%
CAC	CAC: 14.0 SEER	0.463	37	12,651	36.59%

Notes:
1. 1986 residential electricity consumption: 34,577 GWh
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family and small (2-4 units) multi-family homes; ESH2: electric space heating in large (5+ units) multi-family homes.

Table 2-33

PEAK DEMAND ASSESSMENT

RESIDENTIAL SECTOR

New York State

Discount rate = 6%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
CAC	Load controller/cycler	184	451	451	6.2%	0	0	0.0%
FRE	Current sales average (1986)	358	54	505	7.0%	50	50	0.7%
RAC	RAC: 8.5 EER	439	381	886	12.3%	0	50	0.7%
RAC	RAC: 10.0 EER	627	267	1,153	15.9%	0	50	0.7%
ESH2	Storm windows	679	0	1,153	15.9%	45	95	1.4%
REF	Current sales average (1986)	681	321	1,474	20.4%	163	258	3.8%
ESH2	Low-emissivity film	693	0	1,474	20.4%	15	272	4.0%
ESH1	Infiltration reduction	766	0	1,474	20.4%	162	434	6.4%
REF	Best current (1988)	795	319	1,793	24.8%	162	596	8.8%
EWH	Load controller/cycler	825	80	1,873	25.9%	207	803	11.9%
ECD	Load controller/cycler	832	260	2,133	29.5%	452	1,255	18.6%
EWH	Traps & blanket (EF=0.9)	837	21	2,154	29.8%	54	1,309	19.4%
RAC	RAC: 12 .0 EER	886	252	2,406	33.3%	0	1,309	19.4%
REF	Near-term advanced	949	134	2,540	35.1%	68	1,376	20.4%
CAC	Window film	1,054	123	2,663	36.8%	0	1,376	20.4%
RAN	Improved oven	1,098	52	2,714	37.5%	35	1,412	20.9%
ESH1	Electric thermal storage system*	1,174	0	2,714	37.5%	682	2,094	31.0%
FRE	Best current (1988)	1,183	38	2,752	38.1%	35	2,129	31.6%
ESH1	Heat pump #1 (HSPF=7)*	1,204	0	2,752	38.1%	103	2,232	33.1%
FRE	Near-term advanced	1,224	19	2,771	38.3%	17	2,249	33.3%
LTG	Tungsten halogen lamps-300 h/y	1,239	33	2,805	38.8%	154	2,402	35.6%
RAN	Improved cooktop	1,254	18	2,823	39.0%	12	2,415	35.8%
ESH1	Heat pump #2 (HSPF=8)*	1,293	0	2,823	39.0%	12	2,427	36.0%

CAC	CAC: 10.0 SEER	1,416	113	2,936	40.6%	0	2,427	36.0%
LTG	Energy saving lamps-620 hr/yr	1,603	4	2,940	40.7%	18	2,445	36.3%
LTG	Energy saving lamps-1,240 h/y	1,659	5	2,945	40.7%	22	2,467	36.6%
LTG	IRF lamps - 300 hr/yr	2,004	39	2,983	41.3%	179	2,646	39.2%
LTG	Compact fluorescents-1240 h/y	2,044	53	3,036	42.0%	243	2,889	42.8%
CAC	CAC: 12.0 SEER	2,354	79	3,115	43.1%	0	2,889	42.8%
LTG	Compact fluorescents-620 h/y	2,561	44	3,159	43.7%	202	3,091	45.8%
EWH	Front loading clothes washer	3,418	22	3,181	44.0%	57	3,148	46.7%
CAC	CAC: 14.0 SEER	3,500	62	3,243	44.9%	0	3,148	46.7%
ESH1	Low-emissivity film	4,296	0	3,243	44.9%	36	3,184	47.2%
ESH1	Add 3" fiberglass in roof/ceiling	41,662	0	3,243	44.9%	3	3,187	47.3%

*The electric thermal storage system (ETS) and heat pumps are mututally exclusive measures. CSE and CRD are calculated independently.

Notes:

1. 1986 residential summer peak: 7,230 MW; winter peak: 6,744 MW
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family homes; ESH2: electric space heating in multi-family homes.
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Table 2-34
ELECTRICITY CONSERVATION ASSESSMENT
COMMERCIAL SECTOR
New York State
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
LTG	Delamping	0.001	141	141	0.35%
REF	Floating head press. control	0.001	172	312	0.78%
REF	Refrig. compressor eff.	0.003	214	527	1.31%
HVAC	Reset supply air temperature	0.005	1,182	1,709	4.26%
LTG	Reflectors	0.010	4,142	5,851	14.60%
HVAC	Fan motor efficiency	0.010	309	6,160	15.37%
LTG	High-efficiency ballast	0.011	513	6,673	16.65%
HVAC	VAV conversion	0.013	2,776	9,449	23.57%
HVAC	Economizer	0.017	301	9,749	24.32%
LTG	Energy saving fluorescents	0.017	593	10,343	25.80%
HVAC	Pump motor efficiency	0.018	23	10,366	25.86%
HVAC	VSD on fan motor	0.021	3,261	13,628	33.99%
LTG	Occupancy sensors	0.033	500	14,128	35.24%
HVAC	Re-size chillers	0.038	2,260	16,388	40.88%
REF	Refrigerated case covers	0.044	54	16,441	41.01%
LTG	Daylighting controls	0.047	1,660	18,102	45.16%
LTG	VHE bulbs and ballasts	0.058	1,085	19,186	47.86%
HVAC	VSD on pump motor	0.063	212	19,398	48.39%
SHELL	Window films (S&W)	0.134	196	19,594	48.88%
SHELL	Low-E windows (N)	0.215	85	19,679	49.09%
SHELL	Low-E windows (all)	0.236	319	19,998	49.89%
SHELL	Roof insulation	0.603	16	20,013	49.92%

Notes:
1. 1986 commercial electricity consumption: 40,087 GWh
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration

Table 2-35

PEAK DEMAND CONSERVATION ASSESSMENT

COMMERCIAL SECTOR

New York State

Discount rate = 6%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
LTG	Delamping	53	44	44	0.4%	22	22	0.3%
HVAC	Reset supply air temperature	163	467	511	5.1%	47	69	0.9%
REF	Refrig. compressor eff.	213	37	548	5.4%	21	90	1.1%
LTG	Reflectors	473	1,134	1,682	16.7%	651	741	9.4%
LTG	High-efficiency ballast	553	132	1,814	18.0%	85	827	10.4%
LTG	Energy saving fluorescents	722	158	1,972	19.6%	94	921	11.6%
HVAC	Fan motor efficiency	733	55	2,027	20.1%	54	975	12.3%
HVAC	VAV conversion	811	550	2,577	25.6%	312	1,288	16.3%
HVAC	Pump motor efficiency	971	5	2,582	25.6%	3	1,290	16.3%
HVAC	Cool storage	1,120	660	3,242	32.2%	0	1,290	16.3%
LTG	Occupancy sensors	1,490	136	3,378	33.5%	80	1,370	17.3%
LTG	Daylighting controls	2,057	475	3,853	38.3%	285	1,655	20.9%
HVAC	Re-size chillers	2,065	499	4,353	43.2%	250	1,905	24.1%
HVAC	VSD on fan motor	2,098	407	4,759	47.3%	424	2,329	29.4%
SHELL	Window films (S&W)	2,333	137	4,896	48.6%	-14	2,315	29.2%
LTG	VHE bulbs and ballasts	2,651	299	5,195	51.6%	166	2,481	31.3%
REF	Refrigerated case covers	3,208	9	5,204	51.7%	5	2,486	31.4%
HVAC	VSD on pump motor	4,545	36	5,241	52.0%	17	2,503	31.6%
HVAC	Economizer	5,330	10	5,251	52.1%	0	2,503	31.6%
SHELL	Roof insulation	8,277	14	5,264	52.3%	1	2,504	31.6%
SHELL	Low-E windows (all)	37,199	36	5,300	52.6%	82	2,586	32.7%
SHELL	Low-E windows (N)	53,704	-1	5,299	52.6%	22	2,608	32.9%

Notes:

1. 1986 commercial summer peak 10,069 MW; winter peak: 7,919 MW;
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty-year period.

Table 2-36
ELECTRICITY CONSERVATION ASSESSMENT
INDUSTRIAL SECTOR
New York State
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
MOT	21 - 50 HP: retire	0.008	25.3	25.3	0.1%
MOT	>125 HP: retire	0.008	7.5	32.8	0.2%
MOT	51-125 HP: retire	0.008	10.1	42.9	0.2%
LTG	Energy saving lamp	0.009	184.0	226.9	1.1%
MOT	5.1-20 HP: retire	0.012	63.7	290.6	1.4%
LTG	Metal halide lamp	0.020	65.8	356.4	1.7%
LTG	High-efficiency ballast	0.027	57.0	413.4	2.0%
MOT	>125 HP: VSD	0.036	1,472.2	1,885.6	9.3%
MOT	1-5 HP: retire	0.037	7.0	1,892.6	9.3%
LTG	High-pressure sodium	0.043	216.6	2,109.3	10.4%
MOT	21-50 HP: rebuild	0.044	72.0	2,181.3	10.7%
MOT	51-125 HP: VSD	0.045	1,077.9	3,259.2	16.0%
MOT	5.1-20 HP: rebuild	0.051	34.3	3,293.5	16.2%
MOT	51-125 HP: rebuild	0.064	122.4	3,415.9	16.8%
MOT	21-50 HP: VSD	0.087	556.8	3,972.7	19.5%
MOT	>125 HP: rebuild	0.090	111.1	4,083.8	20.1%
MOT	<1 HP: retire	0.103	0.8	4,084.6	20.1%
MOT	5.1-20 HP: VSD	0.129	374.6	4,459.2	21.9%
MOT	1-5 HP: VSD	0.373	25.4	4,484.6	22.0%

Notes:
1. 1986 industrial electricity sales: 20,365 GWh
2. MOT: Motor efficiency measure; LTG: Lighting efficiency measure

Table 2-37

PEAK DEMAND CONSERVATION ASSESSMENT
INDUSTRIAL SECTOR
New York State

Discount rate = 6%

			SUMMER			WINTER		
Area	Option	Marginal CRD(20) ($/kW)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)
MOT	>125 HP: retire	574	1.2	1.2	0.0%	1.2	1.2	0.0%
MOT	21 - 50 HP: retire	602	4.1	5.3	0.2%	3.9	5.0	0.2%
MOT	51-125 HP: retire	605	1.6	6.9	0.2%	1.5	6.6	0.2%
LTG	Energy saving lamp	665	29.5	36.3	1.1%	28.2	34.8	1.1%
MOT	5.1-20 HP: retire	912	10.2	46.5	1.4%	9.8	44.6	1.4%
LTG	Metal halide lamp	1,576	10.5	57.0	1.7%	10.1	54.7	1.7%
LTG	High-efficiency ballast	2,121	9.1	66.2	2.0%	8.7	63.4	2.0%
MOT	>125 HP: VSD	2,752	235.7	301.8	9.3%	225.8	289.2	9.3%
MOT	1-5 HP: retire	2,787	1.1	303.0	9.3%	1.1	290.2	9.3%
LTG	High-pressure sodium	3,406	34.7	337.6	10.4%	33.2	323.5	10.4%
MOT	21-50 HP: rebuild	3,410	11.5	349.2	10.7%	11.0	334.5	10.7%
MOT	51-125 HP: VSD	3,430	172.5	521.7	16.0%	165.3	499.8	16.0%
MOT	5.1-20 HP: rebuild	3,898	5.5	527.2	16.2%	5.3	505.1	16.2%
MOT	51-125 HP: rebuild	4,879	19.6	546.8	16.8%	18.8	523.8	16.8%
MOT	21-50 HP: VSD	6,728	89.1	635.9	19.5%	85.4	609.2	19.5%
MOT	>125 HP: rebuild	6,794	17.8	653.7	20.1%	17.0	626.3	20.1%
MOT	<1 HP: retire	7,809	0.1	653.8	20.1%	0.1	626.4	20.1%
MOT	5.1-20 HP: VSD	9,822	60.0	713.8	21.9%	57.4	683.8	21.9%
MOT	1-5 HP: VSD	28,349	4.1	717.9	22.0%	3.9	687.7	22.0%

Notes:
1. 1986 industrial summer peak demand : 3,260 MW
2. 1986 industrial winter peak demand : 3,123 MW
3. MOT: Motor efficiency measure; LTG: Lighting efficiency measure
4. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Table 2-38
ELECTRICITY CONSERVATION ASSESSMENT
RESIDENTIAL SECTOR
New York State
Discount rate = 10%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
FRE	Current sales average (1986)	0.006	373	373	1.08%
REF	Current sales average (1986)	0.012	1,876	2,249	6.50%
REF	Best current (1988)	0.015	1,865	4,114	11.90%
EWH	Traps & blanket (EF=0.9)	0.016	265	4,378	12.66%
REF	Near-term advanced	0.017	781	5,160	14.92%
FRE	Best current (1988)	0.018	259	5,419	15.67%
FRE	Near-term advanced	0.019	129	5,548	16.05%
ESH1	Infiltration reduction	0.020	593	6,141	17.76%
RAN	Improved oven	0.028	212	6,353	18.37%
ESH2	Storm windows	0.029	112	6,465	18.70%
LTG	Energy saving lamps-620 hr/yr	0.030	82	6,547	18.93%
LTG	Energy saving lamps-1,240 h/y	0.030	98	6,645	19.22%
ESH2	Low-emissivity film	0.031	35	6,680	19.32%
LTG	Tungsten halogen lamps-300 h/y	0.031	697	7,377	21.33%
RAN	Improved cooktop	0.032	74	7,451	21.55%
LTG	Compact fluorescents-1240 h/y	0.039	1,102	8,553	24.74%
EWH	Front loading clothes washer	0.041	447	8,999	26.03%
LTG	IRF lamps - 300 hr/yr	0.050	813	9,812	28.38%
ESH1	Heat pump #1 (HSPF=7)*	0.051	236	10,048	29.06%
LTG	Compact fluorescents-620 h/y	0.053	918	10,966	31.71%
ESH1	Heat pump #2 (HSPF=8)*	0.068	23	10,989	31.78%
ECD	Heat pump clothes dryer	0.082	858	11,847	34.26%
ESH1	Low-emissivity film	0.102	163	12,010	34.73%
RAC	RAC: 8.5 EER	0.110	144	12,153	35.15%
CAC	Window film	0.158	76	12,230	35.37%
RAC	RAC: 10.0 EER	0.180	87	12,317	35.62%
CAC	CAC: 10.0 SEER	0.191	79	12,396	35.85%
RAC	RAC: 12 .0 EER	0.231	91	12,487	36.11%
CAC	Variable speed drive	0.263	55	12,542	36.27%
CAC	CAC: 12.0 SEER	0.375	47	12,589	36.41%
CAC	CAC: 14.0 SEER	0.549	37	12,626	36.52%
ESH1	Add 3" fiberglass in roof/ceiling	0.590	25	12,651	36.59%

Notes:
1. 1986 residential electricity consumption: 34,577 GWh
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family and small (2-4 units) multi-family homes; ESH2: electric space heating in large (5+ units) multi-family homes.

Table 2-39

PEAK DEMAND ASSESSMENT

RESIDENTIAL SECTOR

New York State

Discount rate = 10%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
CAC	Load controller/cycler	174	451	451	6.2%	0	0	0.0%
FRE	Current sales average (1986)	358	54	505	7.0%	50	50	0.7%
RAC	RAC: 8.5 EER	402	381	886	12.3%	0	50	0.7%
RAC	RAC: 10.0 EER	574	267	1,153	15.9%	0	50	0.7%
ESH2	Storm windows	679	0	1,153	15.9%	45	95	1.4%
REF	Current sales average (1986)	681	321	1,474	20.4%	163	258	3.8%
ESH2	Low-emissivity film	693	0	1,474	20.4%	15	272	4.0%
ESH1	Infiltration reduction	723	0	1,474	20.4%	162	434	6.4%
EWH	Traps & blanket (EF=0.9)	774	21	1,495	20.7%	54	488	7.2%
EWH	Load controller/cycler	779	80	1,575	21.8%	207	695	10.3%
ECD	Load controller/cycler	786	260	1,835	25.4%	452	1,147	17.0%
REF	Best current (1988)	795	319	2,154	29.8%	162	1,309	19.4%
RAC	RAC: 12 .0 EER	810	252	2,406	33.3%	0	1,309	19.4%
CAC	Window film	943	123	2,529	35.0%	0	1,309	19.4%
REF	Near-term advanced	949	134	2,663	36.8%	68	1,376	20.4%
LTG	Tungsten halogen lamps-300 h/y	1,063	33	2,696	37.3%	154	1,530	22.7%
RAN	Improved oven	1,072	52	2,748	38.0%	35	1,565	23.2%
ESH1	Heat pump #1 (HSPF=7)*	1,138	0	2,748	38.0%	103	1,668	24.7%
ESH1	Electric thermal storage system*	1,174	0	2,748	38.0%	682	2,350	34.8%
FRE	Best current (1988)	1,183	38	2,786	38.5%	35	2,385	35.4%
ESH1	Heat pump #2 (HSPF=8)*	1,221	0	2,786	38.5%	12	2,398	35.6%
FRE	Near-term advanced	1,224	19	2,805	38.8%	17	2,415	35.8%
RAN	Improved cooktop	1,225	18	2,823	39.0%	12	2,427	36.0%

LTG	Energy saving lamps-620 hr/yr	1,240	4	2,827	39.1%	18	2,445	36.3%
LTG	Energy saving lamps-1,240 h/y	1,290	5	2,831	39.2%	22	2,467	36.6%
CAC	CAC: 10.0 SEER	1,296	113	2,945	40.7%	0	2,467	36.6%
LTG	IRF lamps - 300 hr/yr	1,719	39	2,983	41.3%	179	2,646	39.2%
LTG	Compact fluorescents-1240 h/y	1,739	53	3,036	42.0%	243	2,889	42.8%
CAC	CAC: 12.0 SEER	2,154	79	3,115	43.1%	0	2,889	42.8%
LTG	Compact fluorescents-620 h/y	2,346	44	3,159	43.7%	202	3,091	45.8%
EWH	Front loading clothes washer	3,161	22	3,181	44.0%	57	3,148	46.7%
CAC	CAC: 14.0 SEER	3,202	62	3,243	44.9%	0	3,148	46.7%
ESH1	Low-emissivity film	4,296	0	3,243	44.9%	36	3,184	47.2%
ESH1	Add 3" fiberglass in roof/ceiling	41,662	0	3,243	44.9%	3	3,187	47.3%

*The electric thermal storage system (ETS) and heat pumps are mututally exclusive measures. CSE and CRD are calculated independently.

Notes:

1. 1986 residential summer peak: 7,230 MW; winter peak: 6,744 MW
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family homes; ESH2: electric space heating in multi-family homes.
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Table 2-40

ELECTRICITY CONSERVATION ASSESSMENT

COMMERCIAL SECTOR

New York State

Discount rate = 10%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
LTG	Delamping	0.002	141	141	0.35%
REF	Floating head press. control	0.002	172	312	0.78%
REF	Refrig. compressor eff.	0.004	214	527	1.31%
HVAC	Reset supply air temperature	0.007	1,182	1,709	4.26%
HVAC	Fan motor efficiency	0.012	309	2,018	5.03%
LTG	Reflectors	0.013	4,142	6,160	15.37%
LTG	High-efficiency ballast	0.014	513	6,673	16.65%
HVAC	VAV conversion	0.017	2,776	9,449	23.57%
LTG	Energy saving fluorescents	0.018	593	10,042	25.05%
HVAC	Pump motor efficiency	0.021	23	10,065	25.11%
HVAC	Economizer	0.021	301	10,366	25.86%
HVAC	VSD on fan motor	0.026	3,261	13,628	33.99%
LTG	Occupancy sensors	0.038	500	14,128	35.24%
HVAC	Re-size chillers	0.049	2,260	16,388	40.88%
REF	Refrigerated case covers	0.052	54	16,441	41.01%
LTG	Daylighting controls	0.055	1,660	18,102	45.16%
LTG	VHE bulbs and ballasts	0.071	1,085	19,186	47.86%
HVAC	VSD on pump motor	0.078	212	19,398	48.39%
SHELL	Window films (S&W)	0.174	196	19,594	48.88%
SHELL	Low-E windows (N)	0.279	85	19,679	49.09%
SHELL	Low-E windows (all)	0.307	319	19,998	49.89%
SHELL	Roof insulation	0.783	16	20,013	49.92%

Notes:

1. 1986 commercial electricity consumption: 40,087 GWh
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration

Table 2-41

PEAK DEMAND CONSERVATION ASSESSMENT

COMMERCIAL SECTOR

New York State

Discount rate = 10%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
LTG	Delamping	50	44	44	0.4%	22	22	0.3%
HVAC	Reset supply air temperature	163	467	511	5.1%	47	69	0.9%
REF	Refrig. compressor eff.	201	37	548	5.4%	21	90	1.1%
LTG	Reflectors	447	1,134	1,682	16.7%	651	741	9.4%
LTG	High-efficiency ballast	523	132	1,814	18.0%	85	827	10.4%
LTG	Energy saving fluorescents	570	158	1,972	19.6%	94	921	11.6%
HVAC	Fan motor efficiency	656	55	2,027	20.1%	54	975	12.3%
HVAC	VAV conversion	811	550	2,577	25.6%	312	1,288	16.3%
HVAC	Pump motor efficiency	869	5	2,582	25.6%	3	1,290	16.3%
HVAC	Cool storage	1,120	660	3,242	32.2%	0	1,290	16.3%
LTG	Occupancy sensors	1,333	136	3,378	33.5%	80	1,370	17.3%
LTG	Daylighting controls	1,840	475	3,853	38.3%	285	1,655	20.9%
HVAC	VSD on fan motor	1,982	407	4,260	42.3%	424	2,079	26.3%
HVAC	Re-size chillers	2,065	499	4,759	47.3%	250	2,329	29.4%
SHELL	Window films (S&W)	2,333	137	4,896	48.6%	-14	2,315	29.2%
LTG	VHE bulbs and ballasts	2,504	299	5,195	51.6%	166	2,481	31.3%
REF	Refrigerated case covers	2,935	9	5,204	51.7%	5	2,486	31.4%
HVAC	VSD on pump motor	4,294	36	5,241	52.0%	17	2,503	31.6%
HVAC	Economizer	5,330	10	5,251	52.1%	0	2,503	31.6%
SHELL	Roof insulation	8,277	14	5,264	52.3%	1	2,504	31.6%
SHELL	Low-E windows (all)	37,199	36	5,300	52.6%	82	2,586	32.7%
SHELL	Low-E windows (N)	53,704	-1	5,299	52.6%	22	2,608	32.9%

Notes:

1. 1986 commercial summer peak 10,069 MW; winter peak: 7,919 MW;
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty-year period.

Table 2-42
ELECTRICITY CONSERVATION ASSESSMENT
INDUSTRIAL SECTOR
New York State
Discount rate = 10%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
MOT	>125 HP: retire	0.009	7.5	7.5	0.0%
MOT	51-125 HP: retire	0.009	10.1	17.6	0.1%
LTG	Energy saving lamp	0.010	184.0	201.6	1.0%
MOT	21 - 50 HP: retire	0.010	25.3	226.9	1.1%
MOT	5.1-20 HP: retire	0.016	63.7	290.6	1.4%
LTG	Metal halide lamp	0.021	65.8	356.4	1.7%
LTG	High-efficiency ballast	0.033	57.0	413.4	2.0%
MOT	>125 HP: VSD	0.044	1,472.2	1,885.6	9.3%
MOT	1-5 HP: retire	0.048	7.0	1,892.7	9.3%
LTG	High-pressure sodium	0.048	216.6	2,109.3	10.4%
MOT	51-125 HP: VSD	0.055	1,077.9	3,187.2	15.6%
MOT	21-50 HP: rebuild	0.056	72.0	3,259.2	16.0%
MOT	5.1-20 HP: rebuild	0.069	34.3	3,293.5	16.2%
MOT	51-125 HP: rebuild	0.076	122.4	3,415.9	16.8%
MOT	>125 HP: rebuild	0.105	111.1	3,527.0	17.3%
MOT	21-50 HP: VSD	0.107	556.8	4,083.8	20.1%
MOT	<1 HP: retire	0.133	0.8	4,084.7	20.1%
MOT	5.1-20 HP: VSD	0.175	374.6	4,459.3	21.9%
MOT	1-5 HP: VSD	0.485	25.4	4,484.7	22.0%

Notes:
1. 1986 industrial electricity sales: 20,366 GWh
2. MOT: Motor efficiency measure; LTG: Lighting efficiency measure

Table 2-43

PEAK DEMAND CONSERVATION ASSESSMENT
INDUSTRIAL SECTOR
New York State

Discount rate = 10%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
MOT	>125 HP: retire	515	1.2	1.2	0.0%	1.2	1.2	0.0%
MOT	51-125 HP: retire	549	1.6	2.8	0.1%	1.5	2.7	0.1%
LTG	Energy saving lamp	558	29.5	32.3	1.0%	28.2	30.9	1.0%
MOT	21 - 50 HP: retire	580	4.1	36.3	1.1%	3.9	34.8	1.1%
MOT	5.1-20 HP: retire	965	10.2	46.5	1.4%	9.8	44.6	1.4%
LTG	Metal halide lamp	1,322	10.5	57.0	1.7%	10.1	54.7	1.7%
LTG	High-efficiency ballast	2,003	9.1	66.2	2.0%	8.7	63.4	2.0%
MOT	>125 HP: VSD	2,591	235.7	301.8	9.3%	225.8	289.2	9.3%
MOT	1-5 HP: retire	2,787	1.1	303.0	9.3%	1.1	290.2	9.3%
LTG	High-pressure sodium	2,933	34.7	337.6	10.4%	33.2	323.5	10.4%
MOT	51-125 HP: VSD	3,230	172.5	510.2	15.6%	165.3	488.8	15.6%
MOT	21-50 HP: rebuild	3,288	11.5	521.7	16.0%	11.0	499.8	16.0%
MOT	5.1-20 HP: rebuild	4,127	5.5	527.2	16.2%	5.3	505.1	16.2%
MOT	51-125 HP: rebuild	4,430	19.6	546.8	16.8%	18.8	523.8	16.8%
MOT	>125 HP: rebuild	6,090	17.8	564.6	17.3%	17.0	540.9	17.3%
MOT	21-50 HP: VSD	6,335	89.1	653.7	20.1%	85.4	626.3	20.1%
MOT	<1 HP: retire	7,809	0.1	653.8	20.1%	0.1	626.4	20.1%
MOT	5.1-20 HP: VSD	10,399	60.0	713.8	21.9%	57.4	683.8	21.9%
MOT	1-5 HP: VSD	28,349	4.1	717.9	22.0%	3.9	687.7	22.0%

Notes:
1. 1986 industrial summer peak demand : 3,260 MW
2. 1986 industrial winter peak demand : 3,123 MW
3. MOT: Motor efficiency measure; LTG: Lighting efficiency measure
4. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Table 2-44
ELECTRICITY CONSERVATION ASSESSMENT
RESIDENTIAL SECTOR
New York State
Discount rate = 3%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
FRE	Current sales average (1986)	0.003	373	373	1.08%
REF	Current sales average (1986)	0.008	1,876	2,249	6.50%
REF	Best current (1988)	0.009	1,865	4,114	11.90%
REF	Near-term advanced	0.011	781	4,895	14.16%
FRE	Best current (1988)	0.011	259	5,155	14.91%
EWH	Traps & blanket (EF=0.9)	0.012	265	5,419	15.67%
FRE	Near-term advanced	0.012	129	5,548	16.05%
ESH1	Infiltration reduction	0.014	593	6,141	17.76%
RAN	Improved oven	0.018	212	6,353	18.37%
ESH2	Storm windows	0.018	112	6,465	18.70%
ESH2	Low-emissivity film	0.019	35	6,500	18.80%
RAN	Improved cooktop	0.020	74	6,574	19.01%
LTG	Tungsten halogen lamps-300 h/y	0.024	697	7,271	21.03%
EWH	Front loading clothes washer	0.029	447	7,718	22.32%
LTG	Energy saving lamps-620 hr/yr	0.030	82	7,799	22.56%
LTG	Energy saving lamps-1,240 h/y	0.030	98	7,898	22.84%
LTG	Compact fluorescents-1240 h/y	0.033	1,102	8,999	26.03%
ESH1	Heat pump #1 (HSPF=7)*	0.035	236	9,235	26.71%
LTG	Compact fluorescents-620 h/y	0.039	918	10,153	29.36%
LTG	IRF lamps - 300 hr/yr	0.040	813	10,966	31.71%
ESH1	Heat pump #2 (HSPF=8)*	0.046	23	10,989	31.78%
ECD	Heat pump clothes dryer	0.052	858	11,847	34.26%
ESH1	Low-emissivity film	0.062	163	12,010	34.73%
RAC	RAC: 8.5 EER	0.080	144	12,153	35.15%
CAC	Window film	0.121	76	12,230	35.37%
RAC	RAC: 10.0 EER	0.132	87	12,317	35.62%
CAC	CAC: 10.0 SEER	0.140	79	12,396	35.85%
RAC	RAC: 12 .0 EER	0.169	91	12,487	36.11%
CAC	Variable speed drive	0.192	55	12,542	36.27%
CAC	CAC: 12.0 SEER	0.274	47	12,589	36.41%
ESH1	Add 3" fiberglass in roof/ceiling	0.361	25	12,614	36.48%
CAC	CAC: 14.0 SEER	0.402	37	12,651	36.59%

Notes:
1. 1986 residential electricity consumption: 34,577 GWh
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family and small (2-4 units) multi-family homes; ESH2: electric space heating in large (5+ units) multi-family homes.

