Industrial Demand-Side Management Programs: What's Happened, What Works

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While residential and commercial demand-side management (DSM) programs have advanced significantly in both quality and quantity over the past decade, industrial programs have been left behind, primarily due to the industrial sector's diverse nature. However, industry consumes substantially more energy than any other sector and has a large potential for improved efficiency. Utilities can act as a catalyst in securing this efficiency potential by offering industrial conservation programs. The purpose of this paper is to aid in this effort by demonstrating lessons learned to date from such programs.

This summary of lessons learned is based on interviews conducted with more than 80 utilities and third-party organizations. A database of 70 programs resulted, including 32 programs with sufficient data to permit analysis. Measures of program success for these programs were primarily based on participation rates and energy savings as a percent of industrial energy sales.

The average industrial DSM program in the database has saved less than 0.4% of industrial energy sales, has a 6% participation rate, and has a levelized utility cost of $.012/kWh. Relative to the average program, successful programs described in this paper have achieved three times the participation and energy savings as a percent of energy sales and have done so at only two-thirds of the levelized utility cost. These programs have been around for almost two years longer than the typical program. There are four main features that appear to be linked to successful industrial DSM programs: insight into the customer's perspective, program flexibility, innovative marketing, and financial incentives.

Introduction

Industry is responsible for 37% of our national energy consumption, considerably greater than any other sector. Industrial natural gas and electricity consumption are respectively 45% and 35% of total national consumption. In light of these figures, it may seem surprising that conservation programs offered by many utilities have all but ignored industrial customers. To the extent attention has been given to industrial customers, it is more often than not within a program that targets both commercial and industrial customers. Utilities generally have avoided purely industrial programs due to the highly diversified and individualistic nature of the sector. The driving forces behind industrial decision-making are significantly different than those in the commercial sector. Commercial and industrial (C&I) programs have generally been designed around the structure of the commercial sector and therefore have had limited application to industry.

The time is ripe for industrial demand-side management. Increased international competition, the present economic slump, and growing environmental awareness and regulations are contributing to the financial strains being experienced in our manufacturing base. Improving the efficiency of our industrial facilities can increase productivity and quality control and decrease the environmental impact of the industrial sector. However, payback periods for industrial energy-efficiency retrofit projects are often beyond the typical two-to-three-year range required by industry in these uncertain times (Alliance to Save Energy et al. 1991; Ross and Steinmeyer 1991). Utilities can play a crucial role in providing the necessary incentives for industry to pursue efficiency improvements.

In response to the increasing need for and interest in industrial efficiency improvement, we have performed a study of existing experience in industrial DSM, identifying what has worked and the lessons learned. A database was created consisting of results from utility programs with a significant industrial component. Attention was also given to information obtained through telephone interviews and additional literature. This work is based on a larger report prepared for the U.S. Department of Energy (Jordan and Nadel 1992).

Overview of Database

To date, industrial DSM programs, like commercial programs, are focused primarily on equipment upgrades such as high-efficiency motors and lighting systems. Few existing programs focus on improving the efficiency of entire manufacturing systems or processes, which account for more than 90% of the energy used in industry. In choosing programs for inclusion in the database, we have paid particular attention to those programs which emphasize process efficiency.

Program Types

Utility DSM programs which have focused on industry primarily come in the form of custom measure incentive programs, and secondarily in the form of prescriptive measure rebate programs. Information on 70 programs offered by 45 utilities was entered into the database. Data from less than half of these programs were sufficient enough to warrant further examination. Thus, Table 1 includes a truncated version of the entire database. Roughly 60% of the programs listed in the database offer custom measure incentives (includes process measure rebates), 40% offer prescriptive measure rebates. Of these programs, 10% offer both types of rebates. Slightly less than half of the programs in the database concentrate specifically on industry, and the remaining programs serve both commercial and industrial customers.

Prescriptive measure rebate programs generally offer direct rebates for installation of high-efficiency motors, steam traps, adjustable-speed-drives, and compressed air system improvements. Rebates are either based on a direct dollar per unit energy saved or on a percentage of project cost.

There are a variety of different customer incentives offered under the custom measure incentive programs, such as cash incentives for the incremental cost of efficient equipment, incentives based on energy saved or load reduced in first year (i.e., $/kWh or kW saved), rebates based on a percentage of materials and installation costs, cash grants, low-to-no-interest loans, and payback period buy-down incentives. These programs are generally structured so that an energy survey is performed first to identify energy-saving opportunities. Some utilities allow the customer to choose their own contractor to perform the initial survey, whereas other utilities have their own industrial engineers or contractors perform the survey. The measures most often rebated in the custom measure programs are process heating and cooling measures, refrigeration improvements, and lighting and motor upgrades. Non-generic, site-specific process improvements are also performed.

