
Niagara Mohawk

High Efficiency Motors and Drives

Profile #41

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Executive Summary

NMPC's High Efficiency Motors and Adjustable Speed Drives program offers rebates to commercial and industrial customers to promote the installation of high efficiency motors and adjustable speed drives in the short term and ultimately transform the market for these devices. While all commercial and industrial customers are eligible for the program, NMPC has concentrated its efforts on large industrial customers with long hours of operation and/or varying motor loads.

Recommendations to potential program participants are often made through NMPC's Energy Audits program. If the Energy Audit identifies opportunities to install or replace motors and adjustable speed drives, the NMPC representative helps with identifying retrofit opportunities and locating the appropriate equipment vendors. The NMPC representative also assists with development of a sales proposal to facilitate the decision to install high efficiency motors or adjustable speed drives.

One of the most important lessons learned by NMPC is that participation levels can be stimulated by changing rebate amounts. In 1992 NMPC increased the rebate levels for the program substantially over their 1991 levels, especially for motors in the 10 to 150 horsepower (hp) range. For example, the rebate in 1991 for a 125 hp motor with a minimum nominal efficiency of 95% was \$457. In 1992 the rebate amount for the same motor was \$1,200. The increased rebate levels were highly successful in enhancing participation rates, so much so that NMPC decreased the 1993 rebate schedule which went into effect in September of 1992. Rebate applications pre-approved prior to that date and installed before the end of the year were eligible for the higher rebate levels, and many customers took advantage of the situation. As a result, energy savings accrued during the last two months of 1992 represent nearly half of all the net savings the program achieved over the two years it has been offered.

The High-Efficiency Motors and Adjustable Speed Drives program has achieved total annual savings of 76.0 GWh and lifecycle savings of 1,140.7 GWh in the two years 1991 and 1992. Total summer coincident peak demand reductions have been 1.4 MW and total winter coincident peak demand reductions have been 1.5 MW for the period 1991 to 1992. To achieve these savings levels, NMPC spent a total of \$5.34 million on the program.

To NMPC's credit, the High Efficiency Motors and Adjustable Speed Drives Program has been remarkably cost effective. The Results Center calculates that the cost of saved energy, based on a measure lifetime of 15 years, decreased between the first and second years of the program, from 1.05¢/kWh in 1991 to 0.68¢/kWh in 1992 at a 5% real discount rate.

High Efficiency Motors and Adjustable Speed Drives

Utility: Niagara Mohawk Power Corp.
Sector: Commercial and Industrial
Measures: High-efficiency motors and adjustable speed drives
Mechanism: Rebates for qualifying purchases
History: Started in 1991, over 800 rebates paid.

1992 Program Data

Energy savings: 67.6 GWh
Lifecycle energy savings: 1,014.0 GWh
Peak capacity savings: 1.1 MW summer
1.0 MW winter
Cost: \$4,482,000

Cumulative Data (1991 - 1992)

Energy savings: 84.5 GWh
Lifecycle energy savings: 1,140.7 GWh
Peak Capacity Savings: 1.4 MW summer
1.5 MW winter
Cost: \$5,339,800

Conventions

For the entire 1992 profile series all dollar values have been adjusted to 1990 U.S. dollar levels unless otherwise specified. Inflation and exchange rates were derived from the U.S. Department of Labor's Consumer Price Index and the International Monetary Fund's International Financial Statistics Yearbook: 1991.

The Results Center uses three conventions for presenting program savings. **Annual savings** refer to the annualized value of increments of energy and capacity installed in a given year, or what might be best described as the first full-year effect of the measures installed in a given year. **Cumulative savings** represent the savings in a given year for all measures installed to date. **Lifecycle savings** are calculated by multiplying the annual savings by the assumed average measure lifetime. **Caution:** cumulative and lifecycle savings are theoretical values that usually represent only the technical measure lifetimes and are not adjusted for attrition unless specifically stated.

Utility Overview

Niagara Mohawk Power Corporation (NMPC) is an investor-owned utility serving the largest area of any utility in New York State. It supplies gas and electric service to approximately 1.5 million customers over some 24,000 square miles, an area extending from Lake Erie to the borders of New England, Canada, and Pennsylvania. Its service area includes Albany, New York's capital. [R#1,5]

Much of the NMPC service area is subject to severe winters, as the people of the notoriously-snowy cities of Syracuse and Buffalo will attest. In fact, in March of 1991, an ice storm swept across New York State, cutting off electrical service to more than 100,000 NMPC customers, as well as to 200,000 others served by neighboring utilities. Niagara Mohawk was nevertheless able to restore power within a week after the storm. [R#6] The annual mean temperature in Albany is 47.3°F, with an average of 150 days when temperatures drop below 32°F, and an average annual snowfall of 64.3 inches. The city has an average of 6,927 heating degree days and 494 cooling degree days each year.

As might be expected, NMPC is a winter peaking utility. In 1991, the system's peak demand was 6,093 MW and occurred in December. In 1992, the winter peak of 6,159 MW occurred in the evening in January, and the system's summer peak of 5,721 MW was in the early afternoon in August. [R#1,5,11] In 1991, NMPC had a total electric capability of 7,963 MW, representing a 31% reserve margin. Sixty-six percent of NMPC's total electric generation in kWh is by thermal sources, including 22% coal, 15% oil, 16% nuclear, 5% natural gas, 1% purchased

1991 NMPC SOURCES OF ELECTRICITY (kWh)

NMPC Owned	
Coal	22%
Oil	15%
Nuclear	16%
Natural Gas	5%
Hydro	9%
Purchased	
Nuclear from NYPA	1%
Other purchased thermal	7%
Hydro from NYPA	16%
Other purchased hydro	3%
Other (various sources)	6%

[R#1]

NMPC 1991 ELECTRIC STATISTICS

Number of Customers	1,529,096
Energy Sales	36,738 GWh
Energy Sales Revenue	\$2,785 million
Winter Peak Demand	6,093 MW
Generating Capacity	7,963 MW
Reserve Margin	30.7%

Average Electric Rates

Residential	9.1 ¢/kWh
Commercial	8.56 ¢/kWh
Industrial	4.69 ¢/kWh

[R#6]

nuclear from the New York Power Authority, and 7% purchased from independently-owned thermal sources. Hydroelectric facilities generate 28% of the company's owned and purchased power, and the remaining 6% is from a variety of other purchased power sources. [R#6]

NMPC has two wholly-owned subsidiaries. The Canadian-based Opinac Energy Corporation operates two companies: Opinac Exploration Limited and Canadian Niagara Power Company Limited. These two companies are involved in exploration in Alberta and power generation at the Niagara Falls hydro plant in Ontario. NMPC's other subsidiary, Hydra-Co Enterprises Inc., located in Syracuse, owns, develops, and operates cogeneration and small power plants. [R#1]

