ENERGY EFFICIENCY MARKET ASSESSMENT OF NEW JERSEY CLEAN ENERGY PROGRAMS

BOOK III – COMMERCIAL AND INDUSTRIAL PROGRAMS

FINAL

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1. C&I CONSTRUCTION PROGRAM MARKET ASSESSMENT

1.1 Program Introduction

1.1.1 Detailed Program Background[1]

The C&I Energy-Efficient Construction Program (C&I Program) is marketed as New Jersey SmartStart Buildings. The C&I Program is the umbrella name for three individual programs or components for targeted market segments:

1) Commercial New Construction
2) Commercial Retrofit
3) Schools, including new construction and retrofit

The program targets buildings of all sizes in the commercial, educational, governmental, institutional, industrial, and agricultural sectors.

Incentives for new construction projects are available only for projects in State-designated "Smart Growth" areas although exemptions are made for grades K-12 public schools and for some public-use buildings such as municipally owned buildings, hospitals, and military facilities.

The programs were designed to address key market barriers to efficient building construction and design on the part of developers, designers, engineers, and contractors including: unfamiliarity or uncertainty with energy-efficient building technologies and designs; bias toward first cost versus operating costs; compressed time schedules for design and construction; aversion to perceived risk-taking despite the proven reliability of efficient technologies and designs; and incentive structures and priorities for engineers, designers, and contractors which are at variance with efficiency considerations.

The program offers the following incentives and assistance:

- Prescriptive incentives
- Custom measure incentives
- Multiple-measure bonus
- Design support and technical assistance
- Specialized technical assistance for small commercial customers and educational institutions
- Technical support for newly enacted commercial energy code including training in energy code requirements

The program provides incentives and assistance for the measures shown in the following table.

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[1] Much of the description of the program was derived from "New Jersey's Clean Energy Program 2005 Program Descriptions and Budget Utility Managed Energy Efficiency Programs" Updated June 8, 2005.

Table 1-1. C&I Program Targeted Measures

ELECTRIC	GAS	DESIGN	SPECIAL SERVICES
Chillers	Boilers	Design Support	Building Commissioning
Ground Source Heat Pump	Cooling	Technical Assistance	Chiller Optimization
HVAC	Desiccant		Compressed Air
LED Traffic Signals	Furnaces		
Lighting	Water Heating		
Lighting Controls	Custom Equipment		
Motors			
Variable Frequency Drives			
Custom Equipment			

1.1.2 Program Specific Methodology

Surveys were implemented with the following four populations:

1) Participating Trade Allies – program-relevant trade companies who were identified as participating with the program.

2) Nonparticipating Trade Allies – program-relevant trade companies who have not participated with the program.

3) Participating C&I End Users – Commercial or industrial building owners who purchased equipment through the program.

4) Nonparticipating C&I End Users – Commercial or industrial building owners who have not purchased equipment through the program.

Participating Trade Allies

Participating Trade Allies are defined as program-relevant trade companies who were identified as participating with the program. The initial population of approximately 250 companies were those companies who listed their services through the program website.[2] This population was screened to include only those companies based in New Jersey or nearby in Pennsylvania or New York. The Sample Frame (see Table 1-2) was created by grouping the companies by geographic area (A1 to A5, see also Figure 1-1) and by company specialty identified from the web-listed services (C1 – C5). Contractors and suppliers (C5) were further grouped by the equipment services identified on the company's web-listing (T2 – T6). Where multiple specialties or technologies were listed, the population was distributed by hand, so that each company fell into only one category. Within each sample bin, the associated companies were assigned a random number which identified the order in which they would be contacted to complete the survey. The target population for each bin was established by hand to obtain reasonable coverage in each bin while staying as close as possible to a neutral distribution – that is, matching the actual distribution of participants.

[2] http://www.njsmartstartbuildings.com/main/fata/index.html

Table 1-2. Sample Frame for Participating Trade Allies

Co. Type	Equip	A1 Newark		A2 Philadelphia		A3 Central Beach		A4 Southern Tip		A5 Northwest	
		Pop	Tgt	Pop	Tgt	Pop	Tgt	Pop	Tgt	Pop	Tgt
C1	T1	43	8	25	5	14	4	2	2	3	3
C2	T1	6	3	4	3	2	1	0	0	1	1
C3	T1	10	5	0	0	0	0	1	1	1	1
C4	T1	4	3	3	2	2	1	1	1	1	1
C5	T2	7	4	2	1	3	2	0	0	1	1
C5	T3	17	4	8	4	3	2	2	1	5	3
C5	T4	13	3	1	1	4	2	1	1	0	0
C5	T5	6	3	1	1	1	1	0	0	0	0
C5	T6	6	3	1	1	3	2	1	1	1	1

Pop = Population; Tgt = Target number of survey completions. See Key below for additional code descriptions.

Sample Frame Key for Participating Trade Allies

New Jersey Area

A1 - Newark and New York state near Newark
A2 - Central-West New Jersey - Philadelphia Suburbs, Trenton
A3 - Central-East New Jersey - Cliffwood Beach to Toms River
A4 - Southern Tip - Atlantic City to Williamstown
A5 - Northwest New Jersey - North of I-78, West of I-287

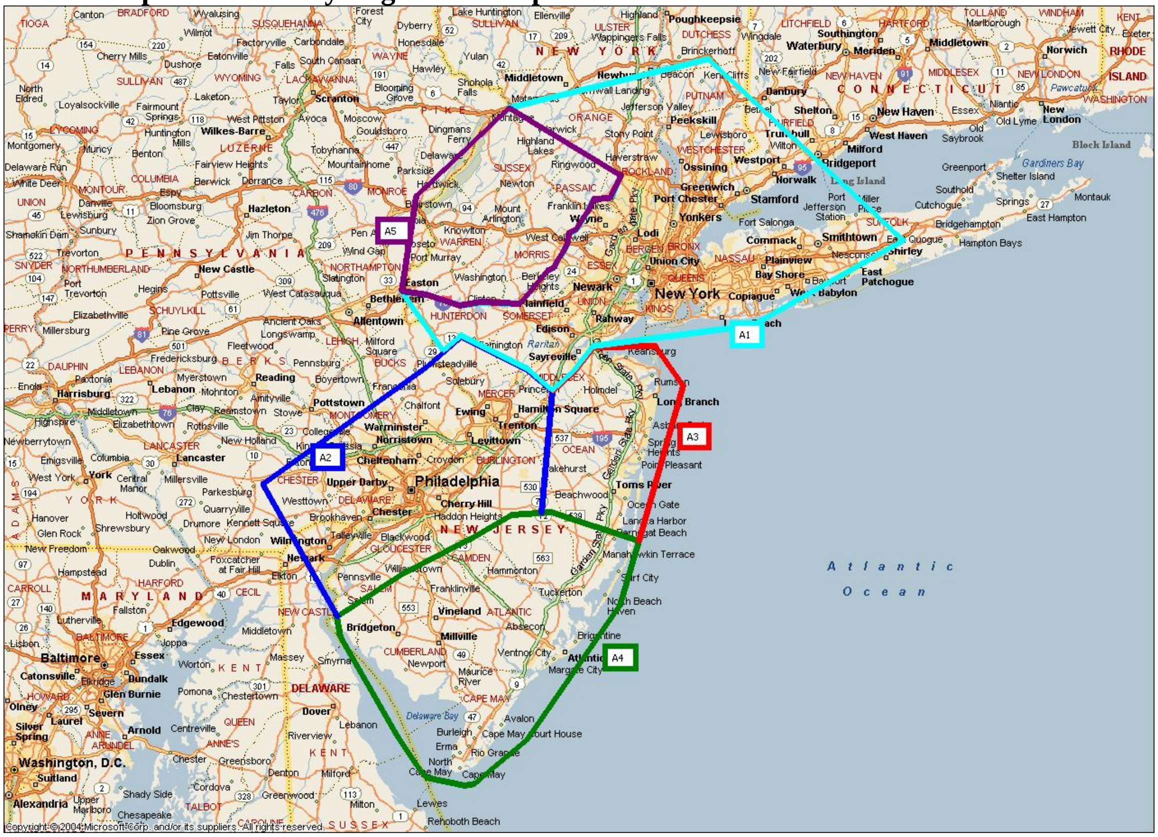
Company Specialty

C1 - Architects, Engineers and Design/Builders
C2 - Developers
C3 - Commissioning Service Providers
C4 - Compressed Air Consultants
C5 - Contractors/Installers; Energy Services; Suppliers-Retail; Suppliers-Wholesale

Equipment

T1 - All Equipment
T2 - Chillers; Ground Source Heat Pump; HVAC
T3 - Lighting; Lighting Controls; LED traffic lights
T4 - Motors; Variable Frequency Drives
T5 - Gas Cooling; Desiccant Gas Cooling
T6 - Gas Boilers; Gas Furnaces; Gas Water Heating

Figure 1-1. Map of New Jersey Regional Groups



New Jersey Areas

A1 - Newark and New York state near Newark
A2 - Central-West New Jersey - Philadelphia Suburbs, Trenton
A3 - Central-East New Jersey - Cliffwood Beach to Toms River
A4 - Southern Tip - Atlantic City to Williamstown
A5 - Northwest New Jersey - North of I-78, West of I-287

Nonparticipating Trade Companies

Nonparticipating Trade Allies are defined as program-relevant trade companies who have not participated with the program.[3] The initial population was identified using two sources: McGraw-Hill and Dun & Bradstreet.

We used the McGraw-Hill Dodge Players Starts Report (McGraw-Hill data) to identify commercial construction projects and architects, engineers, builders, and developers. McGraw-Hill collects their data through interviews with owners, architects, and contractors as well as permit filings. Using the McGraw-Hill data we identified 3,835 commercial construction projects starting in New Jersey between January 1, 2004 and December 31, 2005. We then narrowed the population by assuming that projects starting

[3] During the survey we found that some "nonparticipating" trade allies had actually participated in the program. We grouped them with the participating trade allies for analysis.

between June 2004 and June 2005 constituted the population of projects likely completed in 2005, and further narrowed by random number assignment. We did not screen out engineering companies based on dates due to the small number of engineers identified in the initial population.

We ordered a custom Dun & Bradstreet database (D&B data) to identify other contractors, distributors, and equipment suppliers. We identified 8,009 relevant New Jersey trade companies, selecting them by standard industrial classification (SIC) codes for HVAC, electrical, motor, and lighting contractors and wholesalers. We then selected a random sample of this population. We cross-checked the final list with the list of participating trade allies to eliminate duplicates.

The sample frame was created by grouping the population by geographic area based on zip code (A1 – A5), and further grouping based on company specialty (N1 – N6). Architects, engineers, and builders were identified as such by the McGraw-Hill data. Developers were identified from the McGraw-Hill data by one of the following identifiers in the owner name: “realty”, “real estate”, “rlty”, or “develop”. HVAC contractors, electrical contractors, motor contractors, and lighting contractors were identified by standard industrial classification code in the D&B data. Within each sample bin, the associated companies were assigned a random number which identified the order in which they would be contacted to complete the survey. The target population for each bin was established by hand to obtain reasonable coverage in each bin while staying as close as possible to a neutral distribution, that is matching the actual distribution of companies.

Table 1-3. Sample Frame for Nonparticipating Trade Allies

Company Type	A1 Newark		A2 Philadelphia		A3 Central Beach		A4 Southern Tip		A5 Northwest		Total	
	Pop	Tgt	Pop	Tgt	Pop	Tgt	Pop	Tgt	Pop	Tgt	Pop	Tgt
N1: Architects; Engineers; Design/Builders	177	8	80	5	39	4	20	2	32	3	348	22
N2: Developers	23	3	10	3	11	1	17	1	17	1	78	9
N3: HVAC	137	7	43	3	42	3	30	2	30	2	282	17
N4: Electrical	124	3	40	1	52	1	28	1	44	1	288	7
N5: Motors	11	2	1		4	1	0		2	1	18	4
N6: Lighting	36	5	6	2	9	3	1		7	1	59	11
Total	**508**	**28**	**180**	**14**	**157**	**13**	**96**	**6**	**132**	**9**	**1073**	**70**

Pop = Population; Tgt = Target number of survey completions. See Key below for additional code descriptions.

Sample Frame Key for Nonparticipating Trade Allies:
Geographic Area
- A1 - Newark and New York state near Newark
- A2 - Central-West New Jersey - Philadelphia Suburbs, Trenton
- A3 - Central-East New Jersey - Cliffwood Beach to Toms River
- A4 - Southern Tip - Atlantic City to Williamstown
- A5 - Northwest New Jersey - North of I-78, West of I-287

Company Specialty
- N1 - Architects, Engineers, and Builders
- N2 - Developers
- N3 - HVAC Contractors
- N4 - Electrical Contractors
- N5 - Motor Contractors
- N6 - Lighting Contractors

Participating C&I End Users

Participating C&I End Users are defined as commercial or industrial building owners who received incentives through the program. The sample data came from spreadsheets each of the utilities provided in response to a request for data from the BPU. We combined the data into one database and then selected as a sample all records where an incentive was paid in 2005, giving us a sample of 1,650 records (Table 1-4).

Table 1-4. Data Records from Utilities

Year	ACE	Etown	JCP&L	NJNG	PSE&G	RECo	SJG	Total
2001	168	0	633	10	348	15	3	1,177
2002	985	13	3,687	19	4,667	114	20	9,505
2003	411	13	1,244	25	1,747	29	21	3,490
2004	355	2	1,455	31	1,847	41	30	3,761
2005	147	3	599	8	831	31	31	1,650
Total	**2,066**	**31**	**7,618**	**93**	**9,440**	**230**	**105**	**19,583**

Data = Number of records by utility and date incentive paid. Each record represents a single incentive payment, not a unique participant.

We initially distributed the sample by the bins shown in Table 1-5 in order to obtain reasonable coverage in each bin while staying as close as possible to a neutral distribution – that is, matching the actual distribution of participants. The sample frame was created by grouping the population by building type as either K-12 schools and child care (C1), or all others (C0). The sample was further grouped by equipment type (T1 – T6) and electric utility (U1 – U7). Finally, the sample was grouped by incentive amount as either above (M1) or below (M0) the median incentive amount. Within each sample bin, the associated companies were assigned a random number which identified the order in which they would be contacted to complete the survey.

Table 1-5. Sample Frame for Participating C&I End Users

Eqp.	Inc. Amt.	U1 ACE		U2 Etown		U3 JCP&L		U4 NJNG		U5 PSEG		U6 Reco		U7 SJG	
		P	T	P	T	P	T	P	T	P	T	P	T	P	T
Schools (C1)															
T2	M1	2	1	-	-	6	1	-	-	2	1	2	1	-	-
T2	M0	-	-	-	-	5	-	-	-	-	-	-	-	-	-
T3	M1	4	1	-	-	7	1	-	-	13	1	6	1	-	-
T3	M0	-	-	-	-	7	1	-	-	12	1	-	-	-	-
T4	M1	1	-	-	-	1	1	-	-	-	-	-	-	-	-
T4	M0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T5	M1	-	-	-	-	-	-	-	-	-	-	-	-	1	1
T5	M0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T6	M1	-	-	-	-	-	-	-	-	-	-	-	-	2	1
T6	M0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
All Others (C2)															
T2	M1	12	1	-	-	38	3	-	-	15	3	4	1	-	-
T2	M0	11	-	-	-	37	1	-	-	-	-	-	-	-	-
T3	M1	32	2	-	-	152	6	-	-	236	8	88	1	-	-
T3	M0	32	1	-	-	149	4	-	-	231	5	87	-	-	-
T4	M1	8	1	-	-	15	1	-	-	16	2	7	1	1	-
T4	M0	-	-	-	-	14	1	-	-	16	1	-	-	-	-
T5	M1	-	-	-	-	-	-	1	1	1	1	-	-	1	-
T5	M0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T6	M1	-	-	3	3	-	-	7	4	7	2	-	-	10	2
T6	M0	-	-	-	-	-	-	-	-	-	-	-	-	9	1

P = Population; T = Target number of survey completions. See Key below for additional code descriptions.

Sample Frame Key for Participating C&I End Users:

Utility

- U1 - Atlantic City Electric (ACE)
- U2 - Elizabethtown Gas (Etown)
- U3 - Jersey Central Power & Light Company (JCP&L)
- U4 - New Jersey Natural Gas (NJNG)
- U5 - Public Service Electric and Gas Company (PSE&G)
- U6 - Rockland Electric (RECo)
- U7 - South Jersey Gas (SJG)

Building Type

- C1 - School
- C0 - All Other

Equipment

- T2 - Chillers; Ground Source Heat Pump; HVAC
- T3 - Lighting; Lighting Controls; LED traffic lights
- T4 - Motors; Variable Frequency Drives
- T5 - Gas Cooling; Desiccant Gas Cooling
- T6 - Gas Boilers; Gas Furnaces; Gas Water Heating

Incentive Amount

- M1 - Above median incentive amount
- M2 - Below median incentive amount

Nonparticipating C&I End Users

Nonparticipating C&I End Users are defined as commercial or industrial building owners who have not purchased equipment through the program. The initial population was identified using the project owners listed in the McGraw-Hill data discussed above. The sample was reduced by considering only projects initiated between June 2004 and June 2005, chosen to represent projects likely completed during 2005. We cross-checked the final list with the list of participating end users to eliminate duplicates.

The sample frame (Table 1-6) was created by grouping the population by geographic area based on zip code (A1 – A5), and grouping by building type as either K-12 schools (S), or all others (O). The sample was further grouped by project type, with McGraw-Hill project descriptions of “New” or “Additions” used to identify new construction (N), and project descriptions of “Alterations/Renovations” used to identify retrofit (R) projects. Finally, the sample was grouped by project cost as either above (UM) or below (BM) the median project cost. Within each sample bin, the associated companies were sorted based on the last 4 digits of the owner’s phone number, which identified the order in which they would be contacted to complete the survey. The target population for each bin was established by hand to obtain reasonable coverage in each bin while staying as close as possible to a neutral distribution – that is, matching the actual distribution of companies.

Table 1-6. Sample Frame for Nonparticipating C&I End Users

Bldg. Type	Proj.	Inc. Amt.	A1 Newark		A2 Philadelphia		A3 Central Beach		A4 Southern Tip		A5 Northwest	
			Pop	Tgt	Pop	Tgt	Pop	Tgt	Pop	Tgt	Pop	Tgt
S	N	UM	5	1	4	1	1	1	2	1	2	1
S	N	BM	3	0	0	0	0	0	0	0	0	0
S	R	UM	7	2	4	1	1	1	3	1	2	1
S	R	BM	24	1	7	1	1	1	0	0	5	1
O	N	UM	68	8	34	4	9	3	11	2	16	3
O	N	BM	55	1	27	1	5	1	9	1	15	1
O	R	UM	47	9	23	4	4	2	10	2	6	2
O	R	BM	143	4	39	2	11	1	11	2	20	1

Pop = Population; Tgt = Target number of survey completions. See Key below for additional code descriptions.

Sample Frame Key for Nonparticipating C&I End Users:

New Jersey Area

A1 - Newark and New York state near Newark
A2 - Central-West New Jersey - Philadelphia Suburbs, Trenton
A3 - Central-East New Jersey - Cliffwood Beach to Toms River
A4 - Southern Tip - Atlantic City to Williamstown
A5 - Northwest New Jersey - North of I-78, West of I-287

Building Type

S - School
O - All Other

Project Type

N - New Construction
R - Retrofit or Renovation

Incentive Amount

UM - Above median project cost
BM - Below median project cost

On-Site Assessments Sample

The C&I evaluation included 10 on-site assessments. The on-sites were chosen from participants who responded to the telephone interview. The sample was selected to provide a cross-section of the most important technologies covered by the program. The sample was weighted toward larger projects, based on the incentives received by the participant. The sample is presented in the following table.

Table 1-7. On-Site Assessment Sample

Utility	Technology	Incentive
ACE	VFDs	$9900
JCP&L	Chiller	$63,900
JCP&L	Performance Lighting	$12,810
JCP&L	Prescriptive Lighting	$20,781
JCP&L	Performance Lighting	$14,250
New Jersey Natural Gas	Absorption cooling	$44,160
PSE&G	Performance Lighting Incentives	$7110
PSE&G	Three-Phase Motor (Premium Motors)	$1650
PSE&G	Variable Air Volume (variable frequency drive)	$12,200
SJG	Gas cooling	$151,800

Sample Disposition

Each telephone survey achieved an accuracy of 10% or better at a 90% confidence interval. The completed surveys are shown in Table 1-8

Table 1-8. Completed Survey Efforts

Market Actor	Collection Mode	Targeted	Completes	%	Accuracy @ 90% Conf. Int.[4]
Participating end-use customers	Telephone Surveys	70	68*	97%	9.9%
Participating end-use customers	On-site Inspections	10	10	100%	NA
Nonparticipating end-use customers	Telephone Surveys	70	65*	93%	10.2%
Participating developers, designers, and specifiers	Telephone Surveys	70	70	100%	9.5%
Nonparticipating developers, designers, and specifiers	Telephone Surveys	70	69*	99%	9.9%

*Population has been exhausted, survey efforts have been halted

1.1.3 Program Specific Previous Evaluations

We used a variety of secondary sources in this analysis. Some of the key reports are listed below.

Consortium for Energy Efficiency. ***2005 Commercial Buildings Program Summary Existing Construction***, January 2005

[4] The confidence and precision levels shown in the table are based on formulae for estimating proportions. The largest variance occurs when the proportion is 0.5; *i.e.*, one-half of the respondents indicate they are in that group and one-half state that they are not in that group. The calculation assumes the variance with this 50/50 split. It should be noted that each question in a survey will have a different confidence interval and precision depending upon the range of possible answers for multi-category questions or continuous variables and the dispersion of responses.

Consortium for Energy Efficiency. ***National Summary Of Energy efficiency Programs for Motors and Drives***, November 2004

Peters, J. ***Best Practices from Energy Efficiency Organizations and Programs***, prepared for the Energy Trust of Oregon, August 2002
http://www.energytrust.org/Pages/about/library/reports/Best_Practices/index.html.

Mahone, Douglas, Hall, Nick, Megdal, Lori, Keating, Ken, and Ridge, Richard. **Codes and Standards White Paper on Methods for Estimating Savings.** April 7, 2005.

Rufo, M., and James, K. ***Energy Efficiency Best Practices: What have we Learned?*** The National Energy Efficiency Best Practices Study, Presentation at ACEEE MT Conference, March 2005.

Rufo, M. ***National Energy Efficiency Best Practices Study***, December 2004.

Vol. NR1 – Non-Residential Lighting Best Practices Report

Vol. NR5 Non-Residential Large Comprehensive Incentive Programs Best Practices Report.

Vol. NR 8 Non-Residential New Construction Programs Best Practices Report
Summary Profile Report: CA Statewide Savings by Design.
Summary Profile Report: HECO Nonres New Construction
Summary Profile Report: Design 2000*plus*
Summary Profile Report: Energy Conscious Construction
Summary Profile Report: NSTAR New Construction Program
Summary Profile Report: Energy Design Assistance.

Rufo, M. ***Gold Mine, Snake Pit, or Both? Issues and Best Practices for Large C&I Incentive Programs***, AESP Brown Bag, Oct. 18, 2005.

York, D. and Kushler, M., ***America's Best: Profiles of America's Leading Energy Efficiency Programs.*** ACEEE Report Number U032. American Council for an Energy-efficient Economy, Washington, DC. 2003.
Design 2000*plus* Program Overview
Energy Conscious Construction Program Overview
Energy Design Assistance Program Overview

Kushler, M., York, D. and Witte, P. **Responding to the Natural Gas Crisis: America's Best natural Gas Energy Efficiency Program**, ACEEE Report Number U035, Dec. 2003.

Hawaiian Electric Co., **Letter to Hawaiian Public Utilities Commission** by W. Bonnet, Docket 05-0069 Energy Efficiency Docket, Dec. 5, 2005.

Final Report: 2003 Building Efficiency Assessment Study An Evaluation of the Savings By Design Program. Prepared for: Pacific Gas and Electric, San Diego Gas and Electric, and Southern California Edison, July 2005

Armstrong, Jim, NSTAR Electric & Gas. Presentation: **The Role of Utility Rebate Programs in Performance Contracting,** US DOE.

March 2006 Newsletter, Energy Center of Wisconsin. **Advanced Buildings – raising our expectations.**

CEC **Non-Residential Market Share Tracking Study Final Report on Phases 1 and 2**, April 2005 CEC-400-2005-013

Evaluation of the Energy Trust of Oregon's New Building Efficiency Program Final Report, August 26, 2005

Tannenbaum, Bobbi, Goldberg, Mimi, and Dyson, Chris. **Focus on Energy Public Benefits Evaluation *Business Programs: Measure Review*** Final: February 3, 2006

New York Energy $mart[SM] Program Evaluation and Status Report **Report to the System Benefits Charge Advisory Group Final Report - May 2005**

Environmental Law Institute. **Building Healthy, High Performance Schools: A Review of Selected State and Local Initiatives**, Sept. 2003.

Amann, Jennifer, and Mendelsohn, Eric, **Comprehensive Commercial Retrofit Programs: A Review of Activity and Opportunities.** ACEEE Report A052, April 2005.

VanGeen, Martha G., Whole Building Design Guide. **Energy Codes and Standards,** http://www.wbdg.org/design/energycodes/php, updated 12-11-2005.

California Energy Commission, **2005 Building Energy Efficiency Standards For Residential And Nonresidential Buildings,** September 2004.

Nadel, Steven, deLaski, Andrew, Eldridge, Maggie, and Kleisch, Jim. **Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards.** Updated from and supersedes Report A051. ACEEE Report A062, March 2006.

Consortium for Energy Efficiency. **National Summary of Energy efficiency Programs for Motors and Drives,** November 2004.

Quantum Consulting, **NRNC Market Characterization and Program Activities Tracking Report PY2004**. May 2005

Highlights of Efficiency Vermont's Plans for 2006, December 16, 2005.

1.2 Assessment of Performance Indicators

This section presents a review of the appropriateness of the current program performance indicators, provides updated values for indicators that should be tracked by evaluation and market assessment efforts, and closes with a list of recommended indicators for the future.

1.2.1 Review of Current Indicators

Table 1-9 contains the "performance indicators that were proposed by the utilities in past filings with the BPU" according to the RFP for this evaluation. These indicators can also be found in "New Jersey Clean Energy Program, 2004-2005 Evaluation and Research Plan, Phase 1: Activities to be Initiated 2004" from August 5, 2004 by the CEEEP.

Table 1-9. C&I Construction Program Performance Indicators

Indicator Area	Performance Indicator	Data Source
Energy and Demand Impacts	Program Savings	Protocols
Program Activity - separate estimates for new construction and retrofit	Number of projects. Projects as a % of new construction and renovation activity statewide.	Program tracking for number of projects. Market assessment for % of statewide activity (using best available data).
Program Activity – separate estimates for new construction and retrofit	Number and percent of repeat design professionals in Comprehensive Design Assistance.	Program tracking
Distribution of Program Activity – separate estimates for new construction and retrofit	Number of prescriptive, custom, and Comprehensive Design Assistance (CDA) projects. Percent of energy savings from prescriptive, custom, and CDA projects, respectively.	Program tracking
Program Activity: Motors, HVAC, and Design Lights	Number of individuals trained, by specialized path and type of training.	Program tracking
Trade Ally Awareness	Percent of design professionals aware of the program, qualifying measures, and design practices.	Market Assessment
Customer Awareness	Percent of customers aware of the program, qualifying measures, and design practices.	Market Assessment
Market Share Monitoring	Periodic estimates (method TBD) of sales of energy-efficient technologies as a percent of total NJ sales.	Market Share Monitoring
Market Changes in energy-efficient lighting design	Decrease in watts per square foot, for participants and nonparticipants, by building type.	Market Assessment

The evaluation team provided a review of these indicators in a memo on December 31, 2005. The purpose of that memo was to update and revise the indicators to serve as the “roadmap” for the market assessment report, guiding the data collection approach and analysis so that the research can effectively measure the efficacy of the programs in meeting the stated market transformation goals. For the C&I programs, the update is summarized in Table 1-10. This table defines which indicators should be added, combined, and dropped from the list of indicators of program performance. Indicators we believe should be dropped are listed in a red strikethrough font. It also lists the source of data for tracking each indicator. This evaluation report will primarily address indicators that should be tracked by evaluation or market assessment efforts, not program tracking efforts.

Table 1-10. Assessment of C&I Indicators

ID*	Topic	Performance Indicator	New?	General Source	Detailed Source	Notes
A	Energy and Demand Impacts	Program Savings	2004-5	Program tracking	Program	Use, combine with E
E	Energy and Demand Impacts	Percent of energy savings from prescriptive, custom, and Comprehensive Design Assistance (CDA) projects, respectively by New Construction and retrofit	2004-5	Program tracking	Program	Use, combine with A
B	Program Activity	Number of projects.	2004-5	Program tracking	Program	Use, combine with D
D	Program Activity	Number of prescriptive, custom, and CDA projects by New Construction and retrofit	2004-5	Program tracking	Program	Use, combine with B
Q	Program Activity	~~Number of comprehensive projects~~ - Number of Multiple Measure projects	2004 (goal)	Program tracking	Program	Multiple measure projects seems to be a more relevant indicator
S	**Program Activity**	**Number of contractors and number of new contractors associated with measure installations.**	**New**	**Program tracking**	**Program**	**An indicator of the effectiveness of outreach to new companies and sectors.**
L	Program Activity	New construction projects as a % of new construction activity statewide.	2004-5	Program tracking for number of projects. Market assessment for % of statewide activity	Program	Cannot track statewide activity in real time easily but using a number that is only updated once or twice a year is realistic.
H	~~Customer Awareness~~	~~Percent of customers aware of the program, qualifying measures, and design practices.~~	2004-5	Evaluation	~~Customers~~	Not timely because not realistic to monitor in real time. As specified here it is too open to interpretation. **Replace with P**
P	**Customer Awareness**	**Percent of customers who answer 3-5 on 5 point scale of "How familiar are you with the features of the program?" where 5 is "very".**	**New**	**Evaluation**	**Customers**	**Use questions that would address specific features of the program. Avoid questions where guesses might produce correct answers.**
G	~~Trade Ally Awareness~~	~~Percent of design professionals aware of the program, qualifying measures, and design practices.~~	2004-5	Evaluation	~~Design professionals~~	Not timely because not realistic to monitor in real time. As specified here it is too open to interpretation. Level of familiarity is a more informative indicator than awareness. **Replace with O.**
O	**Trade Ally Awareness**	**Percent of design professionals who answer 3-5 on 5 point scale of "How familiar are you with the features of the program?" where 5 is "very".**	**New**	**Evaluation**	**Design professionals**	**Use questions that would address specific features of the program. Avoid questions where guesses might produce correct answers.**

ID*	Topic	Performance Indicator	New?	General Source	Detailed Source	Notes
F	~~Program Activity~~	~~Number of individuals trained, by specialized path and type of training for Motors, HVAC, and Design Lights (edit per below)~~	2004-5	Program tracking	Trainees	**Replace with N**
N	**Program Activity**	**Total number of individuals and companies trained, number of individuals and companies trained who have not been to program training before, by specialized path and type of training for Motors, HVAC, and Design Lights**	**New**	**Program tracking**	**Trainees**	**Tracking total training is useful. To get an indicator of the effectiveness of outreach to new companies and sectors, track the number of people and companies who are new to program training events.**
C	~~Program Activity~~	~~Number and percent of repeat design professionals in Comprehensive Design Assistance by New Construction and Retrofit~~	2004-5	Program tracking	~~Design professionals~~	The program is getting repeat business from a small number of professionals. It should stretch beyond the core group. **Replace with K.**
K	**Program Activity**	**Number of design professionals in Comprehensive Design Assistance (CDA) who are new to the program and total number of design professionals in CDA.**	**New**	**Program tracking**	**Design professionals**	**Could be tracked as number and reported as percent of total design professionals in CDA.**
J	~~Market changes in energy-efficient lighting design~~	~~Decrease in watts per square foot, for participants and nonparticipants, by building type.~~	2004-5	Market Assessment	Program	Measuring this at the level of detail to be meaningful is not realistic - it would be quite expensive. DO NOT USE
I	Market share monitoring	Periodic estimates (method TBD) of sales of energy-efficient technologies as a percent of total NJ sales.	2004-5	Market Share Monitoring	Program	Unless market share monitoring is funded as a regular activity, this indicator will not be timely. Thus this is useful for a periodic status check but not as a regular indicator.
M	~~Program Activity~~	~~Retrofit projects as a % of renovation activity statewide.~~	2004-5	Program tracking for number of projects. Market assessment for % of statewide activity	Program	Total renovation activity statewide is too broad to be quantifiable. **DO NOT USE**

*The indicator ID reflects the order of the indicators in the 2004-2005 Indicator list. This list has been reordered to align similar indicators.

Table 1-11 rearranges the indicators from the previous table after erasing indicators we are recommending be deleted. This table makes it clear which indicators we are analyzing in this report and which should be analyzed on an ongoing basis using program tracking data. As we step through the indicators in the remainder of this section, we will repeat rows from this table to signify the indicator we are currently addressing.

Table 1-11. C&I Performance Indicators Addressed in This Evaluation

ID	Topic	Performance Indicator	General Source	Data Presented Here?
P	Customer Awareness	Percent of customers who answer 3-5 on 5 point scale of "How familiar are you with the features of the program?" where 5 is "very".	Participants survey	Y
O	Trade Ally Awareness	Percent of design professionals who answer 3-5 on 5 point scale of "How familiar are you with the features of the program?" where 5 is "very".	Trade allies survey	Y
I	Market Share Monitoring	Periodic estimates (method TBD) of sales of energy-efficient technologies as a percent of total NJ sales.	Market Share Monitoring	Y
L	Program Activity	New construction projects as a % of new construction activity statewide.	Program tracking for number of projects. Market assessment for % of statewide activity	Y
A	Energy and Demand Impacts	Program Savings	Program tracking	Y
B	Program Activity	Number of projects.	Program tracking	Y
E	Energy and Demand Impacts	Percent of energy savings from prescriptive, custom, and Comprehensive Design Assistance (CDA) projects, respectively by New Construction and retrofit	Program tracking	N
D	Program Activity	Number of prescriptive, custom, and CDA projects by New Construction and retrofit	Program tracking	N
K	Program Activity	Number of design professionals in Comprehensive Design Assistance who are new to the program and total number of design professionals in CDA.	Program tracking	N
N	Program Activity	Total number of individuals and companies trained, number of individuals and companies trained who have not been to program training before, by specialized path and type of training for Motors, HVAC, and Design Lights	Program tracking	N
Q	Program Activity	Number of Multiple Measure projects	Program tracking	N
S	Program Activity	Number of contractors and number of new contractors associated with measure installations.	Program tracking	N

1.2.2 Update of Current Indicators

Customer Awareness

ID	Topic	Performance Indicator	General Source	Data Presented Here?
P	Customer Awareness	Percent of customers who answer 3-5 on 5 point scale of "How familiar are you with the features of the program?" where 5 is "very".	Participants survey	Y

Early in the End User surveys, participants and nonparticipants were asked "On a scale where 1 is 'not at all familiar' and 5 is 'very familiar', how familiar are you with the services and incentives the SmartStart Buildings program offers?" The participants' average answer was 2.5, which indicates they felt relatively **un**familiar with the program. As expected, nonparticipants were less familiar, with an average answer of 1.4.[5] Among participants, those who participated in the New Construction component felt most familiar with the program, giving an average answer of 3.2, followed by Retrofit at 2.5 and Schools at 2.2, however the differences between the groups were not statistically significant.

Participants and nonparticipants were asked whether they were aware that the program offered incentives for specific program-targeted measures and how familiar they were with specific services offered by the program. Just over 40% of participants knew the program offered incentives for lighting, one-third knew of incentives on gas boilers and HVAC equipment, and less than a quarter knew of incentives on gas cooling, VFDs, and ground source heat pumps (Figure 1-2). Just over 10% of nonparticipants were aware the program offers incentives for lighting, 7% knew of HVAC incentives and less than 5% knew of any other incentives. On average, participants knew of incentives on three measures and nonparticipants knew of incentives on less than one measure (Figure 1-3).

Participants were relatively unfamiliar with program services (Figure 1-4). They were most familiar with the program's technical assistance, giving it an average familiarity score of 2.3 on a scale where 1 is "very unfamiliar" and 5 is "very familiar". Nonparticipants had very little familiarity with any program service.

Variations across business types for awareness of incentives and awareness of program services were not statistically significant with and without nonparticipants in the analysis. Variations across program component (school, retrofit, new construction) were not significant for awareness of incentives or program services but they were close to significant for services.[6] Participants in the New Construction component gave an average familiarity score of 2.3 across the seven services tested while retrofit and schools gave an average score of 1.6. Variations across regions of the state were not significant for the awareness questions.

In general, the more familiar a participant or nonparticipant was with energy efficiency options for a technology, the more likely they were to be aware of utility incentives for that technology (see Figure 1-5 and Figure 1-6).

The majority of participants (60%) were not aware that they could get increased incentives for installing more than one type of measure. That knowledge did not vary significantly between participants in the school, new construction, or retrofit components.

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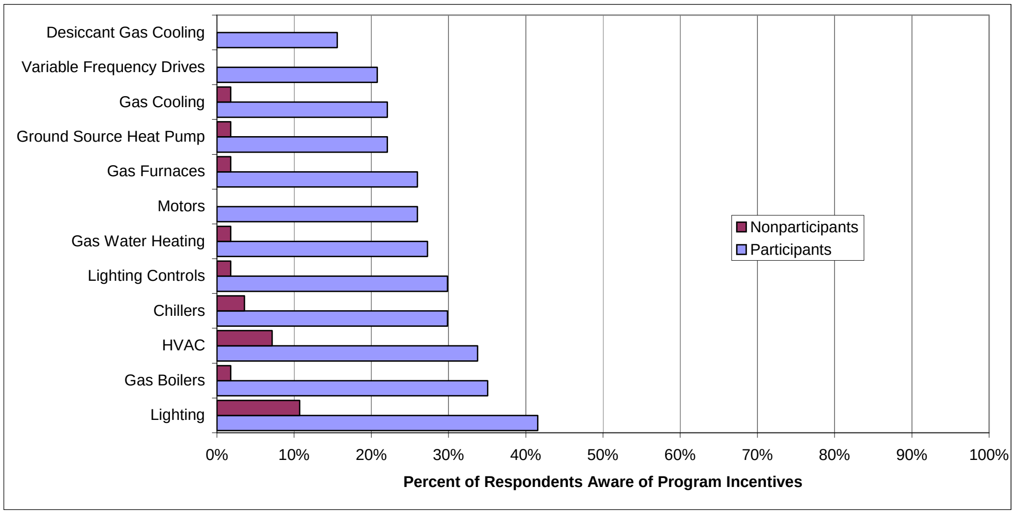
[5] The difference between participants and nonparticipants was statistically significant.

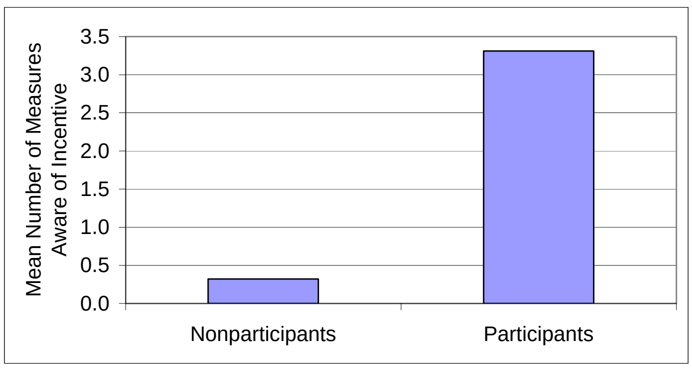
[6] For participants only, F=2.822, significance=0.066 where 0.05 is typically considered significant. F=0.205, significance=0.815 when participants and nonparticipants were analyzed together.

Figure 1-2. "Were you aware the program offered incentives for …?"



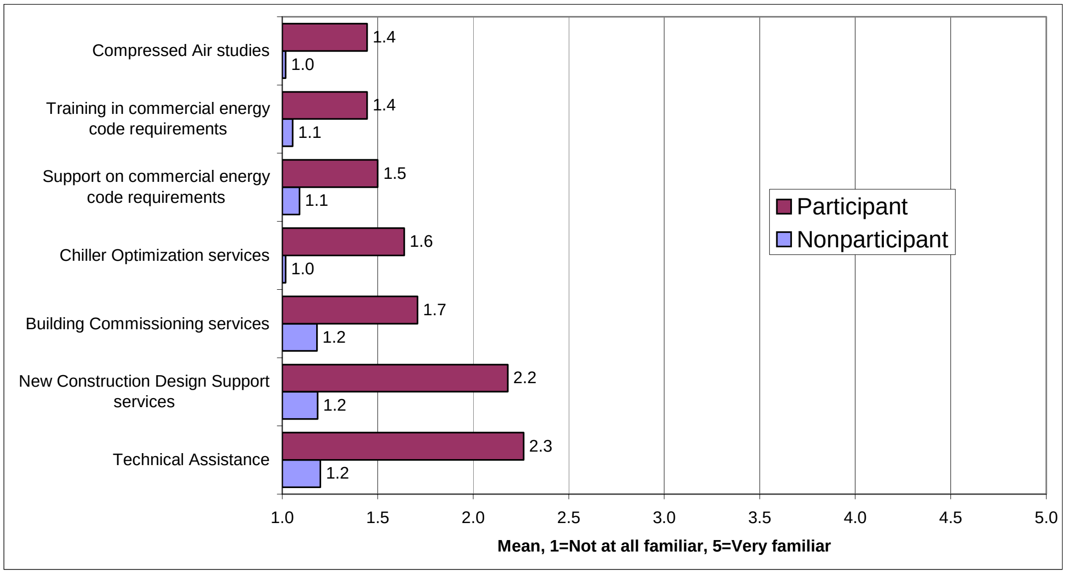
Source: Participant and Nonparticipant Survey Question IN2. N=133.

Figure 1-3. Number of Measures Aware of Incentives



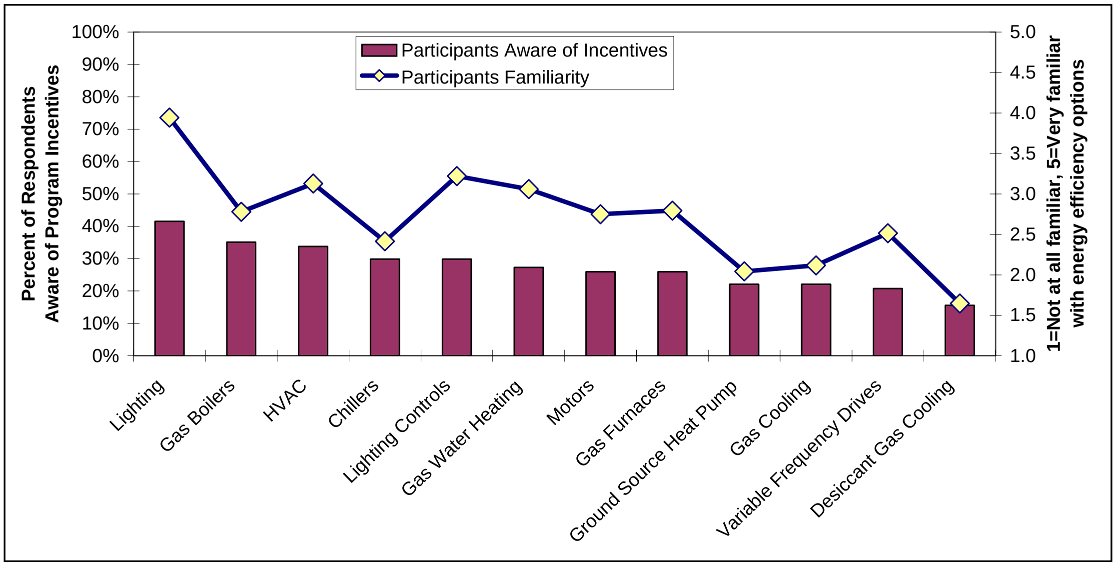
Definition: Average of the count of the number of measures shown in the previous graph that participants and nonparticipants knew there were incentives on.
Source: Participant and Nonparticipant Survey Question IN2. N=133. Count

Figure 1-4. Familiarity with Program Services



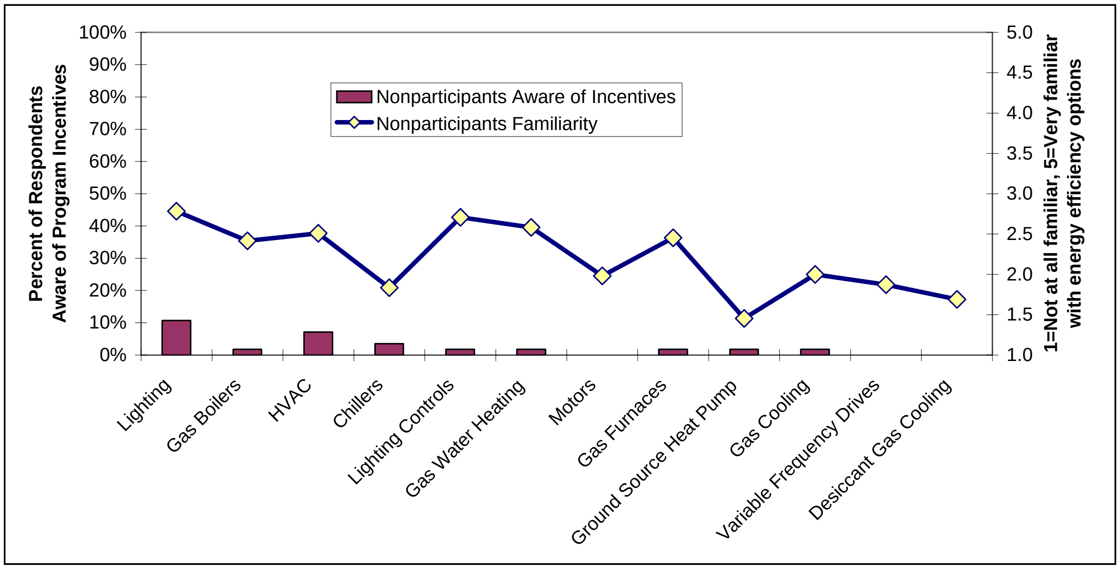
Source: Participant and Nonparticipant Survey Question IN12. N=127.

Figure 1-5. Awareness of Incentives vs. Familiarity with Technology – Participants



Source: Participant Survey Questions IN2 and IN11. N=77.

Figure 1-6. Awareness of Incentives vs. Familiarity with Technology – Nonparticipants



Source: Participant Survey Questions IN2 and IN11. N=56.

Conclusion. Participants were not very familiar with the SmartStart Buildings programs in general and its financial incentives and services. Nonparticipants were even less familiar. Participants were most familiar with the lighting incentives. One third or fewer were aware of other incentives. Ten percent of nonparticipants knew the program offers lighting incentives and less than 10% were aware of other incentives.

Trade Ally Awareness

ID	Topic	Performance Indicator	General Source	Data Presented Here?
O	Trade Ally Awareness	Percent of design professionals who answer 3-5 on 5 point scale of "How familiar are you with the features of the program?" where 5 is "very".	Trade allies survey	Y

Participating trade allies felt they were fairly familiar with the New Jersey SmartStart Buildings program overall but were significantly less familiar with the program's services (Figure 1-7 and Table 1-12). Participating trade allies were significantly more likely to be aware of the program and its services than nonparticipating trade allies.

Figure 1-7. Awareness of Program and Program Services Among Trade Allies

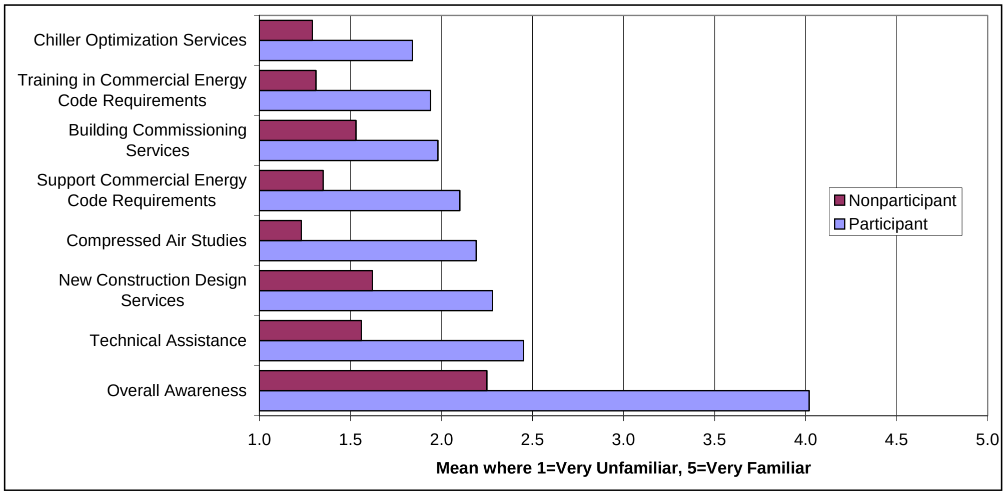


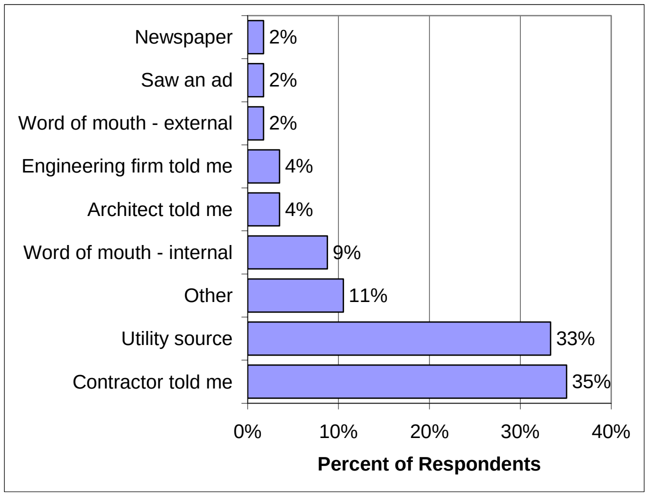
Table 1-12. Awareness of Program and Program Services Among Trade Allies

Participation Status	Participant (N=73)	Nonparticipant (N=66)
Overall Awareness	4.02	2.25
Technical Assistance	2.45	1.56
New Construction Design Services	2.28	1.62
Compressed Air Studies	2.19	1.23
Support Commercial Energy Code Requirements	2.10	1.35
Building Commissioning Services	1.98	1.53
Training in Commercial Energy Code Requirements	1.94	1.31
Chiller Optimization Services	1.84	1.29

Mean where 1=Not at all familiar, 5=very familiar
Source: trade ally survey questions AF1 and AF2.

Participants most likely learned about the incentives from their contractors (Figure 1-8). The next most common source was their utility, either through utility reps, mailings, or the program website. Of those who had a contractor install their program-incented equipment, 35% said their contractor brought up the equipment and the incentives.

Figure 1-8. How did you first learn there were incentives available?



Source: Participant survey question How1. N=68.

Conclusion. Participating trade allies felt they were fairly familiar with the New Jersey SmartStart Buildings program overall but were significantly less familiar with the program's services. Participating trade allies were significantly more likely to be aware of the program and its services than nonparticipating trade allies.

Market Share Monitoring and Program Activity

ID	Topic	Performance Indicator	General Source	Data Presented Here?
I	Market Share Monitoring	Periodic estimates (method TBD) of sales of energy-efficient technologies as a percent of total NJ sales.	Market Share Monitoring	Y
L	Program Activity	New construction projects as a % of new construction activity statewide.	Program tracking for number of projects. Market assessment for % of statewide activity	Y

Detailed results that address these two indicators are presented later in this report in Section 9.7.2, Characteristics of Participating End Users.

The program's 2005 goals were as follows:[7]

New Construction = 134 completed jobs
Existing Construction (Retrofit) = 3128 completed jobs
Schools = 195 completed jobs

[7] New Jersey's Clean Energy Program 2005 Program Descriptions and Budget Utility Managed Energy Efficiency Programs Updated June 8, 2005.

The C&I Program met its goal in New Construction and Schools but fell short in Retrofit (Table 1-13).

Table 1-13. C&I Program Number of Participants in 2005

	New Construction	Retrofit	School	Total
Atlantic City Electric	67	200	29	296
JCP&L	59	580	101	740
PSE&G - Electric	53	1,072	42	1,167
Rockland Electric Co.	1	22	3	26
New Jersey Natural Gas Co.	7	5	83	95
Elizabethtown Gas Co.	1	5	3	9
PSE&G - Gas	0	15	1	16
South Jersey Gas Co.	10	24	4	38
Total	**198**	**1,923**	**266**	**2,387**
Goal	134	3,128	195	3,457
Percent of Goal	148%	61%	136%	69%

Source: New Jersey's Clean Energy Program Report submitted to the New Jersey Board of Public Utilities March 28, 2006.

Other Evidence of Program Impact

The discussion above has centered on data that directly speaks to specific indicators of program success. The remainder of this subsection will discuss results that further illuminate the program's impacts on participants and nonparticipants.

Impact of Program on Installation Decision

Participants were asked how important various aspects of their experience was in their decision to implement energy efficiency measures. On average they thought financial incentives were quite important, giving it an average score of 4.2 on a scale of 1 to 5 where 1 is "not at all important" and 5 is "very important" (N=68). They also thought the technical assistance was important, giving it an average score of 4.1 (N=27). These scores did not differ significantly by program component or geographic area.

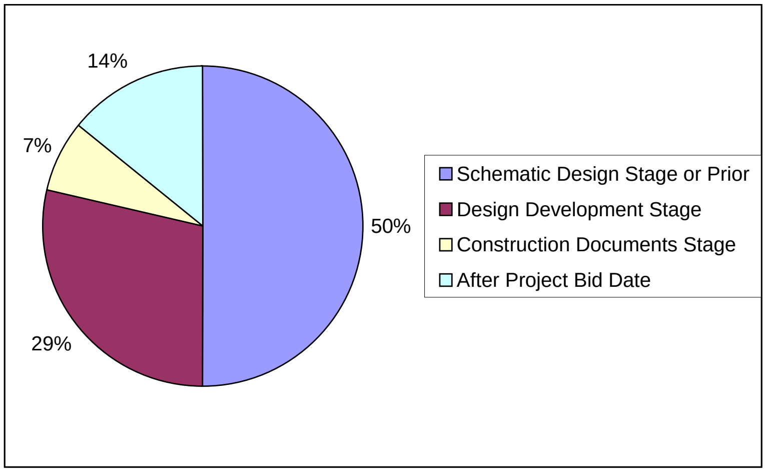
The survey also tested the program's impact on the timing of installing energy efficiency measures. When asked "How important was the New Jersey SmartStart Buildings program (including its financial and technical assistance) in your decision to purchase energy-efficient equipment **when you did**?", participants gave an average answer of 3.8 indicating that the program was moderately important in the timing (N=67). These scores did not differ significantly by program component or geographic area. Schools responses averaged 3.3 compared to 4.0 for non-schools; the difference was not significant at 95% but was at 90%.

Program Effectiveness

When asked how they would rate the effectiveness of the program, on a scale where 1 is "not at all effective" and 5 is "very effective", participants gave an average answer of 4.1 (N=60). The answers did not differ significantly by program component, geographic area, school/non-school, or business type.

Only one out of 8 participants surveyed who had done a new construction project recalled getting technical or design assistance. One-half of the new construction participants recalled learning about the incentives at or prior to the schematic design stage and 29% at the design development stage (Figure 1-9).

Figure 1-9. When New Construction Participants Learned of the Program Incentives



Participating trade allies also provided some additional feedback regarding the amount of referrals or business they can attribute to the program. As Table 1-14 shows, most trade allies indicated that their participation in this program has not led to any increased business nor an increased number of customer referrals. In examining the responses more closely, only two participating trade allies could attribute any increase in business directly to this program.

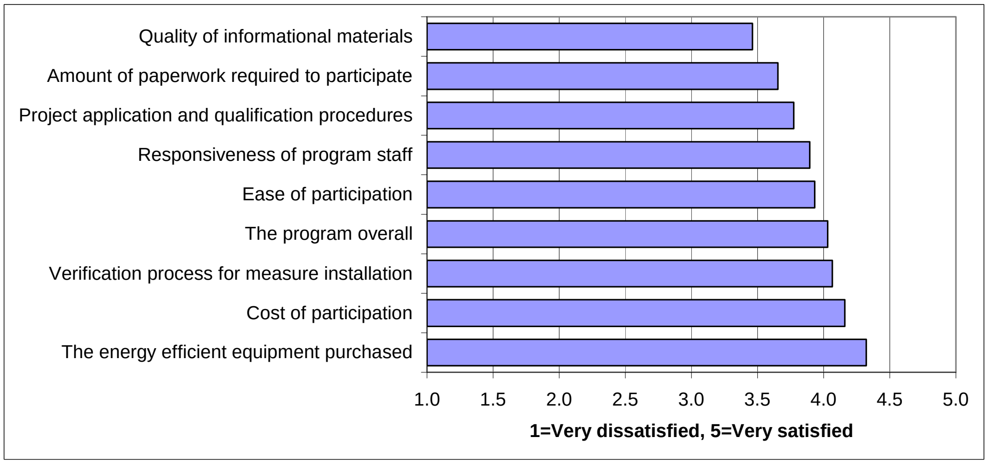
Table 1-14. Summary of Lead Referrals from Trade Allies

	How many referrals do you get a month?	What percentage of business do they represent?
N	43	19
Mean	.1933	.0101

Satisfaction with Program Features

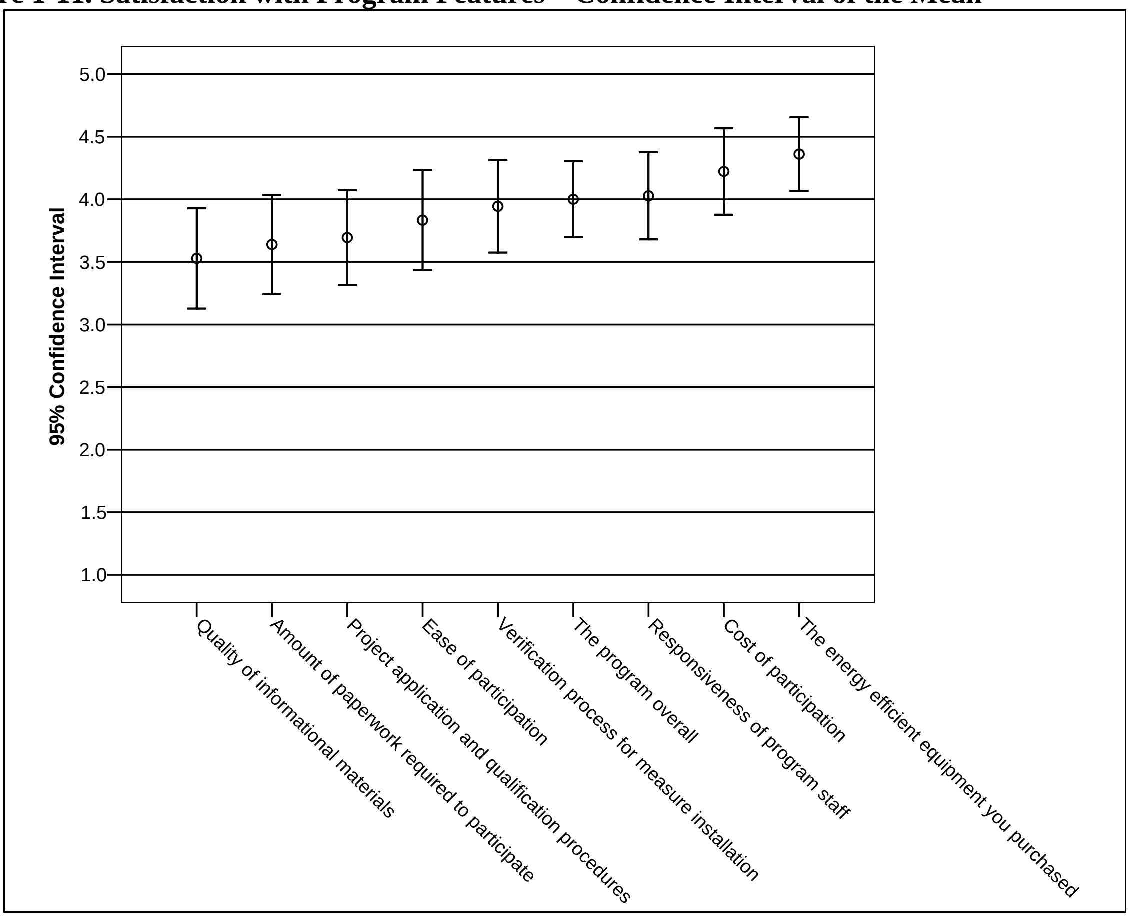
Participants on average were quite satisfied with the features of the program we examined (Figure 1-10). They were most satisfied with the energy-efficient equipment purchased and the cost of participation. They were least satisfied with the quality of informational materials and the amount of paperwork required to participate. The difference between the means of the top and bottom features in Figure 1-10 were statistically different (see Figure 1-11).

Figure 1-10. Satisfaction with Program Features



Source: Participant Survey Questions S1 through S9. N=46-63.

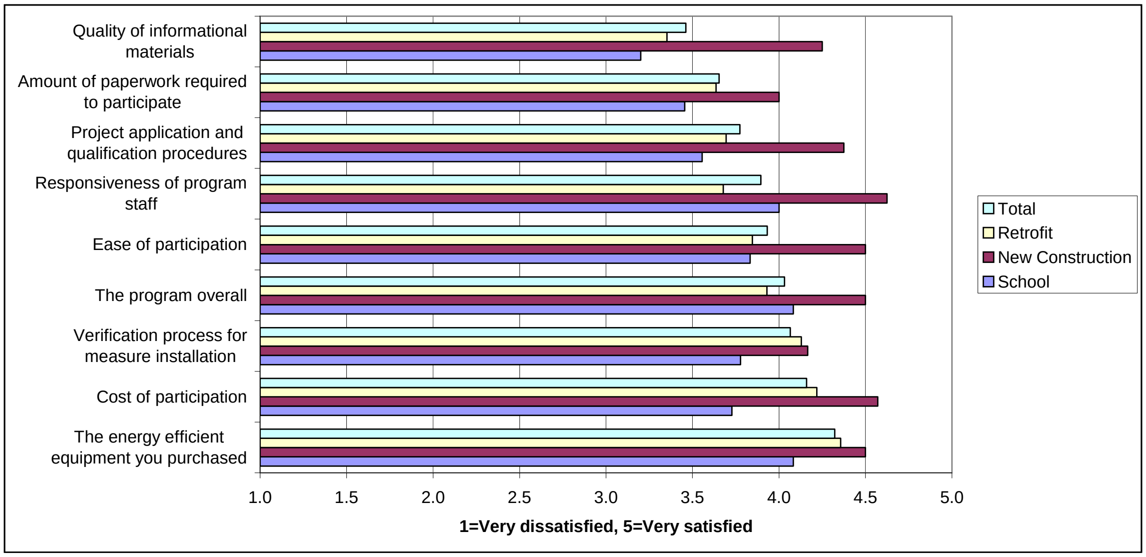
Figure 1-11. Satisfaction with Program Features – Confidence Interval of the Mean



Source: Participant Survey Questions S1 through S9. N=46-63.

New Construction participants tended to be most satisfied and Schools participants least, but the differences between respondents within each group were so large that the differences between groups were not statistically significant (Figure 1-12).

Figure 1-12. Satisfaction with Program Features – By Program Component



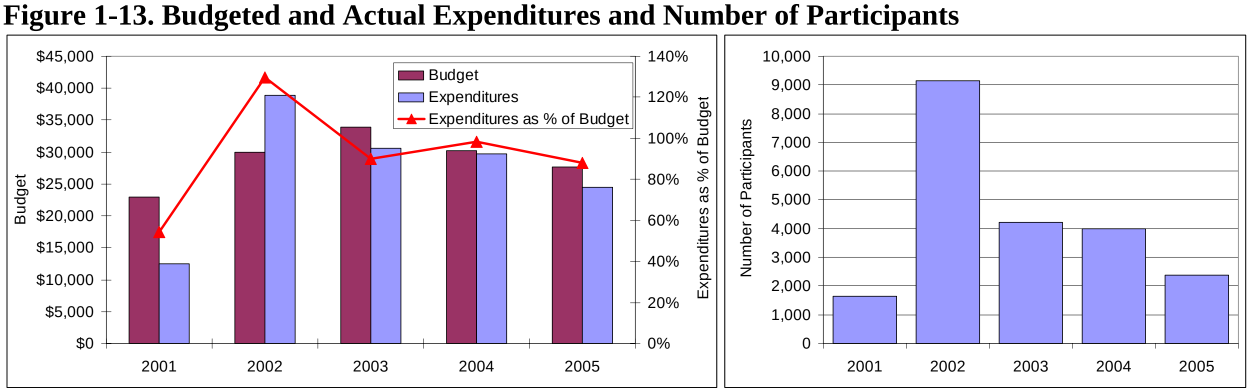
Program Tracking Data

ID	Topic	Performance Indicator	General Source	Data Presented Here?
A	Energy and Demand Impacts	Program Savings	Program tracking	Y

This section will present summary data based on the program tracking data provided to the evaluation or available in public reports.