Methodology

In analyzing recent activity in industrial demand-side management, both qualitative and quantitative approaches were taken. Telephone interviews were conducted with over eighty utilities and third-party organizations (based on names found in other reports and by word-of-mouth) to further elucidate the extent of each utility's industrial conservation programs. Load management programs such as interruptible rate, time-of-use rate, and stand-by generation programs were not examined in this study. For those utilities that tracked industrial results, data were collected on the program's industrial participation, energy savings, and expenditures. A complete set of results was obtained for 32 programs representing 18 private and public utilities.

In order to evaluate the results of this study, certain measures of success were defined. Our primary measures of success for the industrial conservation programs are high participation rates and/or high net electricity savings as a percent of industrial energy sales. Also considered are levelized utility cost per kWh saved and qualitative information obtained through telephone interviews.

Data were obtained from the individual utilities conducting the programs. There is significant variation in the methods with which utilities track industrial data. Some utilities track participation by the number of rebates given or the number of projects completed, whereas others track the participation of individual customers. For this study, efforts were made to directly reflect the number of industrial participants in the participation rates. Since many of the utilities in the database have not estimated the free-ridership of their industrial programs, participation rates include free riders and therefore exaggerate the effectiveness of the program in acquiring new net conservation savings.

In addition, for about one-third of the programs in Table 1, the energy savings results are highly approximated. For many of the joint C&I programs in the database, a formal delineation of industrial versus commercial savings has not been performed. Instead, managers of these programs have made rough estimates of the percentage of total savings attributable to the industrial sector. Furthermore, in order to supply us with comparable participation rates, many utilities who only track the number

Table 1. Industrial DSM Database: Program Results

Utility	Program	Custom, Pre-scriptive, or Both	Comm., Ind., or Both	Program Start Date	Elec-tricity Savings (GWh)	Cumul. or Ann. Savings	Util. Costs (1000 $s)	Total, Direct, Cumul., or Ann. Costs	Partici-pation Rate	Cumul. or Ann. Partici-pation	Savings as % of Industry Sales	Levelized Utility Cost ($/kWh)
BC Hydro	Power Smart: Bonus Partners	Custom	Ind.	8/90	67.8	Cum.	1300.0	Tot,Cum	0.5%	Cum.	0.34%	0.003
BC Hydro	Power Smart: Motors	Prescr.	Ind.	4/90	56.6	Cum.	1800.0	Tot,Ann	3.8%	Cum.	0.28%	0.016
BC Hydro	Power Smart: Fans	Prescr.	Ind.	4/90	4.5	Cum.	1400.0	Tot,Cum	18.3%	Cum.	0.02%	0.042
BC Hydro	Power Smart: Compressed Air	Prescr.	Ind.	9/89	30.0	Cum.	1000.0	Tot,Cum	60.0%	Cum.	0.15%	0.005
BC Hydro	Power Smart: Pumping Profits	Prescr.	Ind.	9/90	1.2	Cum.	500.0	Tot,Cum	5.4%	Cum.	0.01%	0.057
BECO	Energy Efficiency Partnership	Custom	Both	3/90	13.3	Ann.	3475.0	Tot,Ann	6.7%	Ann.		0.035
BPA	Conservation/Modernization	Custom	Ind.	1987	3499.6	Cum.	17900.0	Tot,Cum	100.0%	Cum.	12.95%	0.001
BPA	Energy Savings Plan	Custom	Ind.	10/88	82.5	Cum.	2538.7	Dir,Cum	0.3%	Cum.	0.31%	0.004
CMP	C&I Custom Rebate Program	Custom	Both	1/91	10.7	Cum.	544.8	Dir,Cum	21.8%	Cum.	0.30%	0.007
CMP	C&I Efficiency Buy-Back Pilot	Custom	Both	1/90	27.9	Cum.	755.5	Dir,Cum	2.1%	Cum.	0.79%	0.004
CMP	C&I Power Partners	Custom	Both	1/90	44.1	Cum.	1511.0	Dir,Cum	7.4%	Cum.	1.25%	0.005
CMP	C&I Retrofit Motor Rebate	Prescr.	Both	1/91	1.2	Cum.	46.5	Dir,Cum	60.3%	Cum.	0.03%	0.005
COMM/Elec	Customized Rebate Program	Custom	Both	1/90	12.5	Ann.	4163.8	Tot,Ann	10.5%	Ann.		0.045
Conn L&P	Customer Initiated Program	Custom	Both	1/88	5.6	Ann.	1868.0	Tot,Ann	0.9%	Ann.	0.16%	0.045
Conn L&P	Energy Action Plan	Custom	Both	1/91	14.4	Cum.	2251.0	Tot,Ann	4.3%	Cum.	0.41%	0.032
Niag. Mohawk	C&I Custom Measure	Custom	Both	1/91	2.4	Cum.	1600.0	Tot,Ann	1.0%	Cum.	0.07%	0.091
Niag. Mohawk	C&I Motors & Drives Program	Prescr.	Both	1/91	9.6	Cum.	1040.0	Tot,Ann			0.27%	0.015
NSP - Wisc.	C&I Custom Rebate/Financing	Custom	Both		0.9	Ann.	38.6	Tot,Ann	0.2%	Ann.		0.006
NSP - Wisc.	C&I Motor Effic. Improvement	Prescr.	Both	1/91	3.2	Ann.	100.4	Tot,Ann	3.3%	Ann.		0.004
Ont. Hydro	Accelerated Paybacks	Custom	Ind.	10/89	33.3	Cum.	3700.0	Dir,Cum			0.08%	0.015
Ont. Hydro	High Efficiency Motors Plan	Prescr.	Both	10/89					1.4%	Cum.		
PGE	Efficient Motor	Prescr.	Both	1/91	5.0	Cum.	93.2	Dir,Cum			0.14%	0.003
PGE	Energy Smart Manufacturing	Custom	Both	1990	0.9	Cum.	53.4	Dir,Cum			0.03%	0.008
PG&E	Customized Rebate	Custom	Both	1989	76.5	Cum.	2884.9	Dir,Cum			0.49%	0.005
PG&E	Direct Rebate	Prescr.	Both		13.3	Cum.	500.5	Dir,Cum			0.08%	0.005
Puget Power	Ind. Conservation Incentive	Custom	Ind.	1/81	68.9	Cum.	5934.5	Tot,Cum	4.5%	Cum.	2.01%	0.012
So Cal Ed	Hardware Rebate	Custom	Both		68.7	Cum.	3395.6	Tot,Cum			0.31%	0.007
UI	Energy Blueprint	Both	Both	6/90	0.5	Ann.	129.5	Tot,Ann			0.05%	0.035
UI	Energy Opportunities	Custom	Both	1/90	13.8	Ann.	1442.0	Tot,Ann	3.2%	Cum.	1.24%	0.014
Wisc. PSCo	C&I Energy Eff. Rebate	Custom	Both		4.1	Ann.	316.3	Dir,Ann				0.011
Wisc. Elec	Smart Money for Business	Both	Both	1/87	239.0	Cum.	28628.0	Tot,Cum	48.9%	Cum.	2.52%	0.016
Wisc. P&L	Bright Ideas for Business	Both	Both	6/87	8.5	Ann.	894.7	Dir,Ann	14.2%	Ann.		0.014