In 1991 NMPC had 1,529,096 electric customers, made up of 1,378,484 residential customers, 145,098 commercial, 2,283 industrial, and 3,231 municipal; NMPC also had 153 resale customers in 1991 for a total of 1,529,249. Total electricity sales in 1991 increased to 37 million MWh from the previous year total of 36 million MWh. Electricity sales were fairly evenly distributed among the residential, commercial, and industrial sectors, at 28%, 32%, and 31%, respectively. [R#1]

The number of gas customers served by Niagara Mohawk in 1991 was 476,570, made up of 438,581 residential, 37,727 commercial, and 260 industrial customers. Total gas sales decreased in 1991, with sales of 71.7 million dekatherms slightly lower than the previous year total of 78.6 million. Though gas sales decreased in 1991, transportation of customer-owned gas increased markedly, rising from 34 million to 51 million dekatherms in one year. Most of 1991 gas deliveries were to residential customers (40%), and 41% of the gas deliveries were transportation of customer-owned gas. NMPC also sold gas to two gas utilities in 1991. [R#1]

Utility DSM Overview

In 1990, the Niagara Mohawk Power Corporation launched 11 demand-side management programs targeted at the residential, commercial and industrial sectors of its service territory. In 1991, the project was expanded under the name Niagara Mohawk Reducing Plan to include farm and nonprofit and public sector operations.[R#2] In the first two years of operation, DSM programs served over 400,000 customers (approximately 25% of Niagara Mohawk's electric customer base) and generated savings of 295 GWh. In 1991, peak load savings as a result of the DSM programs were 95 MW in the summer and 111 MW in the winter. In 1991, NMPC spent \$42.8 million on DSM, representing 1.5% of its gross revenues.[R#2,3,12]

DSM Overview	Annual DSM Expenditure (x1000)	Annual Energy Savings (GWh)	Annual Summer Peak Capacity Savings (MW)	Annual Winter Peak Capacity Savings (MW)
1990	\$17,026	84.38	30.84	33.18
1991	\$42,779	210.99	94.98	111.45
Total	\$59,804	295.37	125.81	144.63

NIAGARA MOHAWK DSM PROGRAMS

Residential

- Energy Saver's Kit
- ReHeat
- Value Plus
- Night Shift
- High-Efficiency Lighting Program
- Refrigerator Roundup
- Demand Savings for Multi-Family Buildings

Farm

- Energy Efficient Farmstead Program

Non-Profit/Public Sector

- Energy Assistance Pilot Program

Commercial / Industrial

- Energy-Saving Lighting Program
- High Efficiency Motors and Adjustable Speed Drives Program**
- Energy Efficient Air Conditioning Program
- Innovative Rate Programs
- Power Partner Programs
- Custom Incentives

Information

- Residential Bill "Disaggregation" Analysis
- Commercial / Industrial Energy Management Service: Load Expert
- Commercial / Industrial Energy Analysis Program
- Integrated DSM Communications

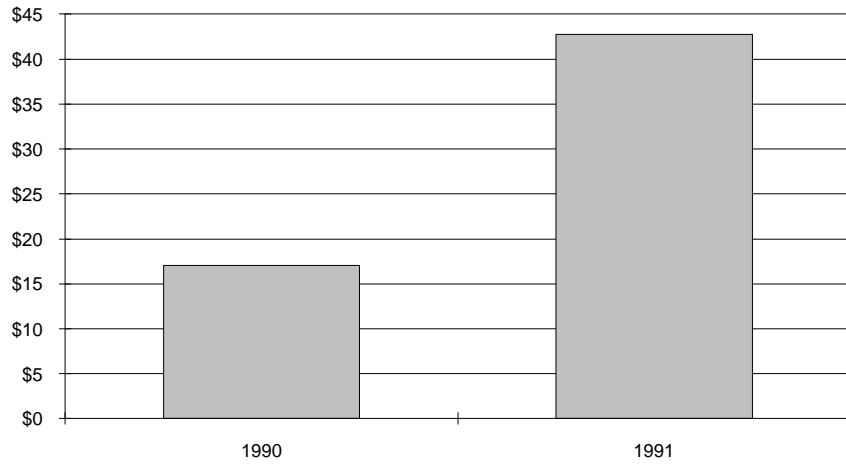
Implemented by Niagara Mohawk's Consumer Services and Regional Sales departments, the Reducing Plan offers cash incentives and rebates for the purchase or installation of energy-efficient lighting, space conditioning equipment, water heating equipment (for residential and farm customers only), motors, and adjustable speed drives. The Plan also has informational programs that offer technical assistance, computer modeling, and free energy audits.[R#2,3]

For example, the Residential Low Cost Measures Program, with over 39 GWh in savings in 1991, provides residential customers with a free Energy Saver's Kit with four low-cost, energy-saving devices. In the commercial/industrial sector, the lighting program achieved more than 147 GWh in energy savings. The High Efficiency Motors and Adjustable Speed Drives Program, described in this profile, has achieved significant savings and participation rates, exceeding its 1991 savings goal by more than 300 percent.[R#2,12]

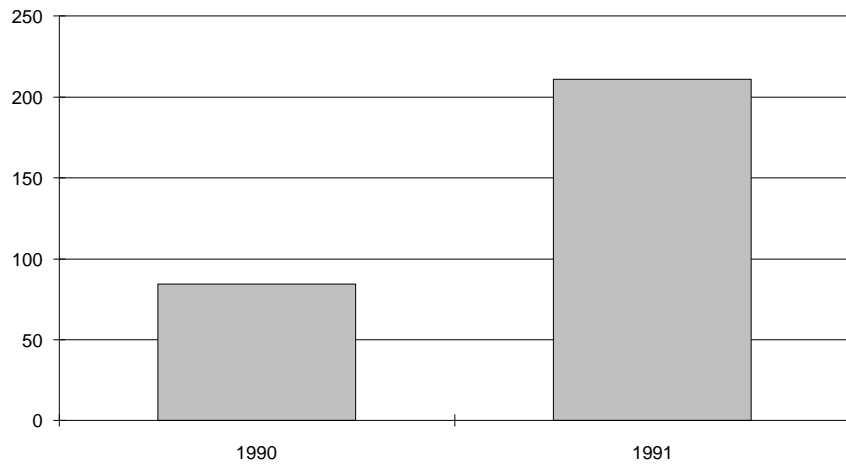
In 1992, Niagara Mohawk implemented 19 demand-side management programs and had several more in the testing and pilot stage. The programs are monitored by the DSM Program Evaluation Unit and incentives are calculated by the Demand Side Planning Unit, which is also responsible for incorporating evaluation results into system planning functions.[R#2]

[R#1]