The program's ability to spend their allocated budget is a useful indicator of program management, staffing, and program targeting. Since 2001, the C&I Program has under spent its budget each year except 2002 (Figure 1-13). Under-spending was modest in 2004. Since 2002, expenditures have declined each year. Savings declined from 2002 to 2003, increased in 2004 and declined again in 2005. The average incentive per participant increased from 2002 to 2003, declined in 2004 and increased again in 2005 to the highest level.

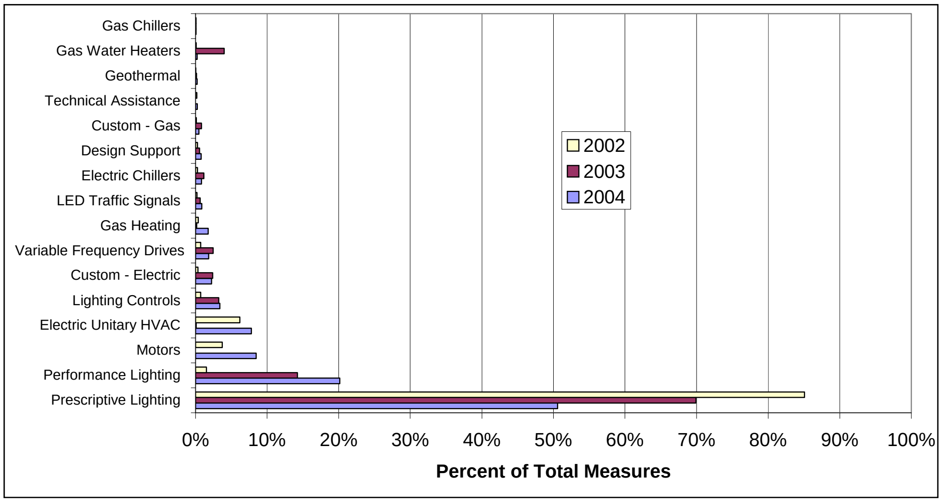
Figure 1-13. Budgeted and Actual Expenditures and Number of Participants



Source: Program Quarterly Reports

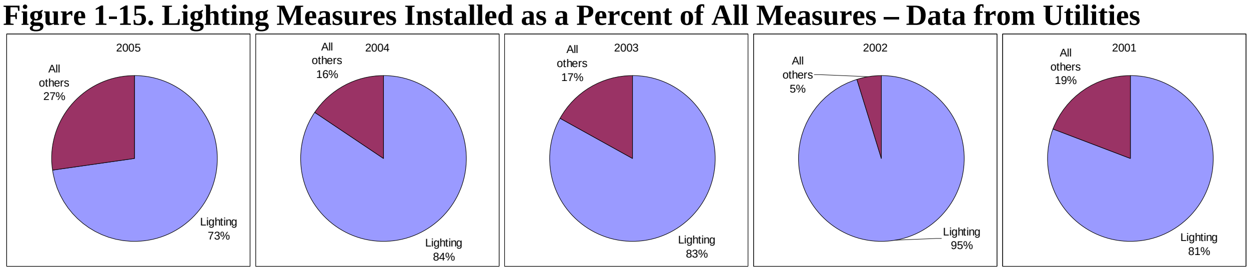
The distribution of program measures across measure types provides an indication of how dependent the program is on particular technologies. Lighting measures have been by far the most common measures, dwarfing all others (Figure 1-14), although their percent of total measures has been declining over time according to data from CEP annual reports (Figure 1-14); however, that trend is less clear in the program tracking data provided by the utilities (Figure 1-15).

Figure 1-14. Percent of Total Measures Installed by Measure Type



Source: Clean Energy Program Annual Reports. The 2005 report has not yet been released.

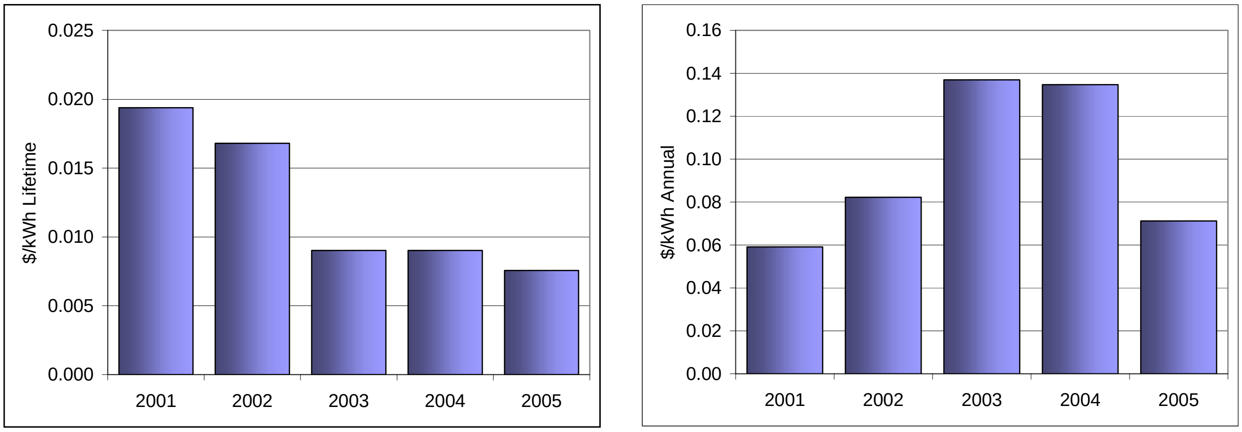
Figure 1-15. Lighting Measures Installed as a Percent of All Measures – Data from Utilities



Source: Program tracking data provided to evaluation team.

Cost of conserved energy is often used as a metric for evaluating the success of a program. Using a simple formula of dividing annual expenditures by total lifetime energy saved (including converting gas savings to kWh) indicates that the C&I Program's cost of conserved energy has been between 0.75 cents/kWh and 2 cents/kWh (compared to annual energy saved it has been 6 cents/kWh and 14 cents/kWh) (Figure 1-16).

Figure 1-16. Cost of Conserved Energy



Source: CEP Annual Report, annual expenditures divided by lifetime energy saved (left graph) and annual energy saved (right graph) (converting DTh to kWh).

Summarized Findings:

Participants were not very familiar with the SmartStart Buildings programs in general and its financial incentives and services. Nonparticipants were even less familiar. Participants were most familiar with the lighting incentives. One third or fewer were aware of other incentives. Ten percent of nonparticipants knew the program offers lighting incentives and less than 10% were aware of other incentives.

Participating trade allies felt they were fairly familiar with the New Jersey SmartStart Buildings program overall but were significantly less familiar with the program's services. Participating trade allies were significantly more likely to be aware of the program and its services than nonparticipating trade allies.

The C&I Program met its goal for completed jobs in New Construction and Schools but fell short in Retrofit.

Participants thought the financial incentives were quite important in their decision to implement energy efficient measures (4.2 on a 5-point scale). They thought the program was moderately important in influencing the timing of the measure installation (3.8 on a 5-point scale). Participants thought the program was quite effective (4.1 on a 5-point scale).

Most trade allies indicated that their participation in this program has not led to any increased business nor an increased number of customer referrals.

Participants on average were quite satisfied with the features of the program we examined. They were most satisfied with the energy-efficient equipment purchased and the cost of participation. They were least satisfied with the quality of informational materials and the amount of paperwork required to participate.

1.2.3 Estimated Program Energy Savings

ID	Topic	Performance Indicator	General Source	Data Presented Here?
A	Energy and Demand Impacts	Program Savings	Program tracking	Y

For the program year ending December 31, 2005, the C&I program reported total annual installed savings of 36,382 kW, 287,671 MWh, and 190,001 DTh (Table 1-15). Retrofit represented 90% of the MWh savings, 92% of the DTh savings, and 78% of the kW savings (Figure 1-17). Schools represented 5% of the MWh savings, 12% of the kW savings, and 1% of the DTh savings. New Construction represented 5% of the MWh savings, 10% of the kW savings, and 6% of the DTh savings. Actual expenditures represented 88% of budgeted expenditures. The C&I program's goals for 2005 were based on numbers of projects. There were no specific kWh and Therm goals. Rather the energy savings goal was stated as "Following approval of the above goals, energy savings will be calculated consistent with the goals."[8]

The evaluation included on-site assessments at 10 sites to review measure installations, look for missed opportunities, and examine the appropriateness of the protocols for calculating energy impacts. The evaluation team reviewed documentation on program-calculated savings for three of those sites and found that the evaluation-calculated savings matched those of the program. In another case, program records provided to the evaluation did not document the savings calculations but it appears likely that the VFD will not produce the savings calculated by the protocol as it was installed in a setting where it will see little variation in output.

Most of the sites appeared to have included all the obvious energy savings measures. At two sites we found modest missed opportunities for savings, two measures at one site and one at the other.

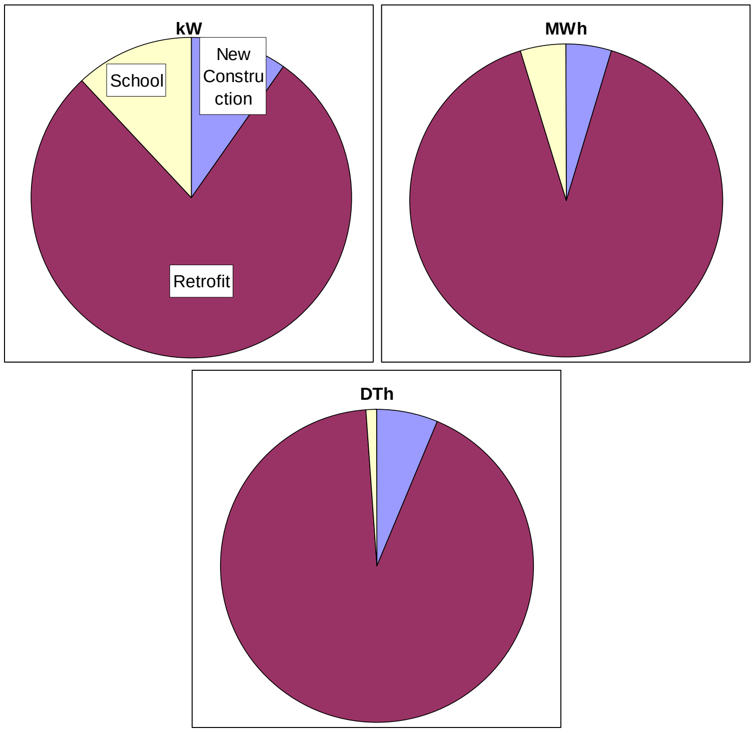
Table 1-15. Program-Reported Installed Energy and Demand Savings

Program	KW	MWh	DTh
C&I New Construction	3,548	13,851	12,335
C&I Retrofit	28,478	260,238	175,613
New School Construction & Retrofit	4,356	13,583	2,053
Grand Total	**36,382**	**287,671**	**190,001**

Source: New Jersey's Clean Energy Program Report submitted to the New Jersey Board of Public Utilities March 28, 2006.

[8] New Jersey's Clean Energy Program 2005 Program Descriptions and Budget Utility Managed Energy Efficiency Programs Updated June 8, 2005.

Figure 1-17. Program-Reported Savings by Program Component



	kW	MWh	DTh
New Construction	10%	5%	6%
Retrofit	78%	90%	92%
School	12%	5%	1%
Total	100%	100%	100%

Source: New Jersey's Clean Energy Program Report submitted to the New Jersey Board of Public Utilities March 28, 2006.

1.2.4 Recommendations for Appropriate Indicators

The indicators we recommended for tracking program performance are listed in Table 1-16, beginning with indicators that should be tracked by evaluation efforts and ending with indicators that should be tracked through the program tracking database. (This lists the same indicators as in Table 1-11 but with more information in the table.)

Table 1-16. Recommended C&I Program Performance Indicators

ID*	Topic	Performance Indicator	New?	General Source	Detailed Source	Notes
P	Customer Awareness	Percent of customers who answer 3-5 on 5 point scale of "How familiar are you with the features of the program?" where 5 is "very".	New	Evaluation	Customers	Use questions that would address specific features of the program. Avoid questions where guesses might produce correct answers.
O	Trade Ally Awareness	Percent of design professionals who answer 3-5 on 5 point scale of "How familiar are you with the features of the program?" where 5 is "very".	New	Evaluation	Design professionals	Use questions that would address specific features of the program. Avoid questions where guesses might produce correct answers.
I	Market share monitoring	Periodic estimates (method TBD) of sales of energy-efficient technologies as a percent of total NJ sales.	2004-5	Market Share Monitoring	Program	Unless market share monitoring is funded as a regular activity, this indicator will not be timely. Thus this is useful for a periodic status check but not as a regular indicator.
L	Program Activity	New construction projects as a % of new construction activity statewide.	2004-5	Program tracking for number of projects. Market assessment for % of statewide activity	Program	Cannot track statewide activity in real time easily but using a number that is only updated once or twice a year is realistic.
E	Energy and Demand Impacts	Program Savings and Percent of energy savings from prescriptive, custom, and Comprehensive Design Assistance (CDA) projects, respectively by New Construction and retrofit	2004-5	Program tracking	Program	
D	Program Activity	Number of prescriptive, custom, and CDA projects by New Construction and retrofit	2004-5	Program tracking	Program	
Q	Program Activity	Number of Multiple Measure projects	2004 (goal)	Program tracking	Program	
S	Program Activity	Number of contractors and number of new contractors associated with measure installations.	New	Program tracking	Program	An indicator of the effectiveness of outreach to new companies and sectors.
N	Program Activity	Total number of individuals and companies trained, number of individuals and companies trained who have not been to program training before, by specialized path and type of training for Motors, HVAC, and Design Lights	New	Program tracking	Trainees	Tracking total training is useful. To get an indicator of the effectiveness of outreach to new companies and sectors, track the number of people and companies who are new to program training events.
K	Program Activity	Number of design professionals in Comprehensive Design Assistance who are new to the program and total number of design professionals in CDA.	New	Program tracking	Design professionals	Could be tracked as number and reported as percent of total design professionals in CDA.

*The indicator ID reflects the order of the indicators in the 2004-2005 Indicator list and has been maintained here to make it easier to discuss the indicators.

1.3 Market Share Assessment

This section addresses changes in the overall market for energy efficiency products and services in New Jersey and the market share of energy efficiency equipment. Data for estimating market share came from three sources: the participant and nonparticipant end user survey, the participant and nonparticipant trade ally survey, and market share studies done in other states or regions.

Nonparticipants were asked if they installed equipment covered by the Program and, if relevant, were asked "Was it an energy efficient or premium efficient model?". The results are shown in Table 1-17. This provides a rough approximation of the installation rate of energy efficient equipment among companies that were in the midst of new construction or major retrofits.[9] Over two thirds of the respondents had installed lighting measures in the past two years, almost half had installed HVAC equipment, and almost one quarter had installed gas boilers and gas water heaters. Almost all respondents thought they had installed energy efficient versions.[10]

Trade allies were asked to estimate the percentage of products their company has sold or installed in the past 12 months that were significantly more efficient than standard equipment. On average, 60% of lighting contractors' sales are energy efficient (N=26) and 44% of HVAC contractors sales are energy efficient (Table 1-18).

Trade allies were also asked "In what percentage of all your current sales transactions/buildings do customers ask for or about the energy efficiency of the equipment?" (Table 1-19). Responses ranged from 60% from builders to 14% for mechanical contractors.

These results will be discussed in the following pages as we present measure-specific results.

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[9] As described in 9.1.2 Program Specific Methodology, the nonparticipant sample was drawn from the McGraw-Hill database of businesses undergoing new construction or major retrofits.

[10] It should be noted that end users frequently over-rate the efficiency of the equipment they install. This is particularly true if they understand that the equipment they purchased is significantly more efficient than the equipment it replaced, even if the new equipment is standard efficiency or just meets code.

Table 1-17. Energy Efficient Equipment Installed in the Past Two Years by Nonparticipants

Equipment	Number Installing Equipment	Percent of All Respondents (A)	Number Installing Efficient	Percent of All Respondents (B)	Percent Of Those Installing Equipment (C)
Lighting	38	68%	35	63%	92%
HVAC	25	45%	23	41%	92%
Lighting Controls	22	39%	NA		
Gas Boilers	13	23%	11	20%	85%
Gas Water Heating	13	23%	12	21%	92%
Chillers	10	18%	9	16%	90%
Motors	5	9%	4	7%	80%
Variable Frequency Drives	5	9%	NA		
Gas Furnaces	3	5%	3	5%	100%
Gas Cooling	2	4%	NA		
Ground Source Heat Pump	1	2%	NA		
Desiccant Gas Cooling	0	0%	NA		
LED Traffic Lights	0	0%	NA		

Source: Nonparticipant survey, only those respondents who had not received rebates from the program. N=56.
A. Number Installing Equipment divided by 56, the number of respondents.
B. Number Installing Efficient divided by 56, the number of respondents.
C. Number Installing Efficient divided by Number Installing Equipment.

Table 1-18. Percent of Products Sold or Installed by Trade Allies that were Energy Efficient

TYPE	Percent of Sales Customers Ask for Energy Efficiency	N	Percent of Sales Energy Efficient	N
Builder	60%	2		
Energy Services	40%	11	83%	6
Architect	31%	19		
Compressed Air	30%	4	61%	4
Motors	26%	16	56%	10
Engineering	25%	4	78%	3
HVAC	25%	21	44%	19
Lighting	22%	35	60%	26
Electrical	18%	12	83%	3
Mechanical	14%	3		
Total	**25%**	**134**	**59%**	**81**

Source: Trade allies survey.

Table 1-19. Measures Covered by Nonparticipants' Energy Efficiency Policies

Measures	N	% of Population
High-efficiency furnaces	6	11%
High-efficiency water heaters	6	11%
High-efficiency lighting	5	9%
Lighting controls	5	9%
High-efficiency boilers	4	7%
High-efficiency packaged air conditioner	4	7%
High efficiency motors	3	5%
Energy management control systems	0	0%
Variable speed motor controls, where appropriate	0	0%
Total nonparticipants with energy efficient policies	7	13%
Total nonparticipants	56	

Source: Nonparticipant survey.

1.3.1 New Construction

Program reporting indicated 198 participants for C&I New Construction. We found approximately 424 unique owners in the McGraw-Hill data as likely completing commercial new construction projects during 2005. This suggests a 47% participation rate for C&I New Construction. While this estimate should be considered approximate, it is in the range of penetration reported in Massachusetts, where 50% of buildings and 56% of owners participated in Design 2000 Plus.[11] The table below shows results for several programs in other locations.

Table 1-20. Market Penetration in New Construction and Major Retrofit Programs

Programs	Savings By Design (CA)	ETO New Building Efficiency (OR)	NGrid D2000+ (MA)	CL&P ECC (CT)	Xcel Energy (MN)	NYSERDA New Construction (NY)
Date of Results	2004[12]	2004	2002	2002	2002	2004
# Projects	497 New Construction 115 Alterations	128	705	310	NA	NA
Market Share	12.9% (New Construction) 2.8% (alterations)	20%	50% of 10,000 new buildings (1992-1999)	80%[13] 2,300 bldgs (1990-2001), 310 bldgs (2002), 111 bldgs (2003)	50% of buildings > 80,000 sq ft. (220 bldgs from 1993-2001)	2.5%

An evaluation done of the Energy Trust of Oregon New Building Efficiency Program in 2005[14] provided results for penetration in terms of new projects and building area (Table 1-21).

[11] Design 2000 Plus as reported for 10,000 new buildings between 1992 – 1999.

[12] NRNC Market Characterization and Program Activities Tracking Report PY2004 Final Statewide NRNC MA&E Program Prepared by Quantum Consulting Inc., May 2005.

[13] Energy Conscious Construction/Energy Conscious Blueprint Program: A Strategy for Success, ECMB Presentation 9/7/2004

Table 1-21. Market Penetration ETO New Building Efficiency Program (2004)

	# Projects	Building Area
New Building Efficiency	128	6,599,360
F.W. Dodge	650	16,641,611
Program Penetration	20%	40%

1.3.2 Lighting

Over two thirds of nonparticipants had installed lighting in the past two years and 92% of those said they had installed energy efficient lighting. This surely reflects an overestimation on the respondents part but it does indicate that a significant fraction of the market is probably already installing energy efficient lighting. Over one third (39%) of respondents had installed lighting controls in the past year. Nine percent (5) of nonparticipants have official energy efficiency policies that cover lighting and lighting controls.

Table 1-22. Lighting Equipment Installed in the Past Two Years by Nonparticipants

Equipment	Number Installing Equipment	Percent of All Respondents (A)	Number Installing Efficient	Percent of All Respondents (B)	Percent Of Those Installing Equipment (C)
Lighting	38	68%	35	63%	92%
Lighting Controls	22	39%	NA		

Source: Nonparticipant survey, only those respondents who had not received rebates from the program. N=56.

Trade allies were asked to estimate the percentage of products their company has sold or installed in the past 12 months that were significantly more efficient than standard equipment. On average, 60% of lighting contractors' sales are energy efficient (N=26), which supports the conclusion from the nonparticipant survey that a significant portion of the market has already moved to energy efficient products.

Almost two thirds (62%) of lighting contractors' projects in the past year have included advanced lighting controls, which covered 52% of the floor space they worked on. Just under half (43%) of architects' projects in the past year have included advanced lighting controls (N=3), which covered 30% of the floor space they worked on. In 22% of lighting contractors' sales their customers ask for or about the energy efficiency of the equipment.

Conclusion. Almost two thirds of all lighting sales are energy efficient in New Jersey and advanced lighting controls cover over half of all floor space.

To place these numbers in context we present market share data from other states. Our estimate of market share for New Jersey is roughly the same as in NYSERDA and in California.

The California Energy Commission (CEC) commissioned a market share tracking study completed in 2005[15] that provided some trends in market penetration for lighting (see table and figure below).

[14] Source: Evaluation of ETO NB Efficiency Program, Aug. 2005

[15] CEC Market Share Tracking Study, 2005.

Table 1-23. California Non-Residential New Construction Market Share

Building	Technology	1994	1996	1998
C&I Storage	Metal Halide	10%	64%	
	T8 Electronic Ballast	22.5%	12%	
Office	T8 Electronic Ballast	62%	70%	74%
Retail	Metal Halide	17%	21%	51%
	T8 Electronic Ballast	29%	38%	28%

Figure 1-18. California Market Share T8 Lighting[16]

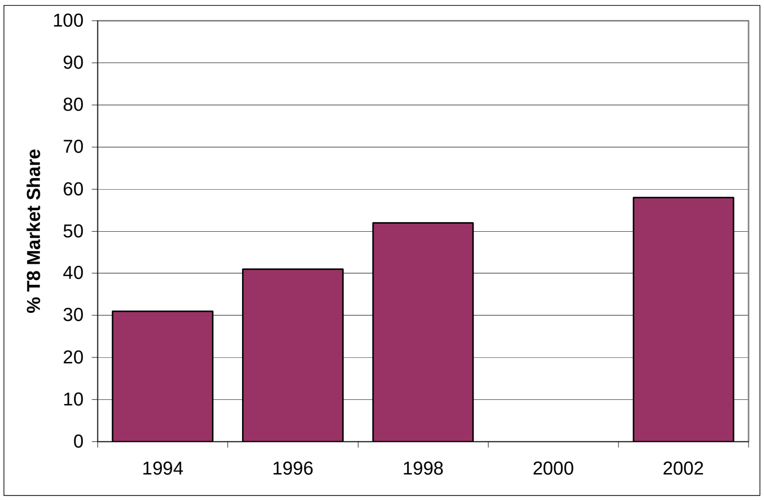


Table 1-24. NYSERDA Measure of Energy Efficiency Practices in New Construction Projects

Measures	Average response to the question "What percentage of your new construction projects incorporated the following energy efficiency measure and activities? MCAC 2004	
	Participating A&E	Nonparticipating A&E
High Efficiency Lighting	69%	67%
Lighting Occupancy Sensors or Controls	64%	60%

1.3.3 HVAC Equipment

Just under a half (45%) of nonparticipants had installed HVAC equipment in the past two years, a quarter (23%) had installed gas boilers and gas water heating (Table 1-25). The vast majority of those installing HVAC-related equipment thought they had installed energy efficiency versions. Between 7 and 11 percent (N=4 to 6) of nonparticipants have official energy efficiency policies that cover HVAC-related equipment (Table 1-27).

Trade allies were asked to estimate the percentage of products their company has sold or installed in the past 12 months that were significantly more efficient than standard equipment. On average, 44% of HVAC contractors' sales are energy efficient (N=19), 83% of sales for those providing energy services

[16] 2002 estimate from large lighting manufacturing firm.

were energy efficient, and 78% of sales were energy efficient for those providing engineering services (Table 1-26).

Table 1-25. Energy Efficient Equipment Installed in the Past Two Years by Nonparticipants

Equipment	Number Installing Equipment	Percent of All Respondents (A)	Number Installing Efficient	Percent of All Respondents (B)	Percent Of Those Installing Equipment (C)
HVAC	25	45%	23	41%	92%
Gas Boilers	13	23%	11	20%	85%
Gas Water Heating	13	23%	12	21%	92%
Chillers	10	18%	9	16%	90%
Gas Furnaces	3	5%	3	5%	100%
Gas Cooling	2	4%	NA		
Ground Source Heat Pump	1	2%	NA		

Source: Nonparticipant survey, only those respondents who had not received rebates from the program. N=56.

Table 1-26. HVAC-Related Percent of Products Sold or Installed that were Energy Efficient

TYPE	Percent of Sales Customers Ask for Energy Efficiency	N	Percent of Sales Energy Efficient	N
Energy Services	40%	11	83%	6
Engineering	25%	4	78%	3
HVAC	25%	21	44%	19
Mechanical	14%	3		
Total	**25%**	**134**	**59%**	**81**

Source: Trade allies survey.

Table 1-27. Measures Covered by Nonparticipants' Energy Efficiency Policies

Measures	N	% of Population
High-efficiency furnaces	6	11%
High-efficiency water heaters	6	11%
High-efficiency boilers	4	7%
High-efficiency packaged air conditioner	4	7%
Total nonparticipants with energy efficient policies	7	13%
Total nonparticipants	56	

Source: Nonparticipant survey.

Conclusion. Energy efficient products represent less than half of all sales in the HVAC market in New Jersey.

To place these numbers in context we present market share data from other states below. Our estimate of market share for New Jersey is roughly the same as in NEEP's 2006 Cool Choice program and less than in NYSERDA.

The market shared for Package HVAC systems greater than 30 tons meeting Tier 2 standards was 10% in NEEP's 2005 Cool Choice program. The program is aiming to achieve a 30% market share by 2008 and a market share of 5% of to-be-created Tier 3 standards by 2010.

Table 1-28. NYSERDA Measure of Energy Efficiency Practices in New Construction Projects

Measures	Average response to the question "What percentage of your new construction projects incorporated the following energy efficiency measure and activities? MCAC 2004	
	Participating A&E	Nonparticipating A&E
High Efficiency Unitary HVAC Equipment	65%	58%
High Efficiency Cooling	56%	46%
Geothermal Heat Pumps	18%	11%

1.3.4 Motors and VFDs

Just 9% of nonparticipants had installed motors or VFDs in the past two years and 80% of those installing motors said they had installed energy efficient models. On average, 56% of motors contractors' sales are energy efficient (N=10) and 26% of their customers ask for or about the energy efficiency of their motors. Five percent (N=3) of nonparticipants have official energy efficiency policies that cover motors and none had policies covering VFDs.

Market share for NEMA (National Electrical Manufacturers Association) Premium Efficiency Motors in California in 2002-2003 (SICs 21-34, 37-39) was 19% for 1-200 hp motors (1-49 hp was 8.5%, 50-200 hp was 17.5%).[17] The market share of high efficiency motors in Wisconsin in 2005 was 20% to 36%.[18] In NYSERDA, NEMA Premium motors were installed in 67% of new construction projects for participating A&E firms and 60% for nonparticipating firms.

Conclusion. Approximately half of motor sales in New Jersey are of energy efficient motors, which is higher than in California and Wisconsin but lower than in NYSERDA.

Table 1-29. Energy Efficient Equipment Installed in the Past Two Years by Nonparticipants

Equipment	Number Installing Equipment	Percent of All Respondents (A)	Number Installing Efficient	Percent of All Respondents (B)	Percent Of Those Installing Equipment (C)
Motors	5	9%	4	7%	80%
Variable Frequency Drives	5	9%	NA		

Source: Nonparticipant survey, only those respondents who had not received rebates from the program. N=56.

Table 1-30. Percent of Products Sold or Installed that were Energy Efficient

TYPE	Percent of Sales Customers Ask for Energy Efficiency	N	Percent of Sales Energy Efficient	N
Motors	26%	16	56%	10
Total	**25%**	**134**	**59%**	**81**

Source: Trade allies survey.

[17] CEC Market Share Tracking Study, 2005.

[18] Business programs evaluations, Feb. 2006.

1.3.5 Chillers

Just 18% of nonparticipants had installed chillers in the past two years and 90% of those said they had installed energy efficient models. On average, 63% of the sales of trade allies who said they sell chillers are energy efficient (N=7). This is substantially higher than the rate found in California.

Table 1-31. Energy Efficient Equipment Installed in the Past Two Years by Nonparticipants

Equipment	Number Installing Equipment	Percent of All Respondents (A)	Number Installing Efficient	Percent of All Respondents (B)	Percent Of Those Installing Equipment (C)
Chillers	10	18%	9	16%	90%

Source: Nonparticipant survey, only those respondents who had not received rebates from the program. N=56.
A. Number Installing Equipment divided by 56, the number of respondents.
B. Number Installing Efficient divided by 56, the number of respondents.
C. Number Installing Efficient divided by Number Installing Equipment.

Table 1-32. Chiller Market Share in California (1999)

Type of Chiller	Size	High Efficiency Market Share (%)
Air Cooled	< 150 tons	2.4
	150-299 tons	50
Water Cooled	< 150 tons	15.2
	150-299 tons	14.8
	> 300 tons	7.6

Source: California Energy Commission[19]

1.3.6 Changes in Market Share

On average, trade allies thought that their energy-efficient sales had been increasing in recent years. They most commonly attributed this increase to increased awareness. Other frequently mentioned reasons for this increased interest among customers included rising utility or energy costs and the emergence of new and better energy technologies, as summarized in Table 1-33.

Table 1-33. Reasons for Increased Energy-efficient Sales

Reason Cited	Number Mentioning	Percentage
Increased awareness	27	47%
Rising utility or energy costs	10	17%
Want to save money	1	2%
Improved technologies	9	16%
Because of utility programs or incentives	10	17%
Total	**57**	**100%**

Source: Trade ally surveys

[19] CEC Market Share Tracking Study, 2005.

1.3.7 Summary

The C&I program was involved in approximately 47% of all major new construction projects in New Jersey. Over two thirds of nonparticipants had installed lighting in the past two years and 92% of those said they had installed energy efficient lighting. This surely reflects an overestimation on the respondents part but it does indicate that a significant fraction of the market is probably already installing energy efficient lighting. Over one third (39%) of respondents had installed lighting controls in the past year. Trade allies were asked to estimate the percentage of products their company has sold or installed in the past 12 months that were significantly more efficient than standard equipment. On average, 60% of lighting contractors' sales are energy efficient, which supports the conclusion from the nonparticipant survey that a significant portion of the market has already moved to energy efficient products. Energy efficient products represent less than half of all sales in the HVAC market in New Jersey. This estimate is roughly the same as in NEEP's 2006 Cool Choice program and less than in NYSERDA. Approximately half of motor sales in New Jersey are of energy efficient motors, which is higher than in California and Wisconsin but lower than in NYSERDA. On average, 63% of the sales of trade allies who said they sell chillers are energy efficient (N=7).

Market share can be assessed by asking end users what equipment they have and purchase, by asking equipment manufacturers, distributors, and installers what equipment they sell and install, and by purchasing and analyzing point-of-sale or scanner data, among other methods. C&I programs such as the New Jersey SmartStart Buildings program cover a wide range of technologies and many of the technologies come in a wide range of sizes. C&I programs also cover a wide range of building types, industrial types and processes, and sectors. As a result, complete coverage in a market share assessment of a broadly focused C&I program would involve addressing a wide range of products, businesses, and distribution chains. Studies whose main goal is measuring market share for C&I programs and that attempt to cover the entire C&I market (or at least a significant fraction of the market) typically take many months to complete and are quite expensive.

The results presented above are from a significantly more modest data collection effort. They provide a reasonably accurate high-level picture of the state of the market for the largest measures covered by the program. However, a more detailed analysis of the state of the market would provide more support for fine-tuning program designs and marketing plans.

1.4 Baseline Savings Assessment

The objective of the Baseline Savings Assessment was to update the baseline against which the energy savings will be calculated and to measure the program success. The primary data for this analysis comes from the surveys with participating and nonparticipating trade allies and end users.

1.4.1 Availability and Common Practice

Participating trade allies are significantly more likely to initiate a discussion about energy efficiency with customers compared to nonparticipants (86% vs. 59%, see Table 1-34). It is also worth noting that customers of participating trade allies are more likely to initiate a discussion about energy efficiency (51%) compared to nonparticipants (35%).

Table 1-34. Frequency of Discussing Energy Efficiency

		% of Time Customers Initiate a Discussion About Energy Efficiency	% of Time Trade Allies Initiate a Discussion About Energy Efficiency
Participants	Mean	51%	86%
	N	70	68
Nonparticipants	Mean	35%	59%
	N	65	62
Total Responding	Mean	43%	73%
	N	135	130

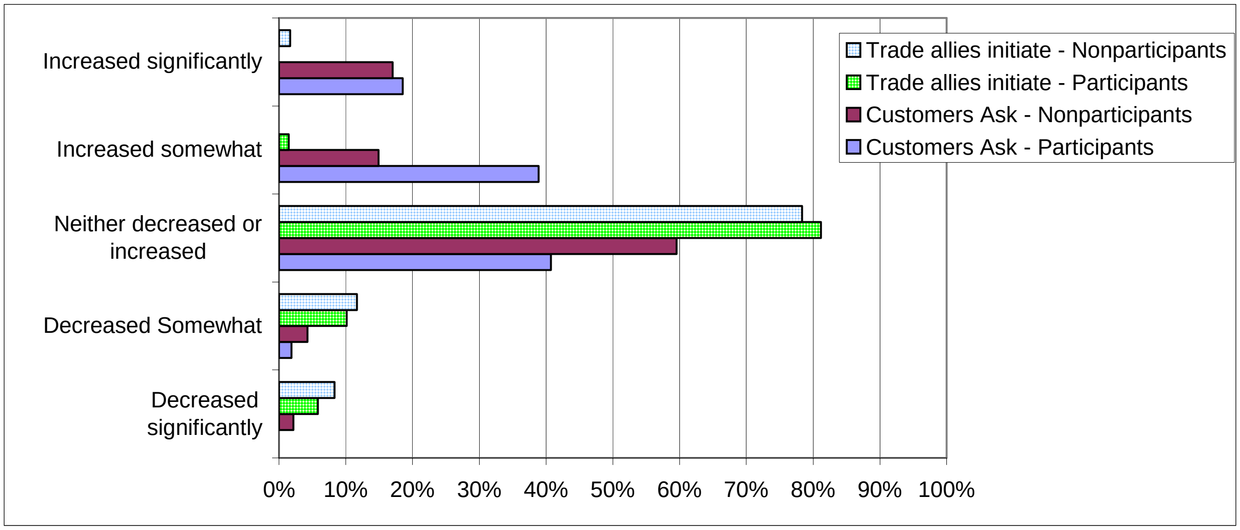
One half of the trade allies indicated that demand for energy-efficient equipment has increased either somewhat or significantly in the past three years (Table 1-35). The vast majority (80%) do not think that they have changed the frequency at which they initiate discussions of energy efficiency with their customers (Table 1-35 and Figure 1-19).

Table 1-35. Comparison of Changes in Customer and Trade Demand

Response	% Change in Customer Demand and Interest †		% Change in Trade Ally Initiation of Energy Efficiency Discussion	
	Number Mentioning	% Mentioning	Number Mentioning	% Mentioning
Increased significantly	26	19%	9	7%
Increased somewhat	36	26%	14	11%
Stayed the same	71	52%	103	80%
Decreased somewhat	3	2%	1	1%
Decreased significantly	0	0%	1	1%
Total	**136**	**100%**	**128**	**100%**

† Change in the percent of customers asking for or about the energy efficiency of the equipment.

Figure 1-19. Comparison of Changes in Customer and Trade Ally Responses Regarding Demand for Energy Efficiency



A few trade allies did report an increased interest in the market for energy efficiency measures. However, this was mostly attributed to rising energy costs and increased awareness about energy efficiency and conservation. This was especially true among customers, as 51 percent of the trade allies said their interest in energy efficiency was due to rising energy prices.

Table 1-36. Reasons Cited for Increased Interest in Energy Efficiency

Reasons Cited for Interest Among Customers			Reasons Cited for Interest Among Trade Allies		
	N	**% Mentioning**		**N**	**% Mentioning**
Awareness/Advertising	24	35%	Awareness/advertising	8	8%
Rising energy costs	35	51%	Rising energy costs	25	26%
Energy codes	3	4%	Energy codes	1	1%
Awareness programs like Energy Star/Green Bldg	4	6%			
Other	2	3%	Customers want the incentives	9	9%
Total	**68**			**97**	

Promotion of Energy Efficiency Among Trade Allies

The majority of trade allies (63%) do not promote their firm in traditional venues such as the newspaper, radio, or print advertisements, while 34 percent do use these methods. A number of trade allies indicated that they generate the majority of their business by responding to Requests for Proposals (RFPs), which minimizes the need to advertise their services elsewhere. This was especially true for the professional trade allies, such as the architects, engineers, developers, and large commercial builders.

In examining these findings by participant group, participating trade allies were more likely to advertise their companies compared to nonparticipating trade allies (i.e., 46% vs. 24%).

Table 1-37. Percentage of Trade Allies that Advertise in Print or TV Media

Do you advertise?	Participants (N=71)	Nonparticipants (N=54)
Yes	46%	24%
No	54%	76%

Among trade allies that do advertise their services (n=43), 75 percent incorporate energy efficiency messages into their promotional materials, while one-quarter do not. Consistent with the previous findings, participating trade allies were much more likely to feature energy efficiency in their advertising messages (89%) compared to the 50 percent of the nonparticipants.

Table 1-38. Percentage of Trade Allies Highlighting Energy Efficiency

Highlight energy efficiency in advertising?	Participants (N=36)	Nonparticipants (N=22)
Yes	89%	50%
No	11%	50%

These findings suggest that energy efficiency is more likely to be promoted by participating trade allies than nonparticipating trade allies. However, there are exceptions. Several architects, lighting manufacturers, and designers interviewed view energy efficiency as integral to their corporate mission and promote it as part of their larger market positioning. This appears a fragmented strategy driven largely by the firm's primary goals and orientation. If it is a standard architectural or engineering firm, then it may or may not highlight energy efficiency in its promotional materials. However, if the firm is positioning itself as a niche player, perhaps an expert in LEED buildings or a manufacturer of high-quality lighting fixtures, then energy efficiency becomes an important part of its overall corporate identity.

Training

We asked trade allies about their training practices. While 84 percent of trade allies conduct some sort of training for employees, one-third (32%) conduct training sessions four times or less per year, while 20 percent conduct training sessions once a month or more (Table 1-39). However, 11% do not conduct any formal training at all and another 9 percent only provide employees training when first hired.

Table 1-39. Frequency of Training

Frequency of Training	Number Mentioning	% Mentioning	Cumulative Percent
Once a year	6	13%	13%
Twice a year	7	15%	28%
Four times a year	2	4%	32%
Once a month	4	9%	41%
Twice a month	3	7%	48%
Weekly	2	4%	52%
Informal training only	5	11%	63%
When they are hired	4	9%	72%
Other	7	15%	87%
No training sessions	6	13%	100%
Total	**46**	**100%**	

The majority of training is conducted by the store manager (51%) or a brand representative (23%), as shown in Table 1-40. Ninety-seven percent of these respondents (N=35) reported that energy efficiency was included in their training sessions.

Table 1-40. Summary of Individuals Conducting Training Sessions

Who conducts the training?	Number Mentioning	% Mentioning
Store manager	18	51%
Brand rep	8	23%
Other	6	17%
Self	2	6%
Manufacturer	1	3%
Total	**35**	**100**

Consistent with their previous responses, these trade allies wanted more information about the benefits of energy efficiency, the program requirements, and simplified explanations of the financial calculations used to determine energy savings. Table 1-41 illustrates these results.

Table 1-41. Desired Topics for Training Sessions

Topics to Include in Training Sessions	Number Mentioning	% Mentioning
Explain energy efficiency	6	40%
Explain program requirements and procedures	3	20%
Explain financial calculations	3	20%
Explain savings potential	3	20%
Total	**15**	**100%**

Baseline Approaches in Other States

Most C&I programs targeted to new construction and the expansion, renovation, or remodeling of existing buildings calculate savings by using a whole building approach to compare savings relative to state or federal energy codes. This has been common practice in new construction program impact studies since the mid 1990s. The use of whole building efficiency as the "measure" is the "…*most practical and useful measure to use for evaluating standards and new construction programs"*.[20] It has also been recognized that comprehensive commercial retrofit programs that focus on the whole building go beyond simple equipment upgrades to identify opportunities in system design, equipment interactions, and building operations and maintenance.[21] Some places just measure the impact of high efficiency equipment versus meeting building code; others help customers reach building code; still others provide incentives to exceed building code. Table 1-42 shows C&I programs in other states that target new construction and expansion, renovation, and remodeling of existing buildings. As shown in the table, many of these programs calculate savings compared to energy codes and standards.

[20] Mahone, Douglas, Hall, Nick, Megdal, Lori, Keating, Ken, and Ridge, Richard. Codes and Standards White Paper on Methods for Estimating Savings. April 7, 2005.

[21] ACEEE A052 April 2005, Amann, JT, and Mendelson, E. Comprehensive Commercial Retrofit Programs: A Review of Activity and Opportunities.

Table 1-42. Savings Calculations for New Construction and Major Retrofit Programs

Location	Program[22]	Baseline and Savings[23]
California	Savings by Design (Ca IOUs)	Financial incentives are available to building owners when the efficiency of the new building exceeds the minimum SBD thresholds, generally 10% better than Title-24 standards. If the building design saves at least 15% relative to Title-24, the design team qualifies for incentives. Incentives for energy-efficient measures are based on the systems approach, e.g., interior lighting, HVAC, or daylighting systems. Program baseline EER values specified in the Title 24 standards. Wherever possible, standard practice, existing regulation, or industry protocols are relied upon to set baselines, including legislated mandates such as EPAct motor efficiency minimums, industry guidelines such as NEMA standards, design protocols such as ASHRAE application guidelines, or other commonly accepted industry practices.
Hawaii	C&I New Construction (HECO)	All systems must document savings in comparison to applicable mandated federal or state standards. Motors, ASDs, booster pumps, cooling towers, building controls, lighting, HVAC, and other energy savings measures are available for incentives. Customer incentives range from $15 to $2,700 per motor. The larger the increase in efficiency between old and new, the larger the rebate.
Iowa	Commercial New Construction (MidAmerican Energy)	Construction incentives are based on a minimum energy savings of 15% beyond that required by the state of Iowa code is required to qualify. Incentives range from $.05 to $.14 per kWh. Rebate incentives also are available for natural gas savings. Projects that cannot achieve the 15% minimum energy savings still qualify for rebate incentives under other EnergyAdvantage programs. These include incentives for efficient lighting, HVAC, motors & drives, heating/cooling systems, and custom measures. Lighting rebates are prescriptive (based on technology), e.g., $2/CFL. Savings for heating/cooling systems are based on size and level of efficiency – base rebate plus bonus for more efficient SEER than minimum specified. Motors are based on NEMA premium efficiency standards. Energy savings for custom measures are based on engineering estimates.
Massachusetts	Design 2000 *Plus* (National Grid) Construction Solutions[24] (NSTAR – new construction only)	Substantial HVAC, Architectural & Lighting System Improvements above the code requirements. Based on DOE-2 or approved building energy simulation. The Code was changed effective July 1, 2001 to reflect improvements in technology, design, and construction of energy systems since the previous requirements were implemented in 1989. The new Code is significantly easier to use, with a clearer structure, simplified tables, and new software to demonstrate design compliance. These changes include elements from both ASHRAE Standard 90.1-1999 and from the International Energy Conservation Code (IECC 2000), as well as some requirements that are unique to Massachusetts. [25] Targets lighting & controls, motors & drives, compressed air, HVAC, and custom measures. Lighting measures are prescriptive with a bonus for higher efficiency measures. HVAC incentives are based on Tier 2 EE/SEER ratings and on size, motors on NEMA premium motor standards, and custom measures on engineering estimates.

[22] Programs to influence design phase – specifically with incentives, promote ally relationships, and have long-term focus or were selected for best practices.

[23] For whole buildings only.

[24] Through 2003, NSTAR licensed the program from NGRID; the programs were almost identical but the administration was independent. NStar has been modifying the program for local conditions.

[25] http://www.mass.gov/bbrs/commercial_home_link.htm.

Location	Program[22]	Baseline and Savings[23]
Minnesota	Energy Design Assistance (Xcel Energy)	The incentive amounts are based on the peak kW saved compared to a MN Energy Code level design. In 2002 achieved 28% savings compared to code. Minnesota is revising its energy standards to be more stringent, with a goal to have the 2006 Minnesota State Building Code published by June 2006 and final rules published by December 2006, with a 90-day implementation offset effective to March 2007.[26] This will raise the program baseline and reduce the amount of claimed benefits per project. In response, the program will need to move toward more advanced technologies. "Code Plus" new construction for lighting systems in new construction projects; the incentive is based on energy performance exceeding building code energy requirements by preset levels. The baseline is current Lighting Power Density (LPD) code requirements (see the Massachusetts Building Code) and incentives begin at a percentage below baseline LPD and are paid for full tenth of a watt reductions multiplied by the square footage (20% greater than MA energy Code Requirements on a watts/sq ft basis - incentive $/sq ft). Most of the other savings are prescriptive with motors once again based on NEMA Premium Efficiency Standards.
New York	New Construction Program (NYSERDA)	Design team incentives are available for projects under the Whole Building Design method that exceed performance requirements of the Energy Conservation Construction Code of NY by a minimum of 15.1%. Incentives start at $0.01/kWh saved and increase up to a maximum of $0.04/kWh saved for projects that exceed the code by 30.1% or more. The program influenced the code put into effect May 2002.
	Commercial Construction Program (LIPA)	The proposed Base Case for the project must conform to the minimum requirements of ASHRAE/IES Standard 90.1 (current version) and standard design practice.
Northeast	Energy Conscious Construction/Energy Conscious Blueprint (CL&P, UI)	The proposed energy efficiency measure must be one that exceeds minimum building code requirements (currently ASHRAE 90.1-2001 and all pertinent addenda) regarding energy efficiency. Continually update baseline to match current construction standards Most of the savings are based on comparisons to standards. Lighting incentives are paid based on the watt reduction below the baseline from the current State of Connecticut Building Code. HVAC and chillers must meet or exceed the Tier 2 minimum System Efficiency. Motor incentives are based on comparisons to NEMA premium motor standards.
Oregon	New Building Efficiency – new construction only (ETO)	Energy saving comparisons using the Oregon Energy Code as a baseline (except for LEED-NC track).
Vermont	WorkPlace New Construction (Vermont Gas Systems)	Local, state, and/or federal energy and building construction codes establish baselines to compare cost-effectiveness of natural gas savings measures. VGS assists customers to comply with the energy-use requirements of Vermont's Act 250 land-use permit criteria, and strongly encourages them to exceed them. For gas savings measures that exceed the Act 205 baseline, VGS may also provide financial incentives.
	Efficiency Vermont business programs	Exceeds minimum energy code requirements.
Wisconsin	New Construction (WE Energies)	Use Advanced Buildings Benchmark™. The prescriptive approach achieves energy savings of approximated 20-30% above ASHRAE 90.1, 2001 for most commercial buildings between 20,000 to 80,000 sq. ft.

The calculation of baselines and savings estimates for energy-efficient equipment will vary depending on the equipment. For example, prescriptive measures such as motors and HVAC equipment are almost always compared to standards, whereas savings for custom measures are generally based on engineering estimates. Prescriptive incentives are typically applied only to pieces of equipment with well-known

[26] Minnesota Dept. of Labor and Industry Memorandum March 7, 2006.

operating efficiencies, baseline conditions, and average operating profiles. Table 1-43 describes how equipment rebate programs calculate savings and baselines. These are often compared to some sort of standard, as is done in New Jersey. However, some programs also provide a bonus to exceed standards, thus pushing the standards curve forward. California, which has the most aggressive codes and standards programs, provides incentives to exceed these standards.

Table 1-43. Equipment rebate programs by state

State	Program	Baseline & Savings Estimates
New York	C&I Performance (NYSERDA)	Eligible energy-efficient measures include lighting, motors, variable speed drives, energy management systems, packaged air conditioning and chillers, and custom measures. All savings are calculated compared to standards.
	Commercial Construction Program (LIPA)	Incentives for pre-qualified lighting, motors and drives, and HVAC. Lighting savings prescribed based on pre-qualified equipment, HVAC savings are by size and must meet min. Tier 2 EER/SEER efficiency; motors and drives are based on NEMA premium motor standards.
Vermont	Efficiency Vermont business programs	Air-to-air heat pumps and AC units must meet minimum efficiency levels per size of unit in tons (CEE TIER 2). Lighting savings are based on prescribed engineering estimates. Also fund other HVAC measures (water source heat pumps, and economizer controls), dairy farm equipment, small commercial refrigeration, motors, traffic signals, transformers, and vending machines.
Washington	Energy Smart Services (Seattle City Light)	Offer incentives for Lighting, HVAC, Controls, Transformers, Glazing, and Insulation, covering up to 70% of the cost for qualifying energy-efficient lighting and equipment. Prescriptive Incentive amounts (e.g., $30 per exit sign, 20 cents/kWh per kWh saved by air-to-air heat pumps) are applied to first year savings.
Wisconsin	Focus on Energy	Focus on Energy offers incentives for qualifying energy efficiency measures: lighting, motors, compressed air, and HVAC equipment, and "custom" projects such as system or building upgrades or process improvements. Savings estimates depend on the technology, for example lighting savings estimates are prescriptive. Motor efficiencies must be equal to or greater than NEMA premium efficiency motors and there is also a bounty on pre-EPAct motors. For custom measures, base incentive levels are calculated on first year savings.

Conclusion. One half of trade allies believe that demand for energy-efficient equipment has increased either somewhat or significantly in the past three years. Among trade allies that do advertise their services (n=43), 75 percent incorporate energy efficiency messages into their promotional materials, while one-quarter do not. Most C&I programs in other states targeted to new construction and the expansion, renovation, or remodeling of existing buildings calculate savings by using a whole building approach to compare savings relative to state or federal energy codes.

1.4.2 What Impact Has the Program Had on the Baseline?

Two conditions must hold to substantiate a claim that the program has had an impact on the baseline. First, the baseline must have changed. Second, there must be evidence that the program caused the movement in the baseline. The previous subsections and the following one (review of the protocols) address whether the baseline has moved. This subsection addresses whether the program is likely to have caused any movement in the baseline.

If the program has caused movement in the baseline, it probably acted through one of two mechanisms (or both). First, by affecting purchase decisions on a large fraction of the sales for a given measure or type of equipment and so moving the market through momentum (among other things). Second, by influencing the thinking of the key market actors. (Of course, these two mechanisms are not mutually exclusive.) The first mechanism is addressed in the Market Segmentation discussion in Section 1.7. The second is discussed in the following.

Did the program affect the thinking of key market actors? If it did, it most likely could not have done so without their knowledge and awareness. Thus the first, and key, test is one of awareness.

In our surveys, trade allies and end users were asked about their familiarity with the program incentive levels and perceptions of the energy efficiency market in New Jersey. Approximately two-thirds of the trade allies (67%) knew about program incentives. Not surprisingly, the participants were significantly more likely to know about the program incentives (75%) compared to the nonparticipants (25%).

Table 1-44. Number of Trade Allies Aware of Program Incentives

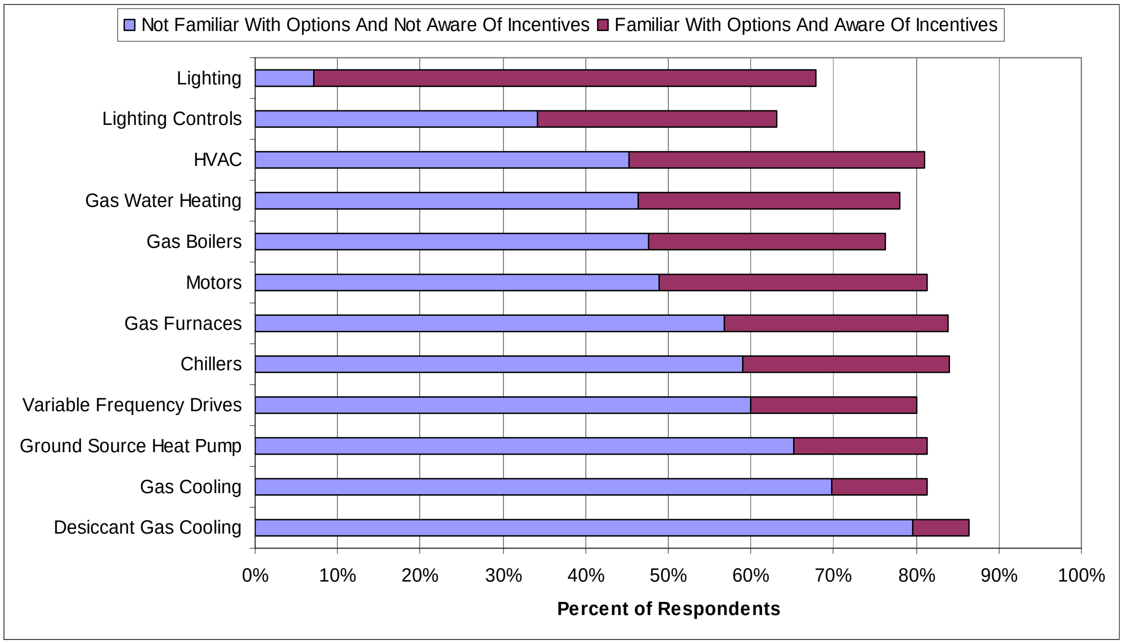
Response	Number Mentioning	% Mentioning
Yes	94	67%
No	46	33%
Total	**140**	

Most end users were not aware of the incentives available for the different equipment. About two-thirds (61%) of the participants knew that incentives were available for lighting, however fewer than one-third were familiar with incentives for any other types of energy-efficient equipment targeted in the program (Table 1-45 and Figure 1-20).

Table 1-45. Participating Customers Familiarity with Program Options and Incentives

Participants (N=68) Aware of rebates on …	Not Familiar With Options and Not Aware Of Incentives	Familiar With Options and Aware Of Incentives
Desiccant Gas Cooling	80%	7%
Gas Cooling	70%	12%
Ground Source Heat Pump	65%	16%
Variable Frequency Drives	60%	20%
Chillers	59%	25%
Gas Furnaces	57%	27%
Motors	49%	33%
Gas Boilers	48%	29%
Gas Water Heating	46%	32%
HVAC	45%	36%
Lighting Controls	34%	29%
Lighting	7%	61%

Figure 1-20. Percentage of Participating Customers Familiar with Options and Incentives



Ratings of 4 or 5 on a 5-point scale were classified as "Familiar". Bars are less than 100% since some participants were familiar and not aware, some were aware and not familiar (ratings of 1-2), and some gave familiarity ratings of 3, neither aware nor unaware.

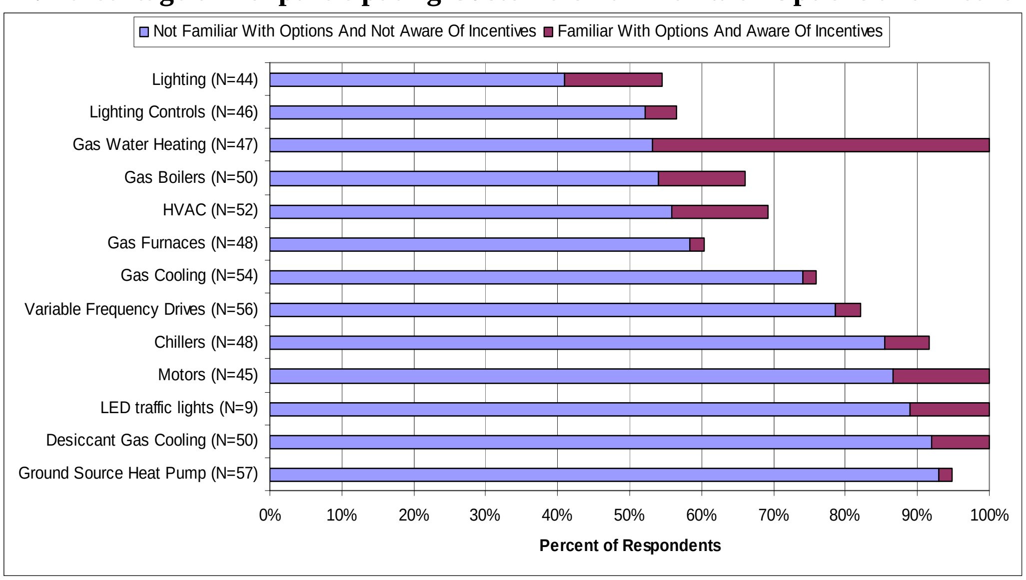
Awareness levels among nonparticipants were even lower in general. Slightly less than one-half (47%) were aware of incentives for gas water heating equipment. However, awareness for the other equipment covered in the program dropped markedly. For example, only 14 percent of the nonparticipants indicated they were aware of incentives for lighting equipment. Even fewer were aware of incentives for other energy efficiency measures.

Table 1-46. Nonparticipating Customers Familiarity with Program Options and Incentives

Aware of Incentives for:	Not Familiar With Options and Not Aware Of Incentives	Familiar With Options and Aware Of Incentives
Ground Source Heat Pump (N=57)	93%	2%
Desiccant Gas Cooling (N=50)	92%	8%
LED traffic lights (N=9)	89%	11%
Motors (N=45)	87%	13%
Chillers (N=48)	85%	6%
Variable Frequency Drives (N=56)	79%	4%
Gas Cooling (N=54)	74%	2%
Gas Furnaces (N=48)	58%	2%
HVAC (N=52)	56%	13%
Gas Boilers (N=50)	54%	12%
Gas Water Heating (N=47)	53%	47%
Lighting Controls (N=46)	52%	4%
Lighting (N=44)	41%	14%

As Figure 1-21 shows, most nonparticipants are unaware of the existence of incentives for specific equipment or energy-efficient technologies featured in the New Jersey SmartStart Buildings Program.

Figure 1-21. Percentage of Nonparticipating Customers Familiar with Options and Incentives



Additional results on awareness were presented in Section 9.2.2, Update of Current Indicators.

Conclusion: End user awareness of program incentives and services is generally quite low, casting doubt on any argument for the program having had a broad impact on the market. The one exception may be in lighting, where awareness levels were higher.

1.4.3 Review and Update Protocol Assumptions

This section presents a review of the resource savings protocols that have been used to determine resource savings from the C&I programs. These protocols are presented in the definition document *New Jersey Clean Energy Collaborative: Protocols to Measure Resource Savings, September 2004 (NJCEP)*. This review will examine the calculations, assumptions used, and the inputs to the calculations.

The protocols for C&I measures are grouped according to the programs in which they are used. There are protocols for electric and gas savings in each program. For the Energy-efficient Construction Program there are protocols for six specific electric technologies and four specific gas technologies, and for the Building Operation and Maintenance Program there is a general formula based on savings in electric and gas use due to improvements in O&M. The following protocols will be examined in this section:

1. C&I Energy-efficient Construction Program electric protocols
   Lighting equipment
   Lighting controls
   Motors
   HVAC systems
   Electric chillers
   Variable frequency drives

2. C&I Energy-efficient Construction Program gas protocols
   Gas chillers
   Gas booster water heaters
   Water heaters
   Furnaces and boilers

3. C&I Building Operation and Maintenance Program
   Electric savings
   Gas savings

Introduction to Protocols

The NJCEP states that the *protocols have been developed to measure resource savings, including energy, capacity, and other resource savings*, and that *the algorithms that have been developed to calculate the energy and or demand savings are driven by a change in efficiency level for the installed measure compared to a baseline level of efficiency. This change in efficiency is reflected in both demand and energy savings for electric measures and energy savings for gas.*[27]

The baseline efficiency is defined as that of a *standard new product*, and the document states that *the baseline estimates used in the protocols are documented in the baseline studies or other market information. Baselines will be updated to reflect changing codes, practices, and market transformation effects.*

[27] New Jersey Clean Energy Collaborative Protocols to Measure Resource Savings September 2004, pages 1 and 4.

Basic Algorithms

Following are the basic algorithms used to determine savings.

Electric Demand Savings = $\Delta kW = kW_{baseline} - kW_{energy\text{-}efficient\ measure}$
Electric Energy Savings = ΔkW * EFLH
Electric Peak Coincident Demand Savings = ΔkW * Coincidence Factor
Gas Savings = $\Delta Btuh = Btuh_{baseline\ input} - Btuh_{energy\text{-}efficient\ measure\ input}$
Gas Energy Savings = ΔBtuh * EFLH
Where:
EFLH = Equivalent Full Load Hours of operation for the installed measure

C&I Energy-efficient Construction Program Electric Protocols

General Note – New and Retrofitted Buildings

This program includes both new and retrofitted buildings. It should be noted that there is no differentiation in these protocol definitions between new or retrofitted buildings. It is stated in the document that the ΔkW and ΔkWh are based on the difference in energy use between standard new products and the high efficiency products promoted through the programs. This is because the programs encourage consumers to purchase high efficiency equipment when compared to standard efficiency equipment – i.e., if the equipment needs to be replaced anyway. However, if the program has caused some participants to replace equipment before its end of life, the savings due to the program could be higher, as the equipment being replaced will probably have a lower efficiency than today’s standard.

Lighting Equipment

Calculations

The calculations for lighting demand and energy savings are as follows:

Demand savings = change in load (kW) * CF * (1 + IF)
Energy savings = change in load (kW) * EFLH * (1 + IF)

Where:
Change in load = (baseline W/sq.ft. – installed W/sq.ft.) * area sq.ft. / 1000
CF = coincidence factor = percentage of lighting load on during Peak Window (12 noon to 8 pm)
IF = HVAC interaction factor = demand and energy savings in HVAC load due to reduced wattage in lighting
EFLH = effective full load hours = annual equipment operating hours at full load

Assumptions

The value of installed W/sq.ft. is taken from “standard wattage tables and verified watts/sq.ft.”[28] The standard wattage tables are maintained by program administrators and are based on “evaluations of several manufacturers’ wattage ratings for a given fixture type.”[29]

[28] New Jersey Clean Energy Collaborative Protocols to Measure Resource Savings September 2004, page 42.
[29] Ibid.

The baseline value for W/sq.ft. is 30% better than ASHRAE 90.1-1989 for commitments prior to 7/16/2002 and 5% better than ASHRAE 90.1-1999 for commitments after 7/16/2002.

Inputs

Values for both CF and EFLH are given for 11 different business sectors. The source of these values is metered data for all the office, retail, and hospital building types, a Cost-Effectiveness Study for all others, and an estimate for industrial.

The HVAC interaction factor is set at 5% for all building types. The source of this value is that it was used in previous lighting savings.

Discussion of Key Assumptions and Inputs

The coincidence factor given is based on metered data and thus would include both coincidence and diversity effects. Diversity factors represent the percentage of installed lighting that is not in use at a given time. As this CF value was developed using metered data, we assume that it is accurate.

The EFLH values are assumed to be correct as they are based on metered data.

The HVAC interaction factor of 5% for all building types seems to be quite low. Interactive effects based on simulation modeling are often found to exceed 20%. In addition, there is often a significant difference between peak demand interaction and annual or heating/cooling energy use interaction. We recommend that interaction factors for different building sectors be developed, either with modeling or metered data, and that there be different values for peak demand interaction factors and annual energy use interaction factors. In fact, the protocols do break the CF out by major market segment.

Details on the standard wattage tables are not given. It would be good to provide more detail on the choice of fixtures used in the tables, and if they represent the most efficient fixtures currently available on the market, such as T8 with fluorescent ballasts, T5 high-output fluorescent, and high-efficiency design watts/square foot for new construction. In addition, a periodic review might be necessary to assess how closely aligned the standard wattage tables are with the fixtures actually installed at the sites where the program was implemented.