Table 2-45
PEAK DEMAND ASSESSMENT
RESIDENTIAL SECTOR
New York State
Discount rate = 3%

			SUMMER			WINTER		
Area	Option	Marginal CRD(20) ($/kW)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)
CAC	Load controller/cycler	193	451	451	6.2%	0	0	0.0%
FRE	Current sales average (1986)	358	54	505	7.0%	50	50	0.7%
RAC	RAC: 8.5 EER	475	381	886	12.3%	0	50	0.7%
RAC	RAC: 10.0 EER	679	267	1,153	15.9%	0	50	0.7%
ESH2	Storm windows	679	0	1,153	15.9%	45	95	1.4%
REF	Current sales average (1986)	681	321	1,474	20.4%	163	258	3.8%
ESH2	Low-emissivity film	693	0	1,474	20.4%	15	272	4.0%
REF	Best current (1988)	795	319	1,793	24.8%	162	434	6.4%
ESH1	Infiltration reduction	802	0	1,793	24.8%	162	596	8.8%
EWH	Load controller/cycler	865	80	1,873	25.9%	207	803	11.9%
ECD	Load controller/cycler	872	260	2,133	29.5%	452	1,255	18.6%
EWH	Traps & blanket (EF=0.9)	896	21	2,154	29.8%	54	1,309	19.4%
REF	Near-term advanced	949	134	2,288	31.6%	68	1,376	20.4%
RAC	RAC: 12.0 EER	958	252	2,540	35.1%	0	1,376	20.4%
RAN	Improved oven	1,119	52	2,591	35.8%	35	1,412	20.9%
CAC	Window film	1,169	123	2,714	37.5%	0	1,412	20.9%
ESH1	Electric thermal storage system*	1,174	0	2,714	37.5%	682	2,094	31.0%
FRE	Best current (1988)	1,183	38	2,752	38.1%	35	2,129	31.6%
FRE	Near-term advanced	1,224	19	2,771	38.3%	17	2,146	31.8%
ESH1	Heat pump #1 (HSPF=7)*	1,262	0	2,771	38.3%	103	2,249	33.3%
RAN	Improved cooktop	1,278	18	2,789	38.6%	12	2,261	33.5%
ESH1	Heat pump #2 (HSPF=8)*	1,355	0	2,789	38.6%	12	2,274	33.7%
LTG	Tungsten halogen lamps-300 h/y	1,491	33	2,823	39.0%	154	2,427	36.0%

CAC	CAC: 10.0 SEER	1,532	113	2,936	40.6%	0	2,427	36.0%
LTG	Energy saving lamps-620 hr/yr	2,010	4	2,940	40.7%	18	2,445	36.3%
LTG	Energy saving lamps-1,240 h/y	2,074	5	2,945	40.7%	22	2,467	36.6%
LTG	Compact fluorescents-1240 h/y	2,364	53	2,997	41.5%	243	2,710	40.2%
LTG	IRF lamps - 300 hr/yr	2,412	39	3,036	42.0%	179	2,889	42.8%
CAC	CAC: 12.0 SEER	2,547	79	3,115	43.1%	0	2,889	42.8%
LTG	Compact fluorescents-620 h/y	2,765	44	3,159	43.7%	202	3,091	45.8%
EWH	Front loading clothes washer	3,657	22	3,181	44.0%	57	3,148	46.7%
CAC	CAC: 14.0 SEER	3,786	62	3,243	44.9%	0	3,148	46.7%
ESH1	Low-emissivity film	4,296	0	3,243	44.9%	36	3,184	47.2%
ESH1	Add 3" fiberglass in roof/ceiling	41,662	0	3,243	44.9%	3	3,187	47.3%

*The electric thermal storage system (ETS) and heat pumps are mututally exclusive measures. CSE and CRD are calculated independently.

Notes:

1. 1986 residential summer peak: 7,230 MW; winter peak: 6,744 MW
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family homes; ESH2: electric space heating in multi-family homes.
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Table 2-46
ELECTRICITY CONSERVATION ASSESSMENT
COMMERCIAL SECTOR
New York State
Discount rate = 3%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
LTG	Delamping	0.001	141	141	0.35%
REF	Floating head press. control	0.001	172	312	0.78%
REF	Refrig. compressor eff.	0.002	214	527	1.31%
HVAC	Reset supply air temperature	0.004	1,182	1,709	4.26%
LTG	Reflectors	0.009	4,142	5,851	14.60%
HVAC	Fan motor efficiency	0.009	309	6,160	15.37%
LTG	High-efficiency ballast	0.010	513	6,673	16.65%
HVAC	VAV conversion	0.010	2,776	9,449	23.57%
HVAC	Economizer	0.013	301	9,749	24.32%
HVAC	Pump motor efficiency	0.016	23	9,773	24.38%
LTG	Energy saving fluorescents	0.017	593	10,366	25.86%
HVAC	VSD on fan motor	0.018	3,261	13,628	33.99%
LTG	Occupancy sensors	0.029	500	14,128	35.24%
HVAC	Re-size chillers	0.030	2,260	16,388	40.88%
REF	Refrigerated case covers	0.038	54	16,441	41.01%
LTG	Daylighting controls	0.042	1,660	18,102	45.16%
LTG	VHE bulbs and ballasts	0.049	1,085	19,186	47.86%
HVAC	VSD on pump motor	0.053	212	19,398	48.39%
SHELL	Window films (S&W)	0.106	196	19,594	48.88%
SHELL	Low-E windows (N)	0.171	85	19,679	49.09%
SHELL	Low-E windows (all)	0.187	319	19,998	49.89%
SHELL	Roof insulation	0.478	16	20,013	49.92%

Notes:
1. 1986 commercial electricity consumption: 40,087 GWh
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration

Table 2-47

PEAK DEMAND CONSERVATION ASSESSMENT
COMMERCIAL SECTOR
New York State
Discount rate = 3%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
LTG	Delamping	55	44	44	0.4%	22	22	0.3%
HVAC	Reset supply air temperature	163	467	511	5.1%	47	69	0.9%
REF	Refrig. compressor eff.	223	37	548	5.4%	21	90	1.1%
LTG	Reflectors	496	1,134	1,682	16.7%	651	741	9.4%
LTG	High-efficiency ballast	580	132	1,814	18.0%	85	827	10.4%
HVAC	VAV conversion	811	550	2,364	23.5%	312	1,139	14.4%
HVAC	Fan motor efficiency	813	55	2,419	24.0%	54	1,193	15.1%
LTG	Energy saving fluorescents	898	158	2,577	25.6%	94	1,288	16.3%
HVAC	Pump motor efficiency	1,078	5	2,582	25.6%	3	1,290	16.3%
HVAC	Cool storage	1,120	660	3,242	32.2%	0	1,290	16.3%
LTG	Occupancy sensors	1,653	136	3,378	33.5%	80	1,370	17.3%
HVAC	Re-size chillers	2,065	499	3,877	38.5%	250	1,620	20.5%
HVAC	VSD on fan motor	2,199	407	4,284	42.5%	424	2,044	25.8%
LTG	Daylighting controls	2,282	475	4,759	47.3%	285	2,329	29.4%
SHELL	Window films (S&W)	2,333	137	4,896	48.6%	-14	2,315	29.2%
LTG	VHE bulbs and ballasts	2,779	299	5,195	51.6%	166	2,481	31.3%
REF	Refrigerated case covers	3,470	9	5,204	51.7%	5	2,486	31.4%
HVAC	VSD on pump motor	4,765	36	5,241	52.0%	17	2,503	31.6%
HVAC	Economizer	5,330	10	5,251	52.1%	0	2,503	31.6%
SHELL	Roof insulation	8,277	14	5,264	52.3%	1	2,504	31.6%
SHELL	Low-E windows (all)	37,199	36	5,300	52.6%	82	2,586	32.7%
SHELL	Low-E windows (N)	53,704	-1	5,299	52.6%	22	2,608	32.9%

Notes:
1. 1986 commercial summer peak 10,069 MW; winter peak: 7,919 MW;
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty-year period.

Table 2-48
ELECTRICITY CONSERVATION ASSESSMENT
INDUSTRIAL SECTOR
New York State
Discount rate = 3%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
MOT	21 - 50 HP: retire	0.006	25.3	25.3	0.1%
MOT	>125 HP: retire	0.007	7.5	32.8	0.2%
MOT	51-125 HP: retire	0.007	10.1	42.9	0.2%
LTG	Energy saving lamp	0.009	184.0	226.9	1.1%
MOT	5.1-20 HP: retire	0.009	63.7	290.6	1.4%
LTG	Metal halide lamp	0.019	65.8	356.4	1.7%
LTG	High-efficiency ballast	0.023	57.0	413.4	2.0%
MOT	1-5 HP: retire	0.029	7.0	420.4	2.1%
MOT	>125 HP: VSD	0.030	1,472.2	1,892.7	9.3%
MOT	21-50 HP: rebuild	0.036	72.0	1,964.7	9.6%
MOT	51-125 HP: VSD	0.037	1,077.9	3,042.6	14.9%
MOT	5.1-20 HP: rebuild	0.039	34.3	3,076.9	15.1%
LTG	High-pressure sodium	0.040	216.6	3,293.5	16.2%
MOT	51-125 HP: rebuild	0.056	122.4	3,415.9	16.8%
MOT	21-50 HP: VSD	0.073	556.8	3,972.7	19.5%
MOT	>125 HP: rebuild	0.079	111.1	4,083.8	20.1%
MOT	<1 HP: retire	0.082	0.8	4,084.7	20.1%
MOT	5.1-20 HP: VSD	0.097	374.6	4,459.3	21.9%
MOT	1-5 HP: VSD	0.296	25.4	4,484.7	22.0%

Notes:
1. 1986 industrial electricity sales: 20,366 GWh
2. MOT: Motor efficiency measure; LTG: Lighting efficiency measure

Table 2-49

PEAK DEMAND CONSERVATION ASSESSMENT

INDUSTRIAL SECTOR

New York State

Discount rate = 3%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
MOT	21 - 50 HP: retire	622	4.1	4.1	0.1%	3.9	3.9	0.1%
MOT	>125 HP: retire	638	1.2	5.3	0.2%	1.2	5.0	0.2%
MOT	51-125 HP: retire	663	1.6	6.9	0.2%	1.5	6.6	0.2%
LTG	Energy saving lamp	780	29.5	36.3	1.1%	28.2	34.8	1.1%
MOT	5.1-20 HP: retire	830	10.2	46.5	1.4%	9.8	44.6	1.4%
LTG	Metal halide lamp	1,850	10.5	57.0	1.7%	10.1	54.7	1.7%
LTG	High-efficiency ballast	2,223	9.1	66.2	2.0%	8.7	63.4	2.0%
MOT	1-5 HP: retire	2,787	1.1	67.3	2.1%	1.1	64.5	2.1%
MOT	>125 HP: VSD	2,906	235.7	303.0	9.3%	225.8	290.2	9.3%
MOT	21-50 HP: rebuild	3,523	11.5	314.5	9.6%	11.0	301.3	9.6%
MOT	5.1-20 HP: rebuild	3,547	5.5	320.0	9.8%	5.3	306.5	9.8%
MOT	51-125 HP: VSD	3,623	172.5	492.5	15.1%	165.3	471.9	15.1%
LTG	High-pressure sodium	3,904	34.7	527.2	16.2%	33.2	505.1	16.2%
MOT	51-125 HP: rebuild	5,345	19.6	546.8	16.8%	18.8	523.8	16.8%
MOT	21-50 HP: VSD	7,106	89.1	635.9	19.5%	85.4	609.2	19.5%
MOT	>125 HP: rebuild	7,548	17.8	653.7	20.1%	17.0	626.3	20.1%
MOT	<1 HP: retire	7,809	0.1	653.8	20.1%	0.1	626.4	20.1%
MOT	5.1-20 HP: VSD	8,938	60.0	713.8	21.9%	57.4	683.8	21.9%
MOT	1-5 HP: VSD	28,349	4.1	717.9	22.0%	3.9	687.7	22.0%

Notes:
1. 1986 industrial summer peak demand : 3,260 MW
2. 1986 industrial winter peak demand : 3,123 MW
3. MOT: Motor efficiency measure; LTG: Lighting efficiency measure
4. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Figure 2-1

ELECTRICITY CONSERVATION SUPPLY CURVE
New York State – 6% Discount Rate

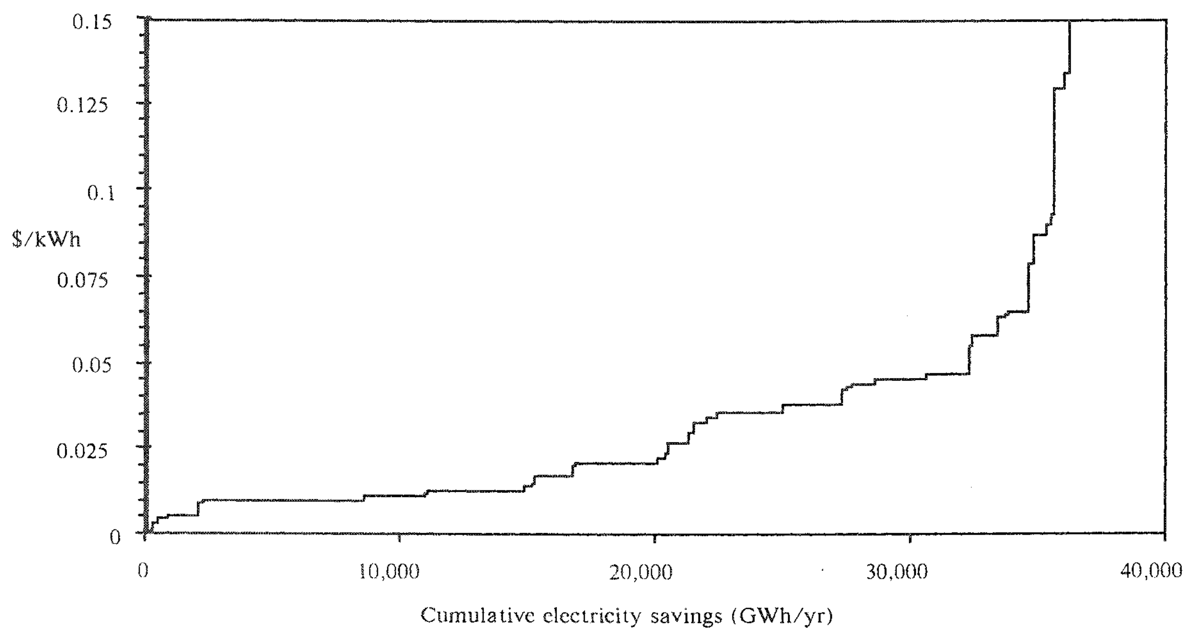


Figure 2-2

SUMMER PEAK DEMAND REDUCTION SUPPLY CURVE
New York State – 6% Discount Rate

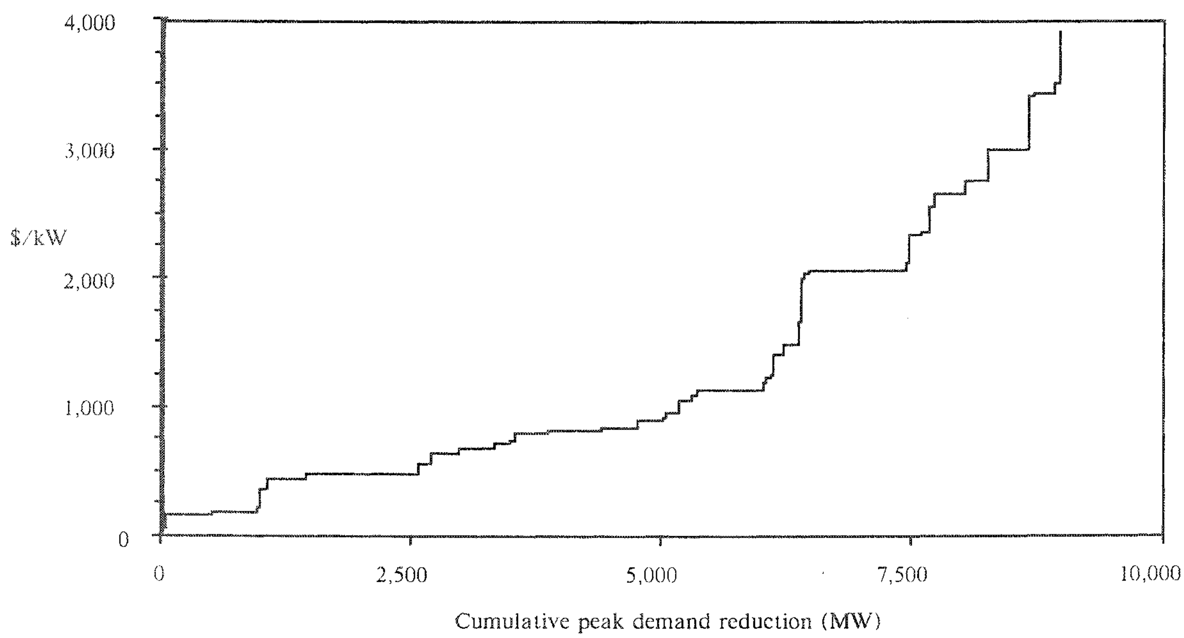


Figure 2-3

ELECTRICITY CONSERVATION SUPPLY CURVE - RESIDENTIAL SECTOR
New York State - 6% Discount Rate

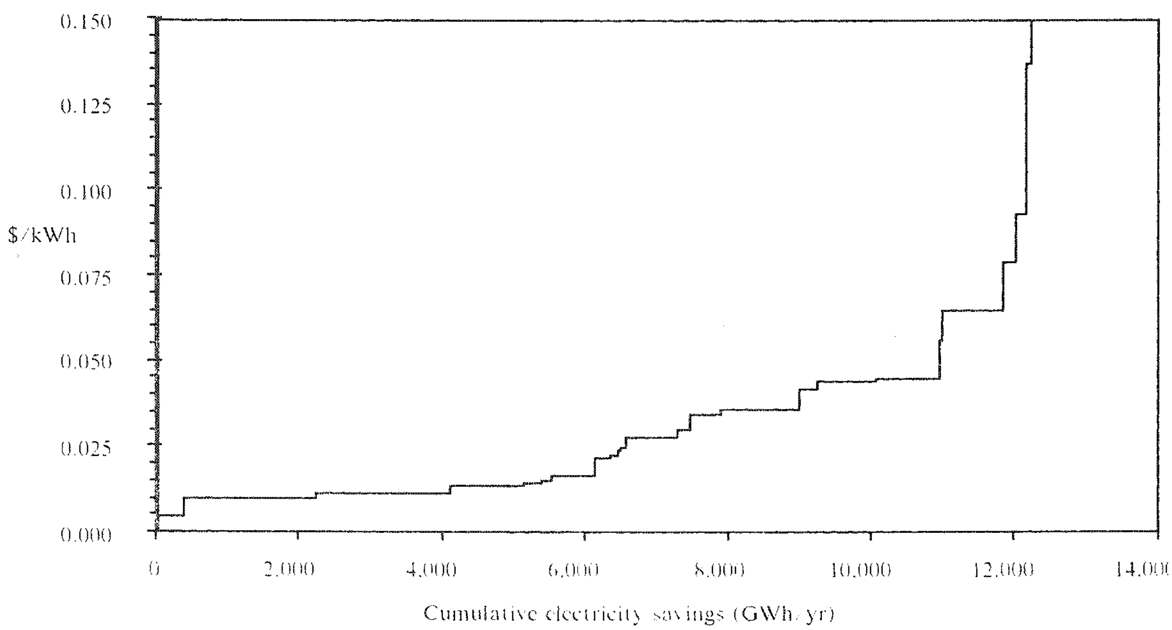


Figure 2-4

SUMMER PEAK DEMAND REDUCTION SUPPLY CURVE - RESID. SECTOR
New York State - 6% Discount Rate

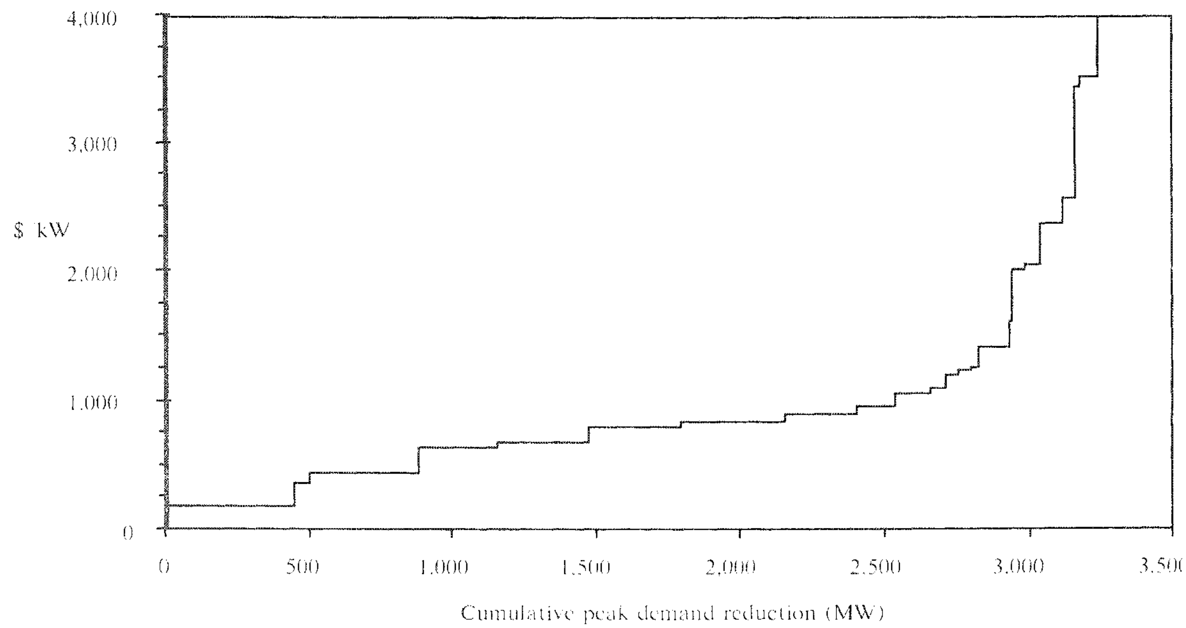


Figure 2-5

WINTER PEAK DEMAND REDUCTION SUPPLY CURVE - RESID. SECTOR
New York State - 6% Discount Rate

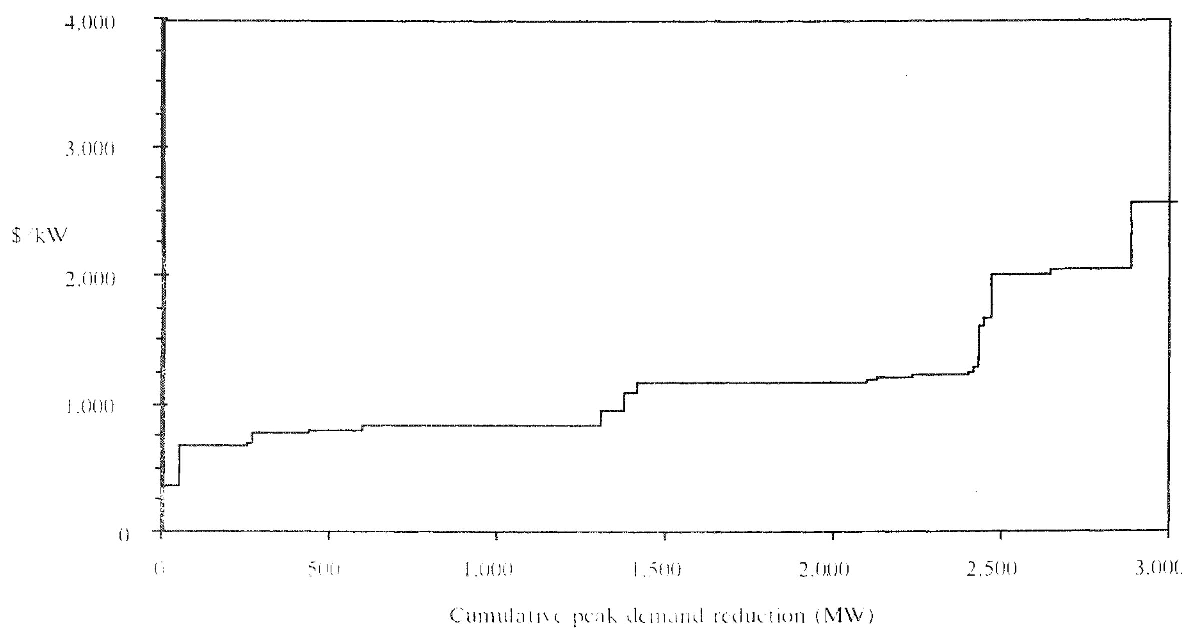


Figure 2-6

ELECTRICITY CONSERVATION SUPPLY CURVE – COMMERCIAL SECTOR
New York State – 6% Discount Rate

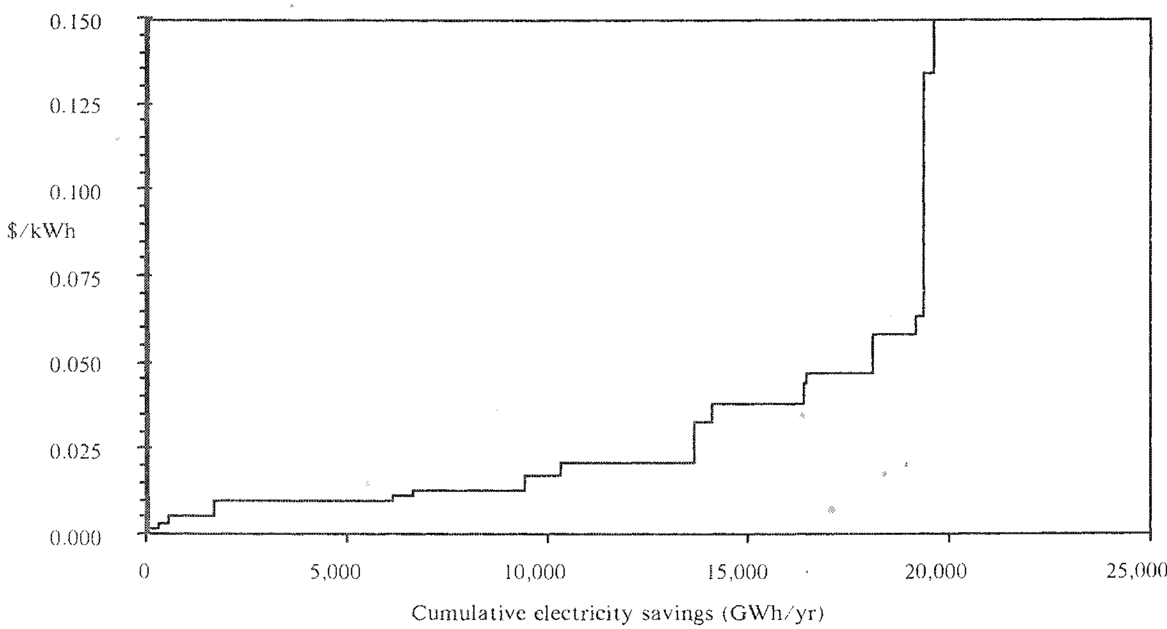


Figure 2-7

SUMMER PEAK DEMAND REDUCTION SUPPLY CURVE – COMM. SECTOR
New York State – 6% Discount Rate

