Chapter 4 - Customer Preferences for Price-Responsive Load Programs

Customer Preferences for PRL Features

Overview

One of the primary objectives of the 2002 evaluation is to better understand customers' decisions regarding participation and performance in the NYISO Demand Response programs. For analysis purposes, customer decisions can be classified into four major areas:

- Current Participation Decisions,
- Continued or Future Participation Decisions,
- Load Reduction Subscription Rates, and
- Actual Event Curtailment Performance.

Current participation decisions include those made both by customers participating in one or more of the three NYISO programs (EDRP, DADRP, and ICAP/SCR) and by informed non-participants, defined as customers that have elected not to enroll in any program but who attended informational meetings regarding the programs. In 2002, customer enrollment increased substantially in the EDRP and ICAP/SCR program, yet it is still critical to gain a better understanding of what motivates the enrollment decision. Because these programs are new and continue to evolve, we must better understand which customers would continue in the programs if critical program features were changed. Moreover, a primary objective of the 2002 evaluation is to characterize the drivers to participation and performance in DADRP, and identify barriers that limit participation and performance in this program.

The amount of load reduction that participants nominate when they subscribe into a PRL program is an important indication of their intention to curtail during an emergency event, or in the case of DADRP, in real-time if their bids are accepted in the day-ahead market (DAM). Each participant's actual performance during emergency events must also be reviewed in order to ascertain how well those intentions were fulfilled. For system dispatchers to view these programs as providing reliable load management resources during times of emergency, it is critical to identify and explain systematic differences between subscription rates and actual performance.

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Moreover, because participant acquisition costs are high, CSPs would like to be able to identify factors that lead to higher performance yields.

We hypothesize that decisions about program participation and performance are influenced by the characteristics of customers (e.g., type of business, number of production shifts, electricity usage patterns, etc.), the particular features of PRL programs, the potential influence of financial assistance from NYSERDA or others in purchasing and installing enabling technologies, the usefulness of information received about current programs, past experience with load management programs, and conditions in the market (e.g. expectations about the level of DAM or RTM prices). We explore how these factors interact to influence customer's decisions through two levels of analysis. The first involves a "top-level" analysis using statistical tests to establish association among factors. The second utilizes behavioral choice models to establish the relative importance of key factors in the decision to participate process. In the "top-level" analysis, we focus on exploratory data analysis and hypothesis tests of differences in mean values of key measures of satisfaction, preference, or performance between sub-groups of survey respondents. In particular, we summarize key characteristics of participants in PRL programs and informed non-participants, explore factors that help us to understand and explain customer participation decisions, subscription levels and actual performance, and analyze barriers to participation in the DADRP as well as EDRP and ICAP/SCR programs.

Top-Level Analysis

Methods and Practices

A customer survey was administered through telephone interviews to a sample of 85 program participants and 59 informed non-participants as part of the evaluation of the 2002 NYISO PRL programs. Respondents were asked targeted questions based on their participation decision that included the following topics: information that characterized the customer's primary business activity, facility characteristics and energy usage patterns, load curtailment strategies, factors that influenced their decision whether or not to participate in various PRL programs, barriers to customer participation, and their reaction to potential changes in program design or new program offerings. Details of the survey design and administration are provided in Chapter 3.

In addition, professional engineers from CERTS conducted more extensive and comprehensive telephone interviews (i.e., "PRL audits") with a sub-set of 35 respondents in the general survey population, in order to further explore factors that customers see as obstacles to participating in the DADRP.[1]

Survey respondents were categorized into four sub-groups for analytical purposes:

- DADRP participants, even if they participated in another program
- Participants in EDRP only
- Participants only in EDRP and ICAP/SCR but not DADRP
- Informed non-participants (INP)

Table 4-1: Survey Sample and Population

Sub-Group	Sample		Population	
	Sample Size, n	Total Subscribed Load (MW)	Population Number, N	Total Subscribed Load (MW)
DADRP	11	131	24	394
EDRP Only	60	69	1522	862
EDRP-ICAP	14	126	165	497
Informed Non-participants	59	N/A	320	N/A
Total	144	326	2031	1752

Informed non-participants were drawn from lists of customers that attended informational workshops on PRL programs sponsored by various New York State agencies during Spring 2002.

The 85 PRL program participants that responded to the survey represent a combined 326 MW of subscribed load reductions, equal to about 19% of that for the entire population of PRL program participants (Table 4-1). Although DADRP respondents are the smallest group in terms of sample size (11), survey respondents represent about one-third of the subscribed load in DADRP. All DADRP respondents had subscribed load reduction levels greater than 5 MW, with a median value of 12 MW (Fig. 4-1). In comparison, the median value for subscribed load reduction for EDRP respondents was much lower (200 kW). The difference in subscribed load

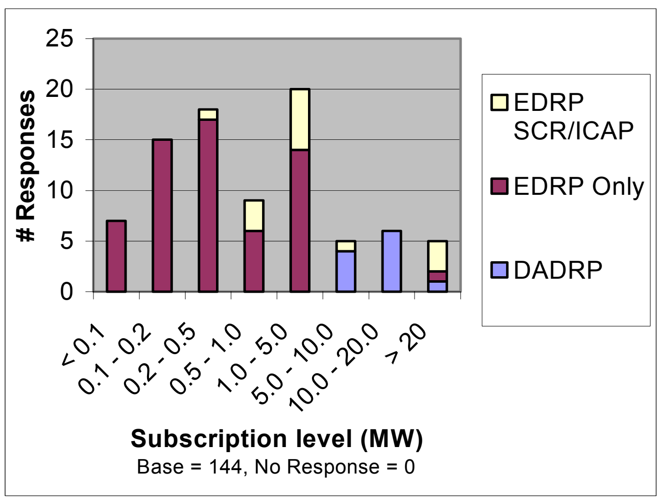


Fig. 4-1: Survey Respondents' Subscribed Load Reduction

[1] The Consortium of Electric Technology Reliability Solutions (CERTS) team consisted of engineers from Lawrence Berkeley National Laboratory (LBNL) and Pacific Northwest Laboratory (PNL).

reductions partially reflects the program rules for minimum participant size: DADRP was restricted to aggregated bids of at least 1 MW, while the minimum load reduction was 100 kW in EDRP.

Customer Characteristics

Participation and performance in PRL programs may be influenced by the attributes of each customer, e.g., their primary business activity, facility size and operational patterns, number of employees, and amount and timing of electricity use. To better understand the diversity of respondents within and among each sub-group, we tabulated summary statistics for various attributes.

Primary Business Activity

Manufacturing firms (38%) and government/institutional (31%) customers were strongly represented among our 144 survey respondents (Fig. 4-2). Commercial office buildings – often thought to represent a large potential source of demand responsive load – represent only 6% of PRL participants in our sample and 12% of informed non-participants.

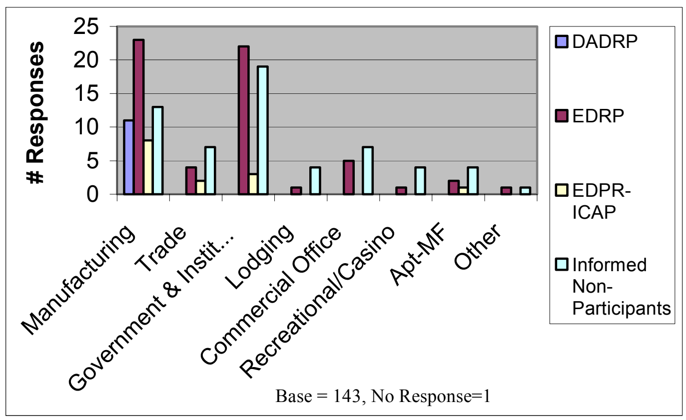


Fig. 4-2: Major Business Activities of Survey

There are some important differences in major business activities among participants in PRL programs and informed non-participants in our sample. Most notably, all DADRP respondents are manufacturing customers. In contrast, our sample of 60 EDRP-only respondents is a more heterogeneous group: 38% are manufacturing companies while 33% are government/institutional (primarily hospitals). The sample of 59 informed non-participants encompasses many market segments: 32% are government or institutional customers, 22% are manufacturing firms, 12% are commercial offices, 12% are involved in wholesale or retail trade, and 7% were multi-family apartment owners.

Facility Size

The survey respondents – both participants and non-participants, alike – spanned a wide range of facility sizes, with the median value ranging from 100,000 to 249,000 ft^2 (Fig. 4-3). Overall, survey respondents in large facilities (defined as greater than 500,000 ft^2) were more likely to be participants in a PRL program, with 79% of these respondents participating in at least one PRL program. In contrast, 71% of the non-participants occupied facilities that were less than 500,000 ft^2. Over 50% of the DADRP participants had facilities that were greater than 500,000 ft^2.

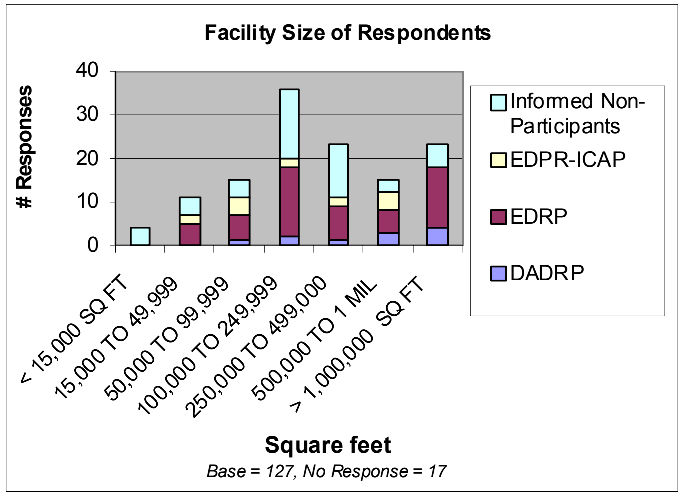


Fig. 4-3. Respondent Facility Size

Number of Employees

Most survey respondents (77%) had less than 500 full-time employees (FTE), and approximately half of these had less than 100 FTEs (Fig. 4-4). Overall, non-participants tended to have slightly fewer FTEs, compared to PRL program participants, which is consistent with the slight trend of smaller facility sizes for non-participants, described above.

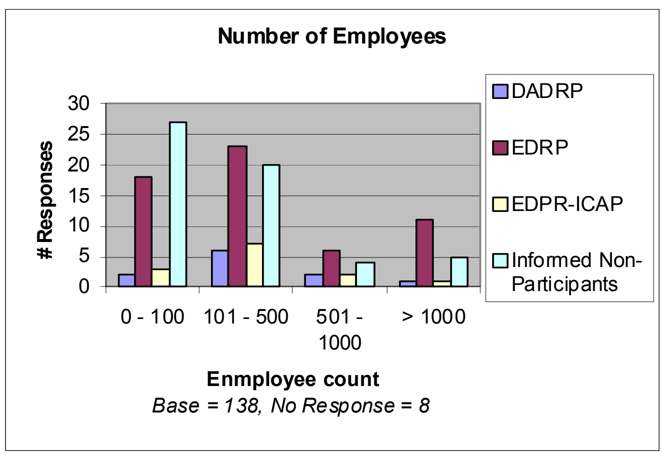


Fig. 4-4: Number of Employees of Survey Respondents

Facility Schedules

Because load curtailments often involve shifting production processes or other business activities to off-peak hours, the ability of an electricity customer to participate in a demand response program may often depend on their business hours and whether or not they operate multiple shifts. Survey respondents were asked how many shifts are operated per day (Fig. 4-5). 60% of respondents reported operating three shifts per day. All DADRP respondents operated multiple shifts (e.g. 2 or 3 shifts), compared to 70-80% for the other three sub-groups. In contrast, about 25% of informed non-participants indicated that they only had one shift of operations in their facilities.

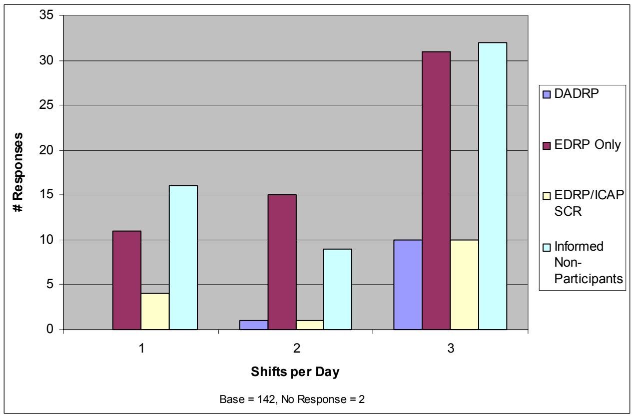


Fig. 4-5: Facility Operation Profile

Electricity Costs and Usage

Survey respondents provided information on the percent of their organization's total monthly operating costs that were attributable to electricity costs (Fig. 4-6). Electricity costs, as a percent of operating expenses, varied widely among the survey respondents with a median value of 5%. For DADRP participants, electricity costs tended to represent a slightly larger percentage of operating expenses than the other sub-groups, with a median value in the 6-10% range. Electricity costs are an important business expense for many customers, as indicated by fact that

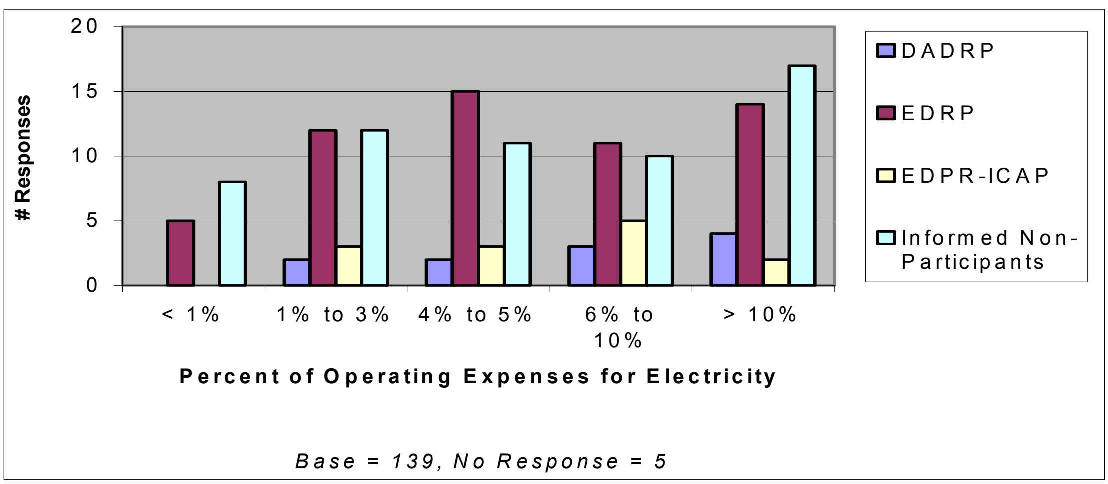


Fig. 4-6: Electricity Cost

about 25% of respondents reported that electricity costs represented greater than 10% of their operating costs.

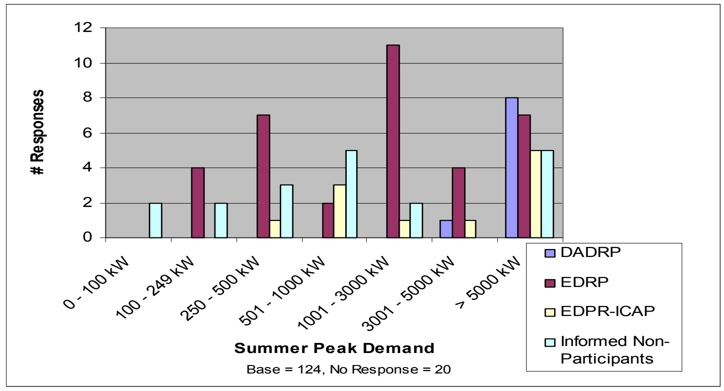


Fig. 4-7: Summer Peak Demand

Participants in a PRL program tended to have significantly higher summer peak demand than non-participants (Fig. 4-7). The median value for non-participants was 750 kW, compared to 1.7 MW for EDRP respondents, 5 MW for EDRP-ICAP respondents, and 14.5 MW for participants in DADRP. Because DADRP required 1 MW minimum load reductions, all survey respondents participating in this program were large customers, almost all of which reported peak demands greater than 5 MW. On the other hand, because EDRP and ICAP-SCR required a minimum load reduction of only 100 kW, participants' summer peak demand varied over a much wider range. Some of this variation in summer peak demand among different programs also reflects the distribution in primary business activity among participants.

Among EDRP/ICAP participants, the median summer peak demand of institutional customers was 435 kW, compared to 6,550 kW for the manufacturing customers in this sub-group. On the other hand, only a slight difference in median summer peak demand values was observed among manufacturing and institutional customers in the EDRP program (1,650 vs. 1,037 kW respectively).

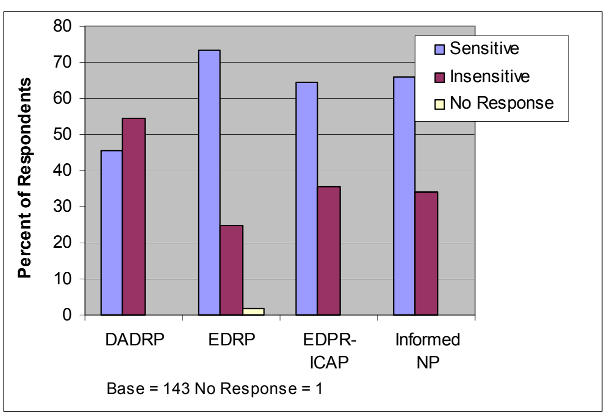


Fig. 4-8: Weather Sensitivity

With the exception of DADRP participants, most survey respondents (65-75%) described their load as temperature sensitive during the summer – which is defined as a 5% change of electricity demand resulting from changes in temperature (Fig. 4-8). This is much higher than the percentage of customers that chose to adopt the temperature-sensitive customer baseline methodology – perhaps indicating lack of familiarity, understanding, or comfort with the temperature- sensitive CBL option. The temperature sensitivity of most respondents was largely related to air conditioning loads. The fact that DADRP participants were less temperature sensitive is a likely corollary to the prevalence of participation by manufacturing customers, whose peak loads are typically much less driven by air conditioning and more by ongoing process needs.

Survey respondents were asked what time their peak electricity usage occurred. The majority of survey respondents reported that their peak electricity usage occurs during daytime hours, with most respondents identifying the morning hours (8 AM – noon) as their peak usage period (Fig. 4-9). About 20% of DADRP participants indicated that their peak usage occurred during nighttime hours (10 PM – 8 AM).

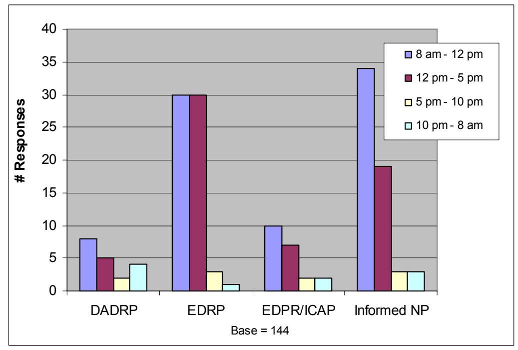


Fig. 4-9: Time of Peak Usage

Understanding Customer Participation in PRL Programs

One of the primary objectives of the customer survey was to obtain insights into factors that influence participation in PRL programs. These factors include awareness of the program, information and knowledge of program requirements in order to determine whether it is advantageous to participate, prior experience with load management programs, and perceived constraints on customer's ability to shift or curtail electricity usage driven by business or facility operations concerns.