The baseline W/sq.ft. of 30% above ASHRAE 1989 for projects before 7/16/2002 and the baseline W/sq.ft. of 5% above ASHRAE 1999 for projects after 7/16/2002 appears to be reasonably consistent based on a review of the lighting power densities for common space types in the two versions of the code. In keeping with our suggestion later that New Jersey should consider upgrading its energy code standards to at least ASHRAE 90.1 - 2001 and plan to upgrade to ASHRAE 90.1 – 2004, it seems appropriate to recommend that the standard here be upgraded as well.

Traffic Signals

A table in the NJCEP gives savings for five types of signals, with kW reduced and EFLH or kWh/year. In addition, there are EFLH values for time period allocation.

The data comes from the NJDOT, and the values appear to be accurate.

Lighting for Small Commercial Customers

This program is a fixture replacement program, targeted at small commercial and industrial customers, either new or renovated.

Calculations

The calculations for lighting demand and energy savings are as follows:

Demand savings = change in load (kW) * CF
Energy savings = change in load (kW) * EFLH

Where:

Change in load = Number of fixtures installed x baseline wattage - number of replaced fixtures * wattage from savings table

Assumptions

The baseline for existing fixtures is:

- Existing T12 fixtures with energy-efficient lamps and magnetic ballast
- 4 times the wattage of the new bulb for compact fluorescents.

The standard wattages for new fixtures are given in the Prescriptive Lighting Savings Table. The table includes values for new watts, baseline, and savings in W/fixture for various sizes of compact fluorescents, high efficiency fluorescents, LED exit sign, and pulse start metal halides.

Inputs

The CF and EFLH values are averages of the values for small retail and office (77.5% and 3677 respectively) taken from metered data.

Discussion of Key Assumptions and Inputs

It is unclear from the definition of savings as given in the protocol document whether the baseline values are taken from the lighting table or the definition of the baseline as given above.

No HVAC interaction factor is included in the savings, and this could be considerable for some small commercial buildings. We recommend analyzing this issue and including interactive effects by building type as appropriate. As discussed above, we also advise disaggregating interaction factors by demand and energy.

The CF and EFLH values are an average of values for retail and office, but this program also includes small industrial properties. These facilities may have a different CF than retail and office.

It is important to recognize that base and energy-efficient wattages for ballasted systems such as tubular fluorescent, compact fluorescent, and HID needs to be the input wattage to the system including the ballast. Lamps and ballasts act as a system and the input wattage is dependent on this interaction. Lamp wattage is not an accurate indicator for these systems, whereas it is accurate for incandescent systems. The values in the table in the protocol document do indeed reflect this combined wattage.

Lighting Controls

Calculations

The calculations for lighting controls demand and energy savings are as follows:

Demand savings = lighting load connected to control (kW) * CF * SVG
Energy savings = lighting load connected to control (kW) * EFLH * (1 + IF) * SVG

Where:
SVG = % of energy saved by lighting control

Assumptions

The baseline is a manual switch.

Savings percentages are based on three different sources, including lighting control savings fractions consistent with current programs offered by a number of utilities.

Inputs

SVG is 50% for daylight dimmer systems and 30% for occupancy sensors, controlled hi-low fluorescent controls, and controlled HID.

The CF and EFLH values are the same as for lighting retrofits.

Discussion of Key Assumptions and Inputs

There is no interaction factor for demand savings. This could be a significant addition to the savings at peak times, such as on a peak summer day.

The percentage savings value for occupancy sensors seems to be reasonable. Savings for specific applications, from manufacturers' data, are shown here:

Energy Savings Potential with Occupancy Sensors

Application	Energy Savings Factor
Offices (1-2 persons)	25-50%
Offices (open space)	20-25%
Rest rooms	30-75%
Corridors	30-40%
Storage areas	45-65%
Meeting rooms	45-65%
Conference rooms	45-65%
Warehouses	50-75%

The percentage savings value of 50% for daylighting controls could be a little high. Case study savings values from a study by Southern California Edison (Daylighting Performance and Design) are shown below. The average over these building types is 25%. This savings figure should be reviewed.

Application	% Savings
Grocery Store	28
Industrial Manufacturing	17
Low-rise Office	39
Retail	17

Motors

Calculations

The calculations for motor demand and energy savings are as follows:

Demand savings = ΔkW * CF
Energy savings = ΔkW * EFLH
ΔkW = HP * 0.7456 * (1/baseline efficiency – 1/installed efficiency)

Assumptions

The baseline is a comparable EPACT motor.

Inputs

CF is set to a constant of 35%.

EFLH is set to 2502 for commercial and 4599 for industrial.

Discussion of Key Assumptions and Inputs

The calculation does not take into consideration a possible change in horsepower between the base and the newly installed unit. It also does not include a rated load factor, which is the ratio of the peak running load to the nameplate rating of the motor. Common industry assumptions assume the RLF to be 0.70 – 0.80. However, since the CF is based on metered data, it could be assumed to include load factor effects. A more complete and potentially more accurate calculation for change in demand would be:

$$\Delta kW = 0.746 \times [(hp_{base} \times RLF_{base})/\eta_{base} - (hp_{ee} \times RLF_{ee})/\eta_{ee}]$$

Where:

hp_{base} = Rated horsepower of the baseline motor
hp_{ee} = Rated horsepower of the energy-efficient motor
RLF_{base} = Rated load factor of the baseline motor
RLF_{ee} = Rated load factor of the energy-efficient motor
η_{base} = Efficiency of the baseline motor
η_{ee} = Efficiency of the energy-efficient motor

The EPACT motor efficiencies are a reasonable baseline to use.

HVAC Systems

Calculations

The calculations for AC demand and energy savings are as follows:

Demand Savings = (Btuh/1000) * (1/EER_{base} – 1/EER_{ee}) * CF
Energy Savings = (Btuh/1000) * (1/EER_{base} – 1/EER_{ee}) * EFLH

The calculations for heat pump demand and energy savings are as follows:

Cooling Energy Savings = ($Btuh_{cooling}$/1000) * (1/EER_{base} – 1/EER_{ee}) * $EFLH_{cooling}$
Heating Energy Savings = ($Btuh_{heating}$/1000) * (1/EER_{base} – 1/EER_{ee}) * $EFLH_{heating}$

Where:

Btuh = cooling/heating capacity in Btu/hour. This comes from ARI, AHAM, or manufacturer's data.
1000 = Conversion from W to kW
EER_{Base} = Energy efficiency ratio of baseline unit (Btu/Wh)
EER_{ee} = Energy efficiency ratio of replacement unit (Btu/Wh)
CF = % of total load on during electric system's Peak Window, determined from the average number of operating hours during this period
$EFLH_{cooling\ or\ heating}$ = energy use by season, determined by existing data of kWh during peak period divided by kW at design conditions.

Assumptions

Baseline EER values are given in the HVAC Baseline Table. These values are based on collaborative agreement and the C/I baseline study. However, EER values from the ASHRAE standards 90.1-1989 and 90.1-1999 are referenced in the HVAC Baseline table. Baseline values are mostly quite close to those in the ASHRAE 90.1-1989 standard. For units <65,000 btu, SEER is used for cooling, and HSPF is used for heating.

The high efficiency EER value comes from ARI, AHAM, or manufacturer's data. For units <65,000 btu, SEER is used for cooling, and HSPF is used for heating

Inputs

CF is set to a constant value of 67%.

EFLH is set at 1131 for HVAC, 381 for HP cooling, and 800 for HP heating.

Baseline EER Values: The table below shows the values of EER in the HVAC Baseline Table. The third column shows EER values from the NJ Commercial Energy-efficient Construction Baseline Study (January 2000, RLW Analytics Inc.). This report provides baseline equipment installation practices for lighting, HVAC, and building shell technologies in the New Jersey new construction market.

Equipment	Efficiency (low/high tons)	NJ EE Baseline Study
Unitary HVAC/Split System	8.9/8.5 EER	9.7
Air-air HP System	6.8 HSPF/8.9/8.5 EER	9.3
Packaged Terminal AC (PTAC)	9 EER	10
Water source HP	10.5 EER	9.7
Central DX AC	8.5 EER	n/a
Ground water source HP	11 EER	12.9

The protocols should be updated to the numbers from the baseline in the table above.

Discussion of Key Assumptions and Inputs

The calculation method appears to be based on the rated capacity of the unit. HVAC units are commonly oversized with the result that they do not typically operate at their rated load even at peak load conditions. This is often accounted for by including a "rated load factor" or "sizing factor". In this case, this effect could be considered to be accounted for in the CF; however, the definition of the CF as "the average number of operating hours during the peak window period" does not explicitly account for this effect.

The baseline EERs relative to the ASHRAE standards are reasonable, although they are lower than the values given in the baseline study in most cases, as shown in the table above. However, poor maintenance is commonly observed in packaged units, and this could argue for a somewhat lower baseline condition both in the baseline study and in the values based on the ASHRAE standards.

The coincidence factor seems reasonable, although it would provide more resolution to have a series of CFs by building type as with lighting.

The EFLH assumptions which are based on JCP&L metered data seem reasonable, although it would provide greater resolution to break out values based on building type.

Electric Chillers

Calculations

The calculations for electric chillers demand and energy savings are as follows:

Demand Savings = unit size (tons) * (kW/ton_b – kW/ton_q) * CF
Energy Savings = unit size (tons) * (kW/ton_b – kW/ton_q) * EFLH

Where:
kW/ton_b = rating of baseline unit
kW/ton_q = rating of new energy-efficient unit

Assumptions

Baseline ratings for units are given in the NJCEP document for the following categories: water cooled (< 70 tons, 70 – 150 tons, 150 – 300 tons); air cooled (< 150 tons, > 150 tons). The values given are the same or slightly lower than the ASHRAE standard 90.1-1989 for projects committed before 7/16/2002, and the same or slightly lower than ASHRAE standard 90.1-1999 for projects committed after 7/16/2002. The sources for these baseline values are collaborative agreement, the C/I baseline study, and an E-cube Inc. study.

EER values are given in the HVAC Baseline Table in the NJCEP. These values are based on standards in the ASHRAE standards 90.1-1989 and 90.1-1999. For units <65,000 btu, SEER is used for cooling, and HSPF is used for heating.

The high efficiency EER value comes from ARI, AHAM, or manufacturer’s data. For units <65,000 btu, SEER is used for cooling, and HSPF is used for heating.

Inputs

Coincidence factor is set to 67% for all building types.

EFLH is set to 1360 for all building types.

Discussion of Key Assumptions and Inputs

The calculation method is based on the “capacity of the chiller at site design conditions”. While possibly less problematic than packaged HVAC units, chillers can also be oversized with the result that they do not typically operate at their rated load even at peak load conditions. This is often accounted for by including a “rated load factor” or “sizing factor”. This effect could be considered to be accounted for in the CF.

The baseline kW/ton values relative to the ASHRAE standards are reasonable.

The coincidence factor seems reasonable, although it would provide more resolution to have a series of CFs by building type.

The EFLH assumptions, which are based on JCP&L metered data, seem reasonable, although it would provide greater resolution to break out values based on building type.

Variable Frequency Drives

Note: this calculation is only for VFDs installed in HVAC and water pump applications.

Calculations

The calculations for variable frequency drives energy savings are as follows:

Energy Savings (kWh) = HP * kWh/HP

Where:

HP = HP of the motor being controlled

The protocol definition document states that there are no demand savings.

Assumptions

The kWh/HP is based on metered data for VFDs and chillers.

The calculation method is based on the nameplate horsepower of the motors.

Inputs

kWh/HP is 1653 for VAV air handler systems and 1360 for chilled water pumps.

Discussion of Key Assumptions and Inputs

As the kWh/HP values are based on metered data, they are assumed to be correct.

The calculation given likely provides a reasonable estimate of savings in most applications similar to those metered, but lacks the variables to account for other specialized situations outside of those to which the metering study applied. It may be worthwhile to expand the calculation to account for factors that could be used to analyze other applications and benchmark the calculation to the metered applications.

The protocol states that there are no demand savings. It is possible that there is a modest demand savings component, due to oversizing of motors and diversity effects in populations of VFD applications. If the metering study confirmed that there were no demand savings, then this can be taken as accurate. If, however, this was not confirmed by the metering study, an estimate of demand savings should be done, taking into consideration typical oversizing of motors and diversity effects in populations of VFD applications.

The calculation used is simplified based on metered data, with a linear relationship between horsepower and energy savings assumed. This assumption may or may not be accurate depending on the range of motors encountered and their application. The savings can be calculated in another way so that a variation in efficiency and load is taken into account, as:

$$\text{Energy Savings (kWh)} = 0.746 * HP * RLF/\eta_{motor} * ESF * FLH_{base}$$
$$\text{Demand Savings (kW)} = 0.746 * HP * RLF/\eta_{motor} * DSF$$

Where:

HP = nameplate motor horsepower
RLF = Rated Load Factor. This is the ratio of the peak running load to the nameplate rating of the motor.
η_{motor} = Motor efficiency at the peak load. Motor efficiency varies with load. At low loads relative to the rated hp (usually below 50%) efficiency often drops dramatically.
ESF = Energy Savings Factor. The energy savings factor is equal to $1 – FLH_{asd}/FLH_{base}$. This factor can also be computed according to fan and pump laws assuming an average flow reduction and a cubic relationship between flow rate reduction and power draw savings.
FLH_{asd} = Full Load Hours of the fan/pump with the VSD
FLH_{base} = Full Load Hours of the fan/pump with baseline drive
DSF = Demand Savings Factor. The demand savings factor is calculated by determining the ratio of the power requirement for baseline and VFD control at peak conditions.
$DSF = 1 – (kW_{asd}/kW_{base})_{peak}$
kW_{asd} = peak demand of the motor under the variable control conditions
kW_{base} = peak demand of the motor under the base operating conditions

C&I Energy-Efficient Construction Program Gas Protocols

Gas Chillers and Chiller Heaters

Calculations

There are both electric savings and gas savings for gas chillers and chiller heaters. The calculations for electric savings are as follows:

Demand Savings (kW) = tons * ($kW/ton_{baseline}$ – kW/ton_{gc}) * CF
Energy Savings (kWh) = tons * ($kW/ton_{baseline}$ – kW/ton_{gc}) * EFLH

Where:

$kW/ton_{baseline}$ = baseline efficiency for electric chillers
kW/ton_{gc} = parasitic electric requirement for gas chiller

The calculations for gas savings are as follows:

Winter Gas Savings (therms) = (VBE_q – Be_b)/VBE_q * Input rating (therms/hr) * EFLH
Summer Gas Usage (MMBtu) = Chiller Cooling Capacity (MMBtu) / COP * EFLH

Where:

VBE_q = vacuum boiler efficiency
Be_b = Baseline gas boiler efficiency
Input rating (therms/hr) = gas input rating of chiller
COP = coefficient of performance of the gas chiller. This is the ratio of the energy content of the gas used by the chiller to the cooling energy produced by the chiller.
EFLH = Equivalent full load hours by season.

Total savings for the gas chiller/heater are given as:

Net Energy Savings = Electric Energy Savings + Winter Gas Savings – Summer Gas Use

Assumptions

The savings for gas chillers are based on replacing an electric chiller with a gas chiller, and on using the gas chiller heater in the winter in place of a regular gas boiler and using the gas chiller in the summer in place of the electric chiller.

kW/ton_{gc}, VBE_q, COP, input rating, tons, and Chiller Cooling Capacity are all based on information in the rebate application (i.e., provided by the applicant) or on manufacturers data.

Be_b is based on ASHRAE 90.1 (year not given).

$kW/ton_{baseline}$ is based on collaborative agreement and the C/I baseline study.

Inputs

Baseline efficiency for electric chillers ($kW/ton_{baseline}$) is given for various sizes of chillers. The values are different for projects committed before or after 7/16/2002. The values for earlier projects are higher in every size category.

CF is set to 67%.

EFLH is set to 1360.

Baseline gas boiler efficiency is set at 75%.

Discussion of Key Assumptions and Inputs

The calculation method relies on boiler and chiller capacity data. Typically, these units are oversized and this is often accounted for by including a “rated load factor” or “sizing factor”. This effect could be considered to be accounted for in the CF.

The baseline kW/ton values seem reasonable.

The coincidence factor seems reasonable, although it would provide more resolution to have a series of CFs by building type.

The EFLH assumptions, which are based on JCP&L metered data, seem reasonable, although it would provide greater resolution to break out values based on building type. We reviewed savings calculations for a gas chiller in one of our on-site inspections. The application used 900 EFLH to calculate winter savings rather than the protocol-specified 1360 no matter what season. It may make sense to use different summer and winter values for EFLH. (In fact, an EFLH value is not usually applied to boilers as they are either on or off, so an operating hours value would be more appropriate.)

It is unclear why a vacuum boiler has been chosen as the replacement for the boiler used in the winter.

The units for electric energy savings (kWh), winter gas savings (MMBtu), and summer gas usage (therms) are all different. The conversion to a single unit should be included with the protocol.

The input rating is assumed to be the same for the replacement and the baseline gas boiler, whereas in reality these might have different ratings. The calculation should take into consideration these different ratings.

Gas Booster Water Heaters

<u>Calculations</u>

Calculations for electric demand and energy savings are as follows:

Demand Savings (kW) = Input Rating (Btuh) * Efficiency/3412 * CF
Energy Savings (kW) = Input Rating (Btuh) * Efficiency/3412 * EFLH

Where:

1/3412 is the conversion factor from Btus to kWh

The calculation for the increase in use of gas is as follows:

Gas Usage (Btuh) = Input Rating (Btuh) * EFLH

Net Energy Savings (MMBtu) = Energy Savings – Gas Usage

<u>Assumptions</u>

The gas booster water heaters would replace an electric booster water heater.

Inputs

CF is set at 50%.

EFLH is set at 1000.

Discussion of Key Assumptions and Inputs

The input rating of a new gas fired unit in Btuh may not correlate directly to the kW rating of the electric water heater being replaced.

Savings are based on the capacity of the new unit, however, a more realistic estimate of kW and kWh would be based on the unit being replaced.

A CF of 50% for water heating seems high. It is not stated in the protocol document whether this is based on metered data from PSE&G or some other data source. If this value is based on metered data then it can be assumed to be accurate. However, if not, the value should be reviewed. Data that Summit Blue has in house (not published) for the CF for hot water heaters in restaurants (the most common use of a gas booster water heater) is 27%. In addition, a model run in Equest for a restaurant showed a CF for hot water at 4 pm (the usual system peak) of 32%.

It is not stated in the protocol document whether the EFLH is based on metered data from PSE&G or some other data source. If this value is based on metered data then it can be assumed to be accurate. However, if not, the value should be reviewed. A value of 516 for EFLH was obtained from a model run in Equest, which indicates that a value of 1000 could be high. However, it should be stressed that the EFLH value varies considerably with the type of facility and the operating hours.

Water Heaters

Calculations

The calculation for gas savings due to an increase in water heater efficiency is as follows:

Gas Savings = $(EF_q - Ef_b)/EF_q$ * Baseline Usage (therms)

Where:

EF_q = Energy factor of the energy-efficient water heater (ratio of the energy supplied in heated water divided by the energy input to the water heater)
Ef_b = Energy factor of the baseline water heater

Assumptions

This measure targets domestic water heaters (50 gallons or less) used in commercial facilities.

The baseline is a less efficient gas water heater, based on the Federal EPACT Standard.

Inputs

Baseline Usage is fixed at 277 therms, taken from the DOE/FEMP website.

The energy factor of the baseline water heater is set to 0.544. This is calculated as:

0.62 – 0.0019 * 40 (capacity in gallons)

Discussion of Key Assumptions and Inputs

Algorithms and assumptions seem reasonable.

The EPACT standard as of January 20, 2004 is an energy factor of (0.67 – 0.0019 * capacity) for gas-fired water heaters. This would give an EF of 0.59 for a tank of 40 gallons. We recommend that this value be used.

The baseline annual energy usage from the DOE/FEMP website is given as 254 therms. We recommend that this value be used.

(Source: www.eere.energy.gov/femp/procurement/eep_gas_waterheaters.cfm)

Performance	Base Model	Recommended Level	Best Available
Energy Factor	0.59	0.62	0.85
Annual Energy Use	254 therms	242 therms	176 therms

Furnaces and Boilers

Calculations

The calculation for gas savings due to a more efficient boiler or furnace is as follows:

$$\text{Gas Savings} = (AFUE_q - AFUE_b)/AFUE_q * \text{CAPY (therms/hour)} * \text{EFLH}$$

Where:

$AFUE_q$ = AFUE (annual fuel utilization efficiency) of qualifying energy-efficient boiler or furnace
$AFUE_b$ = AFUE of baseline furnace or boiler
CAPY = Capacity of furnace or boiler
EFLH = Equivalent full load heating hours

Assumptions

This measure targets small-scale boilers (1500 MBH or less) and furnaces (no size limitation) in commercial facilities.

The baseline efficiency is based on the EPACT standard for furnaces and boilers.

Capacity is based on information in the application form or manufacturer's data.

Inputs

EFLH is fixed at 900.

Baseline AFUE is fixed at 78% for furnaces and 80% for boilers.

Discussion of Key Assumptions and Inputs

It is not stated in the protocol document whether the EFLH is based on metered data from PSE&G or some other data source. If this value is based on metered data then it can be assumed to be accurate. However, if not the value could be reviewed. An value of 1500 for the EFLH was calculated from ASHRAE climate bin data by Summit Blue. This indicates that a value of 900 may be too conservative.

The capacity of the new boiler could be different than old boiler, but this is not included in the calculation. If so, it would be advisable to account for the difference in sizing between the baseline and energy-efficient unit.

The baseline AFUE values are reasonable and agree with current EPACT standards.

C&I Building Operation and Maintenance Program Protocols

Savings for this program are based on saving a fixed percentage of electric and gas usage through improvement in O&M. Information on prior electric and gas usage for the facility will be needed.

Electric Savings

Calculations

The calculations for energy and peak demand electric savings are as follows:

Energy Impact (kWh) = PYEL * ESF
Peak Demand Impact (kW) = Energy Impact/EFLH * CF

Where:

PYEL = previous year electricity use (kWh)
ESF = electric savings factor (% of facility load saved)
EFLH = EFLH of operation for the average C/I property in NJ

Assumptions

ESF is based on a review of multiple O&M improvement programs.

EFLH is based on a typical NJ load profile from the NJ 200 Forecast.

Inputs

CF is fixed at 87.5%, which is an average of 85% for commercial and 90% for industrial customers.

EFLH is fixed at 3900.

ESF is set at 10% of pre-participation facility load.

Discussion of Key Assumptions and Inputs

The energy savings factor seems reasonable.

Estimating demand savings for this program is challenging. Using the energy impact divided by the EFLH produces an average number that may not reflect the load shape of a given project or the typical load shape of a class of projects. It would be advisable to benchmark this value with some case study analyses of O&M actions taken and their demand savings estimates compared to energy savings estimates. Another approach would be to estimate load factors and operating hours by building type as follows:

Demand savings (kW) = kWh savings / (LF_{bldg} x $Hours_{bldg}$)

Gas Savings

<u>Calculations</u>

The calculation for gas savings is as follows:

Energy Savings (therms) = PYGL * GSF

Where:

PYGL = previous year gas use (therms)
GSF = gas savings factor (% of facility load saved)

<u>Assumptions</u>

GSF is based on a review of multiple O&M improvement programs.

<u>Inputs</u>

GSF is set to 7% of pre-participation facility load.

Discussion of Key Assumptions and Inputs

The energy savings factor seems reasonable.

1.5 Incremental Cost Assessment

This section presents an analysis of the incremental cost of energy-efficient measures in the New Jersey market. The results for motors and lighting come from our interviews with trade allies, the remaining results come from secondary data sources.

Motors. The motors trade allies indicated that customers could pay more for an energy-efficient compared to a standard motor. However, this increase varies depending upon a variety of factors including the type of customer and the availability of the required motor. In fact, the motor allies indicated that equipment availability was a much higher barrier to energy efficiency installations than the upfront price. If a customer needs a motor, it is a critical replacement decision and the customer will buy whatever motor is available in order to resume or continue operation.

> *Rebates for the larger motors and drives not needed. The list prices for 100 HP for a standard motor are $4604, for an energy-efficient version is $5535, so that is the difference.*
>
> *200 HP do more repair than replace it. In the higher output ranges, tend to repair above 250 HP.*
>
> *The final price I charge them also depends on the kind of customer they are. My price is volume specific. We offer customers different prices based on volume, so a good customer with high volume is going to get more savings compared to another customer.*

Lighting. In general, the trade allies believe that the incremental cost for efficient lighting technologies is relatively low. Some trade allies estimated that the difference was between 5 and 10 percent for most established products, such as T8s. Others said that the cost premium for efficient lighting has either stayed the same or even declined a bit due to the increased demand for energy-efficient lighting and improved technologies. A few lighting manufacturers believed that the price had increased due to the rising cost of raw materials.

> *The prices went down because of the cost of the product so there isn't really an incremental difference.*
>
> *…Reason price went down- China.*
>
> *…0% incremental costs—energy efficiency is not more expensive. The customers are starting to request energy efficiency lamps in the last 2 years because of the national energy codes—the more widely used energy-efficient technologies are cost competitive because the technology makes it so.. The metal halide technology is becoming cost competitive. Other lamps, such as the recessed fixtures with the PAR 38s, are more expensive.*
>
> *There are better products coming out and the costs are going down for energy-efficient lighting, so people are asking for it. The demand drives the price down.*
>
> *Even T8s are getting cheaper comparable to other systems. The technology is catching up. More technology makes it cheaper and more customers get into it. People have energy concerns that we are going to run out of oil.*
>
> *See about a 5%-10% price differential for products like T8's.. but the upfront cost equals out over time.*
>
> *Specifying energy-efficient equipment use lighting from Energy Star thinks it is only 5 to 7% more expensive, but the dealers increase the margin- ways to make it less expensive thru proper building practices; commercial buildings are uniquely design.*
>
> *Rebates reduce the incremental costs by 5%-20%, see a 5% rebate reduction… show and save energy in a few years.*
>
> *Rising costs. The cost of steel and copper went thru the roof, caused high prices for equipment; if build efficiently though, then the margins are only about 10-15%; because can avoid other costs*
>
> *… Getting all European manufacturers, so getting higher prices*

Conclusion. For motors and lighting, the incremental cost of energy efficient products is not high enough to provide a significant barrier to market acceptance. For motors availability is a bigger issue than cost.

1.5.1 Detailed Incremental Cost Data

Beyond the incremental cost data we collected with trade ally surveys, there are several other sources for incremental cost data. In the table below, we present incremental cost data for C&I measures derived from a database created for NYSERDA's programs. NYSERDA's costs are quite likely to be similar to New Jersey's costs, given the proximity and the fact that many suppliers operate in both markets simultaneously. For some technologies (e.g., motors) pricing is determined to a large extent by regional or even national forces so New Jersey's prices and NYSERDA's should track closely. Other sources include the DEER database created to support California energy efficiency programs (http://eega.cpuc.ca.gov/deer/) and a NEEP study from 2000 (http://www.neep.org/files/MD_AttachE_111700.PDF).

We used the detailed incremental cost shown in the following table as well as data from the other sources listed above to support recommendations for changes in the rebate levels.

Table 1-47. Incremental Cost[30]

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
195	H.CHILLER-AC-RECIP.30-150.CI._._.N	Air Cooled Chiller, Recip 30 - 150 tons, IPLV kW/ton <0.90	$248.89	1	$248.89	$248.89
196	H.CHILLER-AC-SCREW.70-200.CI._._.N	Air Cooled Chiller, Screw 70 - 200 tons, IPLV kW/ton <0.98	$142.39	1	$142.39	$142.39
194	H.CHILLER-AC-SCROL.30-60.CI._._.N	Air Cooled Chiller, Scroll 30 - 60 tons, IPLV kW/ton <0.86	$290.23	1	$290.23	$290.23
157	H.RTU-AS-TIER1.<5.CI.1994.2005.N	Air-Source Unitary or Split System HVAC <5.4 tons - AC or HP (Tier 1)	$80.00	6	$80.00	$80.00
158	H.RTU-AS-TIER2.<5.CI.1994.2005.N	Air-Source Unitary or Split System HVAC < 5.4 tons - AC or HP (Tier 2)	$139.00	6	$130.00	$143.50
161	H.RTU-AS-TIER1.11-20.CI.1994.2002.N	Air-Source Unitary or Split System HVAC > 11.25 to 20 tons - AC or HP (Tier 1)	$4.23	4	$4.23	$4.23
134	H.RTU-AS-TIER2.11-20.CI.1994.2002.N	Air-Source Unitary or Split System HVAC > 11.25 to 20 tons - AC or HP (Tier 2)	$5.30	2	$5.30	$5.30
162	H.RTU-AS-TIER2.11-20.CI.2003._.N	Air-Source Unitary or Split System HVAC > 11.25 to 20 tons - AC or HP (Tier 2)	$29.91	4	$5.30	$103.72
122	H.RTU-AS-TIER1.5-11.CI.1994.2002.N	Air-Source Unitary or Split System HVAC > 5.4 to 11.25 tons - AC or HP (Tier 1)	$113.13	4	$113.13	$113.13
130	H.RTU-AS-TIER2.5-11.CI.1994.2002.N	Air-Source Unitary or Split System HVAC > 5.4 to 11.25 tons - AC or HP (Tier 2)	$169.10	2	$169.10	$169.10
160	H.RTU-AS-TIER2.5-11.CI.2003._.N	Air-Source Unitary or Split System HVAC > 5.4 to 11.25 tons - AC or HP (Tier 2)	$108.77	4	$88.66	$169.10
168	H.RTU-AS-TIER1.>75.CI.2003._.N	Air-Source Unitary System HVAC, >75 tons - AC or HP (Tier I)	$14.00	2	$14.00	$14.00
174	H.RTU-AS-TIER2.>75.CI.2003._.N	Air-Source Unitary System HVAC, >75 tons - AC or HP (Tier II)	$197.20	2	$182.39	$212.00
165	H.RTU-AS-TIER1.20-40.CI.2003._.N	Air-Source Unitary System HVAC, 20 - 40 tons - AC or HP (Tier I)	$49.00	2	$49.00	$49.00

[30] Deemed Savings Database Version 8 (2005 3rd Quarter) prepared for the New York State Energy Research and Development Authority. Prepared by Nexant. November 7, 2005.

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
170	H.RTU-AS-TIER2.20-40.CI.2003._.N	Air-Source Unitary System HVAC, 20 - 40 tons - AC or HP (Tier II)	$223.35	2	$140.69	$306.00
167	H.RTU-AS-TIER1.41-75.CI.2003._.N	Air-Source Unitary System HVAC, 41 - 75 tons - AC or HP (Tier I)	$29.00	2	$29.00	$29.00
172	H.RTU-AS-TIER2.41-75.CI.2003._.N	Air-Source Unitary System HVAC, 41 - 75 tons - AC or HP (Tier II)	$183.35	2	$140.69	$226.00
460	H.BOILER-WATER-GAS.>300000.CI._._.N	Boilers >300,000Btuh (hot water, fired by NG) Comb Eff. >= 84%, Therm Eff. >80%	$3,568.00	2	$3,568.00	$3,568.00
463	H.BOILER-WATER-OIL.>300000.CI._._.N	Boilers >300,000Btuh (hot water, fired by oil) Comb Eff. >= 84%, Therm Eff. >83%	$1,500.00	1	$1,500.00	$1,500.00
462	H.BOILER-STEAM-GAS.>300000.CI._._.N	Boilers >300,000Btuh (steam, fired by NG) Comb Eff. >= 84%, Therm Eff. >79%	$3,568.00	1	$3,568.00	$3,568.00
464	H.BOILER-STEAM-OIL.>300000.CI._._.N	Boilers >300,000Btuh (steam, fired by oil) Comb Eff. >= 84%, Therm Eff. >83%	$1,500.00	1	$1,500.00	$1,500.00
498	L.CFL-24HR._.CI._._.N	CFL - "24-hour" Common Areas	$20.89	1	$20.89	$20.89
7	L.CFL-H.13.CI._._.N	CFL - Hardwired (13 watt) - (Non-Residential)	$15.00	1	$15.00	$15.00
8	L.CFL-H.18.CI._._.N	CFL - Hardwired (18 watt) - (Non-Residential)	$15.00	1	$15.00	$15.00
11	L.CFL-H.2x13.CI._._.N	CFL - Hardwired (2 x 13 watt) - (Non-Residential)	$30.00	1	$30.00	$30.00
12	L.CFL-H.2x26.CI._._.N	CFL - Hardwired (2 x 26 watt) - (Non-Residential)	$35.00	1	$35.00	$35.00
9	L.CFL-H.26.CI._._.N	CFL - Hardwired (26 watt) - (Non-Residential)	$20.00	1	$20.00	$20.00
10	L.CFL-H.28.CI._._.N	CFL - Hardwired (28 watt) - (Non-Residential)	$20.00	2	$20.00	$20.00
499	L.CFL-HOSP-GUEST._.CI._._.N	CFL - Hospitality Lighting - Guest Rooms	$20.35	1	$20.35	$20.35
193	H.CHILLER.300.CI._.2002.N	Chiller Replacement - (300 tons, 0.65 kW/ton)	$913.69	1	$913.69	$913.69
434	A.CW._.CI._.2003.N	Commercial clothes washers (coin-operated), high efficiency (CEE Tier 2, MEF=1.42)	$300.00	1	$300.00	$300.00
522	A.CW._.CI.2004._.N	Commercial clothes washers (coin-operated), high efficiency (CEE Tier 2, MEF=1.60)	$660.00	2	$660.00	$660.00
420	O.ICEMAKER - TIER1._.CI._._.N	Commercial Packaged Refrigeration Equipment, Commercial Ice-Maker (All sizes) - Tier 1 (or FEMP)	$59.06	2	$59.06	$59.06
419	O.LRPA.>200.CI._._.N	Commercial Packaged Refrigeration Equipment, Liquid Refrigerant Pressure Amplifier (>200 tons)	$43,000.00	1	$43,000.00	$43,000.00

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
418	O.LRPA.100-200.CI._._.N	Commercial Packaged Refrigeration Equipment, Liquid Refrigerant Pressure Amplifier (100 to 200 tons)	$45,000.00	1	$45,000.00	$45,000.00
416	O.LRPA.20-50.CI._._.N	Commercial Packaged Refrigeration Equipment, Liquid Refrigerant Pressure Amplifier (20 to 50 tons)	$9,400.00	1	$9,400.00	$9,400.00
417	O.LRPA.50-100.CI._._.N	Commercial Packaged Refrigeration Equipment, Liquid Refrigerant Pressure Amplifier (50 to 100 tons)	$12,400.00	1	$12,400.00	$12,400.00
409	O.FR - TIER1.<35.CI._._.N	Commercial Packaged Refrigeration Equipment, Reach-in Freezer (One-Door Unit, <35 cu. ft.) - Tier 1 (Energy Star)	$200.00	1	$200.00	$200.00
412	O.FR - TIER2.<35.CI._._.N	Commercial Packaged Refrigeration Equipment, Reach-in Freezer (One-Door Unit, <35 cu. ft.) - Tier II	$157.50	1	$157.50	$157.50
411	O.FR - TIER1.>60.CI._._.N	Commercial Packaged Refrigeration Equipment, Reach-in Freezer (Three-Door Unit, >60 cu. ft.) - Tier 1 (Energy Star)	$300.00	1	$300.00	$300.00
414	O.FR - TIER2.>60.CI._._.N	Commercial Packaged Refrigeration Equipment, Reach-in Freezer (Three-Door Unit, >60 cu. ft.) - Tier II	$262.51	1	$262.51	$262.51
410	O.FR - TIER1.35-60.CI._._.N	Commercial Packaged Refrigeration Equipment, Reach-in Freezer (Two-Door Unit, 35 - 60 cu. ft.) - Tier 1 (Energy Star)	$250.00	1	$250.00	$250.00
413	O.FR - TIER2.35-60.CI._._.N	Commercial Packaged Refrigeration Equipment, Reach-in Freezer (Two-Door Unit, 35 - 60 cu. ft.) - Tier II	$210.01	1	$210.01	$210.01
403	O.RF - TIER1.<35.CI._._.N	Commercial Packaged Refrigeration Equipment, Reach-in Refrigerator (One-Door Unit, <35 cu. ft.) - Tier 1 (Energy Star)	$200.00	1	$200.00	$200.00
406	O.RF - TIER2.<35.CI._._.N	Commercial Packaged Refrigeration Equipment, Reach-in Refrigerator (One-Door Unit, <35 cu. ft.) - Tier II	$157.50	1	$157.50	$157.50
405	O.RF - TIER1.>60.CI._._.N	Commercial Packaged Refrigeration Equipment, Reach-in Refrigerator (Three-Door Unit, >60 cu. ft.) - Tier 1 (Energy Star)	$300.00	1	$300.00	$300.00
408	O.RF - TIER2.>60.CI._._.N	Commercial Packaged Refrigeration Equipment, Reach-in Refrigerator (Three-Door Unit, >60 cu. ft.) - Tier II	$262.51	1	$262.51	$262.51

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
404	O.RF - TIER1.35-60.CI._._.N	Commercial Packaged Refrigeration Equipment, Reach-in Refrigerator (Two-Door Unit, 35 - 60 cu. ft.) - Tier 1 (Energy Star)	$250.00	1	$250.00	$250.00
407	O.RF - TIER2.35-60.CI._._.N	Commercial Packaged Refrigeration Equipment, Reach-in Refrigerator (Two-Door Unit, 35 - 60 cu. ft.) - Tier II	$210.01	1	$210.01	$210.01
70	L.HID-DC._.CI._._.N	Daylight Controlled (HID - Continuous or stepped dimming)	$175.00	1	$175.00	$175.00
523	L.T8-DC.2-4x4.CI._._.N	Daylight Controlled (T8 fluorescent fixtures, 2 fixtures, 4 ft - 4 lamp, Continuous or stepped dimming)	$175.00	1	$175.00	$175.00
65	L.T8-DC.4-4x4.CI._._.N	Daylight Controlled (T8 fluorescent fixtures, 4 fixtures, 4 ft - 4 lamp, Continuous or stepped dimming)	$125.00	2	$125.00	$125.00
189	H.ECONOMIZER-DB._.CI._._.N	DB Economizers (air or water side) - Outdoor air differential dry bulb economizer	$1,540.00	2	$1,540.00	$1,540.00
188	H.DCV-2._.CI._._.N	Differential Demand Controlled Ventilation	$1,000.00	1	$1,000.00	$1,000.00
186	H.DEC._.CI._._.N	Differential Enthalpy Economizer Control System	$1,000.00	1	$1,000.00	$1,000.00
472	O.TRANSFORM.112.CI._.2002.N	Efficient Transformer, 112.5 kVA, 98.2% Eff.	$1,012.30	1	$1,012.30	$1,012.30
468	O.TRANSFORM.15.CI._.2002.N	Efficient Transformer, 15 kVA, 97% Eff.	$521.96	1	$521.96	$521.96
473	O.TRANSFORM.150.CI._.2002.N	Efficient Transformer, 150 kVA, 98.3% Eff.	$1,384.53	1	$1,384.53	$1,384.53
474	O.TRANSFORM.225.CI._.2002.N	Efficient Transformer, 225 or greater kVA, 98.5% Eff.	$2,506.49	1	$2,506.49	$2,506.49
469	O.TRANSFORM.30.CI._.2002.N	Efficient Transformer, 30 kVA, 97.5% Eff.	$535.67	1	$535.67	$535.67
470	O.TRANSFORM.45.CI._.2002.N	Efficient Transformer, 45 kVA, 97.7% Eff.	$797.18	1	$797.18	$797.18
471	O.TRANSFORM.75.CI._.2002.N	Efficient Transformer, 75 kVA, 98% Eff.	$902.63	1	$902.63	$902.63
97	O.EMS._.CI._._.N	Energy Management System (EMS) - control of HVAC and lighting loads	$1.20	1	$1.20	$1.20
393	H.ESTAR-ROOF._.CI._._.N	Energy Star Roofing	$0.18	1	$0.18	$0.18
96	L.T8-MIOC._.CI._._.N	Fluorescent Fixture - Manufacturer Integrated Occupancy Sensor (on/off control)	$55.16	1	$55.16	$55.16
46	L.T5.4x1.CI._._.N	Fluorescent Fixture (4 ft - 1 lamp T5)	$104.97	3	$104.97	$104.97
547	L.T8-HP.4x1.CI.2003._.N	Fluorescent Fixture (4 ft - 1 lamp T8 - High Performance)	$20.00	1	$20.00	$20.00

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
51	L.T8.4x1.CI._._.N	Fluorescent Fixture (4 ft - 1 lamp T8)	$35.00	4	$10.00	$80.00
60	L.T5.4x2.CI._._.N	Fluorescent Fixture (4 ft - 2 lamp T5)	$88.66	8	$45.00	$110.86
548	L.T8-HP.4x2.CI.2003._.N	Fluorescent Fixture (4 ft - 2 lamp T8 - High Performance)	$22.00	1	$22.00	$22.00
53	L.T8.4x2.CI._._.N	Fluorescent Fixture (4 ft - 2 lamp T8)	$48.89	9	$10.00	$105.00
28	L.T5.4x3.CI._._.N	Fluorescent Fixture (4 ft - 3 lamp T5)	$150.00	1	$150.00	$150.00
549	L.T8-HP.4x3.CI.2003._.N	Fluorescent Fixture (4 ft - 3 lamp T8 - High Performance)	$25.00	1	$25.00	$25.00
50	L.T8.4x3R.CI._._.N	Fluorescent Fixture (4 ft - 3 lamp T8 w/ reduced light output)	$22.00	4	$9.00	$40.00
19	L.T8.4x3.CI._._.N	Fluorescent Fixture (4 ft - 3 lamp T8)	$42.50	2	$5.00	$80.00
58	L.T5.4x4.CI._._.N	Fluorescent Fixture (4 ft - 4 lamp T5)	$150.00	3	$150.00	$150.00
550	L.T8-HP.4x4.CI.2003._.N	Fluorescent Fixture (4 ft - 4 lamp T8 - High Performance)	$27.00	1	$27.00	$27.00
57	L.T8.4x4.CI._._.N	Fluorescent Fixture (4 ft - 4 lamp T8)	$57.50	4	$5.00	$100.00
16	L.T8.8x1.CI._._.N	Fluorescent Fixture (8 ft - 1 lamp T8)	$125.00	1	$125.00	$125.00
41	L.T8.8x2.CI._._.N	Fluorescent Fixture (8 ft - 2 lamp T8)	$92.71	5	$11.78	$175.00
20	L.T8.8x3.CI._._.N	Fluorescent Fixture (8 ft - 3 lamp T8)	$130.00	1	$130.00	$130.00
22	L.T8.8x4.CI._._.N	Fluorescent Fixture (8 ft - 4 lamp T8)	$135.00	1	$135.00	$135.00
62	L.NHID-LT._.CI._._.N	Fluorescent Timer - Non HID lighting timer control	$10.50	1	$10.50	$10.50
183	H.GSHP-1._.CI.2003._.N	Ground Source Heat Pump (C/I application), EER 14.5 and COP 3.2	$3,270.00	2	$3,270.00	$3,270.00
182	H.GSHP-2._.CI.2003._.N	Ground Source Heat Pump (C/I application), EER 15.0 and COP 3.4	$3,270.00	1	$3,270.00	$3,270.00

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
397	O.HP-WH.287000.CI._._.N	Heat Pump Water Heater (Commercial unit)- Storage tank of 50 to 120 gallons.	$74,275.00	1	$74,275.00	$74,275.00
396	O.HP-WH.51000.CI._._.N	Heat Pump Water Heater (Commercial unit)- Storage tank of 50 to 120 gallons.	$5,375.00	1	$5,375.00	$5,375.00
72	L.T5HO-HB.4x3.CI._._.N	High Bay Fluorescent Lighting - T5HO	$150.00	1	$150.00	$150.00
71	L.T8HO-HB.4x4.CI._._.N	High Bay Fluorescent Lighting - T8HO	$150.00	1	$150.00	$150.00
466	A.WATERHEATER-GAS._.CI.2004._.N	High Efficiency Gas Water Heater, EF>0.61	$61.00	1	$61.00	$61.00
566	L.T8-HP-HE-LG.4x1.CI.2003._.N	High efficiency low glare recessed or surface mounted fluorescent fixture (4ft - 1-lamp T8- High Performance)	$50.00	1	$50.00	$50.00
561	L.T8-HE-LG.4x1.CI.2003._.N	High efficiency low glare recessed or surface mounted fluorescent fixture (4ft - 1-lamp T8)	$35.00	1	$35.00	$35.00
567	L.T8-HP-HE-LG.4x2.CI.2003._.N	High efficiency low glare recessed or surface mounted fluorescent fixture (4ft - 2-lamp T8- High Performance)	$52.50	1	$52.50	$52.50
570	L.T8-HP-HE-LG-TANDEM.4x2.CI.2003._.N	High efficiency low glare recessed or surface mounted fluorescent fixture (4ft - 2-lamp T8 Tandem wired - High Performance)	$52.50	1	$52.50	$52.50
569	L.T8-HE-LG-TANDEM.4x2.CI.2003._.N	High efficiency low glare recessed or surface mounted fluorescent fixture (4ft - 2-lamp T8 Tandem wired)	$52.50	1	$52.50	$52.50
564	L.T5-HE-LG.4x2.CI.2003._.N	High efficiency low glare recessed or surface mounted fluorescent fixture (4ft - 2-lamp T8)	$35.00	1	$35.00	$35.00
562	L.T8-HE-LG.4x2.CI.2003._.N	High efficiency low glare recessed or surface mounted fluorescent fixture (4ft - 2-lamp T8)	$35.00	1	$35.00	$35.00
565	L.T5-HE-LG.4x3.CI.2003._.N	High efficiency low glare recessed or surface mounted fluorescent fixture (4ft - 3-lamp T5)	$80.00	1	$80.00	$80.00
568	L.T8-HP-HE-LG.4x3.CI.2003._.N	High efficiency low glare recessed or surface mounted fluorescent fixture (4ft - 3-lamp T8- High Performance)	$55.00	1	$55.00	$55.00
563	L.T8-HE-LG.4x3.CI.2003._.N	High efficiency low glare recessed or surface mounted fluorescent fixture (4ft - 3-lamp T8)	$35.00	1	$35.00	$35.00

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
528	H.HEOILBURNER._.CI.2004._.N	High Efficiency Oil Burner (high-e DC brushless comb air blower and piston-type fuel pump)	$430.72	1	$430.72	$430.72
579	L.T5-HE-INDIRECT-HO.4x1.CI.2003._.N	High efficiency pendant or wall-mounted indirect fluorescent fixture (4ft - 1-lamp T5 - High Output)	$80.00	1	$80.00	$80.00
577	L.T5-HE-INDIRECT.4x1.CI.2003._.N	High efficiency pendant or wall-mounted indirect fluorescent fixture (4ft - 1-lamp T5)	$65.00	1	$65.00	$65.00
574	L.T8-HP-HE-INDIRECT.4x1.CI.2003._.N	High efficiency pendant or wall-mounted indirect fluorescent fixture (4ft - 1-lamp T8- High Performance)	$75.00	1	$75.00	$75.00
571	L.T8-HE-INDIRECT.4x1.CI.2003._.N	High efficiency pendant or wall-mounted indirect fluorescent fixture (4ft - 1-lamp T8)	$55.00	1	$55.00	$55.00
580	L.T5-HE-INDIRECT-HO.4x2.CI.2003._.N	High efficiency pendant or wall-mounted indirect fluorescent fixture (4ft - 2-lamp T5 - High Output)	$95.00	1	$95.00	$95.00
578	L.T5-HE-INDIRECT.4x2.CI.2003._.N	High efficiency pendant or wall-mounted indirect fluorescent fixture (4ft - 2-lamp T5)	$75.00	1	$75.00	$75.00
575	L.T8-HP-HE-INDIRECT.4x2.CI.2003._.N	High efficiency pendant or wall-mounted indirect fluorescent fixture (4ft - 2-lamp T8- High Performance)	$90.00	1	$90.00	$90.00
572	L.T8-HE-INDIRECT.4x2.CI.2003._.N	High efficiency pendant or wall-mounted indirect fluorescent fixture (4ft - 2-lamp T8)	$65.00	1	$65.00	$65.00
576	L.T8-HP-HE-INDIRECT.4x3.CI.2003._.N	High efficiency pendant or wall-mounted indirect fluorescent fixture (4ft - 3-lamp T8- High Performance)	$102.50	1	$102.50	$102.50
573	L.T8-HE-INDIRECT.4x3.CI.2003._.N	High efficiency pendant or wall-mounted indirect fluorescent fixture (4ft - 3-lamp T8)	$75.00	1	$75.00	$75.00
556	L.T8-HP-HE-RECESSED.4x1.CI.2003._.N	High efficiency recessed or surface mounted fluorescent fixture (4ft - 1-lamp T8- High Performance)	$50.00	1	$50.00	$50.00
551	L.T8-HE-RECESSED.4x1.CI.2003._.N	High efficiency recessed or surface mounted fluorescent fixture (4ft - 1-lamp T8)	$30.00	1	$30.00	$30.00
554	L.T5-HE-RECESSED.4x2.CI.2003._.N	High efficiency recessed or surface mounted fluorescent fixture (4ft - 2-lamp T5)	$80.00	1	$80.00	$80.00
559	L.T8-HE-RECESSED-TANDEM.4x2.CI.2003._.N	High efficiency recessed or surface mounted fluorescent fixture (4ft - 2-lamp T8 - Tandem wired)	$30.00	1	$30.00	$30.00

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
557	L.T8-HP-HE-RECESSED.4x2.CI.2003._.N	High efficiency recessed or surface mounted fluorescent fixture (4ft - 2-lamp T8- High Performance)	$52.50	1	$52.50	$52.50
560	L.T8-HP-HE-RECESSED-TANDEM.4x2.CI.2003._.N	High efficiency recessed or surface mounted fluorescent fixture (4ft - 2-lamp T8 Tandem wired - High Performance)	$52.50	1	$52.50	$52.50
552	L.T8-HE-RECESSED.4x2.CI.2003._.N	High efficiency recessed or surface mounted fluorescent fixture (4ft - 2-lamp T8)	$30.00	1	$30.00	$30.00
555	L.T5-HE-RECESSED.4x3.CI.2003._.N	High efficiency recessed or surface mounted fluorescent fixture (4ft - 3-lamp T5)	$100.00	1	$100.00	$100.00
558	L.T8-HP-HE-RECESSED.4x3.CI.2003._.N	High efficiency recessed or surface mounted fluorescent fixture (4ft - 3-lamp T8- High Performance)	$55.00	1	$55.00	$55.00
553	L.T8-HE-RECESSED.4x3.CI.2003._.N	High efficiency recessed or surface mounted fluorescent fixture (4ft - 3-lamp T8)	$30.00	1	$30.00	$30.00
73	L.HPS-E.150.CI._._.N	High Pressure Sodium Fixtures - Exterior Lighting	$30.00	1	$30.00	$30.00
61	L.T8-IOCHL._.CI._.2002.N	Integrated Fluorescent Occupancy Controlled Hi-Low Switching	$137.00	1	$137.00	$137.00
546	L.T8-IOCHL._.CI.2003._.N	Integrated Fluorescent Occupancy Controlled Hi-Low Switching	$75.00	1	$75.00	$75.00
1	L.LEDEXIT._.CI._._.N	LED Exit Signs (Baseline = CFLs) - Energy Star (all sizes)	$1.07	3	($16.80)	$10.00
6	L.LEDEXIT._.CI._._.R	LED Exit Signs (Baseline = Incandescent)	$30.00	1	$30.00	$30.00
2	L.LEDEXIT.3.CI._._.N	LED Exit Signs (Baseline CFLs) - Energy Star (<3 watt LED)	$10.00	1	$10.00	$10.00
4	L.LEDEXIT.8.CI._._.N	LED Exit Signs (Baseline CFLs) - Energy Star (7-8 watt LED)	$10.00	1	$10.00	$10.00
84	L.TL._.CI._._.N	LED Traffic Lights - (complete unit replacement)	$91.00	2	$91.00	$91.00
88	L.TL-GA._.CI._._.N	LED Traffic Signals - Green Arrow Replacement	$151.00	1	$151.00	$151.00
85	L.TL-GB._.CI._._.N	LED Traffic Signals - Green Ball Replacement	$249.00	1	$249.00	$249.00
90	L.TL-RA._.CI._._.N	LED Traffic Signals - Red Arrow Replacement	$99.00	1	$99.00	$99.00
87	L.TL-RB._.CI._._.N	LED Traffic Signals - Red Ball Replacement Kit	$134.00	1	$134.00	$134.00
89	L.TL-YA._.CI._._.N	LED Traffic Signals - Yellow Arrow Replacement	$99.00	1	$99.00	$99.00
86	L.TL-YB._.CI._._.N	LED Traffic Signals - Yellow Ball Replacement	$154.00	1	$154.00	$154.00
204	M.ODP1200.1.5.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$86.00	1	$86.00	$86.00

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
203	M.ODP1200.1.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$35.00	1	$35.00	$35.00
209	M.ODP1200.10.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$92.00	1	$92.00	$92.00
218	M.ODP1200.100.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$124.00	1	$124.00	$124.00
219	M.ODP1200.125.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$1,106.00	1	$1,106.00	$1,106.00
210	M.ODP1200.15.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$114.00	1	$114.00	$114.00
220	M.ODP1200.150.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$630.00	1	$630.00	$630.00
205	M.ODP1200.2.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$92.00	1	$92.00	$92.00
221	M.ODP1200.200.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$598.00	1	$598.00	$598.00
212	M.ODP1200.25.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$227.00	1	$227.00	$227.00
206	M.ODP1200.3.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$40.00	1	$40.00	$40.00
213	M.ODP1200.30.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$214.00	1	$214.00	$214.00
214	M.ODP1200.40.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$495.00	1	$495.00	$495.00
207	M.ODP1200.5.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$50.00	1	$50.00	$50.00
215	M.ODP1200.50.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$382.00	1	$382.00	$382.00
216	M.ODP1200.60.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$259.00	1	$259.00	$259.00
208	M.ODP1200.7.5.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$69.00	1	$69.00	$69.00
217	M.ODP1200.75.CI._._.N	Motors - Open Drip-Proof (ODP) - 1200 RPM	$35.00	1	$35.00	$35.00
223	M.ODP1800.1.5.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$86.00	1	$86.00	$86.00
222	M.ODP1800.1.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$35.00	1	$35.00	$35.00
228	M.ODP1800.10.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$92.00	1	$92.00	$92.00
237	M.ODP1800.100.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$124.00	1	$124.00	$124.00
238	M.ODP1800.125.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$1,106.00	1	$1,106.00	$1,106.00
229	M.ODP1800.15.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$114.00	1	$114.00	$114.00
239	M.ODP1800.150.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$630.00	1	$630.00	$630.00
224	M.ODP1800.2.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$92.00	1	$92.00	$92.00

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
240	M.ODP1800.200.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$598.00	1	$598.00	$598.00
231	M.ODP1800.25.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$227.00	1	$227.00	$227.00
225	M.ODP1800.3.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$40.00	1	$40.00	$40.00
232	M.ODP1800.30.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$214.00	1	$214.00	$214.00
233	M.ODP1800.40.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$495.00	1	$495.00	$495.00
226	M.ODP1800.5.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$50.00	1	$50.00	$50.00
234	M.ODP1800.50.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$382.00	1	$382.00	$382.00
235	M.ODP1800.60.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$259.00	1	$259.00	$259.00
227	M.ODP1800.7.5.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$69.00	1	$69.00	$69.00
236	M.ODP1800.75.CI._._.N	Motors - Open Drip-Proof (ODP) - 1800 RPM	$35.00	1	$35.00	$35.00
242	M.ODP3600.1.5.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$55.08	1	$55.08	$55.08
241	M.ODP3600.1.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$35.00	1	$35.00	$35.00
247	M.ODP3600.10.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$92.00	1	$92.00	$92.00
256	M.ODP3600.100.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$124.00	1	$124.00	$124.00
257	M.ODP3600.125.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$1,106.00	1	$1,106.00	$1,106.00
248	M.ODP3600.15.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$114.00	1	$114.00	$114.00
258	M.ODP3600.150.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$630.00	1	$630.00	$630.00
243	M.ODP3600.2.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$92.00	1	$92.00	$92.00
259	M.ODP3600.200.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$598.00	1	$598.00	$598.00
250	M.ODP3600.25.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$227.00	1	$227.00	$227.00
244	M.ODP3600.3.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$40.00	1	$40.00	$40.00
251	M.ODP3600.30.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$214.00	1	$214.00	$214.00
252	M.ODP3600.40.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$495.00	1	$495.00	$495.00
245	M.ODP3600.5.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$50.00	1	$50.00	$50.00
253	M.ODP3600.50.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$382.00	1	$382.00	$382.00

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
254	M.ODP3600.60.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$259.00	1	$259.00	$259.00
246	M.ODP3600.7.5.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$69.00	1	$69.00	$69.00
255	M.ODP3600.75.CI._._.N	Motors - Open Drip-Proof (ODP) - 3600 RPM	$35.00	1	$35.00	$35.00
261	M.TEFC1200.1.5.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$86.00	1	$86.00	$86.00
260	M.TEFC1200.1.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$35.00	1	$35.00	$35.00
266	M.TEFC1200.10.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$92.00	1	$92.00	$92.00
275	M.TEFC1200.100.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$124.00	1	$124.00	$124.00
276	M.TEFC1200.125.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$1,106.00	1	$1,106.00	$1,106.00
267	M.TEFC1200.15.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$114.00	1	$114.00	$114.00
277	M.TEFC1200.150.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$630.00	1	$630.00	$630.00
262	M.TEFC1200.2.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$92.00	1	$92.00	$92.00
278	M.TEFC1200.200.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$598.00	1	$598.00	$598.00
269	M.TEFC1200.25.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$227.00	1	$227.00	$227.00
263	M.TEFC1200.3.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$40.00	1	$40.00	$40.00
270	M.TEFC1200.30.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$214.00	1	$214.00	$214.00
271	M.TEFC1200.40.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$495.00	1	$495.00	$495.00
264	M.TEFC1200.5.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$50.00	1	$50.00	$50.00
272	M.TEFC1200.50.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$382.00	1	$382.00	$382.00
273	M.TEFC1200.60.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$259.00	1	$259.00	$259.00
265	M.TEFC1200.7.5.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$69.00	1	$69.00	$69.00
274	M.TEFC1200.75.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1200 RPM	$35.00	1	$35.00	$35.00
280	M.TEFC1800.1.5.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$86.00	2	$86.00	$86.00
279	M.TEFC1800.1.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$35.00	2	$35.00	$35.00
323	M.TEFC1800.10.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$92.00	2	$92.00	$92.00
294	M.TEFC1800.100.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$124.00	2	$124.00	$124.00

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
582	M.TEFC1800.125.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$1,106.00	2	$1,106.00	$1,106.00
324	M.TEFC1800.15.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$114.00	2	$114.00	$114.00
333	M.TEFC1800.150.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$630.00	2	$630.00	$630.00
281	M.TEFC1800.2.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$92.00	2	$92.00	$92.00
297	M.TEFC1800.200.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$598.00	2	$598.00	$598.00
326	M.TEFC1800.25.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$227.00	2	$227.00	$227.00
282	M.TEFC1800.3.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$40.00	2	$40.00	$40.00
327	M.TEFC1800.30.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$214.00	2	$214.00	$214.00
328	M.TEFC1800.40.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$495.00	2	$495.00	$495.00
283	M.TEFC1800.5.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$50.00	2	$50.00	$50.00
329	M.TEFC1800.50.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$382.00	2	$382.00	$382.00
292	M.TEFC1800.60.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$259.00	2	$259.00	$259.00
322	M.TEFC1800.7.5.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$69.00	2	$69.00	$69.00
331	M.TEFC1800.75.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 1800 RPM	$35.00	2	$35.00	$35.00
299	M.TEFC3600.1.5.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$66.45	1	$66.45	$66.45
298	M.TEFC3600.1.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$35.00	1	$35.00	$35.00
304	M.TEFC3600.10.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$92.00	1	$92.00	$92.00
313	M.TEFC3600.100.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$124.00	1	$124.00	$124.00
314	M.TEFC3600.125.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$1,106.00	1	$1,106.00	$1,106.00
305	M.TEFC3600.15.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$114.00	1	$114.00	$114.00
315	M.TEFC3600.150.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$630.00	1	$630.00	$630.00
300	M.TEFC3600.2.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$92.00	1	$92.00	$92.00
316	M.TEFC3600.200.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$598.00	1	$598.00	$598.00
307	M.TEFC3600.25.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$227.00	1	$227.00	$227.00
301	M.TEFC3600.3.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$40.00	1	$40.00	$40.00

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
308	M.TEFC3600.30.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$214.00	1	$214.00	$214.00
309	M.TEFC3600.40.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$495.00	1	$495.00	$495.00
302	M.TEFC3600.5.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$50.00	1	$50.00	$50.00
310	M.TEFC3600.50.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$382.00	1	$382.00	$382.00
311	M.TEFC3600.60.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$259.00	1	$259.00	$259.00
303	M.TEFC3600.7.5.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$69.00	1	$69.00	$69.00
312	M.TEFC3600.75.CI._._.N	Motors - Totally Enclosed Fan-Cooled (TEFC) - 3600 RPM	$35.00	1	$35.00	$35.00
83	L.MH.1200.CI._._.N	Non-Pulse Start Metal Halide Greater than 1,200 Watts and 91 LPW	$125.00	1	$125.00	$125.00
69	L.HID-OC._.CI._._.N	Occupancy Sensors (HID fixture - Hi-Low Switching)	$150.00	1	$150.00	$150.00
67	L.T8-OCHL._.CI._._.N	Occupancy Sensors (T8 fluorescent fixture - Hi-Low Switching)	$60.00	1	$60.00	$60.00
63	L.T8-OC._.CI._._.N	Occupancy Sensors (T8 fluorescent fixtures - On/Off Control)	$35.00	2	$35.00	$35.00
113	H.PTAC.<7000.CI.2003._.N	Packaged Terminal AC or HP - 0.58 tons (<7,000 Btu/h)	$62.00	3	$45.00	$70.50
114	H.PTAC.7000-9500.CI.2003._.N	Packaged Terminal AC or HP - 0.75 tons (7,000 - 9,500 Btu/h)	$83.25	3	$67.50	$91.13
115	H.PTAC.9500-15000.CI.2003._.N	Packaged Terminal AC or HP - 1.00 tons (9,500 - 15,000 Btu/h)	$111.00	3	$90.00	$121.50
111	H.PTAC.>15000.CI.2003._.N	Packaged Terminal AC or HP - 1.25 tons (>15,000 Btu/h)	$138.75	3	$112.50	$151.88
435	P.MILK-PRECOOL.<15000.CI._._.N	Plate Pre-coolers for Raw Milk (<15,000 lbs/day milk)	$3,700.00	2	$3,400.00	$4,000.00
438	P.MILK-PRECOOL.>35000.CI._._.N	Plate Pre-coolers for Raw Milk (>35,000 lbs/day milk)	$8,000.00	1	$8,000.00	$8,000.00
436	P.MILK-PRECOOL.15000-25000.CI._._.N	Plate Pre-coolers for Raw Milk (15,000 - 25,000 lbs/day milk)	$6,500.00	1	$6,500.00	$6,500.00
437	P.MILK-PRECOOL.25000-35000.CI._._.N	Plate Pre-coolers for Raw Milk (25,000 - 35,000 lbs/day milk)	$8,000.00	1	$8,000.00	$8,000.00
78	L.PSMH-E.100.CI._._.N	Pulse Start Metal Halide Fixtures For Exterior Use (100 watt)	$37.50	1	$37.50	$37.50
79	L.PSMH-E.150.CI._._.N	Pulse Start Metal Halide Fixtures For Exterior Use (150 watt)	$40.00	2	$40.00	$40.00
80	L.PSMH-E.175.CI._._.N	Pulse Start Metal Halide Fixtures For Exterior Use (175 watt)	$40.00	1	$40.00	$40.00
81	L.PSMH-E.250.CI._._.N	Pulse Start Metal Halide Fixtures For Exterior Use (250 watt)	$42.00	1	$42.00	$42.00
74	L.PSMH-I.100.CI._._.N	Pulse Start Metal Halide Fixtures For Interior Use (100 watt)	$37.50	1	$37.50	$37.50

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
77	L.PSMH-I.250.CI._._.N	Pulse Start Metal Halide Fixtures For Interior Use (250 watt)	$42.00	2	$42.00	$42.00
76	L.PSMH-I.400.CI._._.N	Pulse Start Metal Halide Fixtures For Interior Use (400 watt)	$50.00	1	$50.00	$50.00
14	L.CFL.13.CI._._.N	Screw-in CFLs - (Non-Residential)	$7.25	1	$7.25	$7.25
440	P.AG-SCROLLCOMP._.CI._._.N	Scroll Compressors, AG	$1,648.00	1	$1,648.00	$1,648.00
187	H.DCV-1._.CI._._.N	Single Demand Controlled Ventilation	$500.00	1	$500.00	$500.00
529	H.THERMOELEC-COOL._.CI.2004._.N	Thermoelectric Solid State Cooling System (Min COP = 4.0, 1200 watts of heat removal)	$4,394.00	1	$4,394.00	$4,394.00
533	H.VSD-HIST-NC._.CI._._.N	Variable Speed Drive - Average HP and end-use application for the NC program for historical installations based on program typical information (from the OPC Database). Average motor size is 10 HP, installed in HVAC fan applications.	$1,084.00	1	$1,084.00	$1,084.00
532	P.VSD-HIST-SEC._.CI._._.N	Variable Speed Drive - Weighted average HP and end-use application for the SEC program for historical installations based on program typical information. Average motor size is 32 HP, with 30% HVAC and 70% Other (or pump) applications.	$2,140.00	1	$2,140.00	$2,140.00
369	H.VSD-AHU._.CI._._.N	Variable Speed Drive (replace constant speed control) - AHU Fan	$80.00	7	$80.00	$80.00
373	P.VSD-OTHER._.CI._._.N	Variable Speed Drive (replace constant speed control) - Other Applications	$80.00	4	$80.00	$80.00
370	H.VSD-PUMP-C._.CI._._.N	Variable Speed Drive (replace constant speed control) - Pump, Chilled Water	$80.00	2	$80.00	$80.00
371	H.VSD-PUMP-H._.CI._._.N	Variable Speed Drive (replace constant speed control) - Pump, Heating	$80.00	2	$80.00	$80.00
432	O.VMOS._.CI._._.N	Vending Machine Occupancy Sensor	$168.00	2	$168.00	$168.00
197	H.CHILLER-WC-CENT.150-299.CI._._.N	Water Cooled Chiller, Centrifugal 150- 299 tons, IPLV kW/ton <0.52	$26.67	1	$26.67	$26.67
198	H.CHILLER-WC-CENT.300-2000.CI._._.N	Water Cooled Chiller, Centrifugal 300 - 2000 tons, IPLV kW/ton <0.44	$45.33	1	$45.33	$45.33
199	H.CHILLER-WC-SCREW.>150.CI._._.N	Water Cooled Chiller, Rotary Screw >150 tons, IPLV kW/ton <0.49	$20.00	1	$20.00	$20.00

ID	Measure Name	Measure Description	Average Incremental Cost	Count	Minimum	Maximum
147	H.RTU-WS-TIER2.11-20.CI.2003._.N	Water-Source Unitary or Split System HVAC >11.25 to 20 tons - AC or HP (Tier 2)	$146.50	2	$101.00	$192.00
137	H.RTU-WS-TIER1.<5.CI.2003._.N	Water-Source Unitary or Split System HVAC < 5.4 tons - AC or HP (Tier 1)	$62.00	2	$0.00	$124.00
143	H.RTU-WS-TIER2.<5.CI.2003._.N	Water-Source Unitary or Split System HVAC < 5.4 tons - AC or HP (Tier 2)	$190.00	2	$101.00	$279.00
141	H.RTU-WS-TIER1.11-20.CI.2003._.N	Water-Source Unitary or Split System HVAC >11.25 to 20 tons - AC or HP (Tier 1)	$42.67	2	$0.00	$85.33
145	H.RTU-WS-TIER2.5-11.CI.2003._.N	Water-Source Unitary or Split System HVAC >5.4 to 11.25 tons - AC of HP (Tier 2)	$177.07	2	$101.00	$253.13
155	H.RTU-WS-FEMP.5-11.CI.1994.2002.N	Water-Source Unitary or Split System HVAC >5.4 to 11.25 tons - AC or HP (FEMP)	$112.50	1	$112.50	$112.50
156	H.RTU-WS-TIER1.5-11.CI.2003._.N	Water-Source Unitary or Split System HVAC >5.4 to 11.25 tons - AC or HP (Tier 1)	$28.13	4	$0.00	$112.50
100	H.RAC.<6000.CI.2003._.N	Window Unit Air Conditioners; <6,000 Btu/h	$35.00	1	$35.00	$35.00
104	H.RAC.>20000.CI.2003._.N	Window Unit Air Conditioners; >20,000 Btu/h	$125.00	1	$125.00	$125.00
103	H.RAC.14000-19999.CI.2003._.N	Window Unit Air Conditioners; 14,000 - 19,999 Btu/h	$100.00	1	$100.00	$100.00
101	H.RAC.6000-7999.CI.2003._.N	Window Unit Air Conditioners; 6,000 - 7,999 Btu/h	$37.00	1	$37.00	$37.00
102	H.RAC.8000-13999.CI.2003._.N	Window Unit Air Conditioners; 8,000 - 13,999 Btu/h	$100.00	1	$100.00	$100.00
588	H.WINDOW(HEAT-ONLY)._.CI._._.N	Windows - High efficiency windows for C/I applications (heating savings only).	$4.00	1	$4.00	$4.00
380	H.WINDOW._.CI._._.N	Windows - High efficiency windows for C/I applications.	$4.00	4	$4.00	$4.00

1.6 Market Barriers Assessment

This section will provide an overall summary of key barriers to the specification and purchase of energy efficiency equipment and energy-efficient system designs. It will begin with data on the state of the key barriers and the program's impact on those barriers. It will then suggest some approaches for improving the program's impact on the key barriers.

