Impact and Process Evaluation of NorthWestern Energy 2007–2011 Demand Side Management Programs

Submitted to

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Please note:
This PDF is a report excerpt including content relating to Building Operator Certification.

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EXECUTIVE SUMMARY

This report presents the methodology, findings and recommendations based on an impact and process evaluation of the NorthWestern Energy (NWE) Demand Side Management (DSM) portfolio. The evaluation covers the operation of 24 energy efficiency and renewable energy programs during the period July 1, 2006 through December 31, 2011.

Evaluation of Impacts and Cost-Effectiveness

The table below shows the net savings and cost effectiveness findings for NWE's natural gas and electric programs funded with Universal System Benefits Charges (USBC) or through natural gas and electric supply rates. We base these findings on data collection and analysis of participant and non-participant samples representative of each program in the portfolio. As part of this evaluation, we completed file reviews for 1,181 participants. Our field staff also completed site visits, and site-specific energy savings estimates for 638 participants and, as part of that effort, we installed 220 light loggers at 75 homes to measure hours of lighting operation. Our team completed telephone surveys with 922 participants to assess free ridership and they assessed spillover for 508 participants. In addition, we interviewed 40 Compact Fluorescent Lamp (CFL) retailers to determine what portion of the Upstream Buy-Down CFLs (and related Northwest Energy Efficiency Alliance (NEEA) Initiatives were purchased by businesses.

The energy impact and cost-effectiveness results from our evaluation are summarized in Table 1. As shown in the table we found that NWE's DSM portfolio achieved 87 percent of reported electric savings and 66 percent of report gas savings over the five year period covered by this evaluation. The table also shows our findings regarding the benefits and costs of the portfolio during this period. Benefits exceeded costs (Benefit/Cost ratio greater than 1) except for the Total Resource Cost and Societal Cost tests for gas.

Table 1: Portfolio Impact and Cost-Effectiveness for All Calendar Years

Funding	Program	Units	Reported Energy Savings	Net Savings Adjustment Rate	Adjusted Savings	Benefit/Cost Ratios			
						Total Resource Cost (TRC) Test	Program Administrator Cost (PAC) Test	Ratepayer Impact Measure (RIM) Test	Societal Cost (SC) Test
Electric									
	All Programs Electric	kWh	309,335,688	0.87	270,564,139	1.43	2.55	1.48	1.58
Natural Gas									
	All Programs Natural Gas	dkt	874,310	0.66	577,245	1.29	1.62	1.21	1.42

A large majority of the portfolio savings were due to the installation of CFLs in homes or businesses. The residential CFL operating hours study we performed determined daily hours of use, averaged over a year, for a typical CFL in a NWE program participant residence. We recruited a sample of 76 participants in the residential CFL direct and owner install program residences, and metered 220 CFLs at these residences (about three per home). We then explored means to annualize the metered data first by applying linear regression techniques to individual meter and aggregate data, then ultimately by applying monthly usage profiles from other lighting metering studies. Extrapolated results showed average use of 2.02 hours/day in 2012, 45% less than the 3.7 hours/day used by NorthWestern Energy from the 2007 Nexant Program Evaluation.

The persistence study we performed assessed claimed measures for programs and measures of particular interest. We inspected a sample of such measures from the 2007–2008 program years to determine whether the measures were still operational and yielding substantial savings. For measures where onsite inspections were unlikely to yield useful information--such as a boiler tune-up, for example--we instead performed literature reviews. We then analyzed both the onsite inspection and literature review data qualitatively and developed recommendations for maintaining or adjusting the portfolio measure lives. For the programs and measures we studied, we generally found the applicable EULs to be reasonable. We did, however, find some areas worthy of additional scrutiny and possible adjustment for future program years.

Based on the impact evaluation findings, NWE should consider the following portfolio-wide opportunities:

- Increase marketing efforts to further awareness of the efficiency opportunities that NWE offers.
- Compile customer e-mail addresses in the tracking database.
- Maintain consistent names for each program across evaluation cycles.
- Update UES values regularly, and apply by building type when applicable.

Additionally, some of the more significant program-specific opportunities to consider include:

- Improve audit report clarity and follow-up.
- Improve CFL hours of use estimation, as well as appropriate light levels and documentation.
- Work with NEEA to use NWE service territory-specific sales data, improve savings analysis transparency, and reassess treatment of CFL retirement.
- Restructure or drop programs with poor participation, such as new construction, motor rewind, and Vending Miser.

Process Evaluation

NWE offers a large portfolio of residential and non-residential programs, including audits, prescriptive rebates, custom incentives, and education and training. It offers this portfolio with an extremely low staff to budget ratio, as compared with program administrators around the

country. NWE's efforts are firmly grounded in efficiency program best practices. It follows over 50 best practices in program planning and design, management and administration, marketing and outreach, quality control, tracking and reporting, and evaluation. NWE clearly adopted recommendations offered in the process evaluation conducted for the 2004–2006 program cycle.

We identified that NWE's program practices adheres to over 50 established best practices, as shown in the following table. Yet the best practices are ideals; in practice, there is always room for improvement and we identify opportunities for NWE to further enhance its strong programs.

Table 2: Executive Summary NWE Efficiency Programs Adhere to Over 50 Best Practices

1	Develop a sound program plan
2	Understand local market conditions
3	Define and identify hard-to-reach customers and target programs accordingly (as appropriate given constraints)
4	Maintain program design flexibility to respond to changes in market and other factors
5	Maintain program funding throughout the year
6	Clearly articulate program changes to trade allies and customers
7	Develop written process plan
8	Keep participation simple
9	Offer assistance in preparing and submitting program applications
10	Use internet to facilitate participation
11	Provide quick, timely feedback to applicants
12	Maintain accurate contact lists
13	Ensure all staff have decision-making authority commensurate with their responsibilities and that assignments avoid bottlenecks
14	Maintain clear lines of communication
15	Capture and retain "program memory" in-house
16	Offer a single point of contact for customers of audit and non-residential programs
17	Use electronic processing
18	Use well-qualified engineering staff for technical programs
19	Communicate with customers through multiple media
20	Use the program's website to broadly inform the market and attract participation
21	Use Energy Star products and logo for leverage and to instill consumer confidence
22	Leverage marketing dollars, including: relationships with trade allies; co-sponsoring or participating in relevant events hosted by other organizations
23	Promote all benefits of energy efficient measures
24	Develop and disseminate testimonials (residential) and case studies (non-residential) to showcase program projects
25	Conduct cross-program marketing
26	Conduct sample-based post-installation inspections

27	Conduct post-project inspections for all large projects (relative to total program savings) and projects with highly uncertain savings (mindful of administrative costs and cost-effectiveness)
28	Similarly, conduct pre-project inspections for large or uncertain impacts, perhaps owing to highly uncertain baseline conditions
29	Assess customer satisfaction
30	Verify accuracy of invoices and incentives; ensure accuracy of reported qualifying installations by target market
31	Implement a contractor QC process, such as training, screening or certification
32	Identify data requirements needed for success metrics and periodic program evaluation (especially pertinent to tracking performance of new or substantially revised programs)
33	Carefully document the tracking system and provide manuals for all users
34	Build in rigorous quality control screens for data entry
35	Use Internet to facilitate data entry and reporting; develop electronic application processes and, as relevant, web-based communications, to the extent the benefits warrant the costs
36	Link databases to dynamically exchange information
37	Integrate all program data, including measure-level data, into a single database
38	Develop accurate algorithms and assumptions on which to base savings estimates
39	Use Internet to facilitate data entry and reporting
40	Include audit recommendations and savings potential in program tracking database
41	Track vendor activity (number of jobs, measure types, savings)
42	Track incentives committed
43	Collect pre-existing wattage data
44	If use proactive marketing, track prospects early and drive program intervention around major equipment-related events
45	Periodically review and update market-level information about measures, including construction practices, EE market share and measure adoption; conduct periodic baseline studies
46	Conduct detailed ex post, impact evaluations -- including measure verification -- routinely, though not necessarily annually; review and update algorithms for calculating project savings; estimate free ridership and spillover
47	Use regular process evaluation activities to provide timely and fresh data providing feedback supporting program rationale and design
48	Create a culture whereby evaluation findings are valued and integrated into program management
49	Support program review & assessment at the most comprehensive level possible
50	Select an evaluator who has a detailed understanding of the market context in which a program operates
51	Clearly explain evaluation roles and responsibilities to participants in advance

NWE has opportunities to build on its successes by considering additional best practices and adopting those that appear to have value for them and their customers. We emphasize that responding to opportunities requires additional work for NWE and may not be cost-effective. No program administrator is in full conformance with all best practices. NWE should adopt those practices whose benefits seem likely to outweigh their implementation costs.

NWE should consider the following opportunities:

- Formalize the outcome of its planning efforts with written program plans

- Reduce the frequency with which it updates its cost-effectiveness analyses and qualifying measures
- Systematically update customers about program changes
- Write down process plans (that is, detailed implementation activities, including roles and responsibilities)
- Include in trade ally program communications a means to provide program feedback to NWE; contractors can be a good source of market intelligence and suggestions for program improvement
- Increase the use of internet tools in facilitating program applications
- Provide participants with more information about efficiency opportunities through mail
- Notify participating trade allies by email of all Montana-based efficiency related workshops, seminars, and training opportunities – the information NWE currently provides the members of its Lighting Trade Ally Network
- Recruit additional trade allies as preferred contractors from among the contractors serving "self-installed" participants
- Incorporate additional non-energy benefits and marketing messages, such as waste reduction and community benefit
- Consider project inspection costs when setting ongoing inspection rates; NWE may be over-inspecting in some programs
- Adopt a fast-feedback evaluation approach, which surveys customers within a month or so of participation to obtain customer satisfaction and free-ridership information
- Monitor product markets and conduct market saturation studies to assess the extent of market transformation; exit transformed markets
- Conduct more frequent, smaller-scope evaluations

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1. INTRODUCTION

1.1. Key Terms

The following are definitions of key terms used throughout this report.

Term	Definition
Choice Customers	In NWE's Montana service territory, legislation was enacted in the late 1990s to allow customers to arrange for electricity and/or natural gas supply in competitive markets. Customers who have moved to competitive supply are Choice Customers. NWE Montana provides its Choice Customers with transmission and distribution services only.
Custom Measures	Measures implemented under NWE efficiency programs that are assigned customized, measure-specific incentives and savings estimates.
Desk Top Review	An analysis of savings that includes engineering review of program documentation but does not involve on-site inspection or metering.
DSM (Demand Side Management)	Describes NWE Montana's entire programmatic efforts for energy efficiency and renewable energy funded through electric and natural gas supply rates as well as with USB funds.
E+ Program Contractors	Entities selected by and contracted with NWE to provide products and services to NWE Montana customers through the E+ Commercial Programs (electric and gas). These contractors are paid based upon the energy savings generated by the E+ Program projects customers undertake.
E+ Programs	DSM programs marketed as Efficiency Plus (E+) Programs includes offerings for all classes of electric and natural gas customers in the NWE Montana service territory.
Firmographic	A term coined to describe for the non-residential sector; a concept analogous to the adjective "demographic" for the residential sector. Firmographic data describes the characteristics of the firms in the population or sample.
Free Rider	Someone who would have installed an energy efficiency measure or followed an energy efficiency recommendation without a financial incentive from NWE but received a financial incentive or rebate anyway.
Free Ridership Estimate	Energy savings likely to have occurred in the program's absence.
Gross Savings	Annual energy savings determined either by NWE or this evaluation. Gross savings do not account for free ridership, leakage or spillover, which are included in estimating net savings.
Implementation Contractors	Entities selected by and contracted with NWE Montana to implement the E+ Programs, including providing products and services to NWE Montana customers.

Term	Definition
Indirect Measures	Non-rebated measures or activities implemented during the program years being evaluated as a result of audits, education and training activities funded by NWE efficiency programs.
Install Date	Date that the implementation of a program measure or project was completed by the customer or project implementer.
Leakage	Movement of rebated or directly installed efficiency measures outside of NWE Montana's service territory.
NEEA (Northwest Energy Efficiency Alliance)	NEEA works in collaboration with its funders and other strategic market partners to accelerate the innovation and adoption of energy-efficient products, services, and practices.
Net Savings	Gross savings adjusted for free ridership, leakage, and spillover.
Net to Gross Ratio	The ratio of net savings to gross savings.
Participant	Customer who receives information, education, training, services, rebates or incentives through the NWE efficiency programs.
Preferred Contractors	Insulation and equipment contractors approved by NWE Montana for higher incentives through the E+ Residential Electric Savings and E+ Residential Gas Rebates programs.
Prescriptive Measures	Measures implemented under NWE efficiency programs that are assigned unitized incentives and unitized (or very simplified) energy savings.
Program	Includes both electric and natural gas energy conservation and renewable programs within the NWE Montana service territory for both residential and non-residential customer segments.
Program Staff	The employees of NWE Montana that design, manage, and implement the E+ and other efficiency programs.
Realization Rate	A decimal fraction that is computed by dividing the evaluation savings estimate by NWE's savings estimate for a sampled measure or project.
Rebate Date	Date that NWE paid the program rebate or incentive to the customer or implementer.
RTF (Regional Technical Forum)	An advisory committee established in 1999 to develop standards to verify and evaluate conservation savings. Its voting members are appointed by the Northwest Power and Conservation Council.
Spillover	Energy savings induced by, but not subsidized by, the program.
Spillover Estimate	An estimate of spillover savings expressed as a proportion of gross savings.
UES (Unit Energy Savings)	The energy savings estimate applied to each unit of a given energy efficiency measure (such as a 13 watt CFL in residential use).
USB (Universal System Benefits)	A funding source established by the Montana legislature for programs that provide benefits to the broad public through such activities as local conservation, market transformation, renewable generation, research and development, and low income activities.

1.2. Portfolio Summary

This report presents the methodology, findings and recommendations based on an impact evaluation of the NWE DSM portfolio. The evaluation covers the operation of 24 energy efficiency and renewable energy programs during the period July 1, 2006 through December 31, 2011.

Following is a brief summary of the programs that comprise the portfolio:

- **E+ Audit Home or Business** – This program has three components; Home Electric Survey, Home On-site Audit, and Small Business Electric Appraisal. The Home Electric Survey is a mail-in survey. The Home On-site Audit and Small Business Electric Appraisal are on-site surveys. The on-site audits may include free installation of hot water efficiency measures. All components include custom reports to customers which recommend efficiency improvements.
- **E+ Building Blocks Pilot** – This former pilot program offered free high-quality investment-grade audits within a concentrated area of downtown Bozeman with the goal of increasing participation in NWE electric rebate, gas rebate, and/or custom incentive programs. Participating customers received a report with recommendations for energy efficiency measures and improvements to operation and maintenance practices.
- **E+ Business Partners** - This custom incentive program serves eligible electric and gas customers in the commercial, industrial, institutional, multifamily, and agricultural sectors. The program includes both retrofit and new construction projects. Any measure that achieves energy savings may be proposed for funding, provided it is not offered through prescriptive rebate programs. Customers may develop projects on their own; however, third party consultants and contractors are involved in the majority of program projects.
- **E+ Irrigation** – This custom incentive program serves eligible customers in the agricultural sector. The program includes both new and existing irrigation equipment. Any irrigation measure achieving energy savings may be proposed for funding, provided it is not offered through the commercial electric rebate programs. Customers may develop projects on their own; however, third parties are involved in the majority of program projects.
- **DEQ Appliance** - The Montana Department of Environmental Quality (DEQ) operated this appliance rebate program with American Recovery and Reinvestment Act (ARRA) funding. NWE provided program support through advertising. Montana residential customers received DEQ rebates for specified Energy Star appliances on a first come, first served basis until the funding was depleted. The program is no longer offered.
- **E+ Commercial Existing Electric Rebate** - This non-residential electric prescriptive rebate program offers incentives to eligible non-residential customers who install prescriptive electric efficiency measures. The program covers all non-residential electric rebate measures with the exception of lighting and motors. General measure areas include heating, ventilation, and air conditioning (HVAC), irrigation, appliances, refrigeration, weatherization, and electric water heating.