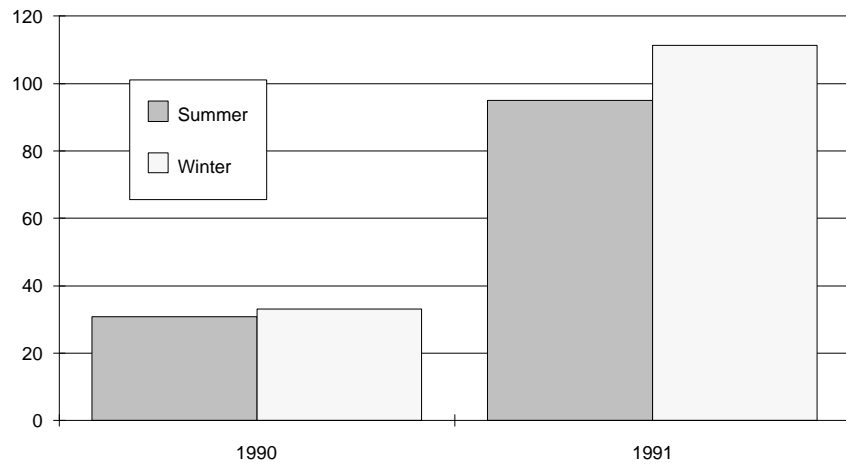
**ANNUAL DSM
EXPENDITURE
(\$1,000,000)**



**ANNUAL ENERGY
SAVINGS (GWH)**



**ANNUAL PEAK
CAPACITY SAVINGS
(MW)**



Program Overview

NMPC's High Efficiency Motors and Adjustable Speed Drives program began in 1991 after several pilot programs had been tested in late 1990. The program offers rebates to commercial and industrial customers who install high efficiency motors and adjustable speed drives in their manufacturing, processing, and HVAC equipment. While all commercial and industrial customers are eligible for the program it is aimed primarily at larger industrial customers with longer hours of operation or varying motor loads, as these customers represent the highest potential for energy savings.[R#4]

Several changes have been implemented in the program since its introduction. During the first year of the program (1991) new and replacement motors were eligible for rebates, but only new adjustable speed drives could qualify under the program. (That is, replacement of an existing adjustable speed drive with a new one did not qualify for a rebate.) In the 1992 program, replacement of certain mechanical, eddy-current coupling, and hydraulic drives became eligible.[R#4] In 1993, the number of hours that motors must operate to be eligible for rebates was increased to 3,000 hours from the 1992 level of 1,000 hours. Since the inception of the program it has been required that replacement motors must be replacing standard motors to qualify for rebates; replacements of existing high-efficiency motors are not eligible under the program.

Additionally, changes in the rebate schedule have been instituted each year in order to best influence customers' decisions to install energy-efficient motors and drives. The 1991 rebate schedule included motors between 5 and 250 horsepower. In 1992, motors from 1 to 400 horsepower were included. Replacements and installations of motors over 400 horsepower and application of adjustable speed drives to such motors are eligible for incentives under NMPC's Custom Incentive program.

Also in 1992, in order to stimulate participation in the program, rebates for motors increased substantially over their 1991 levels, especially for motors in the 10 to 150 horsepower range. For example, the rebate in 1991 for a 125 hp motor with a minimum nominal efficiency of 95% could receive a rebate of \$457, whereas in 1992 the rebate amount for the same motor was \$1,200. The increased rebate levels were successful in enhancing participation rates. As a result, the 1993 rebate schedule, which went into effect in September of 1992, has rebate levels that are

lower than the 1992 levels. Rebate applications pre-approved prior to that date and installed before the end of the year were eligible for the higher rebate levels, and many customers took advantage of the situation. NMPC paid more rebates in the last quarter of 1992 than it did in the first three quarters of 1992. Rebates for adjustable speed drives were slightly increased between 1991 and 1992, thus leveling the rebate amounts for the two years.

In the first year of the program, most participants were large industrial customers and hospitals.[R#4] A survey of NMPC's commercial sector found that hospitals represented 70% of NMPC commercial customers who had motors of 5 horsepower or greater.[R#4] A comprehensive market evaluation was conducted in 1991 to identify which customer types NMPC should target with the Motors and Drives program to achieve optimal savings. The evaluation found that customers in the new and expanded construction market offered the greatest opportunity for savings, as these customers were most likely to be willing to install high efficiency motors and adjustable speed drives.[R#4]

There are many barriers to installation of high-efficiency motors and adjustable speed drives. The primary obstacle is an aversion to downtime; customers who are replacing failed motors are likely to choose the motor replacement option that is most expedient, rather than that which may be most energy-efficient, even if the energy-efficient option is cost effective. Additionally, high first cost of high efficiency motors, limited access to capital, and lack of knowledge are other reasons that prevent the widespread installation of energy-efficient motors. The NMPC High Efficiency Motors and Adjustable Speed Drives program seeks to break down these barriers by offering incentives that reduce the first cost. Promotion of the program serves to educate customers regarding the cost-effectiveness and energy saving benefits of installation and replacement of high efficiency motors and adjustable speed drives.

Implementation

MARKETING AND DELIVERY

The High Efficiency Motors and Adjustable Speed Drives program is marketed primarily in conjunction with NMPC's other commercial and industrial DSM programs. The program brochure, "Reducing Plan for Business," includes a booklet that identifies all the DSM programs for which customers may be eligible. The brochure also includes rebate application forms and postage paid envelopes for returning the forms to NMPC. The terms and conditions regarding customer and product eligibility are described both in the booklet and on the rebate application form.

NMPC's DSM marketing plan builds both customer and trade ally awareness through trade shows, direct mailings, and media advertisements. Recommendations to potential program participants are often made through NMPC's Energy Audits program.[R#4] Customers must request performance of energy audits, which are promoted through direct mail and direct contact with NMPC representatives. Individual contact is emphasized with NMPC's larger customers.[R#3]

If the Energy Audit identifies opportunities to install or replace motors and adjustable speed drives, the NMPC representative assists with identifying financial requirements of a project, and locating trade allies who can supply the customer with eligible equipment. The NMPC representative also assists with development of a sales proposal to assist the customer in obtaining in-house approval for the decision to install high efficiency motors or adjustable speed drives. Once the proposal has been accepted, rebate forms are generally filled out by the customer with the assistance of a trade ally or an NMPC Consumer Relations Representative or Energy Utilization Specialist.[R#4]

To receive a motor rebate for under \$5,000, the customer simply makes the required purchase and mails the completed rebate form along with the original motor invoice to NMPC in a postage paid envelope. NMPC reserves the right to perform a post-installation inspection of the installation to verify its eligibility prior to issuing a rebate check.[R#4]

Motor rebates greater than \$5,000 and all drive rebates are subject to a pre-approval process, in which NMPC verifies the eligibility of the installation prior to the customer making any motor or ASD purchases or instal-

lations. After pre-approval is given, the customer may proceed with the purchase and installation. After installation is completed, the NMPC representative verifies the project, the customer then submits the invoice and completed rebate form, and receives a rebate check.[R#4]