1.6.1 Has the Program Reduced the Market Barriers?

This section examines the extent to which it appears that the program has reduced market barriers.

Trade Ally Findings

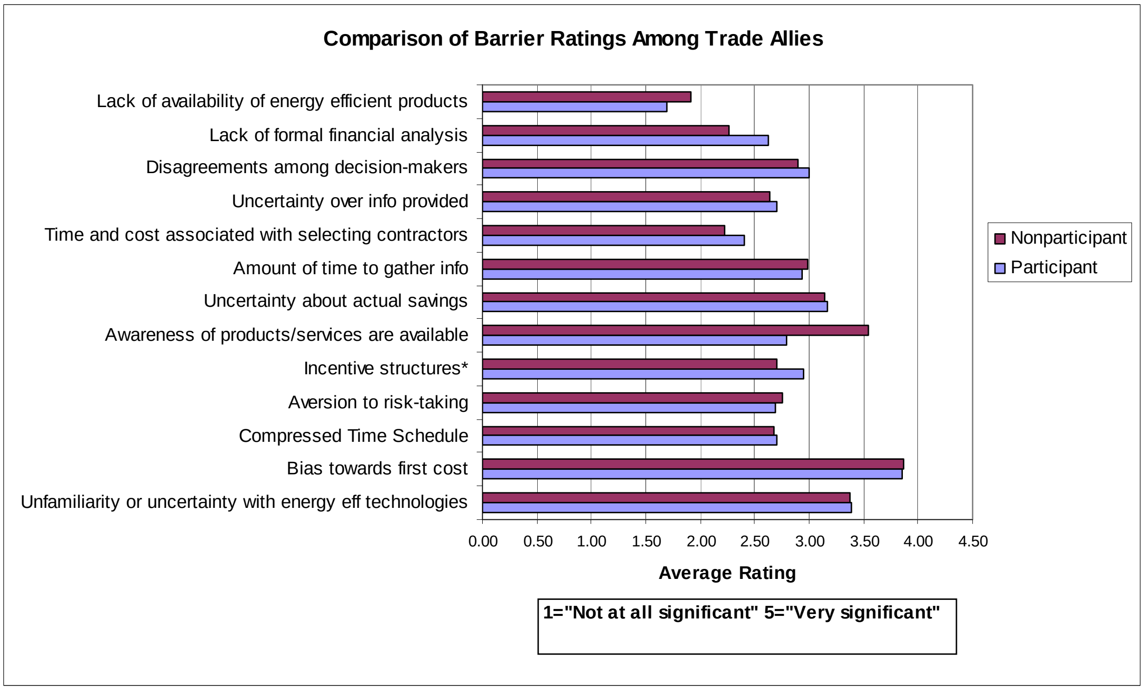
Trade allies were asked a series of questions that focused on specific obstacles customers faced. Based on the average ratings from trade allies, the biggest market barriers are the bias towards first cost and a lack of awareness, and perhaps availability, of energy-efficient products and services (Table 1-48). These ratings are virtually the same among both participating and nonparticipating trade allies. The only significant difference was that participating trade allies viewed the complexity of the incentive structure as a higher barrier to program implementation compared to nonparticipants.

Table 1-48. Summary of Ratings of Market Barriers for Trade Allies

Market Barriers	Participants (N=70)	Nonparticipants (N=62)
Bias toward first cost	3.85	3.86
Unfamiliarity or uncertainty with energy-efficient technologies	3.38	3.37
Lack of availability of EE products and services	3.38	3.37
Uncertainty over savings	3.17	3.14
Disagreements between decision makers	3.00	2.90
Incentive structures and priorities for engineers	2.95	2.70
Amount of time it takes to acquire information	2.93	2.98
Awareness of which products and services are available	2.79	3.55
Compressed time schedules	2.71	2.67
Uncertainty over information provided by firms	2.71	2.64
Aversion to perceived risk-taking	2.70	2.75
Lack of access to financing	2.63	2.27
Time and cost associated with selecting contractors	2.41	2.22
Lack of use of formal financial analyses	1.69	1.92

Mean where 1=”Not at all important” and 5=”Very important”.

Figure 1-22. Comparison of Barrier Ratings by Trade Ally Type



Before asking about the specific barriers discussed above, we asked the trade allies an open-ended question about the barriers they thought their customers faced to participating in the C&I Program. Some trade allies (14%) did not believe there were any customer barriers to participation. The biggest barriers to program participation they cited unprompted were the lack of program awareness and the high initial first costs, as summarized in Table 1-49.

Table 1-49. Major Barriers to Program Participation Cited Unprompted by Trade Allies

Barrier Mentioned	Frequency	% Mentioned
Lack of education or awareness	48	26%
First costs	36	19%
None	26	14%
Specific program requirements	14	7%
Poor utility administration	12	6%
Takes too long to complete	10	5%
Incentives are too low	8	4%
Confusing rules or inconsistent administration	8	4%
Not remaining in building long enough to reap benefits	7	4%
Too much work or hassle	7	4%
No incentive for contractors	5	3%
Customers not interested	5	3%
Other	1	1%
Total	**187**	

End User Findings

The end user surveys also evaluated various market barriers. Similar to the trade allies, the customers also viewed the bias towards first cost as a significant market barrier, especially among participating customers. Participating customers were also significantly more likely to view the internal disagreements among organizational decision-makers, the lack of availability of energy-efficient technologies, and the time and cost associated with measure installation as bigger barriers compared to nonparticipants. (See Table 1-50 and Figure 1-23.)

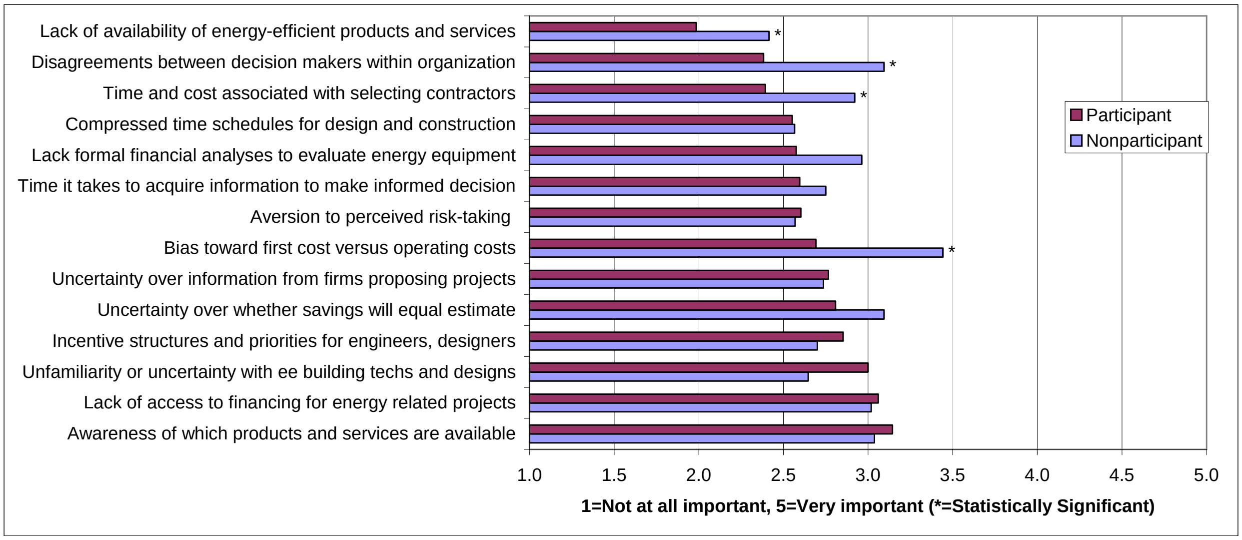
Table 1-50. Summary of Ratings of Program Barriers by End Users

Barrier	Participant	Nonparticipant
Lack of access to financing for energy efficiency related projects	3.16	2.89
Bias toward first cost versus operating costs	3.14	2.82
Uncertainty over whether actual savings will be equal to or greater than expected	2.96	2.77
Awareness of which products and services are available	2.95	3.21
Incentive structures and priorities for engineers, designers	2.87	2.67
Uncertainty over information provided by firms proposing efficiency improvements	2.85	2.57
Lack of use of formal financial analyses to evaluate energy efficiency projects	2.82	2.61
Disagreements between decision makers within your organization	2.80	2.50
Unfamiliarity or uncertainty with energy-efficient building	2.79	2.87
The time and cost associated with selecting contractors	2.68	2.49
Compressed time schedules for design and construction	2.55	2.48
Aversion to perceived risk-taking despite the proven reliability	2.52	2.55
Amount of time it takes to acquire enough information to make a decision	2.48	2.75
Lack of availability of energy-efficient products and services	2.00	2.35

Mean where 1=”Not at all important” and 5=”Very important”.

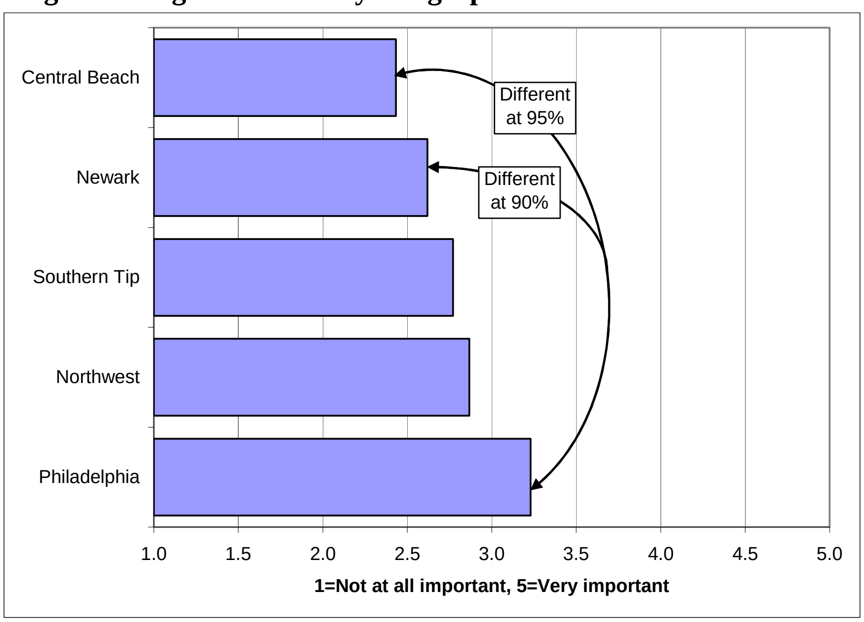
Figure 1-23 highlights these customer differences regarding market barriers.

Figure 1-23. Comparison of Barrier Ratings by Customer Type



Further examination of these barrier ratings revealed that customers had differing perceptions of barriers based on geographic location. As the following figure illustrates, customers in the Philadelphia region tended to rate barriers much higher, on average, compared to customers in the Central Beach or Newark regions.

Figure 1-24. Average Ranking of Barriers by Geographic Location



Trade Ally Awareness

The participating trade allies were also asked to evaluate various program strategies, as a further way to identify areas for program improvement. Overall, the participating trade allies viewed these strategies as not particularly effective, with average ratings in the neutral range or lower. The least effective strategy, according to these trade allies, was the “coordinated and consistent marketing,” with an effectiveness rating of 2.78 where 1 is “Not at all successful” and 5 is “Very successful”. Participants did view the “consistent efficiency and incentive levels” as slightly more effective with a mean rating of 3.21.

Table 1-51. Average Participant Ratings for Program Strategies

Strategies	Participant Mean Score	Number Responding
Prescriptive incentives and custom measure incentives	3.25	62
Consistent efficiency and incentive levels	3.21	64
Specialized technical assistance for small commercial	3.06	53
Technical support for the energy code	3.02	52
Program emphasis on customer-initiated events	3.00	61
Design support and technical assistance to developers	2.94	54
Coordinated and consistent marketing	2.78	62

Mean where 1 = “Not at all successful” and 5 = “Very successful”.

Consistent with the previous findings, participating trade allies were significantly more likely to be aware of the New Jersey SmartStart Buildings Program compared to nonparticipating trade allies, as shown in Table 1-52.

It is important to note that most trade allies, regardless of their participation status, are not familiar with the range of services offered by this program.

Table 1-52. Awareness of Program and Program Services Among Trade Allies

Participation Status	Participant (N=73)	Nonparticipant (N=66)
Overall Awareness	4.02	2.25
Technical Assistance	2.45	1.56
New Construction Design Services	2.28	1.62
Compressed Air Studies	2.19	1.23
Support Commercial Energy Code Requirements	2.10	1.35
Building Commissioning Services	1.98	1.53
Training in Commercial Energy Code Requirements	1.94	1.31
Chiller Optimization Services	1.84	1.29

Mean where 1=Not at all familiar, 5=very familiar

Lack of program awareness was the single biggest reason given for not participating in this program, cited by 85 percent of these trade allies as shown in Table 1-53.

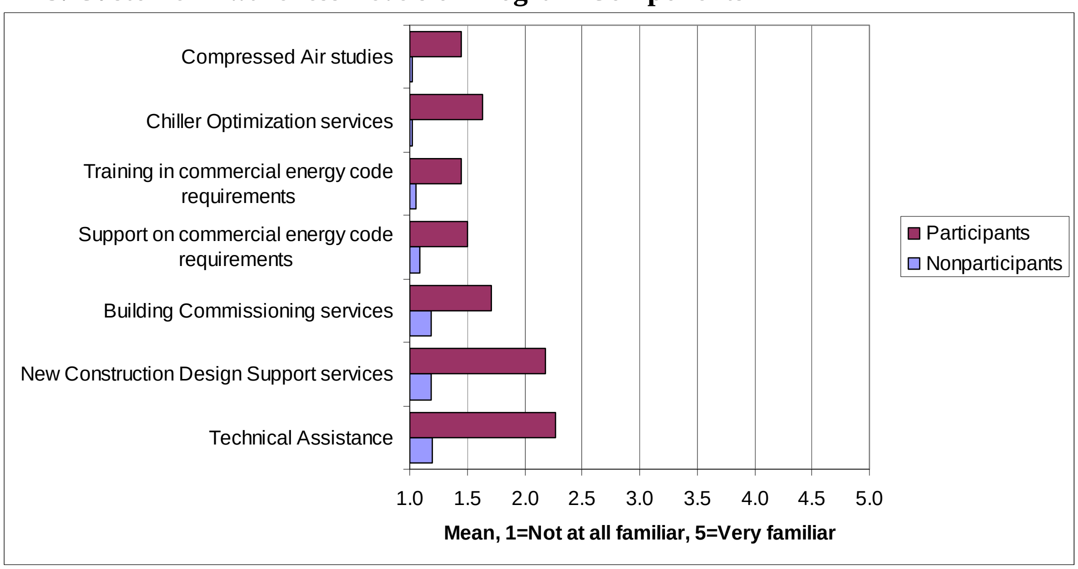
Table 1-53. Reasons for Not Participating in the Program

Reason Mentioned	N=65	% Mentioning
Unaware of program	55	85%
Not part of my business	6	9%
Tried but application denied	2	3%
Too much paperwork	1	2%
Other	1	2%
Total	**65**	**100%**

End User Familiarity with Program Services

Participating end users are significantly more familiar with the program's services than nonparticipants. However, the familiarity levels among end users are still relatively low as shown in Figure 1-25.

Figure 1-25. Customer Awareness Levels of Program Components



Program Effectiveness

The participating trade allies indicated that the New Jersey SmartStart Buildings program is not particularly effective in reducing market barriers. The average effectiveness rating among trade allies was 3.32 on a five-point scale where 1 is "very ineffective" and 5 is "very effective, which suggests that the rating is slightly above neutral. Clearly, the trade allies are split as to whether the program is having any impact in the New Jersey energy efficiency market.

The participating trade allies also provided additional insights regarding the rationale behind their ratings. Note that 29 respondents (42%) provided positive feedback, while the majority (58%) offered negative reasons for their overall ratings. Table 1-54 displays these results.

Table 1-54. Summary of the Reasons for Trade Ally Effectiveness Ratings

Reason Cited	Number Responding	Percentage Responding
Program is promoting energy efficiency	24	37%
Program is too much of a hassle	12	18%
Program needs more marketing	15	23%
Program has not helped me generated work	3	5%
Incentive levels are too low	5	8%
Incentive levels are just fine	6	9%
Total	**65**	**100%**

Barriers to Schools Participation and Best Practices

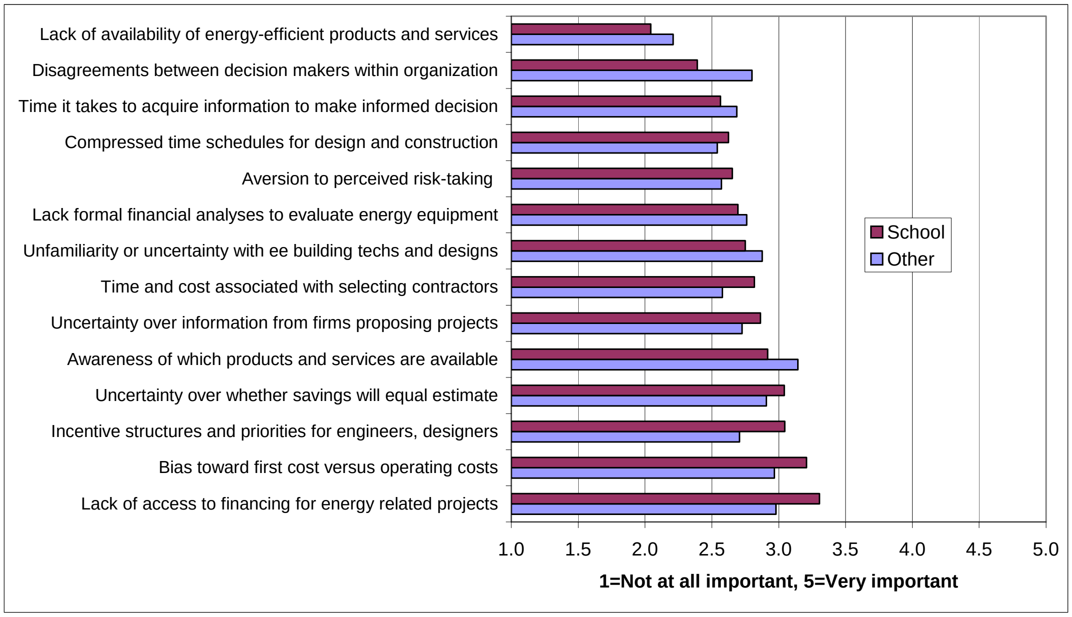
Program staff have been disappointed in the level of success in attracting public school participation in the program. However, the proportion of all schools participating in the program is relatively higher than for many other types of companies, as we will discuss below.

Barriers were not significantly different for schools than for other types of companies. Lack of access to financing and first cost were the highest barriers for schools, and the second and third highest for everyone else, following awareness of products and services (Figure 1-26). Trade allies are seeing an increased awareness of energy efficiency opportunities and the LEEDs standard in schools.

The financial incentives were not quite as important to the school participants as to other participants, although the difference was not quite statistically significant.[31] Schools rated the financial incentives at 3.7 on a scale of 1 to 5 where 1 is “not at all important” and 5 is “very important”, while other companies rated incentives at 4.3.

[31] F=3.1, significance=0.081

Figure 1-26. Barriers – Schools vs. Other Companies



N=104-121. Participants and nonparticipant end users survey combined.

Lack of Awareness

> "*…one of the greatest challenges is a lack of awareness…[it is] vital to communicate both the benefits of high performance schools and the availability of an increasing variety of resource to help achieve these benefits.*"[32]

The single biggest barrier to program participation seems to be awareness of the program. The nonparticipating schools interviewed were quite **un**familiar with the services and incentives offered by the program. The nonparticipant survey sample was taken from companies (and schools) who had completed a building project in 2005. Of the schools interviewed, eight had gotten no utility incentives. On a scale where 1 is "not at all familiar" and 5 is "very familiar" seven of the eight responded "1" and the eighth responded with a "2" for an average of 1.1.

Other Barriers

Table 1-55 shows the barriers to high performance school buildings that were identified in a best practices study done in 2003 by the Environmental Law Institute.

[32] Environmental Law Institute, Report on Best Practices called Building Healthy High Performance Schools: A Review of Selected State and Local Initiatives, September 2003.

Table 1-55. Barriers to High Performance Schools

Barrier	Comments
Education and Awareness	District leadership is a critical component. Outreach was particularly challenging with respect to construction contractors and community residents
Technical Assistance and Information	Need for technical information, training, and assistance for school district office and staff and for private design and construction professions. Need for more explicit technical information, e.g., detailed specifications and product information. Challenge of working with AE firms and builders that do not have experience in the area.
Financial Considerations	Added design costs may result from additional time and analysis of alternative strategies. Key was to emphasize integrated design and life cycle cost analysis.
Other	State energy codes for non-residential construction and renovation projects can have a broad impact on energy efficiency in school building programs.

Other States

The following section describes how other states are addressing energy efficiency in school construction and major retrofits.

In 2000 in California state agencies launched a partnership with utilities to facilitate a high performance approach to local school design and construction. This led to the formation of the Collaborative for High Performance Schools (CHPS) a public-private entity with funding primarily from the utilities through their Public Goods Charge program. Driven largely by concerns over energy supplies, California state agencies have made efforts to promote sustainable building practices for several years, an important factor in the development of the CHPS initiative, whose defining characteristic is the convening of various state agencies, along with utilities, to promote high performance schools. The Division of the State Architect oversees school design and construction, and is also the state's "policy leader" for building design and construction. All public school construction projects must comply with the state Building Standards Code including the energy efficiency standards, which are the most aggressive in the nation.

> CHPS is foremost a vehicle for communicating to school districts and architects the reasons why they should build high performance schools and for increasing their capacity to do so. It has done this chiefly by connecting districts and designers with the technical and other resources needed to create high performance schools. To achieve its broad goals, CHPS has developed a substantial body of technical resources that comprise the CHPS system for developing high performance schools.
>
> Environmental Law Institute, 2003

Key barriers were identified as financial, time pressure, education and awareness, and technical assistance and information. There is a concern over higher design costs—architects don't generally feel they can afford the time on the additional analysis required, there is separation between capital and operating budgets, and the added design and construction costs to meet the CHPS criteria are estimated at about 1-2% of a typical project's budget. Activities are focused on information services and incentive programs aimed primarily at school districts and designers. The principle strategies used are: 1) inter-agency collaboration; 2) utility incentive programs (Savings by Design, Section 9.9.1); 3) best practices manual; 4) metric, i.e., CHPS criteria; 5) training and technical assistance; 6) other informational materials; and 7) state policies.

In 2001 Massachusetts initiated the Green Schools Initiative which funds pilot school building demonstration projects that incorporate renewable energy technologies and other related high performance design features. The plan is to eventually integrate high performance goals into the state's school construction funding program. The Green Schools Initiatives is carried out by a quasi-governmental entity, the Massachusetts Technology Park Corp. The initiative provides grants for feasibility studies, design, and construction as well as criteria to select projects[33], and plans to collect data for five years after the pilot schools are open to assist in program evaluation, as well as to develop case studies and sponsor tours of pilot schools. Education and technical information provided include a high performance design manual (MASS-CHPS), and community-based workshops and information services. The Department of Education also provides funding incentives and has hired (with Massachusetts Technology Collaborative funding) a full time staff person devoted to promoting green school design and construction. And two utilities in Massachusetts offer incentives and technical assistance for new construction and major renovations (see Section 9.9.1).

In Oregon the High Performance School Program offers technical assistance, best practices research, design guidelines, and financing to encourage, support, and ensure that new schools constructed in Oregon over the next few years are high performance schools. Oregon school districts build from five to 10 new schools a year, but over the next decade, the state expects an increase in school construction as school districts deal with deferred maintenance and aging school buildings. Many school district staff are not familiar with design approaches that include eco-charettes, energy modeling, and commissioning that meets LEED standards. Also, many districts are wary of costs for needed up-front conceptual design. The cost of building a new high performance school is estimated to be 0-4% higher than a standard school. Design adds 0-2.5% of the total building cost and energy efficiency measures adds another 0-0.5%. Commissioning the whole building may cost an additional 0.5-1.5% or about $1.00 per square foot. The LEED certification process can cost an additional 1%. The Oregon program provides technical assistance through a team of energy analysts specializing in school energy efficiency, and special funding of up to $50,000/ school currently available for new schools that commit to designing a high performance school.

In addition, there is a Business Energy Tax Credit Pass-through Option which lets a project owner transfer a tax credit project eligibility to a pass-through partner in return for a lump-sum cash payment upon completion of the project. The Pass-through Option allows non-profit organizations, schools, governmental agencies, tribes, other public entities, and businesses without tax liability to use the Business Energy Tax Credit. Businesses with a tax liability may also choose to use the Pass-through Option. The same review, rules, and standards apply to Business Energy Tax Credit projects approved under the Pass-through Option. The Business Energy Tax Credit is 35 percent of the eligible project costs.

In Wyoming, Rebuild America is a Department of Energy Program that is designed to assist public entities to insure that public facilities, both new and old, are energy-efficient. CANDO (Converse Area New Development Organization) is facilitating the implementation of the Rebuild America program in the State of Wyoming, focusing on building a network of public-private partnerships and projects engaged in making energy-efficient improvements to their communities. CANDO is targeting new and existing K-12 schools, working with the State of Wyoming to adopt and aggressively pursue energy-efficient building concepts. CANDO, through the Rebuild America program, will work with local governments and school districts to develop energy-efficient projects with the Department of Energy to provide the resources and training necessary to improve energy efficiency in public buildings. To that end, CANDO is offering seminars to architects.

Recommendation: The programs should increase marketing to schools and school districts that may be building their own projects, as well as to trade allies that specialize in servicing the schools market, including architects. They may also want to develop a website and provide seminars and create case

[33] Grantees must use the Massachusetts CHPS Best Practices Manual.

studies such as Oregon and Wyoming. They may also want to look at components from other programs such as Oregon's High Performance Portables design or Business Tax Credits.

Summary of Findings

According to trade allies, the biggest market barriers are the bias towards first cost and a lack of awareness, and perhaps availability, of energy-efficient products and services. End users also viewed the bias towards first cost as a significant market barrier, especially among participating customers. Participating customers were also significantly more likely to view the internal disagreements among organizational decision-makers, the lack of availability of energy-efficient technologies, and the time and cost associated with measure installation as bigger barriers compared to nonparticipants. Barriers were not significantly different for schools than for other types of companies. Lack of access to financing and first cost were the highest barriers for schools, and the second and third highest for everyone else, following awareness of products and services. The financial incentives were not quite as important to the school participants as to other participants.

Lack of program awareness was the single biggest reason given by trade allies for not participating in the program, cited by 85 percent of the nonparticipating trade allies. It was also the primary reason cited by nonparticipating end users.

Both participating and nonparticipating end users were not very familiar with the program's services. As expected, participating end users are significantly more familiar with the program's services than nonparticipants.

The participating trade allies indicated that the program is not particularly effective in reducing market barriers (3.3 rating on a 5-point scale).

1.6.2 Are There New Products That May Help Improve Customer Acceptance?

The C&I Program is funding many of the same technologies as the programs in other parts of the country. In addition to current measures, participant and nonparticipant end users recommended adding the following measures: controls including energy management systems, ceramic metal halide lighting, LED, and fiber optic lighting.

Table 1-56. Equipment End Users Want Program Incentives For

Participants	Participants	Nonparticipants
HVAC Controls	Smaller HVAC Units	Control upgrades for HVAC (2 mentions)
Ceramic Metal Halide Lights	Individual Gas Boilers and Hot Water Heaters in Townhomes Instead of Centrally Located	Heat Pumps
Fluorescent Lighting	LED Lighting	Lighting Controls
Energy Management Systems (3 mentions)	Prescriptive Rebates for Fiber Optic Lighting	Light Bulbs
Cooking Equipment	Windows (2 mentions)	Energy Management Systems
Gas Fryers	Window Tinting	Windows (2 mentions)
Electric Panels	Tankless Water Heating	
Fractional Horsepower Motors	Insulation (2 mentions)	
Door Seals	Ice Machines	

1.6.3 Best Practice Strategies for Overcoming Barriers

The information for best practices in non-residential new construction was derived primarily from three best practice studies:

Best Practices from Energy Efficiency Organizations and Programs, prepared for the Energy Trust of Oregon, August 2002.

America's Best: Profiles of America's Leading Energy Efficiency Programs, ACEEE Report, 2003.

National Energy Efficiency Best Practices Study, December 2004.

Six programs which focus on the design phase of new construction and renovation projects in the C&I market provided the basis for best practices. Two programs—Energy Conscious Construction (NE Utilities) and Design 2000 Plus (NGrid)—showed up in all three best practices studies. The other programs are Energy Design Assistance (Xcel Energy), Savings by Design (CA), Construction Solutions (NStar), and CI New Construction (HECO). There are three key components that seem to drive the success of programs in non-residential new construction[34]—integrated design and design assistance, relationship building, and long-term commitment to the sector.

An early and active role in project design is crucial. Opportunities for some cost-effective energy efficiency measures decline as projects progress through design stages. Incorporating efficiency into projects with completed design often requires costly and time-consuming design changes. Once an energy-efficient element is incorporated into design, the challenge is to keep it in place through subsequent design changes and value engineering.

Good relationships between market actors and implementers are critical. Solid relationships with architects and engineers are particularly key as they provide the best opportunity to identify and get

[34] 2004 study.

involved with projects early in the design process. A long-term commitment to be active in the market and to build relationships is critical to success, particularly as programs change.

A long term commitment to the sector is beneficial. Commercial and industrial new construction programs often require three years or more from the start of a project to completion. Program managers must be able to assure a degree of stability in program funding levels and project requirements over a similar time horizon in order for participation to be a viable option.

It was clear to us from our interviews with utility program staff that they recognize the importance of these approaches and strategies and have incorporated appropriate elements in the program strategy. However, this kind of involvement in the market takes significant staff resources and consistent interaction over time with the appropriate market actors. With utility program staffing levels dropping over time as they anticipated the transition to independent program administration, the amount of staff time available for focusing on these activities dwindled below the optimal level.

Trade Ally Relationships

The National Best Practices study notes that *"listening to trade allies and including their legitimate concerns and needs is crucial to an effective program design. Educating the appropriate trade allies on what the program has to offer and why comprehensive projects make sense for their customers and their own bottom line can play a big part in ensuring program success. Building strong relationships with trade allies can encourage them to work with the program and adapt more readily to changes in program design, incentive levels, and so on."* The Comprehensive Commercial Retrofit Report done for ACEEE notes the importance of trade allies in identifying comprehensive projects. *"Building services professionals are often better qualified to identify opportunities for more comprehensive projects, while customers are more likely to move forward with a single retrofit project they have identified".*

There is currently no centralized database of trade allies actively working with the New Jersey C&I programs. The closest thing to such a list is the list of trade allies who have voluntarily signed up to be represented on the program's website, but no data is kept on how active these allies are in the program. In the absence of better data, we examined the web list of allies to characterize the types of and number of companies participating in the program. By comparing that list to data from other sources, we can estimate the level of participation in the program among all contractors and suppliers in the state. We found that HVAC, lighting, and motor contractors are fairly well represented in the web list, with approximately 30% of the population listing on the website. Approximately 50% of the population of architects, builders, and developers are listed on the website. However, relatively few of the most active firms in New Jersey are on the site.

Recommendation: An effort to better incorporate the most active architectural firms, general contractors, and real estate developers may help increase new construction penetration even further. Efforts could include face-to-face meetings, incorporation in focus groups, targeted mailings, lunch-and-learn events, co-branding or advertising, regular mailings with program status updates and describing program offerings and changes.

1.7 C&I Market Segmentation

This section characterizes the size of the market segments faced by the C&I Program. We used data collected for survey samples, other market data, and the demographic data collected in our surveys to segment the C&I market.

1.7.1 Characteristics of the Trade Ally Market

Three different data sources were evaluated to identify the size and distribution of the total New Jersey trade market relevant to the program (i.e., the Trade Allies market):

- Dun & Bradstreet data identifying relevant companies and associated sales by standard industrial classification (SIC) code.
- ReferenceUSA data identifying relevant companies based on yellow pages listings as well as several other sources.
- McGraw-Hill data identifying architects and builders for New Jersey commercial construction projects.

A custom Dun & Bradstreet database was used to identify New Jersey companies by standard industrial classification (SIC) codes for program relevant trades. This data source includes annual sales, which establishes the size of the market in financial terms, and also the distribution of sales among the trade companies. The reported sales are not limited to projects occurring within New Jersey. A total of 8009 companies were identified (see Table 1-57), of which 99% were either Plumbing, Heating, and Air Conditioning (SIC 1711) or Electrical Work (SIC 1731). Annual revenues for Plumbing, Heating, and Air Conditioning (4600 companies in the D&B data) were $2.8 billion, while Electrical Work (3300 companies in the D&B data) had total revenues of $2.5 billion. Table 1-57 also considers the distribution of revenues within a trade, by showing the total companies accounting for 90% and 50% of sales. For example, of the 17 total New Jersey companies with primary SIC 3621 (motors & generators), 90% or more of the sales are attributable to 6 companies, while 50% or more of the sales are attributable to 2 companies. For a list of the companies representing the top 50% of sales (except for the two biggest subsets), see Table 1-58.

Recommendation: Specific program staff should be assigned the responsibility for maintaining regular contact with the companies accounting for 50% of sales in Table 1-57. Since there are so many companies responsible for 50% of sales for “Plumbing, Heating, AC” and “Electrical Work”, it does not make sense to assign someone to each company but staff should be assigned to working with the group.

Table 1-57. Sales Volume and Number of Program Relevant Trade Companies Identified in New Jersey Using Data from Dun & Bradstreet

SIC	Company Type	Sales	Total NJ Companies [1]	Companies Accounting for 90% of Sales	Companies Accounting for 50% of Sales
1711	Plumbing, Heating, AC	2,755,161,129	4600	1651	180
1731	Electrical Work	2,469,370,928	3300	899	56
3641	Electric Lamps	38,507,000	16	4	2
3645	Residential Lighting Fixtures	60,340,000	23	6	1
3646	Commercial Lighting Fixtures	112,824,968	23	9	3
3648	Lighting Equipment NEC	21,500,000	27	14	5
3621	Motors & Generators	38,042,568	17	6	2
7694	Armature Rewinding	3,440,000	3	1	1
5063	Electrical Apparatus & Equip	5,641,976,363	719	106	1
3999	Manufacturing Industries NEC	5,760,000	6	3	1
	Total	**11,141,162,956**	**8009**	**2696**	**251**

[1] Source: Dun & Bradstreet
[2] NEC = Not Elsewhere Classified

Table 1-58. Companies Representing 50% of Revenue by Type (Other than Plumbing, Heating, AC, Electrical Work and Electric Apparatus and Equipment)

DUNS Number	Company	Type	SIC
043849975	Trinity Products Inc	Motors Generators	3621
001345610	Airflyte Electronics Company	Motors Generators	3621
034103718	Cml Innovative Technologies	Electric Lamps	3641
002158103	Superior Quartz Products Inc	Electric Lamps	3641
002275600	Seagull Lighting Products	Residential Lighting Fixtures	3645
002158855	Mercury Lighting Products Co	Commercial Lighting Fixtures	3646
001471614	Kurt Versen Company	Commercial Lighting Fixtures	3646
016107208	Interra Industries LLC	Commercial Lighting Fixtures	3646
001261031	Unilux Inc	Lighting Equipment NEC	3648
142317788	Innovative Photonic Solutions	Lighting Equipment NEC	3648
113991959	Smartpool Inc	Lighting Equipment NEC	3648
001802933	Accutec Inc	Lighting Equipment NEC	3648
145196098	Erco Lighting Inc	Lighting Equipment NEC	3648
611479874	Lite Tops Inc	Manufacturing Industries NEC	3999
011627783	Reliable Electric Motor Repair	Armature Rewinding Shops	7694
826949224	Wesco Distribution Inc	Electrical Apparatus Equipment	5063

[1] Source: Dun & Bradstreet
[2] NEC = Not Elsewhere Classified

Trade allies were also identified using data on the number and type of all companies in New Jersey as identified by ReferenceUSA. [35] This source includes yellow pages listings as well as several other sources and likely provides a broader description of the total market. The distribution of the 16,773 total New Jersey trade companies is shown in the following table. This data source may overstate the relevant population, as it doesn't exclude contractors specializing in residential markets.

Table 1-59. Number and Distribution of Program Relevant Trade Companies Identified in New Jersey Using ReferenceUSA

Company Service	New Jersey Companies[1]	% Distribution
Architect	1251	7.5%
Engineer, Energy Services & Consulting	474	2.8%
Builder	5884	35.1%
Developer	546	3.3%
Building Contractor	1645	9.8%
HVAC, Mechanical, Heating & Chillers	3162	18.9%
Lighting	200	1.2%
Motors	164	1.0%
Electrical	3407	20.3%
Compressed Air	40	0.2%
Total	**16,773**	**100.0%**

[1] Source: ReferenceUSA

A third data source was used to compare trade allies participating in the program with the total population. The programs do not keep a unified list of participating trade allies. However, the program website[36] lists contractors and their specialties. This list is not necessarily comprehensive as it largely contains those who have volunteered to put their information on the website. We extracted all trade allies and their self-identified specialties from the website to develop a list of 208 participating trade allies, referred to as "web listed" trade allies below. We used this list for the sample for the participant survey.

The market size and distribution estimates in this section provide an opportunity to gauge program penetration among trade allies. Table 1-60 compares total trade companies identified in New Jersey to the self-reported services reported by trade allies listed on the program website. This comparison indicates high penetration for lighting, motor, and engineering services, and low penetration among architects, builders, developers, and HVAC contractors. This apparent lower penetration may actually be misleading, as many of the architects, builders, and HVAC contractors identified may specialize in residential markets.

[35] As identified by www.ReferenceUSA.com. Information is compiled from the following public sources: more than 5600 Yellow Page and Business White Page telephone directories; annual reports, 10-Ks, and other SEC information; Continuing Medical Education (CME) directories; federal, state, provincial, and municipal government data; Chamber of Commerce information; leading business magazines, trade publications, newsletters, major newspapers, industry and specialty directories; and postal service information, including both U.S. and Canadian National Change of Address updates.

[36] http://www.njsmartstartbuildings.com/main/fata/index.html

A fourth data source, the McGraw-Hill Dodge Players construction database, was used to identify architects, builders, and developers who are currently most active in New Jersey commercial construction. The size of the building construction market can be identified using McGraw-Hill data, and was approximately $4 billion in 2005.[37] New school construction and retrofits accounted for 25% of this total. New construction for other buildings was 56% of this total, and retrofits for other buildings accounted for 19% of the total. The McGraw-Hill data allows the identification of the most active architects, builders, and developers in New Jersey. While Table 1-59 lists 5884 builders, only 464 builders were identified in the McGraw-Hill data as starting at least two commercial projects between June 2004 and June 2005. Similarly, 432 architects with at least two projects, and 160 developers with one or more project could be identified. It is likely that many of the equipment installations that are eligible for the program are not associated with a “construction project” as defined by McGraw-Hill data. This data is therefore not appropriate for measuring the market size of equipment retrofits, and Dun & Bradstreet data was used to identify the sample for equipment installations. Table 1-61 demonstrates a higher penetration among architects, builders, and developers when identified from a population of active companies in commercial construction.

Table 1-60. Participation Rates among New Jersey Trade Companies

Trade Ally Service	Total New Jersey Companies [1]	Percent of Total	Web-Listed [2]	Percent of Web-Listed Total	Web-Listed as % of New Jersey Total [3]
Architects	1251	11%	10	2%	1%
Design/Builders/General Contracting	5884	51%	60	12%	1%
Engineering (Building or Energy Related)	249	2%	92	18%	37%
Developers	546	5%	16	3%	3%
Chillers; Heating; HVAC	3162	28%	90	18%	3%
Lighting; Lighting Controls; LED traffic lights	200	2%	136	27%	68%
Motors; Variable Frequency Drives	164	1%	106	21%	65%
Total	**11,456**	**100%**	**510**	**100%**	**4%**

[1] Source: ReferenceUSA
[2] Extracted from the self-reported services reported by trade allies listed on the program website. Includes multiple services for individual companies (e.g., 510 services were identified from 208 reporting companies).
[3] (Web-Listed)/(Total New Jersey Companies)

[37] McGraw-Hill’s Dodge Players (MHDP) database. The MHDP data are based on construction project starts based on interviews with owners, architects, and contractors as well as permit filings. Projects with start dates between June 2004 and June 2005 were used as a reasonable measure of projects completed in 2005.

Table 1-61. Nonparticipant Self-Reported Services and Participation

Trade Ally Service	A	B	C	D=C/B
	Nonparticipant Survey Sample Using Sample Service Categories	**Nonparticipant Survey Completes by Self-Reported Services**	**Number of Nonparticipants Who Said They Were Participants**	**Percent of Survey Respondents Who Were Participants**
Architects	83	19	3	16%
Design/Builders/General Contracting		3	1	33%
Engineering (Building or Energy Related)		1	0	0%
Developers	78	2	2	100%
Chillers; Heating; HVAC	282	13	3	23%
Lighting; Lighting Controls; LED traffic lights	59	19	1	5%
Motors; Variable Frequency Drives	18	13	2	15%
Total	**808**	**70**	**12**	**17%**

1.7.2 Characteristics of Participating End Users

The size and distribution of the New Jersey commercial buildings was estimated using data from the Energy Information Administration's Commercial Buildings Energy Consumption Survey (CBECS).[38] This data is broken down by region but not by state, so we extrapolated to calculate New Jersey buildings by using a combination of CBECS and U.S. census data. CBECS identifies 761,000 commercial buildings in the Northeast Region consisting of nine states. Using 2001 Census data, the ratio of "Private non-farm establishments with paid employees" among these nine states were used to assign a fraction of the total buildings (16.5%) to New Jersey. By doing so, we estimate there are a total of approximately 126,000 commercial buildings in New Jersey. The following table shows the total number and distribution of these buildings.

[38] CBECS data is from the Energy Information Administration at http://www.eia.doe.gov/emeu/cbecs/contents.html. New Jersey buildings were estimated from the total Northeast buildings and the fraction Northeast "private non-farm establishments with paid employees" in New Jersey as reported by the U.S. Census at http://quickfacts.census.gov/qfd/states/.

Table 1-62. Number and Distribution of Commercial Buildings

Building Type	NJ Estimated Buildings [1]	% Distribution
Office	21,867	17%
Mercantile	15,660	12%
Service	14,108	11%
Religious Worship	7336	6%
Grocery or food sales	5643	4%
Food Service, restaurants	5220	4%
Education	4373	3%
Lodging, Hotel, Motel	3809	3%
Government Service Building	3245	3%
Health Care	2539	2%
Other	41,901	33%
Total	**125,701**	**100%**

[1] Estimated for New Jersey based on CBECS and Census data.

Table 1-62 provides a basis of comparison for program participation rates and relative distribution. Program reporting indicates a total of 2387 unique commercial or industrial participants received incentives in 2005. Assuming one building per owner, this would correspond to roughly 2% penetration of the commercial building stock in 2005 (2387/125,701). Using the same methods, HVAC penetration is approximately 0.3% of the total building stock. The detailed program data identify 151 motor rebates, which would imply a 2.1% penetration when compared against New Jersey manufacturing establishments.[39] Due to the regional basis of the building stock data, these estimates should be considered rough approximations. One segment of the population which should be readily identifiable, however, is new construction projects. Program reporting indicated 198 participants for C&I New Construction. We found approximately 424 unique owners in the McGraw-Hill data as likely completing commercial new construction projects during 2005. This suggests a 47% participation rate for C&I New Construction. While this estimate should be considered approximate, it is in the range of penetration reported in Massachusetts, where 50% of buildings and 56% of owners participated in Design 2000 Plus.[40]

Data compiled on building types from detailed program data (2001 – 2005) allows a comparison of the relative distribution of participants among building types, as shown in Table 1-62 and Figure 1-27. The distribution of participating buildings is based on 7833 identifiable building types[41]. The ratio in Table 1-63 should give an indication of relative program penetration between different market segments. For example, CBECS data suggest that educational facilities may comprise 3% of the total building stock.

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[39] Based on 14,402 manufacturing establishments identified by www.ReferenceUSA.com.

[40] Design 2000 Plus as reported for 10,000 new buildings between 1992 – 1999.

[41] The data we got from the utilities did not include company or building type. We classified building types based on key words in the company name using common-sense rules (e.g., if “Hospital” was in the name we classified it as “Health Care”) and, in some cases, looking up companies on the internet. We were able to classify only a small portion of all participants so it is possible some segments are under-represented.

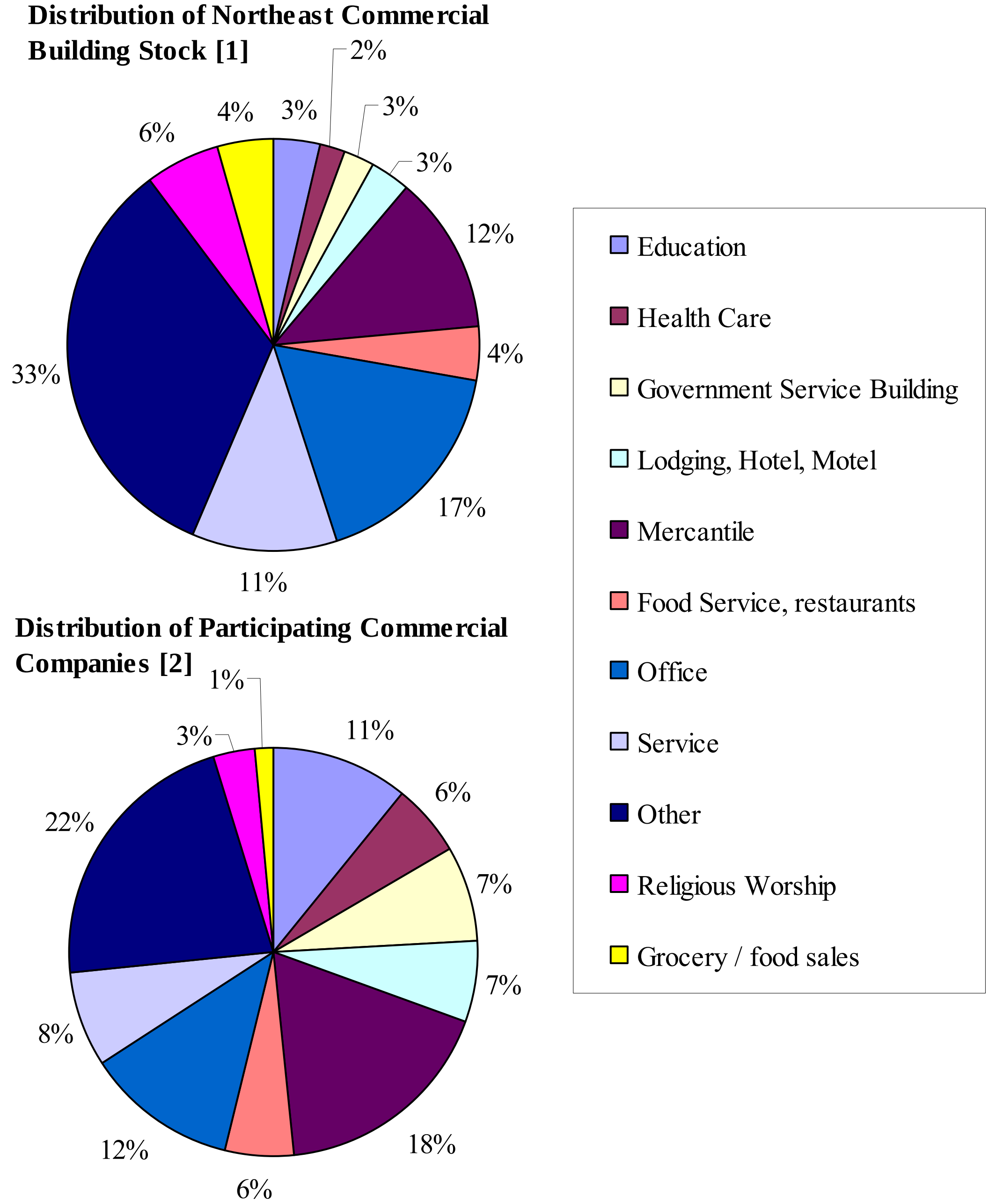
The fact that 14% of the identifiable participants were classified within education indicates a high degree of relative success within this market segment. This comparison shows significantly higher success within education, healthcare, government, and lodging. It shows relatively lower success for grocery and religious worship.

Table 1-63. Comparison of Participating to New Jersey Building Stock

Building Type	**Distribution of Northeast Commercial Buildings Stock [1]**	**Estimated Building Use of Participating Commercial Companies [2]**	**Ratio [3]**
Education	3%	11%	3.2
Health Care	2%	6%	2.9
Government Service Building	3%	7%	2.8
Lodging, Hotel, Motel	3%	7%	2.2
Mercantile	12%	18%	1.4
Food Service, restaurants	4%	6%	1.4
Office	17%	12%	0.7
Service	11%	8%	0.7
Other	33%	22%	0.7
Religious Worship	6%	3%	0.6
Grocery or food sales	4%	1%	0.3
Total	**100%**	**100%**	

[1] Source: EIA, CBECS Survey.
[2] Based on 7833 categorized historic participants.
[3] Participant percentage divided by regional building stock percentage.

Figure 1-27. Comparison of Participating Buildings to Northeast Building Stock



[1] Source: EIA, CBECS
[2] Based on 7833 categorized historic participants.

A final estimate of penetration by building type can be made by comparing the total buildings in New Jersey to the participant buildings. Using the building distribution in Table 1-63 and multiplying it by the 19,583 participant projects listed in detailed program data for years 2001 – 2005 produces the estimate of building types in the program shown in Table 1-64. For example Education = 19,583 * 10.97% = 2148. This then supports an estimate of the program penetration rate by building type. As with the previous table, penetration is highest for education, health care, and government service buildings, and lowest for religious worship and grocery.

Table 1-64. Estimated 5-year Penetration Rate by Building Type (2001 – 2005)

Building Type	NJ Estimated Buildings [1]	Estimated Building Use of Participating Commercial Companies [2]	Penetration Rate By Building Type[3]
Education	4373	2148	49%
Health Care	2539	1128	44%
Government Service Building	3245	1438	44%
Lodging, Hotel, Motel	3809	1285	34%
Mercantile	15,660	3463	22%
Food Service, restaurants	5220	1103	21%
Office	21,867	2305	11%
Service	14,108	1483	11%
Other	41,901	4313	10%
Religious Worship	7336	645	9%
Grocery or food sales	5643	275	5%
Total	**125,701**	**19,583**	**16%**

[1] Estimated for New Jersey based on CBECS and Census data.
[2] Based on 7833 categorized historic participants (percentages shown in Table 1-63) extrapolated to the entire participant population.
[3] Penetration Rate = Participant Buildings / New Jersey Buildings

Summary and Conclusions. Program penetration is relatively higher in education, healthcare, government, and lodging. It is relatively lower in grocery and religious worship. If the programs design new components to target specific sectors or trade allies, the data and sources used in this section can provide information on the size and characteristics of the market.

Five or fewer trade allies are responsible for half of all sales in several categories of equipment, including lighting, motors and generators, and armature rewinding. Specific program staff should be assigned the responsibility for maintaining regular contact with these companies.

1.8 Upgrade of Energy Efficiency Codes and Standards Assessment

The U.S. Energy Conservation and Protection Act requires that each state certify that it has a commercial building code that meets or exceeds ASHRAE Standard 90.1-1999. Some states, such as Florida and California, have independently developed and adopted their own energy codes. California's adoption of aggressive standards has resulted in energy use per capita remaining steady from 1976-2001, while energy use per capita in the rest of the US continued to rise. The federal government has now included incentives for high efficiency buildings in its 2005 Energy Policy Act, for buildings or systems placed in service from January 1, 2006 through December 31, 2007. A tax deduction of up to $1.80/sq feet is available for new or existing commercial building constructed (or reconstructed) to save at least 50% of the heating, cooling, water heating, and interior lighting energy costs of a building that meets ASHRAE Standard 90.1, 2001. The map and table below show the implementation of commercial state energy codes in the various states as of December 2005. As can be seen from the map and table, New Jersey's code, which meets ASHRAE 90.1-1999, is not on the leading edge of energy codes.

Figure 1-28. Status of Commercial Energy Codes by State

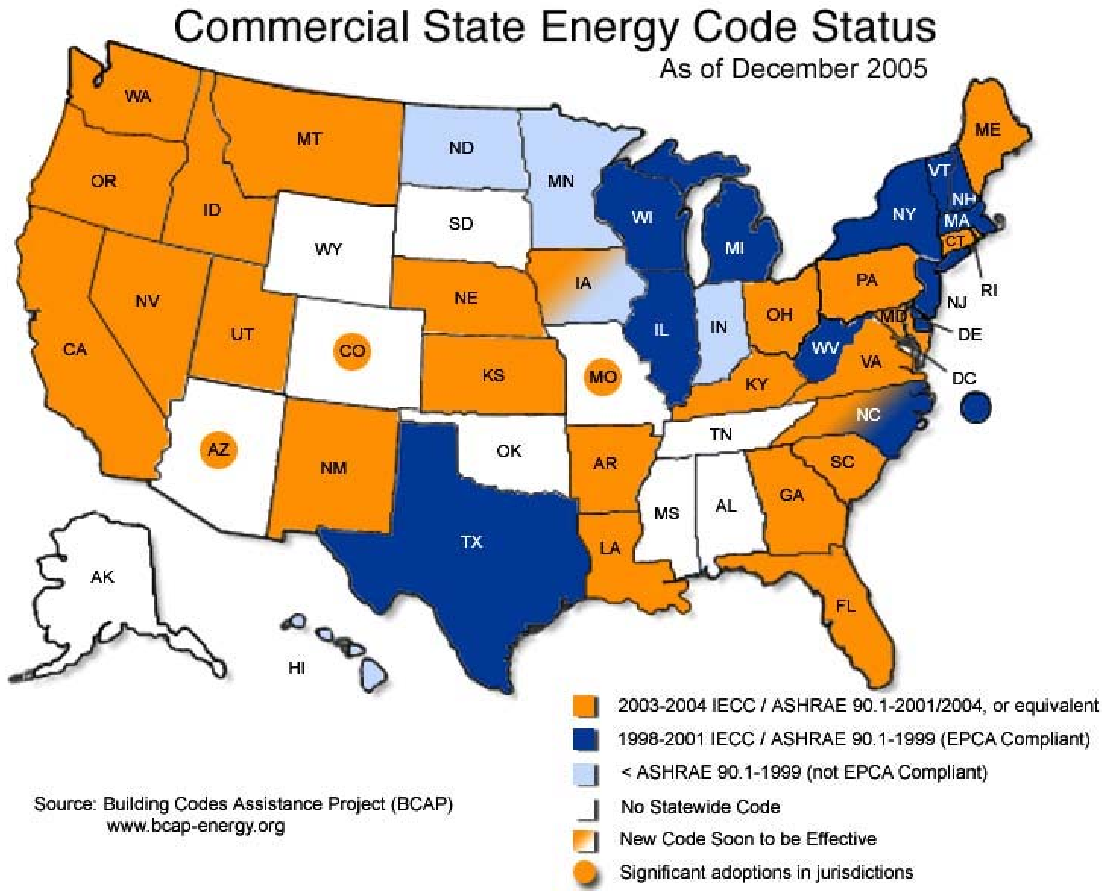


Table 1-65. Commercial Energy Code Adoption

ASHRAE/IESNA Standard or Equivalent State Code	States Adopted
ASHRAE 04	4 States: GA, IA, OH, WA
2003 IECC	15 States: AR, CT, ID, KS, KY, MD, MT, NE, NM, NV, PA, RI, SC, UT, VA
2001 IECC	3 States: IL, NY, TX
ASHRAE 01	6 States: AL[c], CA, CO[b], FL, LA, ME
2000 IECC	6 States: DC, NC[a], NH, VT[b], WI, WV
ASHRAE 99	6 States: AZ[bc], DE, MA, MI, NJ, OR
ASHRAE 89	6 States: HI, IN, MN, MO[c], ND[b], OK[b]
90A90B	1 State: TN[b]
PRIOR 90A90B	1 State: WY[b]
None	3 States: AK, MS[c], SD[b]

a Code adopted but not yet effective. Click on the state for more information.
b Code implementation depends upon voluntary adoption by local jurisdictions.
c Mandatory for state owned/funded commercial buildings.
Source: Building Codes Assistance Project, http://www.bcap-energy.org/code_status.php

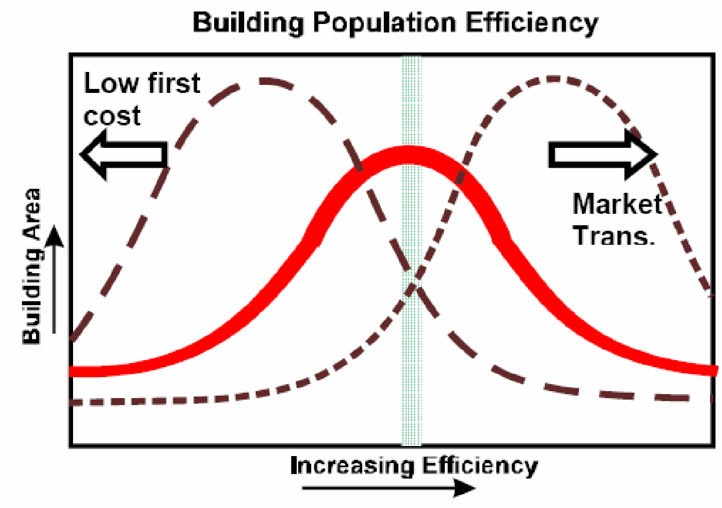
Energy codes cannot incorporate good design practices. Energy codes generally dictate requirement for the building's envelope, mechanical, and lighting requirements. Since they must be easy for architects to understand, builders to use, and code officials to enforce, they "…*cannot incorporate all good design practices and should not be confused with good practice*."[42] However, according the Doug Shanne at the Northeast Energy Efficiency Partnership, "*most new buildings are built to a standard higher than the minimum code, because the market demands this higher level.*"[43] Building envelope requirements generally include minimum insulation levels and window requirements and vary by climate region. Mechanical system requirements include such things as minimum equipment efficiency requirements and controls. Commercial building requirements for lighting include total building wattage requirements for interior and exterior lighting and controls. Codes generally have prescriptive and performance paths for compliance. Prescriptive paths consist of tables with min/max values and performance paths trade off energy savings measures, and generally allow the use of a computer trade-off program or detailed energy budget method. Detailed computer-based energy analysis programs like DOE2 that calculate annual consumption on an hourly basis are useful for the energy budget method which compares annual building energy use meeting prescriptive requirements to the proposed building to determine compliance.

As programs change the market, codes and standards need to be upgraded. The conceptual graph in the figure below illustrates the unique role of energy efficiency standards in the marketplace. The heavy, bell-shaped curve in the center represents the distribution of buildings and their energy efficiency in the market. The dotted line to the left represents the distribution of efficiency that might result if lowest first cost prevailed; builders are always pushed to reduce costs for measures that are less important to consumers, such as energy efficiency. The dotted line to the right represents the distribution of efficiency we might attain if we achieve market transformation. The dashed vertical bar represents mandated level of efficiency. Standards are part of the latter stages of the technology adoption cycle, coming after efficient technologies have been developed and proven effective. Many standards changes in California were supported by efforts made through the ongoing utility market transformation programs; some were only possible because of the familiarity with the technology new construction and retrofit programs developed. As time goes on and market transformation programs shift the curve to the right, it is important to also move the vertical bar representing standards to the right, by setting new, more stringent ones. Raising standards brings more laggards to improved efficiency, reduces the drag on market transformation efforts to push the efficiency curve forward, and reduces costs of better efficiency as incentives are not needed. Market transformation programs can push the limits of new standards.

