

Measurement and Verification Evaluation of Demand Response Impact For the New York Energy SmartSM Peak Load Reduction Program

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ABSTRACT

An independent measurement and verification evaluation review of the Peak Load Reduction Program operating in New York State was conducted during the last quarter of 2003. Review of the program indicates that the Program has helped create a pool of demand response participants that either has the potential to remove or has permanently removed 355 MW of load from the grid. The 355 MW is 95% of the demand reduction potential previously reported by the Program.

The Peak Load Reduction Program is one offering of the New York State Energy Research and Development Authority's **New York Energy SmartSM** portfolio of programs that are funded through a systems benefit charge. This paper reports the methods and results of the Program's first-ever independent measurement and verification evaluation review. Historical and programmatic information needed to understand the Program is presented for context. Some key Program indicators that have been researched by other **New York Energy SmartSM** evaluators and reviewers are also summarized.

Introduction

The Peak Load Reduction Program (PLRP) is an offering of the **New York Energy SmartSM** Program, a systems benefit charge portfolio of forty programs administered by the New York State Energy Research and Development Authority (NYSERDA). The PLRP provides financial incentives to enable commercial, industrial, institutional and multifamily customers or their agents to participate in demand response programs. Permanent demand reduction projects are also eligible for incentive dollars. A condition for some but not all participants is that they must enroll in a demand response or price-responsive program, typically done through the New York Independent System Operator (NYISO) or a local distribution utility. However, since some of these programs are voluntary, actual participation or response is not required.

In the spring of 2003 NYSERDA initiated an extensive, multi-year evaluation of all programs in the **New York Energy SmartSM** portfolio, hiring five specialty contractors to perform the work. Tasks included market characterization and analysis, process evaluation, program logic, measurement and verification, and benefit/cost analysis.

In late 2003 Nexant, Inc. (Nexant), the measurement and verification (M&V) evaluation specialty contractor, conducted an independent M&V evaluation review of the PLRP. The activities and findings of the review, the first independent analysis of the Program's reported impacts, are the focus of this paper. The paper also summarizes work performed by the market

assessment evaluation contractor and includes an analysis of actual demand response performance conducted under joint sponsorship by NYSERDA and the NYISO.

Peak Load Reduction Program Background and Overview

The PLRP is one of many initiatives that grew out of the Price Responsive Load Working Group (PRLWG) convened by the New York Independent System Operator (NYISO) in late summer, 2000. The PRLWG was formed to enable input from market participants interested in the development of New York's demand response programs, which are intended to mitigate potential capacity shortfalls during summer on-peak periods.

The PLRP provides incentives to end-use customers, load aggregators, load serving entities and other parties to help develop and implement strategies that can reduce peak system electric demand in New York State. The Program helps to offset the costs for the equipment and technology that customers need to have in place in order to participate in demand response programs. Participants use PLRP incentives to install interval meters, Internet-based communication and control software, direct load controls, and automatic transfer switchgear. The Program addresses the lack of installed control and communication equipment that was identified by the PRLWG as a barrier to successful demand response initiatives. Incentives can also be used for traditional energy efficiency retrofits that result in permanent summer on-peak coincident demand reduction.

The PLRP is structured to equip participants to enroll in one or more of the NYISO's family of demand response programs, which include Emergency Demand Response Program (EDRP), Day Ahead Demand Response Program (DADRP) and Installed Capacity/Special Case Resources (ICAP/SCR). Note that the PLRP does not require its participants to respond to a NYISO call, and therefore credits enabled, not actual, demand reduction. While a complete discussion of the NYISO Price Responsive Load Program is beyond the scope of this paper, participation generally requires hardware and software capabilities to allow quick response to calls for load reduction and to record performance data.

The NYISO, through their various demand response programs, offers revenues for end users who curtail load. Although intended to motivate end users to change behavior, these revenues are not offered directly to end users, but rather to demand response providers who must meet specific NYISO eligibility criteria. This limits the pool that the NYISO works with, making the programs easier to administer. More importantly, this has also given rise to a new business, or a new venture for an existing business. Very often, it is these same businesses that seek PLRP incentives for their clients.

The PLRP allows customers to participate via one or more of four components or paths:

- Permanent Demand Reduction Efforts (PDRE). PDRE projects result in reduced peak demand, through the installation of equipment that provides long-term coincident peak demand reduction. PDRE projects resemble traditional demand-side management initiatives, and because the measures are 'permanent,' participants are not required to participate in a demand response program.
- Load Curtailment/Shifting (LC/S). LC/S projects curtail (or shift) peak demand either in response to an electric capacity shortfall, or defined price signal. Each participating

facility must enroll in a NYISO demand response program or comparable program administered by an acceptable load serving entity or transmission owner.