Information and Awareness

A threshold issue for a customer's decision to participate in a PRL program is simply whether or not they are aware of the programs. Non-participants in each PRL program (e.g., DADRP, EDRP, ICAP/SCR) were asked whether they were aware of that program.

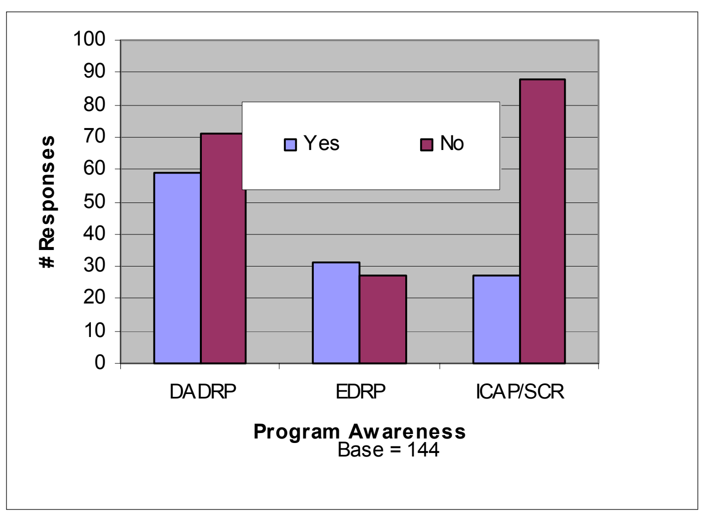


Fig. 4-10: Program Awareness

A significant number of survey respondents indicated that, in fact, they were unaware of NYISO program offerings, ranging from 45% for EDRP, 55% for DADRP to 77% for ICAP (Fig. 4-10). Given this widespread lack of familiarity with the PRL programs, additional marketing and informational workshops are clearly needed to acquaint customers with NYISO program offerings.

Informational presentations on PRL programs were sponsored during spring 2002 by various entities (e.g., NYSERDA, NYDPS, and electricity service providers). A significant portion of EDRP (50%) and DADRP (73%) participants reported that they attended these meetings (Fig. 4-11). Although the names for informed non-participants were drawn from attendance lists from these informational meetings, more than 30% of those surveyed reported that they did not attend any meetings. This might be due to the survey respondent being different from the workshop attendee.

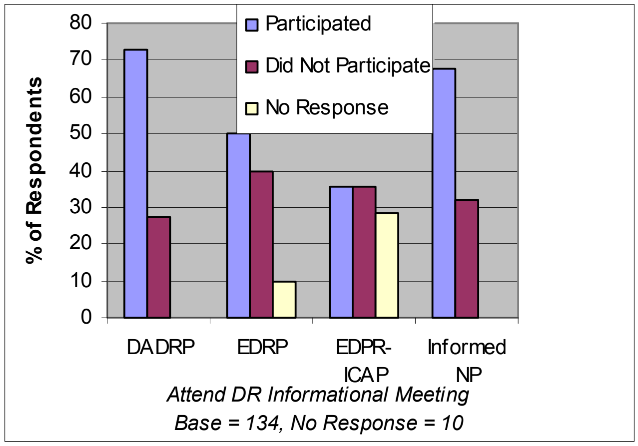


Fig. 4-11: Participation by DR Workshop Attendance

Informational and marketing brochures published and distributed by NYSERDA were major marketing tools for generating interest in PRL programs. Three different brochures were produced in 2002: NYISO Demand Response Programs, Smart Metering, and Low Cost/No Cost Demand Reduction Strategies. Table 4-2 represents the survey respondents who indicated they had received the NYSERDA informational brochure in question. Across the sub-groups, a greater percent of informed non-participants (64%) reported receiving the Demand Response Program brochures than PRL program participants (29-64% for various programs). About 30-40% of the informed non-participants reported receiving the Smart Metering and Low Cost/No Cost Strategies brochures compared to 7-22% of program participants. This

Table 4-2: Respondents who indicated receipt of NYSERDA Informational Brochures

Brochure	New Pgm. Participants	Old Pgm. Participants	Informed NP
NYISO Demand Response Programs	43%	48%	50%
Smart Metering	24%	6%	63%
Low-Cost/No-Cost Strategies	19%	10%	59%

result reflects the fact that these brochures were distributed at the informational workshops, and the informed non-participants were drawn from attendance lists from these workshops. Over 40% of new program participants reported receiving the Demand Response Program brochure. When asked about the value of the brochure on the decision whether or not to participate in NYISO demand response programs, the vast majority of participants (79%) and non-participants (71%) indicated that they found these brochures to be useful (a rank of 4 or 5 on a scale of 1-5). Thus, overall, most recipients appear to find the brochures useful, although broader and more widespread dissemination would be helpful.

Knowledge and Experience

Prior participation in utility-sponsored load management programs – such as real time pricing (RTP), interruptible rates, and time-of-use-rates (TOU) – provide customers with an opportunity to develop both the organizational knowledge and the technological capacity necessary for participation in PRL programs. Survey respondents were asked whether they previously participated in any load management program. The results indicate that customers with prior experience in one or more utility load management programs are, in fact, more likely to participate in a PRL program compared to informed non-participants (at greater than 95% confidence level). The effect was particularly strong among DADRP respondents; virtually all of these customers previously participated in at least one utility load management program, compared to 40% of non-participants and 57% of EDRP-only respondents (Fig. 4-12).

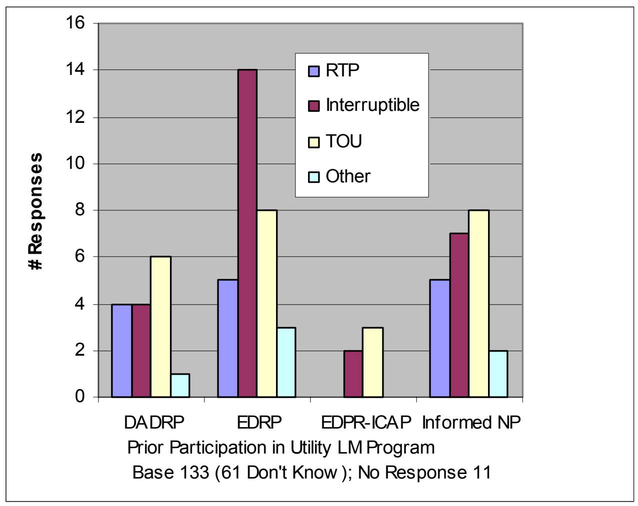


Fig. 4-12: Prior Load Management Program Participation

The presence of a designated on-site energy manager that is able to coordinate and implement load reductions may be an important enabling condition for participation in PRL programs. This issue is particularly relevant for DADRP, since a combination of a high degree of technical knowledge and organizational authority are likely needed in order to conduct the bidding activities required by the program. For many facilities, these activities would typically be the responsibility of a facility energy manager, or some other employee with a similar level of training and authority. Consistent with this proposition, among our sample of respondents, we find that the PRL participants were more likely than non-participants (80% to 60%) to have an employee responsible for managing or procuring energy (Fig. 4-13). However, the difference is not as large as we might expect.

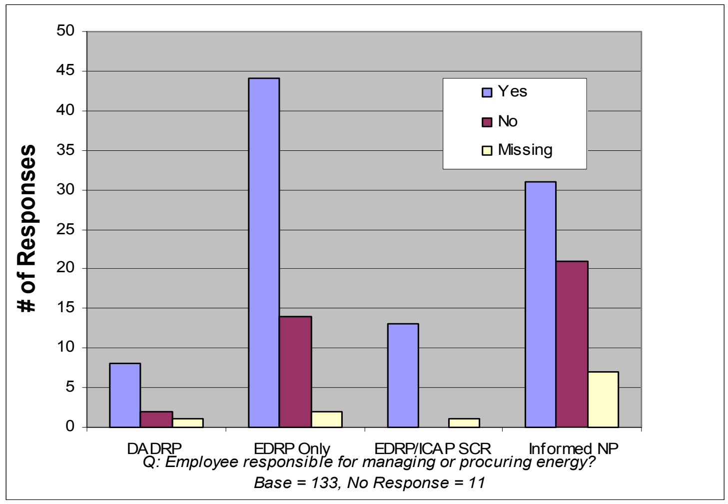


Fig. 4-13: Dedicated Energy Manager

Facility or Operational Constraints

Respondents were asked about the largest impediment to shifting load from the noon – 6:00 p.m. period to other hours of the day. Production schedules were cited as the largest impediment by the preponderance (over 75%) of the industrial customers (Fig. 4-14). In contrast, concerns about occupant comfort were cited as the biggest impediment by 80% of commercial customers, 85% of the multi-family building owners, and 55% of the institutional facilities. These findings suggest that the factors that customers view as impeding load curtailments can be

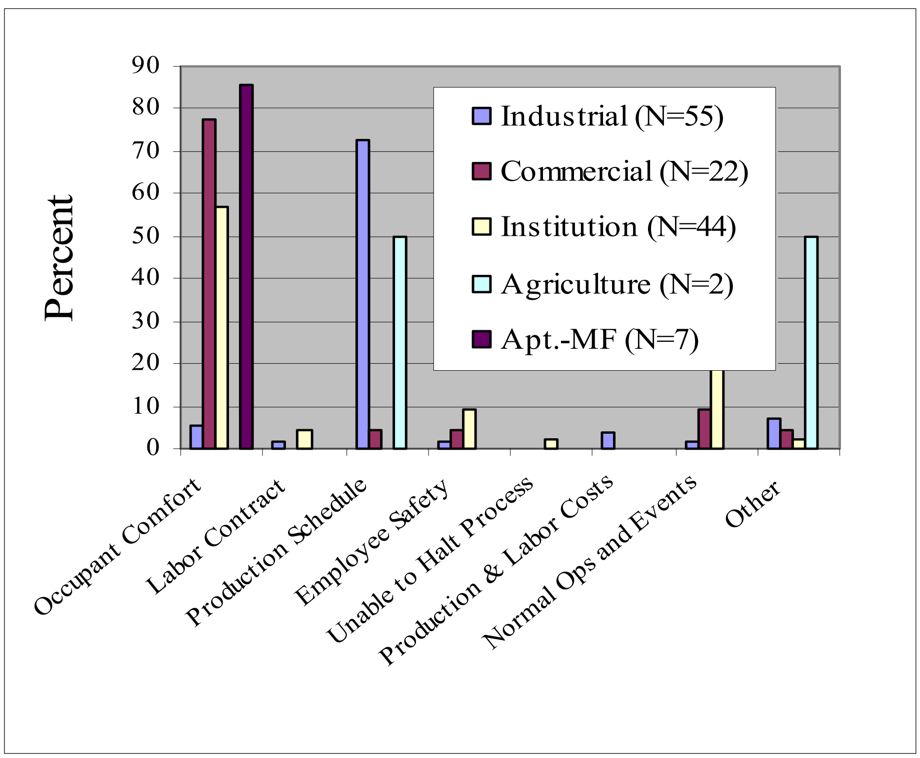


Fig. 4-14: Impediments to PRL program participation

fairly well defined based on primary business activity. Recognizing this correspondence in the design of marketing materials will help CSPs overcome customer reluctance to participate.

Load Management and Energy Efficiency Technology

HVAC or Process Controls

The existing energy management and process control infrastructure is a key element for effective load reduction strategies. HVAC equipment and industrial processes can be remotely controlled and scheduled while operations can be monitored and supervised to varying degrees depending upon the sophistication of the controls and automation technologies. It is difficult to fully assess the capability of the facility's controls infrastructure or its suitability for load management strategies without a site audit. Based on self-reports by survey respondents, between 65 and 70% of the DADRP, EDRP, and non-participants reported using HVAC or energy management and process controls systems on a facility or building-wide basis (Fig. 4-15). In contrast, about 35% of the EDRP/ICAP respondents indicated that they used building-wide HVAC or process control technology. Based on these survey responses, it is not possible to determine whether these control systems are capable of supporting cost-effective dispatching of load reduction strategies that would achieve a higher level of performance compared to manual control. However, most survey respondents performed load reductions manually which suggests that the existing control infrastructure configuration was compatible with the load reduction strategies that participants chose to carry out. Resolving that incompatibility may be a low cost means of increasing participant performance.

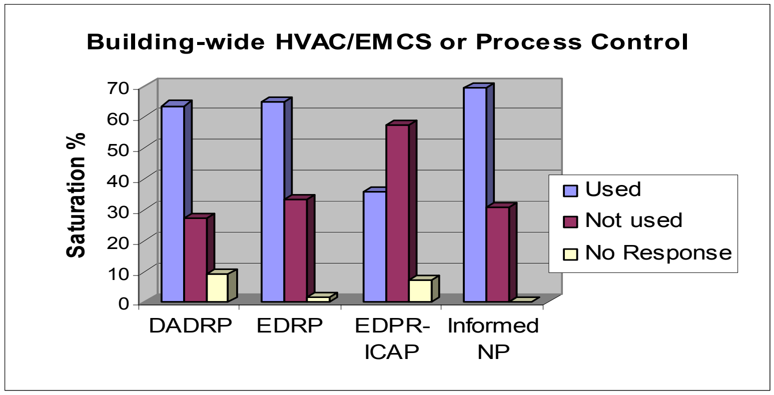


Fig. 4-15: Use of Control Technologies to Respond to PRL Events.

Fig. 4-16 shows the saturation of building-wide HVAC or process control technology by business type. Based on customer self-reports, saturation ranges from 0% for multi-family respondents to 100% for customers in wholesale and retail trade. Manufacturing is the second lowest with 43% saturation, which is characteristic of established heavy industry as opposed to new high-tech manufacturing plants, which are highly automated. Customers in government, institutional, health, lodging facilities, commercial office buildings, and recreational facilities reported saturations of building-wide HVAC controls of around 75-80%.

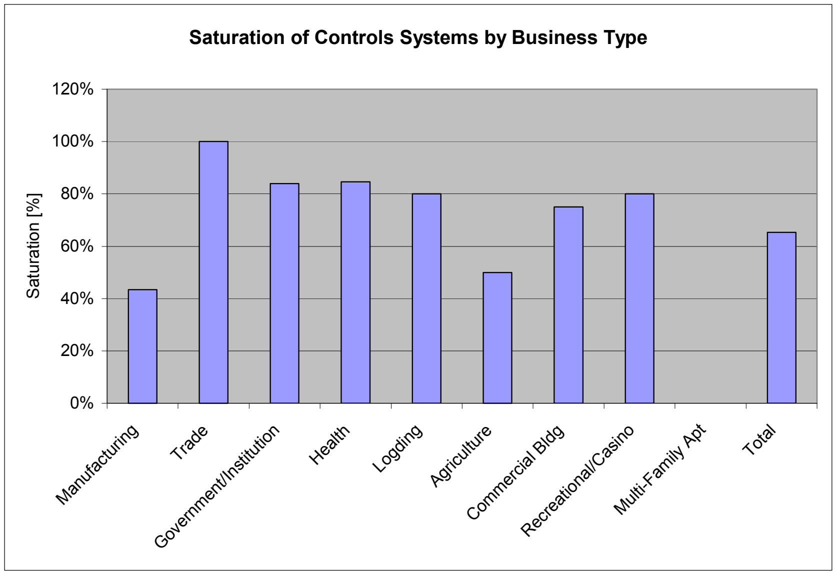


Fig. 4-16: Control Technology Saturation by Business Type

Access to Real-Time Metering, CBL, Curtailment Performance, or Wholesale Electricity Prices

An hourly interval meter is required for PRL participation. Access to that meter in real-time or near real-time can be helpful for PRL program response, especially for programs like DADRP and ICAP/SCR that impose penalties for noncompliance. Some customers reported installing web-based energy information systems (EIS) that provide information on customer baselines (CBL) prior to a load curtailment event. These EIS provide customers that do not already have an integrated metering and EMCS with the option to view consumption data on a day-after or near real-time basis.

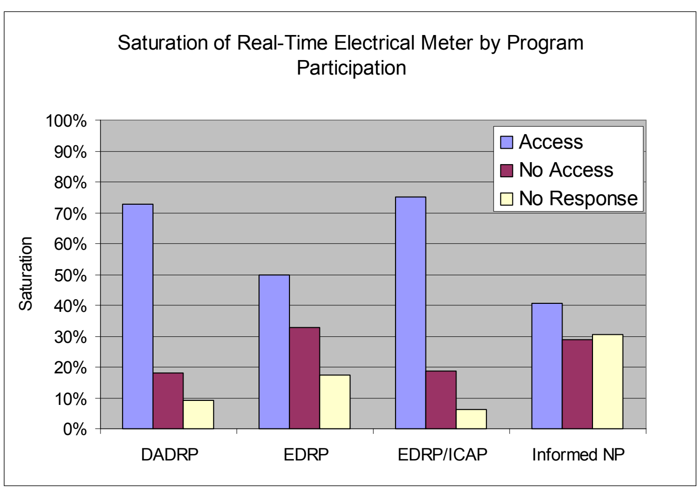


Fig. 4-17: Saturation of Real-time Metering

Fig. 4-17, 4-18, 4-19 and 4-20 show the saturation of real time or near real-time electric metering, CBL monitoring, curtailment event performance, and wholesale electricity price monitoring systems among program participants. Survey respondents reported that access to electrical meter data achieved the highest saturation levels among the four technologies categories investigated. Access to interval meter data was accomplished through a web-based product offered by the CSP or LSE or available through the customer's facility automation system entered meter readings directly into the system. The web-based products typically display historical and most current usage data as recorded on the meter. CBL products are generally web-based and display CBL on an hourly basis superimposed onto load data. Saturation of both CBL and curtailment event performance technology was in the 10% to 30% range suggesting that the majority of the customers performed curtailments without immediate feedback on their performance.

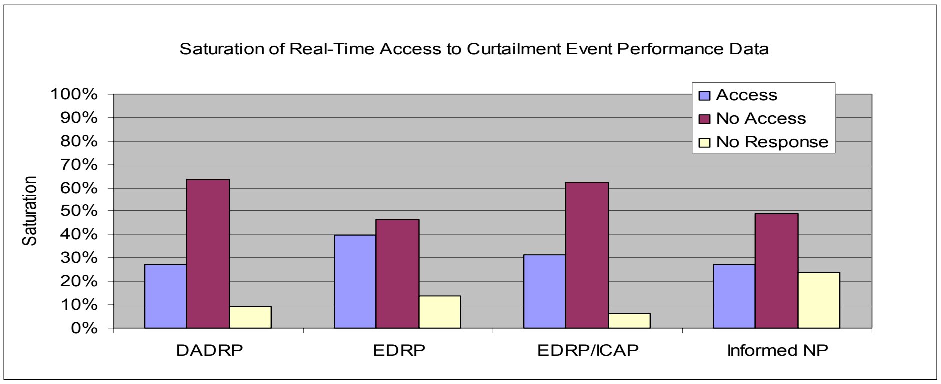


Fig. 4-18: Access to Real-time Performance Data

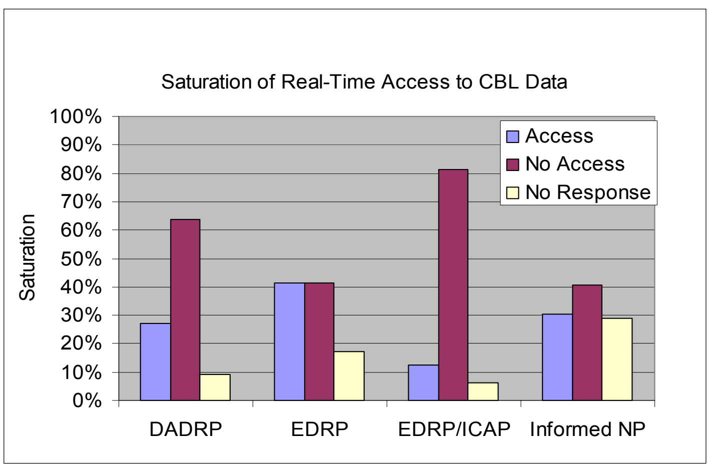


Fig. 4-19: Access to CBL Data

It is surprising that few of the jointly subscribed EDRP/ICAP program participants reported using the real time CBL and/or curtailment event performance tools given the penalty clauses of the ICAP/SCR program. Nevertheless, as discussed in Chapter 5, EDRP/ICAP participants managed a high degree of performance relative to their subscription level suggesting that they either used onsite generators that delivered a predictable load reduction, or that they shut off industrial processes, which provided a predictable and firm load reduction.