[42] Whole Building Design Guide: Energy Codes and Standards, M. VanGeem, Construction Technology Laboratories Inc. www.wbdg.org/design/energycodes.php, updated 12-11-2005.

[43] Summit Blue Interview.

Figure 1-29. Impact of Standards



The federal government has mandated equipment standards for many appliances and several states have adopted standards for other equipment as shown in the table below. New Jersey adopted standards on several C&I measures in 2005, these standards were subsequently superseded by the Federal standards set in the Energy Policy Act of 2005.

Table 1-66. C&I Products Covered by Federal or State Standards[44]

Product	Federal	NJ	CA	AZ	MA	NY	OR	RI	WA
Heating and Cooling									
Furnaces & Boilers	X	X							
Boilers & Central Furnaces not covered by federal standards			X						
Lighting									
Exit Signs**	X	X							
Fluorescent Lamps	X								
Fluorescent Lamp Ballasts	X								
Fluorescent Lamp Ballasts (F34 & F96ES types)**	X								
General Service Incandescent Lamps			XO						
High Intensity Discharge Lamps	X								
Incandescent Reflector Lamps	X								
Incandescent Reflector Lamps Not Federally Regulated			O		X	O	X		X
Mercury Vapor Lamp Ballasts**	X								
Metal Halide Lamp Fixtures			XO	X	X	X	X	X	X
Pedestrian Traffic Signals**	X								
Traffic Signals**	X	X							
HVAC									
AC & Heat Pumps (unitary equipment 240-760k Btu/hr)**	X	X							
Commercial Packaged AC & Heat Pumps	X								
Commercial Water Heaters	X								
Computer Room AC			X						
Water & Ground Source Heat Pumps			X						
Motors									
Electric Motors (1-200 hp)	X								
Small Electric Motors*	X								
Other									
Clothes Washers**	X	X							
Commercial Hot Food Holding Cabinets			X						
Distribution Transformers (low voltage)**	X	X							
Distribution Transformers (medium voltage dry type)					X				
External Power Supplies			X	X	X	O	X	X	X
Ice-makers (cube type, 50 to 2,500 lbs/day)**	X								
Pre-rinse Spray Valves**	X								
Refrigeration									
Refrigerators & Freezers (packaged)**	X	X							
Walk-In Refrigerators & Freezers			X						

X = Standard Adopted, O = standard pending, XO = standard adopted and revised standard pending
* DOE was instructed by Energy Policy Act of 1992 to investigate whether standards were technically feasible and economically justified and to set standards where these criteria were met.
** Standards set in Energy Policy Act of 2005

Conclusion: New Jersey's building code meets ASHRAE 90.1-1999. This is the same as 10 states in the Northeast plus Texas but it is lower than codes adopted by 33 states and the District of Colombia, including most of the west and southwest, and Pennsylvania, Ohio, and Virginia. New Jersey should consider upgrading its energy code standards to at least ASHRAE 90.1 - 2001 and plan to upgrade to

[44] Modified from Nadel et al, Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards, ACEEE A062, March 2006.

ASHRAE 90.1 – 2004. Otherwise building efficiency levels will be established at levels lower than can actually be achieved, which is particularly important for new construction which represents lost opportunities. In addition, as in California, New Jersey could implement state codes to further drive up the level of equipment efficiency.

1.9 Rebate and Incentive Level Assessment

> *"Programs used financial incentives to overcome builder hesitation about program participation in general and integrated design in particular. Over time, as builders have learned to appreciate the benefits of program participation and integrated design, programs have been able to reduce subsidies."*[45]

Programs can be viewed along a continuum from simple rebates for individual energy-efficient equipment to bring equipment efficiency up to a minimum standard (pull strategy), through to new construction programs aimed to influence the adoption of higher standards (push strategy). Some examples of C&I programs for new construction, retrofit, and equipment replacement are shown in the table below categorized by where they fall in the continuum. Several programs with similar goals as those in New Jersey, i.e., targeting the design of new buildings and major renovations or retrofits, are analyzed in the following sections.

Table 1-67. Types of C&I Programs

Equipment Incentives	Business Performance & Equip. Incentives	Standard Offer Programs (ESCos)	New Construction/ Major Retrofit	New Construction
Lighting Efficiency (Xcel Energy, MN)	Energy Initiative (NGrid, MA)	BPA C&I Standard Offer	Design 2000 Plus (National Grid MA)	C&I New Construction (NSTAR, MA)
Efficiency Vermont Business Programs	Custom Services (NU, Northeast)	California Nonresidential Standard Performance Contract	Commercial Construction (LIPA)	New Building Efficiency (ET0, Oregon)
Energy Smart Services (Seattle City Light, WA)		NYSERDA C&I Performance Program	Efficiency Vermont Custom Programs	
Wisconsin Focus on Energy Business Programs		Texas C&I Standard Offer	Energy Conscious Construction (Northeast Utilities)	
			Energy Design Assistance (Xcel – MN)	
			New Construction (WE Energies)	
			Savings by Design (CA)	
			Workplace New Construction (VGS)	

[45] Rufo, M. National Energy Efficiency Best Practices Study, December 2004.

1.9.1 New Construction and Retrofits

This section describes incentives and incentive structures for comparable programs aimed at C&I new construction and retrofit projects in other states.

Whole Building Approach

Commercial retrofits, long a staple of energy efficiency program portfolios, have generated substantial energy savings. However, even greater savings can be realized by addressing the full range of retrofit opportunities in an individual building as well as interactive effects among systems components or building systems. For example, custom measures in a National Grid program account for half the savings and half the spending. The program requires six interactive measures and is limited to projects greater than 50,000 square feet. To capture such savings, programs designed to address whole buildings have been implemented, often providing a range of non-energy benefits in the process. The programs recognize the value of a systems approach that goes beyond simple equipment upgrades to identify opportunities in system design, equipment interactions, and building operations and maintenance. Large comprehensive incentive programs: 1) focus on implementation of custom efficiency measures and projects that do not lend themselves well to a prescriptive rebate approach; 2) encourage comprehensive projects that go beyond single measures and common efficiency practices; 3) use incentive strategies that encourage and allow for custom and comprehensive projects; and 4) include technical engineering review as part of the incentive approval process, and require proof of project installation.

It is particularly critical to take a comprehensive approach to chiller replacement projects. This approach looks at interactions with lighting needs for example, and allows for downsizing the proposed new system, maximizing energy savings and customer costs. Integrated chiller retrofits take a systems engineering approach rather than focusing on the chiller alone. Projects include a review of whole building systems to identify opportunities to reduce loads from lighting, fenestration, pumps and fans, and resized cooling towers and thereby to downsize the chiller.

> *Results from one chiller retrofit program that included a comprehensive approach to install additional efficiency measures reported whole building energy savings of 14% at an average cost of $4.50 per square foot of floor space (Fryer and Leach 1995).*
>
> *In a recent analysis of integrated chiller retrofits, annual energy savings from replacement of a 550-ton chiller were estimated at 55% (more than 550,000 kWh) compared with energy savings of 37% for a simple chiller upgrade (Sachs 2001). Recent data on six chiller projects completed through National Grid's Comprehensive Chiller Initiative in 2003 report average energy and demand savings of 1,078,669 kWh and 242 kW per project (National Grid 2004). While these savings may not be typical for average comprehensive retrofit programs, it illustrates the extent of additional savings available from comprehensive retrofits.*

New Jersey's C&I Program is dominated in many ways by the retrofit program, which represented 71% of spending and 81% of participants in 2005. Schools represented 14% of spending and New Construction 15%. The retrofit program, and to a certain extent the New Construction and Schools programs, focuses on providing financial rewards for participants to do the right thing and those rewards are predominantly prescriptive and custom rebates, even within New Construction. The programs promote a whole-building approach by providing multi-measure bonuses as well as services such as design support. However, the level of effort spent on supporting the whole building approach is relatively small and it has been diminishing in recent years. Of course, this trend has to be put in the context of the transition from utility to independent administration of the energy efficiency programs. The BPU has placed restrictions on utility marketing in recent years and utilities have faced some significant staff attrition as they looked to the day when they would no longer be administering the energy efficiency programs.

Table 1-68. C&I Construction Program Budget ($000s)

C&I Programs	Actual Expenditures	Percent of Total	Actual Participants	Percent of Total
C&I New Construction	3,730	15%	198	8%
C&I Retrofit	17,347	71%	1,923	81%
New School Construction & Retrofit	3,360	14%	266	11%
Total	**24,437**	**100%**	**2,387**	**100%**

Source: New Jersey's Clean Energy Program Report Year-to-Date through Fourth Quarter 2005. (January 1, 2005 through December 31, 2005)

Design Incentives

An analysis of best practices for C&I new construction and retrofit programs revealed that the most effective programs target the design phase.[46] The philosophy behind design incentives is that more detailed design and analysis can often yield substantial energy efficiency opportunities that have minimal incremental cost. Equipment-based incentives (especially incentives tied to incremental construction costs) typically would not reward such measures or would reward only the project owner, leaving the design team to shoulder the burden of extra design time and expense. The table below shows incentive structures for programs focused on non-residential new construction and major retrofits. New Jersey's design incentives of up to $11,000 are in line with industry practice but neither Xcel nor HECO provide design incentives and they seem to be doing well.

[46] National Best Practices Study 2004.

Table 1-69. Selected C&I New Construction and Retrofit Programs

Programs	CA SBD	HECO C&I NCP	NGRID D2000+	NSTAR CS	CL&P ECC	Xcel Energy
Design incentives	Up to $50,000/proj.	None	Design Team Honorarium	100% of incremental costs	$2,500/project brainstorming honorarium	None
Equipment Incentives - custom measures - comprehensive bonus	 X -	 X -	 X X	 X X	 - X	 X -
Eligible measures - lighting & controls - HVAC - motors & drives - chillers - other - gas measures	 X X X X X X	 X X X - - -	 X X X - X X	 X X X X X -	 X X X X X -	 X X X X X X
Commissioning			X	X	X	
Comprehensive/ Custom Incentives	Not specified.[47]	$125/kW + 6 cents/kWh	Up to 90% of incremental costs/1 yr payback	Up to 90% of incremental costs (up to 75% for EE equipment)	100% of incremental costs	Tied to portfolio implementation
Incentive Caps	$150,000/ project	None	None	$750,000/ project	$100,000	None
Date of Program Results	2002	1999	2002	2001	2002	2002
# Projects	576	NA	705	138	310	NA
MWh Savings (annual net)	82,697	8,546	31,804	14,230	33,365	63,093[48]
Incentive Costs ($000)	13,469	631	12,060	5,209	5,937	3,169
Total Costs ($000)	22,604	935	13,916	7,926	7,435	5,650
TRC/SCT	2.43	1.30	1.72	5.08	3.20	6.74
Market Share	12.9% (New Construction) 2.8% (alterations) 2004[49]	NA	50% of 10,000 new buildings (1992-1999)	NA	80%[50] 2,300 bdgs (1990-2001), 310 bldgs (2002), 111 bldgs (2003)	50% of buildings > 80,000 sq ft. (220 bldgs from 1993-2001)

[47] Based on precedent, expected cost/benefits, min. amount to get participation, expert opinion.

[48] Gross savings only.

[49] NRNC Market Characterization And Program Activities Tracking Report PY2004 Final Statewide NRNC MA&E Program Prepared by Quantum Consulting Inc., May 2005.

[50] Energy Conscious Construction/Energy Conscious Blueprint Program: A Strategy for Success, ECMB Presentation 9/7/2004.

Recommendation. It was clear to us from our interviews with utility program staff that they recognize the importance of taking a whole-building approach to design and have incorporated appropriate elements in the program strategy. However, this kind of involvement in the market takes significant staff resources and consistent interaction over time with the appropriate market actors. With utility program staffing levels dropping over time as they anticipated the transition to independent program administration, the amount of staff time available for focusing on these activities dwindled below the optimal level. The current program design should be maintained and appropriate staffing levels achieved so that the program can focus on developing strong relationships with trade allies, particularly architects, and place the focus on identifying projects early in the design phase to maximize energy savings.

1.9.2 Prescriptive Rebates for Energy-Efficient Equipment

Ninety percent of the measures installed in the New Jersey program were lighting (prescriptive and performance), motors and HVAC, and lighting controls. Only 1% of the measures were design support. Incentive levels provided by other programs for these measures were compiled and analyzed compared to those provided by New Jersey. In addition we looked at some other technologies incented elsewhere. Results for each measure are described in the following sections. We concentrated most of our analysis on the measures that contribute to 80% of the program savings (Table 1-70).

Table 1-70. Program Savings by Measure Type

Measure Type	Total kWh Saved	% of Total Sum	Cumulative % of Total
Performance Lighting	5,727,405	40.3%	40.3%
Prescriptive Lighting	1,881,887	13.3%	53.6%
Chiller	1,121,529	7.9%	61.5%
VFD	937,471	6.6%	68.1%
Custom Electric & Gas Equipment Incentives	885,806	6.2%	74.3%
Geothermal Heat Pump	834,448	5.9%	80.2%
All other measures	2,812,479	19.8%	100.0%
Totals	**14,201,026**	**100.0%**	

Source: Program tracking data for measures installed in 2005.

The following sections compare prescriptive incentives provided for various technologies by programs in other states to those provided by New Jersey's programs. Table 1-71 outlines how New Jersey's level of rebates for various energy efficiency technologies compares to other states and the following sections present details comparing New Jersey's incentives to other states and to estimates of incremental cost.

Table 1-71. Comparison of Level of Efficient Equipment Rebates

Measure	Table	NJ vs. Other Programs			Comments
		Lower	Average	Higher	
Chillers	Table 1-76			X	Most programs that provide chiller rebates offer a bonus for higher efficiency and promote comprehensive, whole building approaches to maximize interactive savings.
Gas Measures • Gas-Fired Boiler • Efficient Furnaces • Water Heating	Table 1-79 Table 1-80			X	There are many fewer programs for natural gas energy efficiency than for electricity—mostly for heating and water heating. No other programs reviewed offer incentives for gas cooling options.
Ground Source Heat Pump			X		Three other programs reviewed offer incentives. Energy Trust of Oregon offers $300/ton, NYSERDA, $350-$500. MidAmerican Energy offers $300/heating ton plus $300/ton ground loop plus efficiency bonuses.
HVAC • Unitary HVAC • Air-To-Air HP • Water Source HP • Economizer Controls • Packaged Terminal HP	Table 1-81		 X X X X	 X	New Jersey's rebates generally match those of Cool Choice in the Northeast. MidAmerican pays higher incentives for heat pumps for higher efficiency levels. Energy Trust of Oregon (ETO) pays incentives on a per unit basis for Unitary AC/Split Systems, and Heat Pumps. Only New Jersey incents DX AC Systems.
LED Traffic Signals				X	Very few programs offer prescriptive rebates to C&I customers for LED traffic signals. Efficiency Vermont pays $40 to $70 and NSTAR $65 to $75. Federal standards in effect.
Lighting • Hard Wired CFLs • High Bay • LED Exit Signs • Metal Halide • T8 and T5 Fixtures	Table 1-73		 X X	 X X X	Several programs also offer incentives for High Pressure Sodium lamps, but many do not pay for hard-wired CFLs or LED exit signs. Rebates for T5 & T8 fluorescent fixtures range from $2 in Wisconsin and Minnesota to $50/fixture in Connecticut. CL&P and Xcel Energy offer bonuses for Super T8 fixtures ($2.25 to $5) and Efficiency Vermont pays $20-50.
Lighting Controls • Occupancy Sensors • High Bay • Daylighting	Table 1-74	 X	 X X		Some programs, e.g. NGrid and NSTAR, provide incentives of $40 for dimmable CFLs with ballasts. Incentives ranged from a low of $10 at CL&P to a high of $75 paid by NGrid, NSTAR, and Efficiency Vermont.
Motors			X		Most programs rebate 1-200 hp motors that meet NEMA Premium Efficiency Standards[51], from $45 for 1-1.5 hp motors to $700 for 150/200 hp motors. NGrid's Energy Initiative offers higher incentives ($130-$4730) and NYSERDA lower ($25 to $480) with rebate tiers based on estimates of previous premium-efficiency motor sales.[52]
Variable Speed Drives	Table 1-78	X			New Jersey's incentives are roughly in the middle of the range of incentives in other states.

[51] The NEMA Premium specification is a voluntary benchmark specification for premium efficiency motors. California's Savings by Design uses NEMA standards as baselines for more efficient options.

[52] CEE, National Summary of Energy Efficiency Programs for Motors and Drives, Nov. 2004.

Performance Lighting

The following table compares New Jersey's performance lighting incentives to those in other states. New Jersey's incentive levels seem appropriate and should be maintained at the same level.

Table 1-72. Lighting Performance Incentives in Other States

State	Program	Incentives	Energy Code Standard
California	Standard Performance Contract	$0.05/kWh saved. Comprehensive projects required (lighting replacements only allowed if they represent max of 20% of savings of a comprehensive application). Max share of cost of utility incentive budget for all lighting (including controls) is 30%.	ASHRAE 90.1 – 2001/2004
Minnesota	Xcel Energy	$1.00/watt per ft^2 below program incentive threshold (currently 20% more energy-efficient than code for Existing Facilities)	ASHRAE 90.1-1999
Connecticut	CL&P	Must reduce installed Lighting Power Density (LPD) in watts-sq ft from the baseline lighting design based on current building code. The incentive is the lesser of $0.08/tenth of a watt reduction below baseline for each square foot of Gross Lighted Floor Area (GFLA) or $0.32 cents for each square foot of GFLA when the full tenth of a watt reduction exceeds four. Emerging lighting technologies may have a bonus available.	ASHRAE 90.1-2001
Minnesota	Xcel Energy – New Construction/Retrofit	Up to $200/kW saved with rebate based on energy savings. Covers other EE measures that exceed standard options.	ASHRAE 90.1 – 1999
New Jersey	***SmartStart Buildings***	***$1.00/watt per ft^2 below program threshold (20% more efficient than code for New Construction/ Major Renovation; 10% for Existing Facilities).***	***ASHRAE 90.1 – 1999***
New York	NYSERDA – CIPP	$0.05-0.06/kWh. Buildings with annual consumption < 1 million kWh are eligible for an additional 20%.	ASHRAE 90.1 – 1999
Washington	Seattle City Light	$0.10-0.14/kWh saved .	ASHRAE 90.1 – 2001/2004
Wisconsin	WE Energies	$0.15 per ft^2 of GLFA to meet Benchmark™ efficiency, i.e., meet or slightly exceed State Code. Each tenth watt/square foot less efficient than the Benchmark reduces the incentive by $0.05.	ASHRAE 90.1 – 1999
	Focus on Energy	$0.01/kWh ($30/peak kW) for lighting conversions. $0.02/kWh ($40/peak kW) for High Performance T8 fixtures > 50% wattage controlled. Based on annual energy savings.	

Prescriptive Lighting

Energy-efficient lighting is now considered standard equipment by most trade allies. They believe that the incremental cost for energy-efficient lighting is now low enough to remove it as a significant factor in the market. An overview of prescriptive incentives for lighting and lighting controls in various states is presented in the following two tables.

Table 1-73. Prescriptive Incentives for Lighting Fixtures in Various States

State/Product	CFL (Hard-Wired)	High Bay fixtures	LED Exit signs	Metal halide (Pulse start)	T-5 & T8 lamps/ballasts
CT (CL&P)[53]	$25	$30**	$10	$30	$10-50
Hawaii (New Construction) (Existing)	- -	- -	--	$20-45 $35-75	$1.30-$2.20 $2.40-$3.60
IA (MidAmerican)	$10	$6-12	$5	-	$6-16
MA (National Grid)*	-	$30-40	-	$10	$10-30
MN (Xcel Energy Retrofit) (Xcel Energy - New Construction) (NSTAR Electric – New Construction)	$8-24 $3-8 $20	$75 $12 -	$6 - -	$25-65 $6-18 -	$9-16 $2-2.50 $10-30
NJ	***$25-30***	***$50-75***	***$20***	***$45***	***$10-20***
NY (NYSERDA – New Construction)	-	$35	-	$25-60	$7-20
NYSERDA (Smart Equipment Choices)	-	$35	$6*	$25-60	$5-20
OR (ETO New Constr.) (ETO Retrofits)	$10-15 $10-15	$35 -	- -	$50-70 -	$10-20 $8-15
VT (Efficiency VT)	$20	$50***	-	$30-75	$25***
WI (FOE/WE Energies)	$15	$25-60	$5	$25	$2-10

* Must be EnergyStar ** Controlled by Occupancy Sensors *** T-5 Only

[53] Offers bonus incentives to promote the use of “Super T8 and high output T5 fixtures where appropriate.

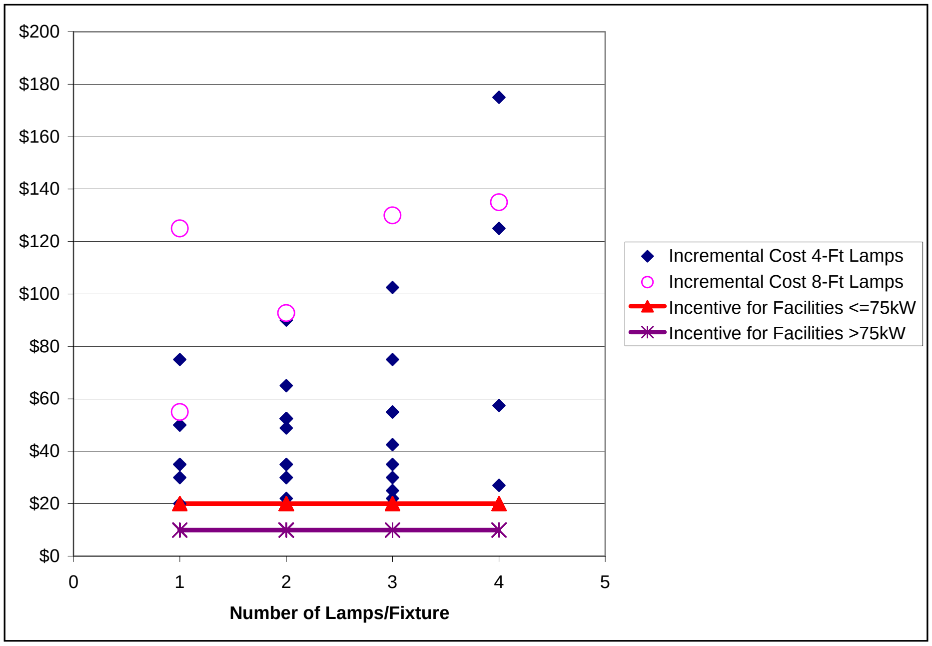
Table 1-74. Lighting Controls

State/Product	Occupancy Sensors		Daylighting	High Bay
	Wall Mounted	Remote Mounted		
CT (CL&P*)	$10	$10	-	$35-75
HI (HECO)	$20	$20	-	-
IA (MidAmerican)	$20	$20	-	-
MA (National Grid)	$30	$75	-	-
MN (Xcel Energy Retrofit) (NSTAR Electric – New Construction)	$12 $30	$36 $75	- $40	- -
NJ	***$20***	***$35***	***$40***	$35-75
NY (NYSERDA – New Construction)	$10	$20	$65-100	-
NYSERDA (Smart Equipment Choices)	$10	$20	$65-100	$35
OR (ETO – New Construction) (ETO – Retrofits)	$20 $20	$40 $50	$100 -	$35 -
VT (Efficiency VT)	$30	$75	-	$50
WI (FOE/WE Energies)	$15	$30	-	-

* Occupancy sensors must control the entire luminaire to be eligible for incentives.

T8s. New Jersey incentives for T8s are equivalent to several other programs but substantially higher than some. New Jersey incentives for larger facilities are less than ½ the incremental cost of the lamps with the smallest incremental cost (Figure 1-30). Incentives for smaller facilities are near the incremental costs for some equipment. The New Jersey T8 incentives are reasonable when compared to incremental cost and other programs, however elsewhere we argue that moving away from lighting to other measures would be appropriate, which would suggest lowering the incentives for T8s.

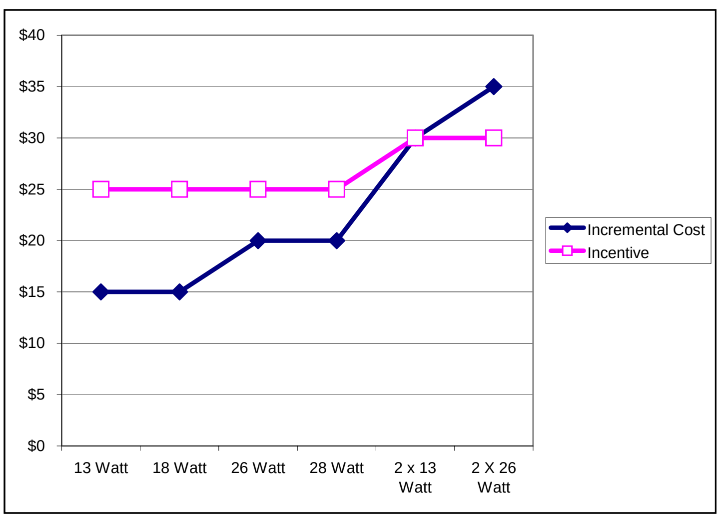
Figure 1-30. Incentives and Incremental Cost – T8s



Source: Incremental cost data from NYSERDA.

CFLs. New Jersey incentives for CFLs are more generous than those in most other programs examined and for many sizes are higher than incremental cost (Figure 1-31). As a result, it appears the New Jersey incentives are too generous and ought to be reduced, probably to the $10 to $15 range.

Figure 1-31. Incentives and Incremental Cost – CFLs

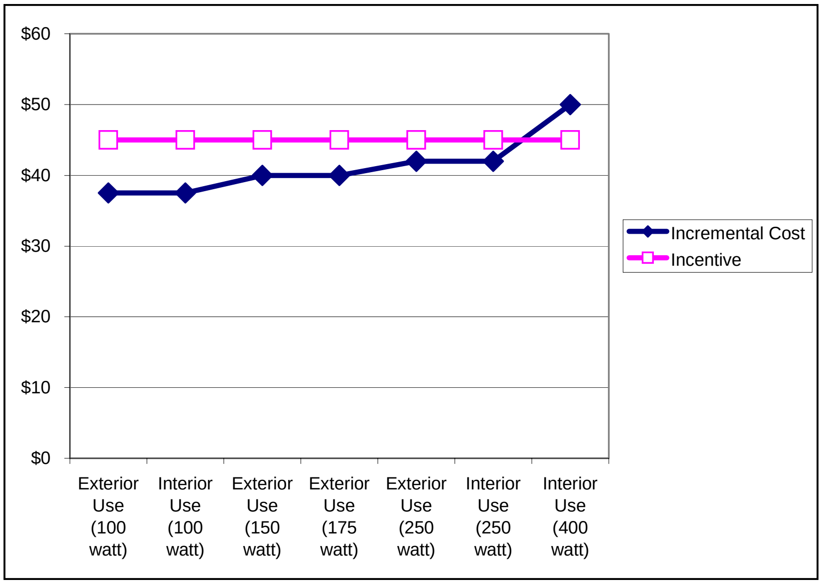


Source: Incremental cost data from NYSERDA.

LED Exit Signs. New Jersey incentives for LED exit signs at $20/fixture are substantially more generous than the other programs we examined. Several programs do not incent LED exit signs at all. Incremental costs from NYSERDA's study were $30/fixture compared to an incandescent fixture and $10 compared to a CFL fixture. The New Jersey incentives seem too generous and should be reduced to the $5 range.

Pulse Start Metal Halide. New Jersey incentives for Pulse Start Metal Halide at $45/fixture are more generous than several other programs but in the same range as others. When compared to NYSERDA data (Figure 1-32), the New Jersey incentives are higher than incremental costs for all uses except the largest. The incentives for Pulse Start Metal Halide seem too high and ought to be reduced to the $25-$30 range.

Figure 1-32. Incentives and Incremental Cost – Pulse Start Metal Halide



Source: Incremental cost data from NYSERDA.

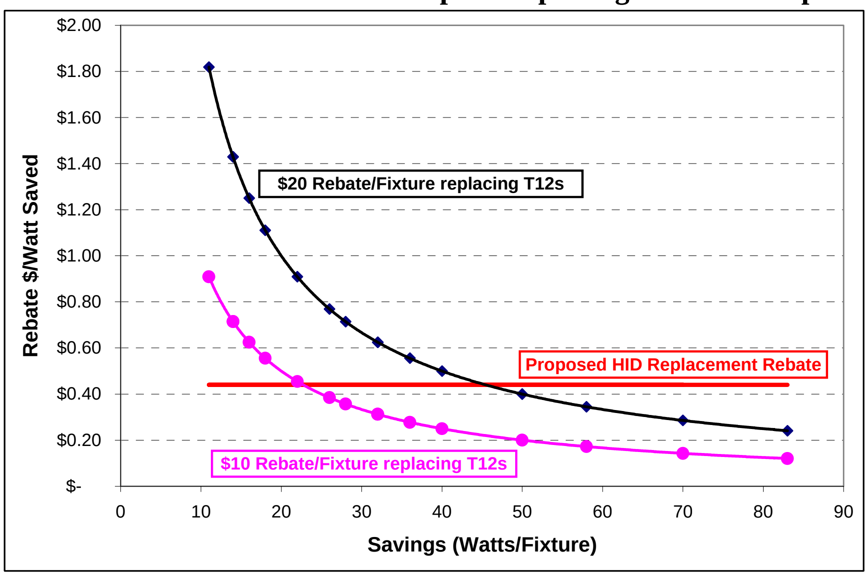
High-Bay. A proposal has been made to the utilities to drop the height restriction on T5 or T8 replacements for HID lights in high bay applications. A second proposal recommended providing incentives for HID replacements below the current 250 Watt minimum, as shown in the following table. The proposed incentive levels were set proportional to energy savings using the incentive levels in the existing incentives for 250-399 Watt HIDs as a base. The proposed incentive levels are constant on a rebate/Watt saved basis. The existing rebates for replacing T12s with T8s are either $10 or $20 per fixture, based on the size and connected load of the facility and thus do vary on a Rebate/Watt saved basis. The proposed HID incentives fall in the middle of the existing T12-T8 incentives on a $/Watt saved basis (Figure 1-33).

Table 1-75. Proposed HID Replacement Incentives

Watt HID	Incentive ($) Proposed	Incentive ($) Existing
400+	$100	$75
250-399	50	50
175-249	43	0
150-174	30	0
100-149	30	0
75-99	16	0

Source: Extracted from April 13, 2006 Memo from S. Lynn Sutcliffe, CEO of the EnergySolve Companies, on behalf of the National Association of Energy Service Companies (NAESCO) to the C&I Subcommittee of the Energy Efficiency Committee of the Clean Energy Council.

Figure 1-33. Fluorescent Fixture Incentives – Compare Replacing T12s with Replacing HIDs



Source: 2004 Protocols for savings and current rebates for replacing T12s, Sutcliffe memo cited above for HID replacement incentives.

We do recommend eliminating the height restriction on HID replacements. We also recommend providing incentives on HID replacements below 250 Watts and defining the incentives in relationship to energy savings, as was done in this proposal. The proposed incentive levels appear to be based on reasonable assumptions and are reasonable when compared to the rebates on replacing T12s with T8s. However, we are recommending below that lighting be de-emphasized in favor of other technologies, which would imply lowering the incentives, not keeping them at the same level while loosening the criteria.

Air-Cooled Chillers

An overview of prescriptive incentives for chillers in various states is presented in the following table.

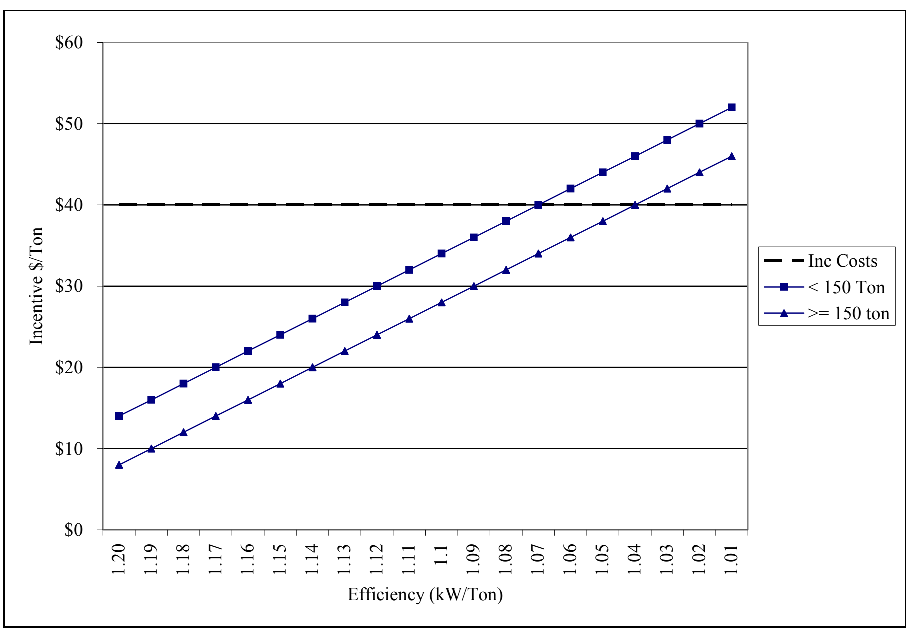
Table 1-76. Prescriptive Incentives for Chillers

State	Program	Air-Cooled	Water-Cooled
Connecticut*	CL&P Energy Conscious Construction[54]	$3.50/ton plus $24/kW/ton efficiency bonus.	$4.00/ton + $530/kW/ton efficiency bonus.
Hawaii	HECO – New Construction	$20/ton + $250/kW/ton for greater efficiency	
Iowa	MidAmerican Energy	$10/ton + $400 efficiency bonus	
Massachusetts**	NGrid – New Construction	$20-30 per ton	$6-25 per ton
		$6-25/ton + bonus for increased efficiency	
Minnesota	Xcel Energy	$20/ton+$5/ton for greater efficiency	
New Jersey	***StartStart Buildings***	***$8-52/ton based on kW/ton***	***$16-124 per ton***
Oregon**	ETO – New Construction	$50/ton	

* ARI Standard 550/590-98   ** ARI – 590-92

The following graphs show that the current New Jersey incentive levels are mostly below the average incremental costs for high efficiency air cooled chillers and that these incentive levels are reasonable. At the higher efficiency levels, the higher savings justifies an incentive level above the average incremental costs.

Figure 1-34. Incremental Costs and Incentives – Air Cooled Chillers



[54] For > 100 tons use custom measures process.

Source: Incremental cost data from DEER.

Water-Cooled Chillers

The following graphs show that the current New Jersey incentive levels are mostly below the average incremental costs for high efficiency water cooled chillers. These incentive levels are reasonable and should not be changed. The LIPA chiller rebates were added to these graphs to provide a point of reference. At the higher efficiency levels, the higher savings justifies an incentive level above the average incremental costs. The incentives for water cooled chillers greater than or equal 300 tons is well above the average incremental costs. This is justified because the incremental costs of achieving these higher efficiency levels is much higher than the average incremental cost for units of this size.

Figure 1-35. Water Cooled Chillers 30 to < 70 Tons

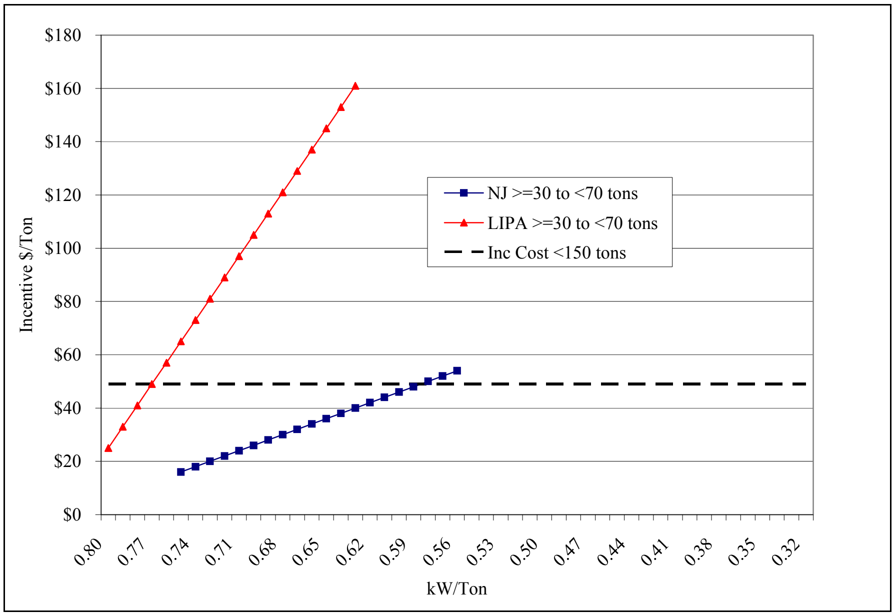


Figure 1-36. Water Cooled Chillers >= 70 to < 150 Tons

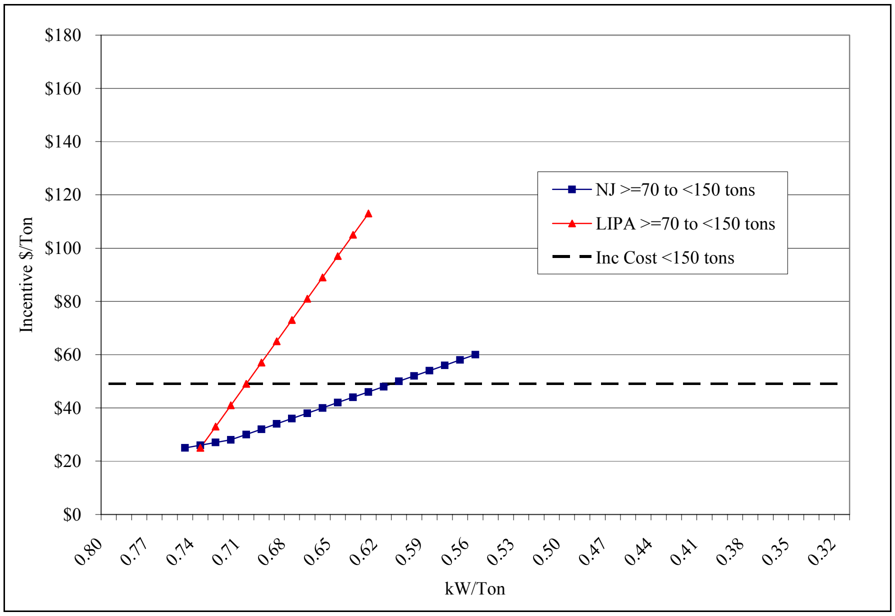


Figure 1-37. Water Cooled Chillers >= 150 to < 300 tons

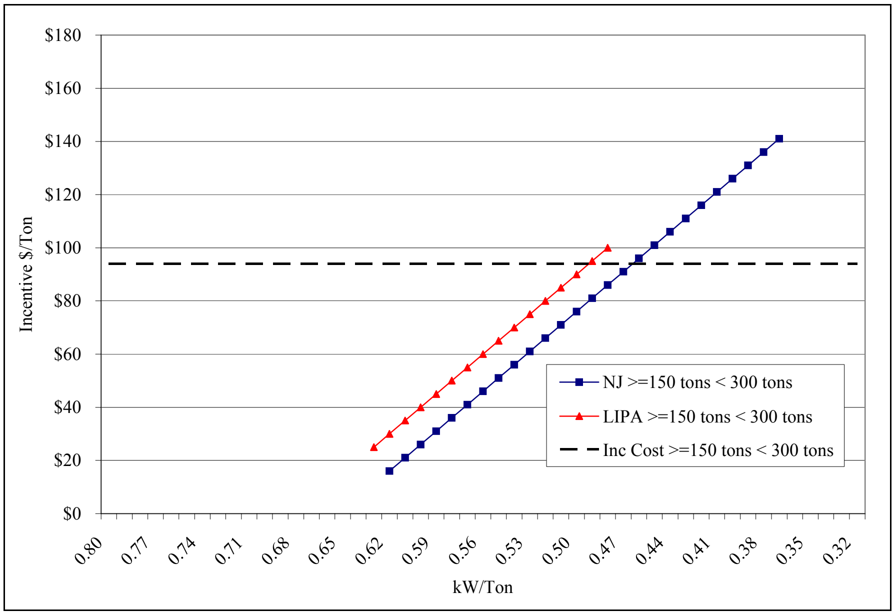
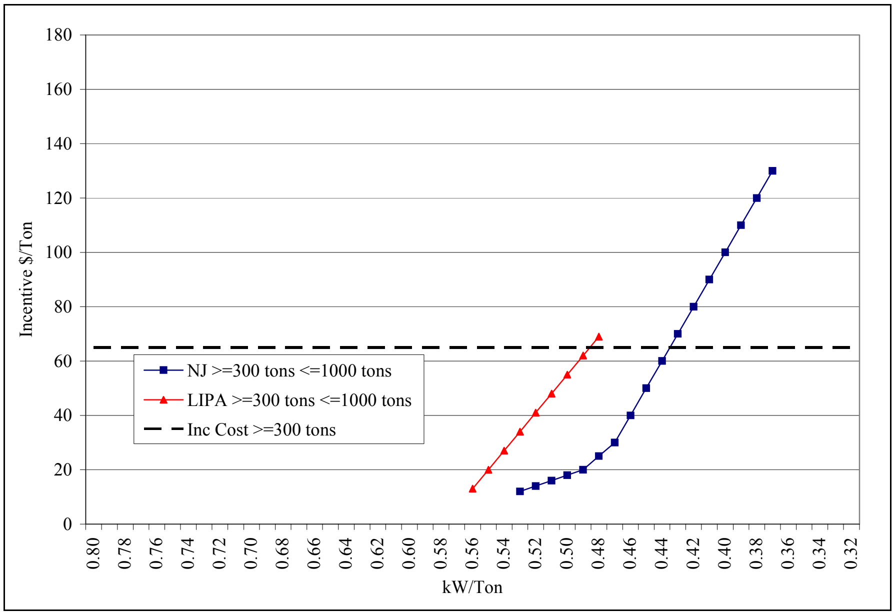


Figure 1-38. Water Cooled Chillers >= 300 tons



Natural Gas Chillers

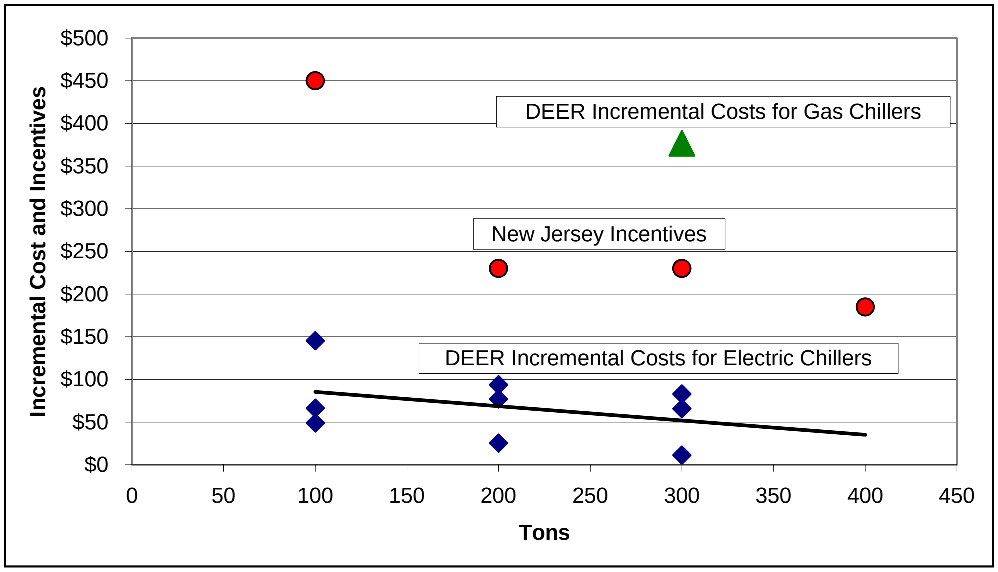
It appears that the incentives for medium and large natural gas absorption chillers are reasonable. The incentives for chillers under 100 tons may be a little high. The DEER database provides only one incremental cost value for gas chillers: $376.71/ton for a gas absorption chiller (direct fired) (0.0071 EIR, 1.0 HIR) compared to a centrifugal chiller of 0.576 kW/ton. This size baseline chiller is compared to electric chillers of 300 tons or more. New Jersey incentives for chillers over 400 tons at $185/ton are 49% higher than the DEER incremental cost. Chillers in the 100-400 ton range are 61% of incremental cost with New Jersey incentives of $230/ton.

Incremental costs for electric chillers in DEER decrease as the size of the chiller increases (see Figure 1-39). If the same trend applies to gas absorption chillers as well, incremental costs of 100 ton absorption chillers would be between $400 and $450/ton. With incentives at $450/ton it appears that New Jersey's incentives for smaller chillers are much closer to incremental cost than for medium and large chillers. A rate closer to $300/ton for chillers 100 tons or less appears to be more appropriate.

NYSERDA provides a single incentive rate for gas absorption chillers of $238/ton.[55] At that rate, New Jersey's incentives are higher than NYSERDA's for small chillers, roughly equal for medium chillers and more generous for the large chillers.

[55] NYSERDA calculation: Chiller kW Bonus = (*Peak Operating Tons) x [(kW/ton baseline - 0.1 kW/ton parasitic load] x $500/kW. kW/ton baseline = 0.576 from DEER database.

Figure 1-39. Comparing Incentives and Incremental Costs for Gas Absorption Chillers



Regenerative Desiccant incentive of $1.00/CFM

Table 1-77. Incentives for Natural Gas Absorption Chillers

State	New Jersey	NYSERDA
<100 tons	$450/ton	$238
100-400 tons	$230/ton	$238
>400 tons	$185/ton	$238

NYSERDA calculation: Chiller kW Bonus = (*Peak Operating Tons) x [(kW/ton $_{baseline}$ - 0.1 kW/ton $_{parasitic\ load}$] x $500/kW. kW/ton $_{baseline}$ = 0.576 from DEER database.

Variable Frequency Drives (VFDs)

It appears that the current rebates levels for variable frequency drives (VFDs) in New Jersey are too generous and should be decreased. VFDs are becoming more common in the market place and the costs of these systems have been coming down.

The DEER database estimates that the incremental costs of a VFD on a variable air volume system is about $221 per horsepower controlled including equipment and labor. The DEER database also estimates that cost of a VFD on a hot or chiller water pumping system is about $212 per horsepower controlled including equipment and labor. In contrast NYSERDA did a review of their VFD projects and calculated that the actual costs of a VFD are about $80 per horsepower controlled.

In addition, other utilities throughout the country have started to lower their incentives for VFD, reflecting the reduced costs of these systems and the increase in use of these systems. Table 1-78 shows a comparison of the incentive levels across the country and the recommended New Jersey incentive levels.

Table 1-78. VFD Rebate Comparison

Controlled HP	Incentive per Controlled Horsepower (HP)				
	NYSERDA	**MidAmerican (IA)**	**Focus on Energy (WI)**	**NJ Current**	**NJ Recommended**
5 to <10 hp	$20	$30	$30	$155	$95
10 to <20 hp	$20	$30	$30	$120	$75
20 – 40 hp	$17.50	$30	$30	$65	$40
>40 – 100 hp	$15	$30	$30	$65	$40
>100 hp	$10	$30	$30	$65	$40
Pump Motors					
>20 hp	*See above*	$30	$30	$60	$40

Geothermal Heat Pump

It appears that the current rebates levels for geothermal heat pumps in New Jersey are low. As seen by the program activity in 2005 there can be large savings from the installation of these units. The six geothermal heat pump projects installed in 2005 saved over 139,000 kWh, for an average of 23,167 kWh each.

The DEER database estimates that the incremental costs of a geothermal heat pump costs an additional $516 per ton and $360 per ton in labor for total incremental costs of $876 per ton. The current rebate of $370 per ton is about 42% of the incremental cost.

We recommend increasing the geothermal heat pump incentive to $430 per ton. This is about 50% of the incremental costs.

Gas Boilers and Furnaces

We collected data on incentive levels offered in other states for natural gas boilers and furnaces (Table 1-79). In general, the New Jersey incentives are higher than other programs for furnaces and about the same for boilers. We see no compelling evidence that the incentives in New Jersey should be changed.

Table 1-79. Prescriptive Incentives for Natural Gas Heating

State	Gas-Fired Boilers	Efficient Furnaces
Massachusetts (GasNetworks)	$200-500	$150-400
Minnesota (Xcel Energy)	$750-$7,500	$75-100
New Jersey	***$1-2/MBH***	***$500-600***
NYSERDA (Smart Equipment Choices)	$600	$500
Oregon (Energy Trust of Oregon)	$2/kBtuh Input	$3/kBtuh Input
Vermont (Vermont Gas Systems)	$150	$150-300
Wisconsin Focus on Energy	$100 for <=300MBh and 85-89% AFUE $150 for 90% AFUE $200 for 90% AFUE or greater Modulating Hot Water Boiler	$150 for 90+AFUE with ECM
PG&E	$1.00/Mbtuh	

Water Heating Measures

New Jersey's water heater incentives are approximately the same as in Oregon, PG&E, and Southern California Gas. For some measures they can be substantially higher than in Massachusetts and Vermont. We see no compelling evidence that the water heater incentives in New Jersey should be changed.

Table 1-80. Prescriptive Incentives for Water Heating Measures

State	Water Heaters
New Jersey	$50 < 50 gals, $2/MBH <300 MBH $1.75/MBH 300-1500 MBH $1/MBH 1500-4000 MBH
Oregon (Energy Trust of Oregon)	$2.50/kBtu/hr in
Vermont (Vermont Gas Systems)	$100
PG&E	$1.50/Mbtu for >75,000 MBtu
Southern California Gas	$2/Mbtuh
Massachusetts (Bay State Gas and Berkshire Gas)	$300

HVAC Measures

We collected data on incentive levels offered in other states electric HVAC measures, as shown in the following table (Table 1-81). In general, the New Jersey incentives for HVAC measures match those in other programs and should remain where they are. The exception is for Packaged Terminal AC, which should be reduced to $50/unit to be in line with Cool Choice.

Table 1-81. Prescriptive Incentives ($/ton) for HVAC Measures

State/Product	Unitary AC & Split Systems	Air-to-Air Heat Pumps	Water Source Heat Pumps	Packaged Terminal AC & HP	Dual Enthalpy Economizer Controls
HI (HECO – New Construction)	$40[56]	-	$80[24]	-	-
IA (MidAmerican Energy)	$200 for <65 MBtu[24, 57]	$50/ton	$50 efficiency rebate	$50/unit	-
MA (NGrid - New Construction)	-	-	-	-	$250/unit
MN (Xcel Energy) (NSTAR Electric)	$150 $73-92[58]	- $73-92	$10 $81	$7.50[24] -	$10/ton -
New Jersey	***$73-92***	***$73-92***	***$81***	***$65/unit***	***$250/unit***
NY (NYSERDA – New Construction)	$106-125	$90	$96-140	$45/unit	$150[59]
Northeast (CT, MA, NJ, RI, VT - Cool Choice)	$73-92	$73-92	$81	$50/unit	$250/unit

Recommendations for Other Measures

New Jersey is funding much the same technologies as the programs in other parts of the country. Participant and nonparticipant end users were asked to recommend other equipment that the program should cover with incentives. Their recommendations are shown in the following table. Controls including energy management systems were frequently mentioned. Three newer lighting technologies were mentioned (ceramic metal halide, LED, and fiber optic) as well as one not-so-new lighting technology (fluorescents). Several nonparticipating trade allies are pushing technologies such as reflective roofs, heat recovery systems, and building envelope features that are integral to qualifying for the LEED program.

[56] Plus bonus for greater efficiency.

[57] Efficiency bonus only for water cooled and = > 65 MBtu air cooled.

[58] $350/unit for Split Systems.

[59] Also provides incentives for Demand Controlled Ventilation Sensors.

Table 1-82. Equipment End Users Want Program Incentives For

Participants	Participants	Nonparticipants
HVAC Controls	Smaller HVAC Units	Control upgrades for HVAC (2 mentions)
Ceramic Metal Halide Lights	Individual Gas Boilers and Hot Water Heaters in Townhomes Instead of Centrally Located	Heat Pumps
Fluorescent Lighting	LED Lighting	Lighting Controls
Energy Management Systems (3 mentions)	Prescriptive Rebates for Fiber Optic Lighting	Light Bulbs
Cooking Equipment	Windows (2 mentions)	Energy management systems
Gas Fryers	Window Tinting	Windows (2 mentions)
Electric Panels	Tankless Water Heating	
Fractional Horsepower Motors	Insulation (2 mentions)	
Door Seals	Ice Machines	

While any technology can be promoted through the custom rebate track, specific attention may still be needed for various technologies.

Efficient Commercial Service Gas Water Heaters: High-efficiency tank-type service water heaters sized for small commercial uses are typically condensing water heaters that transfer a claimed 95 to 99 percent of fuel energy to the water in the tank. The cooled exhaust from the water heaters is ducted outside through a wall or ceiling. In recent years, improved models have become available on the market.

Drainwater Heat Recovery: Drainwater heat exchangers recover heat contained in wastewater from appliances, equipment, and processes before the wastewater flows to the sewer. They pre-heat water coming in to the building's water heating system. The company RenewABILITY Energy has adapted a heat exchanger to non-residential markets.

Food Service Technologies: A variety of different kinds of food service equipment is available. For example, the Massachusetts utilities' statewide GasNetwork program identifies a set of efficient gas fryers that qualify for technology-specific incentives.

Fluorescent "Super T8" Systems: The appropriate combination of "Super T8" lamps and ballast can get up to 20% energy savings with the same amount of light as a standard T8 System. For example a 32W Super T8 System uses 48 Watts compares to 59 Watts for a standard T8 and lasts 24-30,000 hours compared to a lamp life of 15-20,000 hours for the standard T8.

1.9.3 Recommendations

In summary, the C&I Program should shift resources away from mainstream energy-efficient lighting and motors to newer technologies (e.g., ceramic metal halide, LED, Super T-8 and high pressure sodium), and technologies affecting specific business types (e.g., cooking equipment). In conjunction with the recommendation on whole-building approaches, consider offering incentives for components of energy-efficient building construction (e.g., thermal envelope measures). Specific recommendations for rebate levels are discussed in the table below.

Table 1-83. Recommended Changes to Incentives

Technology Classification	2005 Incentive	Proposed 2006 Incentive
Design Support Incentives:		
Pre-design planning session	1000	No change
Design simulation and screening	$5,000 or more depending on the size of the building or; service may be provided by utility	No change
Incorporation of energy efficiency measures into the Final Design	$5,000 depending on the measures included	No change
Custom Measure Incentives:		
Measures not covered by the prescriptive incentive tables	Generally, up to 80% of eligible qualifying measure's incremental cost or a buy down to a 2 year payback, whichever is less. To be eligible for incentives, these projects must first pass several 'cost-effectiveness' criteria.	No change
Qualifying Equipment Incentives (no measure incentive shall exceed the non-installed cost of the measure):		
Electric Chillers:		
Water Cooled Chillers	Up to $12 - $170 per ton depending on size and efficiency	No change. The current New Jersey incentive levels are mostly below the average incremental costs for high efficiency water cooled chillers and are reasonable. At the higher efficiency levels, the higher savings justifies an incentive level above the average incremental costs.
Air Cooled Chillers	Up to $8 - $52 per ton depending on size and efficiency	No change. New Jersey incentive levels are mostly below the average incremental costs for high efficiency air cooled chillers and are reasonable. At the higher efficiency levels, the higher savings justifies an incentive level above the average incremental costs.
Natural Gas Chillers:		
Gas Absorption Chillers	1.1 full or part load COP	
< 100 tons	Up to $450 per ton	Reduce to $300/ton
100 to 400 tons	Up to $230 per ton	No change
> 400 tons	Up to $185 per ton	No change
Gas Engine Driven Chillers	Treated under Custom measure path (1.1 full or part load COP)	
Desiccant Systems	Up to $1.00 per cfm (gas or electric)	
Unitary HVAC Systems:		
Unitary AC and Split Systems	Follows the Regional Cool Choice Program Incentive Schedule (See Appendix A)	No change.

Technology Classification	2005 Incentive	Proposed 2006 Incentive
Air to Air Heat Pumps	Follows the Regional Cool Choice Program Incentive Schedule (See Appendix A)	No change.
Water Source Heat Pumps	Qualifying equipment is eligible for an incentive of up to $81/ton.	No change.
Packaged Terminal AC & HP	Up to $65 per ton	Drop incentives to $50/unit to be in line with Cool Choice.
Dual enthalpy Economizers	Follows the Regional Cool Choice Program Incentive Schedule (See Appendix A)	No change.
Central DX AC Systems => 9.5 EER	>30 to 63 tons: Up to $40 per ton > 63 tons: Up to $72 per ton	No change.
Ground Source Heat Pumps:		
Open Loop & Closed Loop => 16 EER	Up to $370 per ton: Energy Star rated equipment only. To be further reviewed	We recommend increasing the geothermal heat pump incentive to $430 per ton. This is about 50% of the incremental costs.
Gas Fired Boilers:		No change.
<300MBH => 85% AFUE	Up to $2.00 per MBH but not less than $300 per unit	
300 MBH – 1500 MBH => 85% AFUE hot water boilers => 84% AFUE steam boilers	Up to $1.75 per MBH	
>1500 MBH – 4000 MBH => 84% AFUE for hot water boilers => 83% AFUE for steam boilers	Up to $1.00 per MBH	
> 4000 MBH	Treated under Custom Measure Path	
Gas Furnaces (=> 90% AFUE)	Up to $300 per furnace	
Variable Frequency Drives (HVAC):		
Variable Air Volume (add on to existing HVAC systems only)	Up to $65 - $155 per hp	The current rebates levels for variable frequency drives (VFDs) in New Jersey are too generous and should be decreased to between $40 and $95.
Air Compressors with VFD's	To be included as a prescriptive measure-specific rebate levels to be determined	
Chilled Water Pumps	Up to $60 per hp	
Gas Fired Water Heating:		No change
<= 50 gallons => 0.62 energy factor	Up to $50 per water heater	
>50 Gallons; <300 MBH => 85% AFUE	Up to $2.00 per MBH, but not less than $50/unit	
300mbh – 1500 MBH => 85 % AFUE	Up to $1.75 per MBH	

Technology Classification	2005 Incentive	Proposed 2006 Incentive
>1500 MBH – 4000 MBH => 84% AFUE	Up to $1.00 per MBH	
> 4000 MBH	Treated under Custom measure path	
Gas Fired Water Booster Heaters:		
=< 100 MBH	Up to $17 per MBH	
> 100 MBH	Up to $35 per MBH	
Premium Efficiency Motors:		
Three phase motors	Follows the Regional MotorUp Program Incentive Schedule	No change.
Prescriptive Lighting:		
T-5 and T-8 lamps with electronic ballast	$20 per fixture for existing facilities with connected load <= 75 kW $10 per fixture for existing facilities <= 50,000 sq. ft with connected load > 75 kW No incentive for new construction or complete renovation	The New Jersey incentives are reasonable when compared to incremental cost and other programs, however moving away from lighting to other measures would be appropriate, which would suggest lowering the incentives for T-5s and T-8s.
LED Exit Signs* - (New Fixtures Only)	Up to $20 per fixture	New Jersey incentives for LED exit signs at $20/fixture are substantially more generous than the other programs we examined. Several programs do not incent LED exit signs at all. Incremental costs from NYSERDA's study were $30/fixture compared to an incandescent fixture and $10 compared to a CFL fixture. The New Jersey incentives seem too generous and should be reduced to the $5 range.
Hard-wired compact fluorescent surface mounted fixtures* - (New Fixtures Only). Must be pin based technology with THD of <33% and BF>0.9		New Jersey incentives for CFLs are more generous than those in most other programs examined and for many sizes are higher than incremental cost. As a result, it appears the New Jersey incentives are too generous and ought to be reduced, probably to the $10 to $15 range.
1 lamp fixture	Up to $25 per 1 lamp fixture	
2 lamp fixture	Up to $30 per 2 or more lamp fixture	
Hard-wired compact fluorescent recessed fixtures*- (New Fixtures Only). Must be pin based technology with THD of <33% and BF>0.9		
1 lamp fixture	Up to $25 per 1 lamp fixture	
2 or more lamp fixture	Up to $30 per 2 or more lamp fixture	
Metal Halide w/ pulse start ballast, for fixtures > 150 watts	Up to $45 per fixture, includes parking lot lighting	New Jersey incentives for Pulse Start Metal Halide are more generous than several other programs but in the same range as

Technology Classification	2005 Incentive	Proposed 2006 Incentive
		others. When compared to NYSERDA data, the New Jersey incentives are higher than incremental costs for all uses except the largest. The incentives seem too high and ought to be reduced to the $25-$30 range.
T-5 and T-8 High Bay Fixtures	Replacing 400W and larger fixtures with bottom of fixture at least 18 feet from the floor = Up to $75 per fixture Replacing 250-399 W fixtures with bottom of fixture at least 14 feet from the floor = Up to $50 per fixture.	We recommend eliminating the height restriction on HID replacements. We also recommend providing incentives on HID replacements below 250 Watts and defining the incentives in relationship to energy savings. The incentive levels included in a separate proposal appear to be based on reasonable assumptions and are reasonable when compared to the rebates on replacing T12s with T8s. However, we are recommending that lighting be de-emphasized in favor of other technologies, which would imply lowering the incentives, not keeping them at the same level while loosening the criteria.
New Construction and Major Renovation	No incentive, performance based only	
LED Traffic Signal lamps (conversion of existing intersections only)		Consider eliminating incentives. Very few programs in other states offer prescriptive rebates to C&I customers for LED traffic signals. Federal standards specify ENERGY STAR v1.1.
8” Lamp	Up to $20 per 8” lamp (red & green only)	
12” Lamp	Up to $35 per 12” lamp (red & green only)	
LED Pedestrian Signal lamps (conversion of existing intersections only)	Up to $20 per fixture	
Lighting Controls:		
Occupancy Sensors (Turning fixtures off in Existing facilities only)		No change. New Jersey incentives are in the middle of the range offered in other states.
Wall mounted	Up to $20 per control	
Remote mounted (e.g., ceiling)	Up to $35 per control	
Day lighting Dimmers – All facilities		No change, although New Jersey incentives at the low end of the range offered in other states.
Fluorescent Fixtures	Up to $25 per fixture controlled	
HID or Fluorescent Hi-Bay controls	Up to $75 per fixture controlled (HID or Fluorescent Hi-Bay)	
Hi-Low Controls – All facilities:		

Technology Classification	2005 Incentive	Proposed 2006 Incentive
Fluorescent Fixtures	Up to $25 per fixture controlled	
HID or Fluorescent Hi-Bay	Up to $75 per fixture controlled (HID or Fluorescent Hi-Bay)	
Performance Based Lighting		
Performance Based Lighting incentives for indoor and outdoor installations (attached to building) - New construction and Major Renovation	Up to $1.00 per watt-per-square foot below baseline which is 20% below (more efficient) code; incentive cap $30/Fixture	No change
Performance Based Lighting incentives for indoor/outdoor installations (attached to building) - Existing construction	Up to $1.00 per watt-per-square foot below baseline which is 10% below (more efficient) code; incentive cap $30/Fixture	No change
Multiple Measures Bonus		
	Up to 10% of the total equipment incentives for the subject project, but not to exceed the smallest individual equipment incentive for the project.	No change

1.9.4 Incentive Caps

Incentive caps are usually put in place to ensure that the budget is not over-spent, to smooth the distribution of funds across the year so the program does not come to a halt when the funds are expended, and to help ensure a broader distribution of the incentives. Incentive caps can help ensure that incentive funds are available throughout the year when the program is not allowed to go over budget. It is not uncommon for programs to run out of incentive funds mid-way through a year but doing so can adversely affect relationships with trade allies and customers and can create distortions in the market.

Incentive caps also can help ensure that incentive funds are distributed across a wider range of participants. Without caps, there is the possibility that a few companies could come up with such large projects that they would monopolize the majority of the funds available. If a program is purely oriented toward achieving cost-effective energy savings, then the distribution of incentives across time, regions, company types, and company sizes should not matter. However, programs rarely are so narrowly focused. With the addition of a goal to move the market toward more efficient equipment and practices comes the need to ensure that the program has some effect on all target markets, which may be expressed in company types or sizes, or in regions. Consistent pressure throughout the year can be very important for moving markets. A program that is only active for part of the year can be much less effective in changing standard operating procedures.

Even if a program is purely oriented toward achieving cost-effective energy savings, with a first-come-first-served approach and no incentive caps, the program runs the risk of spending a large portion of its budget on large but marginally cost-effective projects that happen to get in the door first. By spreading funds more broadly across time and projects, a program will have more leeway to pursue aggressively the most cost-effective projects.