Notes: A revised version of this table will be available in the forthcoming report to the U.S. Dept. of Energy, "Industrial Demand-side Management: Experience and Future Directions," 1992, Jordan and Nadel, American Council for an Energy-Efficient Economy, Washington, D.C.

of rebates given (rather than the number of rebated customers) made rough guesses of the ratio of rebates given to customers participating in a particular program.

In calculating each program's levelized cost, we have used only the utility program expenditures, rather than both the cost to the utility and participant, since data on customer costs are rarely collected. As calculated in Table 1, levelized utility costs have their own caveats. For a quarter of the programs, only the direct utility expenditures for the program (i.e. rebates) were available, and not the total indirect and direct costs which would include administrative and evaluation expenditures. All levelized utility costs assume a ten-year measure lifetime and a 6% real discount rate. A ten-year measure life is assumed since industrial equipment is often removed before the end of its useful life during changes to production processes.

Due to the limitations of the data outlined above, figures reported in this study are best used for scoping purposes only, rather than for detailed program evaluation.

Results

Typical Programs. Analysis of data results and interview responses reveals that a number of features typify industrial conservation programs. The average program (after eliminating remote outliers) has been offered for almost 4 years, has cumulatively saved less than 0.4% of the utility's industrial energy sales, has seen participation from roughly 1 of every 16 industrial customers (a 6% participation rate), and has done so at a levelized utility cost of $.012/kWh. The typical program offers a custom rebate or loan to large commercial and industrial customers.

While the average industrial program has had only limited impact, there are a few programs which have achieved significant savings and participation. Many of these programs are summarized in the following section.

Successful Programs: Descriptions. Relative to the typical program in the database, the successful programs described below have achieved approximately three times the cumulative participation and energy savings as a percent of energy sales and have done so at only two-thirds of the typical levelized utility costs. On average, these programs have been around for almost two years longer than the typical program.