Wholesale electricity prices are provided by the NYISO and accessible on the NYISO website. To the degree that customers have Internet servers at their facility, they have access to day-ahead market electricity prices. The saturation levels for near real-time access to electricity prices as shown in Fig. 4-20 is probably more indicative of customer's general knowledge regarding the accessibility of electricity price information rather than the actual ability to obtain the data.

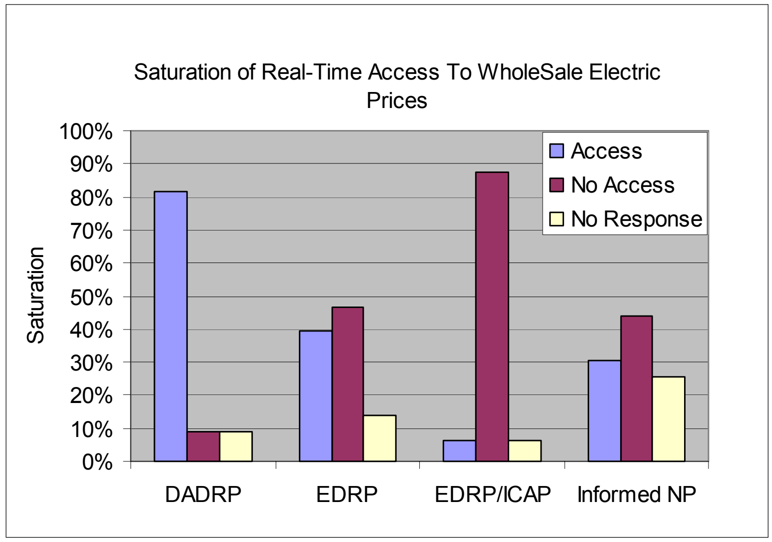
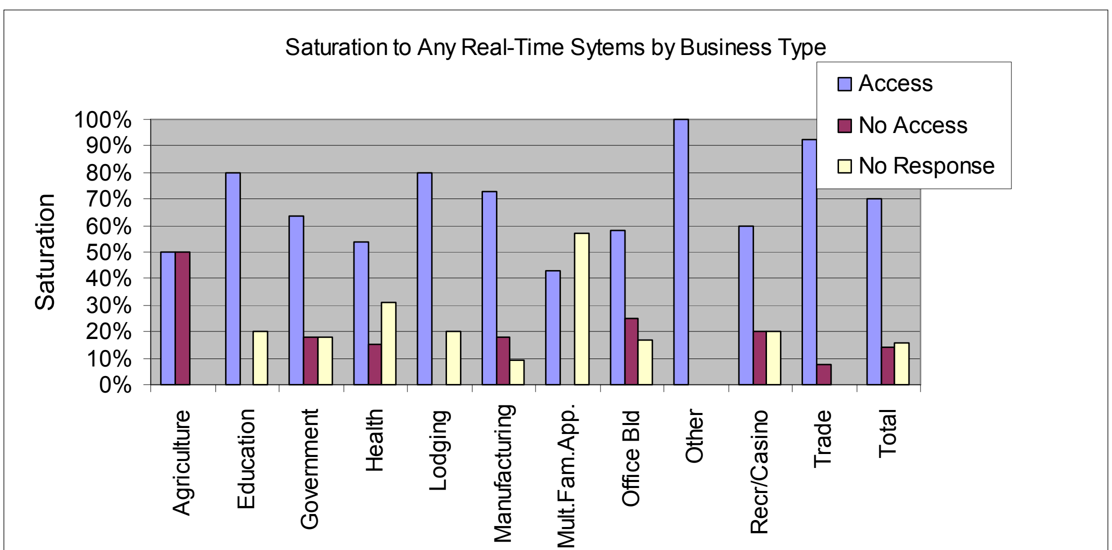


Fig. 4-20: Real-Time Access to NYISO Electricity Prices

DADRP participants would be expected to monitor wholesale electricity prices in order to determine their bid price offers. As a consequence, their saturation level for access to wholesale electricity prices is the highest of all other program participants. The lower saturation



Agri	Educ.	Govern	Health	Lodge	Manuf.	Multi App.	Office Bld	Other	Recr/ Casino	Trade	Total
2	20	11	13	5	55	7	12	1	5	13	144

Fig. 4-21: Real-Time Saturation by Business Type

level for the EDRP and EDRP/ICAP participants could reflect the fact that customers do not have a direct need for this price information as they are notified by the ISO, LSE, or CSP when there is a system emergency condition that requires load curtailments.

Aggregated saturation levels of real- or near real-time technologies are shown by business type in Fig. 4-21. Overall, for most market sectors, saturation levels are in the 70-80% range with the exception of agriculture and multi-family apartment buildings (~50% saturation), although sample sizes are small.

PRL Audit Results: Barriers to Participation in DADRP

While participation in the NYISO's emergency (EDRP) and capacity (ICAP/SCR) programs increased during 2002, this enthusiasm has not translated into increased bidding in the day-ahead energy market. In fact, bidding activity in the DADRP was lower in summer 2002 compared to summer 2001, despite an increase in program registrations. A primary objective of the customer research initiatives included in the 2002 PRL program evaluation was to characterize and quantify the factors that act as barriers to participation in DADRP. This section draws primarily on in-depth interviews that were conducted with a sub-set of 35 customers (i.e., PRL audit) to characterize better the various barriers to customer participation in DADRP.

Low Awareness Levels for DADRP program

Awareness levels of the DADRP program are low, even among those registered in other NYISO programs. Table 4-3 shows DADRP awareness levels for EDRP participants and informed non-participants. It is notable that a smaller percentage (39%) of EDRP participants are aware of DADRP compared to informed non-participants (53%); the difference is statistically significant at a 15% confidence level. Apparently, customers are being recruited to specific programs with very little selling of the PRL portfolio, which suggests that, at least with respect to awareness levels, the potential "training ground" boost that EDRP participation was expected to provide to DADRP is not being

Table 4-3. DADRP Awareness Levels

	Yes	No	Totals
Informed NP	31 *53%*	28 *47%*	59 *100%*
EDRP	28 *39%*	43 *61%*	71 *100%*
Totals	59 *45%*	71 *55%*	130 *100%*

q52: Are you aware of the NYISO DADRP Program?
a) "EDRP" also includes those in EDRP in combination with ICAP
b) There were no responses from ICAP Only participants.

widely exploited at present by load serving entities (LSE) marketing the program. Informational and marketing efforts should target the program element to which the customers seem to be best matched. However, customers should be made aware of the full range of participation opportunities so that they can use their initial experience to gauge their capability of participating in other programs in the future.

Primary reasons given for not participating in DADRP

Respondents that were aware of the DADRP were asked to indicate their primary reason for not participating in the program. Inadequate compensation for perceived risks (35%) and inability to shift or curtail usage (35%) were the primary reasons given by DADRP non-participants overall (Totals column in Table 4-4). Inadequate knowledge of program requirements was mentioned only half as often (17%). Surprisingly, and contrary to popular belief, the existence of a penalty for non-performance was not cited as nearly as important – only 6% of all respondents so indicated.

Table 4-4. Primary Reasons for Non-Participation

	Risks or Payments	Can't Shift Usage	Inadequate Knowledge	All Other	Totals
Informed NP	9 *29%*	19 *61%*	1 *3%*	2 *6%*	31 *100%*
EDRP	13 *41%*	3 *9%*	10 *31%*	6 *19%*	32 *100%*
Totals	22 *35%*	22 *35%*	11 *17%*	8 *13%*	63 *100%*

q53: Which best describes your primary reason for not participating in the DADRP Program?
a) "EDRP" also includes those in EDRP in combination with ICAP.
b) There were no responses from ICAP Only participants.
c) "Penalty is too severe" was cited only 4 times. It is counted in All Other

There were some dramatic differences in the reasons offered by EDRP participants relative to those of informed non-participants. About 58% (19 of 31) of the informed non-participants indicated that operational and business constraints on their ability to shift load were a primary reason for not participating in DADRP. About half that many (9 out of 31) cited inadequate compensation levels for perceived risks as the main barrier. In contrast, EDRP participants, for whom doubts about ability to respond to prices are presumably resolved, most often cited inadequate compensation for perceived risks (41%), followed closely by inadequate knowledge of DADRP program requirements (33%). Apparently, non-participants do not believe that they can shift usage, and therefore dismiss participation out of hand, while EDRP participants are more concerned with the risks associated with what and how they are paid. Additional insight into this question comes from other survey responses, as discussed below.

<u>Customer's relative confidence level in performing activities necessary to participate in DADRP program</u>

Participation in DADRP requires both more active involvement in their electricity usage, as it related to business activity, and knowledge of day-ahead energy markets. Participants must decide whether or not to submit load reduction offers in the day-ahead market and determine the bid strike price at which they are willing to curtail load. PRL audit respondents were asked to rate their comfort level on a scale of 1 (low) to 5 (high) in performing the following activities:

- Creating a load curtailment plan to meet a specific kW reduction target;
- Monitoring day-ahead energy prices to determine whether to bid; and
- Determining at what price to bid.

Table 4-5: Information/Knowledge Barriers

	Creating Curtailment Plan		Monitoring Energy Prices		Determining Bid Prices	
	DADRP	Other	DADRP	Other	DADRP	Other
Not Comfortable	1	6	1	12	1	17
Comfortable	9	14	9	7	9	3
Total	***10***	***20***	***10***	***19***	***10***	***20***

Respondents with a score of three or higher were characterized as being comfortable, those with lower scores as not comfortable. Table 4-5 compares the comfort levels for each activity for 10 DADRP participants and other respondents (19 of 20 are in EDRP or EDRP/ICAP). Ninety percent of DADRP respondents report that they are comfortable performing all three activities, creating a curtailment plan, monitoring energy prices, and establishing a bidding strategy. In contrast, while 70% of non-DADRP respondents are comfortable preparing a load curtailment plan, only 35% are comfortable monitoring day-ahead energy prices, and only 15% report that they are comfortable determining prices at which to bid load curtailments.

These results suggest that EDRP/ICAP participants need additional information, education, and training on preparing and executing bidding strategies in day-ahead energy markets before they will join DADRP. These findings may also indicate that currently most customers are more comfortable participating in PRL programs where they only have to create a curtailment plan, since putting it into action is determined by a third party (i.e., NYISO).

Many customers report high minimum bid price thresholds to participate

PRL audit respondents were asked questions about the minimum price at which they would submit load curtailment bids as well as the amount and duration of a load curtailment. Bid prices ranged between $0.05 to $5.00/kWh, with mean and median values of $0.87 and about $0.50/kWh respectively (Fig. 4-22). About 80% of the 19 respondents indicated that their minimum bid prices was $.20/kWh or higher.

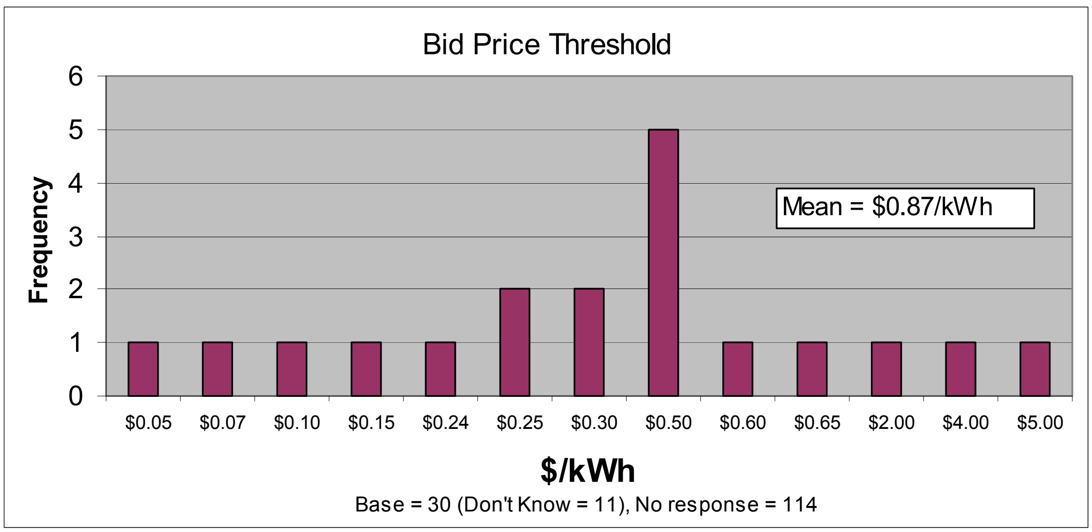


Fig. 4-22: Bid Price Thresholds.

The bid threshold results create a conundrum. The average bid price threshold of $0.87/kWh stated by respondents is over 50% above the EDRP floor price (which in almost every case is also the actual payment level for EDRP curtailments). But, participants in DADRP should require a lower premium than EDRP since curtailments are in effect announced a day in advance, and customers control under what circumstances they can be called upon.[2] However, recall that customers indicated that the major deterrent is uncertainty about the characterization of the NYISO's DAM prices that constitute the benefit stream from DADRP bidding. It may be that this uncertainty is reflected in the relatively high bid price thresholds.

Role of Enabling Technologies

DR-enabling technologies can be grouped into the following categories:

- Electrical metering, monitoring, and information systems,
- Control and automation systems, and
- On-site generation systems.

Each technology, either directly (generation) or indirectly (via improved control) facilitates load management strategies. Metering at the service entrance or end-use sub-metering combined with an appropriate representation of metered data are the most basic services available for effective load management strategies. Process control and energy management and control systems allow the automation of load reduction measures from a central location in the facility. They improve the accuracy and timing of load management at low or no labor cost. The investment requirements of controls, automation, and generation technology vary greatly with the size of the facility and the particular technology of interest.

Some have asserted that the presence of energy information tools and enabling technologies is a necessary condition to elicit sustained customer participation in PRL programs. Such contentions give rise to proposals to increase the floor on guaranteed payment levels for curtailments in order to pay for these technology investments. Others argue that public benefit program funds should be directed at such investments to reduce barriers to participation. Accordingly, the customer survey and PRL audit sought to help clarify the role of technology in demand response program participation.

PRL audit respondents were asked a set of questions about technologies that enable load curtailments/reductions: whether or not respondents performed or received feasibility assessments, major factors that contributed to their decision not to invest in the technologies under consideration, and respondents' perception of other benefits of DR enabling technologies. Of the 22 PRL audit respondents that answered these questions, most reported that they had considered and rejected 1 or 2 enabling technologies. Respondents also reported that they considered or were approached relatively frequently by load aggregators/vendors to install onsite generation equipment (15) or interval meters (12), and that these overtures were mostly rejected. The later result is understandable as an interval meter is required for participation. Asked to

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[2] This is in contrast to NYISO DAM LBMP's being higher than their real-time equivalents because of the risks of committing a day ahead, and one of the reasons why DADRP should be encouraged as it will tend

indicate acceptable payback periods for investments in equipment or controls to facilitate load curtailment, approximately 80% of the respondents indicated that load management investments would have to pay back in three years or less for their firm to be interested. This may explain why DG investment opportunities were eschewed.

PRL audit respondents were then asked to rate the value on a 1 to 5 scale (where 1 is low and 5 is high) of other ancillary benefits that have been identified for DR enabling technologies. Respondents were provided with a table that included enabling technology and list of possible ancillary benefits. Energy information tools ranked highest on average (3.5), while customers average values ranged between 2.2 - 2.9 for other DR enabling technologies: upgrading on-site generation for duel-fuel capability or improved switch gear, enhanced EMCS system, load control, and interval meters with two-way communications (Table 4-6). These ratings suggest that customers do not recognize and/or have not been convinced that DR enabling technologies have significant "spill-over" benefits that can help them manage their businesses better and/or reduce their energy costs.

Table 4-6: Indicated Value of DR Enabling Technology

Technology	Benefit	Mean
1. Interval meters with two-way communication	Better manage peak energy and demand charges with day-after access to facility interval data	***2.78***
2. Load Control	Shed load and/or initiate on-site generation, in order to reduce demand charges	***2.87***
3. Upgrade switchgear for on-site generation	Increase load mgmt. flexibility to modify load profile for more desirable energy procurement	***2.61***
4. Upgrade on-site generation for dual-fuel capability	Fuel flexibility to mitigate fuel price volatility	***2.23***
5. Enhanced energy management or control system	Ability to schedule and/or automate load mgmt., and reduce labor for facility operations, increase reliability to integration with maintenance procedures	***2.97***
6. Energy information tools	View individual and mulitiple facility interval electricity data, increase understanding of loads for lower cost energy procurement	***3.47***

Given the relatively high costs of various technologies that facilitate automated load response compared to expected benefits, if such technologies are critical to participation, then market intermediaries (e.g., load aggregators, controls vendors, performance contractors), perhaps supplemented by public benefit investment funds, will be required to fully develop the demand-response potential. However, the survey results indicate that technology alone is not sufficient. In

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to reduce that spread.

addition to providing financial incentives to buy down the cost of enabling technologies, administrators of public benefit funds need to develop a broad set of informational/educational tools to help make the "business case" for DR investments to senior managers and educate customers on ancillary benefits that can result from installation of DR enabling technology.

Expected Participation Effects of Changing DADRP Rules

Non-participating DADRP customers were also asked whether various changes in DADRP program design or rules (e.g., ability to submit bids to curtail loads on daily, weekly or monthly basis, reduced penalties for non-compliance, information on actual Customer Baseline Load (CBL) prior to submitting bid) would change their decision regarding participation. A relatively small number of respondents (16 or 26%) indicated that they would be more likely to participate in the DADRP if their preferred approach to submitting bids were adopted. Most respondents were unsure (48%) or indicated that it would not influence their choice not to participate (26%) (Fig. 4-23). Survey respondents unmistakably have indicated in many ways that they are uncomfortable with bidding into DADRP. It is not yet possible to sort out the relative influences of factors they cited, although it seems clear that a greater understanding of how customers make productive decisions is needed in order to refine programs so that they are in accord with electricity valuation. Moreover, someone will have to take the initiative to develop educational materials and tools to help customers develop a sufficient understanding or market price formation so that customers can develop and execute a bidding strategy.