Conclusion #1. If the C&I Program is intended to move markets, not just to achieve current energy savings, then an incentive cap that is low enough to ensure a reasonable distribution of incentives across time, across company sizes and types, and across regions of the state is a sensible approach.

As we have discussed, incentive caps are used not just to distribute incentives across companies but to also distribute them across time – to ensure budgets were not over-spent or exhausted too early in the year. Some argue that because some utilities have not been spending their entire budgets lately, incentive caps should be raised to increase spending. In this view, incentive caps could be raised without harming the distribution across companies, regions, or time – the extra funds spent on large projects would simply use up funds that were typically going unspent, rather than robbing other projects. While this scenario is conceivable, it assumes that raising incentive caps is the best method for increasing program spending. This is not a foregone conclusion. The amount of incentives distributed could be increased in a number of ways, including increased training and advertising, increased staffing of sales and technical assistance teams, broadening the technologies covered by the program, and increased targeting of sectors with high potential but low participation. Given the staff attrition utilities have experienced as they look to the time when the Market Managers take over the programs, it seems likely that reduced spending levels relative to budgets are more strongly correlated with staffing levels and level of effort than with incentive caps.

Conclusion #2. If under-spent budgets are a problem, raising incentive caps is not necessarily the best solution.

If we now start with the assumption that a reasonable distribution of projects is an important goal as we look to define the appropriate incentive cap, how do we define "reasonable"? We can look at two pieces of evidence, first how does the distribution look within New Jersey given the existing $100,000 cap? Second, what caps do programs in other states use and why?

Distribution of Incentives in New Jersey

If each participant received the maximum incentive of $100,000, the C&I Program could have at most 237 participants in 2005 (see the following table). (This assumes that each "participant" has no more than one account and is thus eligible for a maximum of $100,000 in incentives. If some participants have more than one account then the program could end up incenting fewer than 237 companies.) The smaller utilities would have fewer than ten participants.

Table 1-84. Budgets and Potential Number of Participants

Program	Total	Conectiv Power Delivery	JCP&L	PSE&G Electric	RECO	NJ Natural Gas	E-Town Gas	PSE&G Gas	South Jersey Gas
Grants, Incentives, Arrears Reduction ($000s) [60]									
New Construction	2,679	400	570	1408	18	11	68	150	54
Retrofit	18,657	1,915	6,570	8,257	180	61	467	800	407
Schools	2,413	327	826	811	23	25	81	97	223
Total	23,749	2,642	7,966	10,476	221	97	616	1,047	684
Maximum number of participants if each gets $100,000 (budget/100,000)									
New Construction	27	4	6	14	0	0	1	2	1
Retrofit	187	19	66	83	2	1	5	8	4
Schools	24	3	8	8	0	0	1	1	2
Total	237	26	80	105	2	1	6	10	7

The program's goals for 2005 call for 3,457 projects, distributed as follows:[61]

- New Construction = 134 completed jobs
- Existing Construction = 3128 completed jobs
- Schools = 195 completed jobs

If the "Grants, Incentives, and Arrears Reduction" budget is divided by those goals, the average new construction project will receive almost $20,000 in incentives, the average retrofit project almost $6,000, and the average schools project just over $12,000 (see the table below). In this context, a cap of $100,000 seems reasonable.

Table 1-85. Average Incentive if Goals Are Met

	Average Incentive
New Construction	$19,993
Retrofit	5,965
Schools	12,374

Average incentive = Budget for Grants, Incentives, Arrears Reduction divided by completed jobs goal

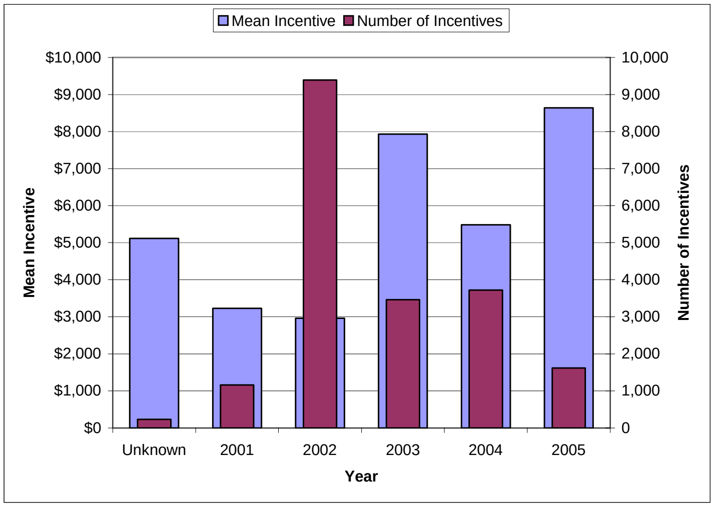
The average incentive in the program tracking data[62] varies from just under $3,000 in 2002 to over $8,500 in 2005. The number of incentives distributed varied from just over 1,000 in 2001 to over 9,000 in 2002.

[60] New Jersey's Clean Energy Program 2005 Program Descriptions and Budget: Utility Managed Energy Efficiency Programs. Updated June 8, 2005

[61] Ibid.

[62] Program data provided by the utilities to the OCE.

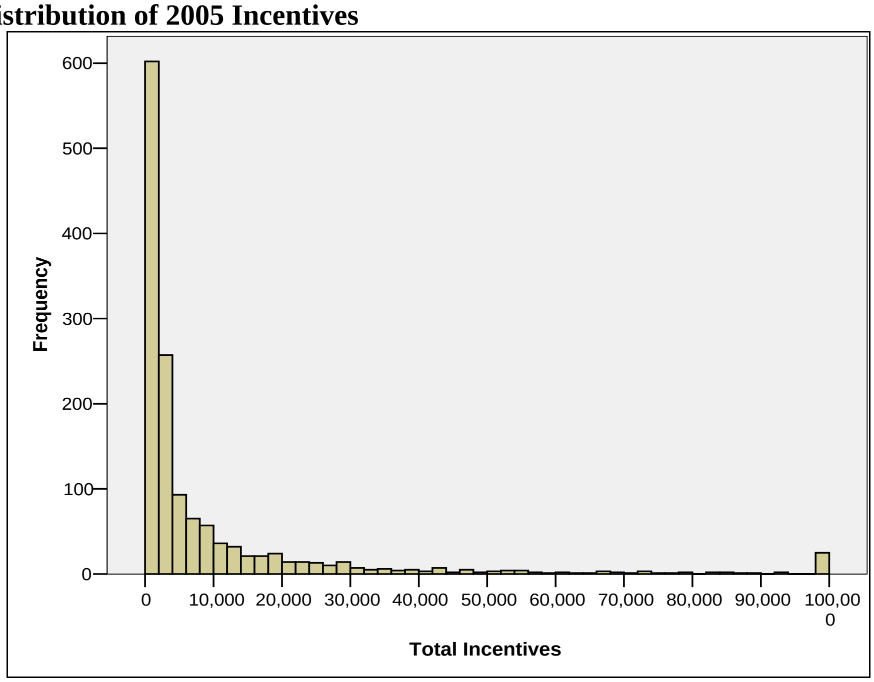
Figure 1-40. Mean Program Incentive and Number of Incentives by Year



Source: Program tracking data

The vast majority of incentives distributed in 2005 were well under the $100,000 cap (see the following figure). Ninety percent of the participants received less than $26,000 in incentives and 75% received less than $9,000. The median incentive was $2,490.

Figure 1-41. Distribution of 2005 Incentives



(Total incentives for each participant for 200563. Any participant with over $100,000 in incentives was grouped in the 100,000 bin.64) Source: Program tracking data

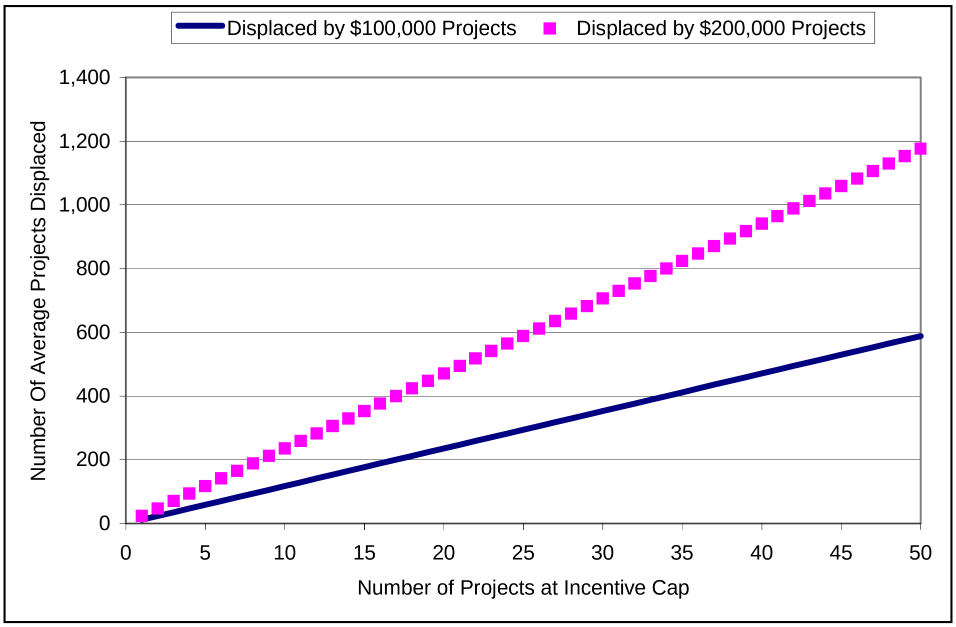
[63] We do not have year installed for participants from RECo, all their records were included in the calculation.

[64] For this graph, the program data was aggregated on unique combinations of participant name and zip code or city, which may have aggregated some companies that were separately subjected to the $100,000 cap, which resulted in some cases above the $100,000 cap.

The scarcity of participants receiving more than $50,000 in incentives (4.6% of the total participants) seems to imply that there are not a large number of projects that would proceed if they got a small amount more than $100,000 in incentives. The data do not support drawing a conclusion about the number of projects that might come forward if the incentive cap was raised significantly.

Without testing a new incentive cap in the market, we cannot know what its effects will be on the distribution of projects. However, we can at least place boundaries around the likely effects by creating a hypothetical situation. If each new project that comes in at the incentive cap displaces smaller projects in proportion to their costs, then a $100,000 project will displace on average $100,000/$8,500 or 12 projects (where $8,500 is the mean project incentive as was the case in 2005). If the incentive cap is raised to $200,000, each new project at the cap would displace 24 projects. Twenty-five projects at the $200,000 cap would crowd out almost 600 average projects (see the figure below), which represent 17% of the program's project goal for 2005.

Figure 1-42. Hypothetical Displacement of Average Projects by Projects at the Incentive Cap



Conclusion #3. The program tracking data do not provide any evidence to suggest that a wealth of projects would come in if the incentive cap were raised modestly. The program budgets could support a few larger incentives but more than a few would likely affect the distribution of other projects.

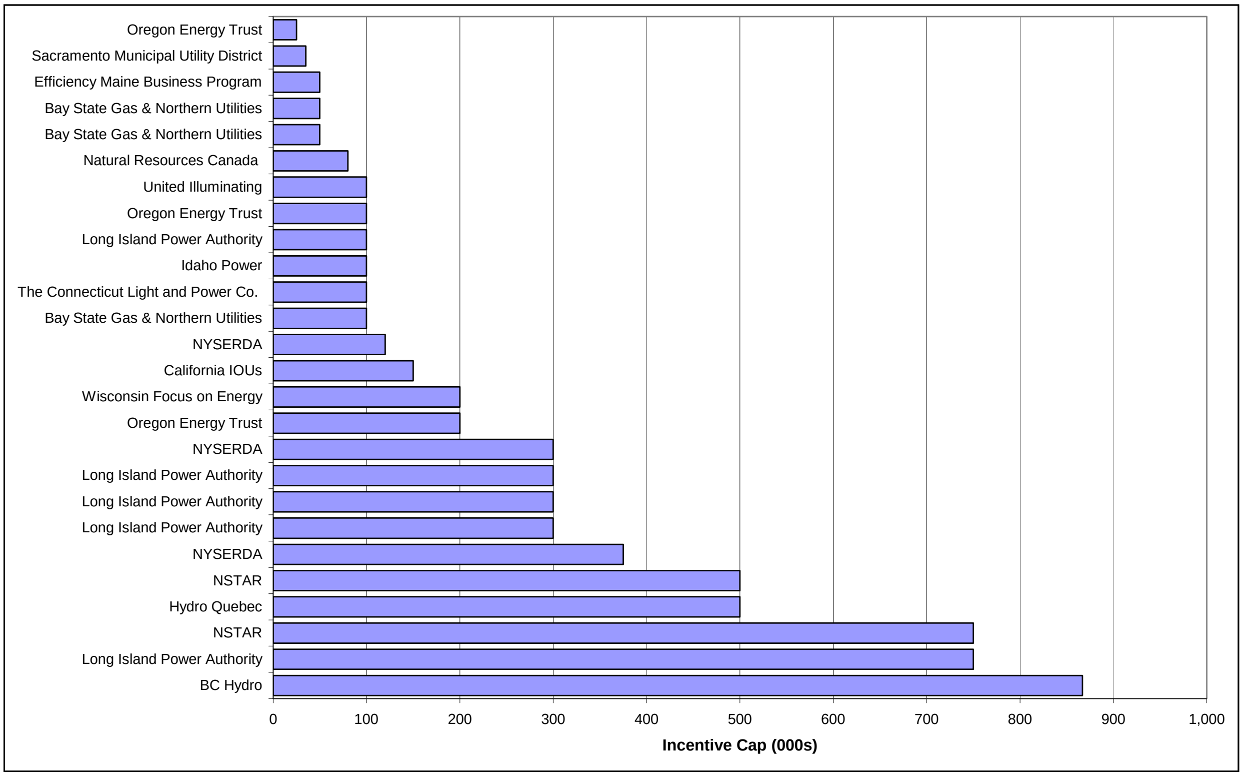
Incentive Caps in Other States

Incentive caps for similar programs in other jurisdictions range from no caps, e.g., National Grid's Design 2000 Plus program, to close to $900,000 for BC Hydro's Power Partner's Program. The average cap in this sample is over $200,000. It is $169,000 if the two largest examples and the programs with no caps are eliminated. Seven programs have caps of $100,000.

Table 1-86. Incentive Caps for C&I Programs

Incentive Cap ($)	Program Type	Location
50,000	Small C&I in MA NH	Bay State Gas & Northern Utilities
100,000	Large C&I in MA	Bay State Gas & Northern Utilities
50,000	Large C&I in NH	Bay State Gas & Northern Utilities
866,857	Commercial existing buildings	BC Hydro
80,000	Commercial existing buildings	Natural Resources Canada (Office of Energy Efficiency)
100,000	C&I New Construction and Retrofit Projects	The Connecticut Light and Power Co. and The United Illuminating Co.
50,000	Retrofit and New Construction	Efficiency Maine Business Program
None	Retrofit	Efficiency Vermont Business Program
None	Major C&I renovation and new construction	Xcel Energy
500,000	Building Optimization	Hydro Quebec
100,000	Industrial incentives, HVAC tune-ups	Idaho Power
300,000	Custom incentive small and mid-sized buildings	Long Island Power Authority
100,000	Major renovation and new construction - Prescriptive - per project	Long Island Power Authority
300,000	Major renovation and new construction - Prescriptive - per year	Long Island Power Authority
300,000	Major renovation and new construction - Custom incentive - per project	Long Island Power Authority
750,000	Major renovation and new construction - Custom incentive - per year	Long Island Power Authority
None	Major C&I renovation and new construction	National Grid
750,000	C&I New Construction – custom solutions	NSTAR
500,000	C&I New Construction – custom solutions	NSTAR
120,000	C&I New Construction - pre-qualified and custom	NYSERDA
300,000	C&I New Construction - Whole Building Design	NYSERDA
375,000	C&I New Construction - Whole Building Design - LEED Certified	NYSERDA
25,000	New Building Efficiency Program - Standard Tract (prescriptive)	Oregon Energy Trust
100,000	New Building Efficiency Program - Custom	Oregon Energy Trust
200,000	New Building Efficiency Program - High Performance	Oregon Energy Trust
150,000	Savings By Design (new construction)	California IOUs
35,000	C&I Incentive Program (all but lighting)	Sacramento Municipal Utility District
100,000	Energy Opportunities – large scale retrofit program for customers > 150 kW.	United Illuminating
200,000	with $100,000 per project limit for commercial and industrial statewide programs	Wisconsin Focus on Energy

Figure 1-43. Incentive Caps for C&I Programs



Conclusion #4. New Jersey's incentive cap is within the most common range of the programs we examined around the country. It is lower than the average. In the final analysis, whether the incentive cap should be raised depends on the balance between a desire to increase total potential savings by widening the pool of potential projects versus the distribution of incentives across the market.

How should the cap be implemented?

Two issues are important for discussing how the incentive cap is implemented: how the corporate entity is defined that is subject to the cap and how exceptions are handled.

Corporate Entity

The incentive cap in the C&I program is specified as "$100,000 per utility account, per calendar year."[65] Using the utility account as the means for defining who is subject to the cap simplifies administration for utilities and is a clear rule for participants.[66] However, it has a distinct limitation in that utility accounts do not always have a one-to-one correspondence with corporate entities as typically thought of in the market. A single business at a single location may have multiple utility accounts. Under the current incentive cap rules, they could receive $100,000 in incentives for each account. A similar business next door could have a single account and thus be eligible for significantly smaller incentives.

[65] New Jersey SmartStart Buildings 2005 Registration Form and interviews with program managers.

[66] Bay State Gas & Northern Utilities also use the utility account number to define the corporate entity for calculating the incentive cap.

If the intent of the cap is to limit incentives to unique businesses, not just to keep a lid on spending, then depending on the utility account number as the sole means for managing the cap does not effectively meet the intent.

This problem has plagued program managers at other utilities; they have addressed it in one of three ways:

Federal Tax ID. Some utilities[67] use the Federal Tax ID[68] to define the entity that is subject to the cap on incentives. This approach should aggregate at the true business level more effectively than utility account. While a business may have multiple utility accounts solely because of how and when they built separate buildings, they are unlikely to have separate Federal Tax IDs unless they are in some way distinguishing between distinct aspects of their business.[69] Using the Federal Tax ID will probably reliably indicate a single entity where the company undertakes one line of business in a building or set of buildings but has more than one utility account number. However, it is still possible that aggregating at the Federal Tax ID will still not uniquely identify businesses in some cases. For example, a manufacturer could operate two separate product lines within the same complex but with separate Federal Tax IDs. Using the Federal Tax ID may not consistently treat some kinds of chain or franchise stores, e.g., chain stores may have separate Federal Tax IDs for each store or Tax IDs covering multiple stores. The NYSERDA program manager cited the Fashion Bug clothing store as an example; each separate store has its own Federal Tax ID.

Using the Federal Tax ID would be a more viable option when the programs are administered by Market Managers instead of the utilities as the Market Managers may not have ready access to all NJ utility account numbers. At least some C&I Construction Program application materials already have a place for the Federal Tax ID.

Ad hoc. Some program managers we spoke with do not have formal criteria for defining the corporate entity that the incentive caps apply for.[70] Typically, these programs apply a broad definition that considers any store or company marketed under the same name to be a single entity. Thus chain stores are subject to the incentive cap as a group, not individually. They deal with exceptions and complications as they arise applying common sense rules to defining corporate entities. The managers using this ad hoc approach do not deal with a lot of applications that reach the cap. This approach may work in part because trade allies and customers recognize the intent of the rule and do not attempt to circumvent it and in part because the volume of large projects has not become an issue.

Specific but Broader Definition. NYSERDA takes a specific approach that is broader than using an account number or the Federal Tax ID. They define their approach as follows:

> For the purposes of determining the maximum incentive, an applicant is further defined to include any and all entities of which the applicant has a 10% or more interest in ownership or control. National or chain accounts are considered a single "applicant" and subject to the maximum incentive per applicant.[71]

[67] E.g., Southern California Edison, United Illuminating, Wisconsin Focus on Energy statewide program.

[68] Also known as the Employer Identification Number (EIN).

[69] Subsidiaries of corporations may have separate ID numbers.

[70] KeySpan Energy provided the most complete description of this approach.

[71] Program Opportunity Notice (PON) number 968. Smart Equipment Choices Program. http://www.nyserda.org/Funding/funding.asp?i=2. This rule applies to most C&I programs, not just this program.

NYSERDA requires the Federal Tax ID on its applications but does not require documentation up-front about the ownership criteria. The application materials state that proof of ownership must be submitted upon request. NYSERDA uses the Federal Tax ID for internal quality control of the ownership issue. The NYSERDA program manager for the Smart Equipment Choices Program noted that although policing the ownership criteria seemed a daunting prospect it has turned out to work surprisingly well. Trade allies and program applicants seem to police themselves. The program manager stated that "the trick is making sure market understands it and does not dispute it."[72]

This approach offers several advantages:

It creates a definition of a corporate entity that is broad enough to conform to a common-sense view of what a single company is.

The approach is specific, concrete, and not complicated, which leaves little room for varying interpretations that would damage uniform application.

The approach is verifiable.

This approach offers two potential disadvantages:

It is possible that New Jersey's experience would not mirror NYSERDA's and program managers would have to expend significant resources policing the rules.

It is a broad definition and will reduce the kinds of customers who are able to fit individually under the cap. Although, if a less-broad definition is needed, the criteria could be increased beyond 10% without throwing out the general approach.

Conclusion #5. Incentive caps serve multiple goals but the primary ones should be to help ensure that incentives can be spread throughout time and across a broad spectrum of the market to support both energy savings and transforming markets. Incentive caps should also be implemented consistently and equitably which implies that customers in largely the same circumstances should not face different incentive caps. **With those goals in mind, the logical conclusion is that the definition of the corporate entity subject to the incentive cap should be broad enough to conform to a common-sense definition of a company. Utility account numbers fail on that criteria. The Federal Tax ID number is significantly better, but can still fail. Defining a company by its ownership makes the most sense. The approach NYSERDA took seems to offer a solution that is not overly complex to administer (at least based on NYSERDA's experience) and still conforms to the intent of limiting the amount of incentives that can go to individual entities.**

Exceptions

New Jersey utilities originally enjoyed some flexibility in interpreting the incentive cap rules and allowed some exceptions to occur. Two years ago, that flexibility went away and all utilities were required to strictly enforce the cap. Going forward, should exceptions ever be made to allow a company to collect more than $100,000 in a given year? If so, under what conditions? Should individual managers be given lee-way in interpreting the rules or should there be specific rules for the exceptions or a specific escalation path that exceptions have to follow?

[72] Interview with Kimberly Lenihan, February 14, 2006.

Most utility programs that we examined did not allow exceptions to the incentive caps. Of those that did, none had specific rules for when the cap could be exceeded but rather dealt with situations on a case-by-case basis. The closest criteria to specific rules were escalation rules – when projects exceeded a certain size they had to be approved by someone higher up the chain of command. For example, in Wisconsin, individual program managers could approve incentives up to $25,000; above that but below the $100,000 cap the overall program manager had to approve applications. Projects that exceeded the cap have to be approved by staff in the state Division of Energy, which is supervising the statewide programs.

No utility we interviewed allowed participants to use two (or three) year's worth of incentives with a promise not to come back for more until two (or three) years had passed by.

Conclusion #6. If the programs change from using utility account numbers to, at a minimum, the Federal Tax ID to calculate incentives paid to individual companies, then we recommend that no exceptions be allowed. This will provide a consistent rule to the market and one that is reasonably fair. If, however, utilities continue to use account numbers to calculate total incentives paid to individual companies, then in the interests of fairness, some exceptions to the rule should be made. These exceptions should be handled on a case-by-case, and should only be allowed when it can be shown that a direct competitor has received more than $100,000 in incentives by virtue of having multiple account numbers. Specific rules should be established to define who has the authority to sign off on these exceptions.

1.10 OCE Program Goals Assessment

This section will review the stated goals for the C&I Program, suggest alternative goals, and discuss target levels for the goals.

The 2004 C&I Program goals as expressed in the Market Assessment RFP were as follows:

Collectively process through completion at least 2,500 total New Jersey SmartStart Buildings Program applications.

Collectively achieve the cited participation levels for the following program paths:

- Tier 2 unitary HVAC installations completed: 700

Collectively achieve the following electric energy savings: 89,000 Megawatt-hours. Collectively achieve the following gas utility energy savings: 300,000 Therms.

Complete 5 compressed air audits/studies.

Complete 5 compressed air projects.

We will address these goals and recommend other goals in the following paragraphs.

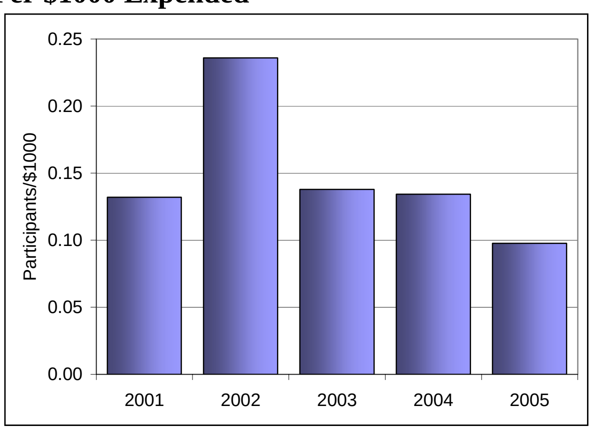
1.10.1 Number of Participants and Energy Savings

Creating goals for the number of participants and the total energy savings is common among C&I programs. In fact, if the energy savings is significantly more important than all other goals, then it may make sense to have it as the **only** goal so that program managers are free to achieve the most savings they can cost-effectively. If, however, other goals are also important, then the energy savings goals have to be set with other goals in mind. When the program focus changes little from year to year historical achievements can give reasonable bounds to targets. However, when programs change significantly, then historical patterns become much less useful and as a result, both these goals become significantly more speculative. In some cases, focus on a goal of total savings or numbers of participants can work against other program goals. For example, if, as we have recommended, the program expands its focus on comprehensive new construction assistance, it will probably mean a shift from efforts that may produce large numbers of participants (perhaps each with relatively small savings) to efforts that will produce a relatively smaller number of participants, but with significant long-term energy impacts. If program managers believe that the "number of participants" goal is more important than the New Construction goal, they will naturally tend to shift resources away from the latter toward the former, undercutting the New Construction effort.

Is this the correct goal? Recommendation: Maintain goals for number of participants and total energy savings but do not push the envelope too much in defining these goals so that other goals are not short-shrifted.

Program goal: Collectively process through completion at least 2,500 total New Jersey SmartStart Buildings Program applications.
Discussion: Historically, the program has achieved between 0.10 and 0.24 participants for each $1000 spent (Figure 1-44).
Recommendation: The participation goals must be set in relation to the budget and in relation to the size of the average project. Given historical patterns, a reasonable floor seems to be around 0.1 participant for every $1000 with a stretch goal at 0.15 participants/$1000. Of course, historical patterns will not be relevant if the program changes its focus significantly. For example, if it expands the number of measures eligible for prescriptive incentives or if it expands its target for small commercial businesses, then it should get relatively high numbers of participants relative to historic patterns.

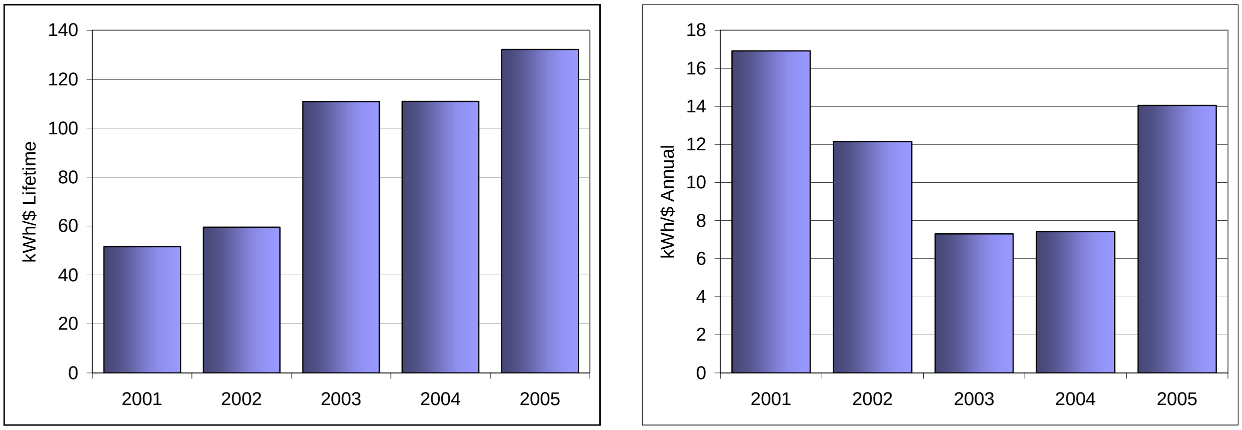
Figure 1-44. Participants Per $1000 Expended



Source: CEP Annual Report. Number of participants divided by annual expenditures.

Program goal: Collectively achieve the following electric energy savings: 89,000 Megawatt-hours. Collectively achieve the following gas utility energy savings: 300,000 Therms.
Discussion: Using a simple formula of dividing total energy saved (including converting gas savings to kWh) by annual expenditures indicates that the C&I Program has produced between 5 and 17 kWh for every dollar spent (Figure 1-45).
Recommendation: The Megawatt-hour and Therm goals must be set in relation to the budget. Given historical patterns, a reasonable floor seems to be around 10 kWh/$ (annual kWh) with a stretch goal at 16 kWh/$ or somewhat higher.

Figure 1-45. Cost of Conserved Energy



Note: Calculated as lifetime (left graph) and annual (right graph) energy saved (converting DTh to kWh) divided by annual expenditures. This is the inverse of Figure 1-16, which was expressed as $/kWh.

Source: CEP Annual Report.

1.10.2 Tier 2 Unitary HVAC

Having a goal for Tier 2 unitary HVAC installations in principle seems appropriate, particularly in light of our general recommendation that non-lighting measures be emphasized. It is also appropriate to maintain a focus on this measure for consistency's sake. In 2002, 600 electric unitary HVAC measures were installed through the program. This dropped to 4 in 2003 and then rose to 329 in 2004. Such inconsistency can significantly reduce trade allies' interest in cooperating with the program. On the other hand, singling out this one measure out for special treatment does not provide sufficient support to non-lighting measures, as we discuss below.

Recommendation: Maintain the existing goal for Tier 2 unitary HVAC installations. The aim should be to keep program managers focused on the technology but not to the detriment of other measures.

1.10.3 Compressed Air Studies and Projects

Compressed air projects are worth pursuing. There are often substantial savings to be achieved and not uncommonly little end user awareness of the issues. As a result, having a goal in this area seems appropriate. However, the goals from 2004 seem overly modest. Assuming the studies and projects did not uncover some significant problems in the market (e.g., too few firms qualified to effectively improve compressed air systems), then it seems reasonable to keep the goal where it is.

Recommendation: Significantly expand the compressed air project goal and allow the program manager to determine the appropriate strategy for meeting that goal, whether it is by compressed air audits or some other method.

1.10.4 Other Goals

If the OCE wants to move the program away from reliance on lighting measures, then establishing goals in other areas would be appropriate. Stretching the program should involve moving into new areas and broadening the range of measures included in prescriptive incentives, rather than doing more of what the program has been doing in the past. Appropriate goals to move the program into new areas could include the following:

Develop marketing strategies and prescriptive rebates for specific markets and significantly increase the number of projects in those measures (e.g., target restaurants and food manufacturers with efficient cooking equipment, drainwater heat recovery, target the grocery and food sales subsector). Appropriate goals could include:
Number of projects in specific sectors
Number of new measures added to the list of prescriptive measures

Create a target for comprehensive projects that involve more than two measures and set the goal at 25% of the total target for projects.

Increase funding for new construction activities and develop a new construction program that has legs of its own, instead of one that appears to be a retrofit program targeted at buildings under construction. Increase the program's focus on a whole building approach for new construction. Appropriate goals could include:
Number of design incentives given to support comprehensive approaches
Number of buildings implementing comprehensive measures
Number of people trained

1.11 Program Recommendations

1.11.1 Incentive Levels

The C&I Program should shift resources away from mainstream energy-efficient lighting and motors to newer technologies (e.g., ceramic metal halide, LED, Super T-8 and high pressure sodium), and technologies affecting specific business types (e.g., cooking equipment). In conjunction with the recommendation on whole-building approaches, consider offering incentives for components of energy-efficient building construction (e.g., thermal envelope measures). Specific recommendations for rebate levels are discussed in the table below.

Table 1-87. Recommendations for New Jersey Incentives and Rebates

Technology Classification	2005 Incentive	Proposed 2006 Incentive
Design Support Incentives:		
Pre-design planning session	1000	No change
Design simulation and screening	$5,000 or more depending on the size of the building or; service may be provided by utility	No change
Incorporation of energy efficiency measures into the Final Design	$5,000 depending on the measures included	No change
Custom Measure Incentives:		
Measures not covered by the prescriptive incentive tables	Generally, up to 80% of eligible qualifying measure's incremental cost or a buy down to a 2 year payback, whichever is less. To be eligible for incentives, these projects must first pass several 'cost-effectiveness' criteria.	No change
Qualifying Equipment Incentives (no measure incentive shall exceed the non-installed cost of the measure):		

Technology Classification	2005 Incentive	Proposed 2006 Incentive
Electric Chillers:		
Water Cooled Chillers	Up to $12 - $170 per ton depending on size and efficiency	No change. The current New Jersey incentive levels are mostly below the average incremental costs for high efficiency water cooled chillers and are reasonable. At the higher efficiency levels, the higher savings justifies an incentive level above the average incremental costs.
Air Cooled Chillers	Up to $8 - $52 per ton depending on size and efficiency	No change. New Jersey incentive levels are mostly below the average incremental costs for high efficiency air cooled chillers and are reasonable. At the higher efficiency levels, the higher savings justifies an incentive level above the average incremental costs.
Natural Gas Chillers:		
Gas Absorption Chillers	1.1 full or part load COP	
< 100 tons	Up to $450 per ton	Reduce to $300/ton
100 to 400 tons	Up to $230 per ton	No change
> 400 tons	Up to $185 per ton	No change
Gas Engine Driven Chillers	Treated under Custom measure path (1.1 full or part load COP)	
Desiccant Systems	Up to $1.00 per cfm (gas or electric)	
Unitary HVAC Systems:		
Unitary AC and Split Systems	Follows the Regional Cool Choice Program Incentive Schedule (See Appendix A)	No change.
Air to Air Heat Pumps	Follows the Regional Cool Choice Program Incentive Schedule (See Appendix A)	No change.
Water Source Heat Pumps	Qualifying equipment is eligible for an incentive of up to $81/ton.	No change.
Packaged Terminal AC & HP	Up to $65 per ton	Drop incentives to $50/unit to be in line with Cool Choice.
Dual enthalpy Economizers	Follows the Regional Cool Choice Program Incentive Schedule (See Appendix A)	No change.
Central DX AC Systems => 9.5 EER	>30 to 63 tons: Up to $40 per ton > 63 tons: Up to $72 per ton	No change.
Ground Source Heat Pumps:		
Open Loop & Closed Loop => 16 EER	Up to $370 per ton: Energy Star rated equipment only. To be further reviewed	We recommend increasing the geothermal heat pump incentive to $430 per ton. This is about 50% of the incremental costs.
Gas Fired Boilers:		No change.
<300MBH => 85% AFUE	Up to $2.00 per MBH but not less	

Technology Classification	2005 Incentive	Proposed 2006 Incentive
	than $300 per unit	
300 MBH – 1500 MBH => 85% AFUE hot water boilers => 84% AFUE steam boilers	Up to $1.75 per MBH	
>1500 MBH – 4000 MBH => 84% AFUE for hot water boilers => 83% AFUE for steam boilers	Up to $1.00 per MBH	
> 4000 MBH	Treated under Custom Measure Path	
Gas Furnaces (=> 90% AFUE)	Up to $300 per furnace	
Variable Frequency Drives (HVAC):		
Variable Air Volume (add on to existing HVAC systems only)	Up to $65 - $155 per hp	The current rebates levels for variable frequency drives (VFDs) in New Jersey are too generous and should be decreased to between $40 and $95.
Air Compressors with VFD's	To be included as a prescriptive measure-specific rebate levels to be determined	
Chilled Water Pumps	Up to $60 per hp	
Gas Fired Water Heating:		No change
<= 50 gallons => 0.62 energy factor	Up to $50 per water heater	
>50 Gallons; <300 MBH => 85% AFUE	Up to $2.00 per MBH, but not less than $50/unit	
300mbh – 1500 MBH => 85 % AFUE	Up to $1.75 per MBH	
>1500 MBH – 4000 MBH => 84% AFUE	Up to $1.00 per MBH	
> 4000 MBH	Treated under Custom measure path	
Gas Fired Water Booster Heaters:		
=< 100 MBH	Up to $17 per MBH	
> 100 MBH	Up to $35 per MBH	
Premium Efficiency Motors:		
Three phase motors	Follows the Regional MotorUp Program Incentive Schedule	No change.
Prescriptive Lighting:		
T-5 and T-8 lamps with electronic ballast	$20 per fixture for existing facilities with connected load <= 75 kW $10 per fixture for existing facilities <= 50,000 sq. ft with connected load > 75 kW No incentive for new construction or	The New Jersey incentives are reasonable when compared to incremental cost and other programs, however moving away from lighting to other measures would be appropriate, which would suggest lowering the incentives for T-5s and T-8s.

Technology Classification	2005 Incentive	Proposed 2006 Incentive
	complete renovation	
LED Exit Signs* - (New Fixtures Only)	Up to $20 per fixture	New Jersey incentives for LED exit signs at $20/fixture are substantially more generous than the other programs we examined. Several programs do not incent LED exit signs at all. Incremental costs from NYSERDA's study were $30/fixture compared to an incandescent fixture and $10 compared to a CFL fixture. The New Jersey incentives seem too generous and should be reduced to the $5 range.
Hard-wired compact fluorescent surface mounted fixtures* - (New Fixtures Only). Must be pin based technology with THD of <33% and BF>0.9		New Jersey incentives for CFLs are more generous than those in most other programs examined and for many sizes are higher than incremental cost. As a result, it appears the New Jersey incentives are too generous and ought to be reduced, probably to the $10 to $15 range.
1 lamp fixture	Up to $25 per 1 lamp fixture	
2 lamp fixture	Up to $30 per 2 or more lamp fixture	
Hard-wired compact fluorescent recessed fixtures*- (New Fixtures Only). Must be pin based technology with THD of <33% and BF>0.9		
1 lamp fixture	Up to $25 per 1 lamp fixture	
2 or more lamp fixture	Up to $30 per 2 or more lamp fixture	
Metal Halide w/ pulse start ballast, for fixtures > 150 watts	Up to $45 per fixture, includes parking lot lighting	New Jersey incentives for Pulse Start Metal Halide are more generous than several other programs but in the same range as others. When compared to NYSERDA data, the New Jersey incentives are higher than incremental costs for all uses except the largest. The incentives seem too high and ought to be reduced to the $25-$30 range.
T-5 and T-8 High Bay Fixtures	Replacing 400W and larger fixtures with bottom of fixture at least 18 feet from the floor = Up to $75 per fixture Replacing 250-399 W fixtures with bottom of fixture at least 14 feet from the floor = Up to $50 per fixture.	We recommend eliminating the height restriction on HID replacements. We also recommend providing incentives on HID replacements below 250 Watts and defining the incentives in relationship to energy savings. The incentive levels included in a separate proposal appear to be based on reasonable assumptions and are reasonable when compared to the rebates on replacing T12s with T8s. However, we are recommending below that lighting be de-emphasized in favor of other

Technology Classification	2005 Incentive	Proposed 2006 Incentive
		technologies, which would imply lowering the incentives, not keeping them at the same level while loosening the criteria.
New Construction and Major Renovation	No incentive, performance based only	
LED Traffic Signal lamps (conversion of existing intersections only)		Consider eliminating incentives. Very few programs in other states offer prescriptive rebates to C&I customers for LED traffic signals. Federal standards specify ENERGY STAR v1.1.
8" Lamp	Up to $20 per 8" lamp (red & green only)	
12" Lamp	Up to $35 per 12" lamp (red & green only)	
LED Pedestrian Signal lamps (conversion of existing intersections only)	Up to $20 per fixture	
Lighting Controls:		
Occupancy Sensors (Turning fixtures off in Existing facilities only)		No change. New Jersey incentives are in the middle of the range offered in other states.
Wall mounted	Up to $20 per control	
Remote mounted (e.g., ceiling)	Up to $35 per control	
Day lighting Dimmers – All facilities		No change, although New Jersey incentives at the low end of the range offered in other states.
Fluorescent Fixtures	Up to $25 per fixture controlled	
HID or Fluorescent Hi-Bay controls	Up to $75 per fixture controlled (HID or Fluorescent Hi-Bay)	
Hi-Low Controls – All facilities:		
Fluorescent Fixtures	Up to $25 per fixture controlled	
HID or Fluorescent Hi-Bay	Up to $75 per fixture controlled (HID or Fluorescent Hi-Bay)	
Performance Based Lighting		
Performance Based Lighting incentives for indoor and outdoor installations (attached to building) - New construction and Major Renovation	Up to $1.00 per watt-per-square foot below baseline which is 20% below (more efficient) code; incentive cap $30/Fixture	No change
Performance Based Lighting incentives for indoor/outdoor installations (attached to building) - Existing construction	Up to $1.00 per watt-per-square foot below baseline which is 10% below (more efficient) code; incentive cap $30/Fixture	No change
Multiple Measures Bonus		
	Up to 10% of the total equipment incentives for the subject project, but not to exceed the smallest individual equipment incentive for the project.	No change

1.11.2 Selection of Measures

The C&I Program is funding many of the same technologies as the programs in other parts of the country. In addition to current measures, participant and nonparticipant end users recommended adding the following measures: controls including energy management systems, ceramic metal halide lighting, LED, and fiber optic lighting.

Table 1-88. Equipment End Users Want Program Incentives For

Participants	Participants	Nonparticipants
HVAC Controls	Smaller HVAC Units	Control upgrades for HVAC (2 mentions)
Ceramic Metal Halide Lights	Individual Gas Boilers and Hot Water Heaters in Townhomes Instead of Centrally Located	Heat Pumps
Fluorescent Lighting	LED Lighting	Lighting Controls
Energy Management Systems (3 mentions)	Prescriptive Rebates for Fiber Optic Lighting	Light Bulbs
Cooking Equipment	Windows (2 mentions)	Energy management systems
Gas Fryers	Window Tinting	Windows (2 mentions)
Electric Panels	Tankless Water Heating	
Fractional Horsepower Motors	Insulation (2 mentions)	
Door Seals	Ice Machines	

Programs in other states have had some significant success with chiller projects, as has New Jersey, but chiller opportunities may warrant more targeted attention.

Several nonparticipating trade allies are pushing technologies such as reflective roofs, heat recovery systems, and building envelope features that are integral to qualifying for the LEED program.

Technologies that are appropriate for small businesses should be examined, such as commercial service water heaters, particularly if the program pursues small businesses with more vigor. A complete list of incentives and technologies recommended is presented in section 1.9.

1.11.3 Incentive Caps

If the C&I Program is intended to move markets, not just to achieve current energy savings, then an incentive cap that is low enough to ensure a reasonable distribution of incentives across time, across company sizes and types, and across regions of the state is a sensible approach. If under-spent budgets is a problem, raising incentive caps is not necessarily the best solution. The program tracking data do not provide any evidence to suggest that a wealth of projects would come in if the incentive cap were raised modestly. The program budgets could support a few larger incentives but more than a few would likely affect the distribution of other projects. New Jersey's incentive cap is within the most common range of the programs we examined around the country. It is lower than the average. In the final analysis, whether the incentive cap should be raised depends on the balance between a desire to increase total potential savings by widening the pool of potential projects versus the distribution of incentives across the market.

Incentive caps serve multiple goals but the primary ones should be to help ensure that incentives can be spread throughout time and across a broad spectrum of the market to support both energy savings and transforming markets. Incentive caps should also be implemented consistently and equitably which implies that customers in largely the same circumstances should not face different incentive caps. With those goals in mind, the logical conclusion is that the definition of the corporate entity subject to the incentive cap should be broad enough to conform to a common-sense definition of a company. Utility account numbers fail on that criteria. The Federal Tax ID number is significantly better, but can still fail. Defining a company by its ownership makes the most sense. The approach NYSERDA took seems to offer a solution that is not overly complex to administer (at least based on NYSERDA's experience) and still conforms to the intent of limiting the amount of incentives that can go to individual entities.

If the programs change from using utility account numbers to, at a minimum, the Federal Tax ID to calculate incentives paid to individual companies, then we recommend that no exceptions be allowed. This will provide a consistent rule to the market and one that is reasonably fair. If, however, utilities continue to use account numbers to calculate total incentives paid to individual companies, then in the interests of fairness, some exceptions to the rule should be made. These exceptions should be handled on a case-by-case, and should only be allowed when it can be shown that a direct competitor has received more than $100,000 in incentives by virtue of having multiple account numbers. Specific rules should be established to define who has the authority to sign off on these exceptions.

1.11.4 Schools

Program staff have been disappointed in the level of success in attracting public school participation in the program. However, the proportions of all schools participating in the program is relatively higher than for many other types of companies.

Barriers were not significantly different for schools than for other types of companies. Lack of access to financing and first cost were the highest barriers for schools, and the second and third highest for everyone else, following awareness of products and services. Trade allies are seeing an increased awareness of energy efficiency opportunities and the LEEDs standard in schools.

The financial incentives were not quite as important to the school participants as to other participants, although the difference was not quite statistically significant.[73] Schools rated the financial incentives at 3.7 on a scale of 1 to 5 where 1 is "not at all important" and 5 is "very important", while other companies rated incentives at 4.3.

The single biggest barrier to program participation seems to be awareness of the program. The nonparticipating schools interviewed were quite **un**familiar with the services and incentives offered by the program. The nonparticipant survey sample was taken from companies (and schools) who had completed a building project in 2005. Of the schools interviewed, eight had gotten no utility incentives. On a scale where 1 is "not at all familiar" and 5 is "very familiar" seven of the eight responded "1" and the eighth responded with a "2" for an average of 1.1.

Recommendation: The programs should increase marketing to schools and to trade allies that specialize in servicing the schools market, including architects.

[73] F=3.1, significance=0.081

1.11.5 Trade Ally Focus

There is currently no centralized database of trade allies actively working with the New Jersey C&I programs. The closest thing to such a list is the list of trade allies who have voluntarily signed up to be represented on the program's website, but no data is kept on how active these allies are in the program. In the absence of better data, we examined the web list of allies to characterize the types of and number of companies participating in the program. By comparing that list to data from other sources, we can estimate the level of participation in the program among all contractors and suppliers in the state. We found that HVAC, lighting, and motor contractors are fairly well represented in the web list, with approximately 30% of the population listing on the website. Approximately 50% of the population of architects, builders, and developers are listed on the website. However, relatively few of the most active firms in New Jersey are on the site.

Recommendation: An effort to better incorporate the most active architectural firms, general contractors, and real estate developers may help increase new construction penetration even further. Efforts could include face-to-face meetings, incorporation in focus groups, targeted mailings, lunch-and-learn events, co-branding or advertising, regular mailings with program status updates and describing program offerings and changes.

1.11.6 Sub-Sector Focus

Program penetration is relatively higher in education, healthcare, government, and lodging. It is relatively lower in grocery and religious worship. If the programs design new components to target specific sectors or trade allies, the data and sources used in this report can provide information on the size and characteristics of the market.

Five or fewer trade allies are responsible for half of all sales in several categories of equipment, including lighting, motors and generators, and armature rewinding. Specific program staff should be assigned the responsibility for maintaining regular contact with these companies.

1.11.7 Awareness

Awareness of products and services was the most significant barrier for participants, followed closely by lack of access to financing for energy efficiency-related projects. Nonparticipants felt the bias toward first cost versus operating costs was the most significant barrier, followed by uncertainty over whether actual savings will equal the projected savings, and disagreements between decision makers in the organization.

Smaller companies (based on number of employees) do not exhibit a higher level of barriers than larger ones. Attitudes toward barriers do not differ significantly across the geographic regions of New Jersey, however end users in the Philadelphia area felt the barriers were more significant than in Newark and the central beach area south of Newark.

According to the trade allies, the biggest barriers to program participation are:

Lack of awareness.
Owners who do not care about energy efficiency even when architects and engineers do.
Customers do not know whom to trust.
Customers do not see or believe the savings.
Energy efficiency is a complex sale requiring sophisticated analyses.

The one theme that is reflected in many of these barriers is a lack of information about the program and knowledge of energy efficiency opportunities. **Related to this is the finding that the awareness of program incentives and services is low among participating and nonparticipating end users and trade allies.**

Recommendations to reduce these barriers:

Target and educate building owners about the benefits of energy efficiency and the services offered by the program. Provide owners and building decision-makers with easy to understand financial calculators that demonstrate lifecycle costing. Create case studies covering a wide range of measures and businesses to create material that will help convince decision makers that savings are achievable. This information must be simplified and credible in order to convince owners to make the initial investment.

Increase awareness through promotions and advertising to all customers. Suggestions include increasing program awareness through bill stuffers, mailings, brochures, and posters in commercial and industrial settings.

Increase program reach by educating vendors, manufacturers, architects, engineers, and specifiers about program features and providing them with support in promoting energy efficiency.

1.11.8 Level of Effort for New Construction

New Jersey's C&I Program is dominated in many ways by the retrofit program, which represented 71% of spending and 81% of participants in 2005. Schools represented 14% of spending and New Construction 15%. The retrofit program, and to a certain extent the New Construction and Schools programs, focuses on providing financial rewards for participants to do the right thing and those rewards are predominantly prescriptive and custom rebates, even within New Construction. The programs promote a whole-building approach by providing multi-measure bonuses as well as services such as design support. However, the level of effort spent on supporting the whole building approach is relatively small and it has been diminishing in recent years. Of course, this trend has to be put in the context of the transition from utility to independent administration of the energy efficiency programs. The BPU has placed restrictions on utility marketing in recent years and utilities have faced some significant staff attrition as they looked to the day when they would no longer be administering the energy efficiency programs.

Recommendation. It was clear to us from our interviews with utility program staff that they recognize the importance of taking a whole-building approach to design and have incorporated appropriate elements in the program strategy. However, this kind of involvement in the market takes significant staff resources and consistent interaction over time with the appropriate market actors. With utility program staffing levels dropping over time as they anticipated the transition to independent program administration, the amount of staff time available for focusing on these activities dwindled below the optimal level. The current program design should be maintained and appropriate staffing levels achieved so that the program can focus on developing strong relationships with trade allies, particularly architects, and place the focus on identifying projects early in the design phase to maximize energy savings.

2. COMBINED HEAT AND POWER PROGRAM MARKET ASSESSMENT

2.1 Program Background

2.1.1 Detailed Program Background

The Combined Heat and Power (CHP) Program was initiated in 2004 on a pilot basis as an addition to the OCE's portfolio of Commercial & Industrial EE programs. The overall stated goals and objectives of the program are (1) to enhance energy efficiency through on-site power generation with recovery and productive use of waste heat, (2) to provide reliability solutions for New Jersey by reducing existing and new peak demands to the electric power grid, and (3) to encourage the use of emerging technologies.

The program offers qualifying customers, contractors, and energy service companies financial incentives to defray a portion of the installed cost of various types of CHP units. The following costs are considered as part of the total eligible system costs for purposes of calculating the maximum financial incentive:

- CHP equipment capital cost
- Engineering and design cost
- Construction and installation costs, including commissioning costs
- Engineering feasibility study costs
- Interconnection costs
- Permitting costs
- Warranties and service contract (up to five years) costs
- Fuel line installation costs, including:
    - Installation and upgrade of fuel line
    - Cost of evaluation planning, design, and engineering costs related to enhancing/replacing the existing fuel service
- Air emission control equipment capital cost
- Primary heat recovery equipment
- Heat recovery piping and controls needed to interconnect primary heat recovery equipment to existing thermal load at the project site.

In order to qualify, the customer's facility must be located in New Jersey, and the customer must purchase electricity from the utility grid and be a contributor to the Societal Benefits Charge (SBC) fund. Customers must install equipment that is sized to meet all or a portion of their on-site load. Only new commercially available, permanently installed equipment, and **not** used, refurbished, temporary, pilot, or demonstration equipment, is eligible for an incentive. Any portion of a customer's load that is committed to an interruptible or peak load reduction program is not eligible for incentives. Back-up generators and any system/equipment that uses diesel fuel, other types of oil, or coal for start-up or continuous operations are **not** eligible under the program.

The CHP system must achieve an average annual fuel efficiency, including any recaptured mechanical energy of at least 60% based on total energy input and total utilized energy output. Waste heat utilization or mechanical recovery systems must be included, and the captured energy can be used in water heating, processes such as pasteurization, product pre-heating, or other such uses.

The program equipment eligibility description indicates that on-site power systems should have the ability to island/disconnect from the utility in the event of substantial grid congestion or failure. However, this is not an absolute requirement, but rather is given extra weight in the evaluation process.

Incentives levels, by technology, are as follows:

Eligible Technology	Incentive ($/watt) (Up to 1.0 MW)	Maximum % of Project Cost	Minimum System Size
Level 1 • Fuel cells not fueled by Class I renewable fuel	$4.00/watt * Incentives not to exceed $1 million per applicant	60%	None
Level 2 • Microturbines • Internal Combustion Engines • Gas Combustion Turbines	$1.00/watt	30% * Maximum increased to 40% where a cooling application is included	None
Level 3 • Heat Recovery or Other Mechanical Recovery Electric Generation Equipment	$0.50/watt	30%	None

Participation guidelines include the following requirements. Participants must submit a completed pre-installation application form and the appropriate technical worksheet within the application window period. Projects are evaluated for funding according to the following criteria:

- System efficiency
- Environmental performance
- Annual system utilization
- Emergency Management Center
- Consideration of general programmatic goals
- Project clarity

The posted evaluation guidelines also indicate that the OCE will consider basing awards on achieving a diversified mix of size, type of system, and type of end-user. Evaluation ties will be broken using the following criteria:

- PJM Locational Marginal Pricing (LMP) for the electric service area in which the project is to be located
- Inclusion of the project in an Emergency Management Center with islanding capability
- Location in a designated Smart Growth area

Posted evaluation guidelines also indicate that no one particular tier will get more than 50% of the available funding, unless there are insufficient technically acceptable projects in other tiers.

Selected projects receive a commitment letter/letter of intent. Awarded funds are reserved for 18 months from the date of the award letter. Any circumstances that will result in a delay past the 18-month timeframe must be reported to the OCE at least one month prior to the scheduled expiration date, and the OCE may at its option determine to extend or cancel the funding.

Finally, applicants must allow inspection of installed systems by a third party inspector contracted by the gas utility, prior to the issuance of the incentive. The inspector will prepare a field inspection report and submit it to the utility.

The inaugural CHP pilot incentive application cycle was initiated in 2004, and a second cycle was initiated in 2005. A third cycle opened in April 2006. An annual incentive funding level of $5 million has been established for the pilot program.

As will be described in more detail in a later section of this report, in the 2004 CHP incentive program cycle, the program received 73 project applications, and 24 projects received incentive commitments. In 2005 the program received 26 applications, and 10 projects received commitments in the initial award announcements.

2.1.2 CHP Program Evaluation Research Methodology

Key CHP Stakeholder Interviews

At the outset of the project, we endeavored to schedule interviews with all of the key stakeholders responsible for design and implementation of the CHP program. Interviews were ultimately scheduled and conducted over an approximate 4-week timeframe between mid-November 2005 and mid-December 2005. The interviews followed a prescribed format, the purpose of which was to elicit information and to develop an understanding, from the key stakeholders' perspective, of the purpose and intent of the CHP program and the mechanics of how the program works. As well, our intent was to gain some insights into both the perceived strengths and weaknesses of the program. In effect, we treated the interviews as opportunities for the key stakeholders to 'flag' issues for further exploration during this market assessment. The interviews generally lasted between 1-2 hours each. The key stakeholders interviewed were as follows:

- Office of Clean Energy (OCE) staff
- Department of Environmental Protection (DEP) staff
- Rutgers University Center for Advanced Energy Systems (CAES)
- The four Local Gas Distribution Companies (LDCs) – SJG, PSE&G, NJNG, and Etown Gas.

OCE staff, DEP staff, and the four LDCs are involved in program design, including development of policy objectives and program details. The Rutgers University CAES has been retained by the OCE for implementation purposes, specifically, to conduct initial reviews and evaluations of the applications received. The evaluations are forwarded to the evaluation committee, comprised of OCE staff, DEP staff, and the four LDCs, for final decisions on program awards.

We also propounded a number of information requests on the LDCs with regard primarily to details concerning the program applicants and awardees during the first two annual cycles (2004 and 2005) of the pilot CHP program. These requests were funneled through the South Jersey Gas (SJG) representative, who in turn disseminated LDC-specific requests to the individual LDC representatives, and served as the central clearinghouse for distribution of answers. We later conducted a number of telephone discussions with the LDC program manager concerning the manner in which energy savings are reported to the OCE for purposes of the annual Clean Energy Program report.

CHP Program Market Actors: Participant and Nonparticipant Surveys

We set out to conduct surveys with participants in the CHP program, as well as potential participants in the program. We developed four separate survey instruments targeted at four distinct categories of market actors. These include:

1. Participating End-Users
2. Nonparticipating End-Users
3. Vendors
4. Equipment Manufacturers

These survey instruments were submitted to the OCE Project Manager for review prior to commencing survey work.

The pool of potential survey respondents among Participating End-Users, Vendors, and Equipment Manufacturers was derived from the 2004 and 2005 program applicant and interviewee database provided by the LDCs. The initial database of applicants and awardees contained, among other information: the end-user company name; the vendor company name (sometimes an engineering firm, sometimes an ESCO, sometimes both); and the type (including manufacturer) of major equipment proposed. Follow-up information requests were made for specific contacts (name, phone number). Because specific contact information for each applicant was not readily available in an existing LDC database and would need to be gathered manually, we were asked by the LDC representatives to pare this request down. The request was subsequently refined to contact information for just the end-users who had been selected as initial awardees. This list submitted to the LDCs contained both awardees whose projects are completed or still in development, and those who subsequently turned down the program incentive award or who had the award rescinded.

The contact information was received over a period of time from the various LDCs, and the response was completed in early February 2006. From the contact information provided by the LDCs, we developed a pool of 32 potential Participating End-Users for surveys. This pool of potential Participating End-User survey respondents included ***all*** initial awardees from 2004 and 2005, including 20 whose projects were completed or were still in development, and 12 initial awardees who subsequently (after initial award) had turned down the incentive or whose projects subsequently had been cancelled. Each of the contacts in this pool of potential survey respondents was called, many on multiple occasions, to schedule interviews. This effort began at the beginning of February 2006. Over the next 8 weeks, concluding at the end of March 2006, surveys were scheduled and conducted with 17 Participating End-Users. The remainder of the original target pool of 32 either did not return repeated phone message or refused outright.

From the contact information provided by the LDCs we also developed a list of 16 potential Vendor survey respondents, which includes ***all*** of the firms for whom contact information was received. Each of these potential respondents was called to schedule interviews. This effort also began at the beginning of February 2006. Over the next 8 weeks, concluding on at the end of March 2006, surveys were scheduled and conducted with Vendors, and numerous messages were left with contacts who did not respond. However, some discussions led to contacts with additional firms that were involved in projects.

Ultimately, surveys were conducted and completed with 19 Vendors, which was a larger number than the original pool of 16 potential respondents.

From the 2004 and 2005 project application database provided by the LDCs we identified 10 different equipment manufacturers whose equipment was being used, or proposed to be used, at one or more CHP project sites. We were able to track down contacts for the local sales representative for each of the equipment manufacturers on this list from their corporate headquarters, and these 10 contacts became the pool of potential Manufacturer survey respondents. Ultimately, we were able to reach and complete a survey with each of the 10 targeted manufacturers.

Finally, we sought to identify and locate a pool of potential Nonparticipating End-User survey respondents (i.e., end-users who had not participated in the CHP program). We made this attempt in order to gain some insight and information from end-users who may be considered potential sites for CHP, but who would not, unlike the pool of potential respondents in the other end-user category, be presumed to necessarily have any knowledge of CHP in general or of the New Jersey CHP program in particular. Our goal was to interview as many Nonparticipating End-Users as Participating End-Users. Our pool of potential survey respondents was developed by searching Reference USA, a database that includes more than 13 million businesses and allows searches by geographic location, SIC code, and major industry. This database contains the names and addresses of thousands of businesses in the state of New Jersey. We narrowed our search to specific SIC codes, coinciding with the SIC codes of the types of businesses that had participated in the first two years of the New Jersey CHP program, and that are representative of SIC codes in a separate database sponsored by the U.S. DOE of pre-existing in-state CHP systems. Our working assumption was that the types of businesses that have participated in the CHP program or have co-generated in the past represent the types of businesses that are generally the most likely candidates for CHP in New Jersey. The SIC codes searched included, but were not limited to, paper and pulp, commercial laundries, nursing homes and hospitals, recreational facilities, colleges and universities, supermarkets, and hotels.

In addition to this database, we used a number of alternative sources in an attempt to find Nonparticipant survey respondents. For example, this included an internet search of local YMCAs throughout New Jersey. This was done because there was one YMCA (Bayonne) on the program participant list and at least one key stakeholder identified YMCAs as potentially good candidates for smaller-scale commercial CHP. Moreover, there are several YMCAs listed in a U.S. DOE-sponsored database of pre-existing New Jersey CHP systems that is discussed later in Section 2.3 of this report. In addition, because of the large number of locations throughout the state and the homogenous nature of these facilities, and because we presumed there may be some overarching centralized organizational structure overseeing these locations, we made the presumption that YMCAs could be good candidates for project replication. By searching the internet, we developed a list of local YMCAs throughout the state. Unfortunately, despite repeated calls to these locations requesting interviews with the facilities managers, we were not able to develop any viable energy facility contacts at any of the YMCAs called.

We also attempted to work through the New Jersey Business and Industry Association (NJBIA) to develop a potential list of Nonparticipating End-User survey respondents. NJBIA's list was based on attendees at meetings it had co-sponsored for members interested in cogeneration. However, after reviewing the contact list provided, it was determined that all attendees representing New Jersey companies indicated that their sites already included cogeneration facilities; attendees indicating that they did not currently co-generate were either energy consultants or vendors. As a result, the NJBIA list was nonproductive for identifying a target list of true 'nonparticipants.'

The businesses in the targeted categories in the database cultivated from the above-described lists were cold-called, and an attempt was made to find the energy facility manager for the company to set up an interview. In total, approximately 500 companies were contacted. We expected a fairly low response and success rate; however, the results were even lower than we had hoped. Out of a total of approximately 500 companies contacted, we were able to generate a total of 15 completed surveys of Nonparticipating End-Users.

2.1.3 Previous Program Specific Evaluations

This section summarizes relevant findings from recent CHP market assessments of both individual states and geographic regions. It describes relevant market insights and lessons learned to inform the current effort and support survey design, analysis, and recommendations.

Introduction

This literature review:

- Identifies reports conducted since 2002 that evaluate both regional and individual state potential for the development and implementation of CHP technologies. No reports earlier than 2002 were evaluated, because increases in natural gas pricing, gas market volatility, and regulatory changes in deregulated retail energy markets since that date limit the usefulness of earlier analyses.

- Summarizes common elements of market assessments conducted to date, highlighting: barriers to CHP development; analysis of technology; and incentives/efforts established to reduce impediments.

- Concludes that individual states, including New Jersey, California, and New York, are taking the lead in evaluating the potential for CHP development, while federal support from the U.S. Department of Energy's CHP Applications Program and support of six regional CHP Application Centers buttress state efforts to develop CHP resources.[74]

A complete list of the reports and other literature reviewed for this report section is provided in Appendix 10-C.

Barriers to CHP Market Development

Virtually all studies identify five market barriers to the further development of CHP markets:

- Utility interconnection regulations
- Air permitting issues
- Local siting issues
- Tariff issues
- Financing/price issues

[74] In April 2001, the U.S. Department of Energy, through Oak Ridge National Laboratory, established the first pilot CHP Regional Application Center (RAC). DOE has subsequently established seven additional RACs, including a Mid-Atlantic CHP Regional Application Center.

Interconnection Rules and Access

1. Virtually all market assessments identify the lack of uniform interconnection rules within and among states as a major barrier to the development of CHP, resulting in confusion and increasing technical and negotiating costs associated with CHP development.[75] The literature indicates that recent state and federal action may limit, but are unlikely to eliminate, interconnection problems associated with CHP projects.