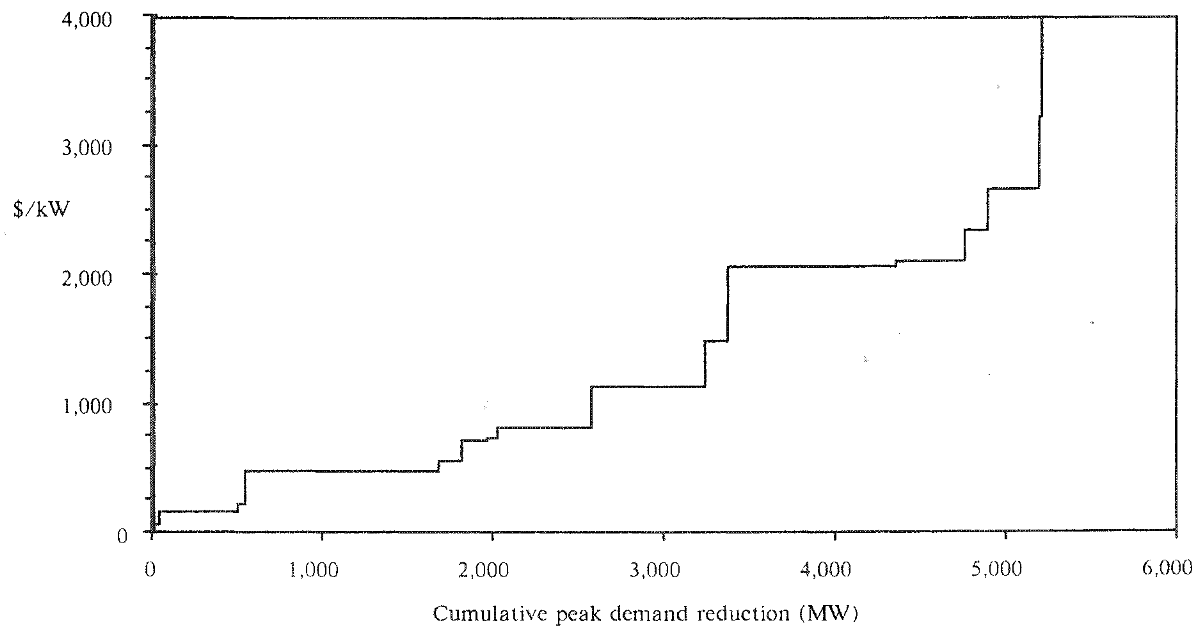


Figure 2-8

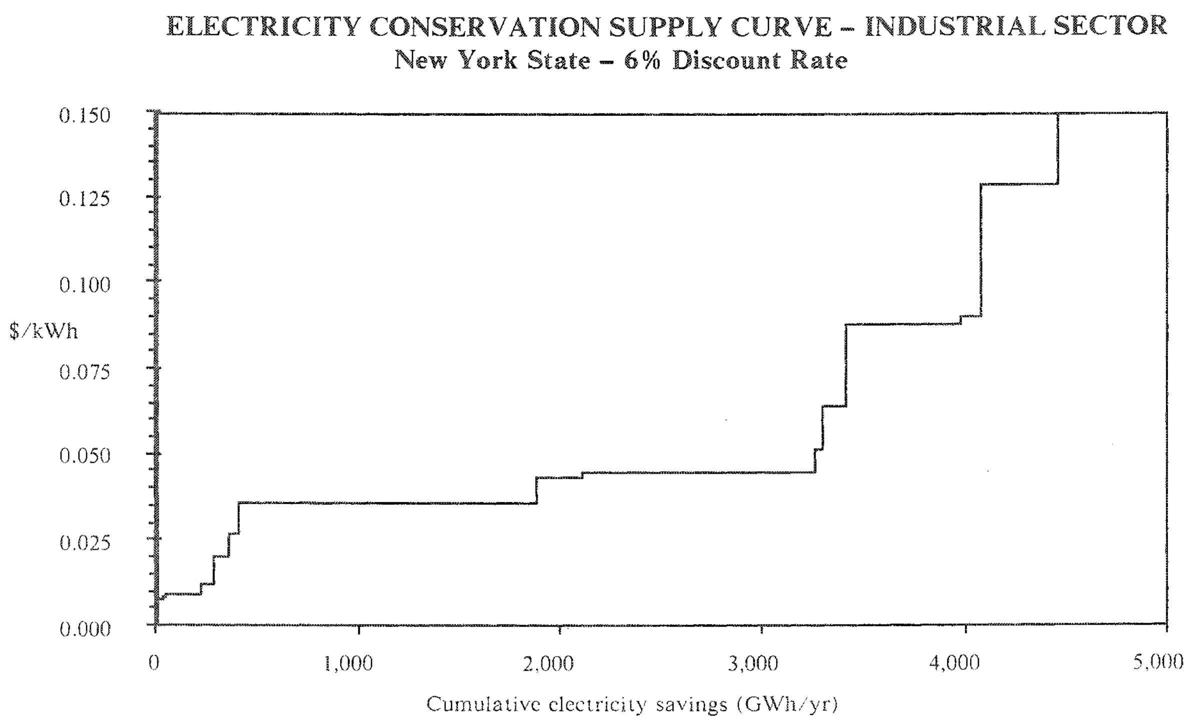

ELECTRICITY CONSERVATION SUPPLY CURVE - INDUSTRIAL SECTOR
New York State - 6% Discount Rate
0.150
0.125
0.100
$/kWh
0.075
0.050
0.025
0.000
0
1,000
2,000
3,000
4,000
5,000
Cumulative electricity savings (GWh/yr)

Figure 2-9

SUMMER PEAK DEMAND REDUCTION SUPPLY CURVE - INDUS. SECTOR
New York State - 6% Discount Rate

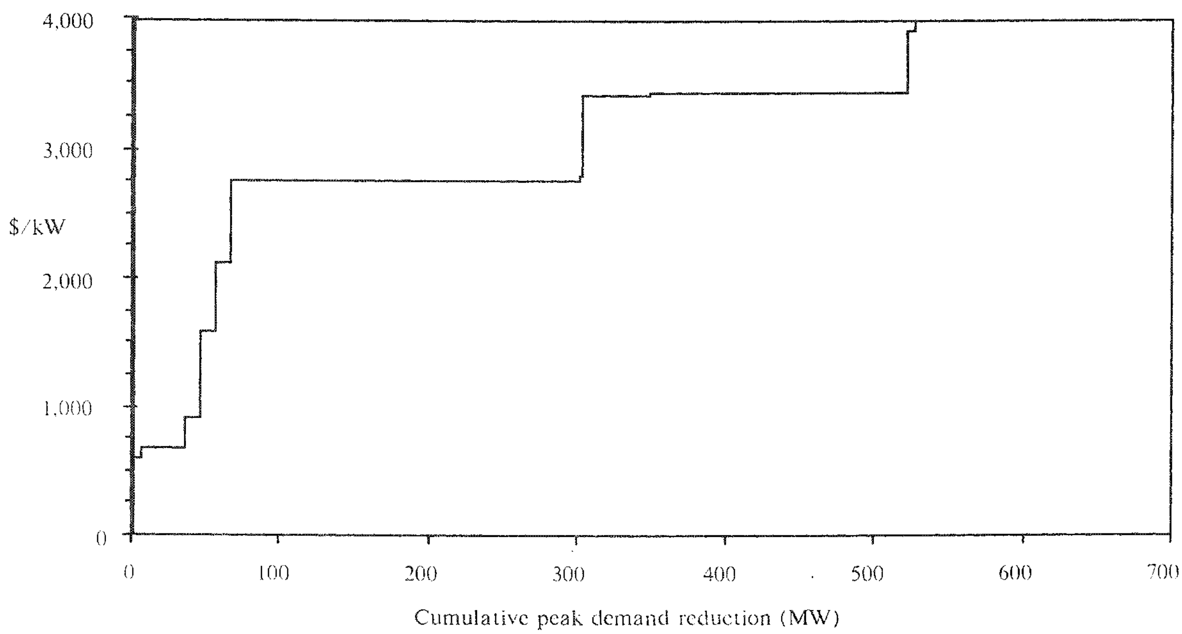


Figure 2-10

ELECTRICITY CONSERVATION SUPPLY CURVE - RESIDENTIAL SECTOR
New York State - 10% Discount Rate

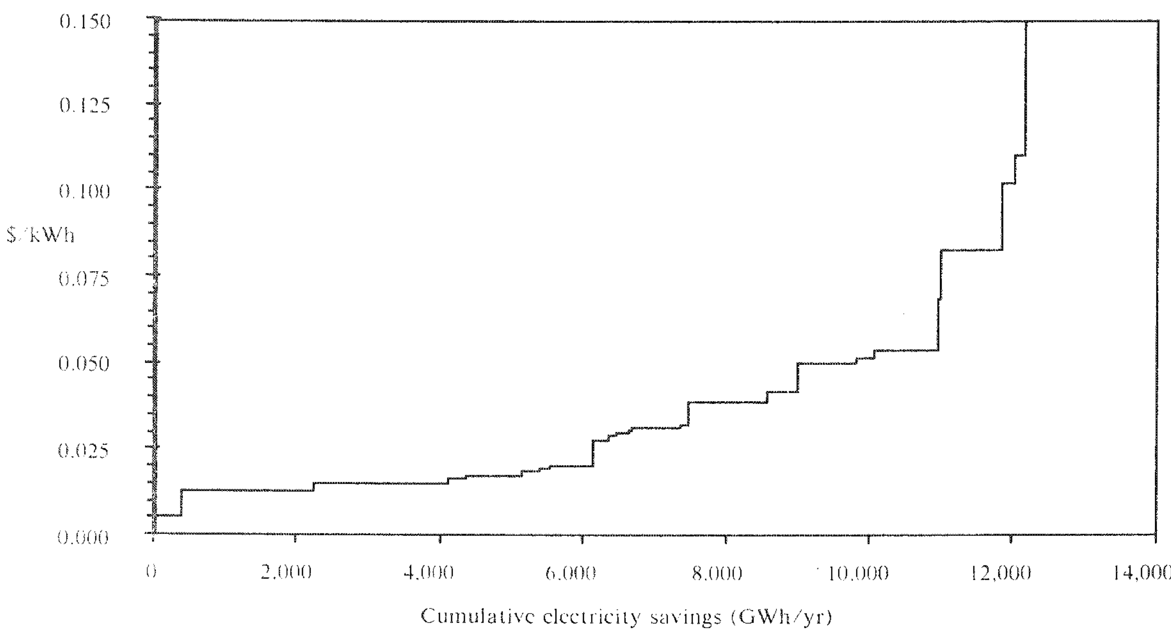


Figure 2-11

SUMMER PEAK DEMAND REDUCTION SUPPLY CURVE – RESID. SECTOR
New York State – 10% Discount Rate

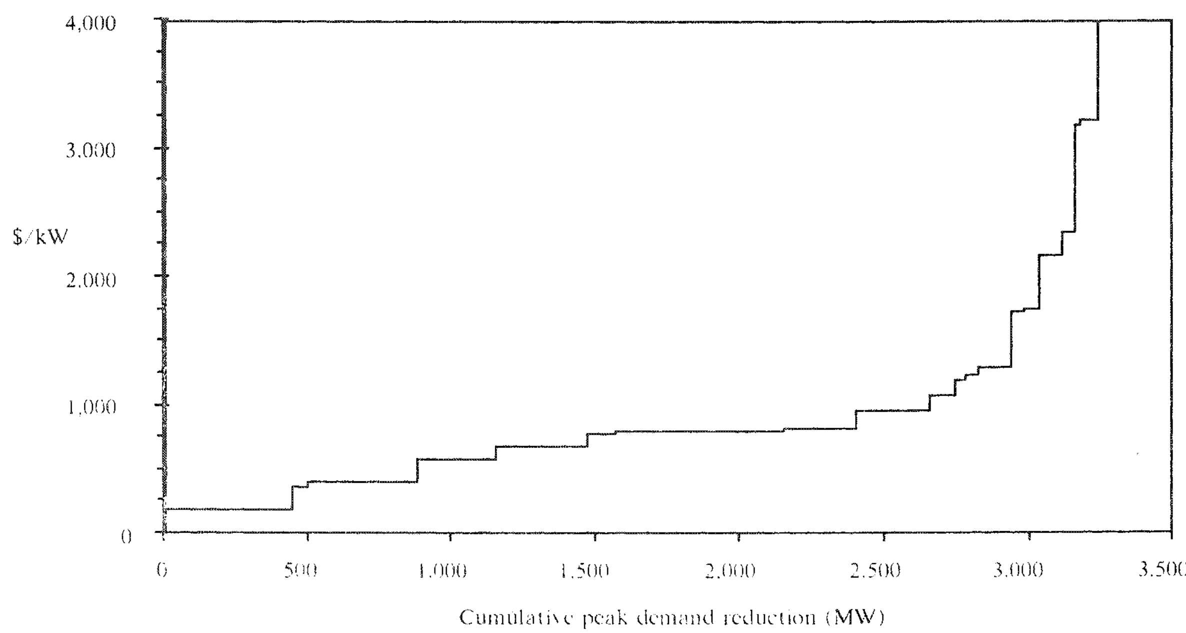


Figure 2-12

WINTER PEAK DEMAND REDUCTION SUPPLY CURVE – RESID. SECTOR
New York State – 10% Discount Rate

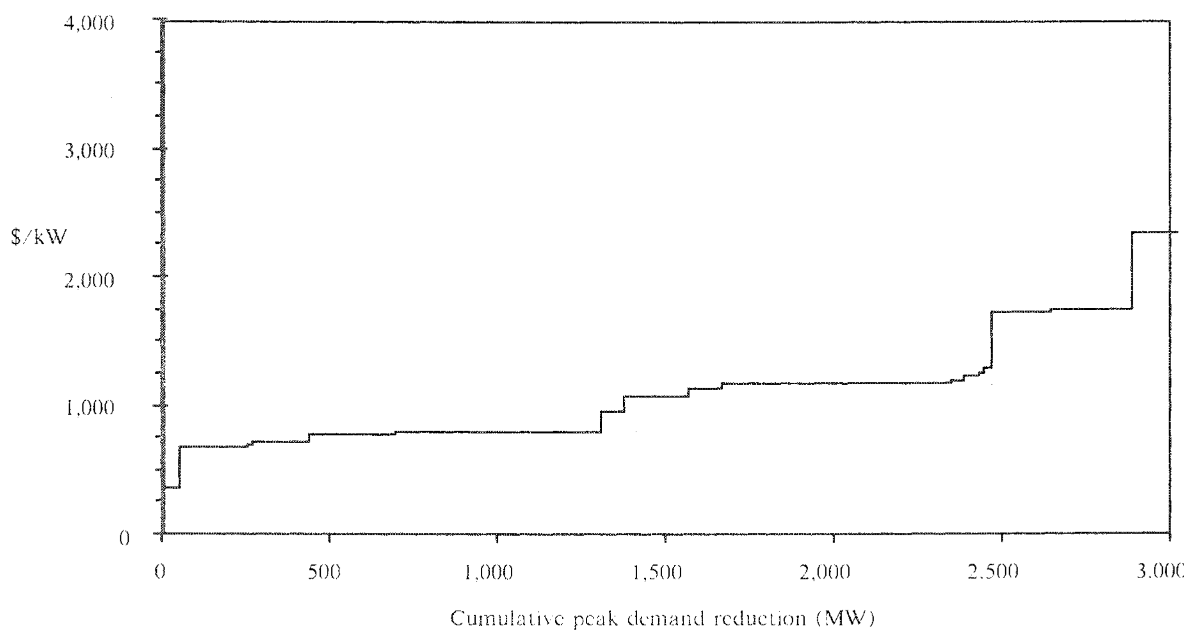


Figure 2-13

ELECTRICITY CONSERVATION SUPPLY CURVE - COMMERCIAL SECTOR
New York State - 10% Discount Rate

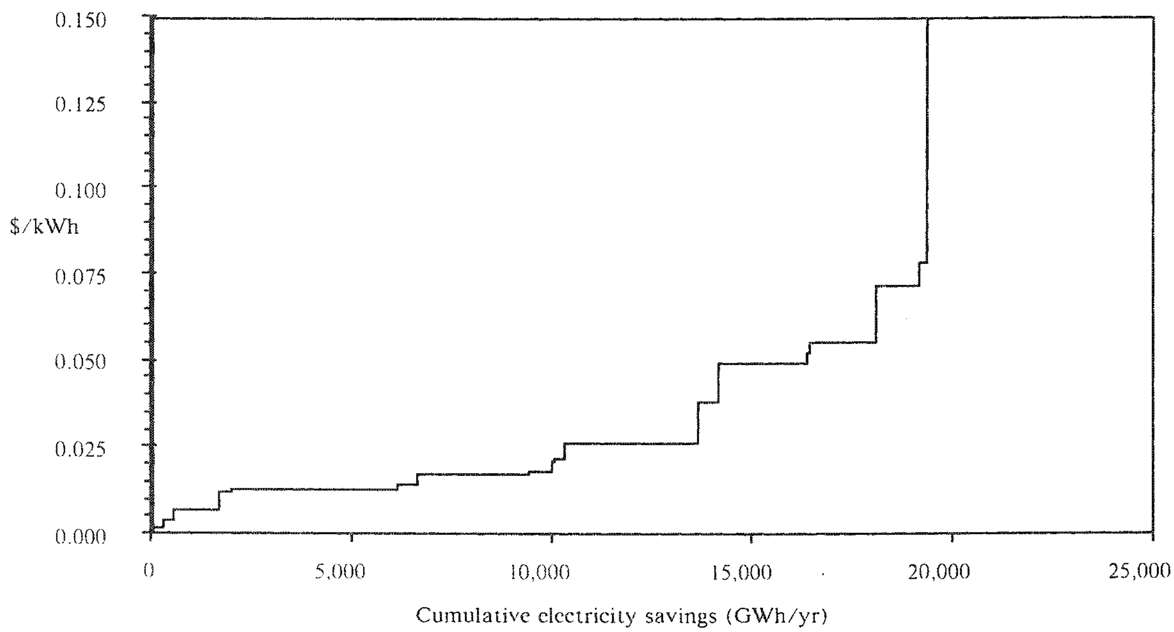


Figure 2-14

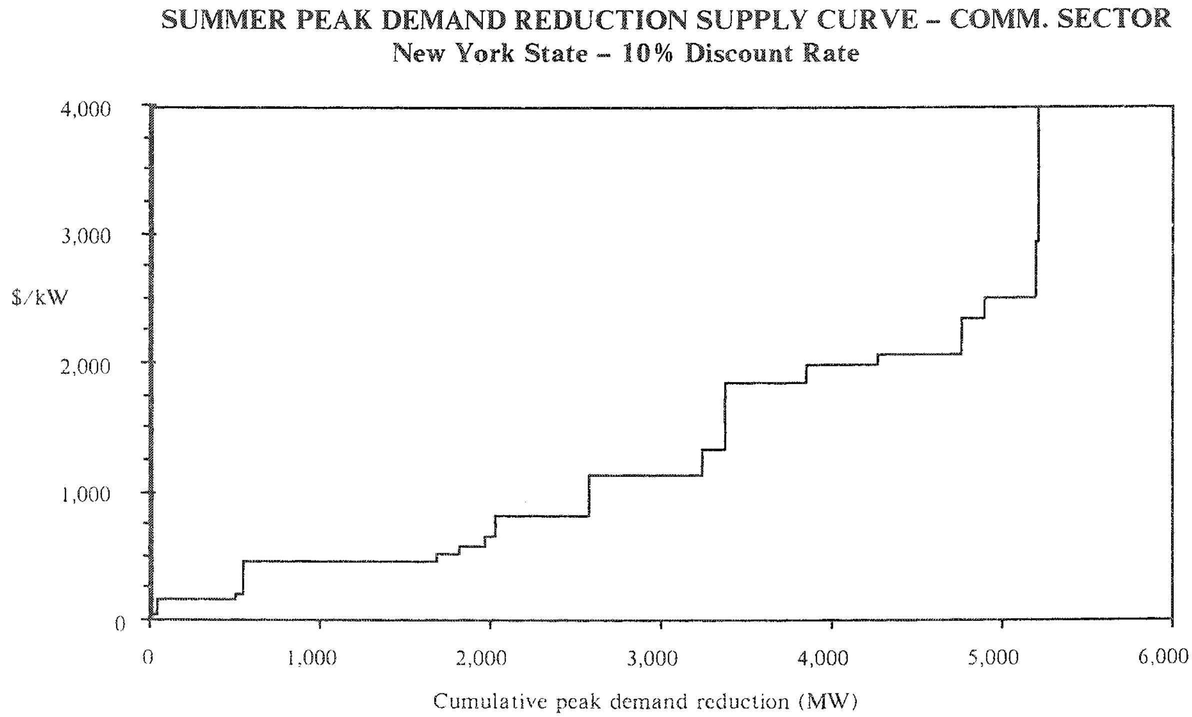

SUMMER PEAK DEMAND REDUCTION SUPPLY CURVE - COMM. SECTOR
New York State - 10% Discount Rate
4,000
3,000
$/kW
2,000
1,000
0
0
1,000
2,000
3,000
4,000
5,000
6,000
Cumulative peak demand reduction (MW)

Figure 2-15

ELECTRICITY CONSERVATION SUPPLY CURVE - INDUSTRIAL SECTOR
New York State - 10% Discount Rate

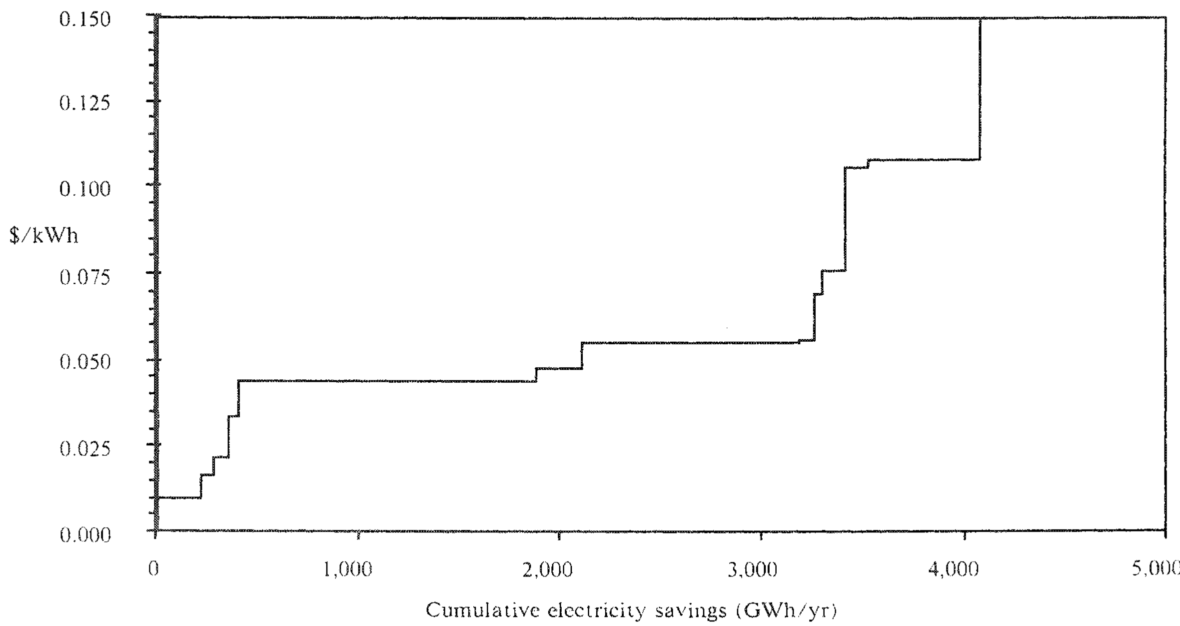


Figure 2-16

SUMMER PEAK DEMAND REDUCTION SUPPLY CURVE – INDUS. SECTOR
New York State – 10% Discount Rate

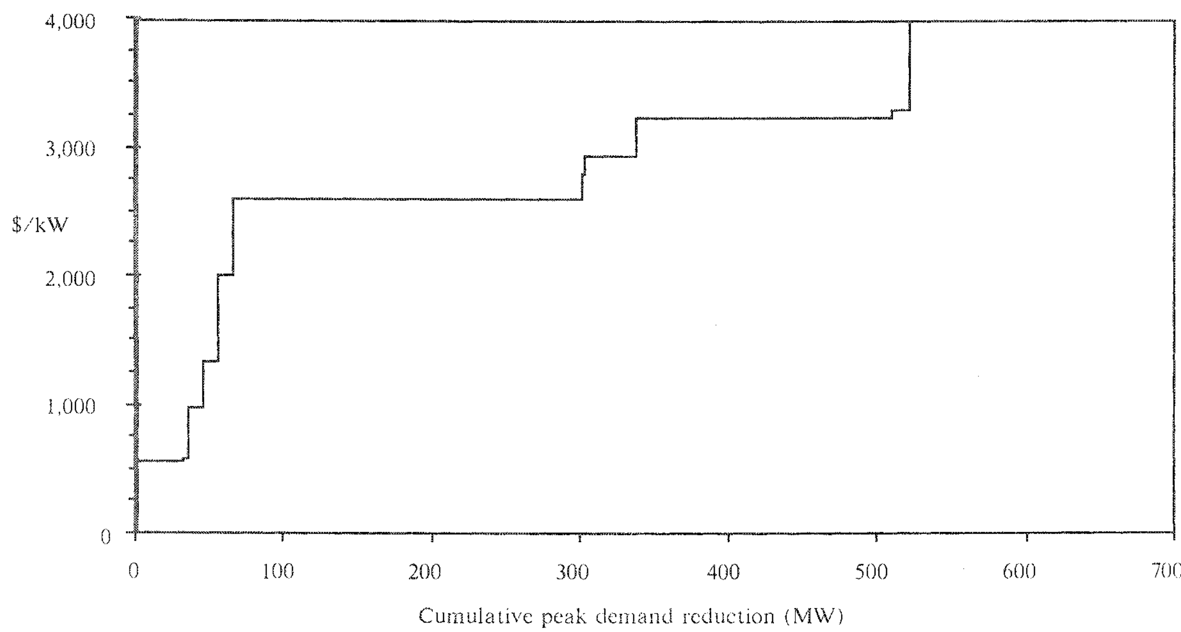


Figure 2-17

ELECTRICITY CONSERVATION SUPPLY CURVE - RESIDENTIAL SECTOR
New York State - 3% Discount Rate

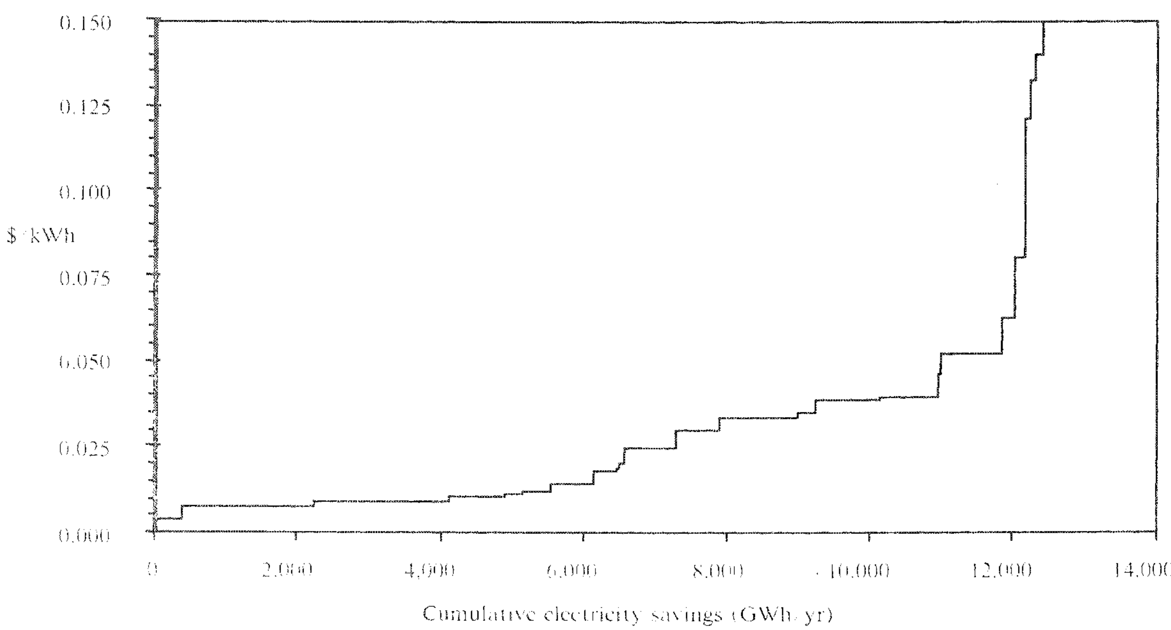


Figure 2-18

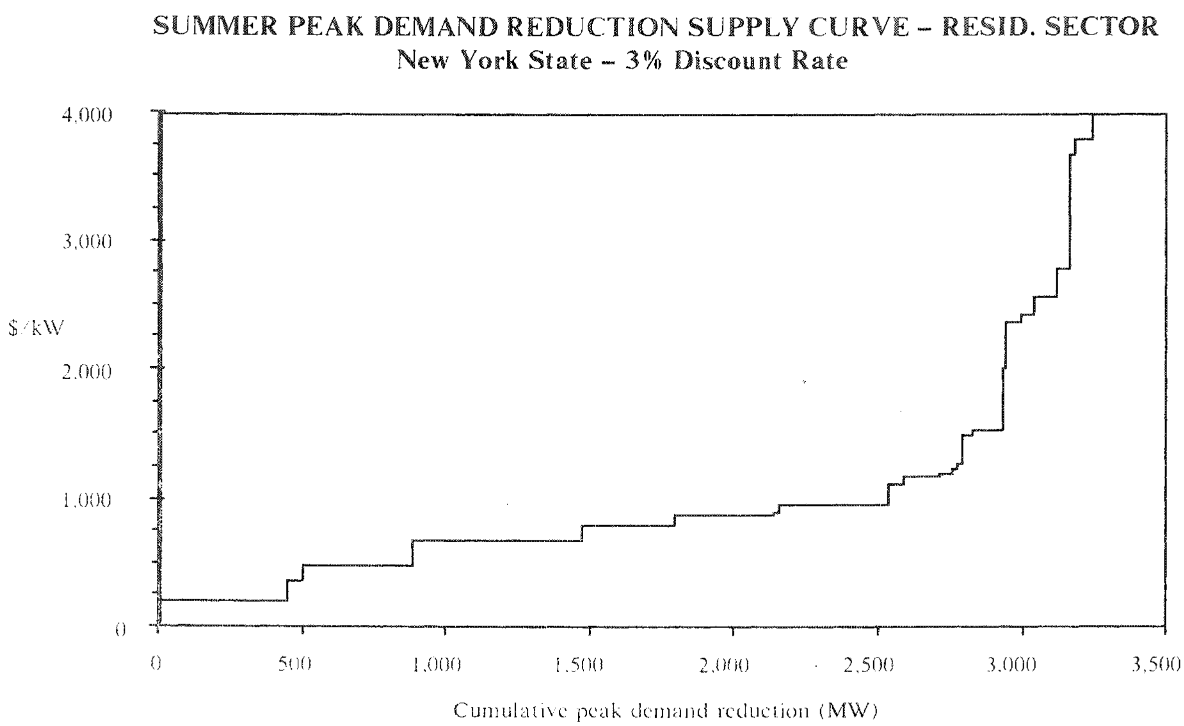

SUMMER PEAK DEMAND REDUCTION SUPPLY CURVE - RESID. SECTOR
New York State - 3% Discount Rate
4,000
3,000
$/kW
2,000
1,000
0
0
500
1,000
1,500
2,000
2,500
3,000
3,500
Cumulative peak demand reduction (MW)