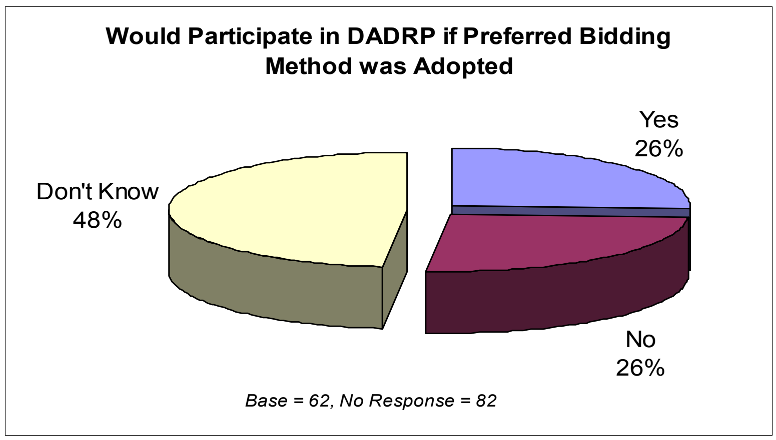

Fig. 4-23: Bidding Method Participation Decision

Summary

We have identified the following factors that in combination contribute to the relatively low participation rates in the DADRP program. These factors include:

- low customer awareness levels;

- inadequate knowledge of DADRP program requirements;
- many customers' belief that operational or business constraints severely limit their ability to shift or curtail loads;
- customer perception that the potential benefits are inadequate to compensate for the perceived risks initial costs;
- customer information and knowledge gaps related to development of effective load curtailment and bidding strategies;
- customer self-reports of high minimum bid price thresholds (>$200/MWh);
- support among some customers for more flexible bidding processes; and
- customer perception that additional benefits of installing DR enabling technologies are limited.

The results of the PRL audit surveys provide considerable insight into why customers are willing to undertake load curtailments under seemingly more restrictive conditions (e.g., shorter notice for both EDRP and ICAP/SCR and a potentially harsh noncompliance penalty for ICAP/SCR) but eschew DADRP bidding under conditions that are analogous to those of successful RTP programs.

Customer EDRP Subscription Levels and Performance

In this section, we analyze factors that may influence EDRP subscription levels and actual event performance drawing from the customer survey results. In particular, we conduct exploratory analysis of varying load reduction strategies, impact of facility size, level of automation in load response, and the extent of energy efficiency investments.

For this analysis, we define a performance index, called the Subscribed Performance Index (SPI), which is the ratio of load reduction actually delivered during events to the load reduction nominated by the customer when they subscribed to the program (see Chapter 5 for more detailed discussion). Formally, SPI is defined as:

$$SPI = (P_{avg} / P_{sub}) \cdot 100\% ,$$

where

$$P_{avg} = \frac{1}{N} \sum_{N}^{t=1} (CBL_t - P_{actual,t})$$

and

N = the number of hours per curtailment event,

$P_{actual,\,t}$ = the facility demand in hour t [MW],

CBL_t = the customer baseline [MW], and

P_{sub} = the load curtailment capability the customers indicated upon subscription.

EDRP Performance Affected by Load Reduction Strategies

Table 4-7 summarizes the subscribed load reduction and actual performance during summer 2002 EDRP events for the 83 program participants that responded to our customer survey (this group includes customers that participated either in EDRP only or in EDRP and ICAP/SCR). The majority (69) of these customers curtailed usage by reducing loads (without utilizing backup or emergency generators). For this group, it is important to note that subscribed and actual performance levels are influenced by the distribution of individual customer results. Most customers reduced their usage by <1 MW, while one large multi-site customer accounted for 92 MW of load reduction (or more than 50% of the load-only subscriber pool).

The average SPI for the load reduction-only customers is 66%, which is surprisingly high compared to the average SPI of only 16% for the 10 customers that relied on onsite generation. Overall, among the population of EDRP participants that utilized onsite generators, SPI values were higher than load reduction-only participants, indicating more reliable performance (see Chapter 5 for more information). Note that several of the 10 customers did not perform during the July 30 and August 14, 2002 events, so the sample size is small).

Table 4-7: Subscription and Performance of Surveyed EDRP Customers

Load Reduction Method	N	Subscribed Load Reduction [MW]				Avg. Performance [MW]	SPI
		Median	Min	Max	Total		
Load-only	69	0.3	0.024	92.0	274.0	179.5	66%
Load + onsite generation	4	1.15	0.5	30.0	32.8	18.0	55%
Onsite Generation only	10	1.1	0.3	3.0	13.4	2.2	16%
Total	**83**				**320.2**	**199.7**	**62%**

EDRP Performance vs. Size of Customers' Facilities

In Fig. 4-24, we show the range in SPI values for customers of different size ranges, as expressed by floor area. Smaller facilities, those between 15,000 ft^2 and 500,000 ft^2 had similar

SPI values, of about 35%. Average SPI values increase dramatically to 50-65% for facilities larger than 500,000 ft^2.

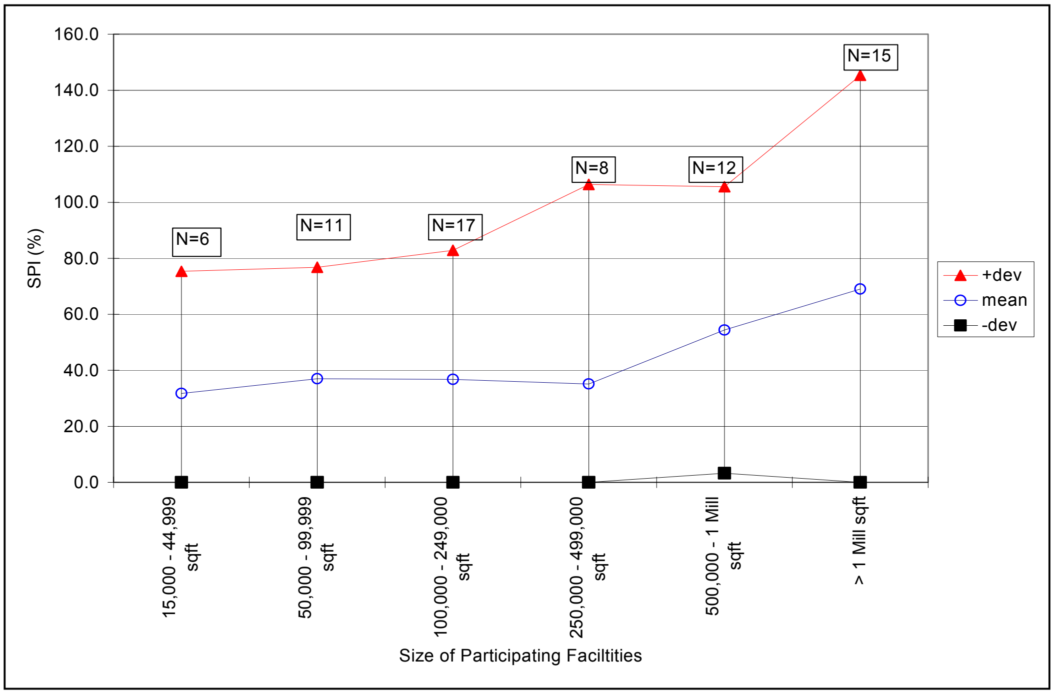

Fig. 4-24: EDRP Performance by Size of Facility Measured in Floor Area

<u>EDRP Performance vs. Level of Automation in Load Response</u>

As part of the survey, customers were asked whether they planned to implement load curtailments manually, semi-automated, or fully automated, with accompanying descriptions of these categories (survey question #28). We hypothesized that participants that implemented load curtailment actions through a semi-automated or fully automated approach were more likely to perform at a higher rate to meet their subscribed load reduction targets than participants that relied on manual approaches.

In Table 4-8, the average individual SPI is defined as the mean value of individual SPIs for each group (manual vs. automated load response), whereas the average overall SPI is defined as the aggregate actual performance divided by the aggregate subscribed MW load reduction for each group. Although the mean values for the sub-group that utilized automated load management strategies are higher compared to group that relied on manual load curtailments (59% vs. 37%), the results are <u>not</u> statistically significant.

Table 4-8: Result of Hypothesis Test on Effect of Automation

Load Management	N	Subscribed Load Reduction [MW]	Actual Performance [MW]	Average Individual SPI [%]	Average Overall SPI [%]
Manual	60	271.9	161.7	36.9	59.5
Automated (semi and fully)	15	46.7	37.0	59.2	79.2

Note: Row for automated load management consists of 13 semi-automated, one fully automated and one with both semi- and fully automated load management. See footnote definition of fully and semi-automated load management[3]. (P-value = 0.14)

EDRP Performance vs. Energy Efficiency Investments

As part of the survey, customers were asked to check off various types of high-efficiency equipment in that they had purchased within the last five years to reduce electricity costs (survey question #31). The hypothesized relationship between customer investments in energy efficiency and EDRP performance is complex. On the one hand, customers that have undertaken significant investments in high-efficiency equipment may have less capability to reduce their usage during system emergencies (e.g., flatter load shape, less inefficiencies in usage). On the other hand, we assume that customer facilities with higher energy efficiency investments have better process control or energy management system infrastructures and a higher awareness of their consumption patterns, which would tend to improve their performance characteristics. On balance, we hypothesized that significant investments in high efficiency equipment would be correlated with improved customer load curtailment performance. We defined "significant" investment in energy efficient equipment as survey respondents that listed three or more categories of high-efficiency equipment purchases (i.e., "energy efficiency upgraders"). Customers that checked less than three categories were classified as "non-energy efficiency upgraders."

[3] Definitions:
semi-automated: Requires the use of EMCS (energy management and control systems) to invoke demand response measures. This could include:

a. remote resetting of one or many thermostats
b. remote turn off of equipment or processes
c. invoking a script or macro established in the EMCS that in turn resets thermostats or turns off equipment or processes

Typically, the facility operator would be notified by a phone call, page, email and then would go to the EMCS to invoke above measures.

fully-automated: Measures that require NO human intervention to be invoked. This could include: direct load control, CSP invokes load reduction, or load reduction measures are pre-programmed in an EMCS and then invoked by an email or pager from CSP without the intervention by facility operator.

We tested the following hypothesis:

Relative to other participants, firms that have upgraded or invested in new load shifting technology in the past 5 years are more likely to have performed at a higher rate during 2002 EDRP event.

Average SPI values tend to increase among customers that listed additional categories of upgrades or purchases of high efficiency equipment (Fig. 4-25), although we found the results not to be statistically significant (Table 4-9).

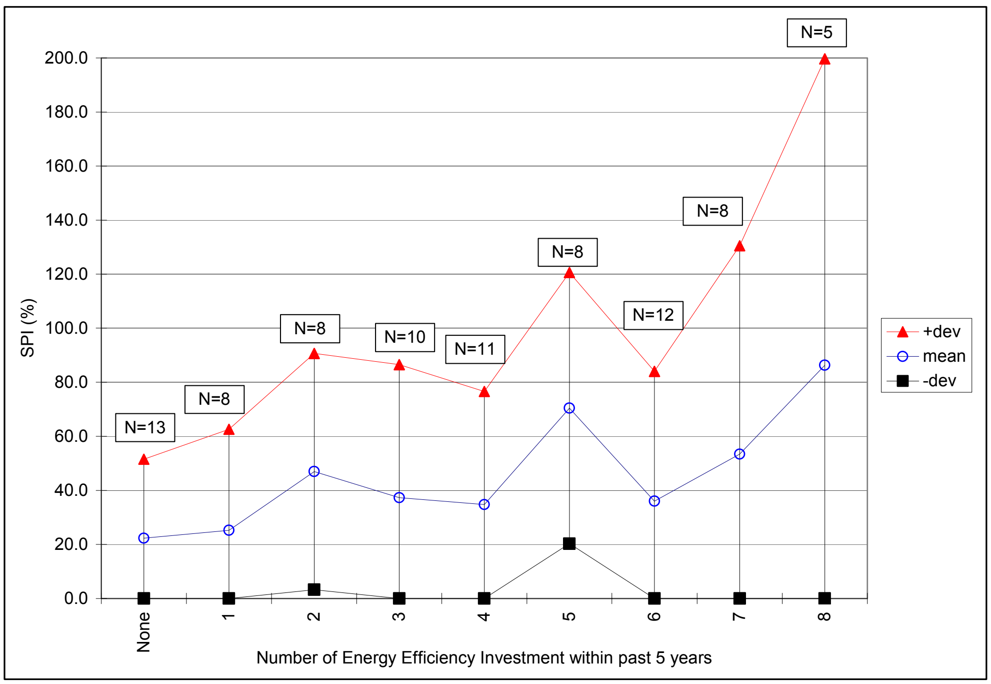

Fig. 4-25: EDRP Performance by Number of Energy Efficiency Investments during the Past 5 Years

Table 4-9: Result of Hypothesis Test on Effect of Energy Efficiency Investments

Investment	N	Subscribed Load Reduction [MW]	Actual Performance [MW]	Average Individual SPI [%]	Average Overall SPI [%]
Non-investors	56	149.8	68.2	46.9	45.5
Investors	27	170.9	131.5	31.5	77.0

Relationship between EDRP Performance and Specific Load Curtailment Strategies

We also conducted exploratory analysis of the relationship between customer performance during EDRP events and the specific load management strategies that customers employed based on a list of ten actions checked by survey respondents. We hypothesize that more predictable performance can be achieved by utilizing on-site generators or by shutting off entire industrial processes compared to other strategies that involve various buildings-related measures (e.g., turn off or dim lights, increase indoor temperatures, reduce plug loads).

We grouped customers into three classes of performers: high, medium, and low performing customers, defined as:

- Low performer: $0\% \leq SPI < 33\%$
- Medium performer: $33\% \leq SPI < 66\%$
- High performer $66\% \leq SPI$

Fig. 4-26 shows the frequencies of load management strategies used for the low, medium, and high performers. Customers within the high and medium performer groups utilize the 10 load management tasks almost equally often. The low performers indicate a high relative contribution of three strategies: 1) increase indoor temperature, 2) turn off or dim lights, and 3) alter major production processes. Two of these strategies ("turning off or dim lights" and "increasing indoor temperature"), if not controlled centrally, require the active participation of facility workers and building occupants, who need to be informed about the emergency and when it occurs. For low performers, the frequency of communication with employee/occupants strategy is significantly less than that of the thermostat reset or light dimming strategy. This could be indicative of a lack of notification and/or awareness of building occupants among this group, which are linked to the effectiveness of these strategies.

The high performer group utilizes a broad range of load reduction strategies. No one single strategy is predominant among our sample, which reflects the heterogeneity of EDRP program participants and load reduction strategies among commercial and industrial customers.

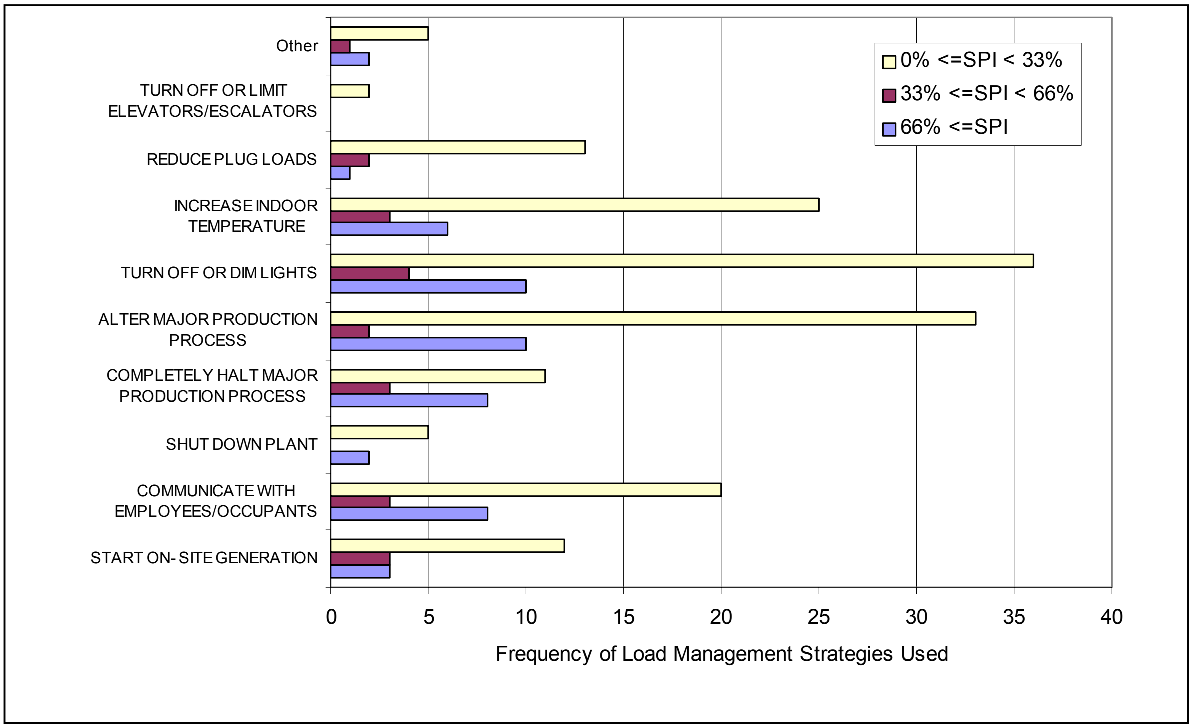

Fig. 4-26: Load Management Strategies Used by high, medium, and low Performance Groups

Factors Affecting Firms' Decisions to Participate in NYISO's Electricity Price Responsive Load Programs and their Valuation of Program Features

Introduction

As in the 2001 PRL program evaluation, we have collected data through a customer survey to gain a better understanding of why some customers participate in the NYISO PRL programs and others do not. To understand enrollment decisions, we need to study the characteristics of participants in order to find patterns that lead to identifying good candidates for program participation and to find out how customers value alternative program designs.

Through a statistical analysis of the data collected in Part I of the Customer Acceptance Survey, this chapter explores those customer characteristics, and actions by New York state agencies, market participants, and other institutions, that affected a firm's decision to participate or not to participate in NYISO's PRL programs this past summer (2002). This analysis is concerned with the "revealed" preferences of customers regarding their decisions to participate in the NYISO programs. Analysis of "revealed" preferences is the mainstay of much economic analysis of consumer and firm behavior (McFadden, 2001). For the 2001 evaluation (Neenan Associates, 2002) it was only possible to model firms' binary decisions to participate in EDRP vs. no PRL program participation. This year, due to an expanded survey instrument design, we are able to model more complex choices: the decision to participate in DADRP and one or both of the PRL emergency programs (EDRP and/or ICAP/SCR), the decision to participate in EDRP or both emergency programs, or the decision not to participate in any PRL program.

Part II of the Customer Acceptance Survey involved a "conjoint" survey designed to solicit customers' "stated" (in contrast to "revealed") preferences for different program characteristics or features. These are "stated" preferences because customers are asked to make choices amongst contingent or hypothetical options regarding new products or programs.[4] To

[4] "Stated" preference models are an outgrowth of the "conjoint" methods developed in the 1970's. A good summary of the methods and applications of conjoint analysis is given by Louviere (1988). These and more recent advances in "stated" preference models have been used extensively in marketing and transportation research, and more recently to examine preferences and values for public or environmental goods not traded in organized markets. See for example, McFadden (2001), Louviere (1988), and Hanley, *et al*. (1998) for discussions of the evolution of these methods. Goett, *et al*. (2000) in an unpublished paper also try to value service attributes from retail energy suppliers. Other applications include studies of how customers value electric service features by Long, *et al*., (1998), and Wood, *et al*., (2000).

place relative values on program features that differ from those available in the summer of 2002, a second discrete choice model was estimated using this "conjoint" survey information. These results provide a measure of the relative contribution of features to the value of participation, and thereby provide a means by which to assess programs different from the current ones . In addition to assigning values to alternative program features, the results of this second model can be used to forecast the odds of program participation due to changes in program design, a capability that has proved useful in evaluating proposed program redesign.

Each of the models is discussed separately below. The theoretical underpinnings of each are presented along with a discussion of the estimation procedures. A summary of the data used in each analysis is provided along with the estimated results, their interpretation, and their implications for policy. Where appropriate, we contrast these results with those of the 2001 evaluation (Neenan Associates, 2002).