2. Most market assessments reviewed cite nonstandard interconnection regulations as being especially burdensome to smaller systems (under 500 kW), adding expense in the form of protracted negotiations.[76] The fact that utilities set their own standards also means that equipment manufacturers cannot design nor produce standardized or modular interconnection equipment, which could also be expected to reduce CHP start-up costs.[77]

3. New Jersey has been in the forefront nationally in seeking to eliminate interconnection barriers. In September 2004, the New Jersey Board of Public Utilities (BPU) expanded the state's existing interconnection standards for small commercial customers. The 2004 rules increased the maximum capacity of these systems from 100 kilowatts (kW) to 2 megawatts (MW). In addition to expanding both system capacity and the scope of eligible technologies, the 2004 NJ amendments standardize and simplify interconnection procedures for small commercial customers. There are three levels of interconnection in New Jersey. Level 1 applies to inverter-based systems that have a rated capacity of 10 kW or less. Level 2 applies to systems with a maximum rated capacity of 2 MW that meet IEEE 1547 and UL 1741 standards for compliance for operation with electric distribution systems. Level 3 interconnection applies to systems with a maximum capacity of 2 MW that do not qualify for either the Level 1 or Level 2 interconnection review procedures. These regulations also specify time periods within which the EDC must respond to applications. See N.J.A.C. 14:4-9.7 - 9.9.

4. New Jersey's electric distribution utilities have filed their proposed standard interconnection agreements with the Board of Public Utilities. These proposals are pending approval.

5. About 15 states have implemented uniform interconnection rules,[78] and the Federal Energy Regulatory Commission (FERC) implemented Order 2006 in May 2005, which creates uniform federal standards for distributed generation units no larger than 20 MW. FERC's new rule directs public utilities to amend their Order No. 888 open access transmission tariffs (OATTs) to offer non-discriminatory, standardized interconnection service for small generators. The amendments are to include a Small Generator Interconnection Procedures (SGIP) document and a Small Generator Interconnection Agreement (SGIA).

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[75] See e.g., Report 1012075, Assessment of California CHP Market and Policy Options for Increased Penetration, Public Interest Energy Research Program and EPRI (July 2005); USCHPA A Vision for the Future of CHP in the US in 2020 (1999); NYSERDA: Combined Heat and Power Market Potential for New York State, Final Report 02-12 (Oct. 2002); Brown & Elliott, State Opportunities for Action: Update of States' Combined Heat & Power Activities, Report Number IE032, ACEEE (Oct. 2003); Oak Ridge National Laboratory, Combined Heat & Power in the Pacific Northwest: Market Assessment, Report B-REP-04-5427-004 (July 04).

[76] USCHPA, A Vision for the Future of CHP in the United States in 2020 (1999).

[77] Id.

[78] In addition to New Jersey, the EPA reports that these states have implemented uniform interconnection standards: California, Connecticut, Hawaii, Massachusetts, Michigan, New Hampshire, New Mexico, New York, North Carolina, Texas, Vermont, Washington, and Wisconsin. www.epa.gov/chp/funding_opps-reg.htm.

a. The SGIP contains the technical procedures that the small generator and utility must follow in the course of connecting the generator with the utility's lines. The SGIA contains the contractual provisions for the interconnection and spells out who pays for improvements to the utility's electric system, if needed to complete the interconnection.

b. The new FERC rule applies only to interconnections with facilities already subject to FERC jurisdiction; the Commission emphasized that the rule does not apply to local distribution facilities.

6. Standardized interconnection requirements – under either federal or state regulations – do not eliminate all interconnection-related barriers faced by CHP developers. NYSERDA points out that even when a state establishes standardized rules – as New York State has done – disputes regarding interconnection remain contentious.[79] NYSERDA cites issues of concern for CHP still include (1) complexity of the interconnection process, (2) time duration of the process, (3) cost for required interconnection equipment, (4) cost for equipment that may be unique to a specific interconnection, (5) billing for utility services, and (6) fees for studies.[80]

7. A CHP market assessment by the American Council for an Energy-Efficient Economy (ACEEE) notes that:

> Many of the interconnection barriers exist at the individual utility level, not the state. Many of the people contacted for this report indicated that it was the utility that was discouraging CHP installation.[81]

This conclusion is echoed by an Oak Ridge Laboratories report which, in assessing the Northwest CHP market, noted that interconnection barriers extend beyond the issue of a standardized agreement. CHP projects generally require continued interaction with local electric distribution utilities to provide interconnection to the power grid, standby service, and supplementary service.[82] "Other services may be desired as well, such as a purchase agreement for excess power production or access to the power grid to transmit the power to another owned site or for a third-party purchase." [83]

New Jersey has taken substantial strides in eliminating a potential market barrier to on-site CHP by adopting standardized interconnection standards. Survey results confirm that utility interconnection is not perceived by market actors to be a serious market barrier in New Jersey, as it is in other states.

Environmental Permitting

CHP market assessments reviewed consistently cite environmental permitting as a barrier to development of this technology, creating additional expense and requiring time-consuming attention.

Delay in the processing of an air permit increases costs to the CHP developer, lowers project returns, and in some instances, threatens the viability of the project. NYSERDA explains that for smaller-sized

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[79] NYSERDA: Combined Heat and Power Market Potential for New York State, Final Report 02-12 (Oct. 2002) at 8-3.

[80] Id. at 8-4.

[81] Brown and Elliott, State Opportunities for Action: Update of States' Combined Heat & Power Activities, ACEEE Report Number IE032 (Oct. 2003) at 6.

[82] Task 1 – Final Report, B-REP-04-5427-004, Combined Heat and Power in the Pacific Northwest: Market Assessment, Submitted to Oak Ridge National Laboratory (July 2004) at 11.

[83] Id.

facilities owners of the facility are not likely to have familiarity with environmental permitting procedures.[84] [85]

Regional and single-state reviews of CHP point out that most air emissions regulations are based on limiting the emission of criteria pollutants per unit of fuel input or their concentration in exhaust streams from specific sources. This approach does not credit CHP with the emissions reductions associated with reduced consumption of electricity from the grid or for displacing emissions from existing sources.[86] In other words, the studies point out, permitting requirements in most states fail to incorporate environmental benefits associated with CHP.

For example, a 2002 NYSERDA report indicates that CHP generation is projected to emit less NO_x than the avoided utility generation emissions in all sizes except the 0.5-1.0 MW size range (which, for purposes of this New York market forecast, was based on lean burn engine technology with no exhaust clean-up). CHP market penetration would provide NO_x reductions in all sizes when avoided boiler emissions are accounted for. CHP penetration also reduces CO_2 emissions and has the potential for large reductions in SO_2 emissions.[87]

In its own evaluation of CHP benefits, the EPA touts output-based approaches. Output-based permitting regulations are defined as including output-based emission standards, as well as output-based allocations of emissions allowances within a cap and trade program. They are intended to consider net changes in air emissions resulting from a CHP application, including off-site reductions in emissions, rather than just considering changes to emissions on-site. The following reasons in support of an output-based approach are cited by the EPA:

- Fuel Savings: Output-based emission approaches encourage energy efficiency improvements.

- Emissions Reductions: Because output-based emission regulations promoted increased fuel conversion efficiency and a corresponding reduction in fuel consumption, they promote pollution prevention and reduced emissions.

- Transparency: Output-based approaches provide a clear measure of the emissions impact of producing an energy product, such as electricity or steam. Because output-based emissions take into account the output and efficiency of the process, they facilitate "apples to apples" comparisons of the emissions impacts of different facilities.[88]

The EPA points out that output-based regulation can be used as part of a regulatory strategy to encourage pollution prevention and the use of efficient energy-generating technologies, and that "[w]hile output-based regulations have been used for regulation in many industries, input-based regulations have been traditionally used for boilers and power generation sources."[89]

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[84] 2002 NYSERDA Report at 8-14.

[85] See also Oak Ridge National Laboratory, Combined Heat and Power in the Pacific Northwest: Market Assessment (July 2004) at 18.

[86] EPA, Combined Heat and Power Partnership: Output-Based Environmental Regulations (2005).

[87] NYSERDA, Combined Heat and Power Market Potential for New York State (Oct. 2002) at ES-11.

[88] www.epa.gov/chp/state_resources/output_based_reg.htm.

[89] Climate Protection Partnerships Division, US EPA, Output-Based Regulations: A Handbook for Air Regulators, Draft Final Report (April 22, 2004) at 1.

Facility Siting/Local Permitting Issues

CHP market surveys also highlight the difficulty of siting small (below 50 MW) facilities. The studies reviewed from other states indicate that site approval responsibility for such facilities remains in the hands of local government agencies, which generally have little experience with CHP technologies. This lack of experience and of applicable local/state CHP siting standards can lead to protracted and expensive proceedings to achieve approval.

For example, an assessment of CHP market barriers by Washington State University's Energy Program stated that:

> *Contentious, lengthy siting processes have significant economic and social costs, the former ultimately resulting in higher electricity costs or lost opportunities for the development of cost-effective generation, and the latter degrading a community's cohesiveness, regardless of the issue … Few local jurisdictions have public involvement standards and procedures for major projects such as energy facilities. Further they rarely have trained staff to facilitate or negotiate complex projects among strongly adversarial groups.*[90]

Electric Tariff Issues: Standby-Service Rates

On-site generation generally requires back-up power from the local electric distribution company to cover downtime for routine maintenance or for unplanned outages. Standby rates are a fixed monthly charge for reserved generation and distribution capacity to provide this back-up power. Published market assessments cite standby charges that exceed the utility's actual cost to serve the CHP customer as a factor negatively impacting the economics of CHP development.

Note: In New Jersey, standby rates for cogeneration facilities were originally adopted shortly after the passage of the Public Utility and Regulatory Policy Act of 1978 ("PURPA"), and provided a sharply lower demand charge (as compared to the full, cost-based tariff demand charge). This lower demand charge reflects the much lower cost-of-service due to the low coincidence factor of cogeneration facility outages. Electric distribution companies have restructured their standby service charges over the past several years to reflect the "unbundling" that was part of the deregulation process that began in 1999. While the EDCs all have different tariffs with rates and terms and conditions that are unique to varying degrees, all have distribution standby demand charges that are at relatively low levels (generally ranging from under $1.00/kW-month for high voltage to the $3.00/kW-month range for secondary voltage) as compared to the full, cost-of-service based distribution demand charges. These charges are applicable to the standby contract demand, which is generally equal to the rated capacity of the cogeneration unit. In addition, with unbundling generation and transmission, capacity is separately charged based upon assigned capacity and transmission obligations applied to Basic Generation Service ("BGS") tariff capacity and transmission rate. To the extent that the cogeneration units are operating on some or all of the 5 coincident peak hours of the summer, these charges can be partially or completely avoided As such, standby rates of New Jersey EDCs are generally favorable for cogeneration and, as discussed in a later section of this report, are not identified by CHP market actors in the state as a serious market barrier.

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[90] R. Gordon Bloomquist, et al. Combined Heat & Power: Legal, Institutional, Regulatory, WSUCEEP01-013, Washington State University Energy Program, March 2001.

Financial and Economic Issues Impacting CHP

Past assessments have concluded that capital costs and fuel prices have a major impact on the economics of CHP development, and several market assessments discuss and seek to quantify the relationship between the size of the CHP system, financing costs and fuel costs. [91,92]

The literature concludes that financing capital-intensive CHP processes remains a challenge, indicating that financing requires forecasts of future fuel and electric prices. Because these cost elements, particularly input fuel, are so critical to project economics and have become so volatile, this creates a significant risk that the required financial margin will not materialize if those forecasts are proved inaccurate. The studies reviewed also found that commercial, industrial, and non-profit entities operating facilities that might benefit from use of CHP may lack capital for investment or be unwilling to commit capital for energy projects that require a significant payback period.

The United States Combined Heat and Power Association notes that new CHP project growth across the country has been curtailed because of natural gas and oil prices and price volatility, making spark spread a less reliable CHP potential indicator than had historically been the case. (Note: the spark spread represents the theoretical margin for a power plant, indicating the difference between the market price for power and the running cost of a generating unit. If a spark spread is a positive number, then the price of the power is higher than incremental cost of generation for a fuel type and the spread is therefore profitable. If the spread is a negative number, the power is priced at less than the cost of incremental cost of generation and is therefore not profitable).[93] The Midwestern CHP Center, for example, has analyzed the potential for CHP in relation to electricity and natural gas prices, since natural gas is the fuel of choice among many CHP systems. It has quantified that relationship, posting calculations that illustrate the effect of natural gas prices on the economics of CHP systems, and providing CHP owners with data to assist them in determining at what natural gas price point it would be economic to turn off the cogeneration system and revert to boilers.

The Midwestern CHP Center report demonstrates how a CHP operator should compare the 'true' cost of electricity at utility tariff rates to the total cost of electricity produced by the CHP unit at different gas prices separately for on-peak and off-peak periods. The cost of electricity produced is derived from a plot of natural gas prices along different 'breakeven' lines. The different 'breakeven' lines reflect different effective system heat rates (efficiency of conversion of natural gas to electricity and useful thermal energy), which depend on the heat rate of the generator, the pressure of recovered steam or hot water, and whether or not steam loads exceed system steam-producing capacity in all hours. The Midwestern CHP Center recommends that this exercise be undertaken by the CHP operator on a monthly basis as gas prices fluctuate, and it is recommended that when the cost of electricity produced exceeds the cost of electricity purchased from the utility, in either the off-peak period only or during all hours, the CHP system should not be operated during those periods and the customer should instead purchase electricity and fire up its boilers.[94] *Note: this economic issue is addressed with specific focus on PJM markets and NJ electric tariffs later in this report in Section 2.5.*

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[91] Public Interest Energy Research Program and EPRI, Assessment of California CHP Market and Policy Options for Increased Penetration Final Report, July 2005 at 2-11.

[92] Baseline Analysis for the CHP Market in Indiana, prepared by the Midwest CHP Application Center (Sept. 2005) at 6.

[93] http://uschpa.admgt.com/markets.htm

[94] Reference Appendix 1 of the following document: www.**chp**centerMW.org/pdfs/IN_Baseline_Final_10242005.pdf.

The California study[95] indicates that, in general, the net cost of producing on-site power goes down as the size of the system increases.[96] The study provides detailed information on installed costs, heat rates, thermal output, O&M costs, and emissions rates for reciprocating engines, turbines, and microturbines of different sizes. The information provided shows installed costs (on a $/kW basis), O&M costs, heat rates and emissions rates all decreasing as unit capacity increases, for all technologies. For example, the installed cost of reciprocating engines drops by about 40% between the smallest sized engine (100 kW) and the largest engine (5,000 kW). Similar economies of scale are noted for gas turbines between the 1 MW and 5 MW (a 40% drop in installed cost). The drop in installed cost is about 20% between the 100 kW size engine and the 1,000 kW engine. These figures demonstrate the economic challenges facing smaller systems.[97]

The relatively lengthy payback period associated with CHP projects (i.e., a payback period that is longer than the required payback on other capital projects) must be factored in, and affects the cost of financing. A market research study conducted in California notes that:

> *Although there are many factors that affect project economics, most energy users ultimately reduce the complexity of a CHP decision to a simple payback calculation. Yet, the payback threshold that California energy users apply is very demanding – less than half of all energy users would be willing to accept a payback of even two years for a CHP project. Most would require a payback of one year or less. These stringent payback requirements imply that projects that often would be considered economic by vendors in the energy industry will not be adopted by California energy users. Users simply require higher rates of return than typically believed necessary.*[98]

In September 2005 the California PUC received a report prepared by Itron, Inc. that provided a preliminary cost-effectiveness evaluation of the PUC's self-generation incentive program through 2004. This report examined the cost-effectiveness of several technologies, including CHP, from a societal, total resource cost (TRC), participant, and nonparticipant perspective. Direct costs considered included: equipment purchase costs; equipment operation and maintenance costs; and equipment salvage value. Direct benefits include: electricity production valued at the electricity retail price (including commodity prices, delivery prices, and non-bypassable wires charges); reliability benefits defined as the value of grid ancillary services (0.3 cents per kWh); avoided T&D costs (defined as the discounted value of delayed T&D investments, but valued at zero due to uncertainty of actual impacts); and waste heat use benefits. Societal tests expand the horizon of benefits to include external environmental benefits associated with avoided grid generation and boiler-related natural gas consumption. Participant end-users typically realize the most direct benefit form CHP. Some benefits to the participant end-user result in a shift of cost-responsibility to other end-users (i.e., non-participants).

The report concluded that from the perspective of the end-user/participant, the CHP incentive program is marginally cost-effective (benefit-cost ratio of 1.05). However, from the nonparticipant, societal, and TRC perspective, the CHP incentive program is not cost-effective (benefit-cost ratios in the approximate range of 0.5 to 0.75). It is noted that the evaluation excludes possible net benefits related to T&D system cost savings, and also notes that cost-effectiveness could improve with maturation of technologies and

[95] Assessment of California CHP Market and Policy Options for Increased Penetration," Report 1012075, Cosponsors Public Interest Energy Research Program and EPRI July 2005

[96] Id. at 2-12.

[97] Specific cost and performance assumptions used by the California Assessment are set forth in Appendix E to that report. (www.eea-inc.com/dg**chp**_reports/ CEC_final_CHP_report_EPRI-EEA-E3.pdf).

[98] Id. at xi.

reduction in installed cost and O&M costs (although this observation was focused primarily on PV systems and microturbine CHP applications, not the more traditional CHP applications). The report also noted the adverse impact of 'high and variable' natural gas prices experienced by end-users during the study period and a possible mismatch with avoided electricity prices that had not yet caught up to the higher natural gas prices. The report concluded that the cost-effectiveness of the program is 'doubtful' from a nonparticipant and societal perspective when viewed at the year 2004 stage of the program development, and that 'major uncertainties with regard to future energy prices and long-term system performance make an absolute definitive cost-effectiveness determination impossible at this time.' The study did note that increased heat recovery through the use of chillers should be considered in sensitivity analyses to assess the impacts of improved performance, since use of chillers can help balance the thermal load.

Finally, with regard to financing, NYSERDA points out that there may be more attractive opportunities in the institutional and not-for-profit sectors as compared with private sector CHP projects. Institutional and not-for-profit developers may be able to finance CHP projects through use of tax-exempt instruments, with lower interest rates than available in the private sectors.[99]

Policy Options and Analysis

A few of the studies examined for this report sought to identify policy options and, in some cases, quantify the impact of implementing each policy on the development of CHP projects.

Categories of CHP incentives that may be utilized independently or coordinated include:

- Systems benefit charges to provide direct support for CHP projects.
- Investment Tax Credits (ITCs) to encourage capital investment. States may enact ITCs that are incremental to or separate from federal provisions.
- Production Tax Credits (PTCs) to credit the facility based on energy produced, which would provide an incentive for reliable operation.
- Accelerated depreciation to shorten pay-off periods.
- Tax exempt financing or leasing to promote investment.
- Loan guarantees to reduce customer risk.
- Emission reduction credits for distributed generation, which would provide market-based incentives to reduce NO_x emissions. Credits may be sold in existing emissions markets.
- Tariff exemptions from standby or other charges for highly efficient CHP.[100]

The California study's evaluation of policy options established various policy scenarios and sought to quantify the net benefits and impacts on CHP penetration levels (in MW) through 2020. This process incorporated a four-step process: (1) determining the key issues slowing the rate of CHP installation; (2) identifying a master list of policy options; (3) developing CHP policy portfolios and qualitatively evaluating key stakeholders issues with each; and (4) performing benefit-cost analysis from the customer, utility, and society perspective.[101]

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[99] 2002 NYSERDA Report at 8-24.

[100] http://www.northeastchp.org/nac/policymakers/incentives.htm

[101] Id. at 4-4.

This multi-stage analysis led to three conclusions. First, the California study concluded that policies facilitating the export of energy from CHP projects into the transmission and distribution system at wholesale prices resulted in significantly increased cumulative CHP market penetration, especially through completion of larger CHP units. Second, all policy options, including the base case, resulted in losses in electric utility revenue that were greater than the corresponding savings. The California study stated that the utilities would need to be compensated either through rate increases or increased utility value from CHP installations, or both. Finally, the authors point out that in the policy scenario the impact of increased incentive levels on CHP development, the majority of the societal benefit from CHP installations is not retained by society but rather transferred to the CHP owner through a production tax credit.[102]

New Jersey Energy Efficiency and Distributed Generation Market Potential Study

KEMA Inc. prepared and submitted in 2004 a Final Report to the Rutgers Center for Energy, Economic, and Environmental Policy that, among other things, estimated the market potential for distributed generation (DG) in New Jersey[103]. The overall objective of the study was to characterize and rank potential energy efficiency and DG measures, technologies, and concepts.

The overall approach taken in the KEMA study of DG market penetration included the following steps:

- Estimate the technical potential for CHP and fuel cells.
- Subdivide the technical potential into 5 size categories (100-500kW; 500-1,000kW; 1-5MW; 5-20MW; and >20MW).
- Develop payback periods for typical DG technologies in each size category.
- Run market penetration scenarios based on paybacks for each technology according to a base case and an accelerated case.

For DG, KEMA assumed that the lowest cost base load technology that can be permitted is used to determine market penetration. Base load DG technologies are assumed to operate as CHP units, since in many cases the economics of DG are not favorable unless process heat can be captured and re-used. Recoverable heat is valued at the cost of natural gas delivered to the end-user.

For developing the technical market potential, KEMA's estimate was based solely on the technologies' ability to meet customer needs, without consideration for economics. For commercial and industrial sites, the criteria for qualification as 'technically feasible' were as follows:

- Relatively coincident electric and thermal loads
- Thermal energy loads in the form of steam or hot water
- Electric-demand-to-thermal-demand ratios in the 0.5-2.5 range
- Moderate to high operating hours (i.e., >4,000 hours)

The estimates for technical feasibility did not consider such factors as ability to retrofit, owner interest, capital availability, natural gas availability, and variation of energy consumption within size classes. KEMA's estimate for commercial and institutional technical potential for CHP is about 30% (net of existing CHP) of total commercial/institutional load, and about 70% of total industrial load. As shown,

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[102] Id. at 4-30.

[103] "New Jersey Energy Efficiency and Distributed Generation Market Assessment." Prepared by KEMA, Inc. 2004

the industrial technical potential estimate is much higher on a proportionate basis than the commercial sector potential.

These technical feasibilities were translated by KEMA into market potential by determining the economic attractiveness to end-users, as estimated based on payback periods. Additional contributing factors include the current market penetration level, the maximum achievable growth rate, and the size of the remaining potential market, recognizing that as market development proceeds, there will be an ever-declining pool of potential customers. The maximum growth rate is tempered by KEMA's use of an economic acceptance factor (EAF), which equals 100% for project paybacks of 2 years or less and declines linearly to zero for payback of 8 years or more.

The base case in the KEMA study assumes current (as of 2004) electric and gas rates and standby charges with no incentives. The New Jersey energy rates assumed in the study were as follows:

Table 2-1. KEMA Base Case Utility Rates

Market Sector	*Gas Rate ($/Mcf)*	*Electricity Rate ($/kWh)*	*Standby Charge ($/kWh)*
Commercial	*$7.50*	*$0.091*	*$0.015*
Industrial	*$4.70*	*$0.079*	*$0.010*

The KEMA study further assumed a 'slight' annual energy cost escalation of 1%.

KEMA's accelerated case assumes a rebate of $1/watt or 30% of installed cost whichever is lower, as well as lower standby rates and a higher maximum market penetration rate. As a result, both the base and accelerated cases include the same energy rates set forth above.

Using the above energy rates, the KEMA study estimated base case paybacks for CHP systems installed in 2004 as follows (assuming an 80% capacity factor).

Table 2-2.Base Case Paybacks on CHP System Investments by Size (KEMA Study Table 4-5)

CHP Size	*100 kW*	*800 kW*	*5 MW*	*10 MW*
Technology	*Engine*	*Engine*	*Turbine*	*Turbine*
Payback (Years) Comm	*38 years*	*13 years*	*8 years*	*5 years*
Payback (Years) Indust	*11 years*	*6 years*	*5 years*	*4 years*

As shown, in the base case (i.e., without any incentives) only the very largest commercial applications (>5 MW) would meet even a minimal (i.e., above 0%) economic acceptance factor as defined by KEMA.[104] For industrial applications, KEMA shows that in the base case 800 kW systems would only achieve a 33% economic acceptance rate, and a very large size CHP application (10 MW) would still see only a 67% economic acceptance.

As such, in the base case (i.e., no incentives) scenario the KEMA study projected that by 2006 cumulative (since 2004) CHP market penetration would total about 30 MW commercial and about 125 MW industrial

[104] Economic Acceptance Factor or "EAF" is defined in the KEMA Report as a number decreasing linearly from 100 percent to 0 percent as paybacks vary from 2 years or less to 8 years or more, and is intended to represent the percentage of end-users that with technical CHP feasibility that would invest in CHP at different paybacks.

(roughly 150 MW total). Conversely, in the accelerated case (program incentives plus other changes) KEMA projected 2006 market penetration of about 425 MW commercial and about 375 MW industrial, totaling about 800 MW. The KEMA estimate of total cumulative C&I CHP market penetration by the year 2020 is 575 MW in the base case and 2,100 MW in the accelerated case. This estimated 1,525 MW incremental CHP penetration (incremental CHP penetration is defined as the difference between the year 2020 base and accelerated case) by the year 2020 would come at an estimated program cost of $662.345M (the cost of incentives plus 5% administrative costs). This represents a cost of a $434 per MW basis for installed DG capacity.

2.2 Assessment of Performance Indicators

Updating and revising performance indicators is typically an important step that precedes much of the program and market assessment activities. Revised performance indicators typically serve as the “roadmap” for the market assessment report, guiding the data collection approach and analysis so that the research can effectively measure the efficacy of the programs in meeting the stated market transformation goals.

In the case of the pilot CHP program, the situation is somewhat unique for a number of reasons:

- There are no specific performance indicators currently in place for the program.
- For CHP the paradigm typical of many other types of EE equipment does not exist, namely that a particular piece of equipment or building component is needed by the end-user, and the choice is between one of standard efficiency or one with higher efficiency. Rather, for CHP, the decision is typically between continuing with an operating mode of purchasing electricity from the grid/local utility and producing needed thermal energy through conventional means such as a separate boiler, and embarking on a completely different mode of operation whereby electricity is generated onsite and thermal energy is derived primarily from recapturing waste heat off the electrical generating equipment.
- CHP itself is by no means a new technology; rather, CHP has been in use for decades. Therefore, the intent of the incentive is not to encourage the use of a new or untested technology.
- The program has been in place for two cycles, and the first projects funded under the pilot have just recently come online, so there is virtually no information with respect to customer satisfaction with the performance of the equipment.
- Because of the nature of the technology as a ‘big-ticket’ item, the program has only been in place for two years, and there is limited funding that translates into a limit of the total number of successful awardees, sample sizes for prospective interviewees are very small as compared to many other EE applications.

Accordingly, in this CHP section, the scope is narrower than the performance indicators sections applicable to other programs assessed in the report.

As described earlier in this report, performance indicators typically can be classified into two broad categories: output and outcome indicators. Output indicators typically provide descriptive statistics to measure program activity levels (e.g., the number of applications, the number of incentives provided, the size of systems being applied for and being awarded incentives, level of project attrition). The other questions, however, are outcome indicators, which look at the impacts of the program on awareness and attitudes, resource commitments by vendors and manufacturers to the market, changes in the market actors' perception of market barriers, etc.

In examining progress indicators, it is also necessary to benchmark against a baseline, assessing time-series (longitudinal) changes in the measurements of interest. For example, longitudinal outcome indicators would examine such questions as:

- Has awareness of the technology changed over time?
- Have market barriers, such as the incremental cost of efficient measures and lack of availability of efficient measures, decreased over time?

As discussed above, a number of questions applicable with respect to other EE programs are not applicable at this time with respect to the pilot CHP program, and there is no foundation of pre-existing indicators or specific goals for this program upon which to build. As such, there can be no review or update of current indicators. Set forth in Table 10-3 are the recommended initial set of performance indicators, reflecting the unique nature of the CHP program as discussed above.

The recommended initial set of performance indicators break down into a number of categories, including those that track: program activity (number of applications and number of awards broken down by size); program attrition; program impacts; end-user awareness (with an eye towards tracking an increase in awareness over time); vendor and manufacturer resource commitment (with an eye towards tracking an increase in market actors' resource commitments in NJ over time); use of emerging technologies (with an eye towards increasing the use of emerging CHP technologies over time); and market barriers (with an eye towards tracking a decrease in critical market barriers over time).

Table 2-3. Combined Heat and Power Program Indicators

Topic	Performance Indicator	New?	General Source	Detailed Source	Notes
Program Activity	Number of applications - Total	Yes	Program tracking	Individual incentive applications and program reports	# of applications can be influenced by a number of factors: amount of marketing; change (i.e., tightening) in application requirements; timing of program announcement and window for applications to be prepared and submitted).
Program Activity	Number of applications - Striated by type and MW size	Yes	Program tracking	Individual incentive applications and program reports	Based on initial round of program staff interviews, there may be an interest in targeting the receipt of more applications from smaller sized projects.
Program Activity	Number of awards - Total	Yes	Program tracking	Individual incentive applications and program reports	
Program Activity	Number of awards - striated by project size	Yes	Program tracking	Individual incentive applications and program reports	Based on initial round of program staff interviews, there may be an interest in targeting a larger number of awards to smaller sized projects.
Program Attrition	Number and % of awarded projects that subsequently drop-out	Yes	Program tracking	Individual incentive applications and program reports, as well as interviews of program drop-outs	Attrition rate can be influenced by a number of factors that change over time: level of rigor of applications; change in vendor behavior; economic/market conditions, etc.
Program Impacts	Peak demand (kW) reduction	Yes	Program tracking	Individual incentive applications and program reports	
End-User Awareness	Level of end-user knowledge and awareness of CHP benefits	Yes	Market Assessment	Survey of end-users	Can survey existing applicant end-user base regarding current awareness and changes in their awareness since program inception. No prior baseline awareness exists to our knowledge.
Vendor Resource Commitment	Change in level of personnel resource commitment in state	Yes	Market Assessment	Survey of vendors	Can survey existing applicant vendor base regarding current change in resource commitment in New Jersey. No prior baseline awareness exists to our knowledge.

Topic	Performance Indicator	New?	General Source	Detailed Source	Notes
Manufacturer Resource Commitment	Change in level of personnel resource commitment in state	Yes	Market Assessment	Survey of manufacturers	Can survey existing manufacturer base regarding current change in resource commitment in New Jersey. No prior baseline awareness exists to our knowledge.
Use of Emerging Technologies	Number, location, and description of projects using new or improved CHP technologies	Yes	Program tracking/Market Assessment	Review of program files, applications and related documents; surveys of manufacturers, vendors	
Market Barriers - Program specific	Initial cost - % of respondents who believe that the barrier has decreased	Yes	Market Assessment	Surveys of vendors, manufacturers, and customers	
Market Barriers - Non program specific but within OCE/BPU/DEP influence	Air permitting, standby tariffs, interconnection, availability of technical assistance, availability of information- % of respondents who believe that the barrier has decreased	Yes	Market Assessment	Surveys of vendors and customers	
Market Barriers - Other	Operating cost, maintenance cost, maintenance and repair infrastructure, energy savings available, local permitting issues- % of respondents who believe that the barrier has decreased	Yes	Market Assessment	Surveys of vendors, manufacturers, and customers	

2.3 Market Share Assessment

2.3.1 Status of the NJ CHP Program

2004 Program Applications, Awards, and Status

The CHP pilot program was initiated in 2004, with an annual incentives budget of approximately $5 million. The program has completed two application cycles – 2004 and 2005. As described below, in both years there was an over-subscription; that is, the requests for incentive awards substantially exceeded the allocated funds available. Projects were ranked and the highest-to-lowest-ranking projects were selected until the incentives budget was exhausted.

In 2004 the program accepted a total of 73 applications, representing a total request for incentives exceeding $25 million, or approximately *5 times* the amount of incentives budgeted by the OCE. The total estimated installed project cost for the 73 project applicants was about $106 million, which translates into an average installed system cost of $1.460 million per project. (Note: the CHP 2004 program data include kilowatt capacity for the initial awardees but do not include the project kilowatt capacity for all applicants. We are using the estimated installed cost data as a proxy for the size of project applicants in 2004.) The average requested incentive for all 73 applicants was about $350,000 per project. After an initial screening process there were 26 projects identified by the evaluation team for initial evaluation. However after many of this first group of 26 were rejected in the technical evaluation stage, additional projects were considered. Ultimately 24 projects were selected to fill the $5 million in incentives budgeted for 2004 (8 of the 24 awardees were not part of the initial screened list but were added only after the elimination of higher initially-ranked projects based upon technical evaluation as described above). The selected 24 projects totaled 8.267 MW in planned capacity (demand reduction), at a total estimated installed cost of about $17 million. As such, the initial group of 24 awardees in 2004 had an average installed capacity of 344 kW, an estimated installed cost of about $700,000, and an average incentive award of $208,000 per project and $604 per installed kW.

Table 2-4. 2004 Program Awardees Summary

# Projects	Capacity (kw)	Incentive ($)	Installed Cost ($)	Average Size (kW)	Average Cost/Project	Average Incentive/Project	Average Incentive/kW
24	8,267 kw	$5M	$17M	344 kW	$700k	$208k/project	$604/kW

As of March 2006, there are only nine projects still active from the original list of 24 awardees. The remainder of the list of awardees have subsequently cancelled projects and rejected the incentive awards. The remaining nine active projects from the 2004 program cycle can be summarized as follows (Table 2-5).

Table 2-5. Profile of Active CHP program Projects from 2004 Cycle

Status	# Projects	Capacity (kW)	Incentive ($)
In Development	3	2,640	$1,109,000
Under Construction	0	0	$0
Complete/Still in Shakedown	3	1,753	$1,094,000
Complete and Paid	3	530	$426,000
Total	**9**	**4,923**	**$2,629,400**

The profile of the remaining active projects from 2004 is an average capacity of 547 kW and an average incentive amount per project of just under $300,000. As such, the profile of the nine remaining projects is that their size is, on average, larger than the average size of all initial awardees (547 kW versus 344 kW). As such, overall the initially awarded projects that subsequently dropped out tended to be some of the smaller projects.

The attrition of over 60% (15 out of 24) of the 2004 awardees has freed up approximately $2.4 million in previously committed funds, which were carried over to expand the 2005 cycle budget.

2005 Program Applications, Awards, and Status

In 2005 the program accepted a total of 26 applications, representing a total of 28.8 MW in potential peak demand reduction. This breaks down to an average project size per applicant of 1,661 kW. The total requested incentives for these 26 projects were $13.5 million, or about $520,000 per project. After the evaluation and ranking process, 10 projects were initially selected as awardees, totaling approximately 18 MW in planned demand reduction, at a total incentive amount exhausting the 2005 incentives budget of $7.4 million. (Note: The 2005 incentives budget reflects $5 million originally allocated to the program, plus approximately $2.4 million freed up from the 2004 cycle as a result of 2004 project attrition.) The initial 2005 awardees had an average installed capacity of 1,827 kW, at an average incentive award amount of approximately $407,000. Subsequently, one large (approximately 2,500 kW) project cancelled and rejected the award, and was replaced by three next-highest ranked projects from the original evaluation, totaling approximately 1,800 kW.

As a result, there are 12 ‘active’ projects currently on the list. The revised 2005 program totals of active projects are about $7.7 million in committed incentives and about 17.6 MW of capacity. This translates into an average project size of 1,467 kW for the 12 active projects from the 2005 cycle. This is nearly *3 times* as large as the average size of the still-active projects from the 2004 program cycle. The majority of these active 2005 projects are in the development stage. As such, and because the awards have only been made within the past few months, it is premature to reach any conclusions from the program data as to whether the attrition rate will be improved in the 2005 cycle. Three of the projects are listed in the program database as having a summer 2006 target completion date, which would imply that they would be well into construction phase by the date of this report. However, at the time of this writing we have not received confirmation that construction is indeed underway at any of these three sites.

The profiles of the 2005 awardees, as compared to the 2004 awardees, is set forth below in Table 2-6.

Table 2-6. Profile of CHP Awardees for First Two Years of Program

Year	# Projects	Capacity (kw)	Incentive ($)	Average Size (kw)	Average Incentive/Project	Average Incentive/watt
2005	12	17,600 kw	$7.7M	1,467 kw	$642k/project	$0.44/watt
2004	24	8,267 kw	$5.0M	344 kw	$208k/project	$0.60/watt

During the first two years of the program, the applications have been dominated by systems with natural gas-fired engines, turbines, and microturbines with thermal recovery. There have been no applications for fuel cells or add-on heat recovery systems.

Pre-Existing CHP Market in New Jersey

The level of program activity can be benchmarked against overall the CHP market in New Jersey, both in historical terms and in projected/potential terms.

Combined heat and power is by no means a new technology, and New Jersey has a substantial and lengthy history of CHP applications at end-users' sites of many sizes and types. The U.S. Department of Energy and Oak Ridge National Laboratory sponsor a database of CHP installations throughout the country, including a breakdown of installations by state. The database includes installations through 2004. The database lists a total of 187 sites with installed CHP systems in New Jersey, representing a total of 3,443 MW of installed capacity, dating back as early as 1936. The following figures represent a breakdown of all of the installed CHP systems in New Jersey listed in the database, categorized by size and by number of sites.

Figure 2-1. All Existing NJ CHP Systems (Capacity) Grouped by Year Installed

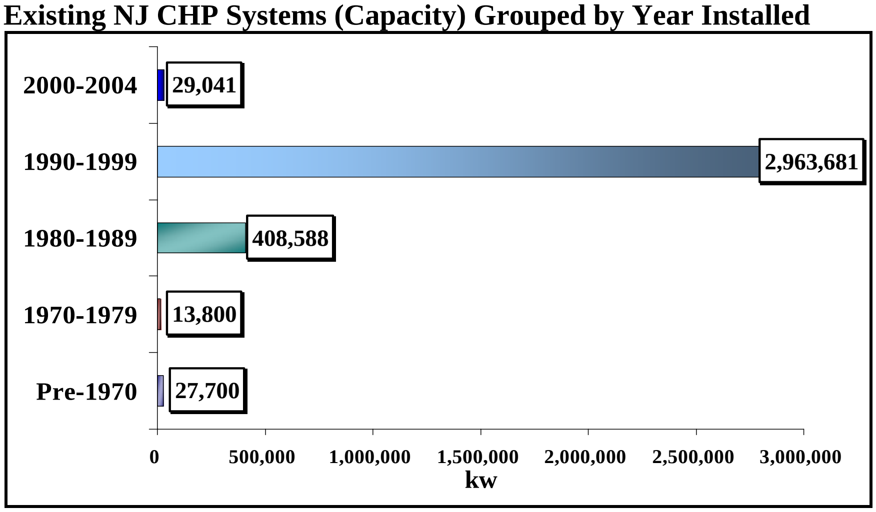
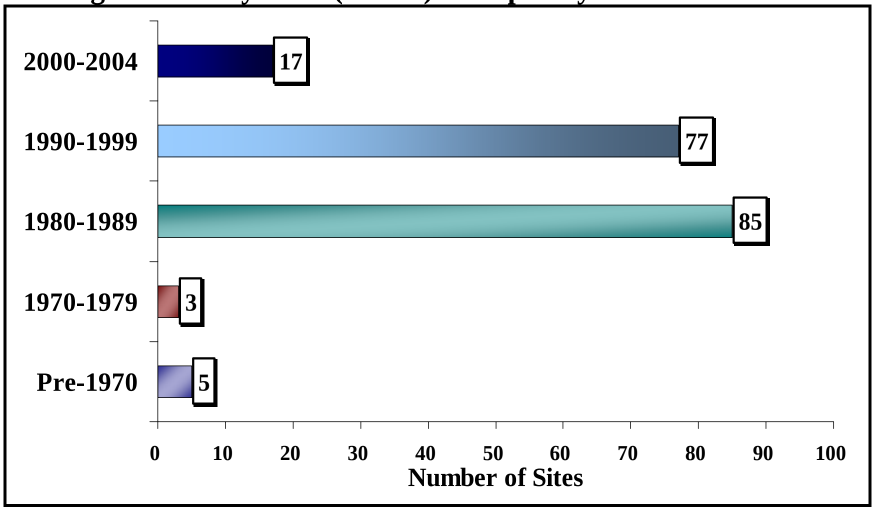


Figure 2-2. All Existing NJ CHP Systems (# Sites) Grouped by Year Installed



As shown in Figure 2-1 and Figure 2-2, there was a limited amount of CHP activity in the state prior to 1979. As stated above, the first site listed in the database was a 4,500 kW installation at a chemical manufacturing facility dating back to 1936. Figure 2-1 and Figure 2-2 show a boom in CHP installations in the state during the 1980s and 1990s. This boom in CHP installations came on the heels of the passage by the U.S. Congress of the Public Utilities Regulatory and Policy Act of 1978 (PURPA), and the subsequent state-level implementation of PURPA-promoting rules and policies. As discussed in detail in Section 2.5 and Appendix 2-A of this report, this period also represents a time when project economics, as driven by the relative prices of natural gas and electricity, were quite favorable. As shown, CHP activity during the first half of the current decade, while greater than the historic (pre-PURPA) period, is substantially lower than during the preceding two decades (even if one were to pro-rate for the fact that the 2000-2004 period only represents half of a decade).

In the review of the database, it was determined that a number of sites were included that are not comparable to the types of applications that are targeted with the CHP program; specifically, the database includes (1) several resource recovery facilities (waste-to-energy facilities) and biomass (methane gas) facilities that operate as designated PURPA-qualifying facilities (QFs) and sell power back to the wholesale grid (via power purchase agreements with electric utilities), and (2) numerous large cogeneration facilities that operate as designated QFs at industrial manufacturing sites but that are sized substantially larger than the loads of the host end-user and that sell significant amounts of excess power back to the wholesale grid (via power purchase agreements with electric utilities or, for many that have had their utility power purchase agreements (PPAs) restructured or bought-out, directly to the grid in a wholesale merchant plant mode). While these wholesale-selling QFs are relatively few in number, they represent a substantial portion of the installed CHP capacity listed in the database, and thereby distort the overall picture of on-site CHP applications (i.e., CHP systems installed primarily to meet on-site, end-user loads).

The data in Figure 2-1 and Figure 2-2 are provided because they represent the actual CHP system data as reported by the U.S. DOE, and because our review indicates that reported CHP data for other states is reported in a similar fashion. As such, this information is needed for purposes of comparing the existing CHP market in NJ to the reported existing CHP market in other states. However, in Figure 2-3 and Figure 2-4 we have re-cast the historical CHP data to exclude biomass and waste-to-energy facilities altogether, and we have excluded the kilowatt capacity of the large cogeneration facilities that are over-sized to sell power back to the grid (we retain these sites in the site count in Figure 2-4 since these do represent legitimate, large industrial applications of CHP). These figures thereby are intended to better represent the historical on-site CHP applications similar to those targeted by the CHP program (i.e., inside-the-fence CHP applications).

Figure 2-3. NJ Existing On-Site CHP Systems (Capacity) Grouped by Year Installed

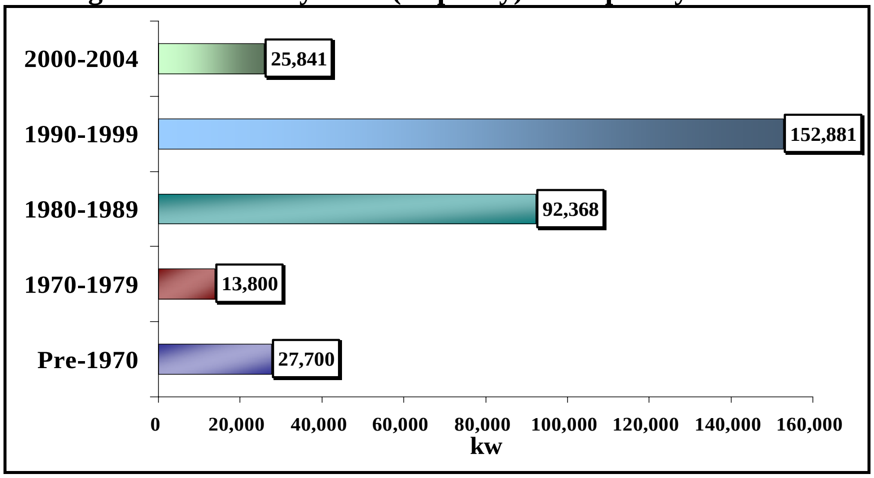
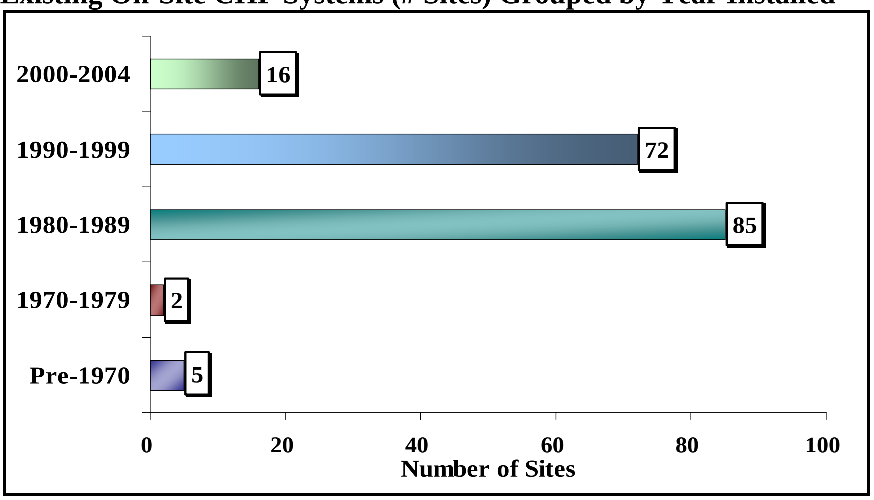


Figure 2-4. NJ Existing On-Site CHP Systems (# Sites) Grouped by Year Installed



As shown in Figure 2-3 and Figure 2-4, the 1980s and 1990s still represent a relative boom period in CHP in terms of on-site applications. The overall total of installed CHP capacity is substantially (about 90% or roughly 3000 MW) lower by re-stating the total capacity to exclude the large cogeneration facilities designed to sell power back to the grid. (Note: The complete exclusion of this capacity tends to understate the end-user load at CHP sites, since most of these facilities are located at the site of a substantial industrial customer that serves as the thermal load.) We did not add any on-site capacity back in because we have no direct basis of knowing the amount of on-site industrial electric load at these host sites. However, these do represent 17 of some of the largest industrial sites in the state, including refineries, chemical manufacturing, etc., so it is safe to assume that these host sites represent at least several hundred MW of on-site load. As such, we conservatively estimate that CHP is installed currently at end-user sites in the state representing over 600 MW of load.

We also sorted the database of on-site CHP applications by size, to show a distribution of CHP systems in the state. Figure 2-5 and Figure 2-6 show the size distribution of on-site CHP applications in the state by capacity and by the number of sites. As shown in Figure 2-5, the vast majority of total on-site CHP projects are in the over 3000 kW category. (Note: this does not include the 17 industrial sites that host the grid-selling cogeneration facilities that would tend to fall into the > 3,000 kW category as well.) However, in terms of the number of sites, Figure 2-6 shows that there is a good size distribution of installed CHP systems in the state, including many applications at smaller-sized customers. The detailed data indicate a good distribution among different business types as well. Included in the smaller-sized CHP projects are a number of apartment buildings, nursing homes, YMCAs, and office buildings. As such, in historic terms these smaller applications experienced a representative market penetration.

Figure 2-5. NJ On-Site CHP (Size Distribution by Capacity)

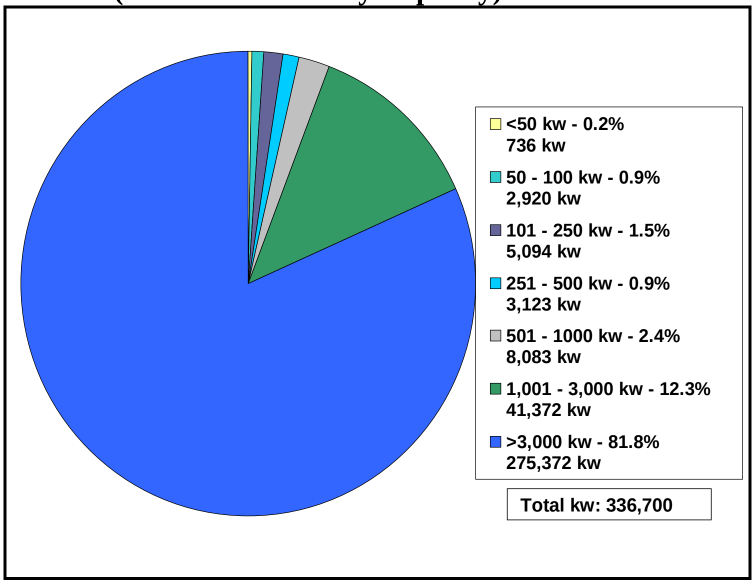
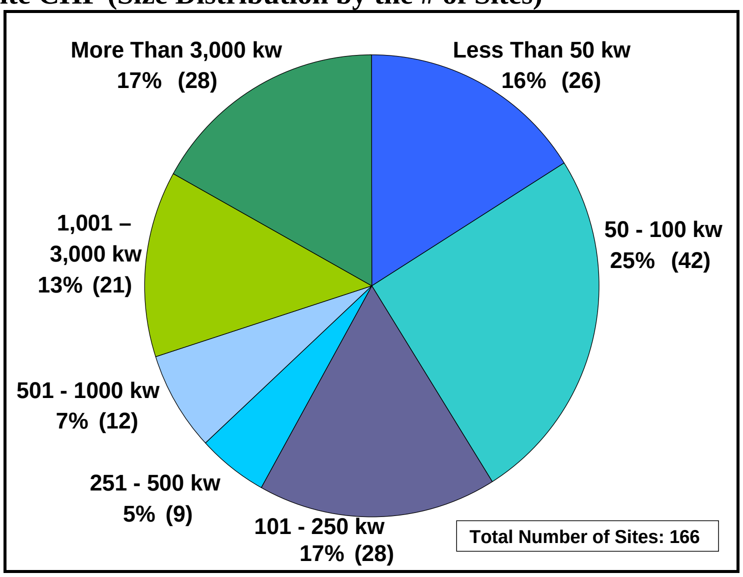


Figure 2-6. NJ On-Site CHP (Size Distribution by the # of Sites)



Benchmarking the Market Share of the Program

The prospective CHP market potential was estimated in the 2004 KEMA study commissioned by the OCE. The KEMA study concluded that with existing market barriers lowered, most specifically financial ones, the feasibility and economic value of CHP to the potential customer or host will increase, the payback will be reduced, and market penetration levels will rise. The KEMA report had two market potential cases, one a base case (status quo) and one an accelerated case that assumed the introduction of incentives amounting to 30% of installed cost. In the base case, cumulative C&I market potential for CHP was projected to be about 575 MW installed by year 2020, with somewhat higher annual market penetration in the early years. In the accelerated case, cumulative C&I market potential for CHP was projected to be about 2,100 MW installed by year 2020, with substantially higher annual market penetration in the early years.

Indeed, market penetration after one year (by 2005) was estimated by KEMA to be about 90 MW in the base case versus about 500 MW in the accelerated case, and after two years (by 2006) the market penetration was estimated to be about 170 MW in the base case versus about 800 MW in the accelerated case. The estimated breakdown of the market potential between commercial and industrial end-users in the base case and the accelerated case was about 20%/80% and about 50%/50% respectively, showing the expectation that the introduction of incentives would have a large impact overall, but particularly so in the commercial market where base case paybacks are otherwise very long. The KEMA study therefore suggested that the introduction of incentives into the market place had the potential to increase CHP market penetration by over 600 MW after two years; however, at an implied estimated incentive program cost of nearly $261 million, or an average of about $0.43/watt installed. Even using a more conservative 'straight-line' approach (spreading the 2020 aggregate market potential evenly over a 16-year period) as opposed to the assumed higher penetration rate in the early years, the KEMA study would still predict the implementation of 72 MW of CHP by 2006 in the base case and 262 MW in the accelerated case.

As compared to these market potential estimates provided by the 2004 KEMA study, as summarized above, after two years of the CHP program, the status of CHP projects selected through the program as of March 2006 is that there are approximately 22 MW of CHP capacity active (defined as either operational, under construction or still in active development) at 21 end-user sites (5 MW active at 9 sites from the 2004 cycle, and 17 MW active at 12 sites from the 2005 cycle). This 'live' capacity represents approximately $10.3 million in CHP program incentive payments or commitments or about $0.47/watt. As shown, the average incentive amounts awarded through the CHP program ($0.47/watt) is very close to the level of incentives assumed by KEMA ($0.43/watt) in KEMA's accelerated case. As such, the accelerated case from the KEMA study would appear to be the appropriate benchmark to assess the market share of the program. In that vein, the active CHP projects participating in the program represent about 2.75% (22 MW active out of 800 MW potential) of the 2006 market potential.

In order to gauge the level of CHP development activity in the state over the same period that is being developed outside of the program, we questioned participating manufacturers (we contacted all manufacturers whose equipment was utilized or was planned to be utilized in one or more 2004 and/or 2005 program applicant projects) about the number and size of CHP projects that they had sold in the state overall during the past year. We also contacted the NJ DEP requesting a list of CHP system air permit applications over the past two years. We were told that the agency does not maintain such a separate database. However, we were told anecdotally by DEP air permit staff that CHP system permit activity has been limited.

From the responding manufacturers, we found that 33% had sold 0 projects in New Jersey in the past year, another 33% had sold three or fewer CHP systems in New Jersey, another 22% had sold six or fewer systems, and 11% (one manufacturer) had sold 17 relatively small reciprocating engine systems in the state. The total breakdown of systems sold in New Jersey by responding manufacturers broke down as follows (Table 2-7).

Table 2-7. CHP Units Sold in NJ in Past Year by Participating Vendors (both CHP and non-CHP-Program Funded)

Size	<100 kW	100-500 kW	500-1000 kW	1000-3000 kW	>3000 kW
#	0	21	1	11	1

Using the mid-point of each size range, we estimate the total capacity of the 34 CHP systems sold in New Jersey by responding manufacturers to be about 31 MW. The responding manufacturers indicated that 5 of the CHP systems sold in the last year, totaling an estimated 6.75 MW of capacity, were recipients of CHP program funding. Based on these numbers, it appears that the level of market penetration outside the CHP program has been relatively modest (estimated at 25 MW for the 10 manufacturers surveyed) overall, and has been relatively modest in comparison to the identified market potential.

This observation is supported further by the responses of the developers surveyed as part of this project. The developers, all of whom had submitted an application in either 2004 or 2005 for one or more CHP project incentive awards, were questioned about their awareness of any end-users in New Jersey who had installed CHP systems outside of the CHP program. Ninety-three percent of the responding developers indicated that they were not aware of any such non-program CHP installations. The developers are relatively active overall, as nearly one-half (44%) indicated that their companies had installed other CHP systems in the last two years. However, only 22% indicated that that activity included other New Jersey projects – representing five in-state projects in total. Moreover, of those five New Jersey projects referenced, one was another CHP program-funded project, and one was a re-powering of an existing system. As such, of all the developers questioned, only two developers could confirm that their firms had installed new CHP systems (three systems in total) outside of the CHP program during the past two years.

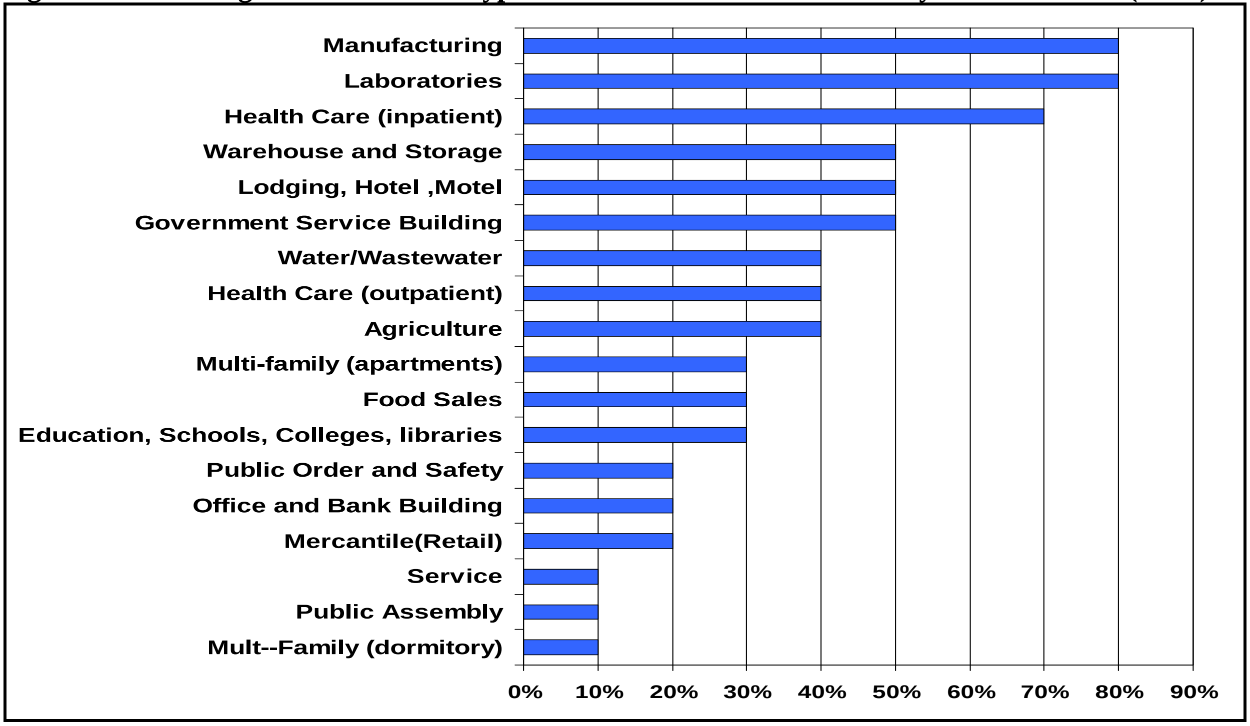
Yet in response to our question regarding the potential market size for CHP in New Jersey, although none of the developers had a specific MW estimate, those who had an opinion indicated that the market potential in the state is substantial (responses ranged from ‘substantial,’ to ‘big,’ to ‘large,’ to ‘huge’).

A modest majority (56%) of manufacturers indicated that the CHP program had increased their resource commitment to selling their equipment in New Jersey, and a slightly larger majority (67%) agreed that the CHP program had increased customer interest in CHP. Similarly modest majorities of surveyed developers indicated an increased resource commitment (56%) and an increase in customer interest (61%) in the state as a result of the CHP program.

Most of the surveyed manufacturers have more than one target market in terms of system and customer sizes. However, overall the target CHP market for equipment manufacturers is clearly at the larger end of the end-user scale. Most of the responding manufacturers (80% of all respondents) indicated that the 1,000 kW-3,000 kW sized customer is included as one of their target markets. Sixty percent indicated that 250 kW-1,000 kW systems were among their target markets, 40% indicated that the 100 kW-250 kW size was among their target markets, 20% indicated the 50 kW-100 kW size was among the target markets, and none of the manufacturers indicated <50kW as a target market.

Manufacturers were also questioned regarding the types of buildings or business sectors (not specific to New Jersey) in which their CHP equipment had been installed. Figure 2-7 summarizes the breakdown of the manufacturers’ responses.

Figure 2-7. Building/Business Sector Types Where Manufacturers CHP Systems Installed (n=10)



As shown, the predominant market for most CHP equipment manufacturers (70% or more of responding manufacturers) has been in the manufacturing, laboratories, and in-patient health care business sectors, followed by warehouse and storage, lodging, and government service buildings.

By contrast, 30% or fewer of the responding manufacturers indicated that they had installed their CHP systems in multi-family apartments, food sales, schools, colleges, and libraries, public order and safety, office and bank buildings, retail, service, public assembly, or dormitories.

It is noteworthy that many of these generally smaller business/entity types are well represented in the historical database of pre-existing on-site CHP systems in New Jersey. The information collected through the surveys and through historical databases suggest that, while smaller-sized CHP projects have in the past been part of the landscape, there is a clear industry emphasis overall on the larger-sized projects. As described above, there was also a clear trend between the first and second CHP program cycle toward larger projects. As described elsewhere in this report, this trend is almost certainly driven, at least in part, by generally longer payback periods for smaller systems, and is likely exacerbated by declining economics associated with rising natural gas prices. As described in the following section, this trend is being repeated in other states.

2.3.2 Benchmarking Against Other States

There is a host of different programs available in many states targeted at CHP, including tax incentives such as investment tax credits, accelerated depreciation and sales tax exemptions on certain equipment, tax-exempt financing, loan guarantees, and utility tariff discounts. We have identified only two states, however, that have implemented an incentive program similar to the OCE pilot CHP program, funded out of the SBC or similar ratepayer-funded wires charge that is targeted specifically at reducing the up-front installed cost of CHP. These states are New York and California.

New York

Market Potential

The New York State Research and Development Authority (NYSERDA) commissioned a CHP market potential study that was completed in October 2002. The final report prepared by the Energy Nexus Group and the Onsite Energy Corporation indicated that at that time the state of New York already had 5000 MW of CHP capacity installed at 210 sites, comprised predominantly of industrial sector end-users. The final report identified a technical potential for nearly 8,500 MW of new CHP in New York at 26,000 sites. The identified sites included 16 remaining sites that could support a plant size greater than 20 MW; the report indicated that close to 74% of the technically potential capacity was below 5 MW and was primarily at commercial and institutional facilities. The final report showed that out of the technical potential there was a *base case* market potential of 764 MW of installed CHP by 2012, and an *accelerated case* market potential of 2,200 MW during the same timeframe.

CHP Program

NYSERDA initiated its DG/CHP program in March 2001. The program is funded through a societal benefits charge at a level of $15 million per year, through an annual competitive solicitation, and provides project funding for: feasibility studies (up to $100,000), product development (up to $500,000), and demonstrations (up to $1 million).

The specific program goals of NYSERDA's DG/CHP program are:

- Demonstrate the viability, cost-effectiveness, reliability, and replicability of DG and CHP systems.
- Foster product development of systems designed to address specific issues and opportunities including fuel type, application, and environmental performance.
- Develop equipment and installation codes and standards and inspector/installer training.
- Stimulate and support the service business for emerging DG and CHP technologies.

NYSERDA estimated that its funding of CHP projects installed through year-end 2004 represent a reduction in peak load of 12.6 MW. In its May 2005 Status Report, NYSERDA also anticipated peak demand reductions of 85 MW, based on the viable projects it had committed to support at that time.[105]

Updates obtained from NYSERDA indicate that project commitments through September 2005 are as follows:

- 107 MW, with 15.3 MW operational
- 105 projects, with 36 operational
- $54.7 million in funding
- $285 million committed by developers[106]

[105] New York Energy Smart Program Evaluation and Status Report, May 2005.

[106] http://www.energetics.com/madri/pdfs/worden_020106.pdf, at Slide 9.

In August 2005, NYSERDA announced its most recent awards, and committed to fund an additional 31 CHP projects. Governor Pataki's office reported that this represented a total investment of more than $90 million in distributed generation technologies and combined heat and power applications, when co-funding was factored in. Collectively, the projects should create approximately 29 MW of new generating capacity with over one-half of that fueled by renewable fuels such as landfill or anaerobic digester gases.

Since its inception in 2001, NYSERDA has solicited DG/CHP projects through five rounds of funding, receiving nearly 500 proposals of which more than 100 CHP demonstration projects and 50 product development projects were selected for funding. As of today, 34 CHP demonstration projects are operational, producing more than 13 MW of electricity.

Throughout its 2005 procurement period, NYSERDA specified that it offered funding for the following categories of CHP projects:

Category A: ***Demonstration*** of DG/CHP systems at industrial/commercial/residential facilities.

Category B: ***Feasibility studies*** to define the baseline design of a DG/CHP system for a specific facility.

Category C: ***Technology transfer studies*** to broaden the market penetration of DG/CHP systems.

Category D: ***Product development*** of new DG power systems and/or related components.

Category E: ***Feasibility studies*** to assess the viability of new DG product designs/concepts.

Category	NYSERDA Cost Share	Maximum Award
Category A:	30% to 60%	$1,000,000
Category B:	50%	$ 100,000
Category C:	75%	$ 100,000
Category D:	50%	$ 500,000
Category E:	50%	$ 100,000

With regard to Category A, Demonstration Projects, NYSERDA's maximum cost-share for specific technologies are as follows:

	Maximum NYSERDA Cost Share	
Technology	**Fossil Fuel**	**Renewable Fuel**
Internal Combustion Engine	30%	40%
Steam Turbines	30%	40%
Combustion Turbines	30%	40%
Microturbines	40%	50%
Fuel Cells	50%	60%[107]

[107] Program Opportunity Notice (PON 914): Power Systems, Distributed Generation, Combined Heat and Power (Proposals Due: April 21, 2005) at Category A: Sheet 1 of 3.