- Dispatchable Emergency Generator Initiatives (DEGI). The DEGI program path allows owners of existing emergency/backup generators to move all or part of their load from the grid to their own generators in response to a request from NYISO or a local transmission owner. This program component is restricted to facilities in the Con Edison service territory.
- Interval Meters (IM). Interval meters are an important element that must be in place to enable participation in load reduction programs administered by NYISO or approved load-serving entities. PLRP incentives help buy down the cost of purchasing and installing Public Service Commission-approved billing IM's or models that meet NYISO accuracy standards. Starting in 2003, each IM-only applicant must enroll in a NYISO demand response program or a comparable program administered by an acceptable load serving entity or transmission owner; enrollment was not required prior to 2003.

The PLRP does not pay for demand reduction performance or penalize for failure to deliver load reduction; these financial and administrative functions belong to the NYISO and others. Accordingly, the PLRP impact is measured by accounting for *enabled* demand response, which is the maximum amount of load relief that the NYISO would see if all PLRP customers delivered all of their assessed load curtailment capability.

The PLRP launched its first offering in January of 2001 with the publication of Program Opportunity Notice (PON) 577. The Program has subsequently been reissued each year through 2004.

Measurement & Verification Evaluation Overview

The objective of the 2003 M&V evaluation review was to investigate the accuracy of NYSERDA's reported demand reduction potential (MW) due to the PLRP. Actual performance, the demand reduction realized by Program participants in response to a call from the NYISO, is the subject of a separate study¹.

For each completed PDRE, LC/S or DEGI project, NYSERDA reports a field-verified potential, based on independent review by a NYSERDA-appointed third-party consultant. For IM projects, NYSERDA's assessed demand reduction potential is based on the applicant's self-reported estimate, as submitted in the project application and reviewed by NYSERDA staff. Due to cost-effectiveness limits, NYSERDA does not conduct an independent review for these IM-only applications.

The basic M&V approach was to examine a representative sample of completed PLRP projects and to apply the findings to all projects in the program. For each project in the sample, the M&V evaluation contractor developed a realization rate, a ratio of project savings based on the review to NYSERDA's estimated savings. To estimate the true savings for a project, the realization rate was then multiplied by NYSERDA's reported savings.

A realization rate is the percentage of NYSERDA-reported savings that is corroborated during the M&V evaluation review, based on interviews, site visit observations and supporting

¹ Neenan Associates. 2002. *NYISO Price Responsive Load Program Evaluation Final Report*.

documents. A realization of 100% indicates no difference between reported and observed savings. To obtain the M&V-adjusted gross savings:

- A random sample of 23 projects was drawn from a population of 1,123 that had been completed as of August 31, 2003. These 23 became the study subjects
- All available hard- and soft-copy records from NYSERDA for each project in sample were obtained.
- A review of the engineering calculations and assumptions used to calculate savings for each project in the sample was conducted
- Site visits were conducted to verify that equipment documented in each sample project was installed and operating as specified
- Savings estimates reported by NYSERDA were adjusted for each project as needed
- The realization rate for the sample was calculated
- The total savings reported by the Program was multiplied by the realization rate to obtain the adjusted/verified Program savings

Measurement & Verification Evaluation Realization Rates

To evaluate the performance of the various PLRP paths, the M&V evaluation contractor adjusted NYSERDA's reported savings by developing realization rates for each of the four Program paths, and applying these rates to a list of all completed projects sorted by Program path.

It was found that the accuracy of NYSERDA's reported savings for any given project depended more on the project's Program path than the location of the facility (i.e. New York load zone or utility territory). In particular, because DEGI, LC/S and PDRE kW estimates underwent more rigorous review than those reported for IM projects, IM estimates were less reliable than for their peers.

A summary of the realization rates obtained for each Program path is shown in Table 1.

Table 1. Realization Rate by Program Path, based on M&V sample

Program Path	Realization Rate	Uncertainty (+/-)
DEGI	100%	0.1%
IM	88%	12%
LC/S	104%	50%
PDRE	102%	0.3%

Measurement & Verification Evaluation Findings

The following conclusions can be drawn from NYSERDA's 2003 M&V evaluation:

1. The total enabled demand impact of the PLRP is approximately 355 MW, $\pm 19\%$
2. The mean estimate of 355 MW represents 95% of the demand reduction potential reported by NYSERDA through December 2003
3. NYSERDA's reported demand reduction of 375 MW falls within the 80% confidence interval of the M&V evaluation contractor's findings

Table 2 shows the calculated range, based on the 80% confidence interval criterion that was used for the M&V evaluation contractor's random sample selection.