Statistical Analysis of Customers' "Revealed Preferences"

As stated above, a major objective of this analysis is to gain a comprehensive understanding of those factors contributing to the supply of load reduction resources available to the New York State electricity market. This supply of resources is the sum of what is offered by individual firms. An important part of this determination is related to customers' decisions to participate in these programs. These decisions are clearly affected by the particular PRL program features, the types of customers throughout the State, market conditions, and any policy instruments in place to promote customer participation. In what follows, we examine specifically firms' decisions to participate in both the emergency programs (EDRP and ICAP/SCR) and the day-ahead program (DADRP). In this way, we are able to extend last year's analysis, which was limited to decisions whether or not to participate in EDRP.

Modeling the Decision to Participate in Current PRL Programs

Before specifying the empirical model of the decision to participate in the NYISO's PRL programs, we must outline a conceptual model and discuss some issues in estimation. We can appeal to a general set of discrete choice models that are most often cast in the form of an index function or random utility model (Greene, 1990). From a statistical standpoint, the discrete choice model is assumed to manifest some theoretically consistent underlying behavior. In this analysis, we are concerned with unordered choices from a set of three or more options, for example, the choice of which shopping centers to do holiday shopping, the choice of modes of travel (e.g. car, train, bus, plane) to visit family over the holidays, or, as in our case, whether to participate in an emergency PRL program, participate in both an emergency and a day-ahead PRL program or not to participate in a program at all.

According to the underlying theory, the choice is based on the individual's or firm's marginal benefit—marginal cost calculation. If the net benefits of making a particular participation decision, net consumer utility or a firm's net income or utility of net income, are positive, then it is assumed that the decision is to participate in that particular program or combination of programs; otherwise, participation is eschewed.

The unordered multiple choice modeling problem is a challenging one because, regardless of the consumer's or firm's decision, we can never actually observe the marginal benefit, only the action consistent with that benefit. In economic terms, the marginal benefit is embodied in the notion of a consumer's or firm's utility, which is difficult, if not impossible to quantifiable in any meaningful way. Therefore, it is necessary to treat the difference between the marginal benefit and the marginal cost of the decision as an unobserved variable, the i^{th} individual's utility of choice j. Thus, for the i^{th} individual faced with J choices, suppose that the utility of choice j is given by:

(1) $U_{ij} = \beta' Z_{ij} + \varepsilon_{ij}$,

Z_{ij} = is a vector of program features and/or customer characteristics where the program feature level include those of the programs currently available and additional values representing alternative program designs;

β' = vector of parameters to be estimated; and

ε_{ij} = an error term.

Following Green's (1990, pp. 695-700) discussion, we will assume that if the individual (or firm) makes choice j, then the utility of that choice U_{ij} is the maximum among the utilities for all other possible choices. Consequently, the statistical model representing this situation can be represented by the probability of that choice, which is:

(2) Prob $[U_{ij} > U_{ik}]$ for all other $k \neq j$.

To make the model operational, we must choose a distribution for the disturbances ε_{ij}, and since the multivariate probit model involves evaluating multiple integrals of the normal distribution, it is of limited use here. However, as McFadden (1973) has shown, if the J disturbances are independently and identically distributed (*iid*) with a Weibull distribution, then, if Y_i is the random variable indicating the choice made, we have:

(3) $\text{Prob}\,[Y_i = j] = e^{\beta' jZij} / \sum_j e^{\beta' Zij}$,

which is called a conditional logit model.[5] In (3), Prob [Y_i = j] is the probability of choice j from the set of alternatives considered.

In this model, utility can be assumed to depend of Z_{ij}, which includes characteristics of the individuals or firms (i) and of the choices (j) as well. It can be useful to distinguish them as Z_{ij} = [X_{ij}, W_i], where W_i are characteristics that are common to all decisions

Thus, the model becomes:

(4) $\text{Prob}\,[Y_i = j] = e^{\beta' jXij + \alpha' Wi} / \sum_j e^{\beta' jXij + \alpha' Wi}$

The terms that do not vary across alternatives (the W_i) now fall out of the probability calculation. One way to deal with this problem is to create dummy variables for the choices and multiply them by the common firm or individual characteristics, W. Since we are primarily interested in identifying the important firm characteristics that affect participation in PRL programs, we use this convention extensively in the empirical specification below.

The model for PRL program choice (no program [0], in one or both emergency programs [1], and in an emergency program plus the day-ahead program [2]) can be formulated for the choice set (j = 0, 1, 2,) as follows:

(5) $\text{Prob}\,[Y_i = j] = e^{\beta' jZij} / \sum_{j=0,1,2} e^{\beta' jZij}$

For these j + 1 choices, there is an indeterminacy in the model (Greene, 1990) that can be resolved by a convenient normalization on the no-choice option [0]:

(6) $\text{Prob}\,[Y_i = j] = e^{\beta' jZij} / \sum_{j=1,2} e^{\beta' jZij}$ for j = 1, 2

(7) $\text{Prob}\,[Y_i = 0] = 1 / \sum_{j=1,2} e^{\beta' jZij}$

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[5] This conditional logit model suffers from what is called the independence of irrelevant alternatives (IIA), in that the ratio of the probabilities of any two alternatives is always independent of the other choice probabilities. Although this is not an appealing restriction to place on choice behavior, it is not a particular problem in this application because all firms are given the same 20 choice sets from which the choices are to be made (Allison, 1999). The IIA assumption, as it is called, can only be tested if some sample members have different choice sets (Allison, 1999, pp. 167-68), so in this case, there is no way to test for any bias.

It can further be shown that the estimated coefficients can be used to calculate the log of the odds ratios between j and the no-choice option.[6] These are given by:

(8) $\ln [P_{ij} / P_{i0}] = \beta'_j Z_i$,

where P_{ij} is the probability of choice I relative to choice J. We can normalize on any other probability by recognizing that:

(9) $\ln [P_{ij} / P_{ik}] = Z_i (\beta'_j - \beta'_k)$.

Model Estimation

Since this multinominal logit model has a dichotomous dependent variable, the choice model takes on a value of 0 or 1 or 2, it is only possible to estimate the coefficients of the model using weighted least squares (if there are grouped data) or maximum likelihood (ML) procedures (Allison, 1999 and Greene, 1990). Since we have do not have grouped data, we use the ML methods based on the Newton-Raphson algorithm. The ML method involves two steps: 1) construct the likelihood function, which is the expression for the probability of the data as a function of the model's unknown parameters, and 2) estimate parameter values, typically through an iterative numerical method, that maximize the value of the likelihood function. The CATMOD procedure in SAS is an effective way to do this estimation.[7]

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[6] Allison (1999) argues that it is helpful to place it into context with the notion of odds and odds ratios as a means to quantify the chances of an event occurring, rather than in terms of the event's probability. The probability of an event occurring is bounded between zero and one. In contrast, the notion of odds is one used in many games of chance—the odds of an event is the ratio of the expected number of times an event will occur to the number of times it is expected not to occur. The relationship between odds (O) and probabilities (p) is: $O = p / (1 – p)$ = [probability of event] / [1 – probability of event], and $p = O / [1 + O]$.

Thus, if the odds are less than 1, the probability of the event is less than 0.5. Because of this simple relationship between odds and probability, one can always derive one from the other, and thus the probability model above can be couched in either way. The major advantage for using the odds (or the odds ratio) in comparing the likelihood of two events is that neither the odds of one event nor the odds ratio between two events occurring is bounded between zero and one. Thus, by transforming the probability to an odds and then taking its logarithm, we can remove both the upper and lower bound on the variable of interest.

Although Allison's argument is couched in terms of a binary choice model, the same principles apply to a multiple-choice model where the odds ratios apply to the ratios of the probabilities of any two of the choices. In this case, it is not so easy to derive the individual probabilities from the odds themselves.

[7] Maximum Likelihood estimators are used widely because of their good large sample properties (Allison, 1999). Most econometric texts (e.g. Greene, 1990, and Maddala, 1983) discuss these properties, and under quite general conditions, ML estimators are consistent, asymptotically efficient, and asymptotically normal.

The Empirical Specification of the Decision Model of PRL Program Participation

The data used to specify this model empirically comes from Part I of the Customer Acceptance Survey administered to New York electricity customers by Neenan Associates as part of the 2002 evaluation of NYISO's price responsive load programs. There were a total of 144 usable responses to the survey, which asked customers to provide, among other things, information about their participation in PRL programs, how they learned about the programs, their understanding of the programs, and characteristics about their business operations that might be related to their decision to participate in either ICAP/SCR, EDRP, or DADRP.[8] A complete description of the survey methodology and a summary of the descriptive data for all respondents are provided in Chapters 2 and 3.

Of the 144 respondents, 58 (40.3%) are participants only in EDRP; another 16 (11.1%) participate in both ICAP/SCR and EDRP (Table 4-10). A total of 11 respondents are enrolled in DADRP; 4 of them are also in EDRP, while the remaining 7 are also in both ICAP/SCR and EDRP. The remaining 59 (41%) of survey respondents are in none of the three PRL programs (Table 4-10). They represent the population of customers that were contacted about PRL participation in 2002, but chose not to participate in any program.

As stated above, we define three categories of respondents for the purposes of our analysis. We designated non-participants as one group (59 respondents or 41% of the total). A second group includes those customers enrolled in at least one of the two emergency programs (EDRP or ICAP/SCR), or both (74 respondents or 51% of the total). The final group includes those respondents in DADRP (11 respondents or about 8% of the total); these individuals are treated separately to identify specific, distinguishing characteristics that affect participation in DADRP. However, it must be acknowledged that all respondents in DADRP are also in EDRP or EDRP and ICAP/SCR. Thus, our model in a sense is trying to identify factors that explain participation in only emergency programs vs. joint participation in day-ahead and emergency programs.

In specifying the empirical model, we classified factors affecting participation into several general categories: a) those that represent the customer's load profile, b) those that characterize the nature of the firm's production processes, c) those that reflect past experience

[8] The survey is included as an appendix of the report.

with load management programs, and d) those that measure the usefulness of the information they received about the program prior to their decision to join. This categorization resulted from preliminary analysis of the data. There are a number of questions in the survey that are related to each of these categories, and a number of models were estimated using a subset of variables to comprise each of these categories. Some of the several variables within each category were understandably correlated with one another. In these cases, it was impossible to statistically isolate the separate contributions of each of these variables on the program participation decision. For this reason, the final model specification included only one or two variables in each of the five categories.

All the variables in the model relate to firm characteristics, and are zero-one categorical variables, as follows:

- Access = 1, if the firm answered "yes" to one or more of the survey questions asking if it had ready access to real-time load information, CBL level, etc., = 0, otherwise.
- Attend_show =1, if the firm attended one of the 2002 PRL program informational meetings sponsored by the PSC, NYSERDA, etc., = 0, otherwise.
- Gen = 1, if the firm had on-site generation to meet PRL load response commitments, = 0, otherwise.
- Lse_pgms = 1, if the firm has had previous experience with an LSE's load management program.
- Manufact = 1, if the firm is a manufacturing firm, = 0, otherwise.
- Nyserda =1, if the firm is participating in a NYSERDA PON, = 0, otherwise.
- Peak_12_4 = 1 if the firm has its peak electricity demand between noon and 4:00 pm, = 0, otherwise.

The Empirical Results

The results of the estimated multinominal logit model are in Table 4-11. The overall performance of this model is very good, as seen in the left-hand section of Table 4-11 labeled

"Global Analysis of Variance",[9] where all but two of the variables, gen and peak_12_4, are globally significant at least at the 10% level. The very high p-value (0.9885) for the likelihood ratio test also suggests a very good fit overall.

The estimated coefficients of the model are reported in the right-hand section of Table 4-11. Each variable has two coefficients associated with it. The first reflects the effect of that variable on the log-odds ratio of participating in DADRP & Emergency Programs vs. No Program, and the second reflects the effect of that variable on the log-odds ratio of participating in Only an Emergency vs. No Program. The effect on the log-odds ratio of participating in the third program combination (DADRP & Emergency Programs vs. Only an Emergency Program) is then calculated according to equation (9) above. From Table 4-11 we can see that 11 out of the 16 coefficients are significant at least at the 0.05 level. Many variables have a significant effect on the log-odds ratio comparing the probabilities of one program combination, but not another, for example gen and attend_show.

To facilitate interpreting the results, we convert the log-odds ratios to odds ratios. We do this in Table 4-12, and some of the results are striking. If the odds ratio is greater than unity, the probability of being in the first program for the comparison listed in a particular column of Table 4-12 is greater than the probability of being in the second program choice listed in the particular column of the table.

There are several important highlights from Table 4-12 that should be underscored. They include:

- If a firm has ready access to real-time load information, etc., it is nearly 12 times (11.87) more likely to be in DADRP and an emergency program than in no program at all (Table 4-12, column a), and 6.05 times more likely to be in both DADRP and at least one emergency program than in just one or more emergency program (Table 4-12, column e).
- Based on the model results, it is clear that the informational meetings helped firms make appropriate decisions about participating in the NYISO PRL programs. For example, if

[9] In the section of Table 4-2 labeled Global Analysis of Variance, the chi-square statistics are actually Wald statistics, except for the last line (Allison, 1999). Each Wald statistic tests the null hypothesis that the explanatory variable has no effect on the outcome (participation) variable. For these tests, a low p-value suggests that the variable has a significant effect on the outcome variable. The likelihood ratio test on the last line of this section of output in Table 4-2 is equivalent to the deviance statistic and is equal to twice the positive difference between the log-likelihood for the fitted model and the saturated model.

firms attended an informational meeting in 2002, they are *less* likely to be in an emergency program than in no program (odds ratio of 0.16 from column c, Table 4-12). However, if they are EDRP participants, they are more than three times more likely to be in both DADRP and an emergency program than just in an emergency program (odds ratio of 3.32 from column e, Table 4-12). Together, these imply that attending a briefing had a stronger influence on customers inclined to participate in an emergency program that to participate in DADRP.

- If a firm has on-site generation to meet PRL load response obligations in an emergency program, it was over three times more likely to be in EDRP and/or ICAP/SCR than in no program at all (odds ratio of 3.07 from column c, Table 4-12).

- Since a firm cannot use on-site generation for DADRP, we gain some added confidence in the model results because the model predicts that firms with on-site generation are *much less* likely to be in both DADRP and an emergency program than in either "just an emergency program" (odds ratio of 0.30 from column e, Table 4-12).[10]

- Firms with prior experience in an LSE's load management program are 1.7 times more likely to participate in an emergency program than in no program. (column c, Table 4-12).

- However, firms with prior experience in load management programs are over 9 times more likely to be in at least one of the two emergency programs and DADRP (odds ratio of 9.06, column a, Table 4-12), and they are 5.32 (column e, Table 4-12) more likely to be in at least one emergency program and DADRP than in just an emergency program.

- Manufacturing firms are 5.58 (column c, Table 4-12) times more likely to be in an emergency program than in no program, and if they are PRL participants, they are 14.76 (column e, Table 4-12) times more likely to be in both emergency programs and DADRP than in just an emergency program.

- The model predicts that manufacturing firms are over 80 times more likely to be in at least one emergency program and DADRP than in no program (odds ratio of 82.31, column a, Table 4-12). While this is an important result, this very high odds ratio probably has as more to do with the particular nature of sample respondents than the

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[10] It is also not surprising that this coefficient is statistically insignificant.

nature of all manufacturing firms. That is, the types of manufacturing firms finding little possible value in these PRL programs may have not been sufficiently interested in learning more about the programs, as a result decided not to attend a briefing, and therefore were not included in the informed non-participant sample frame. They may also have just not completed the survey questionnaire.

- As one would expect, participants in a NYSERDA PON were much more likely (odds ratio of 66.36, column c, Table 4-12) to participate in an emergency program than no program at all, and they were also more likely (odds ratio of 33.19, column a, Table 4-12) to participate in both DADRP and an emergency program. Accordingly, the model also predicts that firms in a NYSERDA PON are *less* likely to be in both DADRP and an emergency program than in just an emergency program (odds ratio of 0.50, column e, Table 4-12).
- Firms with peak loads during the afternoon hours (noon to 4:00 pm.) are 2.36 (column c, Table 4-12) times more likely to be in an emergency program than in no program, and 3.04 (column a, Table 4-12) times more likely to be in an emergency program and DADRP.

Modeling Customers' "Stated" Preferences for PRL Program Features

The modeling of the "stated" preferences of customers for PRL program features can also be accomplished within a random utility formulation. This analysis was facilitated in Part II of the Customer Acceptance Survey by having respondents make several choices from among four PRL programs, with each choice indicating different values for five program features, and a "no program" alternative.[11] Survey respondents were asked to indicate their preference on each of twenty such choice sets.

The Choice Model

As above, we model this choice situation as though the i^{th} customer is faced with J choices, and the utility of the choice j is given by:

[11] A copy of the survey instrument is provided in the appendix to Chapter 2. The features used in the choice sets represent the major PRL program characteristics. The range in values used in creating the choice sets reflect those ascertained by the research team as feasible, given NYISO's operating procedures and market rules.

(10) $U_{ij} = \beta' Z_{ij} + \varepsilon_{ij}$.

where

U_{ij} = the utility of customer i making choice j;

Z_{ij} = is a vector of program features and/or customer characteristics where the program feature level include those of the programs currently available and additional values representing alternative program designs;

β' = vector of parameters to be estimated; and

ε_{ij} = an error term.

If the customer chooses program j, then it is assumed that U_{ij} is the maximum of the utilities for all the J alternatives. The statistical model is driven by the probability that choice j is made:

(11) Prob $[U_{ij} > U_{ik}]$ for all $k \neq j$.

This indicates the probability that the utility of choice j for individual i is greater than the utility of any other choice k.

To make this model operational, we again must make an assumption about the distribution of disturbances, ε_{ij}. Following McFadden (1973) and Greene (1990), we let Y_i be a random variable for the choice made. It can be shown that if (and only if) the disturbances are independent and identically distributed according to a Weibull distribution, then

(12) $F(\varepsilon_{ij}) = \exp(-e^{-\varepsilon ij})$,

and we can express the probability of choice j by individual i (Prob $[Y_i = j]$) as:

(13) $\text{Prob}\,[Y_i = j] = \exp\,[\beta' Z_{ij}] \,/\, \{\Sigma_j\,[\exp \beta' Z_{ij}]\}$,

which is called the conditional logit model.

In this conditional logit model, utility (as expressed through the choice made) is assumed to depend on both characteristics of the choices considered and the firm's characteristics. It is helpful, therefore, to distinguish between the two sets of factors. $Z_{ij} = [X_j + W_i]$, where the former, X_j, are the variables that characterize program features, and the latter, W_i, are firm characteristics. The model now can be written more explicitly as.

(14) $\text{Prob}\,[Y_i = j] = \exp\,[\beta' X_j + \alpha' W_i] \,/\, \{\Sigma_j\,[\exp\,(\beta' X_j + \alpha' W_i)]\}$

In this formulation, the alternative choices that are explicit to the firm making the decision fall out, because while a firm makes 20 decisions as part of the survey exercise, and those choices reflect differences in program features, its firm characteristics do not vary from choice to choice, and they do not vary even across the several data observations that must be constructed for each choice set. This will lead to singularities in the data matrix if estimation is attempted in this form. Therefore, if these factors are to be in the model, the model must be modified. An effective modification is to create a set of dummy variables for the choices and multiply each by the common W_i set of firm characteristics (Greene, 1990).[12]

This modeling strategy was used extensively in the revealed preference model above. However, there are two reasons why it is used only to a very limited extent in this "stated" choice application. First, in contrast to the revealed choice analysis which focuses primarily on decisions to participate in existing programs, the primary focus of this "stated" choice analysis is to understand how program features affect participation. Second, due to the greater complexity of the choices available and the smaller number of respondents completing part II of the survey, the only firm characteristic modeled was whether or not the firm is a current EDRP participant. This is a similar specification to last year's analysis (Neenan Associates, 2002), thus, facilitating comparisons with last year's results.