There is little differentiation between the success of prescriptive rebate versus custom rebate programs when using a joint participation and energy savings indicator. However, differences arise among the two types of programs when savings and participation rates are looked at separately; prescriptive rebate programs tend to reach a larger number of customers, whereas custom rebate programs appear to result in greater energy savings. Using participation rates as an indicator, 60% of the prescriptive programs are above average whereas only 30% of the custom rebate programs are above average. Using as an indicator the cumulative energy savings as a percent of industrial energy sales, 10% of the prescriptive programs fare better than average, whereas 35% of the custom rebate programs are above average. The following programs are listed in order of decreasing energy savings as a percent of industrial energy sales, with programs offered by the same utility grouped together.

Bonneville Power Administration's (BPA) Aluminum Smelter Conservation/Modernization program, ongoing since 1987, encourages the region's primary aluminum smelters to make additional investments in plant modernization. These smelters are BPA's largest customers, purchasing more electricity from BPA than do all the investor-owned utility customers combined. All of the primary aluminum smelters participated in the planning and design of the program. BPA's incentive to the customer pays roughly one-third of the costs of efficiency improvements through a modest incentive of $0.005/kWh saved over a ten-year period. Despite the small incentive, in 1991 alone the Con/Mod program saw energy savings of 3.9% of industrial sales and a 70% participation rate. BPA has not estimated the free-ridership of this program, which is most likely quite significant.

BPA's Energy Savings Plan (ESP) was initiated in 1989 as a custom rebate program to promote energy-efficiency in industry. According to program staff, the program was not initially effective in attracting customers. BPA transformed its marketing techniques in mid-1990. Vendors, contractors, utility customers, and others are directly involved in the planning, design, and on-going evaluation of the new program structure. BPA decentralized the ESP as of 1990 to give administering power to their utility customers, thus reducing the paperwork and increasing the flexibility of the program. An increased emphasis has been placed on equipment vendors. Utility marketing staff attend trade shows and educate vendors on effective methods for marketing their products by marketing the ESP program. Staff cites the marketing change as largely contributing to the increased success of the program in attracting participants and savings. The past 1 1/2 years of the program have seen a four-fold increase in the number of participants compared to the first 1 1/2 years. Although cumulative energy savings as a percent of industrial energy sales are only 0.3%, this program is only available to customers purchasing less than 5% of industrial energy sales. More than 95% of

BPA's industrial energy sales are to primary aluminum smelters who are not eligible for this program. If smelter electricity sales are subtracted from total industrial sales, ESP has cumulatively saved 5.5% of remaining industrial sales. BPA pays the customer $0.15/kWh saved in the first year or 80% of the project costs, whichever is smaller. ESP's low levelized utility cost of $0.003/kWh saved indicates its cost-effectiveness.

COMM/Electric administered a Custom Rebate program to commercial and industrial customers between 1987 and 1991. The program offered a free comprehensive energy audit which recommended energy-saving measures. Participants solicited bids to contractors to install the measures, and the utility was involved in selecting the winning bid. The resulting customer incentive was based on the kWh saved over the measure life and was determined using a sliding scale depending both on the measure life and the contract term selected by the participant. Contractors initially paid for the installation of the measure and recovered costs over the contract life. Therefore, the customer did not have any up-front costs. The utility pays an incentive to the participant over the lifetime of their contract. The longer the contract life, the higher the incentive. However, industrial participants generally chose a two-year contract life. The average incentive was $0.19/kWh saved over the contract life. This rebate usually paid for 100% of the installation and labor costs. There was no need for the utility to market the program, since contractors eagerly took this role.

In 1991 alone, the Custom Rebate program achieved a 10.5% participation rate and savings of 2.6% of industrial energy sales. These results are well above average, but come at a price. The levelized utility cost for the program was $0.045/kWh saved. When the program first began, lighting projects were the measure of choice. In the last two years of the program, although lighting was often still the project focus, efficient HVAC, motors, and energy management systems were also being installed. The program administrator indicated that custom process measures were rarely performed, primarily because audits indicated that such measures were usually gas-saving rather than electricity-saving. According to the utility, a DSM budget that was supposed to last five years was exhausted in three years. Therefore, the program is on hold until early 1993 as COMM/ Electric works within a collaborative on program re-design. The success of the program is partly due to COMM/Electric's high avoided cost, which permits more expensive projects to qualify, and high incentive payments.