- **E+ Commercial Existing Gas Rebate** - This non-residential gas prescriptive rebate program offers incentives to eligible non-residential customers who install prescriptive gas efficiency measures. The program covers measures for high efficiency HVAC, service water heating, and refrigeration heat recovery.
- **E+ Commercial Lighting** – This program has two components; Commercial Lighting Rebate and Commercial compact fluorescent lamp (CFL) Direct Install. The E+ Commercial Lighting component targets NWE's commercial, industrial, and institutional customers. The program provides prescriptive rebates for customers replacing obsolete lighting equipment with more efficient technologies and the installation of lighting controls. The CFL Direct Install component is implemented during the Small Business Electric Appraisal audit.
- **E+ Commercial New Electric Rebate** – This program for new construction is a prescriptive rebate program that offers prescriptive electric measures for commercial new construction projects.
- **E+ Commercial New Gas Rebate** – This program for new construction is a prescriptive rebate program that offers measures for high efficiency HVAC, service water heating, and refrigeration heat recovery to eligible gas customers.
- **E+ Electric Motor/Rewind Rebate** – This program has two components; Premium Efficiency Motor Rebates and Motor Rewind Rebates. The program serves the commercial, industrial, institutional, and agricultural sectors. The Motor Rewind component offers rebates to eligible customers that participated through a rewind shop certified as a Green Motors Practice Member. The Premium Efficiency Motor Rebate component offered rebates to eligible customers that purchased new National Electrical Manufacturers Association (NEMA) Premium efficiency motors. The motor rebate program is no longer offered.
- **E+ Free Weatherization/Fuel Switch** – This program provides weatherization and conversions from electric heat to natural gas heat to qualified low income NWE customer households. The program is a partnership between NWE and Montana's Department of Public Health and Human Services (DPHHS).
- **E+ New Homes** – This legacy rebate program offered prescriptive incentives to new homeowners for efficiency improvements to new residences through 2008. From 2009 through the end of 2011, the program provided training, verification, marketing, and advertising.
- **E+ Residential Existing Electric Rebate** – This residential electric prescriptive rebate program offers incentives to eligible residential customers who install prescriptive electric efficiency measures. Measure eligibility varies depending on whether the home uses electricity for space and/or service water heating.
- **E+ Residential Existing Gas Rebate** – This program has two components; Residential Existing Gas Rebate and Residential Existing Gas Free Kits. All NWE residential gas supply customers are eligible to participate in the program. The Residential Existing Gas Rebate component offers prescriptive rebates measures such as insulation, high-efficiency gas space-heating and water-heating equipment. The Residential Existing Gas Free Kits offers

free weatherization kits through distribution events or at the time of a home energy audit. There are four types of kits; weatherization, hot water, windows and programmable thermostats.

- **E+ Residential Lighting** – This program has six components which involve the distribution of energy efficient CFLs to residential customers. The components include;
  - in-store coupons redeemed by customers at local retailers
  - trade show give-aways
  - mail-in rebates mailed to customers after submittal of an application and product documentation
  - mail-out CFL bulbs sent to Home Electric Survey participants along with their audit report
  - direct install bulbs installed by NWE during the Home On-site Audit
  - upstream buy-down bulbs distributed through local retailers
- **E+ Residential New Electric Rebate** - This prescriptive rebate program offers rebates on a whole-house basis for manufactured homes meeting the Northwest (NW) Energy Star certification standard and for specific electric measures within the newly constructed electrically heated site-built homes.
- **E+ Residential New Gas Rebate** - This prescriptive rebate program offers rebates on a whole-house basis for manufactured homes meeting the Northwest Energy Star certification standard and for specific gas measures within newly constructed natural gas heated site-built homes.
- **Low Income Appliance** – This pilot program was operated in partnership with Energy Share of Montana, a private non-profit agency, to provide free Energy Star refrigerators to qualified low income NWE customers who met certain eligibility criteria. The program is no longer offered.
- **Vending Miser** – This program involves the installation of energy efficient Vending Misers (VMs) in schools and local government facilities participating in other NWE programs. VMs are also installed in NWE facilities.
- **E+ Renewable** – This program offers incentives for qualifying renewable energy installations in residential and non-residential facilities. Prescriptive rebates are offered through qualifying installers primarily for residential solar photovoltaic (PV) and wind power projects. Custom incentives are considered through individual project proposal submittals. Funding decisions are made by NWE with input from the NWE USB Advisory Committee's renewable subcommittee. The majority of program projects are 1 to 3 kW PV systems on residential structures, followed by wind turbines, and a small number of other renewable projects such as solar thermal systems, low-head hydro, biomass, and larger PV arrays.
- **Building Operator Certification** – This is a NWE sponsored professional development program for managers and operating engineers of commercial and public facilities. NWE

contracts with the International Building Operator Association to conduct the training. The program is designed to teach best practices for optimizing energy and resource efficiency in the operation and maintenance of buildings. The program is open to commercial customers and trade allies. NWE provides scholarships to qualifying customers from public schools, local governments, and hospitals.

- **Motor Management Training** - This is a professional development program designed for those involved in electric motor system operation, maintenance, purchasing, or repair. The one day training program is presented in various locations around the state each year by the Green Motors Practices Group. Topics include motor operating costs, motor systems improvements, motor operating characteristics, rewinds and repair specifications, and legislation pertinent to the field. Motor management training is targeted to electricians and commercial facilities and open to NWE electric facilities and the trade allies who support them.
- **NEEA Initiatives** – NWE is a funding utility of the Northwest Energy Efficiency Alliance (NEEA). NEEA's portfolio is funded by electric utilities in the Northwest, BPA, and the Energy Trust of Oregon through multi-year contracts. A handful of other NEEA market transformation initiatives are separately funded by a subset of funders. This evaluation assessed the impacts of 18 NEEA initiatives for which NWE reported savings across the 2006-2011 program years. NEEA is counted as one of the 24 NWE programs in this evaluation.

1.3. Research Objectives

The research objectives for the impact portion of the evaluation are as follows:

- Estimate gas and electric gross savings, by program, for tracker years 2006-07 thru 2010-11 and calendar years 2007-2011.
- Estimate net savings, accounting for free ridership, spillover and leakage.
- Collect data on measure persistence to inform the estimation of measure life.
- Determine the impact of estimating savings for each program or calendar year based on measure installation date rather than measure rebate date.

We used the following information to address these objectives:

- NWE's project files (documentation of measure installation and inspection).
- Program tracking databases maintained by program staff and implementation contractors.
- On-site inspections of measure installation and operation, including in some cases collection of trend logs from special metering of customer control systems.
- NWE unit energy savings estimates and associated documentation.
- NWE Testimony and Exhibits related to USB or DSM in all relevant electric/natural gas dockets.

- Applicable impact evaluation studies conducted by NEEA and others.
- Telephone surveys with program participants and trade allies.
- NWE DSM potential assessments and end use surveys.

The research objective for the economic analysis portion of this evaluation is:

- Estimate benefits, costs and cost-effectiveness of each Program by calendar and program year.

We used the following to address this objective:

- NWE life cycle costing inputs, including program costs, avoided energy costs, discount rates, inflation rates and other economic parameters.
- Results from the impact evaluation.

The research objectives for the process portion of the evaluation are discussed in section 2.3.1

1.4. Organization of the Report

The following section of this report describes our methodology for the impact and process evaluation. This is followed by 24 sections, each devoted to a specific program. Within each program-specific section, there is further discussion of our methods, as they related to each program. In addition, each program-specific section contains impact, cost-effectiveness and process evaluation results, along with recommendations that are based on those results.

The program-specific sections are followed by three sections devoted to special evaluation topics (Residential CFL Operating Hours Study, Savings Persistence, and Installation vs. Rebate Date). These special topics are followed by sections that summarize impact, cost-effectiveness and process results for the entire portfolio. The final section of the main body of the report is devoted to portfolio-level recommendations. Following the main body of the report are a series of technical appendices that provide further detail about our research methods.

All impact and cost-effectiveness results presented in the main body of the report are on a calendar-year basis. However, parallel results for tracker years are also provided in an accompanying Excel workbook.

2. METHODOLOGY

2.1. Sample Design

In this evaluation, we collected data from samples of program staff (both NWE employees and their implementation contractors in this reference), program participants, nonparticipants, and trade allies (firms that participate in the delivery of efficiency measures, e.g., retail chains that sell CFLs). Table 3 shows the completed sample sizes. The samples of participants were drawn from a standardized database we developed from NWE program tracking records. All program-tracking records associated with each NWE account were grouped by type of measure to form the participant-sampling unit. We drew the file review samples from the first three years of program activity. The site visit samples were selected to represent program activity in 2010 and 2011, as were the lighting logger, free ridership and spillover samples.

Table 3: Portfolio Evalution Samples

		Completed Samples					
Type	Program	File-Review Only	Site Visit	Light Logger	Free Ridership	Spillover	Other Survey
Participant Samples							
	Building Operator Certification	-	-		-	-	
	DEQ Appliance	-	-		-	-	
	E+ Audit Home or Business	266	144		70	129	
	E+ Building Blocks Pilot	10	8		-	8	
	E+ Business Partners	32	12		7	8	
	E+ Commercial Existing Electric Rebate	17	16		10	11	
	E+ Commercial Existing Gas Rebate	39	22		38	18	
	E+ Commercial Lighting	98	61		83	50	
	E+ Commercial New Electric Rebate	5	5		3	1	
	E+ Commercial New Gas Rebate	15	10		-	7	
	E+ Electric Motor/Rewind Rebate	16	6		4	4	
	E+ Free Weatherization/Fuel Switch	86	-		-	-	
	E+ Irrigation	31	13		3	-	
	E+ New Homes	32	20		23	19	
	E+ Renewable	57	29		52	30	
	E+ Residential Existing Electric Rebate	43	27		28	13	
	E+ Residential Existing Gas Rebate	74	94		162	86	
	E+ Residential Lighting	285	129	220	403	92	
	E+ Residential New Electric Rebate	5	4		1	4	

		Completed Samples					
Type	Program	File-Review Only	Site Visit	Light Logger	Free Ridership	Spillover	Other Survey
	E+ Residential New Gas Rebate	55	31		29	22	
	Low Income Appliance	-	-		-	-	
	Motor Management Training	-	-		-	-	
	NEEA Initiatives	-	-		-	-	
	Vending Miser	15	7		6	6	
	All Participant Samples	1,181	638	220	922	508	
Non-Participant Samples							
	Existing Residential						67
	Existing Non-residential						
	Irrigation						30
	Other Small						67
	Other Large						67
	All Non-Participant Samples						231
Trade Ally Samples							
	Residential Insulation/Audit						28
	Residential Heating & Cooling and Other						30
	CFL Coupon Retailers						40
	CFL Buy-down Retailers						18
	Commercial Lighting						42
	Commercial Motors (including 4 Motor Rewind)						33
	Commercial Heating & Cooling and Other						20
	Irrigation						10
	Renewable Energy Systems						7
	All Trade Ally Samples						228
Program Staff Interviews							
	Corporate DSM Staff						8
	Other NWE Staff (e.g., Communications, Division Offices)						7
	Implementation Contractors Staff						15
	Low Income Free Weatherization Contacts (at state and local level)						5
	All Program Staff Interviews						35

The impact evaluation samples were designed to represent each of the NWE programs. Some of these programs are made up of multiple components. Table 4 lists the programs and their components. The table also shows how these components were assigned to evaluation studies.

For example, the E+ Residential Lighting program has six components each involving a different method for delivering lighting measures, e.g., Upstream Buy-Down. These six components were addressed in this evaluation by three studies.

In most cases, we used stratified sample designs. We stratified in order to achieve greater sampling precision within the fixed resources of this evaluation. In most cases, if stratification was used, it was based on NWE's reported savings for each of the participants. If the study covered participants with both gas and electric savings we converted these savings to the common energy unit of a million british thermal unit (MMBTU) and then used that common unit for stratification. In one case, instead of stratification by reported savings we stratified on the fuel type (gas or electric). Table 4 shows the stratification used for each study.

Table 4: Portfolio Evaluation Studies and Sample Stratification

Program	Study	Program Component	Sample Stratification
Building Operator Certification	Building Operator Certification	Building Operator Certification	No Sample
DEQ Appliance	DEQ Appliance	DEQ Appliance	No Sample
E+ Audit Home or Business	Home Electric Survey	Home Electric Survey	Reported Savings
	Home On-site Audit	Home On-site Audit	Fuel Type
	Small Business Electric Appraisal	Small Business Electric Appraisal	Reported Savings
E+ Building Blocks Pilot	E+ Building Blocks Pilot	E+ Building Blocks Pilot	Reported Savings
E+ Business Partners	E+ Business Partners	E+ Business Partners	Reported Savings
E+ Commercial Existing Electric Rebate	E+ Commercial Existing Electric Rebate	E+ Commercial Existing Electric Rebate	Reported Savings
E+ Commercial Existing Gas Rebate	E+ Commercial Existing Gas Rebate	E+ Commercial Existing Gas Rebate	Reported Savings
E+ Commercial Lighting	Commercial CFL Direct Install	Commercial CFL Direct Install	Reported Savings
	Commercial Lighting Rebate	Commercial Lighting Rebate	Reported Savings
E+ Commercial New Electric Rebate	E+ Commercial New Electric Rebate	E+ Commercial New Electric Rebate	Reported Savings
E+ Commercial New Gas Rebate	E+ Commercial New Gas Rebate	E+ Commercial New Gas Rebate	Reported Savings
E+ Electric Motor/Rewind Rebate	E+ Electric Motor/Rewind Rebate	E+ Electric Motor/Rewind Rebate	Reported Savings
E+ Free Weatherization/Fuel Switch	E+ Free Weatherization/Fuel Switch	E+ Free Weatherization/Fuel Switch	Reported Savings
E+ Irrigation	E+ Irrigation	E+ Irrigation	Reported Savings
E+ New Homes	E+ New Homes	E+ New Homes	Reported Savings
E+ Renewable	Business Renewable	Business Renewable	Reported Savings
	Residential Renewable	Residential Renewable	Reported Savings
E+ Residential Existing Electric Rebate	E+ Residential Existing Electric Rebate	E+ Residential Existing Electric Rebate	Reported Savings
E+ Residential Existing Gas Rebate	Residential Existing Gas Free Kits	Residential Existing Gas Free Kits	Reported Savings
E+ Residential Existing Gas Rebate	Residential Existing Gas Rebate	Residential Existing Gas Rebate	Reported Savings
E+ Residential Lighting	Residential CFL Owner Install	In-Store Coupon	Reported Savings

Program	Study	Program Component	Sample Stratification
		Trade Show	Reported Savings
		Mail-In	Reported Savings
		Mail-Out	Reported Savings
	Residential CFL Direct Install	Residential CFL Direct Install	Reported Savings
	Upstream CFL Buy-down	Upstream CFL Buy-down	No Sample
E+ Residential New Electric Rebate	E+ Residential New Electric Rebate	E+ Residential New Electric Rebate	Reported Savings
E+ Residential New Gas Rebate	E+ Residential New Gas Rebate	E+ Residential New Gas Rebate	Reported Savings
Low Income Appliance	Low Income Appliance	Low Income Appliance	No Sample
NEEA Initiatives	NEEA Initiatives	80 Plus Power Supply	No Sample
		Commercial Commissioning Public Buildings	No Sample
		Commercial Verdiem	No Sample
		Energy Codes 1997-2004	No Sample
		Energy Codes 1997-2011	No Sample
		Irrigation Soil Moisture Data Logger	No Sample
		Residential Ductless Heat Pump	No Sample
		Residential Energy Star CFL Bulbs	No Sample
		Residential Energy Star CFL Fixtures	No Sample
		Residential Energy Star Clothes Washers	No Sample
		Residential Energy Star Dishwashers	No Sample
		Residential Energy Star New Construction	No Sample
		Residential Energy Star Refrigerators	No Sample
		Residential Energy Star Specialty CFL Bulbs	No Sample
		Residential Energy Star TVs	No Sample
		Residential Energy Star Windows	No Sample
		Residential Multi-Family Codes > 2004	No Sample
		Residential Single-Family Codes > 2004	No Sample

Program	Study	Program Component	Sample Stratification
Vending Miser	Vending Miser	Vending Miser	Reported Savings

2.2. Impact Evaluation

We performed an impact evaluation on 24 programs in the NWE portfolio. For each program listed, we assessed gross and net energy in kilowatt hours (kWh) and dekatherms (dkt) and demand or kilowatt (kW) savings associated with participants that were paid during the 2010–2011 program years. The methods used to assess gross and net savings varied with the program being evaluated. Whenever possible, we based the gross program savings assessment on file reviews and site inspections for a representative sample of cases estimated to achieve 90/10 precision for each of the two program years. We performed a more limited savings assessment for some programs that was based on the review of previous evaluations, other available literature and the methods used by NWE to apply this previous work to the program estimates in their portfolio. We extrapolated the results from the sampled cases to the program level for all five program years that are included in this evaluation.