The resulting model, as in the case of the model above, is estimated by the method of maximum likelihood, in this case estimating the model in SAS using PROC PHREG.

The Empirical Specification

The key to understanding the empirical specification of the conditional logit model is to discuss explicitly what is in ($\beta' X_j + \alpha' W_i$). In contrast to other applications, each of the programs in the choice sets are characterized exclusively by five separate program features, each

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[12] Because all firms are given the same 20 choice sets from which the choices are to be made this application conditional logit model also suffers from what is called the independence of irrelevant alternatives (IIA), in that the ratio of the probabilities of any two alternatives is always independent of the remaining probabilities (Allison, 1999). The IIA assumption, as it is called, can only be tested if some sample members have different choice sets Allison, 1999, pp. 167-68), so in this case too, there is no way to test for any bias.

of which can assume one of four separate values. These features include (the units are in (), and the specific values used to construct the individual choices are in { }):[13]

1. Payment level ($/kWh) { 0.10, 0.25, **0.50**, 0.75 }, what participants are paid for curtailments;
2. Penalty (multiples of payment) { **0**, 0.1, 0.25, 0.50 }, the amount participants pay if they fail to comply when called on to do so;
3. Start Time { 11am, 12noon, **1pm**, 2pm }, when the curtailment begins;
4. Notice (prior to curtailment) { 30 min., **2 hrs**, 4 hrs, noon day-ahead }, the length of time prior to the event that customers are notified that they will have to curtail; and
5. Event Duration { 1hr, 2hrs, **4hrs**, 30 min }, how long the curtailment event lasts.

Each of these values for the program features was assigned a dummy variable [0,1] for inclusion in the model. Since it is necessary to eliminate one of the dummy variables from each of the features so that the data matrix is non-singular, we eliminated the variable associated with the values in bold above. In this way, the empirical results are normalized on the base program, which consists of a payment of $500/MWh, no penalty, a 1:00 pm start time, a 2-hour notice and 4-hour event duration. For convenience of interpretation, the base program was chosen to resemble the current EDRP configuration.

For the two reasons outlined above, the only firm characteristic included in the empirical estimation is a dummy variable indicating if the firm is a participant in EDRP. To capture this firm effect, the other variables for program features were multiplied by this one firm-level dummy variable to create the necessary interaction variables.[14]

The specification of the linear function ($\beta' X_j + \alpha' W_i$) can now be given as:

$$(15) \quad \{ \Sigma_{k=1,2,4}\, \beta_{1k}\, PAY_k + \Sigma_{k=2,3,4}\, \beta_{2k}\, PEN_k + \Sigma_{k=1,2,4}\, \beta_{3k}\, ST_k + \Sigma_{k=1,3,4}\, \beta_{4k}\, NT_k$$

$$+ \Sigma_{k=1,2,4}\, \beta_{5k}\, DUR_k \} + \{ \Sigma_{k=1,2,4}\, \alpha_{1k}\, PAY_k\, (EDRP\text{-}DUM)$$

[13] The values of these program payments are somewhat different from those used in the 2001 evaluation. In 2001, the alternative payment levels were set at { **0**, 1, 1.5, 2 } (see Neenan Associates, 2002). Also the 30-minute notice in 2002 replaced the 15-minute notice in the 2001 evaluation, and the 30-minute duration in 2002 replaced the 8-hour duration of a year ago.

[14] By specifying the model in this way, we also obtain a natural test of the hypothesis that the effects of the various characteristics on program choice are not different for EDRP participants and non-participants.

$+ \sum_{k=2,3,4} \alpha_{2k}\, PEN_k\, (EDRP\text{-}DUM) + \sum_{k=1,2,4} \alpha_{3k}\, ST_k\, (EDRP\text{-}DUM)$

$+ \sum_{k=1,3,4} \alpha_{4k}\, NT_k\, (EDRP\text{-}DUM) + \sum_{k=1,2,4} \alpha_{5k}\, DUR_k\, (EDRP\text{-}DUM) \}$

$+ \gamma\, (NO\text{-}CHOICE) + \gamma\, (NO\text{-}CHOICE)\, (EDRP\text{-}DUM).$

The last two terms in the specification assign a value to the "no-program" choice option that was included in each of the 20 choice sets given to customers.

The Values for PRL Program Features

To begin the discussion and as seen in Table 4-13, 69 survey respondents answered the conjoint survey (Part II of the Customer Acceptance Survey). Of that number, 34 are participants in only EDRP; 9 participate in both ICAP/SCR and EDRP. There are also 8 respondents in DADRP; and of these, 2 are also in EDRP and the remaining 6 are also in both ICAP/SCR and EDRP (Table 4-13). Finally, 18 of the respondents are non-participants.

In responding to the 20 choice sets, the non-participants preferred no program over participation an average of 7.5 times out of the 20 choice sets they evaluated. The range of responses was from 0 "no-program" choices to 20 "no-program" choices (Table 4-13). In contrast, the participants only in EDRP selected the "no-program" choice an average of only 6.5 times, and the maximum number of "no-program" choices was 20. The participants in both ICAP/SCR and EDRP selected the "no-program" choice an average of 11.7 times, and the maximum number of "no-program" choices was 17.

Although differences in these summary responses between participants and non-participants are not as dramatic as they were last year,[15] we still estimated the model for the two groups to see if they value the program features differently.[16]As is seen below, the similarity in responses across groups leads to smaller differences in the values for program features between the subgroups of respondents than was seen last year (Neenan Associates, 2002).

[15] It is difficult to know why this is so, but part of the explanation is perhaps because this was the first year that some of the respondents participated in any PRL program. The first-year participants may find slightly less value in the programs (even though they are enrolled) than firms that have been enrolled since 2001. Thus, they may value particular program characteristics somewhere in between non-participants and participants in the program for a second year.

[16] There were not sufficient DADRP participants to treat them as a separate group in the analysis.

The results of the estimated conditional logit model are in Table 4-14. Again the overall performance of this model is very good. The joint tests of all the coefficients being equal to zero are rejected soundly, as shown in the bottom right box of Table 4-14. Regarding the specific parameter estimates, the coefficients on payment and penalty for non-participants are statistically significant as well. However, many of the interaction terms for the program participants are not statistically significant, except for some of the interaction variables for notice and duration.

Thus, despite the good overall performance of the model, there is less evidence than in the 2001 evaluation (Neenan Associates, 2002) that participants and non-participants value these program features differently. However, even though many coefficients are not significant, they are left in the model. This was done for two reasons. First, by doing so, we do obtain a value for the individual feature value, which is in most of those cases very small. Second, and perhaps equally important, by leaving them in the model, we do not run the risk of introducing bias into the other coefficient estimates if these variables happen to be correlated with the ones that might be dropped.

In interpreting these results, we can think of the "base" program (which can be viewed as EDRP) as yielding an average utility of zero. This normalization is convenient because in estimating a model in which dummy variables are used to indicate different levels of program features, it is necessary to eliminate one set of program features. Further, since utility measures are always relative, the results and relative comparisons for programs differently configured are independent of this reference point, and it made sense to make this "base" case mimic EDRP. Thus, if the coefficient on the particular value of a feature is positive, then, *ceteris paribus,* it is preferred to the "base" program feature since it is above the reference level of zero. If the coefficient is negative, then the reverse is true. In Fig. 4-27 through 4-36, the relative feature values are graphed for the two sub-groups of respondents. For purposes of comparison, the figures also contain the values from the 2001 evaluation (Neenan Associates, 2002). Again, in all cases, these program feature values are relative to the "base" features: a $500/MW payment, a zero penalty, a 1:00 pm start time, a 2-hour notice, and a 4-hour event duration.

In Fig. 4-27 through 4-36, several striking relationships are revealed by comparing the value of features across the two sub-groups and across years:[17]

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[17] Some care must be taken when interpreting the results because some of program feature values are different between the two survey years.

- For 2002, the relative utility of the smallest payment rate is just slightly lower for PRL participants than for the non-participants. The utilities for the highest payment rate are about the same for both groups (Fig. 4-27 and 4-28). Clearly, the level of payment is very important for both groups in deciding whether or not to participate in the PRL programs, but differences between them are small.

- In sharp contrast, the 2001 results suggested that the relative utility of the smallest payment rate was substantially lower for EDRP participants, but higher for the largest payment rate (Fig. 4-27 and 4-28).

- As was the case in 2001, the dis-utility of the penalty is more pronounced for 2002 PRL participants than for non-participants (Fig. 4-29 and 4-30).

- Compared with last year, the dis-utilities of the penalty fall less rapidly as the penalty rises for both groups of 2002 respondents (Fig. 4-29 and 4-30). This result is explained in part by the fact that the 2002 survey reflected smaller penalty rates. These rates were changed for the 2002 survey because from last year's survey some respondents appeared to have some difficulty in understanding the penalty. However, given this year's results, it appears that this was not the case.

- For 2002 respondents, non-participants place a higher value on start times either earlier or later than 1:00 pm (Fig. 4-31 and 4-32). Participants, on the other hand, seem to prefer later start times, suggesting that participants see a reduction in outage costs of load curtailment if the events begin later in the afternoon.

- There is a general preference for a longer notice period by 2002 respondents currently participating in a PRL program (Fig. 4-33 and 4-34). They clearly placed negative values on notice periods of less than an hour. There was substantial consistency in this regard relative to last year, but this year the 30-minute notice carried a smaller negative value this year than the 15-minute notice did in last year's survey. In contrast to last year, however, PRL participants responding to this year's survey placed a high value on the day-ahead notice. It may be EDRP participants have come to value greater notice since under this year's provisions, EDRP and ICAP/SCR were called coincidently, and ICAP/SCR provides a 24-hour notice of the intent to curtail, followed by a two-hour advance announcement of the actual event.

- In contrast to last year, where non-participants placed an increasing value on length of notice, there was no significant difference between the value of the base notice and any other notice time for this year's non-participant respondents (Fig. 4-33 and 4-34).
- As with 2001, there is a general preference for longer durations by PRL participants. (Fig. 4-35 and 4-36). Both sub-groups assigned the highest levels of dis-utility to the 30-minute duration.
- In both years, non-participants seemed to prefer either very short or very long durations; they assigned the highest dis-utilities to the 2-hour duration in both years (Fig. 4-35 and 4-36).

Preferences for Some Re-Designed Programs

We can now use the results from the conditional logit model to examine customers' preferences for programs with different features. As seen in Table 4-15, the total utility of the "base" (EDRP) program for current PRL program participants (normalized to "zero") is higher than the "no program" option, *ceteris paribus.* The "no program" option reduces utility by 0.57 (the row for "total utility" and column for "no program" in Table 4-15), which is interpreted as follows: if the decision were to be made between the "no program" and the "base" program, there are odds of 1.78 to 1 that these customers would sign up (the customer utility value in Table 4-15 for the row "odds of program vs. no program" and "base program" column).

As the value for utility and the odds ratio for Program Options P1-P5 in Table 4-15 indicate, customers would prefer a program with a higher payment (Program Option P1) but eschew a program with shorter notice and duration (Program Option P2). It is noteworthy that in spite of the dis-utility associated with a modest penalty, it can be compensated for by a longer notice and higher payment rate, as illustrated by Program Option P5. For this option, the odds of participating in this program relative to no program are 1.33 to one. This particular option was constructed to mirror the current DADRP (day-ahead notice, penalty = 0.1). In contrast to last years results where achieving an odds of participation ratio of 1:1 required only a $250/MW strike price, this year's respondents would require a $750/MW strike price. One way to interpret this result is that current PRL participants are unlikely to find DADRP attractive unless they can be guaranteed to be scheduled a significant number of times at a strike price of $750/MW). This is consistent with the strike prices respondents indicated they would require to bid in DADRP, which averaged $.87/kWh (see Chapter 4).

From Table 4-16, it is not surprising that the utility of the “no program” option (0.06) for non-PRL participants is higher than it is for the “base” program (0.0). They have already turned down an opportunity to participate in a PRL program, and it is extremely encouraging that the results of this “stated” preference model are consistent with the “revealed” preferences of these customers. If this were not the case, one might well question whether their responses to the choice sets could be used to predict future behavior.

For this sub-group of customers, it requires very high levels of beneficial feature to achieve a program design that is preferred to the “base”, as well as to find programs preferred to the “no program” option. This also is not a surprising result. Since non-participants could not find enough value in EDRP to participate currently, they would need a higher payment or a later start time in order to generate even odds or better than even odds of participation (e.g. Options P1 and P3 in Table 4-16).

Table 4-10: Summary Data on Customer Acceptance Survey Part I

Item	Number of Customers	% of Total
Non-Participants	59	41.0
EDRP & SCR	16	11.1
DADRP & EDRP	4	2.8
DADRP, EDRP & SCR	7	4.9
EDRP Only	58	40.3
Total	144	

Table 4-11: Multinomial Model Results from Revealed Choice Analysis, 2002

	Global Analysis of Variance			Parameter Estimates				
Parameter	DF	Chi-Square	Pr > ChiSq	Function Number	Estimate	Standard Error	Chi-Square	Pr > ChiSq
Intercept	2	16.8	0.0002	1	-7.6939	1.9433	15.68	<.0001
				2	-1.048	0.5397	3.77	0.0521
manufact	2	17	0.0002	1	4.4105	1.2119	13.24	0.0003
				2	1.7184	0.5552	9.58	0.002
gen	2	3.95	0.1389	1	-0.098	1.3929	0	0.9439
				2	1.1202	0.6175	3.29	0.0696
peak_12_4	2	3.59	0.1659	1	1.1118	0.8692	1.64	0.2009
				2	0.8594	0.4745	3.28	0.0701
nyserda	2	15.21	0.0005	1	3.5022	1.3207	7.03	0.008
				2	4.1951	1.0915	14.77	0.0001
access	2	4.48	0.1064	1	2.4744	1.244	3.96	0.0467
				2	0.6735	0.5056	1.77	0.1828
lse_pgms	2	6.09	0.0476	1	2.2035	0.894	6.08	0.0137
				2	0.5324	0.526	1.02	0.3115
attend_show	2	14.23	0.0008	1	-0.6311	0.9218	0.47	0.4936
				2	-1.8319	0.5025	13.29	0.0003
Likelihood Ratio	**120**	**87.59**	**0.9885**					

Table 4-12: Summary of Revealed Choice Analysis, 2002

	DADRP & Emergency vs. No Program			Emergency Only vs. No Program			DADRP & Emergency vs. Emergency Only		
Parameter	Odds Ratio		Chi-Square Value	Odds Ratio		Chi-Square Value	Odds Ratio		Chi-Square Value
	(a)		(b)	(c)		(d)	(e)		(f)
Intercept	0.00	**	15.68	0.35	**	3.77	0.00	**	12.32
access	11.87		3.96	1.96		1.77	6.05		2.33
attend_show	0.53		0.47	0.16	**	13.29	3.32		2.04
gen	0.91		0.00	3.07	*	3.29	0.30		0.89
lse_pgms	9.06	**	6.08	1.70		1.02	5.32	**	4.30
manufact	82.31	**	13.24	5.58	**	9.58	14.76	**	5.56
nyserda	33.19	**	7.03	66.36	**	14.77	0.50		0.74
peak_12_4	3.04		1.64	2.36	*	3.28	1.29		0.10

Note: the odds ratios are the ratios of the probability of participating in the first program or set of programs vs. the second program or set of programs listed in the column headings.
Note: Recall that is the odds ratio is greater than unity, the probability of being in the first program listed a particular column of this table is greater than the probability of being in the second column listed.
Note: The * and ** indicate the coefficients are statistically significant at least at the 10% and 5% level, respectively.

Table 4-13: Summary Data on Customer Acceptance Survey Part II

Item	Number of Customers	Number of "No Program" Choices: Average	Standard Deviation	Minimum	Maximum
Non-Participants	18	7.5	8.0	0.0	20.0
EDRP & SCR	9	11.7	4.1	5.0	17.0
DADRP & EDRP	2	8.5	12.0	0.0	17.0
DADRP, EDRP & SCR	6	6.0	3.3	1.0	11.0
EDRP Only	34	6.5	6.0	0.0	20.0
Total	69				

Table 4-14: Conditional Logit Model Results for the "Stated" Choice PRL Program Characteristics

	For EDRP Non-Participants						Increment Added to Coefficients for EDRP Participants[#]					
Variable	Parameter Estimate	Standard Error	Chi-Square	PR > ChiSq	Odds Ratio	Variable	Parameter Estimate	Standard Error	Chi-Square	PR > ChiSq	Odds Ratio	Combined Parameter[#]
PAY_1	-0.94	0.26	12.97	0.00	0.39	EDRP-DUM X pay_1	-0.07	0.30	0.05	0.82	0.93	-1.01
PAY_2	-0.63	0.26	6.00	0.01	0.53	EDRP-DUM X pay_2	0.02	0.30	0.01	0.94	1.02	-0.61
PAY_3			BASE			EDRP-DUM X pay_3			BASE			
PAY_4	0.81	0.19	18.90	0.00	2.25	EDRP-DUM X pay_4	-0.23	0.22	1.10	0.29	0.80	0.58
PEN_1			BASE			EDRP-DUM X pen_1			BASE			
PEN_2	-1.04	0.20	28.09	0.00	0.36	EDRP-DUM X pen_2*	-0.42	0.24	3.13	0.08	0.66	-1.45
PEN_3	-1.47	0.22	44.71	0.00	0.23	EDRP-DUM X pen_3	0.06	0.25	0.06	0.81	1.06	-1.41
PEN_4	-1.67	0.24	48.54	0.00	0.19	EDRP-DUM X pen_4*	-0.34	0.29	1.42	0.23	0.71	-2.01
ST_1*	0.20	0.24	0.71	0.40	1.22	EDRP-DUM X st_1*	-0.13	0.28	0.23	0.63	0.87	0.07
ST_2*	0.29	0.23	1.56	0.21	1.34	EDRP-DUM X st_2*	-0.26	0.28	0.90	0.34	0.77	0.03
ST_3			BASE			EDRP-DUM X st_3			BASE			
ST_4	0.06	0.25	0.06	0.81	1.06	EDRP-DUM X st_4	0.21	0.29	0.52	0.47	1.23	0.26
NT_1	0.02	0.22	0.01	0.93	1.02	EDRP-DUM X nt_1	-0.29	0.27	1.11	0.29	0.75	-0.27
NT_2			BASE			EDRP-DUM X nt_2			BASE			
NT_3*	-0.05	0.23	0.05	0.82	0.95	EDRP-DUM X nt_3*	0.19	0.28	0.46	0.50	1.20	0.13
NT_4	0.03	0.22	0.02	0.89	1.03	EDRP-DUM X nt_4*	0.55	0.25	4.73	0.03	1.74	0.58
DUR_1*	-0.14	0.22	0.42	0.52	0.87	EDRP-DUM X dur_1	-0.72	0.25	8.12	0.00	0.49	-0.86
DUR_2	-0.45	0.25	3.34	0.07	0.64	EDRP-DUM X dur_2*	-0.36	0.28	1.62	0.20	0.70	-0.81
DUR_3			BASE			EDRP-DUM X dur_3			BASE			
DUR_4*	-0.03	0.22	0.01	0.90	0.97	EDRP-DUM X dur_4*	-1.01	0.26	14.94	0.00	0.37	-1.03
NO_CHOICE	0.06	0.27	0.04	0.84	1.06	EDRP-DUM X no_choice	-0.63	0.30	4.26	0.04	0.53	-0.57

Testing Global Null Hypothesis: BETA=0

Test	Chi Square	PR > ChiSq
Likelihood Ratio	1001	< .0001
Score	886	< .0001
Wald	654	< .0001

[#] To find the effects for EDRP participants relative to the non-participants, one added these coefficients to the ones for nonparticipants.
*Note: Although some coefficients for both groups were "not significant" they were retained for the graphic presentation, and they had little effect on the simulation exercises. This is a common practice if it is believed that eliminating a variable will bias the other coefficients.