Regardless of the rebate amount, NMPC usually takes about four to five weeks to process completed rebate application forms, enter information into the program tracking system, and issue a rebate check to the customer.[R#7]

MEASURES INSTALLED

The High Efficiency Motors and Adjustable Speed Drives program offers rebates for installations of qualifying equipment as shown in the Sample Rebate Amounts table on the following page. Some restrictions apply to motor and adjustable speed drive applications. For motors, specific eligibility requirements are that the motor must operate a minimum of 3,000 hours per year, the motor must be a three phase NEMA design B or C, and must meet specified minimum nominal efficiencies. All motors must be tested in accordance with IEEE Standard 112 test method B, or an acceptable substitute method if the motor is foreign. High efficiency motors from 1 to 200 HP required by the New York State energy code in commercial new construction and substantial renovations are not eligible, as they are required to be installed by law. To be eligible for a rebate, replacement motors must be replacing a standard motor of the same size; high-efficiency motor replacements are not eligible for rebates under the program. Up-sizing is permitted if there is adequate reason for the change.

All drive applications must be pre-approved by NMPC, and only AC (variable frequency) adjustable speed drives applied to throttled fan and pump applications are eligible. To be eligible for a rebate, the adjustable speed drive can only be installed in an application which does not require an ASD as a standard mode of operation. Additionally, energy savings must result from the installation. Drives which are mandated by the New York State Energy Conservation Construction Code are not eligible for rebates under the program. Customers are responsible for mitigating any negative impacts on power quality, and limitations on harmonic distortion. Rebates for replacements of existing adjustable speed drives are not eligible under the Motors and Drives program, but may qualify for rebates under NMPC's Custom Program.[R#7]

Implementation(continued)

STAFFING REQUIREMENTS

The High Efficiency Motors and Adjustable Speed Drives program is delivered primarily through staff located at NMPC's eight regional and three divisional offices. Corporate staff oversee implementation of the program and are responsible for program design. At the corporate level, the Marketing Programs and Services and the Sales and Technical Services departments oversee implementation of the program, provide technical support, coordinate training sessions, and promote the program.[R#4] The Program Manager, Tom DePaull, and the Implementation Leader, Joseph G. Berardi, spend 30% to 50% of their time on these duties. In the evaluation section, six people are responsible for evaluating NMPC's 20 programs, with significant contractor support. About 0.2 FTE in-house evaluation staff are devoted to the High Efficiency Motors and Drives program.

Energy Utilization Specialists and Consumer Representatives and Advisors have most of the direct contact with customers, promoting the program to eligible customers, and performing pre- and post-installation inspections. On average, Energy Utilization Specialists and Consumer Representatives and Advisors spend 15% to 40% of their time on implementation of various DSM programs, one of which is the High Efficiency Motors and Adjustable Speed Drives program. There are ten to twelve Energy Utilization Specialists in each of the three divisional offices.

1993 REBATE LEVELS

Motor HP	Minimum Nominal Motor Efficiency for Motor Rebate Eligibility	Motor Rebate	Adjustable Speed Drives Rebate
1	84.0%	\$35	\$0
1.5	84.0%	\$35	\$0
2	85.0%	\$35	\$0
3	86.0%	\$35	\$0
5	87.0%	\$40	\$550
7.5	89.0%	\$60	\$750
10	90.0%	\$80	\$900
15	90.0%	\$120	\$1,050
20	91.0%	\$160	\$1,400
25	93.0%	\$200	\$1,750
30	93.0%	\$240	\$2,100
40	93.6%	\$320	\$2,800
50	94.0%	\$400	\$3,000
60	94.1%	\$480	\$3,300
75	94.5%	\$600	\$3,750
100	94.5%	\$800	\$4,500
125	95.0%	\$1,000	\$5,625
150	95.0%	\$1,200	\$6,750
200	95.4%	\$1,600	\$9,000
250	95.8%	\$2,000	\$12,500
300	95.8%	\$2,400	\$13,500
350	95.8%	\$2,800	\$15,750
400	95.8%	\$3,200	\$18,000

Monitoring and Evaluation

MONITORING

All of NMPC's DSM programs are tracked via the Customer Information Management System (CIMS), a computerized database system. After rebate application forms are verified, the information regarding the customer, customer account number, number and type of motors installed, number and type of motors replaced, and amount of rebate are entered into the system. The system has three components: Customer Activity Tracking, Proposal Tracking, and Rebate Processing. To avoid data entry errors, regional staff may only enter data into the files of customers within their regions.

All rebates for amounts more than \$5,000 and all drive applications must be pre-approved. NMPC representatives verify that the installation is eligible, and conduct a post-installation inspection for every installation subject to pre-approval. Additionally, for smaller rebate applications where the installation seems questionable, or the rebate form has been improperly filled out, a post-installation inspection is conducted to ensure that qualifying equipment was installed and the application was appropriate.

In addition to implementation inspections, the evaluation group also conducts post-installation spot-checks in about 20% of the applications. During these checks, the evaluation staff collect information regarding site-specific operational variations, such as hours, rates and efficiencies at which motors are actually being used.[R#10]

EVALUATION

In July, 1992, NMPC completed a comprehensive evaluation of the High-Efficiency Motors and Adjustable Speed Drives Program.[R#4] The evaluation had three discrete components including an evaluation of the market for the program, a process evaluation, and an impact evaluation. The program had been operating for one year when the evaluation was conducted.

The market evaluation was based primarily on a literature search and telephone interviews with nine customers in the industrial and hospital sectors. Potential markets were identified and barriers to installation of high-efficiency motors and adjustable speed drives were explored. The evaluation defined three conditions under which a new motor or adjustable speed drive would be installed: new construction; early replacement of existing

equipment; and normal replacement of failed or failing equipment.

The new construction category was found to offer the most savings with the fewest obstacles to overcome. Decision makers typically would not consider early replacement of a motor unless the operating cost savings were demonstrated to be significant enough to warrant the halt in production necessary to replace a motor. This area was identified as having a high probability for installations of high efficiency motors and adjustable speed drives, but a low frequency of opportunities. Finally, normal replacement of failed or failing equipment is usually driven by expediency and low first cost. Because standard motors are cheaper and more likely to be readily available, whether through a dealer or in the facility's stock, there is a lower chance that a high-efficiency motor would be chosen in the normal replacement category. It is this latter group, however, that is best targeted through promotion of the program to trade allies.

In fact, the process evaluation found that program staff hoped that promotion to trade allies would be pursued in 1992.[R#4] The process evaluation was based on the results of personal interviews and telephone interviews of 22 staff at the corporate and regional levels, and reviews of program documents.[R#4] The process evaluation made several recommendations regarding program administration and implementation. NMPC responded to the recommendations in the process evaluation by continuing to strengthen the relationship with trade allies, implementing changes in the tracking system, and making some of the suggested changes in training, program promotion, and administrative procedures.