The evaluation of net savings included the assessment of free ridership, leakage and spillover on participant samples, through a combination of interviews and site visits. We also performed an economic analysis for each program that assessed its cost-effectiveness. Below is an overview of the methods that we used to assess gross and net energy (kWh and dkt) and demand (kW) savings and perform the economic analysis.

2.2.1. Site-Specific Impacts

This section describes the methods we used to assess gross and net energy (kWh and dkt) and demand (kW) savings for the programs we evaluated.

2.2.1.1. Gross Energy and Demand Savings

For most programs, we estimated annual gross savings based on the results of site inspections, customer interviews and subsequent engineering analysis. This included energy (dkt) savings for gas measures and energy (kWh) and average demand (kW) savings for electric measures. We computed average demand savings by dividing the evaluation kWh values by 8,760, the number of hours in a year. For some programs, we based the savings estimates on a critical review of prior evaluation work. Throughout, we applied results from the review of the program calculation methods (custom, simplified or UES) where appropriate.

The following sections provide an overview of the methods that we used for each type of program in the NWE portfolio. The procedures are described in more detail in the individual sections devoted to each program.

Review of Project Files

The first step in the impact evaluation procedure for most programs was to determine whether the detailed documentation (referred to as project files) was consistent with program tracking records. We made this comparison for all programs for which NWE claimed savings and provided access to samples of project files. We completed file reviews for entire samples drawn

to represent 2007–2009 participation. We also completed file reviews for the site visit sample of 2010–2011 participants.

The file review for all sampled measures included a comparison of program tracking data to information in the project files for parameters relevant to energy savings (e.g., installed units, installed wattages) to identify data entry errors. We made corrections to the errors that were found and we recalculated energy savings (kWh or dkt). We recorded reasons for differences between the evaluation savings and the program tracking savings.

Review of Program Savings Estimates

We performed a thorough review of the methods used by NWE to estimate program savings for each program where savings were claimed. Our review encompassed prescriptive measures with UES based savings; simplified measures (such as lighting and motors) that utilized simplified engineering techniques; and custom measures (such as Business Partners), that utilized more complex, customized engineering methods. NWE, NEEA and other organizations provided program materials and project files relevant to the methods used for all three measure types. We reviewed these materials for all sampled measures that were included in our impact analysis.

Our review of UES measures included an examination of relevant documentation from prior studies and efficiency program development throughout the country; with special emphasis on studies that were relevant to the conditions experienced by NWE in their service area. This documentation included:

- The Nexant potential assessment of 2010 and the KEMA potential assessments of 2003 and 2008
- The Nexant NWE evaluation of 2007
- Northwest Power and Conservation Council Regional Technical Forum (RTF) measure workbooks
- Energy Star calculators and supporting documents
- California Energy Commission Database for Energy Efficient Resources (DEER)
- Technical Reference Manuals for the states of New York, Massachusetts, Vermont, Ohio, Minnesota, Wisconsin, Maine, New Jersey, Connecticut and Pennsylvania.
- Department of Energy Technical Support Documents

We compared and contrasted unit energy savings values (kWh or dkt) that were found for each measure. We also critiqued them for their relevance to conditions that exist at NWE. Based on our engineering judgment about the best available information, we determined the most appropriate unit savings values. In cases where we determined that changes to the UES values used by the program were appropriate, we submitted the revised values to the NWE project manager for review and comment.

For simplified and custom measures, we reviewed for reasonableness the application and rigor of the engineering algorithms used by NWE to estimate savings for the sampled measures. In

cases where these engineering methods were found not to be reasonable, we developed a more appropriate and defensible approach that improved the rigor and accuracy of the savings estimates. For custom measures, we considered interactive effects between end uses within a measure and across measures, when appropriate to do so.

Estimation of Evaluation Savings for UES Measures

NWE provided project files for all sampled UES measures where project files were available. We reviewed the files to gain a thorough understanding of the measures that were installed. We completed site visits for the 2010–2011 sampled sites to verify the measures installed under the program. During the site visits we confirmed that the program measures were installed, were operational and produced energy savings. We collected data as necessary to support a re-estimation of energy (kWh and dkt) savings, using the unit energy savings method that resulted from the UES review, discussed above. In most cases our site data collection included a verification of the installed counts for each UES measure. It also included the collection of data necessary to support an estimate of the inputs to the UES method. We calculated evaluation energy savings (kWh or dkt) by applying the final UES method to the data observed during the site visit. To the extent possible, we documented reasons for differences between the evaluated and program savings.

Estimation of Evaluation Savings for Audit Measures

We estimated both direct and indirect energy (kWh or dkt) and demand (kW) savings for NWE's residential and commercial audit programs. Direct savings were those associated with the measures installed by NWE during the audit. Indirect savings were associated with customer actions and/or measures implemented by the customer based on audit recommendations but for which the customer did not receive an incentive through any other NWE program, regardless of whether or not an incentive was available. We used the telephone survey of 2010–2011 participants and customer interviews during site visit recruitment to determine which of the audit participants received direct installation measures (water-related energy saving measures) or implemented audit recommendations without incentives. We conducted site visits and/or follow-up telephone interviews for those homes or businesses to gather the data needed to estimate savings.

We used the UES methods discussed above to estimate savings for prescriptive measures (direct and indirect). For other measures we used standard engineering methods to estimate energy (kWh or dkt) and demand (kW) savings. We then summed savings for each sample participant.

Estimation of Evaluation Savings for Simplified and Custom Measures

NWE provided project files for all sampled simplified and custom measures where project files were available. We reviewed the files to gain a thorough understanding of the measures that were installed. We performed site visits on the sampled sites to verify the measures installed under the program. The site visits included confirmation that the program measures were installed, were operational and produced energy savings. We collected data as necessary to support a re-estimation of energy (kWh and dkt) savings. For some sampled cases our data collection included one-time and/or short terms measurements of parameters relevant to the

energy performance of the installed measures. For measures where the NWE methods were determined to be reasonable, we recalculated savings using the as-built conditions observed during the site visit. For measures where the NWE method was not determined to be adequate, we recalculated energy (kWh or dkt) and demand (kW) savings using the more reliable techniques. To the extent possible, we documented reasons for differences between the evaluated and program savings

Estimation of Evaluation Savings for Residential CFLs

In general we estimated energy and demand savings for residential CFLs using the methods described above for simplified measures. However, because of the importance of residential CFLs to the NWE claim, we made a special effort to estimate the annual hours of operation based on detailed submetering of a representative sample of CFL lamps in participant homes. We installed light loggers in 76 homes throughout the NWE service area to directly measure CFL on-time for a period of up to 3 months. More detailed information on the estimation of residential CFL annual operating hours for the full evaluation period is provided in section 27, which is devoted entirely to this important aspect of the evaluation.

Estimation of Savings for Training Programs

We evaluated two NWE training programs; Building Operator Certification and Motor Management Training. We estimated annual energy (kWh or dkt) and demand (kW) savings for the Building Operator Certification program and attempted to do so for the Motor Management Training program. For both programs NWE provided tracking data that contained a list of training attendees and relevant information gathered from the registrants (e.g., floor area of the buildings operated) for each program year. We searched for and reviewed prior evaluations of these programs performed by NEEA and others. To the extent possible, we derived energy (kWh and dkt) and demand (kW) savings from this information and applied it to the registration data to estimate program savings.

Estimation of Savings for NEEA Initiatives

We reviewed the methodology used by NWE to develop their savings claims for the 18 NEEA Initiatives during the five year evaluation period. The review included a review of spreadsheet summaries provided by NWE that documented the methodology used to calculate the reported energy savings (kWh, kW and dkt) by measure for each program year

We also conducted detailed reviews of the NEEA sponsored evaluations that were performed during program cycles covered by the evaluation and relevant to savings claimed by NWE. We critiqued the methods used and results obtained by these evaluations and extracted important information relevant to the application of these results to NWE savings.

Based on the information gathered during the review of the NEEA programs and NWE methods, we calculated realization rates for measures and for each program year. We calculated an average realization rate for the initiatives and applied to NWE-reported energy savings to determine an adjusted energy (kWh or dkt) and demand (kW) savings.

Estimation of Savings for the CFL Buy-Down

We estimated the energy (kWh) and demand (kW) savings for this component of the E+ Residential Lighting[1] program by drawing on the results from three other elements of the evaluation work.

- **Proportion Non-residential**. A critical factor in this evaluation was the fraction of CFL Upstream Buy-Down bulbs that were purchased and installed by non-residential customers. The number of operating hours for such bulbs is typically much greater than observed for residential customers, thus the savings for buy-down program is very sensitive to the assumed split between residential and non-residential applications of the bulbs. It was not possible to directly determine the disposition of each buy-down bulb. Therefore, we obtained information on the sector split was obtained from the telephone survey of trade allies (CFL Buy-Down Retailers). Responses wereWe analyzed responses to support an estimate of the proportion of bulbs that went to non-residential applications.
- **Installation Rate**. We conducted site visits for samples of residential and non-residential CFL installations. During these site visits, we compared the number of bulbs purchased to those verified to have been installed or in storage. Since CFLs have a low effective useful life of six years and the site inspections occurred up to 2 years after initial installation, verification was based upon confirmation that the measure was installed by the program. We analyzed these data yielded to yield the installation rate for both residential and non-residential applications.
- **Hours of Operation**. The metering subsample of residential CFL installations (see section 27) provided the data needed to estimate average residential hours of operation. The site visit data collection for non-residential direct install CFLs provided the average non-residential hours of operation.

We combined the data above with program tracking data on bulb counts by bulb Wattage to compute energy (kWh) and demand (kW) savings for this program.

Estimation of Savings for Other Programs

We performed a desk top review (i.e., no site visits) for a sample of the Low Income Appliance, and E+ Free Weatherization/Fuel Switch programs. We reviewed available and relevant prior evaluations for similar low-income programs, including evaluations currently available through the Montana Department of Public Health and Human Services (MDPHHS), to derive unit energy (kWh or dkt) and demand (kW) savings that are appropriate to these participant populations and consistent with NWE customer characteristics. We applied these unit energy savings to the measures investigated in the desktop review to derive program savings.

Individual project files were not available for the DEQ Appliance program. NWE provided a detailed workbook that listed each appliance installed and provided the expected unit energy savings. We verified the counts of implemented measures, to the extent possible. We reviewed

[1] The entire CFL Buy-Down component was funded under this residential program even though it provides savings from both residential and non-residential applications of the bulbs.

the unit energy savings for measures implemented in this program as part of the UES review discussed above. We applied the final UES values, as appropriate, to estimate energy (kWh or dkt) and demand (kW) savings from this program.

2.2.1.2. Free Ridership

To estimate free ridership rates we used a self-report method through surveys with a statistically valid sample of participants. The self-report method asked participants a series of carefully constructed survey questions to learn what participants thought they would have done in the absence of the program and their views of how the program influenced them. We used responses to the survey questions to construct a free ridership rate for each participant/site in the evaluation sample. Among E+ Audit Home or Business participants, we calculated free ridership only for participants who received directly installed measures during the audit.

We calculated attribution (the extent to which the program can be attributed with inducing the efficiency action, the converse of which is free ridership) using sets of questions appropriate to program type. We explored two components of attribution: 1) intention to carry out the energy-efficient project without program funds or support; and 2) influence of the program in the decision to participant and carry out energy-efficient upgrades.

We assessed intention by asking how the project likely would have differed if the respondent had not received the program incentive or program provided measures. For rebate programs, for example, we specifically asked how the project would have changed in the absence of the incentive. That is, from *no change* (would have done the project exactly as it was done), to *use of or purchase of less efficient equipment*, to *cancelling altogether or postponing the project for at least one year*.

For programs with incentives, we assessed program influence by asking the respondent how much influence – from "1" (no role at all) to "5" (major role) – elements of the program had on the decision to do the project the way it was done. The program elements we explored included, as applicable, the program incentive, NWE's website or other information, the energy assessment, and the respondent's interaction with a contractor or NWE program representative.

For programs with incentives, the free rider (FR) rate is given by the following equation. (Note that questions yield attribution scores, the converse of which is free ridership; thus, the equation begins with "1 minus" the measured values. Low attribution corresponds with high free ridership.)

FR rate = 1 – [(stated intention score, 0 to 0.5) + (program influence score, 0 to 0.5)]

For programs providing free energy-efficient measures, such as weatherization kits or direct-install items, it would not make sense to the participant to be asked the extent to which the program influenced them to have the efficiency measures; we assumed program influence plays a "major role" – a score of "5" on the influence scale. For these programs, we based free ridership solely on the assessment of intention, that is, the installation of specific items in the absence of the program offer.

FR rate = 1 – [(stated intention score 0 to 0.5)]

2.2.1.3. Spillover

Our spillover method combines survey and on-site research. Using the self-report (survey) method, we asked participants whether they installed efficiency measures in addition to those they obtained through the program and, if so, asked the extent to which NWE DSM activities had influenced them to undertake the efficiency action outside of the program. For respondents rating NWE's influence on their decision to install non-incented measures (influence ratings of "3" or higher), we investigated during the on-site research whether the measures were, indeed, energy efficient, and we again inquired about the program influence. We estimated savings for spillover measures using site visit observations and site-specific savings estimation procedures similar to those used for measures provided by the programs.

2.2.1.4. Leakage

Leakage occurs when a program-supported measure leaves the utility's service territory. We assessed leakage of measures by asking participants whether they still had the program-supported equipment. If the measure(s) was no longer in the respondent's possession, we asked what happened to the measure and if it was given to another person, we inquired as to the recipient's location. We compared responses to questions about electric efficiency measures to NWE's electricity service territory and responses about gas measures to its gas service territory. We considered as "leaked" any measures we found that left the relevant service territory.

2.2.2. Estimation of Program-Level Impacts

To estimate program-level impacts, we estimated the following parameters:

- Savings realization rate
- Free ridership rate
- Spillover rate
- Leakage rate

For each program, we combined these parameters to produce the estimated net adjusted energy and demand savings (Equation 1).

$$NAED = SRR \times RPT \times ((1 - FR) \times SR) \times LR \quad (1)$$

where:

NAED = Net adjusted energy and demand savings

SRR = Savings realization rate

RPT = Reported gross energy and demand savings

FR = Free ridership rate

SR = Spillover rate

LR = Leakage rate

Note that $SRR \times ((1-FR) \times SR \times LR)$ is referred to as the *net savings adjustment rate*.

This section discusses the estimation of each of these parameters beginning with the savings realization rate, followed by the free ridership rate, the spillover rate, the leakage rate, and the reported net energy and demand savings. This section concludes with a discussion of three programs (the E+ Building Blocks Pilot Program, the E+ Residential Existing Gas Rebate Program, and the E+ Residential Lighting Program) that required different methods to estimate gross savings.

2.2.2.1. Savings Realization Rate

The savings realization rate is the product of the file-review realization rate and the site-visit realization rate. However, there are two complicating factors in the calculation of the savings realization rate that must first be discussed before presenting the details of its calculation. To help in describing these two factors, the period 2007–2009 is referred to as the file-review-only study period and the period 2010–2011 is referred to as the site-visit study period. The first complicating factor was that the file reviews and on-sites used the same baseline for calculating savings. This meant that the site-visit realization rates incorporated the adjustment already made in the file-review realization rates. The second complicating factor is that while file reviews were done for samples across the full evaluation period 2007–2011, site visits were only conducted for 2010–2011. This meant that a savings realization rate had to be imputed for the file-review-only study period. The first problem was addressed by recalculating the savings realization rate for the site-visit study period as the ratio of the site-visit energy savings to the file review energy savings. The second problem was addressed by multiplying the file-review realization for the file-review-only study period by the adjusted savings realization rate for the site-visit study period to produce a savings realization rate for the file-review-only study period. Both of these factors also complicated the calculation of the standard error for the savings realization rate which is also discussed in more detail below. Once these problems were addressed, for a given program, for each period, there was a savings realization rate. An overall savings realization rate was then calculated across both periods and inserted into Equation 1. The details of the calculation for the savings realization rate are presented next.