Wisconsin Electric's (WEPCo) Smart Money for Business program has experienced cumulative industrial energy savings of 2.5% of industrial energy sales at a cost of less than $0.02/kWh saved since the start of the program in 1987. This combination custom and prescriptive rebate program offers commercial and industrial customers a wide variety of incentives. Over the past five years, almost half of all WEPCo's industrial customers have received rebates through Smart Money. The majority of participants have focused on prescriptive measures, emphasizing lighting measures. After administering the program for over three years and studying the managerial structure of their industrial customers, WEPCo refined their marketing approach to reflect what they had learned. A two-pronged strategy is now taken: utility engineers communicate with and market the program to process-level plant personnel, such as plant engineers and maintenance operators. Simultaneously, utility executives interact with and market the program to industrial vice presidents. Generally, smaller projects can be handled by the process-level employees, whereas larger projects must be dealt with at a senior management level.

Puget Power has administered its Industrial Conservation Incentive program since 1981. The program has achieved a cumulative energy savings as a percent of industrial energy sales of 2.0% and a cumulative participation rate of 4.5%, well-above-average savings and below-average participation. The customer incentive is based on the utility's avoided cost for the energy saved, and usually lies in the $0.02-$0.15/first year kWh saved range. The incentive covers approximately 50-80% of measure costs. Puget targets their 100 largest customers. Utility staff work with participants to perform analyses of entire industrial systems, identify where the energy savings and greatest overall customer benefits lie, oversee project bidding, assist in project design, and perform energy-savings verification tests. Three-to-five-year plans are developed with participants to coordinate what will be done and when. Puget staff noted that due to the intensive labor requirements of this program, the availability of staff to broadly market the program is limited. Surprisingly, the program is marketed simply by word-of-mouth.

Central Maine Power's (CMP) Power Partners Program is an all-source bidding program in which C&I customers or energy service companies (ESCOs) submit bids for energy management projects. The incentive is $0.01/kWh delivered. Although bids have not been solicited for almost three years due to adequate power availability,

savings from existing projects are still coming in strong, including savings from industrial projects. This bidding program has cumulatively saved 1.3% of industrial energy sales and has experienced an above-average cumulative industrial participation rate of 7%. The cumulative levelized utility cost of $0.005/kWh saved only includes the payments made through 1991 and does not take into account the fact that projects typically receive payments for 15 years. Utility staff consider the program's flexibility to be a key component contributing to its success.

CMP's Efficiency Buy-Back program allows a targeted customer base to competitively bid for conservation projects. This program is limited to large customers. An incentive of up to 50% of project cost is available, rather than Power Partner's fixed dollar per kWh incentive. Proposed projects must save at least 5 GWh per year. The program has achieved large savings with low participation at low cost. The success in achieving savings that are almost twice the average (0.8% of industrial energy sales) lies primarily in the flexibility of the program and in the fact that they are looking for large energy-saving projects.

United Illuminating (UI) is now into the second year of their commercial and industrial custom rebate program, Energy Opportunities. Marketing brochures emphasize the user-friendly nature of the program. The customer can choose its own vendors and contractors to carry out project implementation. The utility will co-fund engineering studies for advanced process, energy management, cogeneration, and heat recovery measures. Financial incentives are taken as a percent of measure costs and depend upon the measure's payback period; even measures with less than a one-year payback period receive rebates. Financial incentives of $0.15/first year kWh saved are offered for measures with payback periods greater than five years. Measures with shorter payback periods receive rebates as a percent of project cost; rebates decrease as the payback period decreases. After its second year of a three-year DSM program planning cycle, UI had still not used a large portion of the program budget. Therefore, in 1992 UI doubled the maximum incentive to $0.30/first year kWh saved. Energy Opportunities has achieved a cumulative participation rate of 3.2%. Cumulative energy savings as a percent of industrial sales have been significantly higher than average at 1.2%, and the cumulative levelized utility cost for the program has been $0.014/kWh saved. Despite the fact that this program is relatively new, UI has achieved high savings without large program start-up costs.

Connecticut Light & Power has offered two customized rebate programs for commercial and industrial customers, the Energy Action Program (EAP) and the Customer-Initiated Program (CIP). EAP, which began in 1987, subsidizes the cost of conservation projects with incentives capped at $0.06/kWh saved over the lifetime of the measure. Initially, the utility performs an audit on the customer's facility. If the customer wishes to go further, a detailed energy study of the facility is performed for which the customer and the utility split the cost. The customer's payment is refunded if the customer decides to go ahead with implementation. The effectiveness of this strategy is apparent in the fact that, to date, not a single participant has decided against implementation of the recommendations after the energy study was performed. CIP, which got underway in 1989, was a response to some industrial customers' hesitation at allowing the utility to enter their facilities for proprietary reasons. This program is similar to EAP with the main difference being CIP's lack of an in-depth energy analysis of participants' facilities. The large financial incentives of these two programs and the intensive labor requirements of EAP audits are reflected in the cumulative levelized utility cost of $0.032/kWh. However, with the cost have come greater savings. The cumulative participation rate and energy savings as a percent of sales for these two programs combined are 4.3% and 0.41% respectively.