The impact evaluation was performed to estimate free ridership for the program and to determine energy and demand savings attributable to the program. Thirty-eight customers were surveyed to determine free-rider-ship. Energy and demand savings were calculated based on prototypical savings for each horsepower category of high-efficiency motors. Energy and demand savings for adjustable speed drives were calculated based on an algorithm relating load level, horsepower, and motor efficiency, and assuming a standard load variation. (The load level was assumed to be 100%, 90%, 80%, 70% and 60% twenty percent of the time the motors were operating, which was assumed to be 6,000 hours per year.) The findings regarding free ridership and savings impacts are discussed further in the Program Savings section.[R#4]

Program Savings

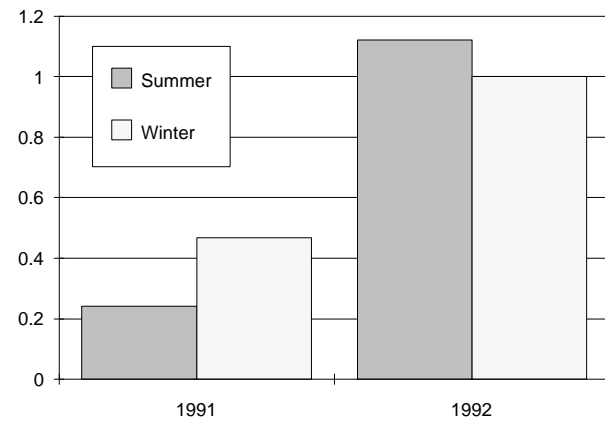
Savings Overview Table	Annual Energy Savings (MWh)	Cumulative Energy Savings (MWh)	Lifecycle Energy Savings (MWh)	Summer Coincident Peak Capacity Savings (MW)	Cumulative Summer Coincident Peak Capacity Savings (MW)	Winter Coincident Peak Capacity Savings (MW)	Cumulative Winter Coincident Peak Capacity Savings (MW)
1991	8,443	8,443	126,645	0.24	0.24	0.47	0.47
1992	67,603	76,046	1,014,045	1.12	1.36	1.00	1.47
Total	76,046	84,489	1,140,690	1.36		1.47	

[R#4,8,10]

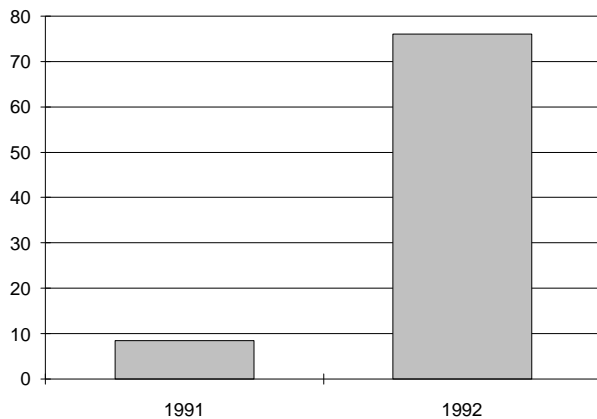
ANNUAL ENERGY SAVINGS (GWH)



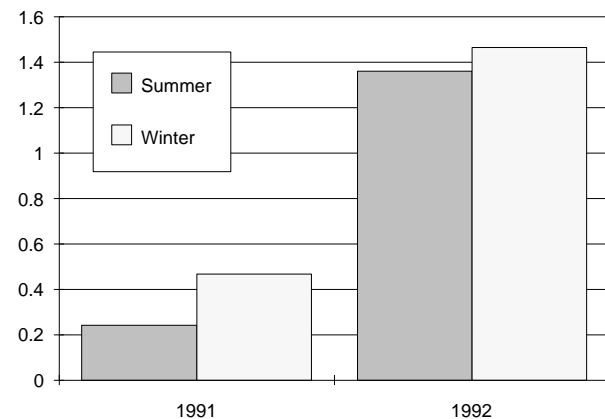
ANNUAL COINCIDENT PEAK CAPACITY SAVINGS (MW)



CUMULATIVE ENERGY SAVINGS (GWH)



CUMULATIVE COINCIDENT PEAK CAPACITY SAVINGS (MW)



PROGRAM SAVINGS

DATA ALERT: 1992 savings were calculated by reducing the gross savings as provided by NMPC by 34% for free-ridership. 1991 savings are adjusted savings as reported in the NMPC Evaluation Report.[R#4,8,10]

The High-Efficiency Motors and Adjustable Speed Drives program has achieved total annual savings of 76.0 GWh and lifecycle savings of 1,140.7 GWh in the two years 1991 and 1992. Total summer coincident peak demand reductions have been 1.4 MW and total winter coincident peak demand reductions have been 1.5 MW for the period 1991 to 1992. In 1992, energy savings were 67.6 GWh, summer coincident peak demand savings were approximately 1.1 MW, and winter coincident peak demand savings were approximately 1.0 MW.[R#8,10]

Energy savings accrued during the last two months of 1992 represent nearly half of all the net savings the program achieved over the two years it has been offered. Increased program activity in those months occurred after NMPC announced that the 1993 rebate amounts (which were lower than the 1992 levels) would go into effect on September 1, 1992, but that any applications pre-approved prior to that date could still receive rebates at the 1992 level if installation was completed by the end of the year. Thus, the number of rebates paid, and the number of installations occurring during the last quarter of 1992 increased dramatically.

PARTICIPATION RATES

In 1991, the program had 115 participants who installed 161 qualifying motors for a total of 4,975 horsepower, and 214 adjustable speed drives for a total of 5,345 horsepower. [R#4] A total of 10,320 horsepower was installed through the program in 1991.[R#4] In 1991,

Participation Table	Number of Rebates Paid	Annual Energy Savings per Rebate Paid (kWh)
1991	115	73,417
1992	689	98,118
Total	804	

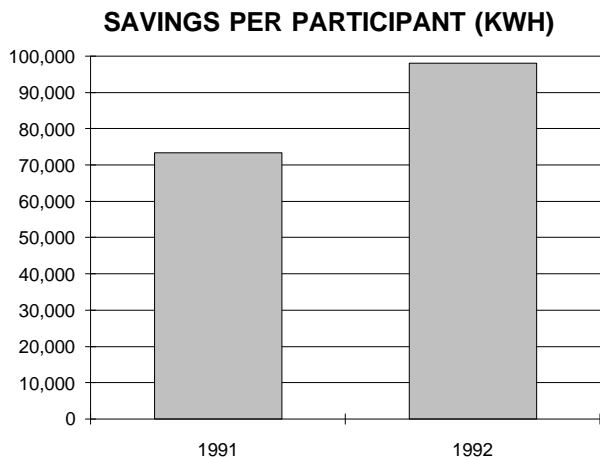
19% of the 161 high-efficiency motors installed were larger than 50 horsepower, and 10% of the adjustable speed drives were applied to motors larger than 50 horsepower.[R#4]