To estimate the savings realization rate, the ratio estimator approach (Cochran 1977) (TecMarket 2004) was used, which, based on samples, involved the estimation of realization rates (evaluated savings divided by reported savings). These ratios were then used to adjust the reported savings for the entire program. For most programs, stratified random sample designs were used, while in others simple random samples were used or a census was attempted for very small programs.

Equation 2 illustrates in general how the ratio approach was used to adjust the reported savings for a given program assuming that the sample design is a stratified random sample.

$$\hat{Y}_R = \frac{\bar{y}}{\bar{x}} X \quad (2)$$

where:

$\hat{Y}_R$ = Ratio estimate of total kWh, kW or dkt impacts in the population of program sites

X = Total kWh, kW, or dkt savings reported by the program for all measures

$\bar{x}$ = Sample-based reported mean kWh, kW or dkt impacts

$\bar{y}$ = Sample-based evaluated mean kWh, kW, or dkt impacts

From Equation 2, we can see that the total reported kWh, kW, or dkt impacts for a program are adjusted using the ratio of the evaluated mean kWh, kW, or dkt impacts for the sampled sites to the mean kWh, kW, or dkt impacts reported by the program for the same sample. This ratio is referred to as the program gross savings realization rate.

The savings realization rate itself is composed of the product of two ratios or realization rates, the file review realization rate and the site-visit realization rate. Equation 3 illustrates that the product of these two components yields the savings realization rate, *b*.

$$b = \frac{\bar{y}}{\bar{x}} = \frac{\bar{y}_q}{\bar{x}_q} \times \frac{\bar{y}_a}{\bar{x}_a} \quad (3)$$

where:

$b \text{ or } \frac{\bar{y}}{\bar{x}}$ =the savings realization rate for a given program

$\frac{\bar{y}_q}{\bar{x}_q}$ = The file-review realization rate: Sample mean evaluated kWh, kW or dkt impacts based on file review divided the sample mean kWh, kW or dkt impacts reported by the program

$\frac{\bar{y}_a}{\bar{x}_a}$ = The site-visit realization rate: Sample mean evaluated kWh, kW or dkt impacts based on site visits divided the sample mean kWh, kW or dkt impacts reported by the program

For each program, the file-review realization rates and site-visit realization rates were based either on stratified random samples of program records or on simple random samples of program records. Equation 1 is the same whether one is using a simple random sample or a stratified random sample. The main difference is in how the file-review and site-visit realization rates and their respective standard errors are calculated. The calculation of the savings realization rate and its standard error for stratified random samples are presented first followed by the method used for simple random samples (Cochran 1977).

Stratified Random Samples

First, for a given program, the means in the file-review ratio, $\frac{\bar{y}_q}{\bar{x}_q}$, were calculated based on stratified random samples. The calculations involved the following steps. Using Equation 4, the sample-based file-review realization rate was calculated.

$$q = \frac{\sum_{i=1}^{n} w_i y_i}{\sum_{i=1}^{n} w_i x_i} \quad (4)$$

where:

q = the file-review realization rate

w_i = case weight for measure i in stratum h (N_h/n_h)

y_i = sample evaluated savings using file review for measure i

x_i = sample savings reported for measure *i*

Note that, within each stratum, q is calculated as the sum of the file-review-adjusted savings divided by the program reported savings. It is this weighted realization rate to which case weights are then applied.

Next, using Equation 5, calculate the standard error of file-review realization rate, q, including the finite population correction factor (Taylor 1997) (TecMarket 2004).

$$\delta(q) = \frac{\sqrt{\sum_{i}^{n} w_i (w_i - 1) e_i^2}}{\sum_{i=1}^{n} w_i x_i} \sqrt{1 - \frac{n}{N}} \quad (5)$$

where:

e = the ex post value minus q times the reported value

The site-visit realization rate, a, which is based on a sample of site-visit study period participants, is computed using the same methods used for the file-review realization rate. However, there are several important differences. First, y is the evaluated savings for measures based on site visits and x is the savings for measures reported by the program. Within each stratum, a is calculated as the sum of the site-review-adjusted savings divided by the program reported savings. It is this weighted realization rate to which case weights are then applied. However, the original savings realization rate once calculated was then adjusted to account for the fact that both the file-review and site-visit realization rates used the same baseline resulting in an underestimate of the savings realization rate. The adjusted savings realization rate was calculated by dividing the site-visit savings for the site-visit study period by the file-review

savings for the site-visit study period. This revised savings realization rate for the site-visit study period was then multiplied by the file-review realization rate for the file-review-only study period to produce a savings realization rate for the file-review-only study period.

This, of course, complicates the calculation of the standard error for the savings realization rate for the site-visit study period and the file-review-only study period. These calculations are illustrated using the variable names used in the discussion of the stratified random sample above. However, the calculations also apply to the case of simple random samples discussed later. We begin with the calculation of the standard error of the adjusted savings realization rate for the site-visit study period in Equation 6.

$$\delta z = \left(\sqrt{\left(\frac{\delta q}{|q|} \right)^2 + \left(\frac{\delta a}{|a|} \right)^2} \right) \times z \qquad (6)$$

where:

δz = standard error of the adjusted savings realization rate for the site-visit study period

δq = standard error of file-review realization rate for the site-visit study period

δa = standard error of the site-review realization rate for the site-visit study period

q = file-review realization rate for the site-visit study period

a = site-visit realization rate for the site-visit study period

z = the adjusted savings realization rate for the site-visit study period

In addition, because there was no estimate of the savings realization rate for the file-review-only study period (because there was no site-visit realization rate), this adjusted savings realization rate was also used to develop the savings realization rate for the file-review-only study period by multiplying it by the file-review realization rate for the file-review-only study period. This means that the standard error of the savings realization rate for the file-review-only study period is calculated using Equation 7.

$$\delta b' = \left(\sqrt{\left(\frac{\delta q}{|q|} \right)^2 + \left(\frac{\delta z}{|z|} \right)^2} \right) \times b' \qquad (7)$$

where:

$\delta b'$ = standard error of the savings realization rate for the file-review-only study period

b' = the savings realization rate for the file-review-only study period

δq = standard error of file-review realization rate for the file-review-only study period

q = file-review realization rate for the file-review-only study period

δz = standard error of the adjusted savings realization rate for the site-visit study period

z = adjusted savings realization rate for the site-visit study period

The overall savings realization rate, $b_{overall}$, was calculated as the savings-weighted average of the savings realization rate across the file-review-only study period and the site-visit study period. Equation 8 was used to estimate the standard error of the savings realization rate across both the file-review-only and site-visit study periods.

$$\delta b_{overall} = \sqrt{\delta b'^{2}_{fro} + \delta z^{2}_{sv}} \times b_{overall} \quad \textbf{(8)}$$

where:

$\delta b_{overall}$ = Standard error of the overall savings realization rate across both the file-review-only study period and the site-visit study period

$b_{overall}$ = Overall savings realization rate across both the file-review-only study period and site-visit study periods

$\delta b'_{fro}$ = Standard error for the savings realization rate for the file-review-only study period

δz_{sv} = Standard error for the savings realization rate for the site-visit study period

Next, the 90% confidence interval around the gross savings realization rate, b, is calculated in Equation 9 by multiplying the appropriate t-statistic (1.645) by the standard error of the gross savings realization rate, δb.

$$CI = b \pm (1.645 \times \delta b_{overall}) \quad \textbf{(9)}$$

The 90% relative precision (rp) of the gross savings realization rate is calculated using Equation 10.

$$rp = 1.645 \frac{CI}{b_{overall}} \quad \textbf{(10)}$$

Simple Random Samples

The file-review realization rate based on a simple random sample is described first followed by a description of the site-visit realization rate based on a simple random sample. Recall that the file review determines whether the detailed documentation (referred to as project files) is consistent with program tracking records, i.e., correcting for data entry errors. This comparison was carried out for all programs for which NWE maintains or can provide access to samples of project files. File reviews were completed for samples drawn to represent participation in both the file-review-only study period and the site-visit study period. Note that site-visit realization rates were calculated only for those participants in the site-visit study period.

First, the means in the file-review ratio, $\hat{R}_q$, i.e., $\frac{\bar{y}_q}{\bar{x}_q}$, were calculated based on simple random samples. Note that $\hat{R}_q$ is calculated as the sum of the file-review-adjusted savings divided by the program reported savings, i.e., it is a weighted realization rate.

The 90% confidence interval for the ratio was then calculated. First, the variance of the ratio was estimated using Equation 11.

$$v(\hat{R}_q) = \frac{(1-f)}{n\bar{x}^2}(s_y^2 + \hat{R}^2 s_x^2 - 2\hat{R}s_{yx}) \quad (11)$$

where:

$v(\hat{R}_q)$ = Variance of the file-review ratio

f = Sampling fraction

n = Size of sample

$\bar{y}$ = Sample-based evaluated mean kWh, kW, or dkt impacts

$\bar{x}$ = Sample-based evaluated mean kWh, kW, or dkt savings reported by the program

s_y^2 = Variance of the evaluated kWh, kW, or dkt impacts

s_x^2 = Variance of the kWh, kW, or dkt impacts reported by the program

s_{yx} = Sample covariance between y_i and x_i

Next, using Equation 12, the standard error of the ratio was calculated.

$$\delta\hat{R}_q = \sqrt{v(\hat{R}_q)} \quad (12)$$

As in the case of stratified random sample, the site-visit realization rate, a, ($\hat{R}_a$, i.e., $\frac{\bar{y}_a}{\bar{x}_a}$), which is based on a sample of site-visit-study period participants, is computed using the same methods used for the file-review realization rate. However, there are several important differences. First, y is the evaluated savings for measures based on site visits and x is the savings for measures reported by the program. The site-visit realization rate, a, is calculated as the sum of the site-review-adjusted savings divided by the program reported savings. It is this weighted realization rate to which case weights are then applied. However, the original savings realization rate once calculated was then adjusted to account for the fact that both the file-review and site-visit realization rates used the same baseline resulting in an underestimate of the savings realization rate. The adjusted savings realization rate was calculated by dividing the site-visit kWh for the site-visit study period by the file-review kWh for the site-visit study period. This revised savings realization rate for the site-visit study period was then multiplied by the file-review realization rate for the file-review-only study period to produce a savings realization rate for the file-review-only study period.

2.2.2.2. Exceptions

Three programs, the E+ Building Blocks Pilot Program, the E+ Residential Existing Gas Rebate Program, and E+ Residential Lighting Program, required different methods for estimating gross savings. The methods used for each are discussed below.

E+ Building Blocks Pilot Program

Since NWE does not report savings for this Program, the stratified ratio estimator was not possible. Instead, the mean savings was estimated based on a simple random sample of measures. Total Program savings were then calculated using Equation 13.

$$\hat{Y} = N\bar{y} \quad (13)$$

where:

$\hat{Y}$ = Estimated total savings for the Program

N = Total number of measures in the program tracking database

$\bar{y}$ = Estimated mean savings per measure

The standard error of $\bar{y}$ is calculated using Equation 14.

$$s_{\bar{y}} = \frac{s}{\sqrt{n}}\sqrt{1-f} \quad (14)$$

where:

N = Total number of measures in the program tracking database

f = Sampling fraction

s = The standard deviation of mean (See equation 15 for calculation of the variance of the mean).

$$s^2 = \frac{\sum^{n}_{1}}{n-1}(y_i - \bar{y})^2 \quad (15)$$

where:

y_i = Estimated savings for measure i

$\bar{y}$ = Estimated mean savings per measure

n = Sample size

Equation 16 was used to calculate the confidence interval for the mean savings, $\bar{y}$.

$$\bar{y}_{st} \pm \text{ts}(\bar{y}) \quad (16)$$

where:

t = the critical value from the t distribution for the 90% confidence interval (i.e., 1.645)

s = the standard error of $\bar{y}$

E+ Residential Existing Gas Rebate Program

While the estimated realization rate was 56.1%, the correlation between the reported savings and the evaluated savings was only 0.13, making the ratio estimator approach unreliable. Instead, the mean savings for the site-visit period were first estimated based on the existing stratified random sample. Equation 17 was used to estimate the stratified mean, $\bar{y}_{st}$.

$$\bar{y}_{st} = \sum_{h=1}^{L} W_h \bar{y}_h \quad (17)$$

where:

$\bar{y}_{st}$ = the mean resulting from a stratified random sample (*st* for *stratified*)

W_h = $\frac{N_h}{N}$ which is the stratum weight

$\bar{y}_h$ = the mean of y for stratum h

With stratified random sampling, Equation 18 yields an unbiased estimate of the variance of $\bar{y}_{st}$

$$s_2(\bar{y}_{st}) = \sum_{h=1}^{L} \frac{W_h^2 s_h^2}{n_h} - \sum_{h=1}^{L} \frac{W_h s_h^2}{N} \quad (18)$$

where:

s_h^2 = The variance of the y within stratum h

Note that the second term in Equation 18 represents the finite population correction.

Equation 19 was used to calculate the confidence interval for the stratified mean savings, $\bar{y}_{st}$.

$$\bar{y}_{st} \pm ts(\bar{y}_{st}) \quad (19)$$

where:

t = the critical value from the t distribution for the 90% confidence interval (i.e., 1.645)

s = the standard error of $\bar{y}_{st}$

Once the mean for the site visit period was calculated, the total savings for the site-visit period was calculated using Equation 20.

$$\hat{Y} = N\bar{y}_{st} \quad (20)$$

where:

N = Population of reported measures in the site-visit period

To calculate the total savings for the file-review-only study period, information from the site-visit study period was used. First, the ratio of the evaluated mean to the reported mean savings was calculated for the site-visit study period. Next, this ratio or realization rate was then used to adjust the savings in the file-review-only study period. The totals for both periods were then summed to yield the total evaluation savings for the Program.

E+ Residential Lighting Program

The E+ Residential Lighting Program Lighting Program is comprised of three separate components: 1) Direct Install, 2) Owner Install, and 3) the CFL Buydown. For components #1 and #2, the methods used to estimate the savings realization rate were the same as described in section 2.2.2.1.However, for the CFL Buydown component, gross savings were based on a review of all records in the program tracking database. Evaluation gross savings were based on adjustments to reported quantities shipped. The savings realization rate was calculated as the ratio of the total evaluation savings to the total reported savings. An overall savings realization rate was then calculated across all three components. The savings realization rate was then applied to the total claimed savings for CFLs and divided by the total number of evaluation bulbs to produce an overall unit energy savings (UES) per bulb. This UES was then multiplied by the quantity of bulbs estimated to be residential bulbs to yield the total gross savings for CFLs in the residential sector. This same UES was then multiplied by the quantity of bulbs estimated to be non-residential bulbs to yield the total gross savings for CFLs in the non-residential sector.

2.2.2.3. Free Ridership Rate

The free-ridership rate was estimated using simple random samples or stratified random samples of participants in the site-visit study period. Once estimated for each program, the net-to-gross ratios (NTGRs) were extrapolated to participants in the file-review-only study period. When simple random samples were used, the NTGR is calculated as an ex post savings weighted mean and the standard error is simply the standard error of the weighted NTGR.

However, when a stratified random sample was used, the calculation was somewhat more complicated. The mean is then calculated using Equation 21.

$$\bar{y}_{st} = \sum_{h=1}^{L} W_h \bar{y}_h \qquad (21)$$

where:

$\bar{y}_{st}$ = the mean resulting from a stratified random sample (*st* for *stratified*)

W_h = $\frac{N_h}{N}$ which is the stratum weight

$\bar{y}_h$ = the mean of y for stratum h

With stratified random sampling, Equation 22 yields an unbiased estimate of the variance of $\bar{y}_{st}$.

$$s_2(\bar{y}_{st}) = \sum_{h=1}^{L} \frac{W_h^2 s_h^2}{n_h} - \sum_{h=1}^{L} \frac{W_h s_h^2}{N} \quad (22)$$

where:

s_h^2 = The variance of the NTGR within stratum h

Note that the second term in Equation 22 represents the finite population correction.