Relative to other motor rebate programs in the database, BC Hydro's Power Smart Motor Rebate program has fared well. The utility offers customers an incentive of $400/kW and $600/kW saved for new and replacement motors respectively. BC Hydro additionally offers a vendor incentive equivalent to 20% of the customer incentive. Since the start of the program in 1988, BC Hydro has seen roughly 4% of their industrial customers participate and has experienced cumulative annualized savings of 0.28% of their industrial energy sales. For comparison, this percent savings is five times as large as the cumulative savings achieved in other motor rebate programs in the database. BC Hydro's levelized cost of $0.016/kWh saved is typical of other motor rebate programs. Although the participation rate appears small, before the program began, high-efficiency motors only accounted for 5% of the horsepower sold in BC Hydro's service territory compared to 60% today. Since program experience has shown that the majority of motors rebated are large motors, it is not surprising that the percentage of horsepower sold in the form of high-efficiency motors is large even though the percentage of customers participating in the program is small. BC Hydro's program manager cited a number of reasons for their success: the presentation of a broad Power Smart package to industry, the close relationship established with customers, comprehensive educational materials, and the vendor incentive.

BC Hydro's Power Smart: Efficient Compressed Air Systems program has already reached 60% of the eligible customers since the program began 2 1/2 years ago. The utility set an internal mandate to achieve 100% participation over a three-year time span. Energy savings have been above-average for prescriptive rebate programs at 0.15% of industrial energy sales. The program has been cheap to administer, with a levelized utility cost of only $0.005/kWh. The utility performs free leak tests on compressed air systems, primarily for their pulp and paper customers. The test identifies the general location of leaks, estimates how much they are costing the customer, and suggests a leak reduction target. BC Hydro has estimated that approximately 70% of the energy used in a compressed air system is lost through leaks. These losses are particularly great with their pulp and paper mills, whose facilities often occupy acres of land and have an extensive network of distribution piping. The customer repairs their own leaks, generally at very low cost. Three months after the initial leak test, the utility performs a follow-up leakage test.

Niagara Mohawk's C&I Motors & Drives Program, which began in January 1991, has proven successful in achieving savings. In its first year, this program exceeded its savings goal by 500%. The program's industrial savings were 0.27% of industrial energy sales. The annual levelized utility cost in 1991 was $0.015/kWh saved. The customer incentive is not a flat dollar per horsepower rebate, but rather takes a series of conditions into account. Niagara Mohawk credits their marketing approach for the program success. The utility marketing staff were thoroughly trained in understanding the advantages of ASDs and efficient motors from the customer's perspective. Substantial funds were spent on marketing to and working with equipment vendors. The utility organized numerous breakfast meetings with trade allies and assisted them in marketing the program at industrial shows.

Successful Programs: Common Traits. For the measures of success used in this study, what has contributed to the above industrial conservation programs achieving considerably greater participation and savings than the typical program? Making this assessment is a challenge considering the small number of programs analyzed. Additionally, success of industrial programs appears to be at least partially related to the composition of the customer base in a certain utility's service territory. For example, on a national average, electricity is only about 1 to 2% of industrial product cost. However, this is closer to 5% for paper mills and 25% for aluminum smelters. Therefore, utilities with many paper mills as customers may have more success marketing industrial conservation programs.

Despite these limitations, there are similar traits among the relatively successful programs. Our analysis of program experience indicates that there are several elements which contribute to above-average participation and savings. Outlined below are some of the primary features which distinguish successful programs from the average industrial program.

1. *Understanding and supporting the customer's perspective* is particularly important when it comes to industrial customers. The more thoroughly a utility understands the industrial customer's perspective, the greater the likelihood that the customer will participate. To date, industry has not readily trusted utilities in the quality and intent of their programs. The Washington State Energy Office (WSEO), in its draft Scoping Study of Industrial Energy Efficiency Programs (Hamilton and Rudeen 1991), noted that industry does not generally perceive utilities and government as credible sources of information. Utilities and third-party representatives indicated that it can take a program a few years to gain industry acceptance, particularly if the program involves changes to a manufacturing process. Wisconsin Power & Light, after administering their C&I Bright Ideas for Business custom measure program for three years, has recently decided to hire consultants with specific industrial process experience to perform the detailed industrial energy analyses offered in their program. They indicated that hiring the average DSM consultant to assist in detailed industrial process energy audits has not been effective, both from a marketing and a technical standpoint.

