Third-Year Program Results for a Utility Recommissioning Program

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Synopsis

Xcel Energy offers the Recommissioning Program to its Colorado commercial customers to reduce summer peak demand. Since 2002, the program has contracted with building owners to service 25 million square feet of building floor area through 63 projects. Currently, the Program has identified low-cost and no-cost savings opportunities totaling 6.5 MW of customer peak demand from 36 projects. Verified savings from installed measures for 17 completed projects total 2.2 MW.

This paper summarizes the basic program design and process. It outlines program modifications that were made in response to implementation challenges. The effect of the changes is evaluated by comparing performance indicators between program years. The paper overviews project impacts. Identified savings categorized by measure type are examined. Data are presented for project implementation costs and simple payback. The evaluation touches upon the cost-effectiveness of recommissioning from the perspectives of the utility and of the customer.

About the Authors

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Introduction

Xcel Energy (the utility) seeks to achieve 124 MW of demand-side management (DSM) resources by 2005 in Colorado as part of its 1999 Integrated Resource Plan. The recommissioning program (the program) is part of a suite of program offerings provided to meet this goal. Nexant, Inc. (the administrator) provides program design and administrative services for the program. As part of this, Nexant develops the program process, manages service providers, facilitates meeting measurement and verification (M&V) requirements, and provides quality assurance of deliverables.

The goal of the program is to achieve verified customer peak-demand savings totaling 6.5 MW by end-of-year 2005. The program targets operation and maintenance (O&M) improvements in existing buildings through a systematic evaluation. The Program is noteworthy because of its focus on peak demand savings, its M&V components, and its ability to be competitive with mature DSM programs.

Program Design

In 2002, the Program started its first year as a pilot. The full-scale program commenced in 2003 will continue through 2005. The program objectives are to meet annual and overall demand savings goals and to be cost effective. The overall savings goal is 6.5 MW of peak-period customer load reduction (on-site demand reduction occurring weekdays during June, July, and August between 3 PM and 7 PM) and 19,500 MWh of annual energy use. The program is on track to meet its objectives and deliver verified savings within the allocated program budget. The cost-effectiveness of the program is evaluated using the total resource cost test (TRC)[1]. TRC values greater than '1' indicated cost effectiveness. The TRC value determined for the Program is '4.7'. This value is comparable to that of a mature commercial building, DSM program focusing on capital improvement measures also offered by the utility in Colorado.

An overview of the program design components is provided below. For additional design considerations see (Franconi, 2003).

Eligibility

The program is available to commercial and industrial (C&I) customers. To be eligible, an applicant must meet the minimum requirements, which include a project with 75,000 square feet of conditioned space and a summer peak demand of 300 kW. In addition, the building owner must be prepared to assume costs and expenses totaling $10,000 for installing agreed-upon measures that net a simple payback of one year or less. In addition, priority is given for projects with the following characteristics:

[1] A benefit-cost test which measures the net costs of a demand-side program as a resource option based on the total costs of the program, including the participants' and the utility's costs. The benefits for the TRC are avoided supply costs. The costs in this test are the program costs (including equipment and service costs) paid by both the utility and the participants.

- Building equipped with an energy management control system
- Systems free of major problems requiring costly repairs or replacements
- The building gross square footage is 250,000 square feet or greater
- The building has high, normalized demand of 5 W/ft^2 or greater

Incentives

Program incentives are provided to participants in two ways.

1) To cover 100% of recommissioning services costs
2) To buy-down implementation costs to achieve a one-year simple payback for the building owner

Tying the implementation incentive to achieving a one-year payback reduces risk for the building owner. It also facilitates the use of funds from the building's O&M service budget to cover implementation expenses (the expense is balanced by savings in energy costs seen within the first year). Because most projects are highly cost-effective with overall simple payback periods of less than one year, few implementation incentives have been paid. Thus, this design attribute has encouraged program participation, without adding significantly to costs.

Service Providers

Recommissioning services are provided in the program by eight contractors. The recommissioning service providers (RSPs) were selected through a request for proposal (RFP) process. Only one RFP has been released to secure service providers since the full-scale program started in 2002. Working with one group of providers has benefited the program through lessons learned through repeated efforts. The group has increased their efficiency through effective prioritization of service tasks. In addition, the quality of project deliverables received for review has steadily improved. These improvements help build the market for services and make recommissioning a viable business model. They also increase cost-effectiveness of the program for the utility by reducing administrative tasks and costs.