Equation 23 was used to calculate the confidence interval for the NTGR.

$$\bar{y}_{st} \pm ts(\bar{y}_{st}) \quad (23)$$

where:

t = the critical value from the t distribution for the 90% confidence interval (i.e., 1.645)

s = the standard error of $\bar{y}_{st}$

See section 31.4 for further discussion of how we treated free ridership in the estimation of net savings for this evaluation.

2.2.2.4. Spillover Rate

The NTGR is calculated as 1 – FR (i.e., the free rider rate). The NTGR is used to adjust the ex post gross estimates of savings. The NTGR can be adjusted upwards by the spillover rate to produce the spillover-adjusted NTGR ($NTGR_{SA}$) using Equation 24.

$$NTGR_{SA} = (1 - FR) \times (1 + SR) \quad (24)$$

where:

FR = The free ridership rate

SR = The spillover rate

This is referred to as the multiplicative version of the spillover adjustment. For this multiplicative version of the spillover-adjusted NTGR to work, the spillover rate was calculated using Equation 25.

$$SR = \frac{Net\ \mathrm{SO}}{\mathrm{Net\ Energy\ Savings}} \quad (25)$$

where:

SR = Spillover rate

Net SO = The net energy or demand spillover savings

The spillover rate was based on sample of participants in the site-visit study period. Once the spillover-adjusted NTGR was calculated for a given program, it was inserted in Equation 17 to produce the $NTGR_{SA}$.

For the CFL Buydown component, the calculation of the spillover rate was somewhat more complex. All telephone surveys included a battery of questions regarding Buydown bulbs. Those respondents who indicated that they had **not purchased** any additional non-Buydown bulbs were assigned a spillover value of zero. Next, respondents who indicated that they **had purchased** additional non-Buydown bulbs because of their experience with the Buydown bulbs were then visited on-site if they met one condition. The condition was that they were part of one of the site visit samples drawn for the other programs. If they were not part of any site visit sample, they were dropped from the spillover sample. Once all site visits were completed, the savings associated with verified non-Buydown bulbs were averaged with the zero values for all the respondents in the other surveys to derive the total net spillover. The spillover rate (SR) was then calculated using Equation 17. Once the spillover-adjusted NTGR was calculated for the Buydown component of a given program, it was inserted in Equation 17 to produce the $NTGR_{SA}$

See section 31.4 for further discussion of how we treated spillover in the estimation of net savings for this evaluation.

2.2.2.5. Leakage Rate

The estimated leakage rates were all 1.0. They are included in the calculation for completeness.

2.2.2.6. Net Savings

The net savings adjustment rate for a given program was calculated using Equation 26.

$$\text{The Net Savings Adjustment Rate} = b_{overall} \times \text{NTGR}_{\text{SA}} \times (1 - LR) \quad (26)$$

where:

LR = Leakage rate

$b_{overall}$ = savings realization rate across both the file-review-only study period and late periods

$NTGR_{SA}$ = Spillover-adjusted net-to-gross ratio

Finally, for each program, for each calendar year or tracker year, the net adjusted energy (or demand) savings was calculated using Equation 27.

$$\textit{Net Adjusted Energy Savings} = \text{RPT} \times \textit{Net Savings Adjustment Rate} \quad (27)$$

where:

RPT = Program-reported savings

2.2.3. Economic Analysis

NWE's cost-effectiveness calculator was reviewed and compared to the California Standard Practice Manual. The objective was to identify any significant aspects of the NWE calculator that did not conform to national best practices or regional requirements. These issues were then discussed with NWE and agreement reached on appropriate changes to the NWE

calculator. Finally, an evaluation benefit-cost calculator was created by making these modifications to the NWE calculator.

2.2.3.1. Cost-Effectivness Model Review

The first step in this review involved examining the benefit-costs models used in the most recent evaluation of NWE program (Nexant 2007) which attempted to adhere closely to the industry standard methods prescribed in the *California Standard Practice Manual* (SPM) (California Public Utilities Commission and the California Energy Commission 2001). As part of its 2007 evaluation, Nexant calculated four benefit-costs tests:

- Total Resource Cost (TRC)
- Program Administrator (PA) Test,
- Rate Impact Measure (RIM) Test, and
- Societal Cost (SC) Test.

Note that the Participant Test was not conducted because Nexant felt that, while useful for DSM program planning purposes, it adds little value in a retrospective evaluation study; program attractiveness from this perspective is demonstrated in the very fact of customer participation.

The equations for the benefits and costs for each of the four tests used by Nexant are presented below.

TRC Test

$$TRC\ Benefits = \sum_{t=1}^{N} \frac{UAC_t}{(1+d)^{t-1}} \quad (28)$$

$$TRC\ \text{Costs} = \sum_{t=1}^{N} \frac{PRC_t + PC_t}{(1+d)^{t-1}} \quad (29)$$

where:

UAC = Utility avoided costs in year t

PRC_t = Program administration and marketing costs in year t

PC_t = Participant device costs (*before* INC is received), i.e., incremental costs in year t

d = Discount rate

t = The number of periods over which future values are discounted

Program Administrator Test

$$B_{pa} = \sum_{t=1}^{N} \frac{UAC_t}{(1+d)^{t-1}} \quad (30)$$

$$C_{pa} = \sum_{t=1}^{N} \frac{PRC_t + INC_t}{(1+d)^{t-1}} \quad (31)$$

where:

UAC = Utility avoided costs in year t

PRC_t = Program administration and marketing costs in year t

INC_t = Incentive costs, restricted to include only dollar benefits such as rebates or rate incentives (bill credits) in year t

d = Discount rate

t = The number of periods over which future values are discounted

Ratepayer Impact Measure (RIM) Test

$$B_{RIM} \sum_{t=1}^{N} \frac{UAC_t}{(1+d)^{t-1}} \quad (32)$$

$$C_{RIM} \sum_{t=1}^{N} \frac{RL_t + PRC_t + INC_t}{(1+d)^{t-1}} \quad (33)$$

where:

UAC = Utility avoided costs in year t

RL_t = Revenue loss from reduced sales in year t

PRC_t = Program administration and marketing costs in year t

INC_t = Incentive costs, restricted to include only dollar benefits such as rebates or rate incentives (bill credits) in year t

d = Discount rate

t = The number of periods over which future values are discounted

Nexant noted that the estimation of economics from the RIM Test was slightly altered from the SPM to improve on the accuracy of results.

In the SPM methodology, RIM benefits of a DSM program are defined as avoided utility supply costs. RIM costs are defined as utility program administration costs plus incentives plus revenue losses due to reduced sales. The concept of lost revenues representing the under-recovery of the fixed-cost portion of rates is defined by the difference between revenues "lost" because of reduced energy sales (impact times rates) and the energy supply costs avoided (impact times marginal costs). The SPM recognizes the difficulty in estimating lost revenues as one of the weaknesses of the RIM test in the following statement (Nexant 2007):

> *Results of the RIM test are probably less certain than those of other tests because the test is sensitive to the differences between long-term projections of marginal costs and long-term projections of rates, two cost streams that are difficult to quantify with certainty.*

To address the weakness inherent in the dependence on forecasts of both avoided costs and rates, the study methodology estimates lost revenues directly from the *fixed-cost portion* of electricity and gas rates. The fixed-cost portion of rates is a known quantity for each of the calendar years of the study and is expected to remain constant in nominal terms throughout the lifetime of expected program impacts. To derive the correct *net* lost revenues, the study defines RIM costs as utility program administration costs plus incentives plus reduced collection of fixed-cost rate components plus avoided utility supply costs. RIM benefits are defined per SPM methods as avoided utility supply costs. Since the term representing avoided utility costs can be netted out of both benefits and costs to the RIM test, the resulting term representing *net* lost revenues is independent of projections of retail rates and thus more accurate than in the SPM methodology. (p. 18-1)

Nexant went on to note that:

> *The RIM benefit-to-cost ratio (one of the secondary measures of test results) can be slightly skewed because of the change in expressing RIM costs. The increased accuracy of the net present value of RIM net benefits—a primary measure of cost-effectiveness—more than offsets the potential decrease in accuracy of the secondary measure. (p. 18-1)*

Societal Test

$$SC\ Benefits = \sum_{t=1}^{N} \frac{(UAC_t * (1 + EA))}{(1+d)^{t-1}} \quad \textbf{(34)}$$

$$SC\ \text{Costs} = \sum_{t=1}^{N} \frac{PRC_t + PC_t}{(1+d)^{t-1}} \quad \textbf{(35)}$$

where

UAC_t = Utility avoided costs in year t

EA = Environmental adder equal to 10%.

PRC_t = Program administration and marketing costs in year t

PC_t = Participant device costs (*before* incentive is received), i.e., incremental costs in year t

d = Discount rate

t = The number of periods over which future values are discounted

Avoided Utility Costs

The avoided utility costs used by Nexant originated from NWE documents in the public domain. The Nexant study examined cost-effectiveness indicators using two scenarios of avoided costs for the electric utility system to reflect a shift in forecast costs during the 2004 to 2006 implementation period. One scenario used 2005 avoided costs (produced midway through three-year implementation period under study), and another used the 2003 avoided costs forecast that was first used during the program planning process. The study used a 2005

NorthWestern Energy forecast of avoided gas costs. In all, the studies relied on three avoided cost forecasts, two for electric and one for gas. The benefit cost tests relied on these three forecasts for all calendar years and tracker years.

Lost Revenues

There were three lost revenue forecasts, one for residential electric, one for residential gas, and one for non-residential electric. As noted above, these were forecast of the *fixed-cost portion* of electricity and gas rates. Note that there was no non-residential gas lost revenue forecast since NWE did not offer non-residential gas programs prior to 2008. The benefit-cost tests relied on these three forecasts for all calendar years and tracker years.

2.2.3.2. Changes to Cost-Effectiveness Model

The comparison of the current NWE and SPM revealed two important inconsistencies:

- The participant costs (PC_t) in the TRC and SC tests (see Equations 29 and 35 above) should have been adjusted by the net-to-gross ratio (NTGR). However, they were rarely adjusted by the NTGR.

  This feature of the TRC and SC cost calculation was introduced into the SPM in 1988 as a way to adjust both the benefits *and* costs for attribution, i.e., ensure symmetrical treatment of costs and benefits. This point was clarified in the 2007 SPM Clarification Memo (D.07-09-043) (California Public Utilities Commission and the California Energy Commission 2007).

- The incentives paid to free riders were not being counted as a cost in the TRC.

  This feature was introduced in the 2007 SPM Clarification Memo (D.07-09-043) as a way to correct for the fact that revenue requirements associated with paying free riders incentives were not being counted. It stated that in the current formulation of the TRC, the costs of all revenue requirements associated with paying free riders a rebate incentive are removed. The memo went on to note:

  > *However, an equivalent financial incentive to the customer offered under a direct install program would not be removed. In other words, if instead of offering a cash rebate to the customer, the utility directly installs that same measure and requires a customer co-payment (such that the out-of-pocket cost to the customer is the same under either approach), the financial incentive to free rider participants would be included in the costs. This is because all of the direct install costs would appear in the "program administrative cost" (PRC) term. (p. 2)*

More details are provided in the 2007 SPM Clarification Memo.

- For the RIM test, the application of Equation 33 to the calculation of the net present value of the fixed cost portion of electricity and gas rates was incorrect, i.e., the first year value was discounted. This resulted in an overestimate of the B/C ratio.

These three changes are reflected in Equations 37, 41, and 43 later in this section.

2.2.3.3. Incremental Participant Costs

When available, incremental participant costs came directly from or were estimated based on tracking data. Otherwise, participant costs were estimated for each energy efficiency measure based on the 2003 electric potential assessment (KEMA 2003) and the 2008 gas potential assessment (KEMA 2008 (b)).

2.2.3.4. Program Administration and Marketing Costs

To derive the program administration and marketing costs, the program costs were first extracted from the USB and DSM gas and electric costs sheets in the tracker reports. Then the incentives paid were subtracted from the program costs to arrive at administration and marketing costs. Additionally, general, non-program-specific costs were allocated across applicable programs.

2.2.3.5. Program Incentive Costs

When available, program incentive costs came from the costs sheets in the tracker files. Otherwise, incentive costs were estimated based on tracking data.

2.2.3.6. Effective Useful Life

When available, effective useful life (EUL) came from tracking data. Otherwise, EUL were determined for each energy efficiency measure based on the 2003 electric potential assessment (KEMA 2003) and the 2008 gas potential assessment (KEMA 2008 (b)).

2.2.3.7. Discount Rates

All discount rates were provided by NWE. The source of all discounts rates for both gas and electric for both residential and non-residential are contained in the following files:

- Resource Value Spreadsheet 2006 RR.xls (Worksheet: NPV)
- Resource Value Spreadsheet 2007 RR.xls (Worksheet: NPV)
- Resource Value Spreadsheet 2008 20080101 RR.xls (Worksheet: Electric NPV)
- Resource Value Spreadsheet 2009 20090102 Rev 1 RR.xls (Worksheet: Electric NPV)
- Resource Value Spreadsheet 2010 20091203 Rev 1 RR.xls (Worksheet: Electric NPV)
- Resource Value Spreadsheet 2011 FINAL 20101227 RR.xls (Worksheet: Electric NPV)
- Resource Value Spreadsheet 2006 RR.xls (Worksheet: Gas NPV)
- Resource Value Spreadsheet 2007 RR.xls (Worksheet: Gas NPV)
- Resource Value Spreadsheet 2008 20080101 RR.xls (Worksheet: Gas NPV)
- Resource Value Spreadsheet 2009 20090102 Rev 1 RR.xls (Worksheet: Gas NPV)

- Resource Value Spreadsheet 2010 20091203 Rev 1 RR.xls (Worksheet: Gas NPV)
- Resource Value Spreadsheet 2011 FINAL 20101227 RR.xls (Worksheet: Gas NPV)

Because the discount rates are in calendar years, each tracker year was assigned the calendar-year discount rate that matched the first year in the tracker year. For example, tracker year 2008–2009 was assigned the discount rate for calendar year 2008 and tracker year 2010–2011 was assigned the discount rate for calendar year 2010.

2.2.3.8. Lost Revenues

For each calendar year and tracker year, lost revenues for both electric and gas and for both residential and non-residential were calculated in the same way that Nexant did for the same reasons (see discussion of the RIM Test in section 2.2.3.1).

Gas Lost Revenues

All data for calculating gas lost revenues for both tracker years and calendar years were from the worksheet *5. Calc Lost Revenues Tracker Year* contained in workbook *EXHIBIT__(WMT-3) 2011–2012 Tracker 9+3 Natural Gas Lost Revenues – final.XLS*. The worksheet contains data that are in *tracker-year* format.

Tracker-Year Calculations: For each tracker year, the sum of gas distribution rate, gas transmission rate, and gas storage rate was calculated. . These rates are in dollars ($) per dekatherm (dkt).

For the *non-residential sector*, gas savings have been reported since 2008. The starting values were determined as follows:

- Since there was no reported rate for tracker year 2007–2008, the non-residential value for Tracker 2008–2009 was used. This is consistent with the fact that the residential 2007–2008 and the 2008–2009 rates were identical.
- Since there was no reported rate for tracker year 2008–2009, the rate was calculated as 2.5% less than the 2009–2010 rate.
- The starting tracker-year rate for 2009–2010 was based on the Tracker 2009–2010 rates.
- The starting tracker-year rate for 2010–2011 was based on the Tracker 2010–2011: July-December 2010 rates.

For the *residential sector*, gas savings have been reported since 2007. The starting values were determined as follows:

- There were no rates for the 2006–2007 or the 2007–2008 tracker years. The January-June 2008 values were used for both of these tracker years.
- The starting tracker-year rate for 2008–2009 was based on tracker year 2008–2009.
- The starting tracker-year rate for 2009–2010 was based on tracker year 2009–2010.
- The starting tracker-year rate for 2010–2011 was based on tracker year 2010–2011: July-December 2010.

Once the starting rate for each tracker year for each sector was established, each was forecasted through 2014 at a compound annual growth rate (CAGR) of 2.5%. The value was set to zero beginning in 2013-2014, the approximate date of the next rate case.

Note that a reset of Lost Revenues to a zero starting point is only momentary since on the effective date of the Final Rate Order, the Lost Revenues begin to build up immediately. By the end of the first year following new rates, there will be new Lost Revenues as DSM program participation proceeds and energy savings again accumulate.