A few managers of successful industrial programs outlined a number of issues that are important for utilities to understand if they wish to gain industrial acceptance of their DSM programs. As one third-party representative and long-time industry observer aptly put it, programs for industry "can't be meringue, it's got to be a pretty solid pie" (Hamilton and Rudeen 1991). Current issues of concern for industry include power quality, waste minimization and disposal, environmental regulations, competitiveness, and reliability of power. It is essential to understand industrial process energy flows and their interconnectedness with all of the above factors. WSEO is currently coordinating with the Washington State Department of Ecology to increase the understanding of the environmental benefits of improved industrial energy efficiency. This effort was initiated partly because environmental concerns are more important to industry right now than are energy costs. Capital budgeting cycles of industrial customers generally reflect the importance of environmental considerations. One utility program manager noted that the first capital expenditures for a large industrial customer are generally related to OSHA

and environmental regulations. The second expenditures are usually for new or improved product development. Here is where a utility can jump in and play a role by offering improved productivity and reduced environmental emissions through energy-efficiency programs.

Understanding that industry operates in an uncertain economy and a constantly changing business climate is important. Whereas industrial plant managers may be keen to the idea of improving the efficiency of non-process systems (such as lighting and space heating and cooling), they may be unwilling to change their process due to the perceived high technical and financial risk associated with it. Various utilities with at least five years of industrial DSM experience behind them, such as Puget Power, indicated that they have had to "prove their value to the industrial customer" and that it has been important for them to find ways to increase the productivity of the customer's facility while also reducing energy consumption.

2. The *marketing techniques* employed by the utility can make the crucial difference between an industrial program's success and failure. Industrial programs can't be run out of an office. Bill stuffers and other direct mail alone will rarely succeed in marketing a conservation program to the appropriate people in a large industrial facility. The utility needs to make continual personal contact with the customer and target the marketing efforts to the customer's appropriate decision makers. One utility program manager indicated that utilities often will market their programs through utility staff who have had no previous contact with the industrial customer, whereas elsewhere in the utility -- most likely in the customer relations department -- close relationships have developed over years of interaction. It is important to target existing utility contacts in an industrial facility, otherwise utility staff will often have to enter through the same door as equipment vendors.

Since "time is money" for an industrial customer, an industrial conservation program must be user-friendly to be widely acceptable to a diverse industrial base: it needs to be well-administered and minimize the paperwork, bureaucracy, and time requirements often associated with utility programs. One drawback associated with many custom measure programs, as they are currently administered, is the long wait between initial customer enrollment in the program and actual receipt of an incentive; this process can take years and proves burdensome to industrial customers.

Some utilities, such as BPA, BC Hydro, and Niagara Mohawk, have focused on trade allies for marketing a program. BC Hydro, for example, provides an incentive to equipment vendors equal to 20% of the customer rebate. Marketing a program through the use of trade allies not only reduces the administrative costs for the utility, but also reduces the participant paperwork required. As the program manager at BC Hydro noted, trade allies and manufacturers can indirectly act as utility marketing staff and thus reduce the utility manpower required to market a program.

A few utility program managers noted that if large industrial customers' capital budgeting cycles are followed closely, then the utility can present the program to the customer well in advance of the start of a new cycle (i.e. offer a free audit and indicate the energy-saving opportunities) and have greater likelihood for marketing success. Planning a marketing approach around the customer's capital appropriations can also shorten the length of time between initial customer contact and final measure implementation. Industries have a limited attention span; if the bureaucratic process drags on too long, their attention tends to shift away from the program and its merits and back to the constantly evolving list of concerns within their facilities.

3. Generally, the more *program flexibility* offered the industrial customer the more successful the utility has been in recruiting participants. This is easier to achieve with the inherently flexible structure of a custom measure incentive program compared to a prescriptive measure rebate program. However, even custom rebate programs can be too rigid for industrial customers, as was demonstrated in the earlier version of BPA's Energy Savings Plan. The failure of the program to recruit participants was partly due to the concrete, restrictive deadlines for submitting project proposals which had no relationship to capital budgeting cycles of industrial facilities (Nadel 1990).

Both custom rebate and prescriptive rebate programs play important roles in securing industrial energy-efficiency improvements. By offering high participation for particular measures and by getting customers accustomed to working with the utility, prescriptive rebate programs can be a positive complement to a custom rebate program. If the two types of rebates are offered in conjunction with each other, the program will most likely reach more customers than if only one type of rebate is offered. Customers passing through the prescriptive portion of the

program may decide to move on to more process-oriented, custom-type projects. Such is the case with Wisconsin Electric's Smart Money for Business program described earlier.

4. *Customer financial incentives* are offered by all the programs in Table 1 (while a few industrial programs in the expanded database do not offer incentives, none of these programs could provide data for our database). Some programs offer the option of low-to-no-interest loans instead of or in addition to a cash rebate. Generally, large financial incentives offered to the participant correlate to above-average participation and savings. For example, BPA has raised the incentive in the Energy Savings Plan program three-fold since the introduction of the program in order to attract participants. As noted previously, participation rates in this program have increased substantially since incentives were increased and marketing methods improved upon. In addition, a few utilities offering relatively successful industrial conservation programs have noted that vendor incentives can streamline and improve the effectiveness of program marketing.