In 1992, rebate levels for motors were increased substantially in an effort to improve participation rates. The effort succeeded and in 1992 a total of 736 rebates were applied for and 689 rebates were paid by March 1, 1993. [R#9]

For 1992 through February 13, 1993, NMPC rebated 5,260 motors for a total of 191,472 horsepower, and 1,469 adjustable speed drives for a total of 58,472 horsepower. Thus, a total of 249,944 horsepower were installed through the program in 1992. In 1992, 23% of motors and 23% of drives were 50 horsepower or greater.[R#9]

The impact evaluation conducted for 1991 revealed that the potential for energy savings was greatest in the hospital and large industrial customer sectors. Additionally, the number of free riders in the hospital sector was low compared to the other sectors. The target market is thus comprised of 300 hospitals and 2,100 industrial customers with annual demand greater than 100,000 kWh. [R#4] Of course, all non-residential customers are eligible to participate in the High-Efficiency Motors and Adjustable Speed Drives program. In 1991, NMPC had 150,612 commercial, industrial, and municipal customers.

Energy savings per rebate paid increased from 73 MWh in 1991 to 98 MWh in 1992. This increase indicates that in 1992 NMPC paid more rebates for larger motors and drives thus generating greater savings for each motor installed.



Program Savings (continued)

FREE RIDERSHIP

As part of the impact evaluation conducted for 1991, [R#4], NMPC attempted to quantify free-ridership for the High Efficiency Motors and Adjustable Speed Drives program. The evaluation found that the number of customer free-riders is likely to range from 23% to 40%. This analysis was based on a survey of 38 customers (33% of the participant population) who had installed 6,772 hp (66% of the total horsepower rebated in 1991).[R#4]. Based solely on their answers to the survey questions, 40% of those surveyed were classified as free-riders. However, when information regarding acceptable payback periods for each customer was compared to the payback period that the customers would have realized in the absence of the program, it was determined that the number of free-riders may actually be lower, or about 23%.

These 23% of the customer participants represent 29% of the total horsepower rebated through the program.[R#4] Based on this analysis of free-riders, NMPC established upper- and lower-bound free-ridership derating factors of 49% and 34%, respectively. Energy savings presented in the Savings Overview Table include an adjustment for free riders at the lower, 34% level.

MEASURE LIFETIME

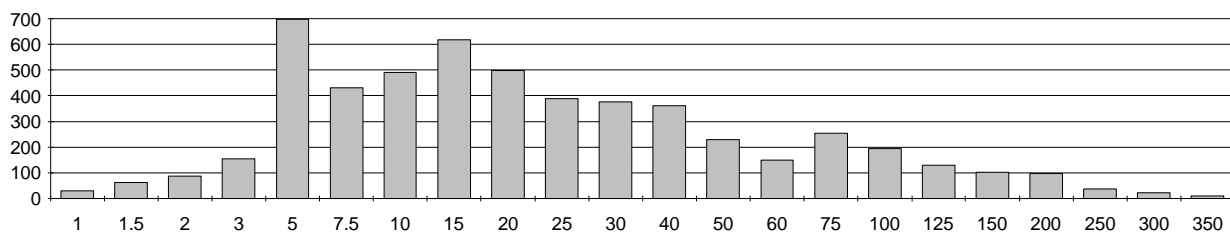
NMPC uses 15 years as the average lifetime for motors and adjustable speed drives installed through the program.[R#9] Thus, The Results Center uses 15 years for calculation of lifecycle savings and in the cost of saved energy calculation found in the Cost of the Program section.

PROJECTED SAVINGS

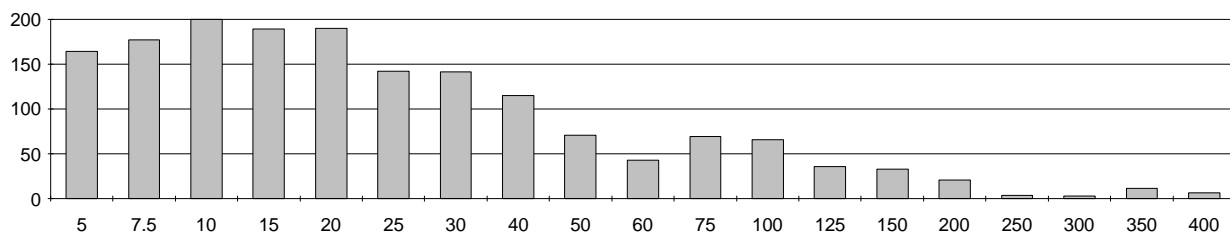
While the High-Efficiency Motors and Adjustable Speed Drives program did not meet its goals for numbers of participants in 1991, it far exceeded its energy savings goal in 1991 and 1992 while at the same time surpassing winter capacity goals in both years and summer capacity goals in 1991. The 1991 goals for participants, energy, winter capacity, and summer capacity were 250 participants, 2,714 MWh, 700 kW, and 300 kW. [R#4]. The 1992 goals were 200 participants, 7,780 MWh, 1,000 kW, and 2,000 kW, respectively.[R#8]

As market transformation takes hold and codes governing the efficiencies of motors installed in new facilities become effective, the need for financial incentives for motors through the High-Efficiency Motors and Adjustable Speed Drives program will be diminished. (Adjustable speed drive rebates still appear attractive.) The program is expected to operate through the end of 1994. Depending on results of the evaluations, the program will continue, although changes would likely be instituted as appropriate.

NUMBER OF MOTORS BY HORSEPOWER



NUMBER OF DRIVES BY HORSEPOWER



Cost of the Program

Costs Overview Table	Rebates Paid (x1000)	Administration and Implementation Cost (x1000)	Total Program Cost (x1000)	Cost per Rebate Paid
1991	\$539.2	\$318.5	\$857.7	\$7,458.66
1992	\$3,687.9	\$794.1	\$4,482.0	\$6,505.15
Total	\$4,227.1	\$1,112.7	\$5,339.8	

[R#8]

COST OF THE PROGRAM

Between 1991 and 1992 NMPC spent a total of \$5.34 million on the High-Efficiency Motors and Adjustable Speed Drives program. The total 1992 expenditure of \$4.48 million was more than five times the 1991 expenditure of \$0.86 million and was clearly the result of increased participation and higher rebate levels. [R#8]

The Results Center calculation of cost of saved energy, based on a lifetime of 15 years and annual savings and cost figures as shown in the Savings Overview Table and the Cost Overview Table, decreases between the first and second years of the program, ranging from 0.85 ¢/kWh to 1.26 ¢/kWh in 1991, and between 0.56 ¢/kWh and 0.82 ¢/kWh in 1992 depending on the discount rate used.