Calendar Year Calculations: Because only tracker-year gas rates were available, starting values for calendar-year rates were simply the year associated with the first year in the tracker year. For example, the value for the tracker year 2007–2008 was used as the value for calendar year 2007.

For the *non-residential sector*, the starting rates for each calendar year were calculated as follows:

- For 2008, the value was the same as that for the 2008–2009 tracker year.
- For 2009, the value was the same as that for the 2009–2010 tracker year.
- For 2010, the value was the same as that for the 2010–2011: July-December 2010 tracker-year.
- For 2011, the value was the same as that for the 2011–2012 tracker year.

For the *residential sector*, the starting rates for each calendar year were calculated as follows:

- For 2007, the value was the same as that for the 2007–2008 tracker year.
- For 2008, the value was the same as that for the 2008–2009 tracker year.
- For 2009, the value was the same as that for the 2009–2010 tracker year.
- For 2010, the value was the same as that for the 2010–2011 tracker year.
- For 2011, the value was the same as that for the 2011–2012 tracker year
- Note that, for the reasons noted earlier, the values for both residential and non-residential sectors were set to zero beginning in 2013.

Electric Lost Revenues

Tracker-Year Calculations: The data used to calculate the residential and non-residential tracker-year lost revenues for electricity were contained in the following Excel workbooks:

- Appendix 3B - 2008–2010 LRAM (Worksheet: *2. Rates*)
- Appendix 3A - 2004–2008 LRAM (Worksheet: *2. Rates*)

The starting rates for each tracker year were calculated as follows:

- The starting tracker-year rate for 2006–2007 was based on rates as of May 1, 2006.
- The starting tracker-year rate for 2007–2008 was based on rates as of May 1, 2007.
- The starting tracker-year rate for 2008–2009 was based on rates as of January 1, 2008.

- The starting tracker-year rate for 2009–2010 was based on rates as of January 1, 2009.
- The starting tracker-year rate for 2010–2011 was based on rates as of January 1, 2010.

Residential rates were calculated as the sum of transmission energy rate per kWh and distribution energy rate per kWh.

The calculation of *non-residential* rates was more complicated. It involved:

- Transmission energy and distribution energy rates for GS 1 Secondary, Non-Demand Customers
- Transmission demand, distribution energy, and distribution demand rates for GS 1 Secondary, Demand Customers
- Transmission energy and distribution energy rates for GS 1 Primary, Non-Demand Customers
- Transmission energy, distribution energy, and distribution demand rates for GS 1 Primary, Demand Customers

These values were used to calculate the following fixed-cost component of rates:

A. GS 1 Secondary, non-demand
B. GS 1 Secondary, demand (kWh)
C. GS 1 Secondary, demand (kW)
D. General Service - 1 Primary, Non Demand (kWh)
E. General Service - 1 Primary, Demand (kWh)
F. General Service - 1 Primary, Demand (kW)

Also involved in the calculation were the following:

- The percent of commercial and industrial savings by class:
  G. GS-1 Secondary, non-demand
  H. GS-1 Secondary, demand
  I. GS-1 Primary, non-demand
  J. GS-1 Primary, demand
- The calculation of billing demand per kWh of impact:
  K. C/I Average Monthly Load Factor
  L. Monthly kW reduction per kWh of impact
  M. Annual demand reduction (kW-months) per kWh
  N. Coincidence factor

The following formula was used to calculate electric lost revenues for the non-residential sector:

$$Lost\ Revenue_{C,I} = G \times A + H \times\ B + M \times N \times C\ + I \times D + J \times\ E + M \times N \times F$$

Calendar-Year Calculations: The starting rates for each calendar year were calculated as follows:

- The starting calendar-year rate for 2007 was based on rates as of May 1, 2007.
- The starting calendar-year rate for 2008 was based on rates as of January 1, 2008.
- The starting calendar-year rate for 2009 was based on rates as of January 1, 2009.
- The starting calendar-year rate for 2010 was based on rates as of January 1, 2010.
- The starting calendar-year rate for 2011 was based on rates that were identical to the rates as of January 1, 2010.

Once the starting rate for each tracker year for each sector was established, each was forecasted through 2013-2014 at a compound annual growth rate (CAGR) of 2.5%. The value was set to zero beginning in 2014-2015, the approximate date of the next rate case. For calendar years, once the starting rate for each calendar year for each sector was established, each was forecasted through 2013 at a compound annual growth rate CAGR of 2.5%. The value was set to zero beginning in 2014 the approximate date of the next rate case.

Note that a reset of Lost Revenues to a zero starting point is only momentary since on the Once the starting rate for each tracker year for each sector was established, each was forecasted through 2013-2014 at a compound annual growth rate (CAGR) of 2.5%. The value was set to zero beginning in 2014-2015, the approximate date of the next rate case. For calendar years, once the starting rate for each calendar year for each sector was established, each was forecasted through 2013 at a CAGR of 2.5%. The value was set to zero beginning in 2014 the approximate date of the next rate caseeffective date of the Final Rate Order, the Lost Revenues begin to build up immediately. By the end of the first year following new rates, there will be new Lost Revenues as DSM program participation proceeds and energy savings again accumulates.

Thus, for both electric and gas, there are 38 forecasts—19 that covered the five tracker years, for each fuel, and for each sector,[2] and 19 that covered the five calendar years, for each fuel, and for each sector.

2.2.3.9. Avoided Supply Costs

Electric Avoided Cost

Electric avoided cost data in calendar years were obtained from the following sources:

- Resource Value Spreadsheet 2006 RR.xls (Worksheet: NPV)

[2] Non-residential gas lost revenues only cover four tracker years since NWE did not offer a non-residential gas program prior to 2008.

- Resource Value Spreadsheet 2007 RR.xls (Worksheet: NPV)
- Resource Value Spreadsheet 2008 20080101 RR.xls (Worksheet: Electric NPV)
- Resource Value Spreadsheet 2009 20090102 Rev 1 RR.xls (Worksheet: Electric NPV)
- Resource Value Spreadsheet 2010 20091203 Rev 1 RR.xls (Worksheet: Electric NPV)
- Resource Value Spreadsheet 2011 FINAL 20101227 RR.xls (Worksheet: Electric NPV)

Calendar-Year Calculations: The calendar-year forecasts for 2007 through 2011 calendar years were provided in the appropriate worksheets in the Excel workbooks listed above. All data are in *calendar-year* format. To handle the largest possible EULs, each forecast was extended through 2045 at a compound annual growth rate of the original series.

Tracker-Year Calculations: The forecasts for 2006–2007 through 2010–2011 tracker years were based on the data provided in the appropriate worksheets in the Excel workbooks listed above. Each tracker year was assigned the calendar-year value that matched the first year in the tracker year. For example, tracker year 2008–2009 was assigned the value for calendar year 2008 and tracker year 2010–2011 was assigned the value for calendar year 2010.

Gas Avoided Cost

Gas avoided cost data in calendar years were obtained from the following sources:

- Resource Value Spreadsheet 2006 RR.xls (Worksheet: Gas NPV)
- Resource Value Spreadsheet 2007 RR.xls (Worksheet: Gas NPV)
- Resource Value Spreadsheet 2008 20080101 RR.xls (Worksheet: Gas NPV)
- Resource Value Spreadsheet 2009 20090102 Rev 1 RR.xls (Worksheet: Gas NPV)
- Resource Value Spreadsheet 2010 20091203 Rev 1 RR.xls (Worksheet: Gas NPV)
- Resource Value Spreadsheet 2011 FINAL 20101227 RR.xls (Worksheet: Gas NPV)

Calendar-Year Calculations: The forecasts for 2007 through 2011 calendar years were provided in the appropriate worksheets in the Excel workbooks listed above. To handle the largest possible EULs, each forecast was extended through 2045 at a compound annual growth rate of the original series.

Tracker-Year Calculations: The forecasts for 2006–2007 through 2010–2011 tracker years were based on the data provided in the appropriate worksheets in the Excel workbooks listed above. Each tracker year was assigned the calendar-year value that matched the first year in the tracker year. For example, tracker year 2008–2009 was assigned the value for calendar year 2008 and tracker year 2010–2011 was assigned the value for calendar year 2010.

Thus, for both electric and gas, there are 20 forecasts—10 that covered the five *tracker years*, for each fuel, and 10 that covered the five calendar years, for each fuel.

2.2.3.10. Calculation of Cost-Effectiveness Tests

The following equations were used to calculate the four benefit-costs tests. The TRC and SC have been modified to better conform to the SPM.

TRC Test

$$TRC\ Benefits = \sum_{t=1}^{N} \frac{UAC_t}{(1+d)^{t-1}} \quad (36)$$

$$TRC\ \text{Costs} = \sum_{t=1}^{N} \frac{PRC_t + NTGR_{SA} * PC_t + (1.0 - NTGR) * INC_t}{(1+d)^{t-1}} \quad (37)$$

where:

UAC_t = Utility avoided costs in year t

PRC_t = Program administration and marketing costs in year t

$NTGR_{SA}$ = Spillover-adjusted net-to-gross ratio

PC_t = Participant device costs (*before* incentive (INC) is received

$NTGR$ = Net-to-gross ratio (NTGR), i.e., unadjusted for participant spillover

INC_t = Incentive costs, restricted to include only dollar benefits such as rebates or rate incentives (bill credits) in year t

Program Administrator Test

$$B_{pa} = \sum_{t=1}^{N} \frac{UAC_t}{(1+d)^{t-1}} \quad (38)$$

$$C_{pa} = \sum_{t=1}^{N} \frac{PRC_t + INC_t}{(1+d)^{t-1}} \quad (39)$$

where

UAC_t = Utility avoided supply costs in year t

PRC_t = Program administration and marketing costs in year t

INC_t = Incentive costs, restricted to include only dollar benefits such as rebates or rate incentives (bill credits) in year t.

Ratepayer Impact Measure (RIM) Test

$$B_{RIM} \sum_{t=1}^{N} \frac{UAC_t}{(1+d)^{t-1}} \quad (40)$$

$$C_{RIM}\sum_{t=1}^{N}\frac{RL_t + PRC_t + INC_t}{(1+d)^{t-1}} \quad (41)$$

where

UAC_t = Utility avoided supply costs in year t

RL_t = Revenue loss from reduced sales in year t

PRC_t = Program administration and marketing costs in year t

INC_t = Incentive costs, restricted to include only dollar benefits such as rebates or rate incentives (bill credits) in year t

Societal Test

$$SC\ Benefits = \sum_{t=1}^{N}\frac{(UAC_t * (1+EA_t))}{(1+d)^{t-1}} \quad (42)$$

$$SC\ \text{Costs} = \sum_{t=1}^{N}\frac{PRC_t + NTGR_{SA} * PC_t + (1.0 - NTGR) * INC_t}{(1+d)^{t-1}} \quad (43)$$

where:

UAC_t = Utility avoided supply costs in year t

EA_t = Environmental adder equal to 10% of the total utility avoided supply cost in year t. The environmental adder is an upward adjustment to utility avoided costs as a way of internalizing the external costs of energy generation

PRC_t = program administration and marketing costs in year t

$NTGR_{SA}$ = Spillover-adjusted net-to-gross ratio

PC_t = participant device costs (*before* INC is received) in year t

$NTGR$ = Net-to-gross ratio (NTGR), i.e., unadjusted for participant spillover

INC_t = incentive costs, restricted to include only dollar benefits such as rebates or rate incentives (bill credits) in year t

Note that the discount rate varies depending on the program or tracker year. Discount rates can also vary within a given program or tracker year by fuel. Note also that the avoided cost and lost revenue forecasts are unique for each calendar and tracker year. Details regarding the calculation of lost revenues and avoided costs for the residential and non-residential sectors are provided in preceding portions of this section.

The societal test includes an environmental adder of 10% as way of internalizing the external costs associated with fossil-fuel-based electricity generation. As noted in the previous portfolio evaluation (Nexant 2007), the adder approach is easy to apply, and a general consensus has been reached that adders in the range of 5-15% are an acceptable way to account for the environmental benefits of demand side management programs and renewable resources.

2.3. Process Evaluation

2.3.1. Objectives

The process portion of the evaluation addresses a variety of research objectives, as shown in Table 5, and employs a variety of information sources. The table indicates the primary information sources with a check mark; secondary or supporting information is indicated with an "S".

Table 5: Information Sources to Be Used to Meet Process Evaluation Objectives

ObjectiveTo Assess	Information Sources				
	Program Documents	Interviews	Surveys		
		Program Staff	Participating Customers	Participating Trade Allies	Nonparticipating Customers
Appropriateness of design and participation procedures	Descriptions; design docs; process descriptions; flow charts; application forms	√	√	√	√
Appropriateness of application and payment processing activities (e.g., ease of use, cycle time)		√	√	√	
Accuracy, consistency, completeness of program records	Participant program records				
Barriers to participation		√	√	S	√
Effectiveness of incentives in motivating action	Incentives rationale (e.g. % buy down)	S	√	√	√
Effectiveness of marketing and promotional efforts	Marketing materials	√	√	√	√
Participant satisfaction with programs		S	√	√	
Opportunities for process improvement		√	√	√	S
Effectiveness of internal communication		√	S	S	
Comparison to best practices	All documents	√			
Obtain data for assessment of free riders, spillover and			√	√	√

ObjectiveTo Assess	Information Sources				
	Program Documents	Interviews	Surveys		
		Program Staff	Participating Customers	Participating Trade Allies	Nonparticipating Customers
leakage					
Obtain data for assessment of savings persistence			√		

2.3.2. Data Collection Activities

To develop an understanding of the individual programs in NWE's E+ Efficiency Portfolio of efficiency programs, we reviewed program documents and discussed program processes with NWE and contractor implementation staff during a two and one-half -day evaluation kick-off meeting held January 30 through February 1, 2012. During that meeting, we refined researchable issues for individual programs and identified data files needed to support the evaluation including contact information for program participants, trade allies, and nonparticipating customers.

Early evaluation team efforts included review and summary of best practices applicable to NWE programs, further review of program collateral and processes, and in-depth interviewing of key program staff. These efforts supported our development of survey instruments that addressed research objectives applicable to residential and commercial customer by program. For comparison across programs, we designed survey instruments to include a subset of questions administered to all participants, as well as questions applicable to individual program. In addition to measures of program satisfaction, we asked all participants about their awareness and knowledge of NWE's energy efficiency activities, and their interest in receiving additional efficiency information from NWE. In collaboration with NWE staff, we reviewed and refined all survey instruments prior to fielding.

We completed telephone surveys with several samples of program actors, including participants, trade allies, and nonparticipants. We began fielding the surveys on April 16 and concluded on September 19, 2012. Table 3, above, provides our sample sizes.

2.3.2.1. Participants

The telephone surveys with participant decision-makers served multiple purposes: to support the process evaluation, gather data needed to compute net savings, and recruit participants for site visits. The audit participant sample comprised audit participants that did not subsequently receive an incentive from NWE; our survey explored their responses to the audit recommendations, including recommendations that involved behavioral changes. Residential and commercial participant surveys included questions about the purchase of compact fluorescent lamps (CFLs) to determine whether they purchased discounted bulbs from retailers participating in the CFL Upstream Buy-Down program.

As described (section 2.1), process surveys were administered to samples of program participants drawn by the impact team using program information provided by NWE. Our surveys with NWE E+ program participants (a sample of those participating between January 2010 and December 2011) were conducted by expert interviewers, primarily those at a reputable survey research firm using computer-assisted telephone interviewing (CATI) software, yet also including members of the process evaluation team. To reach program and strata goals for completed surveys and agreements to on-site visits by the impact team, we placed calls to residential and commercial participants at various times of the day and evening (no call attempts were made on Sundays). Repeated call attempts are made when calls are not answered by the household or business; we do not repeat a call when the customer contact we are seeking declines to be surveyed. Five call attempts to complete a survey is the industry standard and the standard we initially employed. For critical strata with small samples and low response rates, we called up to ten times; for a few strata, we called up to 14 times.

To encourage residential participants to volunteer to an on-site inspection of program related measures, we offered these participants a one-in-ten chance of winning a $100 gift card.[3] Because of low response rates, this offer was later changed to a $25 gift card for each on-site inspection volunteer.

Although participant surveys continued into early September to obtain free ridership data for impact estimation purposes, process results include only those responses collected before July 31, 2012, as we needed sufficient time for data analysis.