Figure 2-19

WINTER PEAK DEMAND REDUCTION SUPPLY CURVE - RESID. SECTOR
New York State - 3% Discount Rate

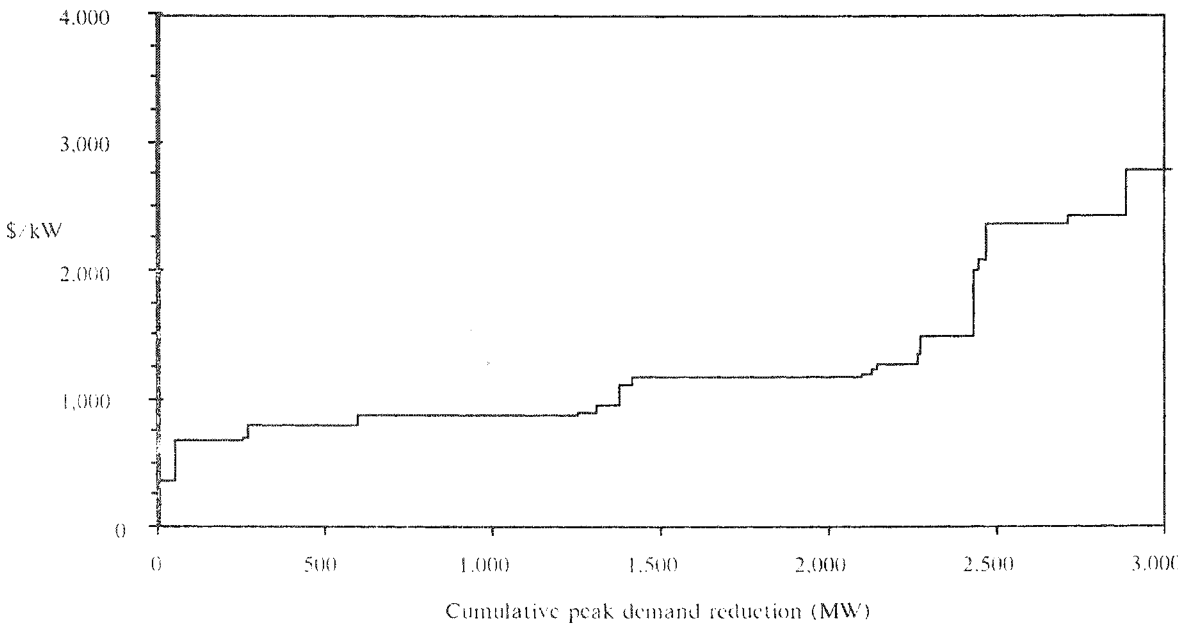


Figure 2-20

ELECTRICITY CONSERVATION SUPPLY CURVE - COMMERCIAL SECTOR
New York State - 3% Discount Rate

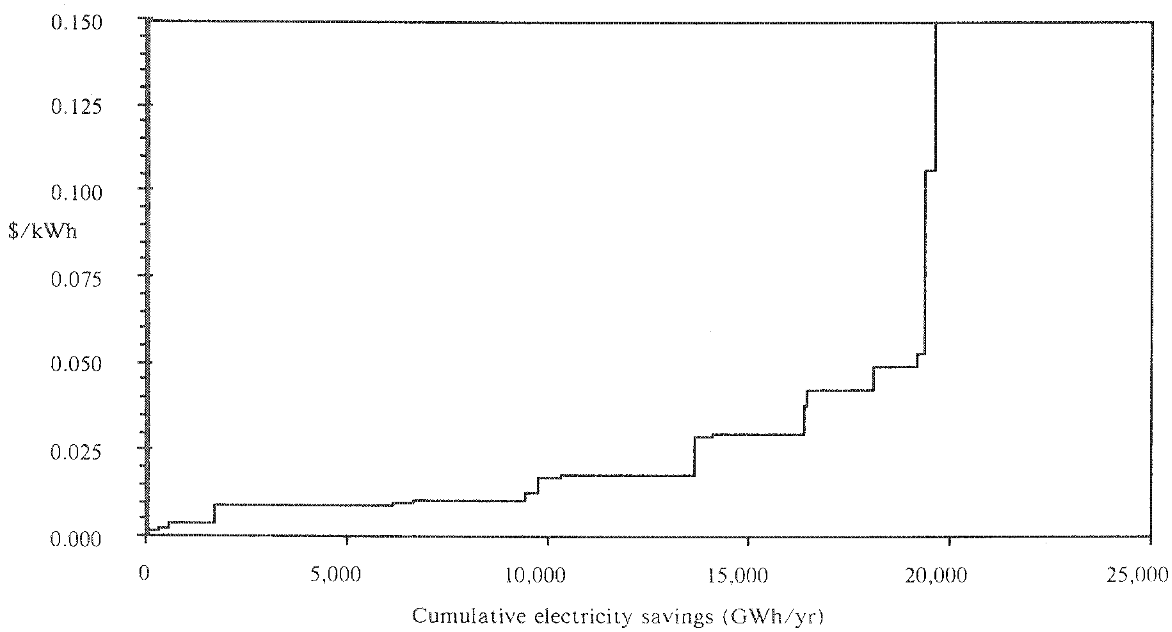


Figure 2-21

SUMMER PEAK DEMAND REDUCTION SUPPLY CURVE - COMM. SECTOR
New York State - 3% Discount Rate

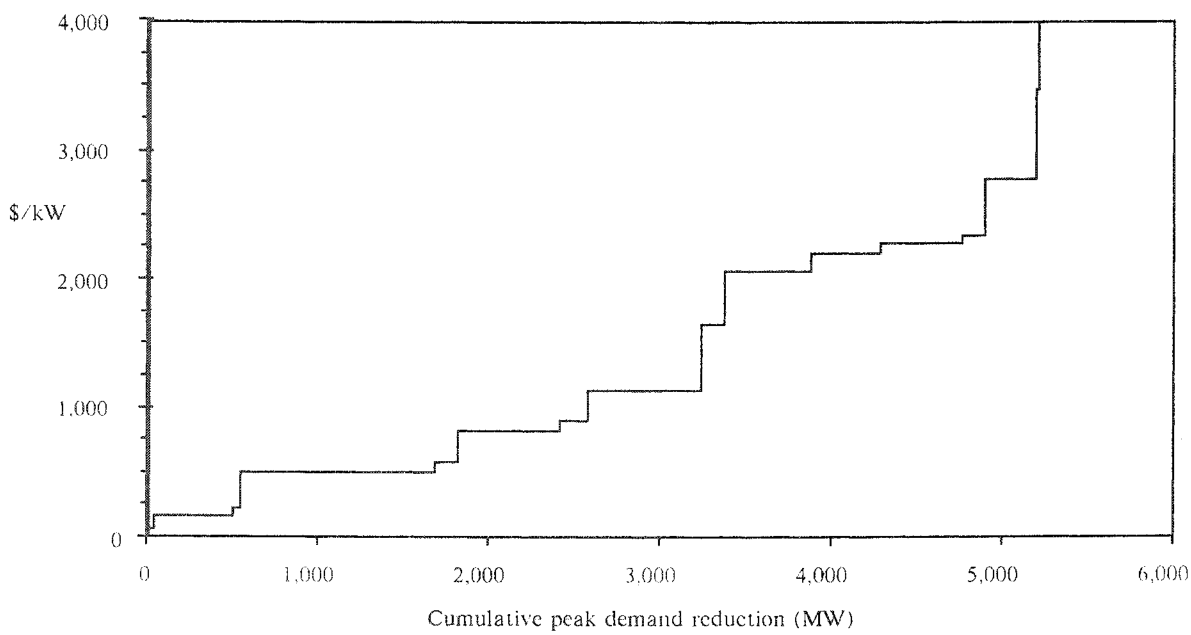


Figure 2-22

ELECTRICITY CONSERVATION SUPPLY CURVE - INDUSTRIAL SECTOR
New York State - 3% Discount Rate

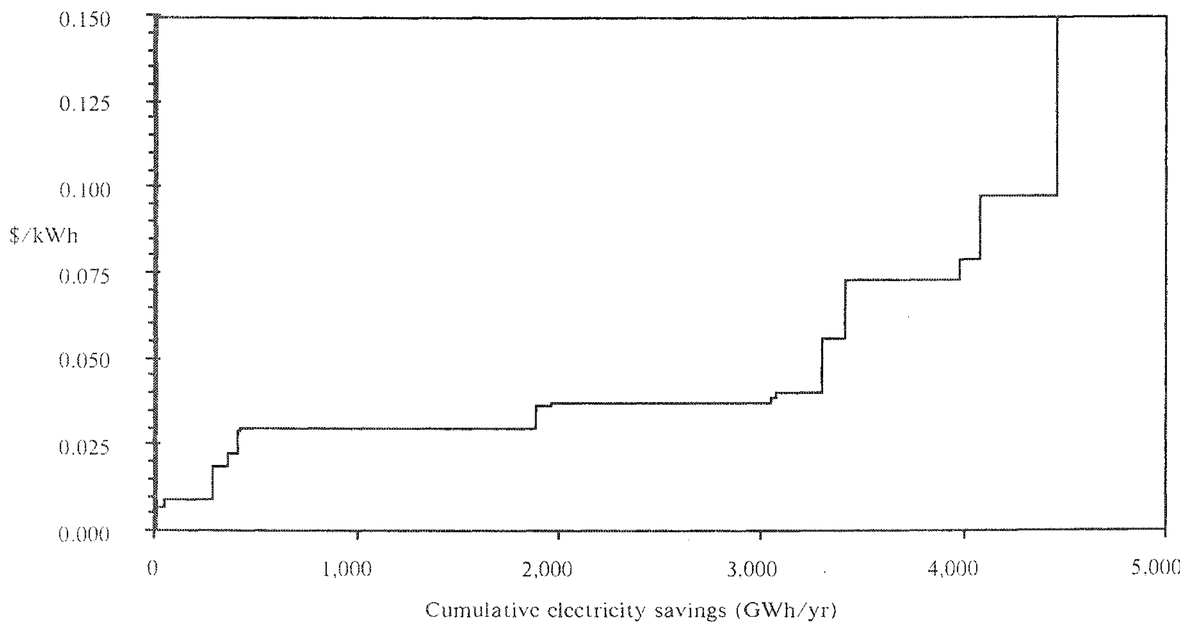
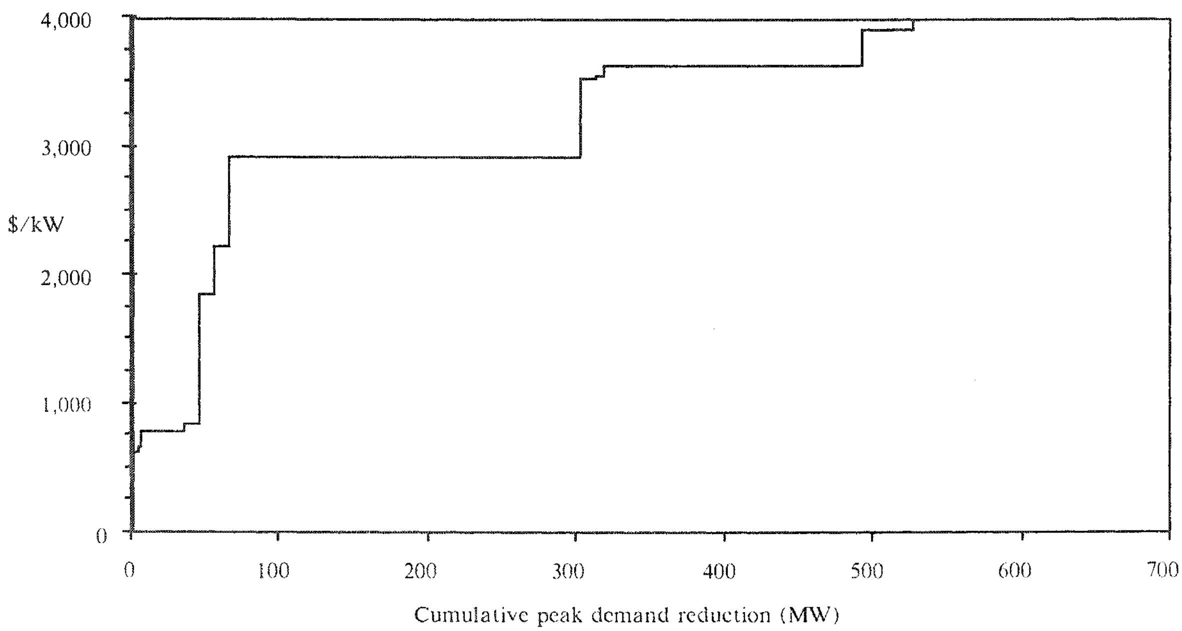


Figure 2-23

SUMMER PEAK DEMAND REDUCTION SUPPLY CURVE - INDUS. SECTOR
New York State - 3% Discount Rate



account for 44% of the total savings available. Lighting and space heating measures each contribute 29% and 9% of total savings, respectively. The eight air conditioning measures dominate the bottom of the list in terms of cost-effectiveness.

In contrast, many of the air conditioning measures rank high in terms of cost-effectiveness with regard to peak demand reductions, as shown in the peak demand conservation assessment for the residential sector in Tables 2-33, 2-39 and 2-45. They also account for over half of the total potential reduction in summer peak demand savings in the residential sector. Electric space heating measures account for the largest share of potential winter peak demand reductions.

The electricity conservation assessment for the commercial sector shows a mix of lighting, HVAC and refrigeration measures in order of decreasing cost-effectiveness. The four shell measures are by far the least cost-effective under all three discount rates. The 22 measures analyzed with respect to electricity savings together reduce commercial sector electricity consumption by 50%. HVAC measures account for 52% of the total electricity savings potential. Lighting measures account for a further 43%. Almost half of the lighting savings is provided by reflectors.

The peak demand conservation assessment for the commercial sector shows the same mix of lighting, HVAC and refrigeration measures with shell measures again among the least cost-effective measures. The 22 measures analyzed with respect to potential peak demand reductions in the commercial sector together reduce summer peak demand by 53% and winter peak demand by 33%.

The electricity conservation assessment for the industrial sector is composed of 19 measures which together reduce industrial electricity consumption by 22%.

The variable-speed drive measures provide 78% of total electricity savings.

The fraction of savings for summer and winter peak demand in the industrial sector is the same as for electricity consumption. This is a logical result of our assumption -- discussed in the previous chapter -- that the ratio of summer and winter peak demand to electricity consumption is the same for all measures and end uses and is equal to the ratios for the industrial sector as a whole.

In total, this study evaluates conservation measures directed at end uses which account for 82,672 GWh/yr or 83% of electricity consumption in the service territories of the seven major private utilities. The measures analyzed in this study together would reduce electricity consumption by these end uses by 37,149 GWh/yr, or 45%.

The potential savings from the 62 conservation measures evaluated in this study equal 37% of total electricity consumption in the service territories of the seven major private utilities. Implementation of these measures would reduce summer peak demand by 9,260 MW, or 45%. Winter peak demand would be reduced by 6,483 MW, or 36%. It can be seen in the overall statewide supply curves, Figures 2-1 and 2-2, that over 20,000 GWh/yr in potential electricity savings are available at a cost of less than 3¢/kWh and that 5,000 kW in summer peak demand reductions are available at a cost of less than $1,000/kW.

B. Cost-Effectiveness Results

The total potential savings of electricity consumption and peak demand from the application of the conservation measures that are below the cost-effectiveness thresholds for each of the individual utilities is presented in Table 2-50. Both total savings and the percent of total consumption and demand are presented from the consumer, utility and societal perspectives. These savings represent the conservation potential for which the

Table 2-50

TECHNOLOGY-COST POTENTIAL
ELECTRICITY AND PEAK DEMAND SAVINGS
NEW YORK STATE
Savings and percent of total

CONSUMER PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	12,297	35.6%	1,951	27.0%	1,859	27.6%
Commercial	19,399	48.4%	4,463	44.3%	2,517	31.8%
Industrial	2,646	13.0%	438	13.4%	411	13.2%
Total	34,342	34.7%	6,852	33.3%	4,787	26.9%

UTILITY PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	9,823	28.4%	2,442	33.8%	1,604	23.8%
Commercial	15,606	38.9%	3,450	34.3%	1,970	24.9%
Industrial	1,859	9.1%	293	9.0%	290	9.3%
Total	27,288	27.6%	6,185	30.1%	3,864	21.7%

SOCIETAL PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	11,856	34.3%	3,083	42.6%	2,998	44.5%
Commercial	18,901	47.1%	5,062	50.3%	2,506	31.6%
Industrial	3,303	16.2%	529	16.2%	507	16.2%
Total	34,060	34.4%	8,674	42.2%	6,011	33.8%

*Discount rates for each perspective are: 6% - consumer, 10% - utility, 3% - societal

technology cost is less than the appropriate cost-effectiveness threshold. Because the cost-effectiveness analysis is based only on the technology costs of the conservation measures, total potential savings under the cost-effectiveness thresholds are referred to as "technology-cost" potential savings". Estimates of full cost-effectiveness will need to take into account administrative program costs and limits to full adoption. Technology-cost potential savings for each of the individual utilities is presented in the following section.

It should be made clear that Table 2-50 presents the sum of the potential savings in electricity and reductions in peak demand from all seven utilities using utility-specific cost-effectiveness thresholds and conservation analyses. It would be possible to instead calculate potential savings using statewide average cost-effectiveness thresholds and conservation analyses. The latter approach produces results that differ by no more than 5% from the former approach and that are not biased toward either larger or smaller estimates of potential savings. We have adopted the former approach in our presentation of statewide savings potential for the sake of overall consistency with the utility-specific results.

It is also important to point out that the summary tables presented in this section include the total energy and peak demand savings from all measures that are judged cost-effective on the basis of either energy (CSE) or peak demand (CRD). That is, they include the peak demand reductions from conservation measures that are cost-effective on the basis of their energy savings, and vice versa.

The conservation analysis from the consumer perspective incorporates a discount rate of 6%. The cost-effectiveness threshold used is current electricity rates. From this perspective, total technology-cost potential electricity savings are 34,342 GWh/yr or 35% of annual consumption in 1986. The commercial sector offers the largest potential for technology-cost electricity savings, 19,400 GWh/yr.

The technology-cost potential reduction in peak demand from the consumer perspective is 6,850 MW, or 33% of 1986 peak demand, for the summer and 4,800 MW, or 27% of 1986 peak demand, for the winter. Because there is no cost-effectiveness threshold for peak demand savings from the consumer perspective, analysis of CSE is the sole criteria for determining cost-effective reductions in peak demand.

The utility perspective utilizes a discount rate of 10% and cost-effectiveness thresholds based on the marginal cost of capacity and electricity supply. The total technology-cost potential electricity savings from this perspective are 27,300 GWh/yr or 28% of annual consumption in 1986. The technology-cost potential reduction in peak demand is 6,200 MW, or 30% of 1986 peak demand, for the summer and 3,900 MW or 22% of 1986 peak demand, for the winter. As with the consumer perspective, the commercial sector offers the largest potential for technology-cost electricity as well as summer and winter peak demand savings.

Total technology-cost potential savings from the utility perspective are the lowest of the three perspectives. This is due to use of a relatively high discount rate, which results both in increased CSEs for the measures and lower cost-effectiveness thresholds.

The societal perspective analysis is based on a discount rate of 3%. The cost-effectiveness thresholds are the marginal cost of electricity and demand, discounted to net present value at 3% (which increases the marginal costs above those assumed from the utility perspective). Total technology-cost potential electricity savings are 34,060 GWh/yr or 34% of annual consumption in 1986. The technology-cost potential reduction in peak demand is 8,700 MW, or 42% of 1986 peak demand, for the summer and 6,000 MW or 34% of 1986 peak demand, for the winter. As with both the consumer and utility perspectives, the commercial sector offers the largest potential for technology-cost electricity and summer peak demand savings. The largest potential for technology-cost reductions in winter peak demand, from this perspective, is in the residential sector.

Technology-cost potential electricity savings from the societal perspective are higher than from the utility perspective. The potential is higher than from the utility perspective because the lower societal discount rate leads to a higher cost-effectiveness threshold and lower CSEs for the measures. With regard to the consumer perspective, current electricity rates are still higher than the marginal costs of energy and peak demand even when evaluated at the societal discount rate of 3%. But, electricity savings potential from measures that are cost-effective on the basis of reduced peak demand raises the total technology-cost electricity savings potential from the societal perspective to slightly less than the total potential from the consumer perspective.

Total technology-cost potential reductions in peak demand from the societal perspective are higher than from the utility perspective due to the lower cost-effectiveness threshold. They are also higher than total technology-cost potential reductions in peak demand from the consumer perspective because the lack of a cost-effectiveness threshold from the consumer perspective excludes measures that are not cost-effective with respect to reductions in peak demand. Much of the additional technology-cost peak demand reduction potential comes from measures in the residential sector, including load controllers and cyclers, and space conditioning measures.

The industrial sector accounts for the smallest fraction of potential electricity savings and peak demand from all three perspectives. This is due to a combination of factors. First, the industrial sector accounts for the smallest fraction of electricity consumption and peak demand among the three sectors. Second, the analysis for the industrial sector includes the fewest number of measures, for reasons discussed earlier. Third, the cost-effectiveness threshold for the industrial sector is lower than for the other two sectors, as industrial electricity rates are lowest of the three sectors. Total technology-cost potential savings from the industrial sector is particularly low from the utility perspective, where the cost-effectiveness threshold is so low that it fails to include any of the variable-speed drive measures. VSDs account for the majority of savings potential in this sector, as discussed earlier.

A number of the conservation measures analyzed will be required under various state or federal efficiency standards[118,119]. In particular, some of the savings from replacement of appliances and fluorescent lamp ballasts with more efficient models will occur without further intervention[120]. Savings from these measures total 5,030 GWh/yr, or 15% of the total technology-cost-effective electricity savings from the consumer perspective. The associated peak demand savings from these measures is 1,245 MW and 495 MW in the summer and winter, respectively. By far the largest fraction of these savings -- 4,373 GWh/yr -- comes from federal standards for residential refrigerators and freezers. Total technology-cost potential savings from the consumer perspective, excluding the savings due to existing efficiency standards, is 28,054 GWh/yr or 28% of statewide electricity use as of 1986.

In conclusion, we find that there is an enormous potential for electricity savings and peak demand reductions within New York's existing stock of buildings and equipment. Developing a significant portion of this resource could save households and businesses in the state billions of dollars and eliminate the need to build a number of new power plants.

To put the total technology-cost savings potential into perspective, a recent forecast prepared by the New York State Energy Office predicts annual demand growth of 1.75% during 1985-2002[121]. This implies that electricity demand in the service areas of the seven major private utilities will increase by about 27,000 GWh/yr between 1986 and 2000. Based on our analysis, all of this demand could be displaced if approximately 80% of the technology-cost electricity savings potential in existing buildings and equipment (based on the consumer or societal perspectives) is realized. Very little of the savings potential in existing buildings and equipment is currently incorporated into the Energy Office's forecast.

It is important to reiterate that the estimates of savings potential in this study do not take into account any of the limitations on implementation. In reality, only a portion of the full technical and economic savings potential can be achieved. Also, utilities will incur costs for the promotion of conservation measures in addition to the purchase and installation costs considered in this study. On the other hand, the adoption of conservation measures provides other benefits besides reducing electricity use and peak demand (e.g., air pollution and greenhouse warming are reduced). As a suggestion for follow-up work, we recommend that this study be combined with analyses of implementation experience in New York and elsewhere as well as environmental and social impacts in order to develop estimates of achievable savings and broader costs and benefits.

V. **UTILITY-SPECIFIC RESULTS**

A. Summary

In this section we report on the potential for technology-cost potential electricity savings and reductions in peak demand from the perspectives of each of the seven utilities included in our analysis. The cost-effectiveness analyses for each of the individual utilities differ from each other for a number of reasons. First, the cost-effectiveness thresholds, presented in Table 2-1, vary substantially from utility to utility. Second, the conservation analyses vary among utilities because of differences in climate zones, appliance and building saturations, and sectoral distributions of energy and peak demand, among other factors.

The total technology-cost potential savings from each of the seven utilities is broken down by utility in Tables 2-51 to 2-53, for each of the three perspectives. Generally, the fraction of statewide potential savings is proportional to each utility's share of statewide sales and/or peak demand. Thus, Con Ed -- which has the highest level of consumption and peak demand -- offers the largest potential for electricity savings and peak demand reduction. The other utilities follow roughly in order of decreasing size.

Superimposed on this general trend is a bias for additional savings potential from those utilities with large commercial and residential sectors relative to their industrial sector. As described earlier, the industrial sector generally offers the smallest potential savings while the commercial sector offers the largest. Thus, CHG&E, NMPC and RG&E offer less potential savings than their relative size would indicate because of the relatively large industrial sectors in their service territories. In contrast, Con Ed's commercial sector comprises a relatively large share of consumption and peak

Table 2-51
TECHNOLOGY-COST POTENTIAL
ELECTRICITY AND PEAK DEMAND SAVINGS
CONSUMER PERSPECTIVE

Utility	Cost-effective electricity savings potential (GWh/yr)	Fraction of statewide potential	Fraction of utility consumption
Central Hudson Gas & Electric	1,230	3.6%	29.6%
Consolidated Edison	13,546	39.4%	44.9%
Long Island Lighting Co.	4,575	13.3%	31.8%
New York State Electric & Gas	3,380	9.8%	28.6%
Niagara Mohawk Power Co.	9,115	26.5%	30.0%
Orange & Rockland	792	2.3%	33.7%
Rochester Gas & Electric	1,704	5.0%	29.5%
Total	34,342	100.0%	34.7%

Utility	Cost-effective summer peak demand savings potential (MW)	Fraction of statewide potential	Fraction of utility summer peak demand
Central Hudson Gas & Electric	220	3.2%	28.6%
Consolidated Edison	2,963	43.2%	38.8%
Long Island Lighting Co.	982	14.3%	29.7%
New York State Electric & Gas	568	8.3%	30.2%
Niagara Mohawk Power Co.	1,636	23.9%	31.9%
Orange & Rockland	172	2.5%	22.1%
Rochester Gas & Electric	312	4.6%	29.2%
Total	6,853	100.0%	33.3%

Utility	Cost-effective winter peak demand savings potential (MW)	Fraction of statewide potential	Fraction of utility winter peak demand
Central Hudson Gas & Electric	165	3.4%	23.1%
Consolidated Edison	1,898	39.6%	36.8%
Long Island Lighting Co.	620	13.0%	24.3%
New York State Electric & Gas	491	10.3%	21.9%
Niagara Mohawk Power Co.	1,264	26.4%	22.8%
Orange & Rockland	112	2.3%	19.7%
Rochester Gas & Electric	237	5.0%	23.6%
Total	4,787	100.0%	26.9%

Table 2-52
TECHNOLOGY-COST POTENTIAL ELECTRICITY AND PEAK DEMAND SAVINGS UTILITY PERSPECTIVE

Utility	Cost-effective electricity savings potential (GWh/yr)	Fraction of statewide potential	Fraction of utility consumption
Central Hudson Gas & Electric	728	2.7%	17.5%
Consolidated Edison	11,118	40.7%	36.9%
Long Island Lighting Co.	3,973	14.6%	27.6%
New York State Electric & Gas	2,482	9.1%	21.0%
Niagara Mohawk Power Co.	7,177	26.3%	23.6%
Orange & Rockland	585	2.1%	24.9%
Rochester Gas & Electric	1,225	4.5%	21.2%
Total	27,288	100.0%	27.6%

Utility	Cost-effective summer peak demand savings potential (MW)	Fraction of statewide potential	Fraction of utility summer peak demand
Central Hudson Gas & Electric	155	2.5%	20.1%
Consolidated Edison	2,622	42.4%	34.4%
Long Island Lighting Co.	1,199	19.4%	36.2%
New York State Electric & Gas	446	7.2%	23.7%
Niagara Mohawk Power Co.	1,345	21.7%	26.3%
Orange & Rockland	160	2.6%	20.5%
Rochester Gas & Electric	260	4.2%	24.3%
Total	6,187	100.0%	30.1%

Utility	Cost-effective winter peak demand savings potential (MW)	Fraction of statewide potential	Fraction of utility winter peak demand
Central Hudson Gas & Electric	98	2.5%	13.7%
Consolidated Edison	1,474	38.1%	28.5%
Long Island Lighting Co.	682	17.7%	26.8%
New York State Electric & Gas	358	9.3%	16.0%
Niagara Mohawk Power Co.	1,002	25.9%	18.1%
Orange & Rockland	82	2.1%	14.4%
Rochester Gas & Electric	168	4.3%	16.7%
Total	3,864	100.0%	21.7%

Table 2-53

TECHNOLOGY-COST POTENTIAL
ELECTRICITY AND PEAK DEMAND SAVINGS
SOCIETAL PERSPECTIVE

Utility	Cost-effective electricity savings potential (GWh/yr)	Fraction of statewide potential	Fraction of utility consumption
Central Hudson Gas & Electric	1,130	3.3%	27.2%
Consolidated Edison	13,297	39.0%	44.1%
Long Island Lighting Co.	4,630	13.6%	32.2%
New York State Electric & Gas	3,372	9.9%	28.6%
Niagara Mohawk Power Co.	9,213	27.0%	30.3%
Orange & Rockland	773	2.3%	32.9%
Rochester Gas & Electric	1,645	4.8%	28.5%
Total	34,060	100.0%	34.4%

Utility	Cost-effective summer peak demand savings potential (MW)	Fraction of statewide potential	Fraction of utility summer peak demand
Central Hudson Gas & Electric	246	2.8%	31.9%
Consolidated Edison	3,628	41.8%	47.6%
Long Island Lighting Co.	1,421	16.4%	42.9%
New York State Electric & Gas	688	7.9%	36.6%
Niagara Mohawk Power Co.	2,083	24.0%	40.7%
Orange & Rockland	216	2.5%	27.7%
Rochester Gas & Electric	393	4.5%	36.8%
Total	8,675	100.0%	42.2%

Utility	Cost-effective winter peak demand savings potential (MW)	Fraction of statewide potential	Fraction of utility winter peak demand
Central Hudson Gas & Electric	157	2.6%	22.0%
Consolidated Edison	1,967	32.7%	38.1%
Long Island Lighting Co.	792	13.2%	31.1%
New York State Electric & Gas	748	12.4%	33.3%
Niagara Mohawk Power Co.	1,913	31.8%	34.5%
Orange & Rockland	126	2.1%	22.1%
Rochester Gas & Electric	308	5.1%	30.6%
Total	6,011	100.0%	33.8%

demand and so offers even more potential savings than its relative size would indicate.