COST EFFECTIVENESS

NMPC performed multiple cost-effectiveness analyses for the High-Efficiency Motors and Drives program for 1991 all with favorable results. Using the Participant Test, the benefit/cost ratio was 5.72, and the B/C ratio was 3.48 using the Utility Cost Test. The Total Resource Cost test (TRC) without environmental considerations was 2.76. The Societal Test, using a mandated environmental adder and a weighted average cost of capital, was 3.65. Finally, the present value of net benefits in the societal test was \$3.6 million in 1991 dollars.

COST PER PARTICIPANT

The Results Center calculated the average cost per rebate paid for 1991 and 1992 at \$7,459 and \$6,505, respectively.

COST COMPONENTS

For 1991 and 1992, the High-Efficiency Motors and Adjustable Speed Drives program cost \$5.34 million. Fully 79%, or \$4.23 million of this cost was spent on rebate payments, while the remaining 21%, or \$1.11 million, was spent on administration, implementation, and program evaluation.

Cost of Saved Energy Table (¢/kWh)	Discount Rates						
	3%	4%	5%	6%	7%	8%	9%
1991	0.85	0.91	0.98	1.05	1.12	1.19	1.26
1992	0.56	0.60	0.64	0.68	0.73	0.77	0.82

Environmental Benefit Statement

Marginal Power Plant	Heat Rate BTU/kWh	% Sulfur in Fuel	CO2 (lbs)	SO2 (lbs)	NOx (lbs)	TSP* (lbs)
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Coal Uncontrolled Emissions

A	9,400	2.50%	182,158,000	4,322,000	874,000	87,000
B	10,000	1.20%	194,240,000	1,673,000	564,000	418,000

Controlled Emissions

A	9,400	2.50%	182,158,000	432,000	874,000	7,000
B	10,000	1.20%	194,240,000	167,000	564,000	28,000
C	10,000		194,240,000	1,115,000	558,000	28,000

Atmospheric Fluidized Bed Combustion

A	10,000	1.10%	194,240,000	511,000	279,000	139,000
B	9,400	2.50%	182,158,000	432,000	349,000	26,000

Integrated Gasification Combined Cycle

A	10,000	0.45%	194,240,000	344,000	56,000	139,000
B	9,010		174,723,000	125,000	42,000	8,000

Gas Steam

A	10,400		105,949,000	0	242,000	0
B	9,224		92,009,000	0	576,000	27,000

Combined Cycle

1. Existing	9,000		92,009,000	0	353,000	0
2. NSPS*	9,000		92,009,000	0	167,000	0
3. BACT*	9,000		92,009,000	0	23,000	0

Oil Steam--#6 Oil

A	9,840	2.00%	153,348,000	2,323,000	274,000	260,000
B	10,400	2.20%	162,641,000	2,305,000	345,000	167,000
C	10,400	1.00%	162,641,000	329,000	277,000	87,000
D	10,400	0.50%	162,641,000	967,000	345,000	53,000

Combustion Turbine

#2 Diesel	13,600	0.30%	203,534,000	405,000	629,000	34,000
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Refuse Derived Fuel

Conventional	15,000	0.20%	241,639,000	623,000	820,000	182,000
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Avoided Emissions Based on 84,489,000 kWh Saved (1991 - 1992)

In addition to the traditional costs and benefits there are several hidden environmental costs of electricity use that are incurred when one considers the whole system of electrical generation from the mine-mouth to the wall outlet. These costs, which to date have been considered externalities, are real and have profound long term effects and are borne by society as a whole. Some environmental costs are beginning to be factored into utility resource planning. Because energy efficiency programs present the opportunity for utilities to avoid environmental damages, environmental considerations can be considered a benefit in addition to the direct dollar savings to customers from reduced electricity use.

The environmental benefits of energy efficiency programs can include avoided pollution of the air, the land, and the water. Because of immediate concerns about urban air quality, acid deposition, and global warming, the first step in calculating the environmental benefit of a particular DSM program focuses on avoided air pollution. Within this domain we have limited our presentation to the emission of carbon dioxide, sulfur dioxide, nitrous oxides, and particulates. (Dollar values for environmental benefits are not presented given the variety of values currently being used in various states.)

HOW TO USE THE TABLE

1. The purpose of the previous page is to allow any user of this profile to apply Niagara Mohawk's level of avoided emissions saved through its High Efficiency Motors and Drives program to a particular situation. Simply move down the left-hand column to your marginal power plant type, and then read across the page to

determine the values for avoided emissions that you will accrue should you implement this DSM program. Note that several generic power plants (labelled A, B, C,...) are presented which reflect differences in heat rate and fuel sulfur content.

2. All of the values for avoided emissions presented in both tables include a 10% credit for DSM savings to reflect the avoided transmission and distribution losses associated with supply-side resources.

3. Various forms of power generation create specific pollutants. Coal-fired generation, for example, creates bottom ash (a solid waste issue) and methane, while garbage-burning plants release toxic airborne emissions including dioxin and furans and solid wastes which contain an array of heavy metals. We recommend that when calculating the environmental benefit for a particular program that credit is taken for the air pollutants listed below, plus air pollutants unique to a form of marginal generation, plus key land and water pollutants for a particular form of marginal power generation.

4. All the values presented represent approximations and were drawn largely from "The Environmental Costs of Electricity" (Ottinger et al, Oceana Publications, 1990). The coefficients used in the formulas that determine the values in the tables presented are drawn from a variety of government and independent sources.

* Acronyms used in the table

TSP = Total Suspended Particulates

NSPS = New Source Performance Standards

BACT = Best Available Control Technology

Lessons Learned / Transferability

LESSONS LEARNED

NMPC's High-Efficiency Motors and Adjustable Speed Drives program has been very successful in encouraging the installation and replacement of energy-saving motors and drives in various applications throughout the NMPC service area. There is no doubt that the program is efficiently delivered, with only about 21% of the program's overall cost being spent on administration, implementation, and evaluation. The Results Center calculation of cost of saved energy also revealed the cost-effectiveness of the program with costs at less than 1 ¢/kWh at a 5% discount rate.

The program has evolved significantly in its short life. The primary change occurred in 1992 when rebate levels for motors were increased significantly in an effort to stimulate participation levels. The experiment worked, with participation quadrupling in 1992. An additional factor which helped to create even more participation in the program was the decision made in response to market conditions, rate impacts, and budget constraints, to decrease motor rebate levels on September 1, 1992. When the rebate level reduction was announced, numerous customers applied for rebates under the high 1992 levels. It seems likely that many of these participants would not have installed eligible high-efficiency motors at that time if rebate levels had remained stable. The number of early replacement motors, an area difficult to reach according to the NMPC market evaluation, was probably increased by this situation.