Other Notable Efforts in Industrial DSM

As noted earlier, although 70 programs are included in the complete database, less than half of these programs are included in the data analysis. However, some of the programs not listed in Table 1 are worth highlighting. There are also notable third-party efforts to encourage improved industrial efficiency. Some of the more unique efforts are summarized below.

North Carolina is the only state with a long-standing cooperative industrial efficiency effort. The North Carolina State University Industrial Extension Service, in cooperation with the North Carolina Energy Office, offers the Energy Preventative Maintenance Measure Program to industry. This program is a series of seminars on improving the efficiency and productivity of industrial facilities. Seminar participants are eligible for a two-day energy audit through the university which focuses on the topic of the seminar. Auditors work together with recent trainees to identify waste in the trainee's facility. The state government pays for 80% of the audit and the customer pays for the rest. On average, industrial customers have had measures recommended to them which will save $75,000 per year at an average audit cost to the customer of only $320-$400. This audit program has been available for two years and has seen 65% of its recommendations implemented.

Carolina Power & Light has offered an intensive industrial audit program since 1983. Audits typically last for two weeks, and sometimes much longer. The program targets industrial customers who need help financially. Audits are performed for not only electricity savings but also for water, gas, and other fuel savings, which enhances customer respect for the program. The auditors only recommend measures with a two-year payback or less because experience has shown that these are the only measures implemented by customers. If all recommended measures are implemented, customer demand is typically reduced by 10-15%.

Since 1990, Southern California Gas has been offering incentives to industrial customers to perform consultant studies and install or replace efficient equipment through their High Efficiency Industrial Equipment Replacement and Industrial Heat Recovery programs. The measures most commonly funded are installation of high-efficiency boilers and burners. Heat recovery equipment most commonly installed are economizers and recuperators. The Industrial Equipment Replacement program has seen high savings and participation rates. According to utility staff, this is primarily due to the fact that industrial customers are rushing to meet air quality standards which have gone into effect and are continually getting more stringent. The utility indicates that it will most likely be difficult to achieve similar results in the future.

Pacific Power & Light, in their newly-created Energy Finanswer: Industrial program, has opted for loan financing rather than cash rebates for energy-efficiency improvement projects in industry. In this industrial new construction and retrofit program, the utility offers to pay 100% of the cost of design and implementation of a cost-effective, energy-saving project up-front, with the customer paying back the utility (with a Prime +2% interest rate) over the period ranging from 5-10 years. Customers must have at least a 500 kW demand to qualify. Utility staff indicated that direct cash rebates are ultimately not effective in changing industrial behavior in the long-run; claiming that simply "giving something away free" isn't an effective approach. The customer significantly benefits from most energy-saving measures rebated by utilities and should pay for the benefits. Initial results from this program have been below expectations. However, the utility has recently changed the program format to include guaranteed savings, a feature which they think will increase participation.

Conclusions

Commercial and industrial customers are very different and warrant unique approaches to program design, marketing, and implementation. Industrial customers want to know how to improve the productivity of their facilities, not simply how to improve their energy efficiency. Therefore, utilities need to understand the industrial processes of their customers and their associated inefficiencies in order to begin to find the links between increased efficiency and increased productivity. By hiring contractors and/or staff who have specific expertise with different types of industrial customers, the utility will more likely succeed in identifying appropriate measures and in assuring the confidence of the industrial customer.

The marketing methods of industrial programs can have considerable impact on the effectiveness of attracting participants. Efforts to remain in regular personal contact with both customers and dealers can pay off in large participation rates and energy savings. A direct incentive to equipment dealers has had a positive impact on savings and participation at the few utilities in this report which have such an incentive.

Through offering a flexible package to an industrial customer, the utility will be working with the diverse nature of industry rather than against it. Offering joint custom and prescriptive rebate programs helps to address the need for achieving long-term impacts through high customer participation and significant energy savings per customer. In addition, higher financial incentives offered to customers are often helpful tools for encouraging participation. Consistently tracking industrial program results provides an invaluable tool for learning lessons from past DSM efforts.

It is time for utilities, regulators, and third-party affiliates to move forward and actively pursue the large energy-saving opportunities in the industrial sector. Although past experience in industrial DSM is not extensive, experience to date provides useful lessons that can be applied to new programs. The important step now for utilities is to simply get started and begin experimenting with industrial program design, using the lessons learned from other utilities as a guide.

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