2.3.2.2. Trade Allies

We collected program specific data from trade allies via a telephone survey to support the impact and process evaluation. NWE provided lists of trade allies classified by type (for example: residential insulation, commercial lighting). We drew simple random samples representative of each type. Table 3, above, provides our sample sizes.

2.3.2.3. Nonparticipants

We surveyed a random sample of residential and commercial customers who had not participated in the NWE program during 2010–2011. Table 3, above, provides our sample sizes. We conducted telephone surveys with the sampled customers to support both the process and impact evaluations.

2.3.3. Response Weighting

As described in section 2.1, we conducted participant process evaluation surveys with participants drawn for the impact sample. We designed the nested sampling plan to achieve a complete understanding – process, impact, free ridership – for each sampled participant.

[3] Initially, residential respondents were offered a one-in-twenty chance of winning a $100 gift card. To encourage a higher acceptance rate we changed the offer to a one-in ten chance.

Because the impact sampling plan was developed for the purpose of accurately estimating program savings, it necessarily oversampled projects with large savings, to minimize total savings estimation uncertainty. To ensure that each participant, regardless of project size, was given an equal "voice" in our process findings, we used proportional weighting to adjust for this oversampling. We developed proportional weights for each stratum within a program according to the following formula:

$$Stratum\ weight = \frac{\%\ of\ stratum\ in\ program\ population}{\%\ of\ stratum\ in\ program\ sample}$$

For programs with a simple random sample (that is, with no strata), no weights were applied to participant responses. Similarly, all trade ally and nonparticipant responses are presented without weights.

2.3.4. Best Practices

We assessed NWE's program activities in comparison with efficiency program best practices. Our primary source of best practices was *Best Practices Benchmarking for Energy Efficiency Programs* (eebestpractices.com). To our knowledge, this source provides the results of the only "true" best practices study, as distinguished by its methodology. The research started with a Delphi Panel of efficiency professionals identifying, for specified program categories (examples: audits, commercial equipment, residential lighting), the programs they believed to be most successful. Nominated programs spanned the country, and included programs of both investor-owned utilities and municipal utilities. The evaluators then systematically investigated these programs to determine their practices within each of seven categories (examples: program planning and design, marketing and outreach), and judged the resulting set of practices as "best."

For the current research, we further synthesized this work, identifying commonalities across the program categories. We identified a set of 54 best practices, many with subcomponent practices. Many of these best practices are applicable to all program types, although some relate specifically to a single program type, such as audits.

Augmenting this national research, we used a study we conducted for a consortium of funders active nationally, *Lesson Learned After 30 Years of Process Evaluation*. (Peters 2007) This study identifies "good" practices; it does not use the methodology of a true "best" practices study.

We considered NWE's staffing ratio in light of findings from a study of 39 efficiency program administrators around the country. (Goldman, et al. 2010)

Finally, we sought to identify efficiency best practices for rural utilities. We contacted a leading energy efficiency consultant who specializes in serving community-owned utilities, which are predominantly rural.[4] She reported being unaware of any report summarizing efficiency best

[4] The consultant is Jill K. Cliburn, who has the website Clean and Efficient Energy Program for Public Power (cleanefficientenergy.org).

practices for utilities serving rural populations. In our best practices assessment in this evaluation, we took into account NWE's unique service territory and customer base.

24. BUILDING OPERATOR CERTIFICATION

24.1. Program Description

Building Operator Certification (BOC) is a professional development program for managers and operating engineers of commercial and public facilities sponsored by NWE since 2004[13]. The program is affiliated with the nationally recognized and accredited BOC training program. NWE contracts with the International Building Operator Association to conduct the training. The program is designed to teach best practices for optimizing energy and resource efficiency in the operation and maintenance of buildings. The program is open to commercial customers and qualified installers. The program is funded through USB.

NWE sponsors two levels of BOC training:

- Level I BOC requires one week of classroom instruction. Course curricula provide an overview of building systems, operations and maintenance practices, and energy management techniques.
- Level II requires one week of combined classroom and field instruction. Level II curricula provide a more in-depth assessment of HVAC systems, building automated control systems, and advanced energy management strategies.

Both levels require that participants pass an exam on each topic to receive certification. Enrollment in Level II requires Level I certification or passing a challenge test. Level 1 graduates must wait a period of time before taking Level II in order to apply learning from Level 1. NWE offers tuition and travel scholarships for a limited number of participants from public schools, state and local governments, and non-profit hospitals. Other participants pay an enrollment fee. The scholarships are funded through USB.

Certification must be renewed annually; Level I certification renewal requires five hours/year of continuing education credits (CEUs) and Level II renewals require ten hours/year of CEUs.

Over the five program years 2006–2011, about 190 participants graduated from NWE-sponsored BOC training programs with an average of 154,000 ft² of facility area per participant.

Additional services offered

BOC participants receive information about NWE's commercial audit and incentive programs and other training opportunities.

[13] NWE participated in BOC as a NEEA initiative prior to 2004.

24.1.1. Energy Savings

Program energy savings estimation methods evolved over the course of the 2006–2011 program years.

- 2006: No BOC program savings were claimed.
- 2007–2008: The program applied a standard unit energy savings of 142,001 kWh per participant based on NEEA's Long Term Monitoring and Tracking (LTMT) Report for 2005 (Summit Blue 2006). No gas savings were claimed. The basis for this assumption is (1) the average area of a BOC participant's facility is 355,000 ft², (2) the average building EUI is 16 kWh/ft²/year, and (3) savings produced by a BOC graduate are 2.5%.
- 2008–2009: The program applied unit energy savings of 0.4 kWh/ft² and 0.0008 dkt/ft² per area controlled by each BOC graduate. Electrical savings are based on the 2008 LTMT (Summit Blue 2008) and the 2005 LTMT (Summit Blue 2006) for gas savings. The 2008 LTMT reduced the average area controlled by each BOC participant to 286,000 ft The savings assumption remained at 2.5% BOC graduate. savings remained, however electrical savings are the same as for the 2007–2008.
- The 2009–2011 program years applied the unit energy savings of 0.4 kWh/ft² and 0.0008 dkt/ft² per BOC graduate. Each participant provided the square footage for their facility which was applied to the electric unit energy savings value and a gas-heated area for the gas unit energy savings value.

Program participants are screened to be NorthWestern Energy electric and/or natural gas customers for savings to be claimed. To the extent that more than one building operator from the same facility attends, the savings are split based upon the square footage of the facilities.

24.1.2. History

The BOC curricula receive periodical updates to keep up with changes in technologies and best practices.

24.1.3. Marketing

Direct marketing for BOC training is done with organizations such as the Montana State School Board Association, the Montana Hospital Association, the Montana DEQ, and local governments. BOC is promoted at trade shows, and through email notifications, electronic newsletters, the NWE website, and direct mailings.

As BOC annual re-certification requires continuing education, NWE maintains contact with past participants to inform them of training opportunities with, for example, the lighting design labs, NEEA webinars and on-site trainings, and NWE Motor Training classes.

24.1.4. Program Steps

Pre-approval is required and applicants must submit applications by a deadline in advance of the training date. Class size is limited to about 30 participants.

24.2. Impact Evaluation

24.2.1. Methodology

24.2.1.1. Estimation of Gross Savings

There is a substantial body of work on the energy impacts associated with BOC training. We examined most of the BOC studies over the past 10 years and selected several recent studies for in-depth review and comparison for a possible revision to the program UES values. Further, we contacted the Northwest Energy Efficiency Council (BOC's parent organization) to find out if they knew of any recent studies we were not aware of, and they were not.

As described above in the Program Description, the current NWE BOC program UES values are 0.4 kWh/ft² and 0.0008 dkt/ft² multiplied by the building area directly under the control of a BOC graduate for each fuel. Underlying the UES values is an average building area of 286,000 ft², building EUI of 16.7 kWh/ft²/year for electricity and 0.32 therms/ft²/year, 2.5% savings per BOC graduate, and a measure life of five years.

We selected three studies for review; two evaluations and a survey of six evaluations which includes the first two evaluations. Each is discussed below.

1. "Long Term Monitoring and Tracking Report (LTMT) for 2011 Activities," prepared for NEEA, by Navigant Consulting, July 23, 2012.
   - This study is the latest in a series of NEEA's LTMT reports with BOC studies. Earlier LTMTs are the basis of NWE's current program savings assumptions, the 2008 LTMT (Summit Blue 2008) for electrical savings and the 2005 LTMT for gas savings (Summit Blue 2006). Summit Blue is now part of Navigant Consulting.
   - The study incorporated a scoring tool developed for their 2011 Midwest Energy Efficiency Alliance (MEEA) report, discussed immediately below, which converts questionnaire responses into energy savings through engineering based algorithms.
   - The study used two UES calculation approaches which resulted in both higher and lower savings than the 2010 LTMT's electric UES value. Navigant elected to take the middle ground and retain the 2010 UES (Navigant Consulting, Inc. 2011) of 0.42 kWh/ft²/year. This is based on an average of 286,000 ft² managed by each BOC-certified operator, a building EUI of 16.7 kWh/ft²/year, a measure life of five years, and savings of 2.5%.
   - The authors of the report were contacted for this evaluation and asked if these savings represent all savings attributed to BOC training or savings net of utility incentives. The authors responded that the savings represent "total market activity" related to BOC

training and therefore include savings attributed to participation in utility incentive programs.

- The study surveyed participants (N=20) and non-participants (N=17) and found significant differences between the two groups with respect to energy savings practices, suggesting a zero baseline is justified.

2. "Evaluation of MN BOC Training," prepared for the Midwest Energy Efficiency Alliance and Minnesota Office of Energy and Security, by Navigant Consulting, March 24, 2011.
   - The sample of 50 BOC participants in Minnesota employed engineering calculations applied to detailed participant surveys to estimate energy savings. The surveys were administered six months after BOC certification.
   - The average facility area for the sample was 194,500 ft^2.
   - The study concluded that BOC attributable savings are in a range of 0.237 – 0.721 per kWh/ft^2/participant and 0.0013-0.0018 dkt/ft^2/participant. The nature of the range is explained thus, "BOC Attributable Savings are considered the top end of the BOC program net savings range while BOC Attributable Savings Net of Utility Rebated Projects represents the minimum attributable savings."
3. "Summary of Building Operator Certification Evaluations," prepared for Consumer's Energy, by Energy Market Innovations and Research Into Action, November 28, 2011.
   - This was a survey of six BOC program evaluations for a Michigan utility with a BOC pilot program. The study was commissioned to develop recommendations for UES values and to synthesize lessons learned and best practices from the other studies. Two of the evaluations in this survey are the two Navigant evaluations discussed above.
   - The study recommended the O&M-only UES values from the Minnesota BOC program in the interest of conservatism from three perspectives, savings estimates relative to the other studies, findings from their engineering desk review, and the average square footage each building operator is assumed to influence.

We compared the findings from the three studies and considered their applicability to the BOC program at NWE. We concluded that the Minnesota study is most appropriate evaluation to apply to the NWE BOC program. This study had 50 participants, an average facility size closer to NWE's average of 154,000 ft^2 than the 2011 LTMT study, and BOC-attributable savings which were net of utility rebated projects. The study by Energy Market Innovations concluded that Navigant's Minnesota study provided the most reliable energy savings estimates but took a more conservative stance by recommending the O&M-only savings

The Navigant Minnesota study presents BOC savings estimates as a range; the high end of the range includes all BOC activity and the low end of the range is net of measures receiving utility incentives. In our judgment, the low end of the range best represents the BOC program savings for NWE, net of other NWE rebate program savings. Accordingly, we re-calculated program savings for each year with the UES values of 0.24 kWh/ft^2 and 0.0013 dkt/ft^2 from the Navigant Minnesota/MEEA study. This is the low end of the savings range presented by Navigant and

represents BOC attributable savings net of utility rebated projects, a combination of non-rebated capital measures and O&M savings.

We're confident that utility interest in the BOC program and associated energy savings will continue to generate more refined evaluation models and recommend NWE continue to periodically review new studies and revise UES values when justified.

24.2.1.2. Free Ridership

No customer surveys were possible for this program. Therefore, we were not able to estimate free ridership.

24.2.1.3. Spillover

No customer surveys or site visits were possible for this program. Therefore, we were not able to estimate spillover.

24.2.1.4. Leakage

No customer surveys were possible for this program. Therefore, we were not able to estimate leakage.

24.2.1.5. Estimation of Program Savings

The methods described in 2.2.2 Estimation of Program-Level Impacts were used to estimate program-level savings from the results of the file review, site visit, free ridership and spillover data collection and analysis.

24.2.2. Energy and Demand Impacts

24.2.2.1. Estimation of Gross Savings

We compared the UES findings from three studies and considered their applicability to the BOC program at NWE. We concluded that the Minnesota study is most appropriate evaluation to apply to the NWE BOC program. We re-estimated program savings for each year to reflect the UES values of 0.24 kWh/ft^2 and 0.0013 dkt/ft^2 from the study. The revised program savings are presented in the table below.

Energy Savings for the Program

The following table provides information on the savings adjustment rate for each study that contributed file review results for this program. The table compares the reported savings to those adjusted for changes based on our file review. All results shown are for gross savings claimed for Level 1 and 2 BOC graduates and are not adjusted for free ridership or spillover.

Table 594: File Review Adjustment to Savings for Building Operator Certification

Funding	Study Name	Units	Savings		Savings Adjustment Rates
			Reported	Final	Final
Electric					
	Building Operator Certification	kWh	16,230,170	7,998,922	0.49
Natural Gas					
	Building Operator Certification	dkt	17,864	36,223	2.03

24.2.2.2. Estimation of Net Savings

The following table shows the savings adjustment rates for this program determined by our evaluation. The savings realization rate reflects our findings from file reviews. The table shows for each funding source and calendar year, the net adjusted savings, which equals the net savings adjustment rate times the reported energy savings.

Table 595: Savings Adjustments by Calendar Year for Building Operator Certification

Funding	Program	Units	Year	Reported Energy Savings	Savings Realization Rate	Free Ridership Rate	Spillover Rate	Net Savings Adjustment Rate	Net Adjusted Energy Savings	Net Adjusted Demand Savings (kW)
Electric - USB										
	Building Operator Certification	kWh	2007	5,112,036	0.49	-	-	0.49	2,519,430	288
	Building Operator Certification	kWh	2008	3,851,497	0.49	-	-	0.49	1,898,182	217
	Building Operator Certification	kWh	2009	3,744,748	0.49	-	-	0.49	1,845,572	211
	Building Operator Certification	kWh	2010	2,509,146	0.49	-	-	0.49	1,236,614	141
	Building Operator Certification	kWh	2011	1,012,744	0.49	-	-	0.49	499,123	57
	Building Operator Certification	kWh	All Years	16,230,170	0.49	-	-	0.49	7,998,922	913
Natural Gas - USB										
	Building Operator Certification	dkt	2008	7,703	2.03	-	-	2.03	15,619	
	Building Operator Certification	dkt	2009	7,414	2.03	-	-	2.03	15,034	
	Building Operator Certification	dkt	2010	2,266	2.03	-	-	2.03	4,595	
	Building Operator Certification	dkt	2011	481	2.03	-	-	2.03	976	
	Building Operator Certification	dkt	All Years	17,864	2.03	-	-	2.03	36,223	
Electric										

Funding	Program	Units	Year	Reported Energy Savings	Savings Realization Rate	Free Ridership Rate	Spillover Rate	Net Savings Adjustment Rate	Net Adjusted Energy Savings	Net Adjusted Demand Savings (kW)
	Building Operator Certification	kWh	All Years	16,230,170	0.49	-	-	0.49	7,998,922	913
Natural Gas										
	Building Operator Certification	dkt	All Years	17,864	2.03	-	-	2.03	36,223	

24.2.3. Economic Analysis

The following table shows the results of our cost-effectiveness analysis for this program. We computed four different tests of cost-effectiveness based on cost data provided by NWE, our estimates of net adjusted savings for the program and the definition of each test. The table shows the benefit-to-cost ratio for each test. Results are provided for each funding source and calendar year.