Program Process

The program process includes: marketing, application review, provision of recommissioning services, implementation of measures, and verification. The utility account executives and customer service representatives, recommissioning service providers, and the program administrator market the program to enlist participants. Interested building owners complete the program application, which the program administrator reviews. An application review is followed by a telephone interview, which completes the screening. To date, 122 applications have been received and 63 accepted for participation.

The program administrator assigns the RSP to the project. Considerations made for assignment include: marketing involvement, service cost, service specialization, and work load. The RSP completes the service work and project deliverables. The services generally follow the standard recommissioning process that include the following phases: planning, investigation, and verification. Implementation is the responsibility of the building owner. An outline of the service tasks and deliverables is provided in Table 1.

To satisfy Colorado Public Utilities Commission (CPUC) requirements for M&V of DSM program savings, the process incorporates M&V elements. The project M&V plan is developed in the **investigation phase**. As part of this, the baseline conditions are identified and documented. Preliminary savings values are calculated. This ensures that all data needed to characterize measures and complete savings calculations are identified up front.

Table 1: Project Phases, Scope, and Deliverables

Project Phase	Planning Phase	Investigation Phase	Verification Phase
Scope	• Scoping • Feasibility Assessment • Work Plan	• Site Assessment • Service Triage • Functional Testing • Data Logging • Evaluation • M&V Plan • Savings Estimates	• Visual Inspection • Controls Sequence Review • Data Collection • Savings Calculations
Deliver-ables	• Recommissioning Planning Report	• Investigation Report	• Final Report

In the M&V Plan, a method is outlined for each recommended measure to verify its potential to reduce demand. Methods follow Option A or Option B of the IMPVP (IPMVP 2001). Option A may use spot measurements and manufacturer's data for determining savings. Option B is based on site trend data. Both methods use engineering analysis to translate performance data to savings values. In general, more rigorous methods are applied to measures with higher savings and greater variability. Typically, trend data characterizes the equipment baseline performance during hot, summer conditions. Demand savings are determined using detailed engineering calculations assuming recommended post-installation conditions are achieved. Energy savings follow similar calculations using binned temperature data. Verification typically entails establishing that recommended post-installation conditions exist. If verification reveals the implemented conditions are not as recommended, the savings are recalculated based on actual conditions.

Summary

While successfully competing with more mature DSM programs, the recommissioning program maintains market transformation elements. These elements contend with market barriers, such as: building owners being skeptical of the savings and persistence of O&M measures, an under-developed service market and lack of a recommissioning service business model.

The market transformation aspects, combined with the types of measures targeted by the program, contribute to the high administrative responsibilities associated with this and similar programs. Based on the experience gained from this program, successful program design should include effective and highly technical administration that covers the components listed below.

- Focused marketing
- Service provider training
- Preliminary project screening
- Project feasibility assessment
- Measure validity, persistence evaluation, and savings verification
- Quality assurance of detailed engineering analysis
- Quality assurance of deliverables

Program Challenges

The original program design developed in 2001 was modified in late 2003 after the pilot and 1 full-scale program year. The modifications made, as outlined in Table 2, were in response to implementation challenges. These challenges include 1) completing projects on schedule, 2) having projects meet savings goals, and 3) paying service providers in a timely manner.

The first two challenges – meeting project schedules and savings goals - impact the savings that can be attributed to the program for the year. Not meeting savings goals puts the program at risk due to cash flow constraints and lower cost-effectiveness. To improve scheduling; projects are started sooner, more time is allocated for contracting, contracting incentives are offered, and RSPs are more tightly managed. To improve project savings, a stricter feasibility assessment was adopted in the Planning Phase. As part of this, projects are dropped from the Program if they cannot identify sufficient potential demand savings. This change resulted in RSPs getting down to business earlier in the project. In 2004, 4 projects out of 26 were terminated after the planning phase.

The third challenge involves timely payment of the service providers. Their subcontracting arrangement with the administrator is “pay when paid.” Thus, the RSP is paid after the utility pays the administrator. This results in RSP invoice aging of at least ~120 days. A short term solution is to make payments closer to the time the work is completed by allowing early invoicing when a deliverable is submitted for review (instead of when accepted in final form). An alternative solution is to have the Utility pay the RSP directly.