Table 2. M&V Evaluation-Adjusted Demand Reduction, with 80% Confidence Interval

Project Type	M&V-adjusted Impacts (kW)		
	Mean	High	Low
DEGI	69,729	69,807	69,651
IM	174,668	195,439	153,896
LC/S	95,912	144,176	47,648
PDRE	14,993	15,036	14,950
Grand Total	355,302	424,458	286,145

While the uncertainty of $\pm 19\%$ applies to all M&V evaluation contractor-adjusted figures, only point estimates (mean values) are provided in subsequent tables, for clarity.

Table 3 below illustrates the enabled demand reduction by Program Year, based on the M&V evaluation contractor's adjusted savings for all completed projects, as of December 31, 2003.

Table 3. M&V Evaluation-adjusted Demand Reduction (kW) by Program Year

	2001 (PON 577)	2002 (PON 620)	2003 (PON 733)	Total kW Reduction
DEGI	36,943	25,641	7,145	69,729
IM	20,344	148,014	6,310	174,668
LC/S	77,715	13,441	4,756	95,912
PDRE	6,248	7,818	926	14,993
Total kW Reduction	141,250	194,915	19,137	355,302

The distribution of total demand savings by Program segment and utility service territory is summarized in Table 4.

Table 4. M&V Evaluation-adjusted Demand Reduction Potential (kW)

Project Type	CHG&E	Con Ed ²	NIMO	NYSEG	RG&E	Total	Percentage
DEGI	-	69,729	-	-	-	69,729	20%
IM	811	75,453	66,931	20,242	11,231	174,668	49%
LC/S	5,611	14,276	71,442	3,877	707	95,912	27%
PDRE	115	8,786	3,640	2,453	-	14,993	4%
Total	6,537	168,244	142,012	26,571	11,937	355,302	100%
Percentage	2%	47%	40%	7%	3%	100%	

As observed in Table 1, the realization rates obtained for LC/S, DEGI and PDRE are all 100% or greater, which means that overall the M&V-adjusted savings either met or exceeded NYSERDA's reported savings for the three Program segments. This result is not surprising because NYSERDA requires detailed technical assessments and post-installation inspections for the three Program segments. The findings show that NYSERDA's technical assessment and

² Includes Orange and Rockland customers.

field-verification prerequisites have been effective M&V tools for the LC/S, DEGI and PDRE components of the PLRP.

The sample of twenty-three projects included fourteen IM projects (or 60%) for which a realization rate of 88% was obtained. A factor that contributed to the relatively low realization rate for IM projects is that prior to 2003 (PON 733), NYSERDA provided interval meter funding for applicants who intended to monitor their own load profiles without enrolling in any demand response programs. Regardless of their motivation for installing interval meters, all IM applicants submitted best estimates of their curtailable kW, which NYSERDA recorded as Program impacts. Based on the M&V evaluation review, reliance on customers' self-reported data is inaccurate since curtailable load does not necessarily translate into demand response potential. During the M&V contractor's site visits, it was observed that some facilities that had installed interval meters were still incapable of effectively responding to emergency calls to reduce demand.

Beginning in 2003 with the release of PON 733, NYSERDA has taken more stringent steps to ensure that only IM projects capable of delivering demand savings receive funding from the Program. IM participants must now also enroll in a demand response program, just like LC/S and DEGI applicants. This requirement reduces the applicant pool to facilities that have seriously assessed their load reduction capabilities, and also helps to ensure that NYSERDA's reported demand impact is closer to the actual enabled kW.

Another reason for the low IM realization rate is the absence of a technical assessment and/or field-verification prerequisite for IM projects. Due to concerns regarding cost-effectiveness, NYSERDA does not use third-party consultants to review estimates provided in IM applications. Thus, even for IM participants who enroll in demand response programs, the enabled kW reduction reported by NYSERDA is based on the applicant's self-reported estimates. NYSERDA does conduct a paper review of these applications in-house, but there is no field verification. Within the M&V sample, it was observed that some of the self-reported estimates involved little technical analysis.