Table 596: Net Savings and Benefit/Cost Ratios by Calendar Year for Building Operator Certification

Funding	Program	Units	Year	Net Adjusted Energy Savings	Benefit/Cost Ratios			
					Total Resource Cost (TRC) Test	Program Administrator Cost (PAC) Test	Ratepayer Impact Measure (RIM) Test	Societal Cost (SC) Test
Electric - USB								
	Building Operator Certification	kWh	2007	2,519,430	7.22	7.22	1.35	7.95
	Building Operator Certification	kWh	2008	1,898,182	9.09	9.09	1.72	10.00
	Building Operator Certification	kWh	2009	1,845,572	6.56	6.56	1.66	7.22
	Building Operator Certification	kWh	2010	1,236,614	3.62	3.62	1.46	3.99
	Building Operator Certification	kWh	2011	499,123	3.60	3.60	1.75	3.96
	Building Operator Certification	kWh	All Years	7,998,922	6.05	6.05	1.55	6.65
Natural Gas - USB								
	Building Operator Certification	dkt	2008	15,619	-0.00	-0.00	2.40	-0.00
	Building Operator Certification	dkt	2009	15,034	-0.00	-0.00	2.33	-0.00
	Building Operator Certification	dkt	2010	4,595	-0.00	-0.00	2.86	-0.00
	Building Operator	dkt	2011	976	-0.00	-0.00	3.14	-0.00

Funding	Program	Units	Year	Net Adjusted Energy Savings	Benefit/Cost Ratios			
					Total Resource Cost (TRC) Test	Program Administrator Cost (PAC) Test	Ratepayer Impact Measure (RIM) Test	Societal Cost (SC) Test
	Certification							
	Building Operator Certification	dkt	All Years	36,223			2.43	
Electric								
	Building Operator Certification	kWh	All Years	7,998,922	6.05	6.05	1.55	6.65
Natural Gas								
	Building Operator Certification	dkt	All Years	36,223			2.43	

24.3. Process Evaluation

24.3.1. Methodology

We met with all key members of NWE's program team, both NWE and implementation contractor staff. To inform our implementation findings for this program, we interviewed those team members involved with the program.

For market findings, the research team surveyed 30 attendees of the Building Operator Certification (BOC) courses conducted in 2010 and 2011. No trade allies were involved with this program.

24.3.2. Implementation Findings

24.3.2.1. Interview Findings

NWE supports two courses that lead to Building Operator Certification upon successful completion of the course tests. The Level I course covers operation and maintenance basics relating to HVAC, controls, lighting, energy, and management techniques. The Level II course provides more advanced training in the efficient operation and maintenance of HVAC systems and covers energy management, management strategies, and energy conservation methods. Both courses span five consecutive days. NWE typically offers two to five classes a year, with the majority of them Level I classes. Each class has 15 to 30 attendees.

The trainings are spread out geographically across Montana to reduce participant travel.

The trainings are designed for facilities managers and staff responsible for operations and maintenance of equipment and systems in commercial and public facilities. NWE promotes

these trainings at trade shows for architects and engineers, as well as the Montana Hospital Association, and through Montana's Department of Environmental Quality. Additionally, NWE staff send emails, includes training information in electronic newsletters to customers, and calls facilities that have previously expressed interest in sending an employee to the training. To fill any vacancies at select training, the implementation contractor recruits additional trainees through one-on-one outreach to targeted customer sector locations. Currently, course registrations are processed online, a change from registrations previously being completed over the telephone, by fax, or by mail.

It is a significant commitment for a business to send facility staff to week-long, off-site training sessions. This is especially true in a region with a low population density where many facilities may be managed by one staff member. To reduce the burden of training costs and encourage attendance, NWE offers scholarships for attendees from the local government, public school, and hospital sectors. Scholarships include tuition waivers, meals, mileage, and lodging. Montana's Department of Environmental Quality also sponsors some scholarships and NWE partners with them to leverage funds.

In addition to information presented on building operations and maintenance, a NWE representative presents attendees with information on applicable utility programs. Both the participants and NWE benefit from the presence of staff because staff inform participants of further opportunities and staff may also learn about opportunities for new measures to add to existing programs.

The certification license that participants can earn requires continuing education in energy management to maintain the certification. In addition to sponsoring Level II BOC courses, other trainings are available to NWE's customers and trade allies, including motors and motor rewind, lighting design, and NEEA sponsored webinars and workshops, and other local activities.

BOC training and certification is available throughout most of the country. In Montana, the training is conducted through the International Building Operators Association (IBOA). The instructor has extensive education and experience in commercial and industrial energy efficiency, including an Energy Management Diploma from the University of Wisconsin, Madison, an Energy Auditor Certificate from the state of Washington, and many specialized classes, such as Boilers, Cogeneration Technology, Energy Analysis for Industrial Refrigeration Systems, HVAC Design and others.

In addition to these program-specific implementation processes, section **31** discusses NWE's activities in support of all programs, including planning and evaluation, tracking, and branding, marketing, outreach, and media use.

24.3.2.2. Best Practices Assessment

Previous evaluations have established many best practices for the design and delivery of adult education and training classes. Components key to successful adult training and education (T&E) courses include:

1. Intentional incorporation of best practices from adult learning theory into T&E activities so they are relevant and accessible to the adults that attend them. These practices increase the likelihood that T&E will result in behavior change:
   a. Offering information and experiences that show how to solve real problems that occur in daily work life,
   b. Providing opportunities during the training for attendees to practice new skills and receive feedback,
   c. Including small group activities and concrete experiences rather than relying solely on expert lecture, and
   d. Providing limited or focused content that does not overwhelm attendees.
2. Market transformation is a frequent driver for non-residential T&E programs. In addition to educating key market actors on desired energy efficiency practices, they serve as a vehicle for disseminating program information to the market and making market actors aware of program opportunities.
3. Effective T&E programs provide value to the target market specifically, not just the utility. Training approaches and content can be enhanced by market research, baseline studies, partnerships with professional organizations, and early evaluation efforts to create training programs that provide significant value to market actors. Coordination with professional organizations can qualify T&E courses for continuing education (CEU) credits, increasing the appeal and value of the program.
4. Successful T&E programs require a long-term commitment from implementing organizations. The multi-year commitment is important in building expertise among trainers, refining curriculum and leveraging word-of-mouth communication. It can take years to build the program, the organizational capacity and the program reputation to the point where the training effort is poised to influence a discernible portion of the targeted market.

   The BOC training program was developed, in part, through funding provided by NEEA, and incorporated all of these best practices into the program. NWE's decision to deliver operations and maintenance training by offering the BOC program automatically delivers multiple best practices.

   Additionally, NWE further supports the second best practices by sending a representative to BOC trainings for delivery of utility program information, and supports the fourth best practice by continuing it history of offering BOC training continuously since 2007.

24.3.3. Participant Findings

The research team surveyed 30 attendees of the Building Operator Certification (BOC) courses conducted in 2010 and 2011.

Interpreting Response Frequencies

This program has a smaller target market than other programs and a correspondingly smaller number of survey respondents. We encourage the reader to recognize that for these small samples, a change in a single respondent's view might change the reported frequencies dramatically (by ±20% for a sample of five respondents, for example). Thus, we caution the reader to interpret these responses as suggestive, but not definitive for the population of all program participants.

Finally, many survey questions allowed the participant to give more than one response; in these cases percentages will not add to 100%. These multiple response questions are indicated by the text "Allowed Multiple" in table headers.

24.3.3.1. Trainee Characteristics

All of these attendees either conducted or directed operations and maintenance activities at their facilities. Surveyed trainees had been in the building operations and maintenance field for between two and 36 years (Table 597).

Table 597: Building Operations and Maintenance Experience, among Building Operator Certification Trainees

Years in Field	Percent (n=29)
Two to five	31%
More than twenty	21%
Six to ten	17%
Sixteen to twenty	17%
Eleven to fifteen	14%

Trainees were associated with various types of facilities, including educational and medical (Table 598). Most trainees reported (Table 599) being responsible for between one and three buildings with an average of 745,779 square feet of conditioned space.

Table 598: Facility Types, among Building Operator Certification Trainees

Facility Type	Percent (n=30)
Educational	52%
Medical	17%
Office building	11%
Prison/jail	10%
Government/community	7%
Mixed	3%

Table 599: Building Responsibilities, among Building Operator Certification Trainees

Number of Buildings	Percent (n=29)
One to three	62%
More than ten	21%
Four to ten	17%

Most trainees worked for facilities with three to five total operations and maintenance staff (Table 600).

Table 600: Number of Operations and Maintenance Staff, among Building Operator Certification Trainees

Number of Staff	Percent (n=29)
1	17%
2	28%
3 to 5	34%
6 to 10	7%
11 to 20	3%
more than 20	10%

Trainees had various responsibilities at their facilities. Most reported involvement with and/or controlling energy use in their facilities (Table 601).

Table 601: Responsibilities at Facility, among Building Operator Certification Trainees

Responsibility at Facility	Percent (n=30)
Monitoring energy use	83%
Controlling energy use	77%
Payment for energy bills	30%

Over half (53%) of trainees represented facilities which had qualified for a rebate or incentive from NWE within the past two years. Of those who had not received a rebate or incentive at their facility, half reported being aware that rebates or incentives are available.

24.3.3.2. Trainee Experience

Most respondents had attended only Level 1 training (Table 602). Of those who had not attended Level 2 training, 68% of trainees indicated that they did not intend to take Level 2 training.

Table 602: Course Attended, among Building Operator Certification Trainees

What level of training course did you attend?	Percent (n=30)
Level I	70%
Both Level I and Level II	23%
Level II	7%

Most trainees heard about the BOC training courses from their supervisor (Table 603).

Table 603: Awareness of Training, among Building Operator Certification Trainees

Source of Awareness	Percent (n=30)
Supervisor	44%
NorthWestern Energy	33%
Word of mouth	13%
Government office	7%
Co-worker/colleague	3%

Eighty percent of respondents reported that no area of the course needed to be improved. Those trainees who thought some area could be improved suggested improvements to the pace of the course, materials (such as textbooks), or applicability to their industry.

We asked participants how satisfied they were with elements of the trainings experience. Most trainees reported being satisfied with the training location and the class length (Figure 201).

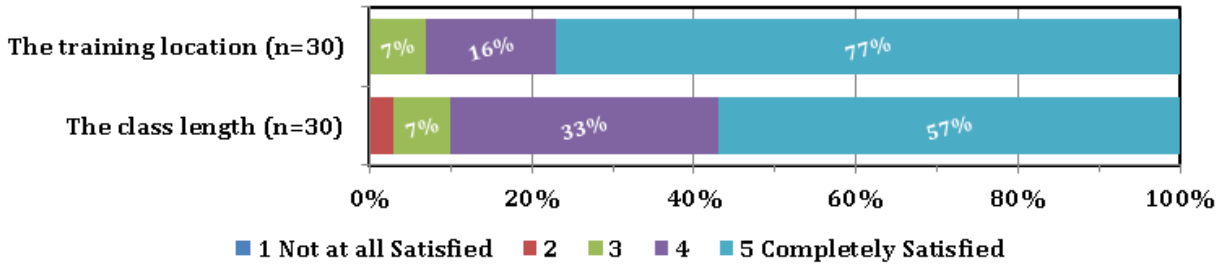

Figure 201: Training Satisfaction, among Building Operator Certification Trainees

Nearly all (29 of 30) surveyed trainees reported that they would recommend the BOC training to their colleagues. Almost all surveyed trainees (28 of 30) indicated that they had applied the concepts or methods from the training at their facilities or shared the concepts with their coworkers (29 of 30). Most trainees reported that their facilities had started or completed at least one project aimed at increasing energy efficiency since they received the training (Table 604).

Table 604: Type of Project Started, among Building Operator Certification Trainees

Project Type (multiple responses allowed)	Percent (n=30)
Boilers	30%
Monitoring	17%
Motors (including fans)	13%
Windows	13%
Variable Frequency Drives (VFDs)	10%
Energy Audit	7%
Electrical	7%
Toilets/faucets	7%

Other projects included roofing, laundry equipment, HVAC upgrades, and air handlers.

Of the participants who had started a project (25) just over half (52%) had completed at least one project (Table 605).

Table 605: Project Status, among Building Operator Certification Trainees

Is project complete?	Pecent
Yes	52%
Some are complete, some are not	40%
No	8%

Half of the trainees reported that the training was influential in their current or recent project (Figure 202). More than half (62%) of trainees indicated that the BOC training has been influential in the likelihood of their organization completing energy efficiency projects in the future.

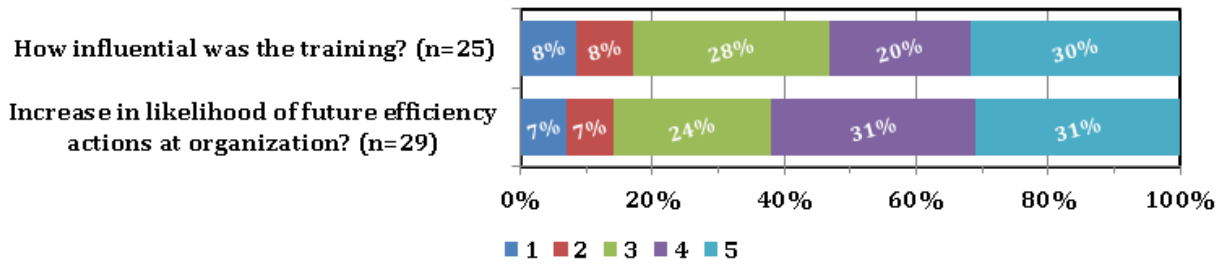

Figure 202: Influence of Training on Projects and Future Actions, among Building Operator Certification Trainees

One-third of trainees indicated that they experienced a job advancement after attending the training (Table 606). However, only 20% of trainees thought that it was likely that the BOC training contributed to the advancement.

Table 606: Job Advancement, among Building Operator Certification Trainees

Advancement (Multiple Responses Allowed)	Percent (n=30)
No change	67%
Increase in pay	23%
Increase in responsibility	17%
New title	10%

24.3.4. Trade Ally Findings

There are no trade allies for this program.

24.4. Recommendations

Below are recommendations for the BOC program.

24.4.1. Impact Evaluation

We compared the findings from three recent BOC savings studies and considered their applicability to the BOC program at NWE. We concluded that Navigant's 2011 Minnesota study is most appropriate evaluation to apply to the NWE BOC program. The Minnesota study had the most participants (N=50), an average facility size closer to NWE's average of 154,000 ft^2 than NEEA's 2011 LTMT report, and unlike NEEA's BOC attributable savings, did not include utility rebated projects.

Based on the impact evaluation findings, we offer the following recommendation for improving the program.

- NWE replace the current UES values from NEEA with the MEEA study UES values of 0.24 kWh/ft^2 and 0.0013 dkt/ft^2 for electrical and gas savings respectively.
- As NWE has used BOC UES values provided by NEEA, we suggest contacting NEEA and exploring the feasibility of developing regional BOC UES values which do not include measures receiving utility incentives.
- We're confident that utility interest in the BOC program and associated energy savings will continue to generate more refined evaluation models in the future.

24.4.2. Process Evaluation

The conclusions that we have reached from the process evaluation of this program are as follows.

NWE follows best practices for content and delivery of educational programs. It follows best practices in program planning and design, including sound program planning based on local market conditions, attention to attracting hard-to-reach customers, responding to market conditions, and maintaining program funding throughout the year. NWE follows best practices for program management and administration, including keeping participation simple, offering participation assistance, and having clear lines of authority and communication, among other things. NWE follows best practices in program marketing and outreach by using multiple communications media and distribution channels, supporting and working through trade allies, and conducting cross-program marketing. Finally, NWE follows evaluation best practices, including conducting baseline studies of technical potential, and conducting regular detailed impact and process evaluations supported by site inspections and customer surveys.

Surveyed BOC trainees reported positive experiences with BOC trainings, and nearly 90% reported having initiated efficiency projects since attending. Over half of trainees reported that the training would increase the likelihood of future efficiency actions at their organization. Half of surveyed trainees worked in schools.

Based on these conclusions, we offer the following recommendations for improving the program.

- **Internet:** Consider ways to increase the use of internet tools to facilitate participation.
- **Written program plans:** Consider developing written program plans. Consistency of objectives/ goals and strategies / tactics can be confirmed through a description of program theory/ logic.
- **Written process plans:** Consider written process plans (detailed implementation activities and roles and responsibilities).

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