Finally, there is a tendancy for additional savings potential from those utilities with higher cost-effectiveness thresholds. From the consumer perspective, both Con Ed and LILCO have particularly high electricity rates while NMPC's are below average. From the utility and societal perspectives, LILCO has particularly high marginal costs while CHG&E's are quite low.

The result of these different effects is that Con Ed accounts for a disproportionate share of potential savings. Alternatively, NMPC, CHG&E and RG&E each account for a disproportionately small share of potential savings.

Overall, only Con Ed shows higher savings potentials from the consumer perspective than the state as a whole. For the other six utilities, the technology-cost savings potentials are in the range of 20-34% of total electricity use or peak demand in 1986. In terms of contribution to the statewide technology-cost savings potential, Con Ed provides 40% of the total, NMPC provides 27%, LILCO provides 13%, and the other four utilities provide the remaining 20%. Con Ed, NMPC, and LILCO contribute 81% of the statewide technology-cost potential for summer peak demand reduction, and 79% of the statewide technology-cost potential for winter peak demand reduction.

B. Central Hudson Gas & Electric Corp.

The total potential technology-cost savings of electricity consumption and peak demand in the service territory of CHG&E is presented in Table 2-54. Both total savings and the percent of total consumption and demand are presented from each of the three perspectives. The sectoral conservation assessments for CHG&E from the consumer perspective are presented in Tables 2-55 to 2-60.

From the consumer perspective, potential technology-cost electricity savings are 1,230 GWh/yr or 30% of annual consumption in 1986. The technology-cost potential

Table 2-54
TECHNOLOGY-COST POTENTIAL
ELECTRICITY AND PEAK DEMAND SAVINGS
CENTRAL HUDSON GAS & ELECTRIC
Savings and percent of total

CONSUMER PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	Electricity consumption (%)	Summer peak demand (MW)	Summer peak demand (%)	Winter peak demand (MW)	Winter peak demand (%)
Residential	498	38.0%	63	27.3%	72	25.2%
Commercial	441	47.4%	106	41.7%	55	25.6%
Industrial	291	17.8%	51	17.8%	38	17.8%
Total	1,230	29.6%	220	28.5%	165	23.1%

UTILITY PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	Electricity consumption (%)	Summer peak demand (MW)	Summer peak demand (%)	Winter peak demand (MW)	Winter peak demand (%)
Residential	368	28.1%	75	32.5%	54	18.9%
Commercial	326	35.0%	74	29.1%	40	18.6%
Industrial	34	2.1%	6	2.1%	4	2.0%
Total	728	17.5%	155	20.1%	98	13.8%

SOCIETAL PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	Electricity consumption (%)	Summer peak demand (MW)	Summer peak demand (%)	Winter peak demand (MW)	Winter peak demand (%)
Residential	442	33.7%	100	43.3%	70	24.5%
Commercial	408	43.8%	97	38.2%	50	23.3%
Industrial	280	17.2%	49	17.2%	37	17.2%
Total	1,130	27.2%	246	31.9%	157	22.0%

*Discount rates for each perspective are: 6% - consumer, 10% - utility, 3% - societal

Table 2-55
ELECTRICITY CONSERVATION ASSESSMENT
RESIDENTIAL SECTOR
Central Hudson Gas and Electric
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
FRE	Current sales average (1986)	0.004	21	21	1.63%
REF	Current sales average (1986)	0.010	65	87	6.62%
REF	Best current (1988)	0.011	65	152	11.57%
REF	Near-term advanced	0.013	27	179	13.65%
EWH	Traps & blanket (EF=0.9)	0.013	15	194	14.79%
FRE	Best current (1988)	0.014	15	209	15.93%
FRE	Near-term advanced	0.015	7	216	16.49%
ESH1	Infiltration reduction	0.017	34	250	19.05%
RAN	Improved oven	0.022	12	262	19.96%
ESH2	Storm windows	0.024	2	264	20.11%
RAN	Improved cooktop	0.025	4	268	20.43%
ESH2	Low-emissivity film	0.026	1	268	20.47%
LTG	Tungsten halogen lamps-300 h/y	0.027	24	292	22.30%
LTG	Energy saving lamps-620 hr/yr	0.030	3	295	22.52%
LTG	Energy saving lamps-1,240 h/y	0.030	3	299	22.77%
EWH	Front loading clothes washer	0.034	25	324	24.70%
LTG	Compact fluorescents-1240 h/y	0.036	38	362	27.59%
LTG	IRF lamps - 300 hr/yr	0.044	28	390	29.73%
LTG	Compact fluorescents-620 h/y	0.045	32	421	32.14%
ESH1	Heat pump #1 (HSPF=7)*	0.047	7	428	32.64%
ESH1	Heat pump #2 (HSPF=8)*	0.062	1	429	32.69%
ECD	Heat pump clothes dryer	0.065	54	483	36.82%
RAC	RAC: 8.5 EER	0.072	6	489	37.27%
ESH1	Low-emissivity film	0.079	10	498	38.01%
RAC	RAC: 10.0 EER	0.115	4	502	38.30%
CAC	Window film	0.128	3	505	38.49%
CAC	CAC: 10.0 SEER	0.132	3	508	38.72%
RAC	RAC: 12 .0 EER	0.146	4	512	39.02%
CAC	Variable speed drive	0.192	2	514	39.17%
CAC	CAC: 12.0 SEER	0.258	2	515	39.31%
CAC	CAC: 14.0 SEER	0.407	1	517	39.41%
ESH1	Add 3" fiberglass in roof/ceiling	0.439	2	518	39.53%

Notes:
1. 1986 residential electricity consumption: 1,311 GWh
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family and small (2-4 units) multi-family homes; ESH2: electric space heating in large (5+ units) multi-family homes.

Table 2-56
PEAK DEMAND ASSESSMENT
RESIDENTIAL SECTOR
Central Hudson Gas and Electric
Discount rate = 6%

			SUMMER			WINTER		
Area	Option	Marginal CRD(20) ($/kW)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)
CAC	Load controller/cycler	159	16	16	7.1%	0	0	0.0%
RAC	RAC: 8.5 EER	345	16	32	13.9%	0	0	0.0%
FRE	Current sales average (1986)	358	3	35	15.3%	3	3	0.7%
RAC	RAC: 10.0 EER	492	11	46	20.1%	0	3	0.7%
REF	Current sales average (1986)	681	11	58	24.9%	6	9	2.2%
RAC	RAC: 12 .0 EER	695	10	68	29.4%	0	9	2.2%
ESH2	Storm windows	700	0	68	29.4%	1	9	2.4%
ESH2	Low-emissivity film	764	0	68	29.4%	0	10	2.4%
REF	Best current (1988)	795	11	79	34.2%	6	15	3.9%
ESH1	Infiltration reduction	802	0	79	34.2%	9	24	6.2%
EWH	Load controller/cycler	825.	5	84	36.2%	12	36	9.2%
ECD	Load controller/cycler	832	16	100	43.3%	28	65	16.5%
EWH	Traps & blanket (EF=0.9)	837	1	101	43.8%	3	68	17.3%
REF	Near-term advanced	949	5	106	45.8%	2	70	17.9%
CAC	Window film	955	4	110	47.6%	0	70	17.9%
RAN	Improved oven	1,098	3	113	48.9%	2	72	18.4%
FRE	Best current (1988)	1,183	2	115	49.8%	2	74	18.9%
CAC	CAC: 10.0 SEER	1,209	4	119	51.6%	0	74	18.9%
FRE	Near-term advanced	1,224	1	120	52.1%	1	75	19.1%
LTG	Tungsten halogen lamps-300 h/y	1,239	1	122	52.6%	5	80	20.5%
RAN	Improved cooktop	1,254	1	123	53.0%	1	81	20.7%
ESH1	Electric thermal storage system*	1,305	0	123	53.0%	40	121	30.8%
ESH1	Heat pump #1 (HSPF=7)*	1,349	0	123	53.0%	3	124	31.6%

ESH1	Heat pump #2 (HSPF=8)*	1,429	0	123	53.0%	0	124	31.6%
LTG	Energy saving lamps-620 hr/yr	1,603	0	123	53.1%	1	125	31.8%
LTG	Energy saving lamps-1,240 h/y	1,659	0	123	53.2%	1	125	32.0%
CAC	CAC: 12.0 SEER	2,000	3	126	54.4%	0	125	32.0%
LTG	IRF lamps - 300 hr/yr	2,004	1	127	55.0%	6	132	33.6%
LTG	Compact fluorescents-1240 h/y	2,044	2	129	55.8%	8	140	35.7%
LTG	Compact fluorescents-620 h/y	2,561	2	130	56.5%	7	147	37.5%
CAC	CAC: 14.0 SEER	3,048	2	133	57.4%	0	147	37.5%
EWH	Front loading clothes washer	3,418	1	134	58.0%	3	150	38.3%
ESH1	Low-emissivity film	5,364	0	134	58.0%	2	152	38.7%
ESH1	Add 3" fiberglass in roof/ceiling	42,210	0	134	58.0%	0	152	38.8%

*The electric thermal storage system (ETS) and heat pumps are mututally exclusive measures. CSE and CRD are calculated independently.

Notes:
1. 1986 residential summer peak: 231 MW; winter peak: 392 MW
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family homes; ESH2: electric space heating in multi-family homes.
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Table 2-37
ELECTRICITY CONSERVATION ASSESSMENT
COMMERCIAL SECTOR
Central Hudson Gas and Electric – Downstate climate zone
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
LTG	Delamping	0.001	5	5	0.50%
REF	Floating head press. control	0.001	5	10	1.02%
REF	Refrig. compressor eff.	0.003	6	16	1.68%
HVAC	Reset supply air temperature	0.004	30	45	4.87%
LTG	Reflectors	0.010	104	149	16.02%
HVAC	Fan motor efficiency	0.011	6	155	16.70%
LTG	High-efficiency ballast	0.011	12	168	18.04%
HVAC	VAV conversion	0.013	55	223	23.98%
LTG	Energy saving fluorescents	0.016	15	239	25.63%
HVAC	Pump motor efficiency	0.018	1	239	25.69%
HVAC	Economizer	0.019	8	247	26.57%
HVAC	VSD on fan motor	0.022	66	314	33.71%
LTG	Occupancy sensors	0.035	12	326	35.01%
REF	Refrigerated case covers	0.044	2	327	35.18%
LTG	Daylighting controls	0.049	40	368	39.52%
HVAC	Re-size chillers	0.054	40	408	43.87%
LTG	VHE bulbs and ballasts	0.058	27	436	46.80%
HVAC	VSD on pump motor	0.062	5	441	47.35%
SHELL	Window films (S&W)	0.112	6	447	47.96%
SHELL	Low-E windows (all)	0.372	4	450	48.35%
SHELL	Roof insulation	0.780	0	451	48.40%
SHELL	Low-E windows (N)	0.883	0	451	48.43%

Notes:
1. 1986 commercial electricity sales: 931 GWh
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration

Table 2-58

PEAK DEMAND CONSERVATION ASSESSMENT

COMMERCIAL SECTOR

Central Hudson Gas and Electric - Downstate climate zone

Discount rate = 6%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
LTG	Delamping	53	1	1	0.6%	1	1	0.3%
HVAC	Reset supply air temperature	135	12	13	5.2%	2	3	1.2%
REF	Refrig. compressor eff.	213	1	14	5.6%	1	3	1.4%
LTG	Reflectors	477	29	43	16.8%	15	18	8.4%
LTG	High-efficiency ballast	558	3	46	18.0%	2	20	9.3%
LTG	Energy saving fluorescents	701	4	51	20.1%	2	23	10.9%
HVAC	Fan motor efficiency	750	1	47	18.5%	1	21	9.9%
HVAC	VAV conversion	766	11	63	24.6%	6	29	13.7%
HVAC	Pump motor efficiency	966	0	63	24.7%	0	29	13.7%
HVAC	Cool storage	1,107	15	78	30.6%	0	29	13.7%
LTG	Occupancy sensors	1,573	3	81	31.9%	2	31	14.5%
LTG	Daylighting controls	2,092	12	93	36.6%	6	38	17.5%
HVAC	VSD on fan motor	2,154	8	101	39.8%	9	46	21.6%
SHELL	Window films (S&W)	2,336	3	115	45.2%	0	50	23.4%
HVAC	Re-size chillers	2,543	10	112	43.9%	4	51	23.5%
LTG	VHE bulbs and ballasts	2,684	7	122	48.2%	4	54	25.2%
REF	Refrigerated case covers	3,208	0	123	48.3%	0	54	25.3%
HVAC	VSD on pump motor	4,556	1	123	48.6%	0	55	25.5%
HVAC	Economizer	4,997	0	124	48.8%	0	55	25.5%
SHELL	Low-E windows (N)	6,072	0	124	48.8%	0	55	25.6%
SHELL	Roof insulation	7,620	1	124	49.0%	0	55	25.6%
SHELL	Low-E windows (all)	42,091	1	125	49.3%	1	56	26.1%

Notes:
1. 1986 commercial summer peak 254 MW; winter peak: 215 MW;
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration

Table 2-59
ELECTRICITY CONSERVATION ASSESSMENT
INDUSTRIAL SECTOR
Central Hudson Gas and Electric
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
MOT	>125 HP: retire	0.008	0.6	0.6	0.0%
MOT	21 - 50 HP: retire	0.008	2.2	2.8	0.2%
MOT	51-125 HP: retire	0.008	0.9	3.7	0.2%
LTG	Energy saving lamp	0.009	14.7	18.4	1.1%
MOT	5.1-20 HP: retire	0.012	5.5	23.9	1.5%
LTG	Metal halide lamp	0.020	5.3	29.2	1.8%
LTG	High-efficiency ballast	0.027	4.6	33.8	2.1%
MOT	>125 HP: VSD	0.036	126.8	160.6	9.8%
MOT	1-5 HP: retire	0.037	0.6	161.2	9.9%
LTG	High-pressure sodium	0.043	17.3	178.5	10.9%
MOT	21-50 HP: rebuild	0.044	6.2	184.7	11.3%
MOT	51-125 HP: VSD	0.045	92.6	277.4	17.0%
MOT	5.1-20 HP: rebuild	0.051	3.0	280.3	17.2%
MOT	51-125 HP: rebuild	0.064	10.5	290.8	17.8%
MOT	21-50 HP: VSD	0.087	48.0	338.8	20.8%
MOT	>125 HP: rebuild	0.090	9.6	348.4	21.4%
MOT	<1 HP: retire	0.103	0.1	348.5	21.4%
MOT	5.1-20 HP: VSD	0.129	32.3	380.7	23.3%
MOT	1-5 HP: VSD	0.373	2.2	382.9	23.5%

Notes:
1. 1986 industrial electricity sales: 1,631 GWh
2. MOT: Motor efficiency measure; LTG: Lighting efficiency measure

Table 2-60

PEAK DEMAND CONSERVATION ASSESSMENT
INDUSTRIAL SECTOR
Central Hudson Gas and Electric
Discount rate = 6%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
MOT	>125 HP: retire	526	0.1	0.1	0.0%	0.1	0.1	0.0%
MOT	21 - 50 HP: retire	551	0.4	0.5	0.2%	0.3	0.4	0.2%
MOT	51-125 HP: retire	554	0.2	0.6	0.2%	0.1	0.5	0.2%
LTG	Energy saving lamp	609	2.6	3.2	1.1%	1.9	2.4	1.1%
MOT	5.1-20 HP: retire	835	1.0	4.2	1.5%	0.7	3.2	1.5%
LTG	Metal halide lamp	1,444	0.9	5.1	1.8%	0.7	3.8	1.8%
LTG	High-efficiency ballast	1,943	0.8	5.9	2.1%	0.6	4.4	2.1%
MOT	>125 HP: VSD	2,521	22.2	28.1	9.8%	16.7	21.2	9.8%
MOT	1-5 HP: retire	2,553	0.1	28.2	9.9%	0.1	21.2	9.9%
LTG	High-pressure sodium	3,121	3.0	31.2	10.9%	2.3	23.5	10.9%
MOT	21-50 HP: rebuild	3,124	1.1	32.3	11.3%	0.8	24.4	11.3%
MOT	51-125 HP: VSD	3,142	16.2	48.5	17.0%	12.2	36.6	17.0%
MOT	5.1-20 HP: rebuild	3,570	0.5	49.0	17.2%	0.4	37.0	17.2%
MOT	51-125 HP: rebuild	4,469	1.8	50.8	17.8%	1.4	38.3	17.8%
MOT	21-50 HP: VSD	6,163	8.4	59.2	20.8%	6.3	44.7	20.8%
MOT	>125 HP: rebuild	6,223	1.7	60.9	21.4%	1.3	45.9	21.4%
MOT	<1 HP: retire	7,154	0.0	60.9	21.4%	0.0	45.9	21.4%
MOT	5.1-20 HP: VSD	8,997	5.6	66.5	23.3%	4.3	50.2	23.3%
MOT	1-5 HP: VSD	25,969	0.4	66.9	23.5%	0.3	50.5	23.5%

Notes:
1. 1986 industrial summer peak demand : 285 MW
2. 1986 industrial winter peak demand : 215 MW
3. MOT: Motor efficiency measure; LTG: Lighting efficiency measure
4. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

reduction in peak demand is 220 MW, or 29% of 1986 peak summer demand and 165 MW, or 23% of 1986 peak winter demand. Potential electricity savings from the utility perspective are substantially lower -- 728 GWh/yr -- while savings from the societal perspective are slightly lower -- 1,130 GWh/yr. It is interesting to note that potential technology-cost savings from the industrial sector are nearly equal from both the consumer and societal perspectives. This is because the long-run marginal cost for CHG&E is quite close to current industrial electricity rates.

C. Consolidated Edison

Of the seven utilities analyzed, Con Ed offers by far the largest potential for technology-cost savings of electricity and peak demand. Table 2-61 presents the results of the cost-effectiveness analysis for Con Ed from each of the three perspectives. The sectoral conservation assessments for Con Ed from the consumer perspective are presented in Tables 2-62 to 2-67.

Total technology-cost potential electricity savings are 13,546 GWh/yr or 45% of annual consumption in 1986 from the consumer perspective. The technology-cost-effective reduction in summer peak demand is 2,963 MW, or 39% of the 1986 peak. The technology-cost potential reduction in winter peak demand is 1,898 MW, 37% of the 1986 peak. Potential savings as a percentage of 1986 use are higher for Con Ed than for any of the other six utilities. This is due to the relatively large commercial sector, relatively small industrial sector, and high electricity rates in Con Ed's service territory.

The technology-cost electricity savings potential is substantially lower from the utility perspective (though still relatively high as a percentage of 1986 use) decreasing to 11,118 GWh/yr in electricity savings and 2,622 MW and 1,474 MW in summer and winter peak demand, respectively. The savings potential from the societal

Table 2-61
TECHNOLOGY-COST POTENTIAL
ELECTRICITY AND PEAK DEMAND SAVINGS
CONSOLIDATED EDISON
Savings and percent of total

CONSUMER PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	4,076	39.6%	938	35.1%	612	43.9%
Commercial	9,186	50.1%	1,965	42.2%	1,245	34.9%
Industrial	284	19.7%	60	19.7%	41	19.8%
Total	13,546	44.9%	2,963	38.8%	1,898	36.8%

UTILITY PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	3,145	30.6%	991	37.1%	434	31.1%
Commercial	7,842	42.8%	1,603	34.5%	1,021	28.7%
Industrial	131	9.1%	28	9.1%	19	9.1%
Total	11,118	36.9%	2,622	34.4%	1,474	28.5%

SOCIETAL PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	3,975	38.6%	1,293	48.4%	689	49.4%
Commercial	9,093	49.6%	2,286	49.1%	1,245	34.9%
Industrial	229	15.9%	49	15.9%	33	15.9%
Total	13,297	44.1%	3,628	47.6%	1,967	38.1%

*Discount rates for each perspective are: 6% - consumer, 10% - utility, 3% - societal

Table 2-62

ELECTRICITY CONSERVATION ASSESSMENT

RESIDENTIAL SECTOR

Consolidated Edison

Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
FRE	Current sales average (1986)	0.004	56	56	0.54%
REF	Current sales average (1986)	0.010	705	761	7.39%
REF	Best current (1988)	0.011	701	1,461	14.20%
REF	Near-term advanced	0.013	294	1,755	17.05%
EWH	Traps & blanket (EF=0.9)	0.013	39	1,793	17.43%
FRE	Best current (1988)	0.014	39	1,832	17.81%
FRE	Near-term advanced	0.015	19	1,852	18.00%
ESH1	Infiltration reduction	0.017	69	1,921	18.67%
RAN	Improved oven	0.022	45	1,966	19.11%
ESH2	Storm windows	0.024	78	2,044	19.86%
RAN	Improved cooktop	0.025	16	2,060	20.02%
ESH2	Low-emissivity film	0.026	24	2,084	20.25%
LTG	Tungsten halogen lamps-300 h/y	0.027	292	2,376	23.09%
LTG	Energy saving lamps-620 hr/yr	0.030	34	2,411	23.43%
LTG	Energy saving lamps-1,240 h/y	0.030	41	2,452	23.83%
EWH	Front loading clothes washer	0.034	65	2,517	24.46%
LTG	Compact fluorescents-1240 h/y	0.036	463	2,979	28.95%
LTG	IRF lamps - 300 hr/yr	0.044	341	3,320	32.27%
LTG	Compact fluorescents-620 h/y	0.045	385	3,706	36.01%
ESH1	Heat pump #1 (HSPF=7)*	0.047	10	3,716	36.11%
ESH1	Heat pump #2 (HSPF=8)*	0.062	1	3,717	36.12%
ECD	Heat pump clothes dryer	0.065	117	3,834	37.26%
RAC	RAC: 8.5 EER	0.072	102	3,936	38.25%
ESH1	Low-emissivity film	0.079	20	3,956	38.45%
RAC	RAC: 10.0 EER	0.115	64	4,020	39.07%
CAC	Window film	0.128	26	4,046	39.32%
CAC	CAC: 10.0 SEER	0.132	31	4,076	39.62%
RAC	RAC: 12 .0 EER	0.146	67	4,144	40.27%
CAC	Variable speed drive	0.192	20	4,164	40.46%
CAC	CAC: 12.0 SEER	0.258	18	4,182	40.64%
CAC	CAC: 14.0 SEER	0.407	13	4,195	40.77%
ESH1	Add 3" fiberglass in roof/ceiling	0.439	3	4,198	40.80%

Notes:

1. 1986 residential electricity consumption: 10,290 GWh
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family and small (2-4 units) multi-family homes; ESH2: electric space heating in large (5+ units) multi-family homes.

Table 2-63
PEAK DEMAND ASSESSMENT
RESIDENTIAL SECTOR
Consolidated Edison
Discount rate = 6%

			SUMMER			WINTER		
Area	Option	Marginal CRD(20) ($/kW)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)
CAC	Load controller/cycler	159	165	165	6.2%	0	0	0.0%
RAC	RAC: 8.5 EER	345	269	434	16.3%	0	0	0.0%
FRE	Current sales average (1986)	358	8	442	16.6%	8	8	0.5%
RAC	RAC: 10.0 EER	492	188	631	23.6%	0	8	0.5%
REF	Current sales average (1986)	681	121	751	28.1%	61	69	4.9%
RAC	RAC: 12 .0 EER	695	178	929	34.8%	0	69	4.9%
ESH2	Storm windows	700	0	929	34.8%	32	101	7.3%
ESH2	Low-emissivity film	764	0	929	34.8%	10	111	8.0%
REF	Best current (1988)	795	120	1,049	39.3%	61	172	12.3%
ESH1	Infiltration reduction	802	0	1,049	39.3%	19	191	13.7%
EWH	Load controller/cycler	825	12	1,061	39.7%	30	221	15.8%
ECD	Load controller/cycler	832	36	1,096	41.1%	62	283	20.3%
EWH	Traps & blanket (EF=0.9)	837	3	1,099	41.2%	8	291	20.8%
REF	Near-term advanced	949	50	1,150	43.1%	25	316	22.7%
CAC	Window film	955	43	1,193	44.7%	0	316	22.7%
RAN	Improved oven	1,098	11	1,204	45.1%	8	324	23.2%
FRE	Best current (1988)	1,183	6	1,209	45.3%	5	329	23.6%
CAC	CAC: 10.0 SEER	1,209	42	1,251	46.9%	0	329	23.6%
FRE	Near-term advanced	1,224	3	1,254	47.0%	3	331	23.8%
LTG	Tungsten halogen lamps-300 h/y	1,239	14	1,268	47.5%	64	396	28.4%
RAN	Improved cooktop	1,254	4	1,272	47.6%	3	398	28.6%
ESH1	Electric thermal storage system*	1,305	0	1,272	47.6%	84	483	34.6%
ESH1	Heat pump #1 (HSPF=7)*	1,349	0	1,272	47.6%	4	487	34.9%

ESH1	Heat pump #2 (HSPF=8)*	1,429	0	1,272	47.6%	1	487	35.0%
LTG	Energy saving lamps-620 hr/yr	1,603	2	1,273	47.7%	8	495	35.5%
LTG	Energy saving lamps-1,240 h/y	1,659	2	1,275	47.8%	9	504	36.2%
CAC	CAC: 12.0 SEER	2,000	29	1,305	48.9%	0	504	36.2%
LTG	IRF lamps - 300 hr/yr	2,004	16	1,321	49.5%	75	579	41.6%
LTG	Compact fluorescents-1240 h/y	2,044	22	1,343	50.3%	102	681	48.9%
LTG	Compact fluorescents-620 h/y	2,561	18	1,362	51.0%	85	766	55.0%
CAC	CAC: 14.0 SEER	3,048	23	1,384	51.8%	0	766	55.0%
EWH	Front loading clothes washer	3,418	3	1,388	52.0%	8	774	55.5%
ESH1	Low-emissivity film	5,364	0	1,388	52.0%	4	778	55.8%
ESH1	Add 3" fiberglass in roof/ceiling	42,210	0	1,388	52.0%	0	778	55.8%

*The electric thermal storage system (ETS) and heat pumps are mututally exclusive measures. CSE and CRD are calculated independently.