Table 4-15: Program Preferences for Current PRL Program Participants

	Base Program		No Program		Program Option P1		Program Option P2		Program Option P3		Program Option P4		Program Option P5	
					Higher Payment		Shorter Notice/Duration		Non-Compliance Penalty		Lower Payment		Pseudo-DADRP	
Program Features	Feature Value	Customer Utility	Feature Value	Customer Utility	Feature Value	Customer Utility	Feature Value	Customer Utility	Feature Value	Customer Utility	Feature Value	Customer Utility	Feature Value	Customer Utility
Payment	$500/MWh	0.00	-		**$750/MWh**	0.58	$500/MWh	0.00	$500/MWh	0.00	**$250/MWh**	-0.61	**$750/MWh**	0.58
Penalty	None	0.00	-		None	0.00	None	0.00	**0.1**	-1.45	None	0.00	**0.1**	-1.45
Start Time	1300 Hrs	0.00	-		1300 Hrs	0.00	1300 Hrs	0.00	1300 Hrs	0.00	1300 Hrs	0.00	1300 Hrs	0.00
Notice	2 Hrs	0.00	-		2 Hrs	0.00	**30 Min**	-0.27	2 Hrs	0.00	2 Hrs	0.00	**Noon, DA**	0.58
Event Duration	4 Hrs	0.00	-		4 Hrs	0.00	**30 Min**	-1.03	4 Hrs	0.00	4 Hrs	0.00	4 Hrs	0.00
Total Utility		**0**		**-0.57**		**0.58**		**-1.30**		**-1.45**		**-0.61**		**-0.29**
Odds:Program vs Base				**0.56**		**1.79**		**0.27**		**0.23**		**0.55**		**0.75**
Odds:Program vs No Program		**1.78**				**3.18**		**0.48**		**0.42**		**0.97**		**1.33**

Table 4-16: Program Preferences for Current Non-PRL Program Participants

	Base Program		No Program		Program Option P1		Program Option P2		Program Option P3		Program Option P4	
					Later Start		Non-Compliance Penalty		Higher Payment		Pseudo-DADRP	
Program Features	Feature Value	Customer Utility	Feature Value	Customer Utility	Feature Value	Customer Utility	Feature Value	Customer Utility	Feature Value	Customer Utility	Feature Value	Customer Utility
Payment	$500/MWh	0.00	-		$500/MWh	0.00	$500/MWh	0.00	**$750/MWh**	0.81	$500/MWh	0.00
Penalty	None	0.00	-		None	0.00	**0.1**	-1.04	None	0.00	**0.1**	-1.04
Start Time	1300 Hrs	0.00	-		**1400 Hrs**	0.06	1300 Hrs	0.00	1300 Hrs	0.00	**1400 Hrs**	0.06
Notice	2 Hrs	0.00	-		2 Hrs	0.00	2 Hrs	0.00	2 Hrs	0.00	**Noon, DA**	0.03
Event Duration	4 Hrs	0.00	-		4 Hrs	0.00	4 Hrs	0.00	4 Hrs	0.00	4 Hrs	0.00
Total Utility		**0.00**		**0.06**		**0.06**		**-1.04**		**0.81**		**-0.95**
Odds of Program vs Base				**1.06**		**1.06**		**0.36**		**2.25**		**0.39**
Odds of Program vs No Program		**0.95**				**1.00**		**0.34**		**2.13**		**0.37**