Table 2: Program Design Enhancements

Category	Problem	Design Enhancement
Project Scheduling	Projects get started late in the year	• Commence application drives earlier
Project Scheduling	Months required to have utility-building owner contract signed	• Offer bonus cash incentive for early signing
Project Scheduling	Service providers falling behind on project deliverable due dates, which leads to difficulties achieving program end-of-year savings goals	• Include deliverable due dates as part of contract • Include payment penalty for late deliverable submittal in contract if meeting due dates have historically been a problem • Regularly provide reminders about due dates and conduct project status reviews
Project Savings	Projects not meeting savings goals	• Improve application screening so projects that need to meet aggressive savings goals to be cost effective are not accepted • Modify service expectations in Planning Phase to emphasize scoping and demonstrating potential for savings • Drop or reduce service cost for projects not able to identify 80% of demand savings goal in the Planning Phase
Invoice Payment	"Pay when paid" arrangement between utility subcontractor and service providers results in aging invoices	• Allow invoice processing to begin before deliverables are finalized

Program Impact

Since its commencement in 2002, the program has contracted with building owners to service 25 million square feet of building floor area through 63 projects. The breakdown of participants by building type is presented in

Table 3. Commercial office space is the most common building type, accounting for about half the projects and floor area serviced through the Program.

Table 3: Program Participants

Building Type	Number	Total Area (ft^2)
Office	32	12,863,246
Hospital	6	2,977,665
Campus	7	2,537,893
Sports complex	3	1,654,129
Industrial	3	657,000
Retail	2	1,600,000
Other	10	2,464,757
ALL	63	24,754,690

High-level program statistics that characterize projects are summarized in Table 4. The average project is ~ 380,000 square feet with demand intensity of 5.5 W/ft^2 and energy intensity of 27 kWh/ft^2. So far, the Program has identified low-cost and no-cost savings opportunities totaling 6.5 MW of customer peak demand from 36 projects. This averages 181 kW per project. Identified savings are those low-cost and no-cost measures recommended for installation in the Investigation Report. Typically, the building owner agrees to implement measures representing 70% of the identified savings. Verified savings from installed measures for 17 completed projects total 2.2 MW. Overall, measure verification has not resulted in decreasing the anticipated program savings. This is a result of conservative assumptions being used in the measure saving estimates.

Program performance indicators were evaluated for periods before and after 2004 and are presented in Table 5 and Table 6, respectively. The data clearly indicates that project performance improved after 2004. The later projects benefited from program maturity and design modifications. The average identified savings per project jumped from 147 kW to 233 kW. Accepted savings also increased from 105 kW to 155 kW.

In terms of normalized values, the identified savings increased between the two program periods from 0.41 W/ft^2 to 0.59 W/ft^2. Similarly, the accepted savings increased from 0.27 W/ft^2 to 0.39 W/ft^2. These changes represent about a 45% improvement in identified and accepted savings. (As noted in Table 4 and true for Tables 5 and 6, the minimum and maximum of the normalized savings values are based on project data. However, the average normalized values are based on Program totals for savings and floor area.)

Table 4: Statistics Summary for Recommissioning Program

Project Statistics	Sample Size	Min	Max	Average	Std Dev
Size[1] (ft^2)	63	86,000	1,280,239	379,741	236,566
Peak Demand[2] (W/ft^2)	47	3.5	8.3	5.5	1.2
Energy Use[3] (kWh/ft^2 year)	51	13.0	49.5	27.0	9.3
Service Cost[4] ($\$/ft^2$)	59	0.02	0.18	0.10	0.03
Identified Savings[5] (kW)	36	5	805	181	192
Accepted Savings[6] (kW)	34	5	489	126	132
Verified Savings[7] (kW)	17	3	609	128	204
Identified Savings[8] (W/ft^2)	35	0.01	1.52	0.46	
Accepted Savings[9] (W/ft^2)	33	0.01	1.40	0.31	
Verified Savings[10] (W/ft^2)	17	0.01	1.23	0.33	

1 Based on building area serviced, typically whole building floor area but is partial floor area of complex in campus projects
2 Excludes participating facilities with available data whose benchmarks do not indicate savings potential within service scope, including: sport complexes, industrial buildings, and campuses
3 Excludes participating facilities with available data whose benchmarks do not indicate savings potential within service scope, including: sport complexes, industrial buildings, and campuses
4 Normalized actual service costs based on payments made to service providers, excludes pilot projects
5 Summer peak demand savings identified in the Investigation Phase and determined from baseline characterization data and engineering calculations
6 Summer peak demand savings identified in Investigation Phase and accepted for implementation by the building owner
7 Summer peak demand savings verified after installation through M&V
8 Min and max values are based on project data, average value is based on program-level data
9 Min and max values are based on project data, average value is based on program-level data
10 Min and max values are based on project data, average value is based on program-level data

Project Data

Details from 30 projects completed through the **investigation phase** are outlined in **Table 7**. The data provides a glimpse of the characteristics of the buildings being serviced and their identified savings potential. Two simple payback values are included: 1) the simple payback based on savings and costs of all recommended measures and 2) the simple payback based on savings and costs for all recommended measures and costs for services. The two values indicate the payback for the building owner with and without utility service incentives.