Notes:

1. 1986 residential summer peak: 2,670 MW; winter peak: 1,394 MW
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family homes; ESH2: electric space heating in multi-family homes.
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Table 2-64
ELECTRICITY CONSERVATION ASSESSMENT
COMMERCIAL SECTOR
Consolidated Edison - Downstate climate zone
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
LTG	Delamping	0.001	50	50	0.28%
REF	Floating head press. control	0.001	59	109	0.59%
REF	Refrig. compressor eff.	0.003	73	182	0.99%
HVAC	Reset supply air temperature	0.006	485	668	3.64%
LTG	Reflectors	0.010	1,825	2,492	13.60%
HVAC	Fan motor efficiency	0.010	160	2,652	14.47%
LTG	High-efficiency ballast	0.011	220	2,872	15.67%
HVAC	VAV conversion	0.013	1,441	4,314	23.53%
HVAC	Economizer	0.017	102	4,416	24.09%
LTG	Energy saving fluorescents	0.017	256	4,672	25.49%
HVAC	Pump motor efficiency	0.018	11	4,683	25.54%
HVAC	VSD on fan motor	0.021	1,676	6,359	34.69%
HVAC	Re-size chillers	0.028	1,261	7,620	41.57%
LTG	Occupancy sensors	0.031	222	7,842	42.78%
REF	Refrigerated case covers	0.044	18	7,860	42.88%
LTG	Daylighting controls	0.044	778	8,639	47.12%
LTG	VHE bulbs and ballasts	0.058	455	9,093	49.60%
HVAC	VSD on pump motor	0.065	93	9,186	50.11%
SHELL	Window films (S&W)	0.143	85	9,271	50.57%
SHELL	Low-E windows (all)	0.245	123	9,394	51.25%
SHELL	Roof insulation	0.666	7	9,402	51.29%
SHELL	Low-E windows (N)	0.837	4	9,406	51.31%

Notes:
1. 1986 commercial electricity sales: 18,332 GWh
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration

Table 2-65

PEAK DEMAND CONSERVATION ASSESSMENT
COMMERCIAL SECTOR
Consolidated Edison - Downstate climate zone

Discount rate = 6%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
LTG	Delamping	53	16	16	0.3%	8	8	0.2%
REF	Refrig. compressor eff.	213	13	28	0.6%	7	15	0.4%
HVAC	Reset supply air temperature	224	166	194	4.2%	20	35	1.0%
LTG	Reflectors	459	490	685	14.7%	305	340	9.6%
LTG	High-efficiency ballast	528	56	740	15.9%	39	379	10.6%
HVAC	Fan motor efficiency	710	28	768	16.5%	26	405	11.4%
LTG	Energy saving fluorescents	715	67	835	17.9%	44	449	12.6%
HVAC	Pump motor efficiency	911	3	838	18.0%	1	450	12.6%
HVAC	VAV conversion	969	243	1,081	23.2%	171	621	17.4%
HVAC	Cool storage	1,124	321	1,402	30.1%	0	621	17.4%
LTG	Occupancy sensors	1,461	59	1,461	31.4%	38	659	18.5%
HVAC	Re-size chillers	1,709	255	1,716	36.9%	143	802	22.5%
LTG	Daylighting controls	1,962	217	1,933	41.5%	140	943	26.5%
HVAC	VSD on fan motor	2,133	204	2,137	45.9%	219	1,162	32.6%
LTG	VHE bulbs and ballasts	2,661	125	2,262	48.6%	75	1,237	34.7%
REF	Refrigerated case covers	3,208	3	2,265	48.7%	2	1,239	34.8%
SHELL	Window films (S&W)	3,209	46	2,311	49.7%	-8	1,231	34.5%
HVAC	VSD on pump motor	4,634	16	2,327	50.0%	7	1,237	34.7%
HVAC	Economizer	4,679	4	2,332	50.1%	0	1,237	34.7%
SHELL	Low-E windows (N)	6,072	0	2,332	50.1%	2	1,239	34.8%
SHELL	Roof insulation	7,721	8	2,339	50.3%	0	1,239	34.8%
SHELL	Low-E windows (all)	42,462	15	2,354	50.6%	43	1,282	36.0%

Notes:
1. 1986 commercial summer peak 4,653 MW; winter peak: 3,563 MW;
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration

Table 2-66

ELECTRICITY CONSERVATION ASSESSMENT

INDUSTRIAL SECTOR

Consolidated Edison

Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
MOT	>125 HP: retire	0.008	0.5	0.5	0.0%
MOT	21 - 50 HP: retire	0.008	1.7	2.3	0.2%
MOT	51-125 HP: retire	0.008	0.7	3.0	0.2%
LTG	Energy saving lamp	0.009	13.0	15.9	1.1%
MOT	5.1-20 HP: retire	0.012	4.4	20.3	1.4%
LTG	Metal halide lamp	0.020	4.6	25.0	1.7%
LTG	High-efficiency ballast	0.027	4.0	29.0	2.0%
MOT	>125 HP: VSD	0.036	102.0	131.0	9.1%
MOT	1-5 HP: retire	0.037	0.5	131.5	9.2%
LTG	High-pressure sodium	0.043	15.3	146.8	10.2%
MOT	21-50 HP: rebuild	0.044	5.0	151.8	10.6%
MOT	51-125 HP: VSD	0.045	74.7	226.4	15.8%
MOT	5.1-20 HP: rebuild	0.051	2.4	228.8	15.9%
MOT	51-125 HP: rebuild	0.064	8.5	237.3	16.5%
MOT	21-50 HP: VSD	0.087	38.5	275.8	19.2%
MOT	>125 HP: rebuild	0.090	7.7	283.5	19.7%
MOT	<1 HP: retire	0.103	0.1	283.5	19.7%
MOT	5.1-20 HP: VSD	0.129	25.9	309.4	21.5%
MOT	1-5 HP: VSD	0.373	1.8	311.2	21.7%

Notes:
1. 1986 industrial electricity sales: 1,436 GWh
2. MOT: Motor efficiency measure; LTG: Lighting efficiency measure

Table 2-67

PEAK DEMAND CONSERVATION ASSESSMENT

INDUSTRIAL SECTOR

Consolidated Edison

Discount rate = 6%

			SUMMER			WINTER		
Area	Option	Marginal CRD(20) ($/kW)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)
MOT	>125 HP: retire	433	0.1	0.1	0.0%	0.1	0.1	0.0%
MOT	21 - 50 HP: retire	454	0.4	0.5	0.2%	0.3	0.3	0.2%
MOT	51-125 HP: retire	456	0.1	0.6	0.2%	0.1	0.4	0.2%
LTG	Energy saving lamp	501	2.8	3.4	1.1%	1.9	2.3	1.1%
MOT	5.1-20 HP: retire	687	0.9	4.3	1.4%	0.6	2.9	1.4%
LTG	Metal halide lamp	1,188	1.0	5.3	1.7%	0.7	3.6	1.7%
LTG	High-efficiency ballast	1,598	0.9	6.2	2.0%	0.6	4.2	2.0%
MOT	>125 HP: VSD	2,074	21.7	27.8	9.1%	14.7	18.9	9.1%
MOT	1-5 HP: retire	2,100	0.1	27.9	9.2%	0.1	19.0	9.2%
LTG	High-pressure sodium	2,567	3.2	31.2	10.2%	2.2	21.2	10.2%
MOT	21-50 HP: rebuild	2,570	1.1	32.2	10.6%	0.7	21.9	10.6%
MOT	51-125 HP: VSD	2,585	15.9	48.1	15.8%	10.8	32.6	15.8%
MOT	5.1-20 HP: rebuild	2,937	0.5	48.6	15.9%	0.3	33.0	15.9%
MOT	51-125 HP: rebuild	3,677	1.8	50.4	16.5%	1.2	34.2	16.5%
MOT	21-50 HP: VSD	5,071	8.2	58.6	19.2%	5.6	39.8	19.2%
MOT	>125 HP: rebuild	5,120	1.6	60.2	19.7%	1.1	40.9	19.7%
MOT	<1 HP: retire	5,885	0.0	60.2	19.7%	0.0	40.9	19.7%
MOT	5.1-20 HP: VSD	7,402	5.5	65.7	21.5%	3.7	44.6	21.5%
MOT	1-5 HP: VSD	21,365	0.4	66.1	21.7%	0.3	44.9	21.7%

Notes:

1. 1986 industrial summer peak demand : 305 MW
2. 1986 industrial winter peak demand : 207 MW
3. MOT: Motor efficiency measure; LTG: Lighting efficiency measure
4. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

perspective is close to the potential as calculated from the consumer perspective.

D. Long Island Lighting Company

Table 2-68 presents the potential technology-cost savings of electricity consumption and peak demand in LILCO's service territory from each of the three perspectives. The sectoral conservation assessments from the consumer perspective for LILCO are presented in Tables 2-69 to 2-74.

Total technology-cost potential electricity savings from the consumer perspective are 4,575 GWh/yr or 32% of 1986 consumption. The associated technology-cost potential reduction in summer and winter peak demand is 982 MW and 620 MW, respectively. When viewed from the utility perspective, potential technology-cost electricity savings decrease to 3,973 GWh/yr, with technology-cost potential reductions in peak demand of 1,199 MW and 682 MW for the summer and winter, respectively. The relatively large savings potential (particularly in peak demand) is due to LILCO's high marginal costs (particularly for capacity). The increase in technology-cost peak demand reduction potential comes from residential measures such as air conditioners, load cyclers and controllers, and electric thermal storage.

The societal perspective produces the largest potential technology-cost savings both in electricity and peak demand; 4,630 GWh/yr in electricity savings and 1,421 MW and 792 MW in summer and winter peak demand, respectively.

E. New York State Electric & Gas Corp.

The potential technology-cost savings of electricity consumption and peak demand in the service territory of NYSEG are presented in Table 2-75. The sectoral conservation assessments for NYSEG from the cosnumer perspective are presented in Tables 2-76 to 2-81. From the consumer perspective, the potential technology-cost

Table 2-68
TECHNOLOGY-COST POTENTIAL
ELECTRICITY AND PEAK DEMAND SAVINGS
LONG ISLAND LIGHTING CO.
Savings and percent of total

CONSUMER PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	1,911	30.6%	379	21.6%	276	21.6%
Commercial	2,414	46.8%	569	41.9%	301	29.5%
Industrial	250	16.9%	34	16.8%	43	16.9%
Total	4,575	31.8%	982	29.7%	620	24.3%

UTILITY PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	1,735	27.8%	698	39.8%	388	30.4%
Commercial	2,000	38.8%	469	34.6%	253	24.8%
Industrial	238	16.1%	32	16.1%	41	16.1%
Total	3,973	27.6%	1,199	36.2%	682	26.8%

SOCIETAL PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	1,966	31.5%	731	41.7%	448	35.1%
Commercial	2,414	46.8%	656	48.3%	301	29.5%
Industrial	250	16.8%	34	16.8%	43	16.9%
Total	4,630	32.2%	1,421	42.9%	792	31.1%

*Discount rates for each perspective are: 6% - consumer, 10% - utility, 3% - societal

Table 2-69
ELECTRICITY CONSERVATION ASSESSMENT
RESIDENTIAL SECTOR
Long Island Lighting Company
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
FRE	Current sales average (1986)	0.004	55	55	0.88%
REF	Current sales average (1986)	0.010	286	341	5.46%
REF	Best current (1988)	0.011	285	626	10.01%
REF	Near-term advanced	0.013	119	745	11.92%
EWH	Traps & blanket (EF=0.9)	0.013	17	762	12.20%
FRE	Best current (1988)	0.014	38	801	12.81%
FRE	Near-term advanced	0.015	19	820	13.11%
ESH1	Infiltration reduction	0.017	76	896	14.34%
RAN	Improved oven	0.022	43	939	15.03%
ESH2	Storm windows	0.024	3	942	15.07%
RAN	Improved cooktop	0.025	15	957	15.31%
ESH2	Low-emissivity film	0.026	1	958	15.33%
LTG	Tungsten halogen lamps-300 h/y	0.027	102	1,060	16.97%
LTG	Energy saving lamps-620 hr/yr	0.030	12	1,073	17.16%
LTG	Energy saving lamps-1,240 h/y	0.030	14	1,087	17.39%
EWH	Front loading clothes washer	0.034	29	1,116	17.85%
LTG	Compact fluorescents-1240 h/y	0.036	162	1,278	20.44%
LTG	IRF lamps - 300 hr/yr	0.044	119	1,397	22.35%
LTG	Compact fluorescents-620 h/y	0.045	135	1,532	24.50%
ESH1	Heat pump #1 (HSPF=7)*	0.047	79	1,611	25.77%
ESH1	Heat pump #2 (HSPF=8)*	0.062	8	1,619	25.89%
ECD	Heat pump clothes dryer	0.065	198	1,817	29.06%
RAC	RAC: 8.5 EER	0.072	45	1,861	29.78%
ESH1	Low-emissivity film	0.079	22	1,883	30.13%
RAC	RAC: 10.0 EER	0.115	28	1,911	30.58%
CAC	Window film	0.128	22	1,933	30.92%
CAC	CAC: 10.0 SEER	0.132	26	1,959	31.34%
RAC	RAC: 12 .0 EER	0.146	29	1,988	31.81%
CAC	Variable speed drive	0.192	17	2,005	32.08%
CAC	CAC: 12.0 SEER	0.258	15	2,020	32.32%
CAC	CAC: 14.0 SEER	0.407	11	2,032	32.50%
ESH1	Add 3" fiberglass in roof/ceiling	0.439	3	2,035	32.56%

Notes:
1. 1986 residential electricity consumption: 6,251 GWh
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family and small (2-4 units) multi-family homes; ESH2: electric space heating in large (5+ units) multi-family homes.

Table 2-70
PEAK DEMAND ASSESSMENT
RESIDENTIAL SECTOR
Long Island Lighting Company
Discount rate = 6%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
CAC	Load controller/cycler	159	139	139	7.9%	0	0	0.0%
RAC	RAC: 8.5 EER	345	118	257	14.7%	0	0	0.0%
FRE	Current sales average (1986)	358	8	265	15.1%	7	7	0.6%
RAC	RAC: 10.0 EER	492	83	348	19.8%	0	7	0.6%
REF	Current sales average (1986)	681	49	397	22.6%	25	32	2.5%
RAC	RAC: 12 .0 EER	695	78	475	27.1%	0	32	2.5%
ESH2	Storm windows	700	0	475	27.1%	1	33	2.6%
ESH2	Low-emissivity film	764	0	475	27.1%	0	34	2.7%
REF	Best current (1988)	795	49	524	29.8%	25	59	4.6%
ESH1	Infiltration reduction	802	0	524	29.8%	21	80	6.2%
EWH	Load controller/cycler	825	5	529	30.1%	13	93	7.3%
ECD	Load controller/cycler	832	60	589	33.6%	104	197	15.5%
EWH	Traps & blanket (EF=0.9)	837	1	590	33.6%	3	201	15.7%
REF	Near-term advanced	949	20	610	34.8%	10	211	16.6%
CAC	Window film	955	36	647	36.9%	0	211	16.6%
RAN	Improved oven	1,098	11	657	37.5%	7	218	17.1%
FRE	Best current (1988)	1,183	6	663	37.8%	5	223	17.5%
CAC	CAC: 10.0 SEER	1,209	35	698	39.8%	0	223	17.5%
FRE	Near-term advanced	1,224	3	701	40.0%	3	226	17.7%
LTG	Tungsten halogen lamps-300 h/y	1,239	5	706	40.2%	23	249	19.5%
RAN	Improved cooktop	1,254	4	709	40.4%	3	251	19.7%
ESH1	Electric thermal storage system*	1,305	0	709	40.4%	57	308	24.2%
ESH1	Heat pump #1 (HSPF=7)*	1,349	0	709	40.4%	34	343	26.9%

ESH1	Heat pump #2 (HSPF=8)*	1,429	0	709	40.4%	4	347	27.2%
LTG	Energy saving lamps-620 hr/yr	1,603	1	710	40.5%	3	349	27.4%
LTG	Energy saving lamps-1,240 h/y	1,659	1	711	40.5%	3	353	27.7%
CAC	CAC: 12.0 SEER	2,000	25	735	41.9%	0	353	27.7%
LTG	IRF lamps - 300 hr/yr	2,004	6	741	42.3%	26	379	29.7%
LTG	Compact fluorescents-1240 h/y	2,044	8	749	42.7%	36	415	32.5%
LTG	Compact fluorescents-620 h/y	2,561	6	755	43.1%	30	444	34.8%
CAC	CAC: 14.0 SEER	3,048	19	774	44.2%	0	444	34.8%
EWH	Front loading clothes washer	3,418	1	776	44.2%	4	448	35.1%
ESH1	Low-emissivity film	5,364	0	776	44.2%	4	452	35.4%
ESH1	Add 3" fiberglass in roof/ceiling	42,210	0	776	44.2%	0	452	35.5%

*The electric thermal storage system (ETS) and heat pumps are mututally exclusive measures. CSE and CRD are calculated independently.

Notes:
1. 1986 residential summer peak: 1,754 MW; winter peak: 1,275 MW
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family homes; ESH2: electric space heating in multi-family homes.
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Table 2-71
ELECTRICITY CONSERVATION ASSESSMENT
COMMERCIAL SECTOR
Long Island Lighting Company – Downstate climate zone
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
LTG	Delamping	0.001	21	21	0.41%
REF	Floating head press. control	0.001	26	47	0.91%
REF	Refrig. compressor eff.	0.003	32	79	1.54%
HVAC	Reset supply air temperature	0.005	161	240	4.66%
LTG	Reflectors	0.010	541	781	15.15%
HVAC	Fan motor efficiency	0.010	38	819	15.88%
LTG	High-efficiency ballast	0.011	65	884	17.14%
HVAC	VAV conversion	0.013	324	1,208	23.44%
LTG	Energy saving fluorescents	0.017	79	1,329	25.79%
HVAC	Economizer	0.017	42	1,250	24.26%
HVAC	Pump motor efficiency	0.018	3	1,332	25.85%
HVAC	VSD on fan motor	0.021	387	1,719	33.35%
LTG	Occupancy sensors	0.033	64	2,026	39.31%
REF	Refrigerated case covers	0.044	8	2,034	39.47%
HVAC	Re-size chillers	0.045	243	1,962	38.07%
LTG	Daylighting controls	0.048	209	2,244	43.53%
LTG	VHE bulbs and ballasts	0.058	142	2,386	46.29%
HVAC	VSD on pump motor	0.062	28	2,414	46.83%
SHELL	Window films (S&W)	0.128	25	2,439	47.32%
SHELL	Low-E windows (all)	0.303	22	2,461	47.76%
SHELL	Roof insulation	0.697	3	2,464	47.81%
SHELL	Low-E windows (N)	0.788	1	2,465	47.83%

Notes:
1. 1986 commercial electricity sales: 5,154 GWh
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration

Table 2-72

PEAK DEMAND CONSERVATION ASSESSMENT

COMMERCIAL SECTOR

Long Island Lighting Company - Downstate climate zone

Discount rate = 6%

			SUMMER			WINTER		
Area	Option	Marginal CRD(20) ($/kW)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)
LTG	Delamping	53	7	7	0.5%	3	3	0.3%
HVAC	Reset supply air temperature	133	67	79	5.8%	9	15	1.5%
REF	Refrig. compressor eff.	213	6	12	0.9%	3	6	0.6%
LTG	Reflectors	470	149	228	16.8%	80	96	9.4%
LTG	High-efficiency ballast	554	16	244	18.0%	10	106	10.4%
LTG	Energy saving fluorescents	710	21	272	20.1%	12	124	12.2%
HVAC	Fan motor efficiency	714	7	251	18.5%	7	112	11.0%
HVAC	VAV conversion	748	68	341	25.1%	35	159	15.6%
HVAC	Pump motor efficiency	984	1	273	20.1%	0	124	12.2%
HVAC	Cool storage	1,127	85	425	31.3%	0	159	15.6%
LTG	Occupancy sensors	1,504	17	443	32.6%	10	169	16.6%
LTG	Daylighting controls	2,064	61	561	41.4%	34	230	22.5%
HVAC	VSD on fan motor	2,118	47	609	44.9%	49	278	27.3%
HVAC	Re-size chillers	2,305	58	501	36.9%	26	195	19.2%
LTG	VHE bulbs and ballasts	2,635	39	648	47.7%	20	299	29.3%
SHELL	Window films (S&W)	2,776	14	663	48.9%	-1	298	29.2%
REF	Refrigerated case covers	3,208	1	649	47.8%	1	300	29.4%
HVAC	Economizer	4,494	2	670	49.4%	0	300	29.5%
HVAC	VSD on pump motor	4,547	5	668	49.2%	2	300	29.4%
SHELL	Low-E windows (N)	6,072	-1	670	49.3%	1	301	29.5%
SHELL	Roof insulation	7,192	3	673	49.6%	0	302	29.6%
SHELL	Low-E windows (all)	42,240	4	677	49.9%	7	309	30.3%

Notes:

1. 1986 commercial summer peak 1,357 MW; winter peak: 1,020 MW;
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration

Table 2-73
ELECTRICITY CONSERVATION ASSESSMENT
INDUSTRIAL SECTOR
Long Island Lighting Company
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
MOT	>125 HP: retire	0.008	0.6	0.6	0.0%
MOT	21 - 50 HP: retire	0.008	1.9	2.4	0.2%
MOT	51-125 HP: retire	0.008	0.7	3.1	0.2%
LTG	Energy saving lamp	0.009	13.4	16.5	1.1%
MOT	5.1-20 HP: retire	0.012	4.7	21.2	1.4%
LTG	Metal halide lamp	0.020	4.8	26.0	1.8%
LTG	High-efficiency ballast	0.027	4.1	30.1	2.0%
MOT	>125 HP: VSD	0.036	107.5	137.6	9.3%
MOT	1-5 HP: retire	0.037	0.5	138.2	9.3%
LTG	High-pressure sodium	0.043	15.8	153.9	10.4%
MOT	21-50 HP: rebuild	0.044	5.3	159.2	10.7%
MOT	51-125 HP: VSD	0.045	79.0	238.2	16.1%
MOT	5.1-20 HP: rebuild	0.051	2.5	240.7	16.2%
MOT	51-125 HP: rebuild	0.064	9.0	249.7	16.8%
MOT	21-50 HP: VSD	0.087	40.7	290.4	19.6%
MOT	>125 HP: rebuild	0.090	8.1	298.5	20.1%
MOT	<1 HP: retire	0.103	0.1	298.6	20.1%
MOT	5.1-20 HP: VSD	0.129	27.4	325.9	22.0%
MOT	1-5 HP: VSD	0.373	1.9	327.8	22.1%

Notes:
1. 1986 industrial electricity sales: 1,482 GWh
2. MOT: Motor efficiency measure; LTG: Lighting efficiency measure

Table 2-74

PEAK DEMAND CONSERVATION ASSESSMENT

INDUSTRIAL SECTOR

Long Island Lighting Company

Discount rate = 6%

			SUMMER			WINTER		
Area	Option	Marginal CRD(20) ($/kW)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)
MOT	>125 HP: retire	685	0.1	0.1	0.0%	0.1	0.1	0.0%
MOT	21 - 50 HP: retire	717	0.2	0.3	0.2%	0.3	0.4	0.2%
MOT	51-125 HP: retire	721	0.1	0.4	0.2%	0.1	0.5	0.2%
LTG	Energy saving lamp	793	1.8	2.2	1.1%	2.3	2.8	1.1%
MOT	5.1-20 HP: retire	1,087	0.6	2.8	1.4%	0.8	3.6	1.4%
LTG	Metal halide lamp	1,879	0.6	3.5	1.8%	0.8	4.5	1.8%
LTG	High-efficiency ballast	2,528	0.6	4.0	2.0%	0.7	5.2	2.0%
MOT	>125 HP: VSD	3,280	14.4	18.5	9.3%	18.5	23.7	9.3%
MOT	1-5 HP: retire	3,322	0.1	18.6	9.3%	0.1	23.8	9.3%
LTG	High-pressure sodium	4,061	2.1	20.7	10.4%	2.7	26.5	10.4%
MOT	21-50 HP: rebuild	4,065	0.7	21.4	10.7%	0.9	27.4	10.7%
MOT	51-125 HP: VSD	4,089	10.6	32.0	16.1%	13.6	41.0	16.1%
MOT	5.1-20 HP: rebuild	4,646	0.3	32.3	16.2%	0.4	41.4	16.2%
MOT	51-125 HP: rebuild	5,816	1.2	33.5	16.8%	1.5	43.0	16.8%
MOT	21-50 HP: VSD	8,020	5.5	39.0	19.6%	7.0	50.0	19.6%
MOT	>125 HP: rebuild	8,099	1.1	40.1	20.1%	1.4	51.4	20.1%
MOT	<1 HP: retire	9,309	0.0	40.1	20.1%	0.0	51.4	20.1%
MOT	5.1-20 HP: VSD	11,708	3.7	43.8	22.0%	4.7	56.1	22.0%
MOT	1-5 HP: VSD	33,794	0.2	44.0	22.1%	0.3	56.4	22.1%

Notes:

1. 1986 industrial summer peak demand : 199 MW
2. 1986 industrial winter peak demand : 255 MW
3. MOT: Motor efficiency measure; LTG: Lighting efficiency measure
4. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Table 2-75
TECHNOLOGY-COST POTENTIAL
ELECTRICITY AND PEAK DEMAND SAVINGS
NEW YORK STATE ELECTRIC & GAS
Savings and percent of total

CONSUMER PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	1,602	33.4%	158	25.4%	247	26.2%
Commercial	1,296	46.8%	329	42.6%	158	20.1%
Industrial	482	16.6%	81	16.6%	86	16.6%
Total	3,380	28.6%	568	30.2%	491	21.9%

UTILITY PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	1,242	25.9%	160	25.8%	196	20.8%
Commercial	964	34.8%	239	31.0%	113	14.4%
Industrial	276	9.5%	47	9.5%	49	9.5%
Total	2,482	21.0%	446	23.7%	358	16.0%

SOCIETAL PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	1,609	33.6%	238	38.3%	505	53.6%
Commercial	1,281	46.2%	369	47.8%	157	20.0%
Industrial	482	16.6%	81	16.6%	86	16.6%
Total	3,372	28.6%	688	36.6%	748	33.3%

*Discount rates for each perspective are: 6% - consumer, 10% - utility, 3% - societal

Table 2-76
ELECTRICITY CONSERVATION ASSESSMENT
RESIDENTIAL SECTOR
New York State Electric and Gas
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
FRE	Current sales average (1986)	0.004	80	80	1.67%
REF	Current sales average (1986)	0.010	206	286	5.97%
REF	Best current (1988)	0.011	205	491	10.26%
REF	Near-term advanced	0.013	86	577	12.05%
EWH	Traps & blanket (EF=0.9)	0.013	60	637	13.30%
FRE	Best current (1988)	0.014	55	693	14.46%
FRE	Near-term advanced	0.015	28	720	15.03%
ESH1	Infiltration reduction	0.015	115	835	17.44%
ESH2	Storm windows	0.020	3	838	17.49%
ESH2	Low-emissivity film	0.020	1	839	17.51%
RAN	Improved oven	0.022	34	872	18.21%
RAN	Improved cooktop	0.025	12	884	18.46%
LTG	Tungsten halogen lamps-300 h/y	0.027	76	960	20.03%
LTG	Energy saving lamps-620 hr/yr	0.030	9	969	20.22%
LTG	Energy saving lamps-1,240 h/y	0.030	11	979	20.44%
EWH	Front loading clothes washer	0.034	101	1,080	22.54%
ESH1	Heat pump #1 (HSPF=7)*	0.035	43	1,123	23.43%
LTG	Compact fluorescents-1240 h/y	0.036	119	1,242	25.93%
LTG	IRF lamps - 300 hr/yr	0.044	88	1,330	27.77%
LTG	Compact fluorescents-620 h/y	0.045	100	1,430	29.84%
ESH1	Heat pump #2 (HSPF=8)*	0.047	4	1,434	29.93%
ECD	Heat pump clothes dryer	0.065	138	1,572	32.82%
ESH1	Low-emissivity film	0.078	30	1,602	33.43%
CAC	Window film	0.154	4	1,606	33.51%
RAC	RAC: 8.5 EER	0.177	3	1,609	33.58%
CAC	CAC: 10.0 SEER	0.258	3	1,612	33.64%
CAC	Variable speed drive	0.296	2	1,614	33.69%
RAC	RAC: 10.0 EER	0.329	2	1,616	33.72%
RAC	RAC: 12 .0 EER	0.439	2	1,618	33.76%
ESH1	Add 3" fiberglass in roof/ceiling	0.482	4	1,622	33.85%
CAC	CAC: 12.0 SEER	0.511	2	1,623	33.88%
CAC	CAC: 14.0 SEER	0.605	2	1,625	33.92%

Notes:
1. 1986 residential electricity consumption: 4,791 GWh
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family and small (2-4 units) multi-family homes; ESH2: electric space heating in large (5+ units) multi-family homes.

Table 2-77

PEAK DEMAND ASSESSMENT

RESIDENTIAL SECTOR

New York State Electric and Gas

Discount rate = 6%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
CAC	Load controller/cycler	251	19	19	3.0%	0	0	0.0%
FRE	Current sales average (1986)	358	12	30	4.9%	11	11	1.1%
ESH2	Low-emissivity film	600	0	30	4.9%	0	11	1.2%
ESH2	Storm windows	646	0	30	4.9%	1	12	1.3%
REF	Current sales average (1986)	681	35	66	10.6%	18	30	3.2%
ESH1	Infiltration reduction	711	0	66	10.6%	31	61	6.5%
REF	Best current (1988)	795	35	101	16.2%	18	79	8.4%
RAC	RAC: 8.5 EER	814	9	110	17.7%	0	79	8.4%
EWH	Load controller/cycler	825	18	128	20.6%	47	126	13.3%
ECD	Load controller/cycler	832	42	170	27.3%	73	199	21.1%
EWH	Traps & blanket (EF=0.9)	837	5	174	28.1%	12	211	22.4%
REF	Near-term advanced	949	15	189	30.5%	7	218	23.2%
ESH1	Electric thermal storage system*	1,004	0	189	30.5%	146	364	38.6%
ESH1	Heat pump #1 (HSPF=7)*	1,020	0	189	30.5%	19	382	40.6%
RAN	Improved oven	1,098	8	197	31.8%	6	388	41.2%
ESH1	Heat pump #2 (HSPF=8)*	1,114	0	197	31.8%	2	390	41.4%
RAC	RAC: 10.0 EER	1,162	6	204	32.8%	0	390	41.4%
FRE	Best current (1988)	1,183	8	212	34.1%	7	398	42.2%
FRE	Near-term advanced	1,224	4	216	34.8%	4	401	42.6%
LTG	Tungsten halogen lamps-300 h/y	1,239	4	220	35.4%	17	418	44.4%
RAN	Improved cooktop	1,254	3	223	35.8%	2	420	44.6%
CAC	Window film	1,274	6	228	36.8%	0	420	44.6%
LTG	Energy saving lamps-620 hr/yr	1 603	0	229	36.8%	2	422	44.8%

RAC	RAC: 12 .0 EER	1,641	6	235	37.8%	0	422	44.8%
LTG	Energy saving lamps-1,240 h/y	1,659	1	235	37.9%	2	424	45.1%
CAC	CAC: 10.0 SEER	1,986	5	240	38.6%	0	424	45.1%
LTG	IRF lamps - 300 hr/yr	2,004	4	244	39.3%	19	444	47.1%
LTG	Compact fluorescents-1240 h/y	2,044	6	250	40.2%	26	470	49.9%
LTG	Compact fluorescents-620 h/y	2,561	5	254	41.0%	22	492	52.2%
ESH1	Low-emissivity film	3,221	0	254	41.0%	9	501	53.2%
CAC	CAC: 12.0 SEER	3,349	3	258	41.5%	0	501	53.2%
EWH	Front loading clothes washer	3,418	5	263	42.3%	13	514	54.5%
CAC	CAC: 14.0 SEER	4,656	3	265	42.7%	0	514	54.5%
ESH1	Add 3" fiberglass in roof/ceiling	40,775	0	265	42.7%	1	514	54.6%

*The electric thermal storage system (ETS) and heat pumps are mututally exclusive measures. CSE and CRD are calculated independently.