With the planned institution in March, 1994 of New York State codes dictating high-efficiency motors for all new commercial construction, the High-Efficiency Motors and Drives program will no longer need to target that market, at least with the motors component of the program. In order to continue its success, the program has begun to emphasize market transformation through development of its relationship with trade allies. NMPC's trade allies have begun to stock high-efficiency motors and adjustable speed drives and to advocate their use to customers who might otherwise not consider them.

TRANSFERABILITY

The High-Efficiency Motors and Adjustable Speed Drives program is highly transferable. The program has few elements which are specific to NMPC's service territory. The program's relatively simple rebate lists and application forms are not specific to the exact models and types of motors that may be available in a particular region, thus increasing their adaptability. Of course, any rebate list and application form would have to be modified to insure that incentives are not being offered for installation of equipment already required by local construction codes.

Regulatory Incentives and Shareholder Returns

Traditional utility ratemaking practices, where each and every kilowatt-hour sold provides profit, is a major barrier to utilities' implementation of energy efficiency programs. Several state regulatory commissions and their investor-owned utilities have been pioneers in reforming ratemaking to a) remove the disincentives in utility investment in DSM programs and lost revenues associated with these programs, and b) to provide direct and pronounced incentives so that every marginal dollar spent on DSM provides a more attractive return than the same dollar spent on supply-side resources.

The purpose of this section is to briefly present exciting and innovative incentive ratemaking mechanisms where they've been applied. This we trust, will not only provide some understanding to the reader of the context within which the DSM program profiled herein is implemented, but the series of these sections we trust will provide useful snapshots of incentive mechanisms being used and tested across the United States.

NEW YORK STATE OVERVIEW

The New York Public Service Commission has taken major steps to encourage energy efficiency programs at the state's seven investor-owned utilities, including Niagara Mohawk, and to remove the financial disincentives from utility investment in DSM.

In 1988 the Commission began a revolutionary process in New York and dramatically changed the tests for cost effectiveness that served as screens for utility DSM investments and opened up the possibility for utilities to actually profit from these investments. The Commission ruled that utilities could no longer rely on the Unit Cost Test (similar to the Non-Participant Cost Test that had been developed in California) to determine the cost effectiveness of demand-side management programs, but instead were directed to use the Total Resource Cost Test, a test that is fundamentally rooted in a societal economic perspective. This has ushered in a new generation of DSM programs. The second major aspect of the ruling in 1988 was that each of the state's utilities were invited to submit suggestions on how to provide shareholders with an incentive for their DSM investments.

Since 1988, the Commission has approved, and in some cases has already approved modifications, of one incentive mechanism for each utility in the state. Thus New York has been a test bed for several mechanisms

concurrently. The Commission was implicitly acknowledging the complexity of incentive ratemaking and leaving open the possibility that different mechanisms may best suit the needs of different utilities. The Commission sought to provide utility shareholders with a piece of the benefit, "such that DSM programs that benefit customers are also rewarding to stockholders." [R#13]

OVERVIEW AT NIAGARA MOHAWK

Niagara Mohawk has been a national leader in developing incentive mechanisms. In fact a majority of incentive mechanisms adopted since 1989 have emulated the shared-savings approach pioneered by Niagara Mohawk and Orange & Rockland Utilities in New York State. [R#14] Shared savings bonuses appear to be finding favor with both utilities and regulators because the concept is simple and readily understood by all parties and the general public. In the shared savings mechanism, the program's costs are subtracted from the gross benefits, as determined using the Total Resource Cost Test for cost effectiveness, then a percentage of the resulting net societal benefit is paid to shareholders, typically 10-20%. For Niagara Mohawk, the benefit paid to the utility was 10% in 1990-1992, and now will be 5% capped at \$5 million. [R#14,16]

Shared savings mechanisms motivate both cost effectiveness and greater spending on DSM. The utility can maximize its bonus by pursuing all opportunities for which benefits exceed costs. Finally, these mechanisms are being developed such that ratepayers get over 75% of the benefits of the DSM programs, limiting windfall profits to shareholders. [R#14]

Niagara Mohawk introduced its shared-savings incentive mechanism in 1989 and it was approved by the New York Public Service Commission in September 1989. The Niagara Mohawk incentive was similar to the one proposed by Orange & Rockland Utilities. Each proposal called for recovery of lost revenues associated with efficiency programs as well as the programs' costs. They also called for bonuses to serve as direct incentives for DSM.

TREATMENT OF DSM EXPENDITURES

In New York, DSM program costs are recovered from ratepayers through base rates and the Fuel Adjustment Clause (FAC). All amounts are recovered subject to

Regulatory Incentives (continued)

reconciliation with actual expenditures. The timing of cost recovery varies from one to five years depending on the utility.

Specifically for Niagara Mohawk, all DSM costs are recovered in base rates or the FAC for the respective service classes whose customers are eligible to participate in the DSM programs. The amount not recovered in base rates is levelized over a twelve-month period and added to each month's FAC. Recovered costs are annually reconciled with actual expenditures and the FAC is adjusted to account for any differences identified.

TREATMENT OF LOST REVENUES

Niagara Mohawk recovers lost revenues in rates, subject to later reconciliation. The rate year sales forecast is adjusted downward to reflect the estimated impacts of DSM programs. DSM program evaluation results will be used to determine actual lost revenue by class of service.

PROVIDING INCENTIVES: DECOUPLING SALES AND REVENUES

Niagara Mohawk's mechanism permits the utility to earn an incentive equal to 5% of the net resource savings attributable to DSM programs. (In 1991 and 1992 NMPC was allowed a 10% incentive level. This was reduced to 5% for 1993.) For NMPC, the net resource saving is defined as the present value of lifetime avoided costs, plus \$0.0157/kWh adjustment for environmental externalities, less utility program's costs inclusive of incentives paid to the customers. This definition is equivalent to net benefits

under the Societal Cost Test as defined by the California Standard Practice Manual.

In 1991 and 1992 each of NMPC's DSM programs were analyzed individually to determine the societal economic benefit of the program and thus the incentive which was awarded. For instance, in 1991 the Motors and Drives Program resulted in a net societal benefit of approximately \$3.6 million, thus the utility earned its 10% share of \$362,000. In 1991 the total incentive to NMPC for all its DSM programs was \$5.270 million; in 1992 the total incentive grew to \$8.042 million. In 1992 the Motors and Drives Program resulted in a utility incentive of \$67,000. In 1993 and in subsequent years, all of NMPC's DSM programs will be bundled together for the purposes of determining incentives. In addition, "non-resource" programs, such as demonstration programs, which were excluded from the incentive mechanism, are now eligible as well for cost recovery and incentive payments. [R#15,16]

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