Projects that have overly high demand values compared to their floor area indicate that they are a building within a campus complex (that is not sub metered). A quick scan of normalized demand savings reveals the large variation in savings as a fraction of total demand experienced in the program. The projects are listed in ascending order based on start date. Savings values per project generally increase down the list, which indicates more savings being identified in later projects.

While the program emphasizes demand savings and not energy savings, energy savings are evaluated and considered in determining project simple payback. On average, 4500 kWh are saved for each kW saved.

Table 5: Pilot and 2003 Program Projects

Indicators of Project Savings	Sample Size	Min	Max	Average	Std Dev
Identified Savings (kW)	20	5	669	147	168
Accepted Savings (kW)	18	5	443	105	117
Verified Savings (kW)	16	3	543	98	137
Identified Savings (W/ft^2)	20	0.01	1.52	0.41	NA
Accepted Savings (W/ft^2)	18	0.01	1.01	0.27	NA
Verified Savings (W/ft^2)	16	0.01	1.23	0.28	NA

Table 6: 2004 Program Projects

Indicators of Project Savings	Sample Size	Min	Max	Average	Std Dev
Identified Savings (kW)	15	16	805	233	205
Accepted Savings (kW)	15	16	489	155	141
Verified Savings (kW)	1	609	609	609	NA
Identified Savings (W/ft^2)	14	0.08	1.40	0.59	NA
Accepted Savings (W/ft^2)	14	0.08	1.40	0.39	NA
Verified Savings (W/ft^2)	1	0.71	0.71	0.71	NA

Based on the 30 projects, the average project size is about 350,000 square feet and the service costs are just under $30,000 (from the program average of 0.084 $\$/ft^2$). Recommended measures save 149 kW and are estimated to cost $36,000 to install. However in the Program, building owners are only obligated to spend $10,000 for installation. The majority choose the most cost effective measures for installation. Thus, the actual average project installation cost is lower than $36,000. Nevertheless, if costs for all measures are considered, the project simple payback period is short – usually within one year, which is the project average. If service costs are also considered, the average simple payback is three years. In the table, the simple paybacks determined from program totals are weighted averages and not project averages. For example, the average simple payback (w/o service costs) is 0.99 if calculated from averaging the project simple payback values. If calculated using the Program totals for floor area and identified savings, the value is 0.85.

For the 30 projects, 146 measures were identified and recommended for implementation. These measures are categorized by the equipment or system they impact.

Table 8 is listed in descending order of total demand savings. The table shows their associated savings, estimated installation costs, and simple payback. The equipment/system most frequently impacted is the air-handling unit (AHU). The savings from these measures account for one-half of the savings identified in the Program. Savings from chillers represent another large piece of the program savings, equaling about one-fourth of the total savings. While encountered less frequently than AHU measures, chiller measures have larger savings. In addition, chiller measures are among the most cost effective measures seen in the program. Measures impacting about a dozen other pieces of equipment make up the remaining one-fourth of program savings.