Notes:

1. 1986 residential summer peak: 621 MW; winter peak: 942 MW
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family homes; ESH2: electric space heating in multi-family homes.
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Table 2-78

ELECTRICITY CONSERVATION ASSESSMENT

COMMERCIAL SECTOR

New York State Electric and Gas – Upstate climate zone

Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
LTG	Delamping	0.001	13	13	0.46%
REF	Floating head press. control	0.001	15	28	1.00%
REF	Refrig. compressor eff.	0.003	19	46	1.67%
HVAC	Reset supply air temperature	0.004	95	141	5.09%
LTG	Reflectors	0.011	304	445	16.05%
HVAC	Fan motor efficiency	0.012	17	462	16.67%
LTG	High-efficiency ballast	0.012	40	502	18.10%
HVAC	VAV conversion	0.013	158	660	23.80%
HVAC	Economizer	0.016	30	689	24.87%
LTG	Energy saving fluorescents	0.017	45	734	26.48%
HVAC	Pump motor efficiency	0.019	2	736	26.53%
HVAC	VSD on fan motor	0.022	192	927	33.45%
LTG	Occupancy sensors	0.034	37	964	34.78%
REF	Refrigerated case covers	0.044	5	969	34.95%
LTG	Daylighting controls	0.053	113	1,081	39.01%
HVAC	Re-size chillers	0.058	114	1,195	43.11%
LTG	VHE bulbs and ballasts	0.059	85	1,280	46.18%
HVAC	VSD on pump motor	0.063	16	1,296	46.74%
SHELL	Window films (S&W)	0.124	15	1,310	47.27%
SHELL	Low-E windows (N)	0.188	12	1,323	47.72%
SHELL	Low-E windows (all)	0.240	26	1,349	48.66%
SHELL	Roof insulation	0.448	1	1,350	48.70%

Notes:

1. 1986 commercial electricity sales: 2,772 GWh
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration

Table 2-79

PEAK DEMAND CONSERVATION ASSESSMENT

COMMERCIAL SECTOR

New York State Electric and Gas - Upstate climate zone

Discount rate = 6%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
LTG	Delamping	53	4	4	0.5%	2	2	0.3%
HVAC	Reset supply air temperature	115	42	47	6.0%	3	5	0.7%
REF	Refrig. compressor eff.	213	3	50	6.4%	2	7	0.9%
LTG	Reflectors	497	86	136	17.6%	44	51	6.5%
LTG	High-efficiency ballast	589	11	146	18.9%	6	57	7.3%
HVAC	VAV conversion	626	41	187	24.2%	16	73	9.4%
LTG	Energy saving fluorescents	731	12	199	25.8%	6	80	10.2%
HVAC	Fan motor efficiency	816	3	202	26.2%	4	84	10.6%
HVAC	Pump motor efficiency	1,084	0	203	26.3%	0	84	10.7%
HVAC	Cool storage	1,094	42	245	31.8%	0	84	10.7%
LTG	Occupancy sensors	1,522	10	256	33.1%	5	89	11.4%
SHELL	Window films (S&W)	1,655	14	269	34.8%	-1	89	11.3%
HVAC	VSD on fan motor	2,045	25	294	38.1%	25	113	14.4%
LTG	Daylighting controls	2,221	33	328	42.4%	18	131	16.7%
LTG	VHE bulbs and ballasts	2,644	24	352	45.5%	12	143	18.3%
HVAC	Re-size chillers	2,712	30	381	49.4%	12	155	19.7%
REF	Refrigerated case covers	3,208	1	382	49.5%	0	155	19.8%
HVAC	VSD on pump motor	4,479	3	385	49.8%	1	157	20.0%
HVAC	Economizer	7,035	1	385	49.9%	0	157	20.0%
SHELL	Roof insulation	13,266	0	386	50.0%	0	157	20.0%
SHELL	Low-E windows (all)	28,491	3	388	50.3%	5	161	20.6%
SHELL	Low-E windows (N)	55,555	0	388	50.3%	3	165	21.0%

Notes:
1. 1986 commercial summer peak 772 MW; winter peak: 785 MW;
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty-year period.

Table 2-80

ELECTRICITY CONSERVATION ASSESSMENT

INDUSTRIAL SECTOR

New York State Electric and Gas

Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
MOT	>125 HP: retire	0.008	1.1	1.1	0.0%
MOT	21 - 50 HP: retire	0.008	3.7	4.8	0.2%
MOT	51-125 HP: retire	0.008	1.5	6.3	0.2%
LTG	Energy saving lamp	0.009	26.2	32.5	1.1%
MOT	5.1-20 HP: retire	0.012	9.4	41.9	1.4%
LTG	Metal halide lamp	0.020	9.4	51.3	1.8%
LTG	High-efficiency ballast	0.027	8.1	59.4	2.0%
MOT	>125 HP: VSD	0.036	216.4	275.8	9.5%
MOT	1-5 HP: retire	0.037	1.0	276.8	9.5%
LTG	High-pressure sodium	0.043	30.8	307.7	10.6%
MOT	21-50 HP: rebuild	0.044	10.6	318.3	11.0%
MOT	51-125 HP: VSD	0.045	158.6	476.9	16.4%
MOT	5.1-20 HP: rebuild	0.051	5.0	481.9	16.6%
MOT	51-125 HP: rebuild	0.064	18.0	499.9	17.2%
MOT	21-50 HP: VSD	0.087	82.0	582.0	20.1%
MOT	>125 HP: rebuild	0.090	16.3	598.3	20.6%
MOT	<1 HP: retire	0.103	0.1	598.4	20.6%
MOT	5.1-20 HP: VSD	0.129	55.2	653.6	22.5%
MOT	1-5 HP: VSD	0.373	3.7	657.3	22.7%

Notes:
1. 1986 industrial electricity sales: 2,899 GWh
2. MOT: Motor efficiency measure; LTG: Lighting efficiency measure

Table 2-81
PEAK DEMAND CONSERVATION ASSESSMENT
INDUSTRIAL SECTOR
New York State Electric and Gas
Discount rate = 6%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
MOT	>125 HP: retire	545	0.2	0.2	0.0%	0.2	0.2	0.0%
MOT	21 - 50 HP: retire	571	0.6	0.8	0.2%	0.7	0.9	0.2%
MOT	51-125 HP: retire	574	0.3	1.1	0.2%	0.3	1.1	0.2%
LTG	Energy saving lamp	631	4.4	5.5	1.1%	4.7	5.8	1.1%
MOT	5.1-20 HP: retire	865	1.6	7.1	1.4%	1.7	7.4	1.4%
LTG	Metal halide lamp	1,496	1.6	8.6	1.8%	1.7	9.1	1.8%
LTG	High-efficiency ballast	2,013	1.4	10.0	2.0%	1.4	10.6	2.0%
MOT	>125 HP: VSD	2,612	36.5	46.5	9.5%	38.5	49.0	9.5%
MOT	1-5 HP: retire	2,645	0.2	46.7	9.5%	0.2	49.2	9.5%
LTG	High-pressure sodium	3,233	5.2	51.9	10.6%	5.5	54.7	10.6%
MOT	21-50 HP: rebuild	3,236	1.8	53.7	11.0%	1.9	56.6	11.0%
MOT	51-125 HP: VSD	3,256	26.7	80.4	16.4%	28.2	84.8	16.4%
MOT	5.1-20 HP: rebuild	3,699	0.9	81.3	16.6%	0.9	85.7	16.6%
MOT	51-125 HP: rebuild	4,630	3.0	84.3	17.2%	3.2	88.9	17.2%
MOT	21-50 HP: VSD	6,386	13.8	98.2	20.1%	14.6	103.5	20.1%
MOT	>125 HP: rebuild	6,448	2.8	100.9	20.6%	2.9	106.4	20.6%
MOT	<1 HP: retire	7,412	0.0	100.9	20.6%	0.0	106.4	20.6%
MOT	5.1-20 HP: VSD	9,322	9.3	110.2	22.5%	9.8	116.2	22.5%
MOT	1-5 HP: VSD	26,906	0.6	110.9	22.7%	0.7	116.9	22.7%

Notes:
1. 1986 industrial summer peak demand : 489 MW
2. 1986 industrial winter peak demand : 516 MW
3. MOT: Motor efficiency measure; LTG: Lighting efficiency measure
4. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

electricity savings are 3,380 GWh/yr or 29% of annual consumption in 1986. The technology-cost potential reduction in peak demand is 568 MW, or 30% of 1986 peak summer demand and 491 MW, or 22% of 1986 peak winter demand. Potential electricity savings from the utility perspective are substantially lower -- 2,482 GWh/yr -- while savings from the societal perspective are approximately equal -- 3,372 GWh/yr.

F. Niagara Mohawk Power Corporation

NMPC offers the second-largest potential for technology-cost savings of electricity and peak demand (following Con Ed). A breakdown of the results of the cost-effectiveness analysis for NMPC is presented in Table 2-82. The sectoral conservation assessments for NMPC are presented in Tables 2-83 to 2-88.

Total potential technology-cost electricity savings are 9,115 GWh/yr or 30% of annual consumption in 1986 from the consumer perspective. The technology-cost potential reduction in summer peak demand is 1,636 MW, or 32% of the 1986 peak. The technology-cost potential reduction in winter peak demand is 1,264 MW, 23% of the 1986 peak.

The technology-cost electricity savings potential is substantially lower from the utility perspective, decreasing to 7,177 GWh/yr in electricity savings and 1,345 MW and 1,002 MW in summer and winter peak demand, respectively. The technology-cost savings potential from the utility and consumer perspectives for the industrial sector is only 9% of annual consumption because of the low marginal costs. The savings potential from the societal perspective is highest of the three perspectives; 9,213 GWh/yr in electricity savings, and 2,083 MW and 1,913 MW in summer and winter peak demand reductions, respectively.

Potential savings as a percentage of 1986 use are somewhat lower for NMPC than the average of the seven utilities. This is due to the relatively large industrial sector and low electricity rates and marginal costs.

Table 2-82
TECHNOLOGY-COST POTENTIAL
ELECTRICITY AND PEAK DEMAND SAVINGS
NIAGARA MOHAWK POWER CO.
Savings and percent of total

CONSUMER PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	3,315	36.0%	312	24.4%	518	23.4%
Commercial	4,822	47.0%	1,183	51.3%	604	34.1%
Industrial	978	9.2%	141	9.2%	142	9.2%
Total	9,115	30.0%	1,636	31.9%	1,264	22.8%

UTILITY PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	2,648	28.8%	355	27.7%	428	19.3%
Commercial	3,555	34.6%	850	36.9%	432	24.4%
Industrial	974	9.1%	140	9.1%	142	9.1%
Total	7,177	23.6%	1,345	26.3%	1,002	18.1%

SOCIETAL PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	3,043	33.0%	508	39.7%	1,067	48.1%
Commercial	4,469	43.6%	1,330	57.7%	599	33.8%
Industrial	1,701	15.9%	245	15.9%	247	15.9%
Total	9,213	30.3%	2,083	40.7%	1,913	34.5%

*Discount rates for each perspective are: 6% - consumer, 10% - utility, 3% - societal

Table 2-83
ELECTRICITY CONSERVATION ASSESSMENT
RESIDENTIAL SECTOR
Niagara Mohawk Power Co.
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
FRE	Current sales average (1986)	0.004	122	122	1.33%
REF	Current sales average (1986)	0.010	481	604	6.56%
REF	Best current (1988)	0.011	479	1,082	11.75%
REF	Near-term advanced	0.013	201	1,283	13.93%
EWH	Traps & blanket (EF=0.9)	0.013	118	1,400	15.21%
FRE	Best current (1988)	0.014	85	1,486	16.13%
FRE	Near-term advanced	0.015	42	1,528	16.59%
ESH1	Infiltration reduction	0.015	262	1,790	19.43%
ESH2	Storm windows	0.020	13	1,802	19.57%
ESH2	Low-emissivity film	0.020	4	1,807	19.62%
RAN	Improved oven	0.022	58	1,865	20.25%
RAN	Improved cooktop	0.025	20	1,885	20.47%
LTG	Tungsten halogen lamps-300 h/y	0.027	152	2,037	22.12%
LTG	Energy saving lamps-620 hr/yr	0.030	18	2,055	22.31%
LTG	Energy saving lamps-1,240 h/y	0.030	21	2,076	22.54%
EWH	Front loading clothes washer	0.034	198	2,274	24.70%
ESH1	Heat pump #1 (HSPF=7)*	0.035	134	2,408	26.15%
LTG	Compact fluorescents-1240 h/y	0.036	240	2,648	28.75%
LTG	IRF lamps - 300 hr/yr	0.044	177	2,825	30.67%
LTG	Compact fluorescents-620 h/y	0.045	200	3,025	32.84%
ESH1	Heat pump #2 (HSPF=8)*	0.047	13	3,038	32.99%
ECD	Heat pump clothes dryer	0.065	277	3,315	35.99%
ESH1	Low-emissivity film	0.078	67	3,382	36.72%
CAC	Window film	0.154	13	3,394	36.86%
RAC	RAC: 8.5 EER	0.177	5	3,400	36.92%
CAC	CAC: 10.0 SEER	0.258	9	3,409	37.02%
CAC	Variable speed drive	0.296	8	3,417	37.10%
RAC	RAC: 10.0 EER	0.329	3	3,420	37.13%
RAC	RAC: 12 .0 EER	0.439	3	3,423	37.17%
ESH1	Add 3" fiberglass in roof/ceiling	0.482	9	3,432	37.27%
CAC	CAC: 12.0 SEER	0.511	5	3,438	37.33%
CAC	CAC: 14.0 SEER	0.605	5	3,443	37.39%

Notes:

1. 1986 residential electricity consumption: 9,209 GWh
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family and small (2-4 units) multi-family homes; ESH2: electric space heating in large (5+ units) multi-family homes.

Table 2-84

PEAK DEMAND ASSESSMENT

RESIDENTIAL SECTOR

Niagara Mohawk Power Co.

Discount rate = 6%

			SUMMER			WINTER		
Area	Option	Marginal CRD(20) ($/kW)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)
CAC	Load controller/cycler	251	62	62	4.9%	0	0	0.0%
FRE	Current sales average (1986)	358	18	80	6.3%	16	16	0.7%
ESH2	Low-emissivity film	600	0	80	6.3%	2	18	0.8%
ESH2	Storm windows	646	0	80	6.3%	5	23	1.0%
REF	Current sales average (1986)	681	82	163	12.7%	42	65	2.9%
ESH1	Infiltration reduction	711	0	163	12.7%	71	136	6.1%
REF	Best current (1988)	795	82	245	19.1%	42	177	8.0%
RAC	RAC: 8.5 EER	814	15	259	20.3%	0	177	8.0%
EWH	Load controller/cycler	825	36	295	23.0%	92	269	12.1%
ECD	Load controller/cycler	832	84	379	29.6%	146	415	18.7%
EWH	Traps & blanket (EF=0.9)	837	9	388	30.3%	24	439	19.8%
REF	Near-term advanced	949	34	422	33.0%	17	456	20.6%
ESH1	Electric thermal storage system*	1,004	0	422	33.0%	312	769	34.7%
ESH1	Heat pump #1 (HSPF=7)*	1,020	0	422	33.0%	59	827	37.3%
RAN	Improved oven	1,098	14	437	34.1%	10	837	37.8%
ESH1	Heat pump #2 (HSPF=8)*	1,114	0	437	34.1%	7	844	38.1%
RAC	RAC: 10.0 EER	1,162	10	447	34.9%	0	844	38.1%
FRE	Best current (1988)	1,183	12	459	35.9%	11	855	38.6%
FRE	Near-term advanced	1,224	6	465	36.4%	6	861	38.9%
LTG	Tungsten halogen lamps-300 h/y	1,239	7	473	36.9%	33	894	40.4%
RAN	Improved cooktop	1,254	5	478	37.3%	3	898	40.5%
CAC	Window film	1,274	19	497	38.8%	0	898	40.5%
LTG	Energy saving lamps-620 hr/yr	1,603	1	498	38.9%	4	902	40.7%

RAC	RAC: 12 .0 EER	1,641	10	508	39.6%	0	902	40.7%
LTG	Energy saving lamps-1,240 h/y	1,659	1	509	39.7%	5	906	40.9%
CAC	CAC: 10.0 SEER	1,986	15	524	40.9%	0	906	40.9%
LTG	IRF lamps - 300 hr/yr	2,004	8	532	41.6%	39	945	42.7%
LTG	Compact fluorescents-1240 h/y	2,044	11	544	42.5%	53	998	45.0%
LTG	Compact fluorescents-620 h/y	2,561	10	553	43.2%	44	1,042	47.0%
ESH1	Low-emissivity film	3,221	0	553	43.2%	20	1,062	47.9%
CAC	CAC: 12.0 SEER	3,349	10	564	44.0%	0	1,062	47.9%
EWH	Front loading clothes washer	3,418	10	574	44.8%	25	1,087	49.1%
CAC	CAC: 14.0 SEER	4,656	9	582	45.5%	0	1,087	49.1%
ESH1	Add 3" fiberglass in roof/ceiling	40,775	0	582	45.5%	1	1,089	49.1%

*The electric thermal storage system (ETS) and heat pumps are mututally exclusive measures. CSE and CRD are calculated independently.

Notes:
1. 1986 residential summer peak: 1,280 MW; winter peak: 2,216 MW
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family homes; ESH2: electric space heating in multi-family homes.
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Table 2-85
ELECTRICITY CONSERVATION ASSESSMENT
COMMERCIAL SECTOR
Niagara Mohawk Power Co. – Upstate climate zone
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
LTG	Delamping	0.001	42	42	0.40%
REF	Floating head press. control	0.001	53	95	0.92%
REF	Refrig. compressor eff.	0.003	66	161	1.57%
HVAC	Reset supply air temperature	0.005	327	488	4.75%
LTG	Reflectors	0.011	1,090	1,578	15.38%
HVAC	Fan motor efficiency	0.011	69	1,647	16.05%
LTG	High-efficiency ballast	0.012	141	1,787	17.42%
HVAC	VAV conversion	0.013	632	2,419	23.58%
HVAC	Economizer	0.016	94	2,513	24.50%
LTG	Energy saving fluorescents	0.018	158	2,671	26.04%
HVAC	Pump motor efficiency	0.019	6	2,677	26.09%
HVAC	VSD on fan motor	0.022	746	3,423	33.37%
LTG	Occupancy sensors	0.034	132	3,555	34.65%
REF	Refrigerated case covers	0.044	17	3,572	34.81%
HVAC	Re-size chillers	0.048	481	4,053	39.50%
LTG	Daylighting controls	0.051	414	4,467	43.54%
LTG	VHE bulbs and ballasts	0.058	300	4,767	46.46%
HVAC	VSD on pump motor	0.063	55	4,822	46.99%
SHELL	Window films (S&W)	0.129	52	4,874	47.50%
SHELL	Low-E windows (N)	0.166	57	4,931	48.06%
SHELL	Low-E windows (all)	0.212	120	5,051	49.23%
SHELL	Roof insulation	0.422	3	5,054	49.26%

Notes:
1. 1986 commercial electricity sales: 10,260 GWh
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration

Table 2-86

PEAK DEMAND CONSERVATION ASSESSMENT

COMMERCIAL SECTOR

Niagara Mohawk Power Co. - Upstate climate zone

Discount rate = 6%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
LTG	Delamping	53	13	13	0.6%	7	7	0.4%
HVAC	Reset supply air temperature	132	140	154	6.7%	10	17	1.0%
REF	Refrig. compressor eff.	213	11	165	7.2%	6	23	1.3%
LTG	Reflectors	489	305	470	20.4%	164	188	10.6%
LTG	High-efficiency ballast	576	37	507	22.0%	23	210	11.9%
HVAC	VAV conversion	670	149	656	28.5%	67	278	15.7%
LTG	Energy saving fluorescents	732	43	699	30.3%	24	301	17.0%
HVAC	Fan motor efficiency	772	12	712	30.9%	13	315	17.8%
HVAC	Pump motor efficiency	1,043	1	713	30.9%	1	315	17.8%
HVAC	Cool storage	1,110	155	868	37.7%	0	315	17.8%
LTG	Occupancy sensors	1,503	37	905	39.3%	20	336	18.9%
SHELL	Window films (S&W)	1,663	49	954	41.4%	-3	333	18.8%
HVAC	VSD on fan motor	2,029	98	1,051	45.6%	97	430	24.3%
LTG	Daylighting controls	2,158	122	1,173	50.9%	68	499	28.1%
HVAC	Re-size chillers	2,425	117	1,290	56.0%	52	550	31.1%
LTG	VHE bulbs and ballasts	2,649	83	1,373	59.6%	44	594	33.5%
REF	Refrigerated case covers	3,208	3	1,375	59.7%	1	596	33.6%
HVAC	VSD on pump motor	4,456	10	1,385	60.1%	5	601	33.9%
HVAC	Economizer	7,154	2	1,387	60.2%	0	601	33.9%
SHELL	Roof insulation	13,172	1	1,388	60.2%	0	601	33.9%
SHELL	Low-E windows (all)	27,723	11	1,399	60.7%	21	622	35.1%
SHELL	Low-E windows (N)	62,479	0	1,399	60.7%	14	636	35.9%

Notes:

1. 1986 commercial summer peak 2,304 MW; winter peak: 1,772 MW;
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty-year period.

Table 2-87
ELECTRICITY CONSERVATION ASSESSMENT
INDUSTRIAL SECTOR
Niagara Mohawk Power Co.
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
MOT	>125 HP: retire	0.008	3.9	3.9	0.0%
MOT	21 - 50 HP: retire	0.008	13.0	16.9	0.2%
MOT	51-125 HP: retire	0.008	5.2	22.1	0.2%
LTG	Energy saving lamp	0.009	96.5	118.6	1.1%
MOT	5.1-20 HP: retire	0.012	32.8	151.3	1.4%
LTG	Metal halide lamp	0.020	34.5	185.8	1.7%
LTG	High-efficiency ballast	0.027	29.9	215.7	2.0%
MOT	>125 HP: VSD	0.036	758.2	973.9	9.1%
MOT	1-5 HP: retire	0.037	3.6	977.5	9.2%
LTG	High-pressure sodium	0.043	113.5	1,091.1	10.2%
MOT	21-50 HP: rebuild	0.044	37.1	1,128.1	10.6%
MOT	51-125 HP: VSD	0.045	555.3	1,683.5	15.8%
MOT	5.1-20 HP: rebuild	0.051	17.7	1,701.1	15.9%
MOT	51-125 HP: rebuild	0.064	63.1	1,764.2	16.5%
MOT	21-50 HP: VSD	0.087	286.7	2,050.9	19.2%
MOT	>125 HP: rebuild	0.090	57.2	2,108.1	19.7%
MOT	<1 HP: retire	0.103	0.4	2,108.5	19.8%
MOT	5.1-20 HP: VSD	0.129	192.9	2,301.5	21.6%
MOT	1-5 HP: VSD	0.373	13.1	2,314.5	21.7%

Notes:
1. 1986 industrial electricity sales: 10,676 GWh
2. MOT: Motor efficiency measure; LTG: Lighting efficiency measure

Table 2-88

PEAK DEMAND CONSERVATION ASSESSMENT

INDUSTRIAL SECTOR

Niagara Mohawk Power Co.

Discount rate = 6%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
MOT	>125 HP: retire	639	0.6	0.6	0.0%	0.6	0.6	0.0%
MOT	21 - 50 HP: retire	669	1.9	2.4	0.2%	1.9	2.5	0.2%
MOT	51-125 HP: retire	673	0.7	3.2	0.2%	0.8	3.2	0.2%
LTG	Energy saving lamp	740	13.9	17.1	1.1%	14.0	17.2	1.1%
MOT	5.1-20 HP: retire	1,014	4.7	21.8	1.4%	4.8	22.0	1.4%
LTG	Metal halide lamp	1,754	5.0	26.7	1.7%	5.0	27.0	1.7%
LTG	High-efficiency ballast	2,359	4.3	31.0	2.0%	4.3	31.3	2.0%
MOT	>125 HP: VSD	3,061	109.1	140.1	9.1%	110.1	141.5	9.1%
MOT	1-5 HP: retire	3,100	0.5	140.6	9.2%	0.5	142.0	9.2%
LTG	High-pressure sodium	3,790	16.3	157.0	10.2%	16.5	158.5	10.2%
MOT	21-50 HP: rebuild	3,794	5.3	162.3	10.6%	5.4	163.9	10.6%
MOT	51-125 HP: VSD	3,816	79.9	242.2	15.8%	80.7	244.5	15.8%
MOT	5.1-20 HP: rebuild	4,336	2.5	244.8	15.9%	2.6	247.1	15.9%
MOT	51-125 HP: rebuild	5,428	9.1	253.8	16.5%	9.2	256.2	16.5%
MOT	21-50 HP: VSD	7,485	41.3	295.1	19.2%	41.6	297.9	19.2%
MOT	>125 HP: rebuild	7,558	8.2	303.3	19.7%	8.3	306.2	19.7%
MOT	<1 HP: retire	8,688	0.1	303.4	19.8%	0.1	306.3	19.8%
MOT	5.1-20 HP: VSD	10,927	27.8	331.1	21.6%	28.0	334.3	21.6%
MOT	1-5 HP: VSD	31,539	1.9	333.0	21.7%	1.9	336.2	21.7%

Notes:

1. 1986 industrial summer peak demand : 1,536 MW
2. 1986 industrial winter peak demand : 1,551 MW
3. MOT: Motor efficiency measure; LTG: Lighting efficiency measure
4. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

G. Orange and Rockland Utilities, Inc.

The total technology-cost electricity savings potential and potential reductions in peak demand in the New York service territory of O&R are presented in Table 2-89. The sectoral conservation assessments at discount rate of 6% for O&R are presented in Tables 2-90 to 2-95. From the consumer perspective, total technology-cost potential electricity savings are 792 GWh/yr or 34% of annual consumption in 1986. The technology-cost potential reduction in peak demand is 172 MW and 112 MW for the summer and winter, respectively.

The utility perspective, shows significantly reduced potentials with 585 GWH/yr in electricity savings, and 160 MW and 82 MW in summer and winter peak demand, respectively. The societal perspective produces the largest potential reduction in peak demand; 216 MW and 126 MW for the summer and winter, respectively. The technology-cost electricity savings potential from this perspective is 773 GWh/yr, slightly lower than from the consumer perspective.

H. Rochester Gas and Electric

The potential technology-cost savings of electricity consumption and peak demand in the service territory of RG&E are presented in Table 2-96. The sectoral conservation assessments at a 6% discount rate for RG&E are presented in Tables 2-97 to 2-102. From the consumer perspective, the potential for technology-cost electricity savings is 1,704 GWh/yr or 30% of annual consumption in 1986. The technology-cost potential reduction in peak demand is 312 MW, or 29% of 1986 peak summer demand and 237 MW, or 24% of 1986 peak winter demand. Potential electricity savings from the utility perspective are substantially lower -- 1,225 GWh/yr -- while savings from the societal perspective are only slightly lower -- 1,645 GWh/yr. The potential for peak demand reductions follows a similar pattern.

Table 2-89
TECHNOLOGY-COST POTENTIAL
ELECTRICITY AND PEAK DEMAND SAVINGS
ORANGE & ROCKLAND
Savings and percent of total

CONSUMER PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	Electricity consumption (%)	Summer peak demand (MW)	Summer peak demand (%)	Winter peak demand (MW)	Winter peak demand (%)
Residential	285	34.1%	41	12.0%	41	17.2%
Commercial	433	44.2%	111	35.6%	54	24.3%
Industrial	74	16.1%	20	16.2%	17	16.1%
Total	792	33.7%	172	22.1%	112	19.8%

UTILITY PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	Electricity consumption (%)	Summer peak demand (MW)	Summer peak demand (%)	Winter peak demand (MW)	Winter peak demand (%)
Residential	222	26.6%	77	22.4%	32	13.4%
Commercial	321	32.8%	71	22.8%	40	18.0%
Industrial	42	9.2%	12	9.2%	10	9.2%
Total	585	24.9%	160	20.5%	82	14.4%

SOCIETAL PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	Electricity consumption (%)	Summer peak demand (MW)	Summer peak demand (%)	Winter peak demand (MW)	Winter peak demand (%)
Residential	271	32.5%	98	28.6%	55	23.0%
Commercial	428	43.7%	98	31.4%	54	24.3%
Industrial	74	16.1%	20	16.2%	17	16.1%
Total	773	32.9%	216	27.8%	126	22.2%

*Discount rates for each perspective are: 6% - consumer, 10% - utility, 3% - societal

Table 2-90
ELECTRICITY CONSERVATION ASSESSMENT
RESIDENTIAL SECTOR
Orange and Rockland
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
FRE	Current sales average (1986)	0.004	13	13	1.57%
REF	Current sales average (1986)	0.010	43	56	6.71%
REF	Best current (1988)	0.011	43	99	11.82%
REF	Near-term advanced	0.013	18	117	13.96%
EWH	Traps & blanket (EF=0.9)	0.013	5	122	14.56%
FRE	Best current (1988)	0.014	9	131	15.66%
FRE	Near-term advanced	0.015	5	135	16.20%
ESH1	Infiltration reduction	0.017	10	146	17.44%
RAN	Improved oven	0.022	3	149	17.85%
ESH2	Storm windows	0.024	2	151	18.14%
RAN	Improved cooktop	0.025	1	153	18.28%
ESH2	Low-emissivity film	0.026	1	153	18.37%
LTG	Tungsten halogen lamps-300 h/y	0.027	18	171	20.47%
LTG	Energy saving lamps-620 hr/yr	0.030	2	173	20.72%
LTG	Energy saving lamps-1,240 h/y	0.030	2	175	21.02%
EWH	Front loading clothes washer	0.034	9	184	22.04%
LTG	Compact fluorescents-1240 h/y	0.036	28	212	25.37%
LTG	IRF lamps - 300 hr/yr	0.044	21	232	27.83%
LTG	Compact fluorescents-620 h/y	0.045	23	256	30.60%
ESH1	Heat pump #1 (HSPF=7)*	0.047	1	257	30.76%
ESH1	Heat pump #2 (HSPF=8)*	0.062	0	257	30.78%
ECD	Heat pump clothes dryer	0.065	19	276	33.00%
RAC	RAC: 8.5 EER	0.072	6	282	33.74%
ESH1	Low-emissivity film	0.079	3	285	34.10%
RAC	RAC: 10.0 EER	0.115	4	289	34.55%
CAC	Window film	0.128	4	293	35.03%
CAC	CAC: 10.0 SEER	0.132	5	297	35.60%
RAC	RAC: 12 .0 EER	0.146	4	301	36.08%
CAC	Variable speed drive	0.192	3	304	36.46%
CAC	CAC: 12.0 SEER	0.258	3	307	36.79%
CAC	CAC: 14.0 SEER	0.407	2	309	37.04%
ESH1	Add 3" fiberglass in roof/ceiling	0.439	0	310	37.10%

Notes:
1. 1986 residential electricity consumption: 835 GWh
2. REF: refrigerator: FRE: freezer: EWH: electric water heater: LTG: lighting: RAC: room air conditioner: CAC: central air conditioner: RAN: cooking range: ECD: electric clothes dryer: ESH1: electric space heating in single-family and small (2-4 units) multi-family homes: ESH2: electric space heating in large (5+ units) multi-family homes.