It is important to note, however, that particularly for IM projects, realization rates do not tell the whole story. In interviews with facility representatives, many building managers indicated that they had used their meters to help them identify ways to reduce customer-coincident peak demand and building energy consumption. Others described their meters as valuable tools for verifying monthly billing kW. Even in the worst-case scenarios, where meters are installed but not used as planned, the prospect of real-time pricing in the near future could make them a good investment. In view of these additional benefits, it would be misleading to evaluate the effectiveness of the IM program solely on the basis of its realization rate. In fact, when the Public Service Commission (PSC) first directed NYSERDA to add the metering component to the PLRP, NYSERDA staff expressed concern that IM projects would have a negative effect on PLRP performance metrics because of the lack of M&V. However, NYSERDA reports that the PSC required the Program to include an interval meter component in the final design.

In conclusion, the M&V evaluation contractor findings suggest that the existing M&V approach for DEGI, LC/S and PDRE projects is reliable. However, for IM projects, NYSERDA could set up a more rigorous process for verifying the applicants' self-reported demand reduction potential. For example, applicants might submit technical documentation to support their load reduction estimates.

Other Evaluation Findings

In addition to the measurement and verification evaluation work that is the focus of this paper, other NYSERDA evaluation contractors have investigated a number of additional performance metrics for the PLRP. Some of their work is reported briefly in this section in order to round out the picture of the Program's evaluation results.

Market Effects and Net-To-Gross Ratios

Summit Blue, the market assessment specialty contractor to the **New York Energy SmartSM** evaluation team, conducted a market effects study for the Program. The objective of the review was to assess the net enabled demand reduction for the PLRP by quantifying free rider and spillover impacts. Free rider impacts account for those impacts that would have been achieved independent of the Program. Spillover analysis accounts for impacts that occurred because of the Program's influence, but which are not captured by the Program's tracking metrics. The product of the free rider and spillover factors is the net-to-gross ratio, which indicates the percentage of the gross demand impact that can be exclusively attributed to the Program.

The market analysis evaluation contractor examined a sample of seventy completed projects that were drawn from the same population used by the M&V evaluation contractor. As part of the evaluation, surveys were distributed to market participants, who shed light on various issues including the role of the PLRP in their decision to pursue demand reduction measures and their overall satisfaction with the Program.

Based on the results of the market effects evaluation³, the Net-to-Gross ratio (NTG) for the PLRP is 0.95, calculated from estimated free ridership and spillover factors of 76% and 125% respectively. This implies an estimated net impact of 322 MW (340 gross MW x 0.95 NTG) from all LC/S, DEGI and IM projects completed through December 2003. The net MW is the portion of the adjusted gross MW (or demand reduction potential) that can be exclusively attributed to the operation of the PLRP.

Emergency Demand Response Performance

In 2000 Neenan Associates was jointly commissioned by NYISO and NYSERDA as the State's Price Responsive Load Program evaluation contractor. As previously mentioned, the PLRP gives participants the ability to curtail, but does not compel them to perform during system emergencies. To get a sense of the actual kW impact on the electric grid, the Price Responsive Load Program evaluation contractor calculated a *weighted performance ratio*, defined as *Curtailed load / Subscribed load*, for all summer emergency events called by NYISO.

In the 2001 report, Neenan Associates determined that overall, NYSERDA-funded participants⁴ in NYISO's Emergency Demand Response Program (EDRP) had outperformed non-NYSERDA participants by delivering an average of 63% of the pledged MW reduction. The non-NYSERDA group had a performance ratio of 56%, which was slightly lower than the overall average performance ratio of 58%. In the 2002 evaluation, the contractor observed a

³ NYSERDA. 2004. Draft of the 2004 New York Energy SmartSM Program Evaluation and Status Report.

⁴ NYSERDA funding may either come from the Peak Load Reduction Program or the Enabling Technology for Peak Load Management Program

slightly bigger differential, with a 53% performance ratio for NYSERDA participants and 45% for the non-NYSERDA group.

These numbers suggest that a significant benefit of NYSERDA's programs is the increased awareness by curtailment program subscribers of their demand reduction potential.

Conclusions

Three years of PLRP operations have resulted in 355 MW of enabled demand response in New York State. Based on an M&V evaluation of a sample of completed projects, the 355 MW is 95% of the Program's recorded impact, indicating good engineering and administrative procedures. Also, the PLRP net-to-gross ratio of 0.95 indicates that the Program free ridership is not excessive.

PLRP participants are more likely to respond to a NYISO emergency than non-Program participants. On average PLRP-enabled facilities deliver 58% of pledged demand response while their peers deliver approximately 51%.

NYSERDA is pleased with the Peak Load Reduction Program and intends to continue administering it for the foreseeable future. Using information from the evaluation activities, incremental modifications are being made to the program design to increase its economic performance and market impact.

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