Fig. 4-27: Relative Utility Levels of Payment Levels for PRL Participants

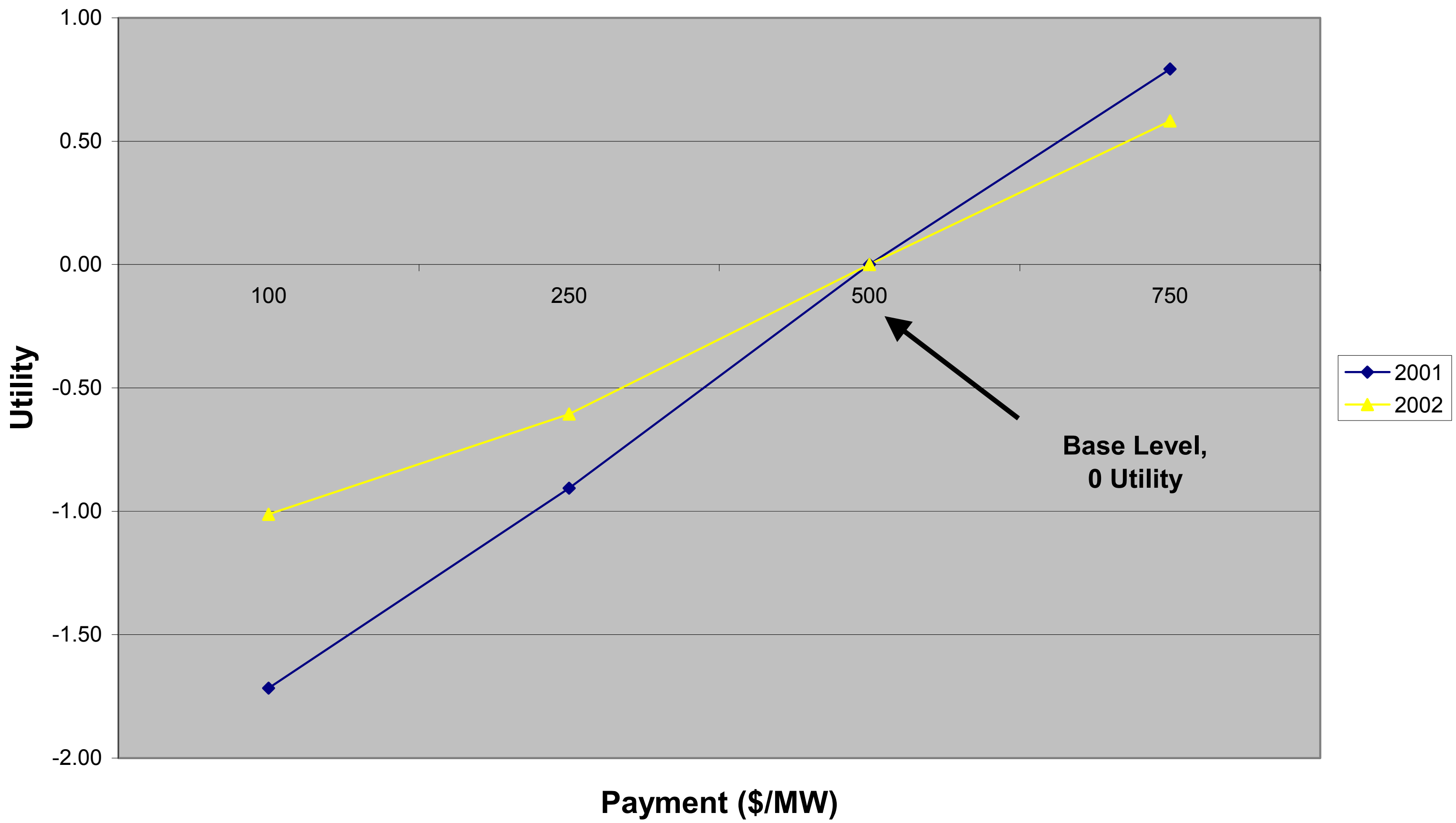

Fig. 4-28: Relative Utility Levels of Payment Levels for Non-PRL Participants

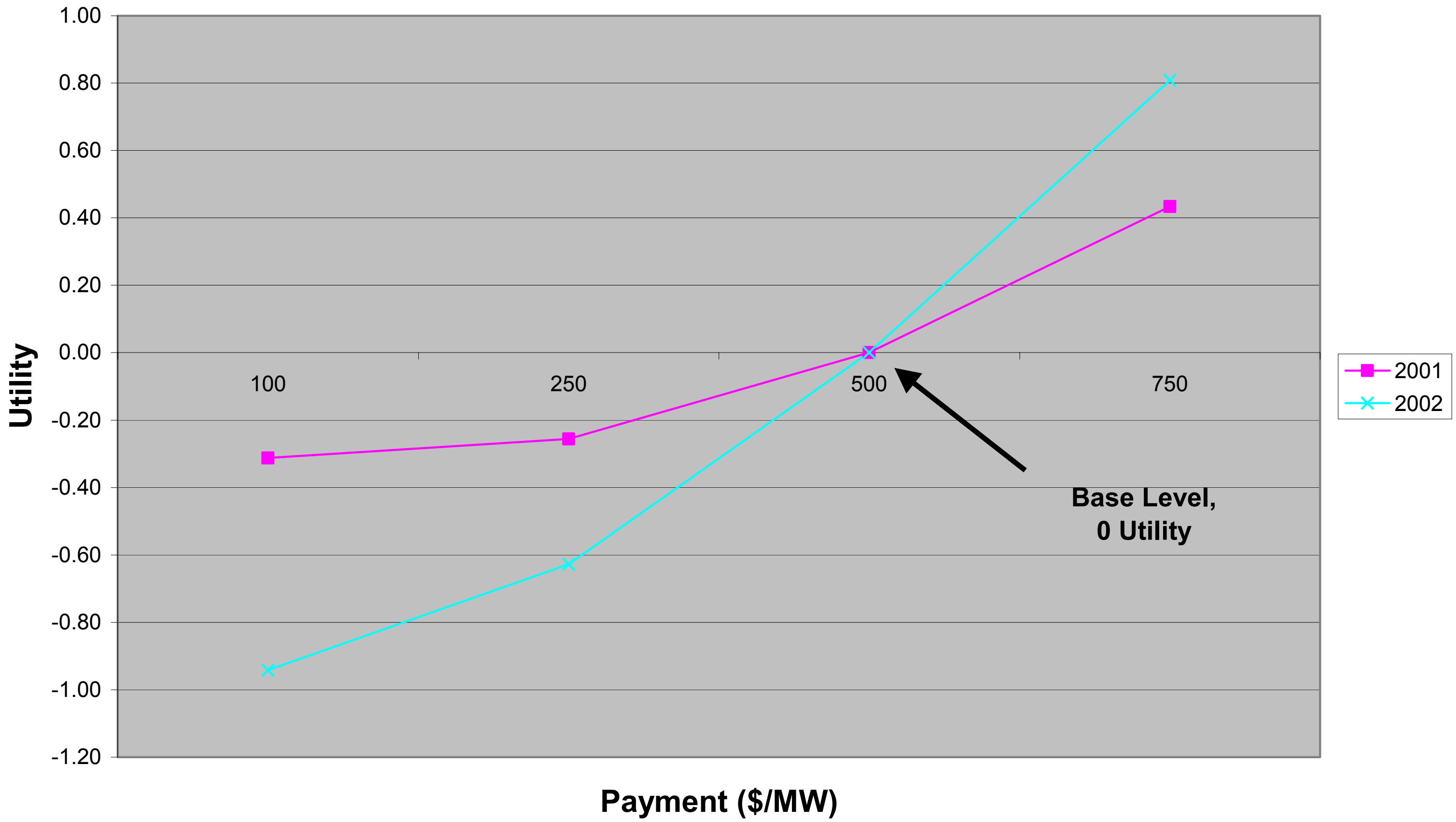

Fig. 4-29: Relative Utility Levels of Penalty Rates for PRL Participants

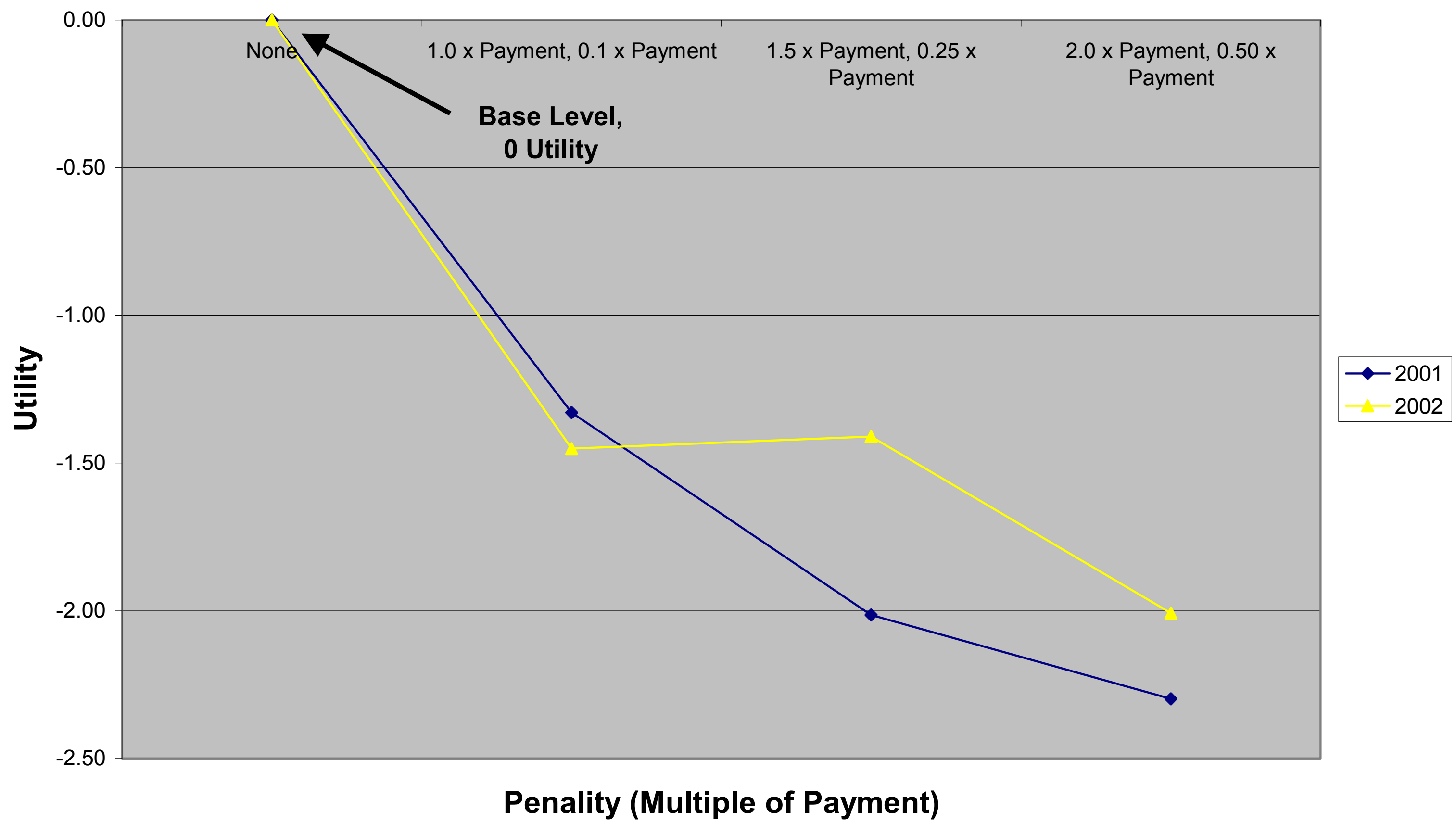

Fig. 4-30: Relative Utility Levels of Penalty Rates for PRL Non-Participants

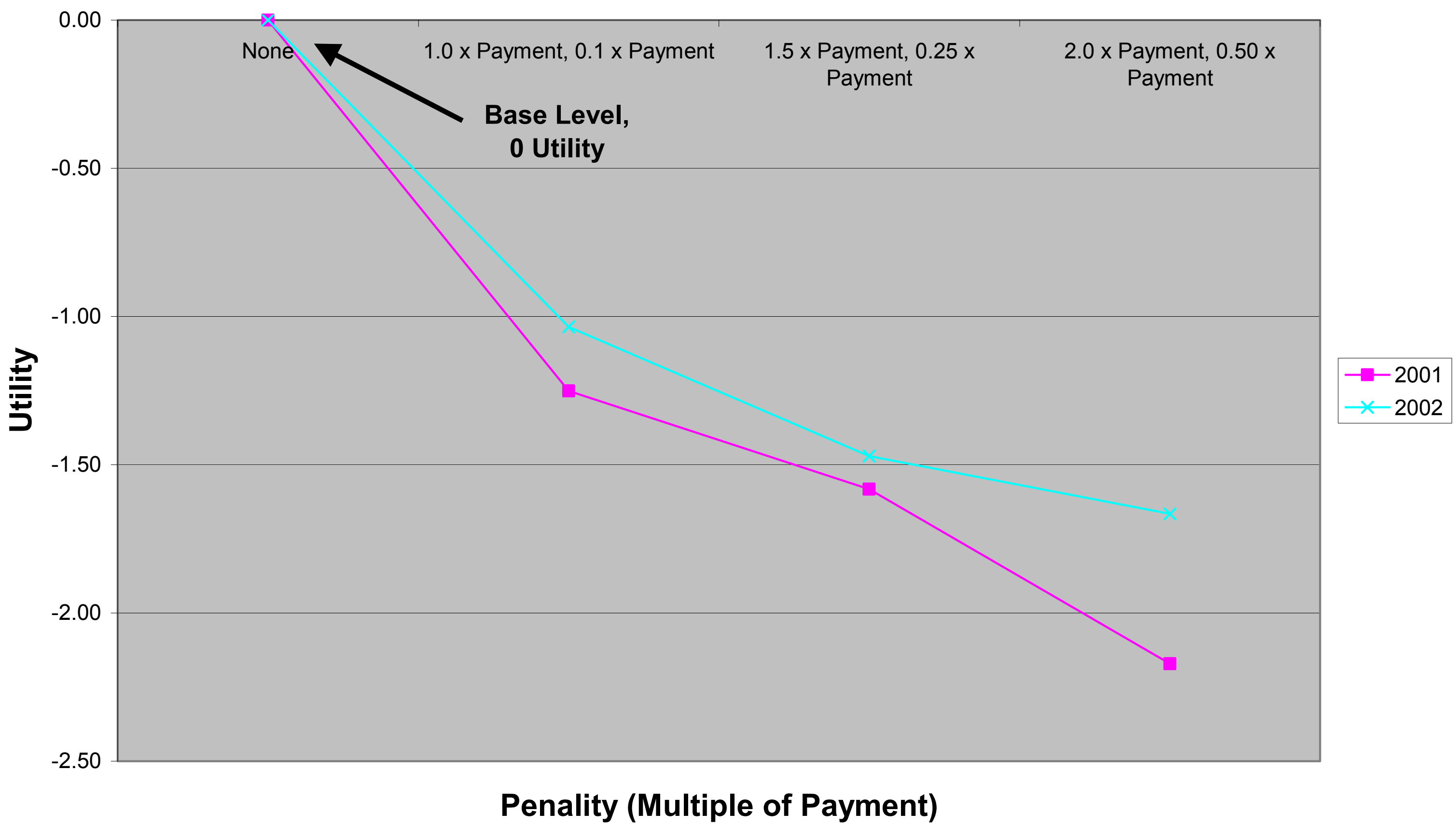

Fig. 4-31: Relative Utility Levels of Start Times for PRL Participants

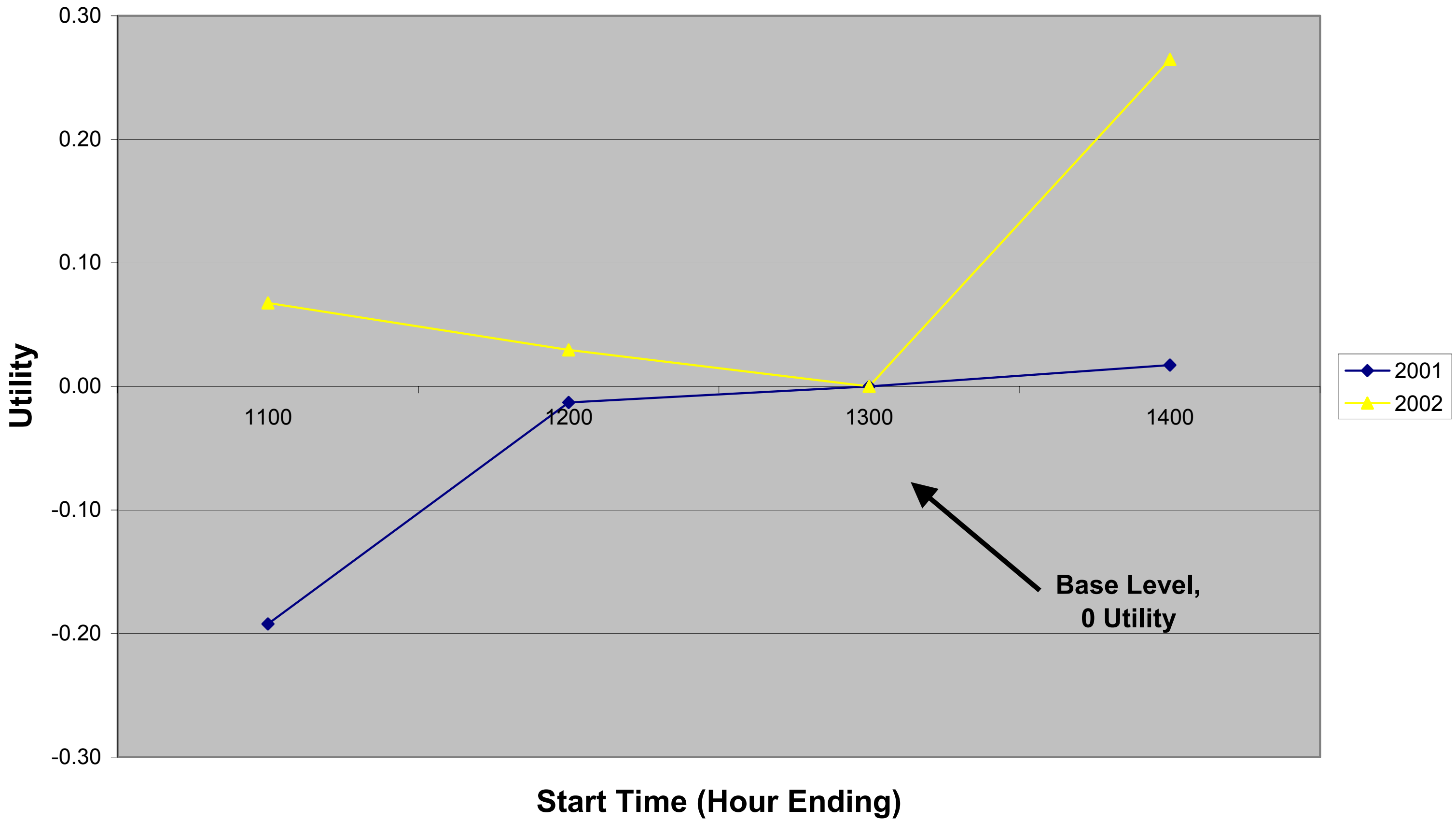

Fig. 4-32. Relative Utility Levels of Start Times for PRL Non-Participants

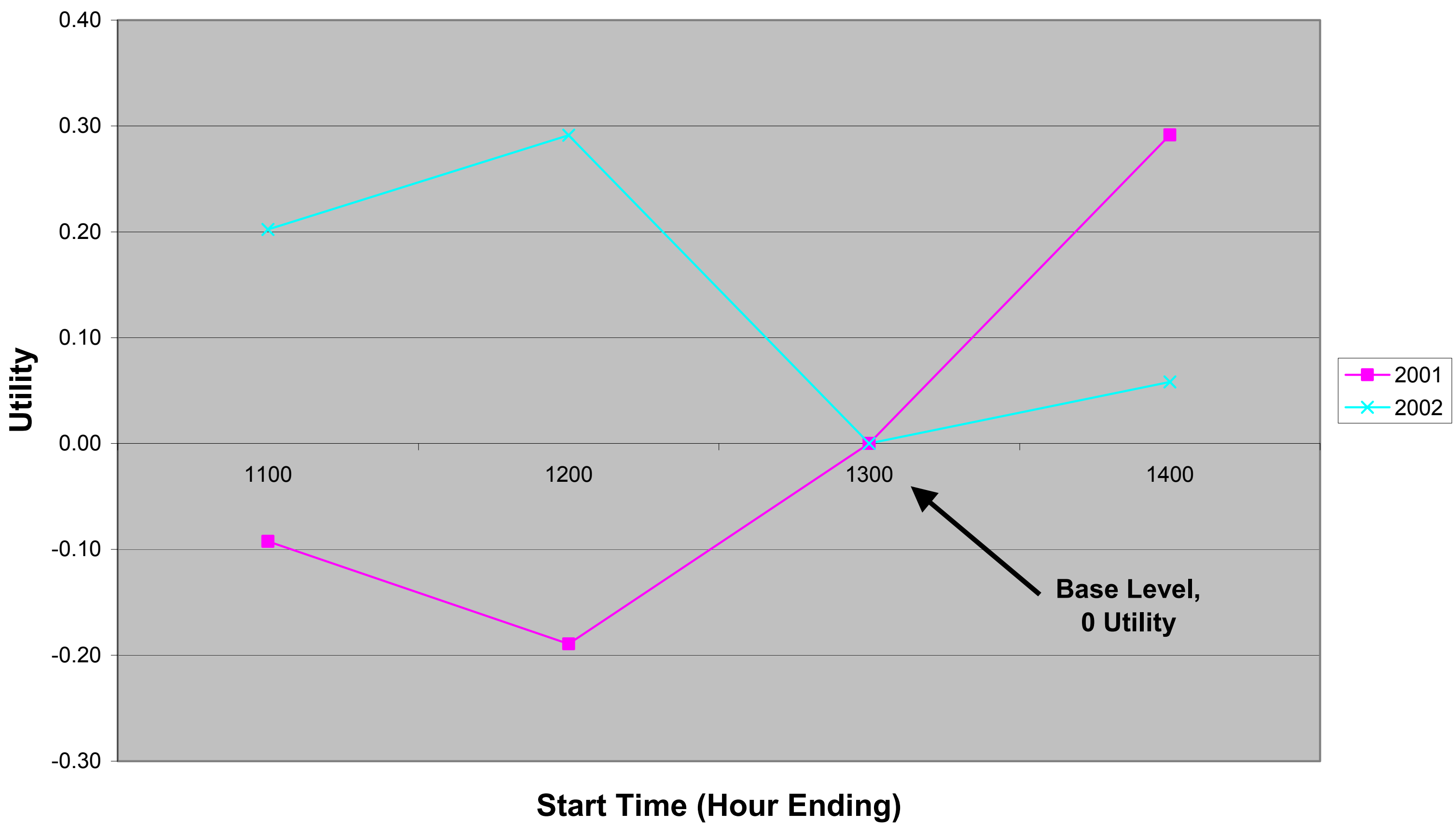

Fig. 4-33: Relative Utility Levels of Notice Periods for PRL Participants

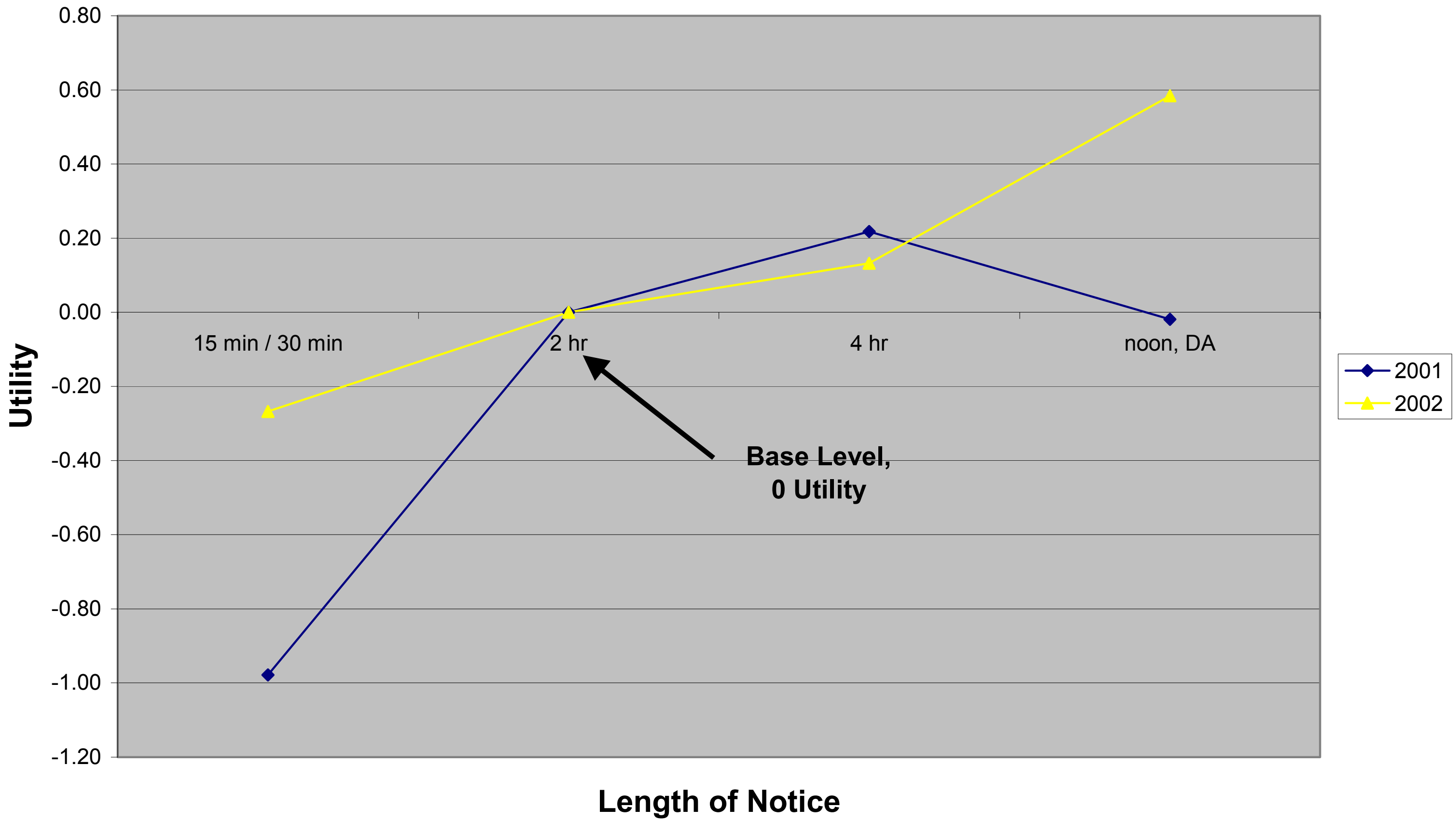

Fig. 4-34: Relative Utility Levels of Notice Periods for PRL Non-Participants

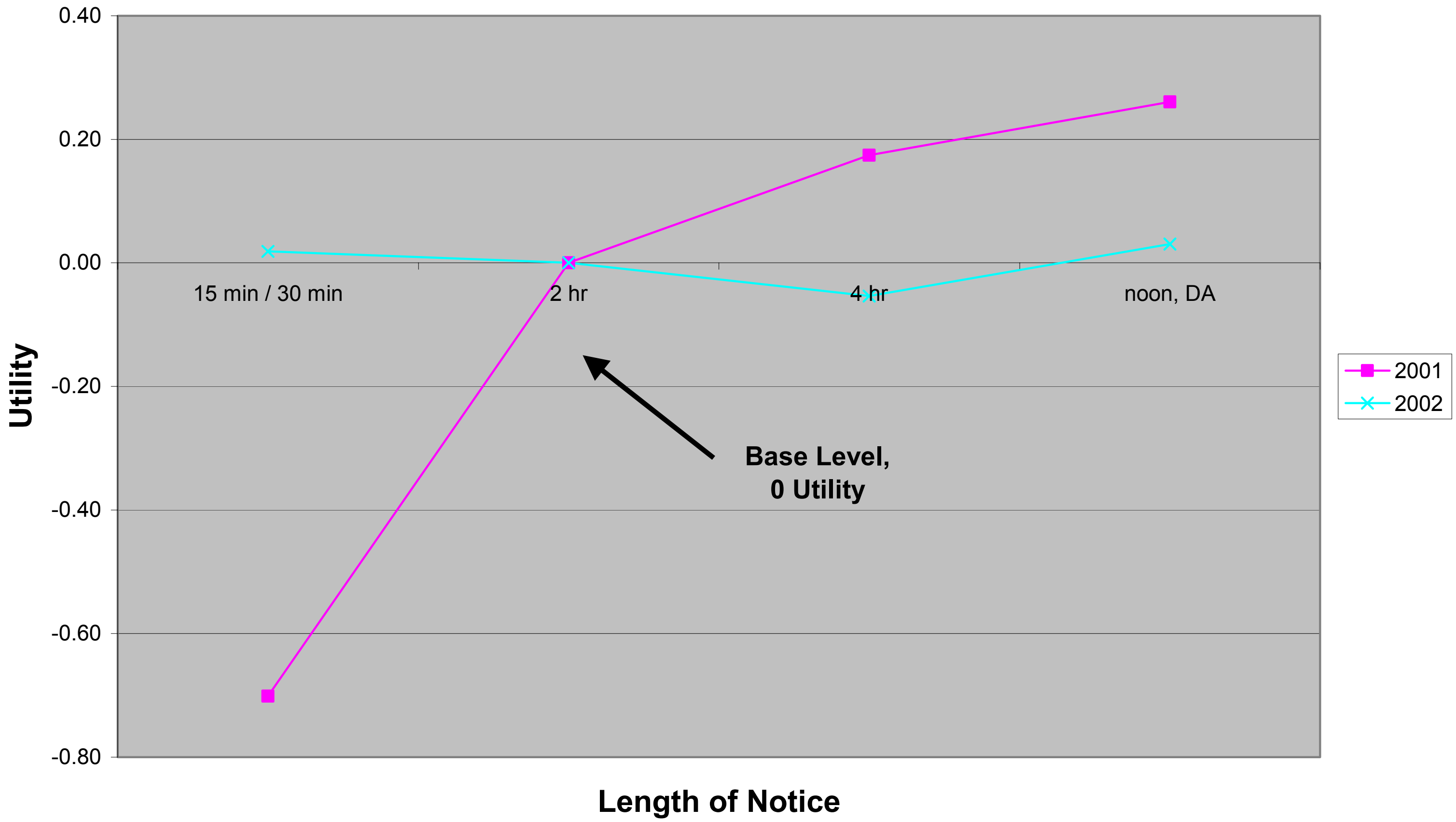

Fig. 4-35: Relative Utility Levels of Event Durations for PRL Participants

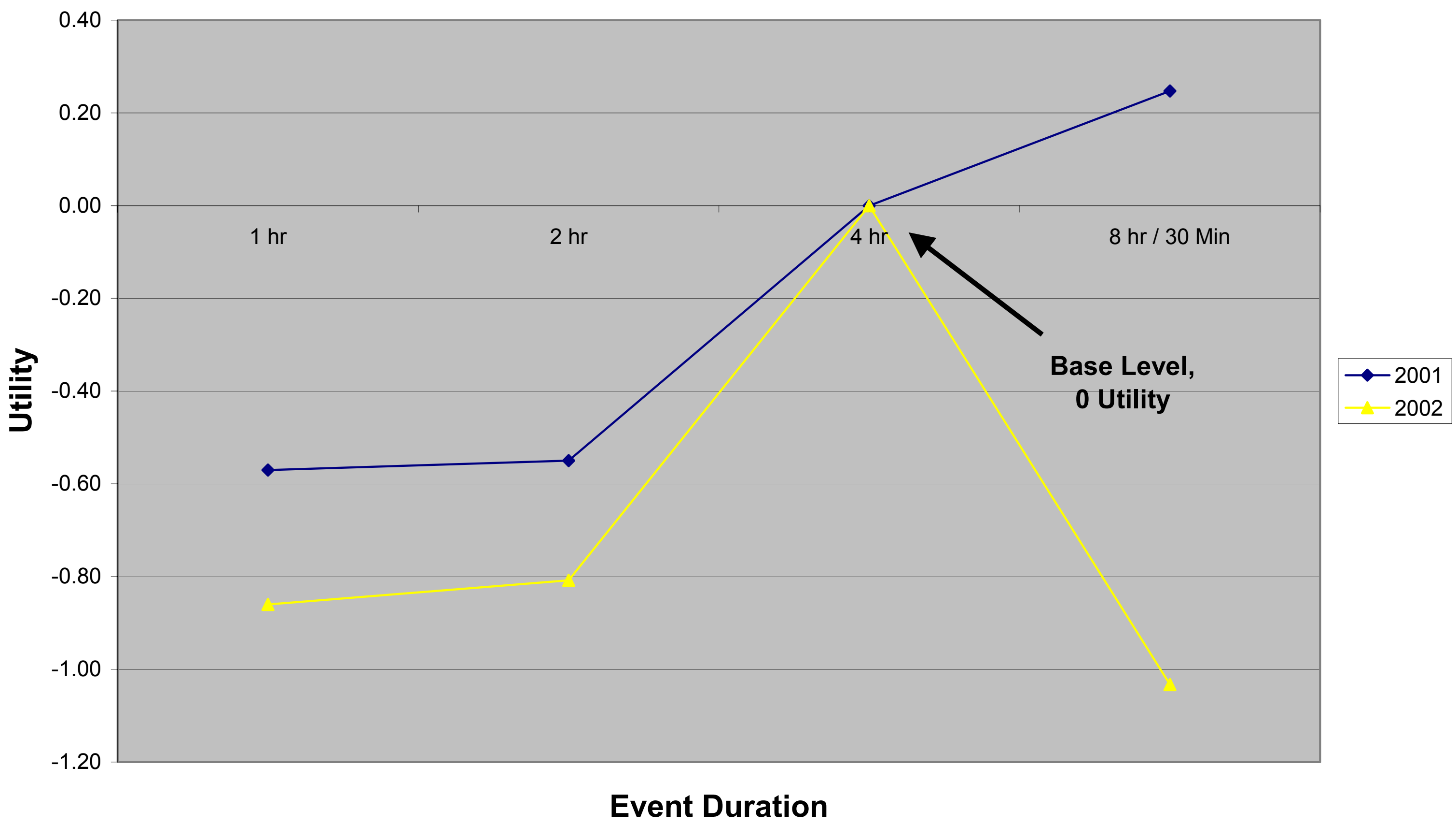

Fig. 4-36: Relative Utility Levels of Event Durations for PRL Non-Participants