Table 7: Details of Identified Savings for 30 Projects

No.	Building Area (ft^2)	Service Cost ($\$/ft^2$)	Building Peak Demand (kW)	Ident. Savings (kW)	Ident. Savings (W/ft^2)	Identified Savings (kWh)	Annual Cost Savings ($)	Estimated Install Cost ($)	Simple Payback w/o Service Costs	Simple Payback w/ Service Costs
1	321,000	0.10	1,706	333	0.35	491,482	33,954	39,000	1.15	2.11
2	260,000	0.13	18,696	61	0.08	565,895	24,498	11,181	0.46	1.87
3	342,488	0.11	1,768	63	0.18	0	11,610	1,500	0.13	3.33
4	324,645	0.11	1,640	247	0.15	1,081,797	45,819	21,140	0.46	1.26
5	847,615	0.05	2,991	5	0.01	167,162	77,618	13,310	0.17	0.69
6	86,000	0.16	570	29	0.11	72,741	3,413	5,600	1.64	5.58
7	289,000	0.09	2,400	135	0.09	846,400	25,629	8,780	0.34	1.33
8	240,000	0.12	1,061	147	0.12	1,388,269	65,275	35,045	0.54	0.97
9	274,700	0.08	1,859	291	0.53	759,099	45,758	18,983	0.41	0.92
10	440,000	0.09	24,460	509	0.11	2,033,954	162,586	20,475	0.13	0.36
11	118,500	0.18	598	6	0.03	22,944	1,858	1,000	0.54	11.90
12	135,620	0.17	682	14	0.02	265,245	4,377	16,580	3.79	9.09
13	288,447	0.09	1,630	82	0.02	532,020	25,093	7,079	0.28	1.35
14	480,000	0.09	2,700	78	0.08	717,759	35,938	11,922	0.33	1.58
15	277,033	0.07	1,000	39	0.05	74,123	21,892	49,548	2.26	3.15
16	237,511	0.07	928	35	0.05	84,767	18,562	15,270	0.82	1.72
17	175,000	0.14	1,100	9	0.03	52,520	3,876	11,500	2.97	9.32
18	320,000	0.10	1,999	198	0.07	2,278,657	80,546	184,426	2.29	2.68
19	860,000	0.05	4,424	0	0.00	2,388,134	179,310	154,650	0.86	1.11
20	215,000	0.12	1,814	119	0.18	821,652	38,186	32,574	0.85	1.56
21	210,500	0.10	810	15	0.07	32,115	2,722	960	0.35	7.98
22	474,629	0.08	5,409	197	0.04	0	37,721	66,300	1.76	2.75
23	223,000	0.11	1,422	65	0.05	717,082	36,176	34,770	0.96	1.66
24	1,280,239	0.02	5,770	789	0.07	783,489	28,397	7,000	0.25	1.30
25	400,000	0.10	1,814	169	0.05	717,687	38,227	82,468	2.16	3.19
26	600,000	0.07	4,300	225	0.06	700,384	45,654	82,420	1.81	2.77
27	386,562	0.09	2,286	289	0.25	1,698,781	133,830	133,488	1.00	1.27
28	160,000	0.13	909	118	0.12	353,488	16,915	7,040	0.42	1.63
29	121,085	0.15	593	152	0.21	286,018	16,023	5,098	0.32	1.46
30	60,000	0.25	360	46	0.26	143,695	5,194	1,350	0.26	3.15
Tot	10,448,574	0.08	97,699	4,463	0.43	20,077,358	1,266,656	1,080,457	0.85	1.55
Avg	348,286	0.11	3,257	149	0.11	669,245	42,222	36,015	0.99	2.97

Table 8: Breakdown of Identified Measures by Equipment

Affected Equipment or System	Measures	Total Identified Savings (kW)	Total Identified Savings (kWh)	Average Annual Savings ($)	Average Install Cost ($)	Average Simple Payback
AHU	83	2,245	9,998,505	8,984	6,267	0.70
Chiller	12	1,097	2,559,525	11,176	5,485	0.49
Lighting	13	239	1,431,129	5,148	3,475	0.67
DX Unit	12	222	2,325,771	9,785	11,932	1.22
Pumps	10	181	881,298	4,486	7,158	1.60
Space	4	175	862,184	9,622	32,943	3.42
Water Heater	1	80	0	14,653	59,000	4.03
Compressor	1	68	594,243	30,741	2,900	0.09
Chiller Plant	4	50	906,379	8,582	2,523	0.29
Various	1	32	35,107	5,414	4,240	0.78
Cooling Tower	2	28	196,026	7,063	10,385	1.47
Terminal Boxes	1	28	244,667	10,085	3,360	0.33
Heat Recovery	1	12	3,377	16,778	8,680	0.52
Boiler	1	7	39,147	2,060	3,500	1.70
ALL	146	4,463	20,077,358	144,576	161,846	1.12

Conclusions

For the utility, recommissioning provides a cost-effective C&I DSM resource. Its cost effectiveness is comparable to mature DSM programs targeting energy-efficient capital improvement projects for the same market. However, its administration requirements are more intensive. Based on the experience of the recommissioning program, greater program success is achieved through tight project management and service accountability.

For the building owner, program project data gives strong evidence of the cost effectiveness of recommissioning. On average, recommissioning projects achieve a one-year simple payback without utility implementation incentives. If service costs are also considered, the average simple payback period is three years.

Yet even with these attractive investment terms, the program requires determined marketing to secure attractive candidates. This program aspect underscores the existence of market barriers for recommissioning services. Because of these barriers, it is more critical for this and similar programs to provide consistent, high quality services resulting in verifiable savings to the market. In doing so, firms develop an effective business model that builds credibility for recommissioning services for building operators and owners.

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