Table 2-91
PEAK DEMAND ASSESSMENT
RESIDENTIAL SECTOR
Orange and Rockland
Discount rate = 6%

			SUMMER			WINTER		
Area	Option	Marginal CRD(20) ($/kW)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)
CAC	Load controller/cycler	159	26	26	7.5%	0	0	0.0%
RAC	RAC: 8.5 EER	345	16	42	12.2%	0	0	0.0%
FRE	Current sales average (1986)	358	2	44	12.8%	2	2	0.7%
RAC	RAC: 10.0 EER	492	11	55	16.0%	0	2	0.7%
REF	Current sales average (1986)	681	7	62	18.2%	4	5	2.3%
RAC	RAC: 12 .0 EER	695	11	73	21.3%	0	5	2.3%
ESH2	Storm windows	700	0	73	21.3%	1	6	2.7%
ESH2	Low-emissivity film	764	0	73	21.3%	0	7	2.8%
REF	Best current (1988)	795	7	80	23.4%	4	10	4.4%
ESH1	Infiltration reduction	802	0	80	23.4%	3	13	5.6%
EWH	Load controller/cycler	825	2	82	23.9%	4	17	7.2%
ECD	Load controller/cycler	832	6	88	25.5%	10	27	11.3%
EWH	Traps & blanket (EF=0.9)	837	0	88	25.6%	1	28	11.8%
REF	Near-term advanced	949	3	91	26.5%	2	30	12.4%
CAC	Window film	955	7	98	28.5%	0	30	12.4%
RAN	Improved oven	1,098	1	98	28.7%	1	30	12.6%
FRE	Best current (1988)	1,183	1	100	29.1%	1	31	13.2%
CAC	CAC: 10.0 SEER	1,209	7	106	31.0%	0	31	13.2%
FRE	Near-term advanced	1,224	1	107	31.2%	1	32	13.4%
LTG	Tungsten halogen lamps-300 h/y	1,239	1	108	31.4%	4	36	15.0%
RAN	Improved cooktop	1,254	0	108	31.5%	0	36	15.1%
ESH1	Electric thermal storage system*	1,305	0	108	31.5%	13	49	20.4%
ESH1	Heat pump #1 (HSPF=7)*	1,349	0	108	31.5%	1	49	20.7%

ESH1	Heat pump #2 (HSPF=8)*	1,429	0	108	31.5%	0	50	20.7%
LTG	Energy saving lamps-620 hr/yr	1,603	0	108	31.5%	0	50	20.9%
LTG	Energy saving lamps-1,240 h/y	1,659	0	108	31.6%	1	51	21.1%
CAC	CAC: 12.0 SEER	2,000	5	113	32.9%	0	51	21.1%
LTG	IRF lamps - 600 hr/yr	2,004	1	114	33.2%	5	55	23.0%
LTG	Compact fluorescents-1240 h/y	2,044	1	115	33.6%	6	61	25.6%
LTG	Compact fluorescents-620 h/y	2,561	1	116	33.9%	5	66	27.7%
CAC	CAC: 14.0 SEER	3,048	4	120	34.9%	0	66	27.7%
EWH	Front loading clothes washer	3,418	0	120	35.1%	1	67	28.2%
ESH1	Low-emissivity film	5,364	0	120	35.1%	1	68	28.4%
ESH1	Add 3" fiberglass in roof/ceiling	42,210	0	120	35.1%	0	68	28.4%

*The electric thermal storage system (ETS) and heat pumps are mututally exclusive measures. CSE and CRD are calculated independently.

Notes:
1. 1986 residential summer peak: 343 MW; winter peak: 239 MW
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family homes; ESH2: electric space heating in multi-family homes.
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Table 2-92

ELECTRICITY CONSERVATION ASSESSMENT

COMMERCIAL SECTOR

Orange and Rockland – Downstate climate zone

Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
LTG	Delamping	0.001	4	4	0.39%
REF	Floating head press. control	0.001	5	9	0.93%
REF	Refrig. compressor eff.	0.003	7	16	1.61%
HVAC	Reset supply air temperature	0.005	28	44	4.49%
LTG	Reflectors	0.010	99	143	14.62%
HVAC	Fan motor efficiency	0.010	7	150	15.30%
LTG	High-efficiency ballast	0.011	12	162	16.52%
HVAC	VAV conversion	0.012	57	219	22.37%
LTG	Energy saving fluorescents	0.017	15	234	23.86%
HVAC	Pump motor efficiency	0.017	1	234	23.92%
HVAC	Economizer	0.020	8	242	24.69%
HVAC	VSD on fan motor	0.021	67	309	31.56%
LTG	Occupancy sensors	0.034	11	321	32.72%
REF	Refrigerated case covers	0.044	2	322	32.89%
LTG	Daylighting controls	0.048	37	360	36.71%
HVAC	Re-size chillers	0.049	41	401	40.94%
LTG	VHE bulbs and ballasts	0.057	27	428	43.64%
HVAC	VSD on pump motor	0.060	5	433	44.16%
SHELL	Window films (S&W)	0.115	5	438	44.68%
SHELL	Low-E windows (all)	0.332	4	441	45.05%
SHELL	Roof insulation	0.663	0	442	45.10%
SHELL	Low-E windows (N)	0.832	0	442	45.13%

Notes:
1. 1986 commercial electricity sales: 980 GWh
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration

Table 2-93

PEAK DEMAND CONSERVATION ASSESSMENT

COMMERCIAL SECTOR

Orange and Rockland - Downstate climate zone

Discount rate = 6%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
LTG	Delamping	53	1	1	0.4%	1	1	0.3%
HVAC	Reset supply air temperature	140	11	12	4.0%	2	2	1.0%
REF	Refrig. compressor eff.	213	1	14	4.3%	1	3	1.3%
LTG	Reflectors	476	27	40	13.0%	15	17	7.9%
LTG	High-efficiency ballast	559	3	43	13.9%	2	19	8.7%
HVAC	Fan motor efficiency	712	1	45	14.3%	1	20	9.2%
LTG	Energy saving fluorescents	715	4	48	15.5%	2	23	10.2%
HVAC	VAV conversion	733	12	60	19.3%	6	29	12.9%
HVAC	Pump motor efficiency	974	0	60	19.3%	0	29	13.0%
HVAC	Cool storage	1,131	15	75	24.1%	0	29	13.0%
LTG	Occupancy sensors	1,564	3	78	25.1%	2	30	13.7%
LTG	Daylighting controls	2,078	11	89	28.6%	6	36	16.4%
HVAC	VSD on fan motor	2,097	8	97	31.2%	9	45	20.4%
HVAC	Re-size chillers	2,436	10	108	34.5%	4	50	22.4%
SHELL	Window films (S&W)	2,523	3	110	35.4%	0	49	22.3%
LTG	VHE bulbs and ballasts	2,639	7	118	37.7%	4	53	24.0%
REF	Refrigerated case covers	3,208	0	118	37.8%	0	53	24.0%
HVAC	VSD on pump motor	4,500	1	119	38.1%	0	54	24.2%
HVAC	Economizer	4,917	0	119	38.2%	0	54	24.2%
SHELL	Low-E windows (N)	6,072	0	119	38.2%	0	54	24.3%
SHELL	Roof insulation	7,307	1	120	38.3%	0	54	24.3%
SHELL	Low-E windows (all)	42,167	1	120	38.6%	1	55	24.9%

Notes:

1. 1986 commercial summer peak 312 MW; winter peak: 222 MW;
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration

Table 2-94
ELECTRICITY CONSERVATION ASSESSMENT
INDUSTRIAL SECTOR
Orange and Rockland
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
MOT	>125 HP: retire	0.008	0.2	0.2	0.0%
MOT	21 - 50 HP: retire	0.008	0.6	0.7	0.2%
MOT	51-125 HP: retire	0.008	0.2	1.0	0.2%
LTG	Energy saving lamp	0.009	4.2	5.1	1.1%
MOT	5.1-20 HP: retire	0.012	1.4	6.6	1.4%
LTG	Metal halide lamp	0.020	1.5	8.1	1.7%
LTG	High-efficiency ballast	0.027	1.3	9.4	2.0%
MOT	>125 HP: VSD	0.036	33.1	42.4	9.2%
MOT	1-5 HP: retire	0.037	0.2	42.6	9.2%
LTG	High-pressure sodium	0.043	4.9	47.5	10.3%
MOT	21-50 HP: rebuild	0.044	1.6	49.1	10.7%
MOT	51-125 HP: VSD	0.045	24.5	73.7	16.0%
MOT	5.1-20 HP: rebuild	0.051	0.8	74.4	16.1%
MOT	51-125 HP: rebuild	0.064	2.8	77.2	16.7%
MOT	21-50 HP: VSD	0.087	12.6	89.8	19.5%
MOT	>125 HP: rebuild	0.090	2.5	92.3	20.0%
MOT	<1 HP: retire	0.103	0.0	92.3	20.0%
MOT	5.1-20 HP: VSD	0.129	8.5	100.8	21.9%
MOT	1-5 HP: VSD	0.373	0.6	101.4	22.0%

Notes:
1. 1986 industrial electricity sales: 461 GWh
2. MOT: Motor efficiency measure; LTG: Lighting efficiency measure

Table 2-95
PEAK DEMAND CONSERVATION ASSESSMENT
INDUSTRIAL SECTOR
Orange and Rockland
Discount rate = 6%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
MOT	>125 HP: retire	339	0.0	0.0	0.0%	0.0	0.0	0.0%
MOT	21 - 50 HP: retire	355	0.2	0.2	0.2%	0.1	0.2	0.2%
MOT	51-125 HP: retire	357	0.1	0.3	0.2%	0.1	0.2	0.2%
LTG	Energy saving lamp	393	1.1	1.4	1.1%	1.0	1.2	1.1%
MOT	5.1-20 HP: retire	538	0.4	1.8	1.4%	0.3	1.5	1.4%
LTG	Metal halide lamp	931	0.4	2.2	1.7%	0.3	1.9	1.7%
LTG	High-efficiency ballast	1,252	0.4	2.5	2.0%	0.3	2.2	2.0%
MOT	>125 HP: VSD	1,624	9.0	11.5	9.2%	7.8	9.9	9.2%
MOT	1-5 HP: retire	1,645	0.0	11.6	9.2%	0.0	10.0	9.2%
LTG	High-pressure sodium	2,011	1.3	12.9	10.3%	1.1	11.1	10.3%
MOT	21-50 HP: rebuild	2,013	0.4	13.3	10.7%	0.4	11.5	10.7%
MOT	51-125 HP: VSD	2,025	6.6	20.0	16.0%	5.7	17.3	16.0%
MOT	5.1-20 HP: rebuild	2,301	0.2	20.2	16.1%	0.2	17.4	16.1%
MOT	51-125 HP: rebuild	2,880	0.8	20.9	16.7%	0.7	18.1	16.7%
MOT	21-50 HP: VSD	3,972	3.4	24.3	19.5%	2.9	21.0	19.5%
MOT	>125 HP: rebuild	4,011	0.7	25.0	20.0%	0.6	21.6	20.0%
MOT	<1 HP: retire	4,610	0.0	25.0	20.0%	0.0	21.6	20.0%
MOT	5.1-20 HP: VSD	5,798	2.3	27.3	21.9%	2.0	23.6	21.9%
MOT	1-5 HP: VSD	16,736	0.2	27.5	22.0%	0.1	23.7	22.0%

Notes:
1. 1986 industrial summer peak demand : 125 MW
2. 1986 industrial winter peak demand : 108 MW
3. MOT: Motor efficiency measure; LTG: Lighting efficiency measure
4. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Table 2-96

TECHNOLOGY-COST POTENTIAL
ELECTRICITY AND PEAK DEMAND SAVINGS
ROCHESTER GAS & ELECTRIC
Savings and percent of total

CONSUMER PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	610	32.3%	60	18.1%	93	23.7%
Commercial	807	48.7%	200	48.0%	100	29.2%
Industrial	287	16.1%	52	16.1%	44	16.1%
Total	1,704	29.5%	312	29.2%	237	23.5%

UTILITY PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	463	24.5%	86	26.0%	72	18.4%
Commercial	598	36.1%	144	34.5%	71	20.8%
Industrial	164	9.2%	30	9.2%	25	9.2%
Total	1,225	21.2%	260	24.3%	168	16.7%

SOCIETAL PERSPECTIVE

Sector	Electricity consumption (GWh/yr)	(%)	Summer peak demand (MW)	(%)	Winter peak demand (MW)	(%)
Residential	550	29.1%	115	34.7%	164	41.8%
Commercial	808	48.7%	226	54.2%	100	29.2%
Industrial	287	16.1%	52	16.1%	44	16.1%
Total	1,645	28.4%	393	36.7%	308	30.6%

*Discount rates for each perspective are: 6% - consumer, 10% - utility, 3% - societal

Table 2-97
ELECTRICITY CONSERVATION ASSESSMENT
RESIDENTIAL SECTOR
Rochester Gas and Electric
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
FRE	Current sales average (1986)	0.004	25	25	1.33%
REF	Current sales average (1986)	0.010	89	114	6.03%
REF	Best current (1988)	0.011	88	202	10.71%
REF	Near-term advanced	0.013	37	239	12.66%
EWH	Traps & blanket (EF=0.9)	0.013	12	251	13.28%
FRE	Best current (1988)	0.014	17	269	14.21%
FRE	Near-term advanced	0.015	9	277	14.67%
ESH1	Infiltration reduction	0.015	29	306	16.21%
ESH2	Storm windows	0.020	5	311	16.45%
ESH2	Low-emissivity film	0.020	1	312	16.53%
RAN	Improved oven	0.022	16	329	17.39%
RAN	Improved cooktop	0.025	6	334	17.69%
LTG	Tungsten halogen lamps-300 h/y	0.027	33	368	19.45%
LTG	Energy saving lamps-620 hr/yr	0.030	4	372	19.66%
LTG	Energy saving lamps-1,240 h/y	0.030	5	376	19.90%
EWH	Front loading clothes washer	0.034	20	396	20.95%
ESH1	Heat pump #1 (HSPF=7)*	0.035	15	411	21.74%
LTG	Compact fluorescents-1240 h/y	0.036	53	463	24.52%
LTG	IRF lamps - 300 hr/yr	0.044	39	502	26.58%
LTG	Compact fluorescents-620 h/y	0.045	44	546	28.89%
ESH1	Heat pump #2 (HSPF=8)*	0.047	1	548	28.97%
ECD	Heat pump clothes dryer	0.065	55	602	31.88%
ESH1	Low-emissivity film	0.078	7	610	32.27%
CAC	Window film	0.154	6	616	32.60%
RAC	RAC: 8.5 EER	0.177	2	618	32.69%
CAC	CAC: 10.0 SEER	0.258	5	622	32.93%
CAC	Variable speed drive	0.296	4	626	33.13%
RAC	RAC: 10.0 EER	0.329	1	627	33.17%
RAC	RAC: 12 .0 EER	0.439	1	628	33.22%
ESH1	Add 3" fiberglass in roof/ceiling	0.482	1	629	33.28%
CAC	CAC: 12.0 SEER	0.511	3	632	33.42%
CAC	CAC: 14.0 SEER	0.605	3	634	33.56%

Notes:
1. 1986 residential electricity consumption: 1,890 GWh
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family and small (2-4 units) multi-family homes; ESH2: electric space heating in large (5+ units) multi-family homes.

Table 2-98
PEAK DEMAND ASSESSMENT
RESIDENTIAL SECTOR
Rochester Gas and Electric
Discount rate = 6%

			SUMMER			WINTER		
Area	Option	Marginal CRD(20) ($/kW)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)
CAC	Load controller/cycler	251	30	30	9.2%	0	0	0.0%
FRE	Current sales average (1986)	358	4	34	10.3%	3	3	1.2%
ESH2	Low-emissivity film	600	0	34	10.3%	1	4	1.4%
ESH2	Storm windows	646	0	34	10.3%	2	6	2.0%
REF	Current sales average (1986)	681	15	49	14.9%	8	13	4.7%
ESH1	Infiltration reduction	711	0	49	14.9%	8	21	7.5%
REF	Best current (1988)	795	15	64	19.5%	8	29	10.1%
RAC	RAC: 8.5 EER	814	4	69	20.8%	0	29	10.1%
EWH	Load controller/cycler	825	4	72	21.9%	9	38	13.3%
ECD	Load controller/cycler	832	17	89	26.9%	29	67	23.5%
EWH	Traps & blanket (EF=0.9)	837	1	90	27.2%	2	69	24.3%
REF	Near-term advanced	949	6	96	29.1%	3	73	25.4%
ESH1	Electric thermal storage system*	1,004	0	96	29.1%	35	107	37.6%
ESH1	Heat pump #1 (HSPF=7)*	1,020	0	96	29.1%	7	114	39.8%
RAN	Improved oven	1,098	4	100	30.3%	3	117	40.8%
ESH1	Heat pump #2 (HSPF=8)*	1,114	0	100	30.3%	1	117	41.1%
RAC	RAC: 10.0 EER	1,162	3	103	31.2%	0	117	41.1%
FRE	Best current (1988)	1,183	3	106	32.0%	2	120	41.9%
FRE	Near-term advanced	1,224	1	107	32.4%	1	121	42.3%
LTG	Tungsten halogen lamps-300 h/y	1,239	2	109	32.8%	7	128	44.9%
RAN	Improved cooktop	1,254	1	110	33.3%	1	129	45.2%
CAC	Window film	1,274	9	119	36.1%	0	129	45.2%
LTG	Energy saving lamps-620 hr/yr	1,603	0	120	36.2%	1	130	45.5%

RAC	RAC: 12 .0 EER	1,641	3	123	37.0%	0	130	45.5%
LTG	Energy saving lamps-1,240 h/y	1,659	0	123	37.1%	1	131	45.9%
CAC	CAC: 10.0 SEER	1,986	7	130	39.3%	0	131	45.9%
LTG	IRF lamps - 300 hr/yr	2,004	2	132	39.9%	9	140	48.8%
LTG	Compact fluorescents-1240 h/y	2,044	3	135	40.7%	12	151	52.9%
LTG	Compact fluorescents-620 h/y	2,561	2	137	41.3%	10	161	56.3%
ESH1	Low-emissivity film	3,221	0	137	41.3%	2	163	57.0%
CAC	CAC: 12.0 SEER	3,349	5	142	42.8%	0	163	57.0%
EWH	Front loading clothes washer	3,418	1	143	43.1%	3	166	57.9%
CAC	CAC: 14.0 SEER	4,656	4	147	44.4%	0	166	57.9%
ESH1	Add 3" fiberglass in roof/ceiling	40,775	0	147	44.4%	0	166	58.0%

*The electric thermal storage system (ETS) and heat pumps are mututally exclusive measures. CSE and CRD are calculated independently.

Notes:

1. 1986 residential summer peak: 331 MW; winter peak: 286 MW
2. REF: refrigerator; FRE: freezer; EWH: electric water heater; LTG: lighting; RAC: room air conditioner; CAC: central air conditioner; RAN: cooking range; ECD: electric clothes dryer; ESH1: electric space heating in single-family homes; ESH2: electric space heating in multi-family homes.
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

Table 2-99
ELECTRICITY CONSERVATION ASSESSMENT
COMMERCIAL SECTOR
Rochester Gas and Electric – Upstate climate zone
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
LTG	Delamping	0.001	7	7	0.41%
REF	Floating head press. control	0.001	9	16	0.94%
REF	Refrig. compressor eff.	0.003	11	27	1.60%
HVAC	Reset supply air temperature	0.005	56	82	4.97%
LTG	Reflectors	0.011	180	263	15.84%
HVAC	Fan motor efficiency	0.011	12	275	16.56%
LTG	High-efficiency ballast	0.012	23	298	17.96%
HVAC	VAV conversion	0.013	108	406	24.48%
HVAC	Economizer	0.014	17	422	25.48%
HVAC	Pump motor efficiency	0.018	1	424	25.54%
LTG	Energy saving fluorescents	0.018	26	449	27.10%
HVAC	VSD on fan motor	0.021	127	576	34.77%
LTG	Occupancy sensors	0.033	22	598	36.08%
REF	Refrigerated case covers	0.044	3	601	36.25%
HVAC	Re-size chillers	0.048	79	680	40.99%
LTG	Daylighting controls	0.050	68	748	45.10%
LTG	VHE bulbs and ballasts	0.057	50	797	48.09%
HVAC	VSD on pump motor	0.057	10	807	48.70%
SHELL	Window films (S&W)	0.128	9	816	49.21%
SHELL	Low-E windows (N)	0.163	9	825	49.78%
SHELL	Low-E windows (all)	0.208	20	845	50.97%
SHELL	Roof insulation	0.395	1	846	51.00%

Notes:
1. 1986 commercial electricity sales: 1,658 GWh
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration

Table 2-100
PEAK DEMAND CONSERVATION ASSESSMENT
COMMERCIAL SECTOR
Rochester Gas and Electric - Upstate climate zone
Discount rate = 6%

Area	Option	Marginal CRD(20) ($/kW)	SUMMER Potential Savings (MW)	SUMMER Cumulative Savings (MW)	SUMMER Net Percent Savings (%)	WINTER Potential Savings (MW)	WINTER Cumulative Savings (MW)	WINTER Net Percent Savings (%)
LTG	Delamping	53	2	2	0.5%	1	1	0.3%
HVAC	Reset supply air temperature	113	27	29	7.0%	1	3	0.8%
REF	Refrig. compressor eff.	213	2	31	7.5%	1	4	1.1%
LTG	Reflectors	482	50	81	19.4%	27	31	9.0%
LTG	High-efficiency ballast	580	6	87	20.9%	4	35	10.1%
HVAC	VAV conversion	643	26	113	27.2%	11	46	13.5%
HVAC	Fan motor efficiency	750	2	115	27.7%	2	48	14.1%
LTG	Energy saving fluorescents	751	7	122	29.3%	4	52	15.3%
HVAC	Pump motor efficiency	1,025	0	122	29.4%	0	52	15.3%
HVAC	Cool storage	1,149	26	149	35.7%	0	52	15.3%
LTG	Occupancy sensors	1,520	6	155	37.1%	3	56	16.3%
SHELL	Window films (S&W)	1,689	8	163	39.0%	0	55	16.2%
HVAC	VSD on fan motor	2,068	16	179	42.9%	16	72	20.9%
LTG	Daylighting controls	2,143	20	199	47.7%	11	83	24.2%
HVAC	Re-size chillers	2,418	19	218	52.2%	8	91	26.7%
LTG	VHE bulbs and ballasts	2,624	13	231	55.5%	7	98	28.8%
REF	Refrigerated case covers	3,208	0	232	55.6%	0	99	28.9%
HVAC	VSD on pump motor	4,324	2	233	56.0%	1	100	29.1%
HVAC	Economizer	6,502	0	234	56.0%	0	100	29.1%
SHELL	Roof insulation	12,304	0	234	56.1%	0	100	29.1%
SHELL	Low-E windows (all)	27,497	2	236	56.5%	3	103	30.2%
SHELL	Low-E windows (N)	64,853	0	236	56.5%	2	105	30.8%

Notes:
1. 1986 commercial summer peak 417 MW; winter peak: 342 MW;
2. HVAC: heating, ventilation and air conditioning; LTG: lighting; SHELL: building shell; REF: refrigeration
3. CRD(20) is the net present value of the cost of reducing peak demand over a twenty-year period.

Table 2-101
ELECTRICITY CONSERVATION ASSESSMENT
INDUSTRIAL SECTOR
Rochester Gas and Electric
Discount rate = 6%

Area	Option	Marginal CSE ($/kWh)	Potential Savings (GWh/yr)	Cumulative Savings (GWh/yr)	Net Percent Savings (%)
MOT	>125 HP: retire	0.008	0.7	0.7	0.0%
MOT	21 - 50 HP: retire	0.008	2.2	2.9	0.2%
MOT	51-125 HP: retire	0.008	0.9	3.7	0.2%
LTG	Energy saving lamp	0.009	16.1	19.8	1.1%
MOT	5.1-20 HP: retire	0.012	5.6	25.4	1.4%
LTG	Metal halide lamp	0.020	5.8	31.1	1.7%
LTG	High-efficiency ballast	0.027	5.0	36.1	2.0%
MOT	>125 HP: VSD	0.036	128.2	164.3	9.2%
MOT	1-5 HP: retire	0.037	0.6	164.9	9.3%
LTG	High-pressure sodium	0.043	18.9	183.9	10.3%
MOT	21-50 HP: rebuild	0.044	6.3	190.2	10.7%
MOT	51-125 HP: VSD	0.045	93.7	283.9	15.9%
MOT	5.1-20 HP: rebuild	0.051	3.0	286.9	16.1%
MOT	51-125 HP: rebuild	0.064	10.6	297.5	16.7%
MOT	21-50 HP: VSD	0.087	48.6	346.1	19.4%
MOT	>125 HP: rebuild	0.090	9.7	355.8	20.0%
MOT	<1 HP: retire	0.103	0.1	355.9	20.0%
MOT	5.1-20 HP: VSD	0.129	32.7	388.6	21.8%
MOT	1-5 HP: VSD	0.373	2.2	390.8	21.9%

Notes:
1. 1986 industrial electricity sales: 1,781 GWh
2. MOT: Motor efficiency measure; LTG: Lighting efficiency measure

Table 2-102

PEAK DEMAND CONSERVATION ASSESSMENT

INDUSTRIAL SECTOR

Rochester Gas and Electric

Discount rate = 6%

			SUMMER			WINTER		
Area	Option	Marginal CRD(20) ($/kW)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)	Potential Savings (MW)	Cumulative Savings (MW)	Net Percent Savings (%)
MOT	>125 HP: retire	510	0.1	0.1	0.0%	0.1	0.1	0.0%
MOT	21 - 50 HP: retire	534	0.4	0.5	0.2%	0.3	0.4	0.2%
MOT	51-125 HP: retire	537	0.2	0.7	0.2%	0.1	0.6	0.2%
LTG	Energy saving lamp	591	2.9	3.6	1.1%	2.5	3.0	1.1%
MOT	5.1-20 HP: retire	810	1.0	4.6	1.4%	0.8	3.9	1.4%
LTG	Metal halide lamp	1,400	1.0	5.6	1.7%	0.9	4.8	1.7%
LTG	High-efficiency ballast	1,883	0.9	6.5	2.0%	0.8	5.5	2.0%
MOT	>125 HP: VSD	2,444	23.1	29.6	9.2%	19.6	25.1	9.2%
MOT	1-5 HP: retire	2,475	0.1	29.7	9.3%	0.1	25.2	9.3%
LTG	High-pressure sodium	3,025	3.4	33.1	10.3%	2.9	28.1	10.3%
MOT	21-50 HP: rebuild	3,028	1.1	34.3	10.7%	1.0	29.0	10.7%
MOT	51-125 HP: VSD	3,046	16.9	51.2	15.9%	14.3	43.4	15.9%
MOT	5.1-20 HP: rebuild	3,462	0.5	51.7	16.1%	0.5	43.8	16.1%
MOT	51-125 HP: rebuild	4,333	1.9	53.6	16.7%	1.6	45.4	16.7%
MOT	21-50 HP: VSD	5,975	8.8	62.4	19.4%	7.4	52.9	19.4%
MOT	>125 HP: rebuild	6,034	1.7	64.1	20.0%	1.5	54.3	20.0%
MOT	<1 HP: retire	6,935	0.0	64.1	20.0%	0.0	54.3	20.0%
MOT	5.1-20 HP: VSD	8,723	5.9	70.0	21.8%	5.0	59.3	21.8%
MOT	1-5 HP: VSD	25,177	0.4	70.4	21.9%	0.3	59.7	21.9%

Notes:
1. 1986 industrial summer peak demand : 321 MW
2. 1986 industrial winter peak demand : 272 MW
3. MOT: Motor efficiency measure; LTG: Lighting efficiency measure
4. CRD(20) is the net present value of the cost of reducing peak demand over a twenty year period

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