With regard to general contracting program requirements, NYSERDA specifies that it "prefers to contract directly with the Host Site, and as such, the Host Site is expected to serve as NYSERDA's Prime Contractor. Under certain circumstances it may be necessary for NYSERDA to contract with a project developer or an energy services company (ESCO), but this contractual arrangement will only be permitted on a limited basis."[108]

In addition, DG/CHP Demonstration Projects must demonstrate a minimum annual overall efficiency of 60% based on the higher heating value of the fuel input in order to be eligible to receive NYSERDA funding.[109]

We conducted an informal interview with the manager of the NYSERDA CHP program.[110] He indicated that their program is in its fifth year, and that they have had significant project attrition. Each project is a different story. They had a significant number of projects devolve after September 11, 2001 because of the economy in New York. They have not seen that gas prices have been linked to attrition, since the spark spread has been maintained (i.e., since electric prices have risen along with gas prices). Plus in New York, there is a DG tariff that takes about 20%-30% off of an on-site customer's gas transportation bill, which reduces their overall gas bill by about 15%-20%.

The NYSERDA program involves a competitive process, with a specified due date. There is an evaluation panel. All judges read all applications, and they are scored and ranked.

NYSERDA indicates that the program has been viewed as a demonstration project. The important benefit of the program is not necessarily to get capacity in field, but education has been most important. They want to see what works and get first-hand experience as to where government policy helps/hurts CHP development.

They have had five different funding cycles. About 105 projects are still viable; of those 105, as stated above, NYSERDA has $50 million invested (about $10 million/yr). They have had about 40 projects drop out (about 140 in total have been selected for funding).

They leverage an additional $225 million through partner funds. Their $50 million must be matched from developers ($270 million capital investment total in New York State associated with this program.)

The approximately 100 active projects will represent about 100 MW of capacity. The forty-or-so projects that are now operational are producing approximately 18 MW of power. (These projects, which represent the fruition of the first years of the program, are about 0.5 MW each.)

NYSERDA indicates that they are 'dabbling' with smaller projects. Now, the 105 still-active projects average about 1 MW each. Of these still-active projects, the most recent batches in the mix are 80 MW in total – about 1.3 MW average – indicating a continuation in the upward trend in average project size).

NYSERDA indicates that the change in average size represents an evolution in the marketplace. Developers are increasing their comfort level and taking on bigger projects. There's a certain amount of fixed costs: getting permits, client nurturing, etc. Those fixed prices don't scale based on the size of the project. So developers can make more profit with the larger-sized projects.

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[108] Id.

[109] Id. at Sheet 2 of 3.

[110] Interview with Dana Levy, NYSERDA March 29, 2006

NYSERDA has gotten more sophisticated in how they require projects to submit proposals. There's less attrition now. They ask more detailed questions, which forces people to crunch numbers with more accurate information. So some people self-select, based on looking at the bottom line required.

The other thing helping with attrition is that developers are more eager to land customers that will go all the way to construction; so they've become more sophisticated in packaging deals; selecting sights that appear to have a higher probability of success.

The first year, NYSERDA had 36 proposals and they picked about one-half. They had 112 in next year, of which they picked 40, and there was a lot of attrition from that batch. They had 29 proposals two years ago and picked 25, and picked 27 of 27 total proposals last year.

NYSERDA indicates that the developers have improved the packaging of the applications. During "open season," they have held proposer and pre-bidder workshops across the state. There were eight workshops: four in Albany, two in NYC, and two in Buffalo, each with 1 hour presentations.

NYSERDA gives debriefings on rejected proposals. All applicants get a "yes" or "no" letter. The "no" letter invites rejected applicants to contact NYSERDA for a debriefing. The initial debriefing is via phone; after 30 or 45 minutes on the phone (typically), if they still want to meet, NYSERDA will arrange a face-to-face meeting.

California

Market Potential

The California Energy Commission and the Public Interest Energy Research Program co-sponsored a CHP market assessment study of the state of California that was prepared by EPRI and completed in July 2005. The final report found that there were already 9,130 MW of active CHP installed in California at 776 sites, nearly 90% of which were for projects with capacity greater than 20 MW. The study found that there is a technical potential for about 20,000 MW of new 'traditional' CHP capacity. The *base case* estimate of cumulative CHP market penetration for the period 2005-2020 was just under 2,000 MW. Importantly, the base case scenario in this study includes an assumed continuation of CHP Self-Generation Incentive Program (SGIP) incentives. High and low cases ranged from about 1,100 MW to 7,300 MW.

CHP Program

The California SGIP provides financial incentives for various types of self-generation projects, including photovoltaics, wind turbines, fuel cells, and CHP systems. The program was implemented in 2001. The incentive levels offered for CHP, including engines, microturbines, and gas turbines are very similar to the incentives offered by the OCE CHP program. For a number of years the California program offered maximum incentives to non-renewable fueled CHP systems of $1.00/watt, up to the first 1.0 MW of capacity. For 2006 the incentive level for non-renewable fueled CHP systems has been reduced to $0.80/watt for microturbines and small gas turbines, and to $0.60/watt for internal combustion engines and large gas turbines. The total incentive can not exceed 30% of eligible project cost. The maximum project size is 5.0 MW, and there is no minimum system size.

Incentive funding is offered on a first-come, first-serve basis for each calendar year, subject to annual budget limits. The total 2006 statewide budget for the SGIP is $385 million; however, the majority of that is allocated to solar generating technologies. Approximately $40 million is allocated statewide specifically to CHP systems.

As of November 2005, the total statewide CHP system statistics were as follows: 183 systems completed, representing approximately 103 MW of installed capacity (average system size of 563 kW), and another 151 projects active representing another approximate 75 MW of potential capacity (average system size of 497 kW). The size distribution of the installed and active projects is significant, as set forth in Table 2-8 and Table 2-9 below.

Table 2-8. Number of IC Engine and Gas Turbine CHP Systems in California

Size	<100 kW	101-200 kW	201-500 kW	501-1,000 kW	>1,000 kW
Complete	6	19	27	32	36
Active	13	10	31	25	21
Total	**19**	**29**	**58**	**57**	**57**

Table 2-9. Number of Microturbine CHP Systems in California

Size	<50 kW	50-100 kW	101-200 kW	201-500 kW	>500 kW
Complete	4	27	23	6	3
Active	0	20	11	17	3
Total	**4**	**47**	**34**	**23**	**6**

California also experienced a substantial amount of project attrition. At year-end 2004, there were a total of 291 'inactive' non-renewable fired CHP projects (as compared to the total of 334 complete or active projects at year-end 2005). This total of inactive projects (291) is nearly as high as the total of complete or still-active projects (334) translates into an attrition rate approaching 50%. Statistics available indicate that the attrition rate has been dropping over the years. Nonetheless, in reaction to the CHP project attrition rate at or near the 50% level, the California Energy Commission instituted an Application Fee in 2005 in an effort to help weed out applicants that may be more speculative and not overly serious (i.e., what they refer to as 'phantom' projects). The Application Fee is equal to 0.5% of the requested incentive amount.

To be eligible for incentives, all CHP project applicants must demonstrate that they will meet both (1) the PURPA-style waste heat utilization requirement measure of efficiency, wherein (electric energy produced plus one-half the useful thermal output)/(Lower Heating Value of fuel consumption) must equal or exceed 42.5%, and (2) a minimum 60% overall system efficiency requirement as measured by: (Btu-equivalent value of produced electricity plus Btu waste heat recovery)/(High Heating Value of fuel consumption).

There are some interesting findings in the CPUC's Fourth Year SGIP Impacts Evaluation Report regarding actual CHP system efficiencies. For purposes of the report, metered thermal data and input fuel were collected from on-line CHP projects and used to calculate overall system efficiency incorporating both electricity produced, as well as useful heat recovered. Metered data collected suggested that none of the 31 monitored CHP systems achieved the 42.5% minimum waste heat utilization measure of system efficiency. The mean PURPA-style actual measured efficiency of the 31 units monitored was 37% (as compared to the 42.5% standard). Similarly the mean overall measured plant energy efficiency of the 31 monitored CHP systems was 49% (as compared to the 60% minimum). The report states that this finding suggests a 'systemic negative variance between planned system efficiencies and actual system efficiencies,' and cites both electrical conversion efficiencies and heat recovery rates as playing roles in explaining this variance.

2.3.3 Conclusions Regarding the Design and Performance of the NJ OCE Program Thus Far as Compared to More-Established NY and CA CHP Programs

The CHP program was modeled after existing state programs, particularly New York. Not surprisingly then, our review indicates that indeed, in many of its primary elements, the pilot CHP program is very similar to the New York and California programs. Specifically, incentive levels and maximum payments are very similar or identical for comparable technologies. As well, the 60% minimum overall CHP system efficiency requirement employed in the OCE program is the same as that employed in the New York and California programs. The 60% minimum efficiency level matches the minimum efficiency level recommended by the U.S. Combined Heat and Power Association.

In terms of the level of funding allocated to the CHP program, the ratio of annual budget commitment is roughly 1:3:8 ($5 million NJ, $15 million NY, and $40 million CA). This ratio of funding is somewhat lower for New Jersey in relative terms as compared to these other states (the ratio of relative electricity consumption among the three states is approximately 1:2:4), but not orders of magnitude so. To be on a proportionate scale, funding would need to be increased to perhaps $7.5 million-$10 million annually.

Market potential studies performed in the three states indicate that New Jersey has a similar amount of existing, installed CHP in the state on a relative basis as compared to New York and California. The identified market potential for new CHP in New Jersey is also similar to the identified market potential in CA and NY (and in fact may be larger on a relative basis than for the other two states). The total capacity of active CHP projects funded through the CHP program is very small relative to the total identified New Jersey CHP market potential However, the same can be said of the magnitude of projects funded through the New York and California programs.

As described above, in the first year of the CHP program there was a very high attrition rate (about 60%). During the second year (2005) of the NJ program there was a significant drop in the number of applications from the initial program year (2004), and there was also a significant increase in the average size (kW) of both project applicants and project awardees between the first and second year. All of these trends appear to mirror the experience of New York and California. Attrition rates in NY and CA had been high in the early program years, but appear to have been dropping in more recent years. The number of applications has dropped recently in NY and CA as compared to the number of applications in the initial program years (resulting in fewer 'rejected' applications). The average project size has markedly increased over time in NY and CA.

We are not recommending the implementation of an Application Fee as adopted by CA in 2005 in an attempt to 'weed-out' frivolous project applications. The CA program is more mature than the OCE's CHP program which has only completed 2 application cycles. The number of applications in 2005 for the CHP program dropped by about 2/3 as compared to 2004, and it is too early in the development of 2005 project awardees to determine whether high attrition rates will continue to be a problem. We recommend that project application and attrition rates continue to be closely monitored, for the possible justification for implementing application fees in future funding cycles.

2.4 Baseline Savings Assessment

As indicated above, the first round of program incentives was awarded in 2004, and CHP projects typically have substantial development lead times. Moreover, there was substantial project attrition in the first (2004) program round. Accordingly, the very first CHP projects funded through the program that have been completed have just started to come online in late 2005 and early 2006. As such, the latest New Jersey Clean Energy Report covering the period through year-end 2005 has very limited reported annual or cumulative energy savings for the CHP program. Moreover, because the few completed CHP installations are so new, there has been no ability to seek or obtain any pre- or post-CHP installation actual energy consumption readings. As described below, currently the manner in which savings are reported is dependent upon project application technical worksheets.

The Clean Energy Report breaks savings down into two main categories. The first category is installed savings, associated with installed measures (in this case installed and operating CHP systems). The second category is committed savings. Committed savings represents the savings that will accrue from outstanding contractual commitments for program participation made since program inception, but scheduled for installation in future reporting periods.

Specifically, for calendar-year 2005 on a statewide basis, there is a reported 140 kW of installed capacity and 767 MWh of installed electricity savings, and another 2,668 kW of committed capacity and 48,642 MWh of committed electricity savings associated with the CHP program.[111] For the same reporting period, there are 0 Dth reported statewide installed gas savings, and 217,927 Dth reported committed gas savings.[112] For calendar-year 2005, there are 529.58 metric tons of CO_2 emissions savings, 0.9755 metric tons of NO_x emissions savings, and 2.2647 metric tons of electric emissions savings associated with the CHP program.[113] Because CHP projects under the program just started coming online in late 2005, the 2005 installed savings totals would equal the cumulative program totals.

According to utility representatives, energy savings and environmental benefits associated with the CHP pilot program are currently reported in the following manner.

Estimated electricity output from the on-site CHP system, as provided by the project developers in their technical worksheets, is reported as *electricity savings* (in MWh).

For thermal savings, an apparent reporting discrepancy arose from a review of the 2005 Clean Energy Report savings data summarized above. As summarized above, there were modest electricity savings (i.e., electrical output) from installed CHP systems in 2005, but there were no reported gas savings associated with installed CHP systems in 2005. However, for committed CHP there are reported electricity (kWh) savings, as well as reported committed gas savings (as would be expected). We inquired with the utility program manager regarding this seeming anomaly in terms of the 2005-installed CHP producing electricity but producing no gas savings as would be expected. The reported gas savings are derived directly from the estimates submitted by developers with the applications. Further, we were informed by the LDCs that different developers/projects do not utilize a single, consistent methodology for reporting gas savings in their applications. Some projects report gas savings as the displacement of Dth of gas previously burned in boilers, etc. in the pre-CHP operating mode (e.g., boiler gas is displaced by recapture of waste thermal energy in the CHP system). Other projects, apparently seeing that net gas usage at the site would in fact *increase* in the CHP mode (because the increased gas usage to fuel the turbine or engine was greater than the boiler gas savings) reported zero gas savings.

For reporting of emissions savings, DEP Emission Reduction Factors[114] (which appear to be based on average PJM system emissions rates in lb/MWh) for major pollutants are multiplied by the electricity

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[111] *Source: Worksheet R-CE1(EE).*

[112] *Source: R-CG1(EE)*

[113] *Source: R-DE1(EE)*

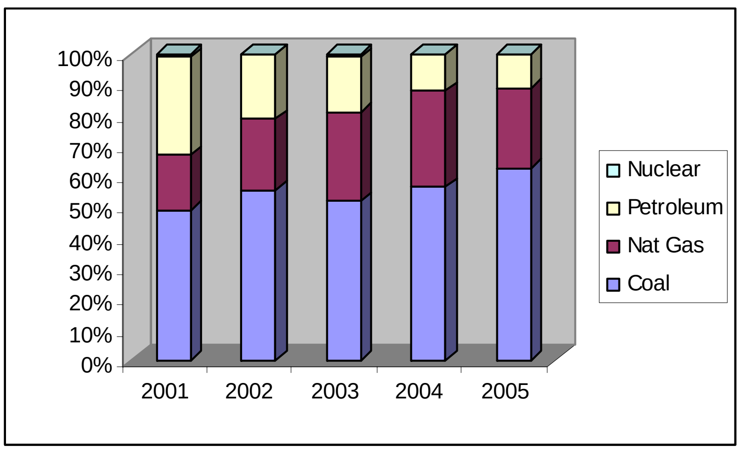
[114] CO2 (Carbon Dioxide) emissions are assumed to be reduced by 1,520 lbs per MWh saved. NOx (Nitric Oxide) emissions are are assumed to be reduced by 2.8 lbs. per MWh saved. SO2 (Sulfur Dioxide) emissions are are assumed to be reduced by 6.5 lbs per MWh saved. Hg (Mercury) emissions are are assumed to be reduced by .0000356 lbs per MWh saved.

savings (i.e., electricity output in MWh) to derive reported electric program *emission savings*. For emissions savings related to gas programs, DEP Emission Reduction Factors (based on typical boilers emission rates) are multiplied by Dth gas savings to derive reported gas program *emission savings*. Because electricity emission savings are reported simply as the avoided pollutants from displaced grid generation, this appears to overstate total emissions reductions as there does not appear to be any accounting for incremental air emissions from the new CHP units.

The savings estimate protocols are based upon those used for other EE and renewables programs. However, they do not recognize the unique nature of CHP systems. Specifically, unlike a typical electric program EE application, a CHP system in and of itself does not reduce electricity consumption by the end-user. Rather, grid-produced electricity is displaced by on-site generated electricity. Moreover, comparing the average heat rates of generating facilities typically operating on the margin on the grid (in the 7500- 9500 Btu/kWh range)[115] to typical heat rates reported for CHP system turbines and engines (in the 11,000-12,000 Btu/kWh range)[116], it can be argued that Btu consumption just for the electricity generation part of the equation may actually be increasing (even adjusted for line loss savings associated with on-site CHP ranging from about 2%-8% depending on voltage levels).

Moreover, unlike a renewable DG project, a natural gas-fired CHP system does not displace fossil fuel generation; rather, it merely replaces a mix of nuclear, coal, gas, and oil-fired generating units with all gas-fired generation. Figure 2-8 below shows the mix of fuel that is typically on the margin on the PJM grid[117], reflecting the type of generation that would be offset by a natural gas-fired CHP system.

Figure 2-8. Type of Fuel Used By Marginal Units on PJM[118]



As shown, typically more than one-half of the time coal-fired generation would be displaced on the margin, followed by natural gas-fired generation generally 20%-30% of the time, followed by petroleum-fired generation whose presence on the margin has been steadily declining from over 30% in 2001 to only 11% of total hours in 2005. Nuclear power is very seldom on the margin.

To further complicate the matter of accurately portraying the actual energy savings associated with the CHP program, while a CHP system certainly improves overall energy efficiency by capturing thermal

[115] Source: 2005 PJM Market Monitoring Unit State of the Market Report dated March 8, 2006, p.130.

[116] Source: 2004 KEMA Report: New Jersey Energy Efficiency and Distributed Generation Market Assessment, Table 4-1.

[117] Data reported by PJM Market Monitoring Unit for all integrated control areas as of actual integration date.

[118] Source: 2005 PJM Market Monitoring Unit State of the Market Report dated March 8, 2006, Table 2-18.

energy from the engine or turbine, there is typically a net *increase* in natural gas consumption at the site. This is the case because the amount of natural gas burned in the turbine or engine is greater than the amount of displaced boiler natural gas (of course there is an offset to fossil fuel that would have otherwise been burned on the grid as portrayed in Figure 10-8 above).

This is not to say that CHP does not result in energy savings. Indeed, the ultimate purpose of CHP is to derive more useful output energy out of a Btu of input energy and thereby increase overall efficiency as compared to the separate production of electricity and thermal energy (heat/hot water, etc.). However, the manner of energy savings reporting for the CHP program should be modified to better reflect the unique nature of CHP, as neither a 'pure' EE application nor renewable application, and the actual net energy savings associated with CHP. Moreover, the manner in which natural gas savings are estimated by project applicants and in turn reported by the utilities needs to be standardized.

Currently it appears that electricity savings are over-reported. This is so because on-site gas-fired electricity production does not truly constitute an electricity savings; rather, there is merely a displacement of grid-produced electricity with on-site produced electricity. Nor does CHP generation constitute renewable electricity production.

Emissions savings may be modestly over-reported, as it appears that CHP system emissions are not offset against displaced grid emissions to derive a net change in emissions.

Conversely, it appears that gas savings may be under-reported, as at least one applicant apparently did not report any gas savings due to the fact that net gas consumption at the site would actually be increasing.

Our review of documents, assessments, and evaluations addressing the two other state CHP incentive programs similar to the New Jersey program indicates that energy savings, per se, are not reported. Rather, the New York and California program reports appear to focus on electricity generation and installed capacity/peak demand savings resulting from installed CHP projects, rather than on energy savings specifically. However as described below, the energy efficiency of CHP projects has been evaluated, at least preliminarily, in California.

Specifically, the California PUC issues annual impact evaluation reports for its SGIP. The data related to operating DG projects, including CHP, are analyzed and presented in three different ways. First, the impact is measured in terms of impact on peak demand. This is a function of installed capacity and more particularly, is looked at in terms of power output of program-funded DG units coincident with grid system peak load. Second, the impact is measured in terms of electric energy production (in MWh). Third, the impact is assessed by measuring actual CHP system operating efficiency and comparing that actual system operating efficiency to planned system operating efficiency. As such, the impact reporting related to their CHP program does not include a direct reporting of energy savings.

To be eligible for incentives, all CHP project applicants in California must demonstrate that they will meet both (1) the PURPA-style waste heat utilization requirement measure of efficiency, wherein (electric energy produced plus one-half the useful thermal output)/(Lower Heating Value of fuel consumption) must equal or exceed 42.5%, and (2) a minimum 60% overall system efficiency requirement as measured by: (Btu-equivalent value of produced electricity plus Btu waste heat recovery)/(High Heating Value of fuel consumption).

As summarized in Sections 2.1.and 2.3 of this report, moreover, impact and cost-effectiveness studies performed in California regarding their CHP program call into question the planned efficiencies of CHP systems funded through its SGIP. Specifically, the CPUC's Fourth Year Evaluation Report reported findings that, overall, funded CHP projects achieved lower actual capacity factors and heat recovery rates than were projected in project planning documents, and that the majority of sampled CHP projects did not achieve the required minimum overall energy efficiency percentage. The report does note the somewhat limited sample size, and cautions that any conclusions drawn from the findings should be ‘interpreted very carefully.’ Nonetheless, these findings do raise some red flags and provide leads that should be pursued in later evaluations as more CHP program-funded projects become operational.

Non-Energy Benefits of CHP

To customers, there are a number of potential benefits not directly related to energy costs (non-energy benefits). Key non-energy benefits cited by customers in a recent California survey of end-users include: system lifetime, operations and maintenance costs, environmental effects, power quality, and power reliability. While these cited non-energy benefits do not directly relate to energy costs, for the most part these benefits (particularly system lifetime and O&M costs) do translate into cost avoidance on the part of the end-user and, as such, would factor into an internal payback analysis. Environmental benefits can also translate into cost avoidance, as emissions reductions due to installation of CHP likely will ameliorate costs that otherwise have to be undertaken in terms of such things as boiler retrofit or replacement, fines, production curtailments, etc. Power quality and power reliability issues are somewhat more difficult to quantify, although end-users can translate production curtailments due to historical power outages into a cost. Use of CHP to address power reliability issues will require a combination of islanding capability, which requires an additional investment, and a load curtailment plan to assure that loads do not exceed the output capability of the CHP system during a grid outage. These additional costs/impacts would presumably be taken into account by the end-user in determining the actual non-energy benefits value of the CHP system during the due diligence stage.

For electric utilities, the benefits associated with DG/CHP can include peak demand savings resulting in capacity savings and transmission savings, as well as the *potential* benefit to the distribution system. However, in restructured markets, reductions in peak demands associated with the operation of DG/CHP units coincident with system peaks will translate into a lower assigned capacity obligation and transmission obligation associated with the load. These lower capacity and transmission obligations directly benefit the end-user in terms of reduced supply costs. Because this reduction in obligations will reduce the total cost of power supply purchased from a third party supplier or the electric utility, these should be considered direct energy cost benefits.

The local distribution system is planned based upon non-coincident peak demands; that is, the system capacity is designed to meet localized peak demands, whether or not coincident with system coincident peaks. Distribution utilities also factor in contingency planning, meaning the system must be planned to remain robust under certain reasonably anticipated contingency conditions. Contingencies can include potential outages experienced by DG during times of localized, non-coincident peaks. As such, there is no direct manner in which an end-user would be credited with distribution cost savings, and there is no assurance whether or to what extent such savings will exist. If DG is installed in an area with excess distribution capacity, there may be little if any value in terms of avoided distribution investment. As well, contingency planning which may result in the assumed unavailability of a particular DG/CHP during the local peak could also tend to negate any investment avoidance impacts.

Distribution benefits may be important, and may impart additional societal value on CHP projects. However, such benefits cannot be universally assumed, and will vary depending on localized circumstances such as distribution facility loadings, circuit redundancies, load diversity, and load growth projections.

For gas utilities, there are obvious benefits associated with the installation of new CHP systems that increase throughput, thereby creating additional margins and contributions to pipes charges that can benefit both gas ratepayers and shareholders. Further, the baseload nature of CHP gas usage can tend to balance the system load profile of a gas distribution utility that likely has weather-driven winter peaks. This has the effect of spreading transportation pipeline capacity costs, and distribution system costs, over a larger number of annual units, thereby justifying a somewhat lower transportation and delivery component of gas rates than for the typical gas customer.

Gas utilities have had tariffs in place for a number of years that provide more favorable delivery and transportation prices for natural gas used to produce electricity. At current commodity market prices and levels of volatility, unfortunately, any such T&D discounts have limited impact on overall project economics, since the commodity component is now by far the largest component (on the order of magnitude of 80% or more) of gas rates. Likely, a much more powerful tool in controlling the cost of the critical fuel input to a CHP system would be a long-term commodity hedge. Such hedges are available in the marketplace from third party suppliers, but are not available from the utility tariff which offers only short-term market pricing for commodity.

2.4.1 Recommendations Regarding Reporting of Various CHP-Related Savings

The following is recommended with respect to the reporting of the various CHP-related savings.

- At this early stage of the program and project completion, installed capacity can continue to be reported as a demand reduction. However, on-site generation is prone to outages and to reduced maximum output during peak periods due to higher ambient air temperatures occurring at times of summer system peak. As such, installed capacity is not a fully accurate measure of contribution to peak demand reduction related to CHP. (Although as more such CHP systems come online, the diversity of many units would tend to diminish the peak impact of any outages.) For the longer term, as a sufficient number of projects come online and meaningful performance data can be obtained, an impact assessment should include an evaluation of CHP plant output coincident at the system peak. This would include effects of both higher ambient temperatures on maximum electric output, as well as the effect of peak-coincident forced outages, to obtain a more accurate picture of the impact of installed CHP program-funded systems on peak demand reduction.

- On-site CHP system output from program awardees should continue to be reported, as on-site generation is an important contribution to system diversity and is indicative of overall program impact. However, CHP system output should not be reported as electricity savings. Moreover, CHP output that is predominantly fueled by natural gas cannot be considered as renewable energy generation. Rather, CHP output should be reported as a separate category of DG generation. Reported electricity savings from CHP would be appropriate in the case of the application of absorption chillers as part of a CHP system that would displace electricity previously consumed through use of centrifugal chillers.

- Thermal savings should be reported on a consistent basis by all applicants as the reduction in fuel related to the recapture of thermal energy (e.g., reduction in boiler gas associated with the recapture of waste heat from the CHP engine or turbine). The reduction in boiler natural gas displaced by CHP waste heat recapture should be reported consistently as Dth savings.

    - A case can be made that there can be an increase in net fuel use associated with replacement of grid-generated electricity by electric generation from gas turbines or engines with higher heat rates, that could offset natural gas savings associated with thermal energy-generated electricity. The grid fuel displaced by CHP natural gas consumption will be a mix of primarily coal, gas, and petroleum. As such, overall net energy savings could be calculated and reported on a 'Btu' basis, to reflect the interchangeability of different types of fuels associated with CHP. This would reflect the multi-energy impact nature of CHP and would also be reflective of net decrease in overall energy consumption associated with net efficiency gains related to the installation and operation of a CHP system from a societal basis. However, this approach would add an additional layer of complexity in reporting that may be premature at this early stage. As such, as discussed above, for initial reporting change purposes, it is probably sufficient to simply report site-specific energy data as follows: 1) on-site CHP generation (in MWh); 2) any electricity savings due to absorption chillers (in MWh); and 3) gas savings due to boiler gas savings (in Dth).

  - As described below and in earlier sections of this report, studies done on the CHP program in California raise questions regarding the accuracy of planned electrical conversion efficiencies, heat recapture rates, and capacity factors of CHP systems, which in turn has raised questions regarding the actual versus planned overall system operating efficiencies. In the short term, due to the small number and limited operating histories of funded CHP projects in New Jersey, use of actual instead of planned thermal energy recapture savings in this regard is not feasible. However, for the longer term an impact assessment should investigate and a monitoring system should be implemented in order to refine the reported CHP output and efficiencies utilized in reporting thermal savings.

- For many CHP applications there can be substantial electric-side emissions benefits due to the superior emissions rates of many new CHP engines and turbines as compared to the average emissions rates of grid units on the margin (in addition to the gas-side emissions benefits associated with offset boiler emissions). However, the CHP engines and turbines do produce emissions of various pollutants, and these should be offset against the displaced grid emissions to reflect net electric-side emissions benefits. The emission signature provided in the technical worksheets for each project applicant, which is subject to technical review by the evaluation team, can be used for this 'offsetting'.

- The manner in which gas emissions savings are reported, by multiplying the typical boiler emissions rate by the displaced boiler gas combustion, appears appropriate. This approach does, of course, depend on an accurate reporting of displaced boiler natural gas combustion.

The following is recommended with respect to non-energy benefits:

- Electric distribution utilities could be asked to report on constrained distribution pockets, current planning and design criteria, and the impact of single versus multiple DG applications in targeted areas. Such an effort could lead to conclusions on whether the realization of actual distribution cost savings requires more geographic focus on program criteria or evaluation. A possible end result could be to target a particular constrained area for potential multiple CHP applications and awards, in order to maximize distribution savings benefits associated with the incentive program.

- Gas transportation capacity market prices have increased substantially, particularly for winter peaking months. Gas utilities should review current tariffs applicable to electric generation/CHP to ascertain whether additional discounts may be justified in light of these increased market prices for transportation capacity and the benefits that baseload CHP provides in terms of spreading transportation costs evenly throughout the year. Any such additional discounts should be cost-based to avoid subsidies by other customers.

- Consideration should be given to whether gas utilities could offer a longer-term price-hedged commodity portfolio to CHP customers.

2.5 Market Barriers Assessment

2.5.1 Has the Program Reduced the Market Barriers?

Key Stakeholder Interviews

As described in Section 2.1, key program stakeholders, including OCE staff, the Rutgers University CAES, and representatives of the four gas distribution utilities were interviewed at the beginning of the project to gain their insights and observations concerning the design and implementation of the CHP program.

A common theme among virtually all key stakeholders was that there is no organized, proactive marketing program for the program. Importantly, as described below this theme was repeated as a statement of fact rather than as a criticism or a perceived shortcoming. The program description is posted on the OCE and utilities' websites. To varying degrees the gas utilities approach their customers with relevant usage patterns through account representatives to make them aware of the program. An attempt is made to spread word of the program to vendors and manufacturers through announcements at major trade conferences, and there is a heavy reliance on vendors marketing the program to end-users. Several key stakeholders raised a concern regarding past delays in ironing out details/budgets, etc. for the program, which prevented the utilities and the OCE from announcing the program in a timely manner. This had the effect of preventing any major announcements at major trade conferences occurring early in the season, and it also pushed the application window period into the summer when vendors have a more difficult time rounding up key people at end-user sites to get a project moving. These factors are believed to have contributed to a lower number of applications (among other factors discussed herein). It was recommended that program details be finalized in the fall for the following year's program, so that announcements could begin in January for the spring program.

It is noteworthy that most of the major stakeholders had the opinion that a more substantial, organized, and proactive marketing program is not needed, and that reliance on the market is sufficient. A number of key stakeholders observed that they already have had an oversubscription of applications in the first two rounds and that, given the relatively limited funds allocated to the pilot program, a substantial marketing program would (1) eat up limited funds that could otherwise be used for incentives, and (2) simply lead to more rejections (since applications already exceed available funds). However, one key stakeholder observed that there is a limit to the number of 'quality' projects among applicants, and asserted that a more aggressive marketing campaign could lead to the submittal of more high quality projects that could move past less-deserving projects on the awardee list.

Virtually all key stakeholders interviewed mentioned the improvements in the applications between the first and second program cycle, which made the process more understandable but also imposed more rigorous application requirements. Many believe that the more rigorous application process has weeded out some of the more frivolous applications of the type received in 2004. The heavy weighting on efficiency and environmental factors in the evaluation process is seen as helping to select the best projects.

One gas utility representative indicated a concern that certain technologies are sometimes forced into projects by vendors where there is not a good fit; for example, forcing absorption chilling where there is not otherwise a good thermal match, just to get the overall efficiency up, but where absorption chillers may not be cost-effective. Such instances of 'forced' technologies can be addressed to some extent, though, through a low point evaluation for project probability of success.

More than one key stakeholder noted that in the marketplace the program appears to be vendor-driven. That is, vendors are in some cases selling the idea of an application to end-users based on limited review, with due diligence to come after grant of awards. Stakeholders cite the dilemma that vendors cannot afford to put a lot of up-front evaluation and design money into projects on speculation, and smaller end-users have a lower level of sophistication and familiarity with CHP than larger end-users. More than one key stakeholder noted that there is a lack of technical support for end-users, other than their vendors, as there is no longer a link between the end-users and the utilities to provide evaluation support, and there is no programmatic technical support. Reference was made to cogeneration feasibility study support that was provided to customers by certain utilities back in the 1980s. These stakeholders suggested that there should be more of a partnership between the utility, the OCE, the end-user, and their vendor/consultant, and suggested programmatic outreach and support, including technical support, particularly for smaller customers who cannot afford their own expertise and/or who may not be a target market of vendors. Some thought that customers should hear more about the program directly from the OCE rather than only from vendors.

All key stakeholders noted the lack of fuel cell applications, but there was not a great deal of concern expressed by any of the stakeholders interviewed concerning this outcome. Fuel cells have high up-front costs, and the few that have been installed in the state several years ago under the CORE program have had spotty performance and significant maintenance issues. It was observed that, because of the high up-front cost of fuels cells, the already high incentive level would have to be raised substantially to get a market response. However, no stakeholders indicated a desire to raise the incentive levels, which would drain limited funds away from non-fuel cell CHP.

A number of key stakeholders observed that there has been a substantial disparity among applicants in terms of key assumptions, such as electricity prices and fuel prices. Different assumptions can obviously impact on the pro forma financials for a project, including calculated payback. However, there were differing opinions concerning what to do about that. The opinion was expressed by some that unrealistic assumptions could ultimately lead to dissatisfied participating end-users when anticipated or 'promised' savings don't materialize. Other key stakeholders expressed a concern about the OCE or Evaluation Team changing assumptions or mandating the use of particular assumed prices, lest the OCE later be accused of guaranteeing certain energy or fuel costs that later prove to be wrong. It was indicated that there has been some effort to do a 'sanity check' to identify project applications with unrealistic assumptions, and efforts have been made to bring these to applicants' attention. However, some also expressed concerns about the appropriateness of contacting applicants to discuss these assumptions or other issues once the submittal deadline had passed. It was indicated that unrealistic assumptions can be addressed to some degree in a reduced score in the project viability category.

Most key stakeholders had the opinion that fuel costs and up-front costs are the major market barriers, and that rising fuel costs in particular are reducing market share. Fuel cost increases have worsened paybacks, and projects for which equipment was already ordered may have proceeded despite fuel price increases; others not as far along may have been cancelled. Also, certain not-for-profit entities such as universities may proceed for other qualitative reasons despite declining economics. It was asserted by one key stakeholder that larger, more sophisticated end-users are more prone to take a longer-term view, and to not be as dissuaded by short-term market price volatility in evaluating project economics.

While first cost was cited by numerous key stakeholders as another major barrier, it was indicated that many projects have exceeded the 1 MW incentive limit, and therefore with larger projects the incentive becomes a smaller offset (on a % basis) to total project cost. As such, one gas utility representative indicated that the primary benefit of the program is to create a heightened interest and gives vendors and manufacturers a reason to look at New Jersey and set up shop here. While first cost and fuel costs were consistently cited as the major barriers, one stakeholder also cited the DEP permitting process as being a barrier; in particular it was recommended that output-based emissions standards be utilized in the permitting process to reflect the emissions benefit of displaced emissions from grid-produced electricity.

It was indicated by key stakeholders that most projects submitted had projected paybacks in the eight-year range, but the thought expressed by stakeholders was that most end-users have a four- to five-year payback threshold for most investments. (The CA study referenced earlier in this report indicated even shorter required payback periods in the 1-4 year range.) This may help explain the relatively high post-award attrition rate, after end-users sharpen their pencils during due diligence.

Given the marginal economics, it was suggested by one key stakeholder that the best way to market CHP is from a reliability perspective because end-users worry about the impact of grid outages. However, it was noted that most machines do not run in a grid-interrupt mode or have black-start capability, which typically require substantial incremental investment.

It was acknowledged by key stakeholders that there is no cost-effectiveness test in place for evaluating the program or the applications. It was indicated by one utility representative that the best approach that is taken for this program is to let the market decide which projects are cost-effective. Also, it was acknowledged by stakeholders that there are no protocols in place for estimating energy savings.

The predominant view of the interviewed key stakeholders was that the broad, general nature of the program goals is appropriate given the pilot nature of the program, and that it would be premature to adopt very specific goals. Some suggested that perhaps broad targets of kWh and therm savings may be appropriate, but others suggested that such goals may unduly encourage selection of the largest projects with the biggest energy savings. There was also a consistent theme among interviewees that it is premature to adopt a series of detailed and specific performance indicators. More than one stakeholder suggested that, with the limited funds available, replication should be a goal of the program (i.e., projects that may be replicated at multiple applications such as supermarkets, schools, hospitals, YMCAs, nursing homes). Also, performance indicators based on the number of applications and reduced attrition rates were suggested.

Stakeholders indicated that there is currently no formal protocol in place for getting feedback from winning and non-winning applicants. Utilities and CAES indicated that they do receive informal phone calls from some non-winning applicants looking for feedback or explanations. Also, it was suggested that support should continue after the incentive award stage, in terms of a facilitator or ombudsman role played by the OCE or its agent in terms of assistance with permit applications, direct contacts with end-users, etc.

Surveys of Market Actors

Demographics of Surveyed Market Actors

A number of topics were examined to help assess the level of familiarity of end-users with CHP and the impact the program has had on that level of familiarity. Both participating end-users and nonparticipating end-users were surveyed in order to compare these two groups.

Market actors were asked a series of questions concerning the importance of various factors in deciding whether to install a CHP system and concerning a number of barriers to the development of CHP systems. Manufacturers, developers, and end-users were asked on an unprompted basis to list the major barriers to the installation of a CHP system, and were also surveyed concerning a specific list of barriers and whether each of these barriers is increasing, decreasing, or has remained the same over the past two years (i.e., the period of time coinciding with the implementation of the CHP program).

The demographics of the market actors that were surveyed are summarized below.

Figure 2-9. Number of Developers' Full-Time, NJ-Based Employees (n=17)

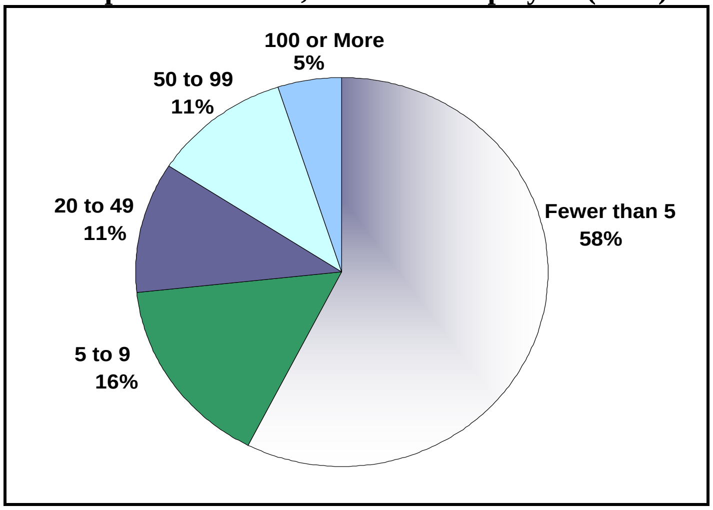


Figure 2-10. Number of Manufacturers' Full-Time, NJ-Based Employees (n=10)

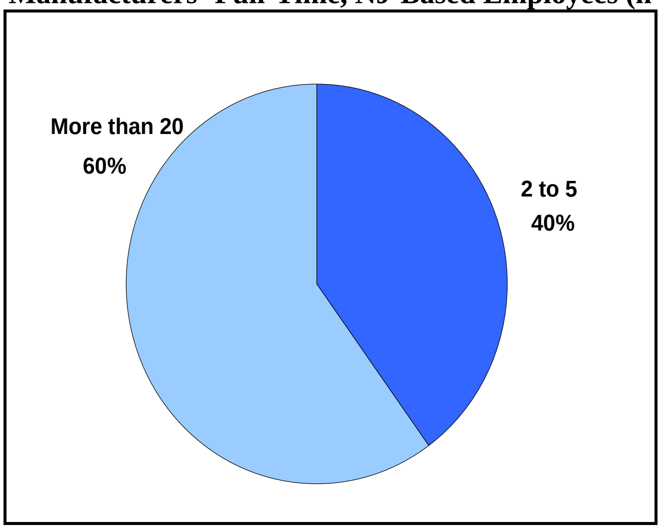
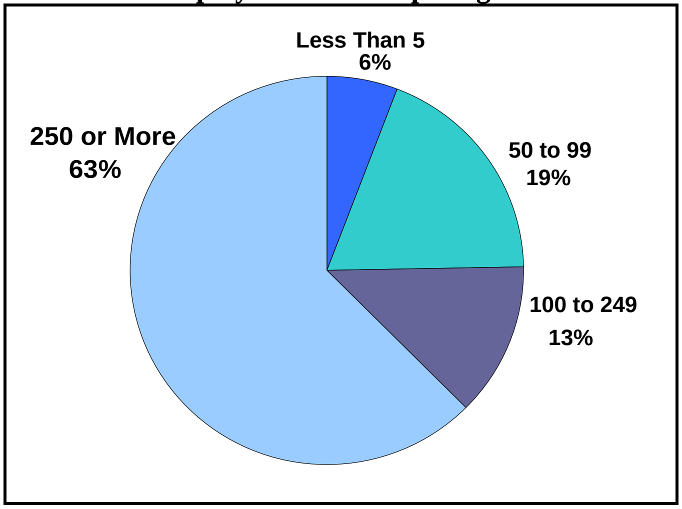


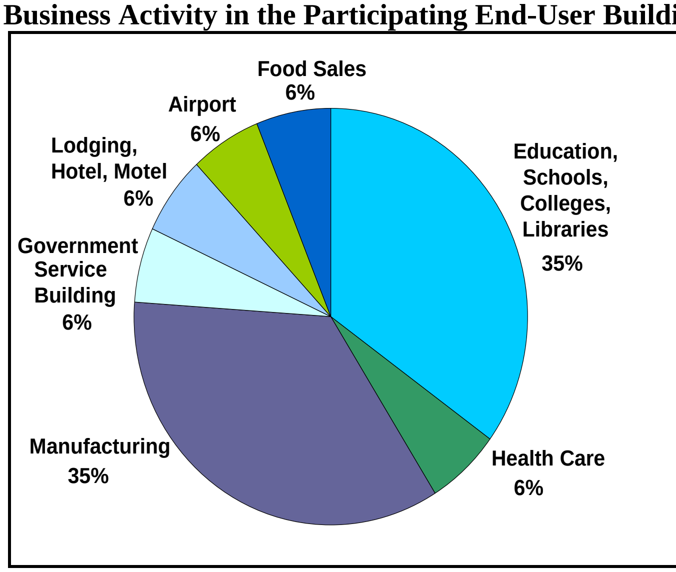
Figure 2-11. Number of Full-Time Employees at Participating End-users' Location (n=15)



As shown, the majority of responding developers that have been involved with the submittal of one or more CHP program applications are relatively small in size, with over one-half having fewer than five full-time employees at their New Jersey locations, and nearly three-quarters having less than ten full-time, in-state employees. Conversely, the majority of manufacturers that have had equipment included in one or more CHP project program applications have more than 20 full-time employees in the state. Of the participating end-users surveyed, most are fairly large businesses/entities, with 63% having 250 or more full-time employees at the location for which CHP was proposed/installed, over three-quarters having 100 or more full-time employees, and about 95% having 50 or more employees.

Moreover, a fairly large proportion of participating end-users surveyed, over 40%, deemed their entities as being non-profit (as shown below, education and government service buildings). Figure 10-4 summarizes the breakdown of business/entity types among the responding participating end-users.

Figure 2-12. Principal Business Activity in the Participating End-User Building/Site (n=16)



As shown, 70% of the responding participants fall into one of two categories: (1) manufacturing, and (2) education, schools, colleges, and libraries. Moreover, all of the participating end-users surveyed have relatively few locations within the state, with over one-half (53%) having only the one location where the

CHP project was planned, and the remainder having five or fewer in-state locations. This suggests that the potential for intra-company replication of CHP program-funded projects may be limited.

Awareness of CHP

As shown in Figure 2-13 and Figure 2-14, nearly one-half (46%) of nonparticipant end-users surveyed indicated that they were either unfamiliar or only slightly familiar with CHP systems, while only 18% of participating end-users indicated that they were not at least somewhat familiar with CHP systems. Moreover, as shown in Figure 2-15, a large majority (88%) of program-participating end-users indicated that their level of familiarity with CHP has increased over the past two years. This is not an unexpected result, as it would stand to reason that end-users at whose properties a CHP project has been the subject of a CHP incentives application would become more focused on and aware of CHP. Conversely, as shown in Figure 2-16 less than one-half (40%) of the surveyed nonparticipating end-users in the targeted SIC code categories indicated that their level of familiarity with CHP had increased over the past two years. It should also be noted that these surveyed end-users represent only the very small percentage of all end-users in these business categories that were contacted in an attempt to make an appointment with a facilities manager to discuss CHP that actually agreed to be interviewed on the subject. As such, these are presumed to represent a subset of nonparticipating end-users that would have at least some interest in and familiarity with CHP relative to the vast majority of businesses in our database that did not positively respond.

Figure 2-13. Participating End-User Familiarity with CHP Systems (n=17)

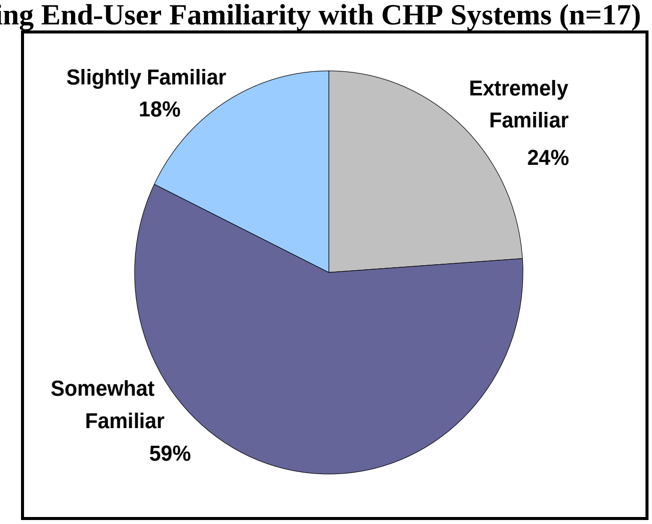


Figure 2-14. Nonparticipating End-User Familiarity with CHP Systems (n=15)

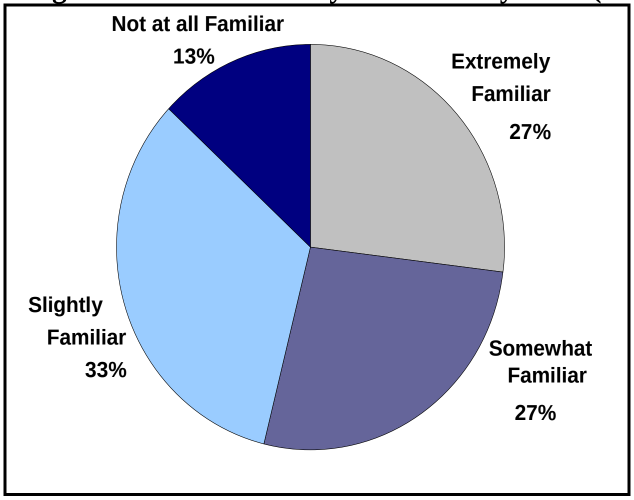


Figure 2-15. Change in Participating End-User Familiarity with DG Systems Over Past Two Years (n=17)

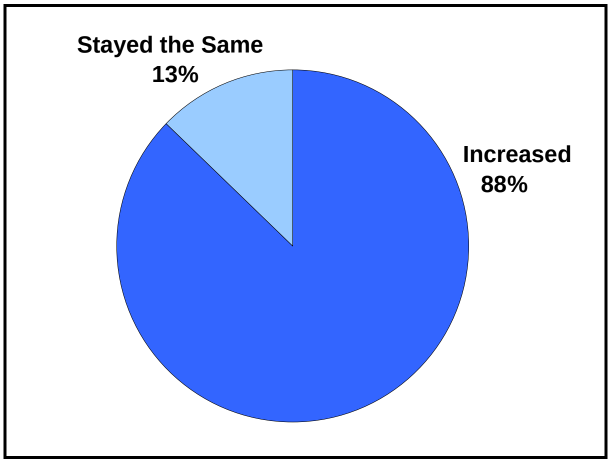
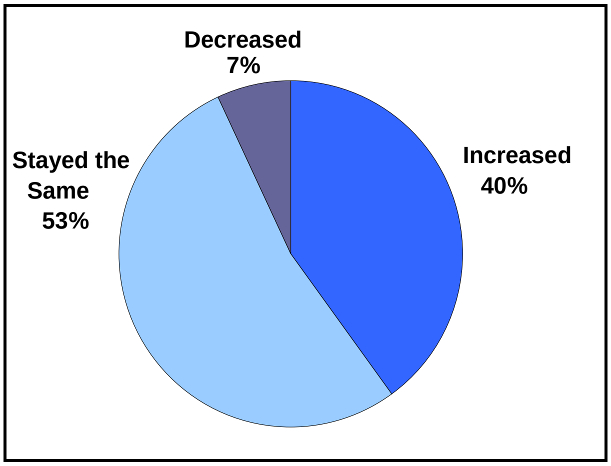


Figure 2-16. Change in Nonparticipating End-User Familiarity with DG Systems Over Past Two Years (n=15)



Market Barriers

In response to the *unprompted* request to list the major barriers to end-users' participation in the New Jersey CHP program, a lack of awareness on the part of customers was the most often mentioned barrier by developers (67% of responding developers named this as a major barrier) and by manufacturers (100% of responding manufacturers named this as a major barrier).

Participating end-users were asked how important a number of key factors were in their decisions of whether to install a CHP system and/or which system to install, ranking each listed factor on a scale from very important to irrelevant. The factors that were indicated by participating end-users most prevalently as being of the highest importance were electric efficiency (76%) and fuel use efficiency (65%). Electric and fuel use efficiency, initial cost, fuel cost, and reliability were factors indicated by end-users as being either important or very important by 88% or higher of responding end-users. Other factors, such as marketing image, environmental benefits, footprint, and O&M costs were deemed less important overall by participating end-users in decisions regarding CHP.

With regard to barriers to CHP overall (not specific to the OCE CHP program), market actors were asked whether various barriers had increased, decreased, or stayed the same during the past two years. The results are summarized in Figures 10-17 through 10-19 below.

Figure 2-17. Changes in Market Barriers: Manufacturers (n=10)

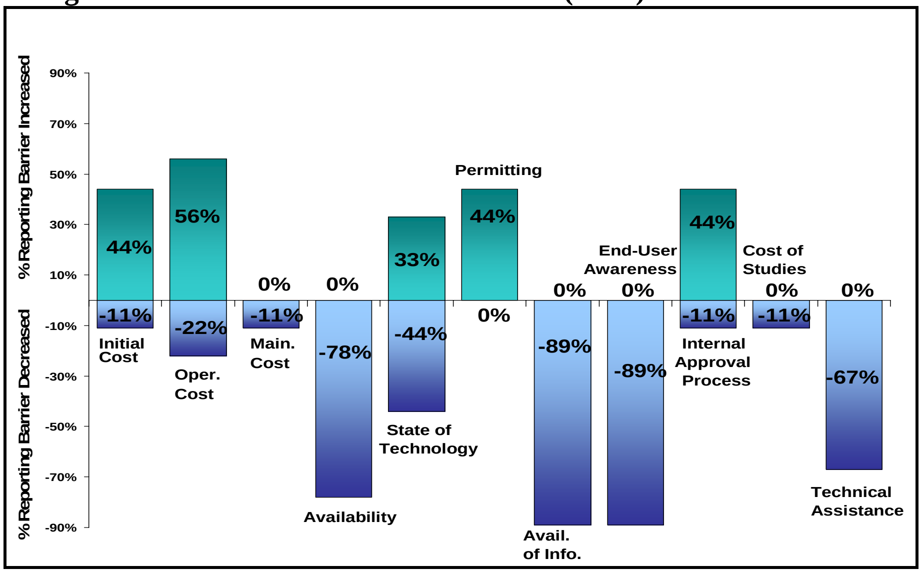


Figure 2-18. Changes in Market Barriers: Developers (n=17)

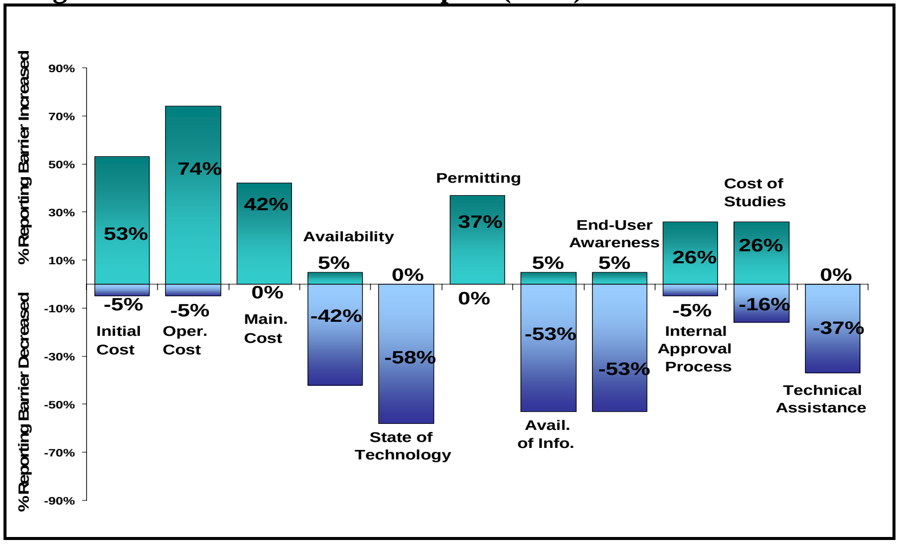
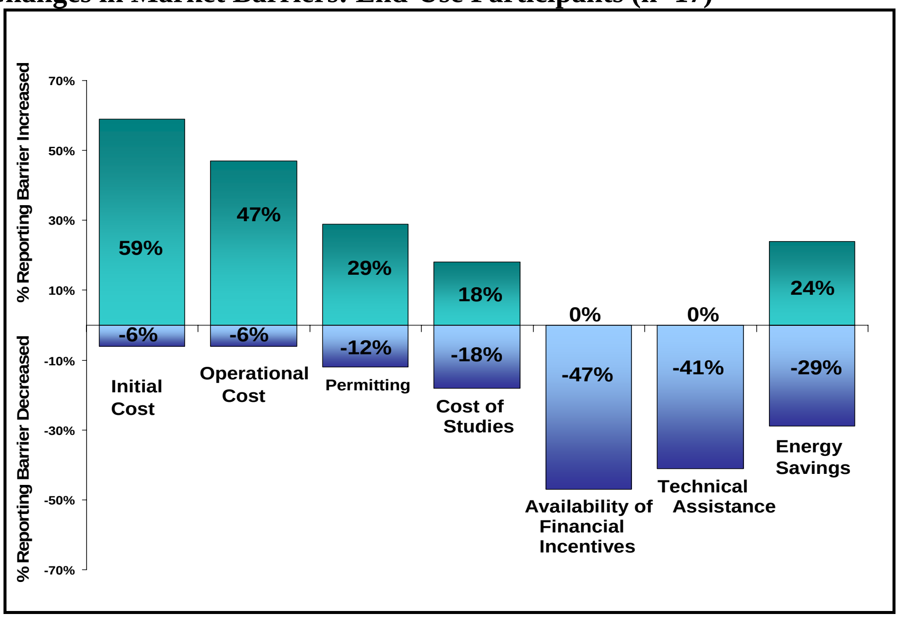


Figure 2-19. Changes in Market Barriers: End-Use Participants (n=17)



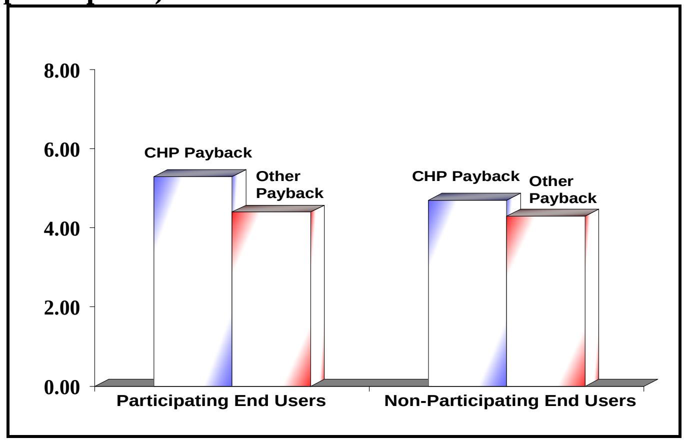
As shown, the results are fairly consistent across all segments of the market with regard to the market barriers that are perceived to have increased the most in the past two years. Specifically, market actors were much more likely to perceive that initial cost, operating cost, and permitting barriers have increased rather than having decreased during the past two years. On the other hand, developers and manufacturers both indicated overall that customer awareness and availability of information barriers have declined in the past two years. On its face this appears to contradict the data summarized above wherein developers and manufacturers both named customer awareness as the most predominant barrier to customer participation in the CHP program. However, upon further reflection these results represent the distinction between awareness barriers having been reduced for those end-users that have participated in the program and a general ongoing concern on the part of vendors and manufacturers that many end-users are not aware of the CHP program.

The indicated perceived increase in the initial cost and operating cost market barriers over the past two years across all market actors is of particular concern, because the initial cost of CHP systems is specifically targeted by the CHP program. It would seem that, although for individual end-users the incentives have proven vital to the project's internal approval and successful development, overall the market benefits of the incentives in terms of reducing up-front investment and thereby reducing payback period, are offset by other market factors, particularly rising natural gas prices.

Payback Period

End-user participants and nonparticipants were surveyed regarding the typical payback period that would be required within their organizations for an investment of capital in a CHP system, as well as other types of major equipment.

Figure 2-20. Payback Periods (in Years) Required for CHP Versus Other Equipment (n=17 participants, n=15 nonparticipants)



As shown in Figure 2-20, the average payback period among participating and nonparticipating end-users, and among CHP versus other types of major equipment end-users, is relatively similar, at approximately five years. On average, responding end-users indicated a slightly longer required payback for CHP equipment, but generally the individual respondents did not indicate a significant difference between the required payback on CHP versus other types of major equipment. While the average payback periods of both participants and nonparticipants is in the five-year range, there was substantial variance among the individual respondents, with 29% of participating respondents indicating a required payback of three years or less, and 18% of respondents indicating a payback of 10 years or more. The findings regarding typical required payback periods for participating end-users (averaging in the five-year range) are interesting, since the indicated required payback period obtained from survey respondents appears significantly shorter than the typical CHP project payback periods indicated in the program applications (stakeholder interviews indicated an eight-year payback was more typical). This is likely a further indication of the fact that some projects have been submitted largely 'on-spec,' and that end-users have not undertaken serious due diligence until after the incentive award has been made. This can also help explain the relatively high attrition rate of projects thus far, as ultimately due diligence and updated economic analysis revealed that internal payback thresholds were not likely to be met.

Program Effectiveness

Ratings of the effectiveness of the program were mixed. Seventy-eight percent of responding developers rated the CHP program as somewhat or very effective overall, while 22% rated the program as being not very effective. However, of responding manufacturers, only 33% rated the CHP program as either somewhat or very effective, while 44% rated the program as not very effective.

Factors Impacting Project Economics and Thereby Creating Barriers

As described above, fuel costs and first cost are cited by market actors as the major market barriers to CHP, and these barriers are actually perceived to be increasing, despite the existence of the CHP incentive program. The bottom line from a business perspective to a CHP investment decision is the payback on investment, and the level of up-front investment and the impact of fuel prices are the two most important factors in determining the payback period.

The installed first cost of CHP systems is relatively predictable, and can be directly impacted by the award of program incentives. All things being equal, an incentive award equal to 30% of the up-front investment can directly reduce the payback period by 30%. For example, an otherwise marginal eight-year payback can be reduced to a more acceptable payback period of about 5.5 years as a result of a 30% incentive award. This is very powerful. In fact, a number of participating end-users specifically stated that incentives were crucial to the decision to proceed with their CHP projects.

Unfortunately, fuel costs are anything but predictable and have been particularly volatile over the past few years. Moreover, while changing fuel prices can very quickly alter project economics, these are largely beyond the influence of the CHP program. Among other factors, this reliance on fossil fuel for operations and the resultant impact of changing fuel prices renders CHP quite distinct from the other energy efficiency measures being assessed in this report.

There are three primary variables for natural gas-fired CHP systems related either directly or indirectly to changing fuel prices and their impact on project economics.

1. Natural gas usage will typically increase at the end-use site, as grid-sourced electricity purchases are replaced with gas-fired on-site generation. The higher the price for gas, the more of an increase in costs there will be to fuel the CHP system, thereby degrading the savings relative to the status quo (all other things being equal).

2. As noted, on-site generation from a CHP system displaces grid-purchased electricity. Grid-purchased electricity has two primary components: wires charges and the cost of power supply. When natural gas prices rise, the cost of grid power supply will, to varying degrees as discussed below, also rise. Thus, with rising gas prices the value of displaced grid purchased will tend to rise, thus resulting in increased savings (all other things equal).

3. Recapture of thermal energy from a CHP system for production of hot water, steam, etc. will displace production of hot water, steam, etc. from on-site boilers, thereby reducing previous levels of boiler fuel consumption (typically natural gas). Thus, as natural gas prices rise, the value of thermal savings from CHP increases.

The interplay among these three factors determines the overall impact on project economics associated with changing fuel prices. The relationships between natural gas prices and wholesale electricity prices experienced in this region, and historical New Jersey retail electricity prices, which directly impact CHP economics, are described in detail in Appendix 2-A at the end of this chapter.

In summary, in restructured markets natural gas prices have had an increasing impact on wholesale electricity prices, as gas-fired generation has become a larger part of the overall generation mix in the PJM region and is increasingly on the margin. Moreover, increased demand for natural gas caused by gas-fired electric generation, as well as other supply/demand factors, have worked to cause substantial escalation in wholesale and retail prices over the past several years. Until recently, retail electricity prices for end-users in New Jersey had not reflected this run-up in natural gas prices. For the larger end-users, the retail price for electricity has caught-up to natural gas prices, i.e., both retail natural gas and retail electricity prices are current with existing market conditions. As such, while price forecasting will still be a challenge, at least the current price signals on both the gas and electric side are in sync. However, for the smaller-to-mid-sized commercial customers, retail electricity prices have not caught up to current market conditions, and therefore are not yet fully in sync with retail gas prices.

Specifically, for all electricity customers taking service at primary and higher voltage levels, and for secondary voltage customers with peak demands at or above 1,250 kW, the utility tariff price for power supply is based on the hourly spot market price for power (i.e., the BGS-CIEP tariff). As such, these customers are seeing a real-time price signal from the utility, and/or have switched to third-party suppliers at pricing that is either fixed, based on current forward market conditions, or that is floating based on real-time markets. Conversely, secondary voltage customers with peak demands less than 1,250 kW are eligible for the utility BGS-FP tariff, which offers a fixed price which is adjusted once annually.

The price for power supply under the BGS-FP tariff is based on a portfolio of staggered, three-year wholesale contracts obtained by the utilities via an auction process. Under this portfolio approach, while power supply costs are market-based overall, in a rising or falling market there can be a lag of one to three years before retail pricing fully catches up with prevailing market conditions. This portfolio-induced lag has produced desired rate stability for consumers in a rising market, but has also resulted in a mismatch between retail electricity pricing and current market conditions.

Current BGS-FP prices for power supply (averaging approximately 7 cents per kWh) are 2-3.5 cents per kWh below the market price for power for customers, as indicated by the result of the most recent BGS Auction and other recent public bids for retail power (prices approaching or exceeding 10 cents per kWh). Even after the next price adjustment in June 2006 (which will increase BGS prices to about 8.6 cents per kWh), BGS-FP prices will remain 1-2 cents per kWh below current market. The below current market retail price for electricity is reflected in the statistics that show very few BGS-FP customers having switched to third-party suppliers. This lag in retail pricing for the smaller customers also tends to perpetuate the prevailing mismatch between gas prices and retail electricity prices, which hurts CHP project economics.

Over the long term the retail prices should equilibrate and reach market. However, in the short run, the current price mismatch for the smaller customers exacerbates the challenges already facing smaller projects in terms of lack of economies of scale, generally longer payback periods, fewer vendors and manufacturers pursuing the market, and a lower level of end-user familiarity. Moreover, as gleaned through the key stakeholder interviews, there is a sense that smaller, less energy-sophisticated customers may be less apt to take a long-range perspective on energy pricing and more likely to make investment decisions based upon current conditions.

Nonetheless, the wires charge component (which currently makes up about 25%-35% of the total retail price) of electricity rates are regulated and not influenced by natural gas volatility, and the power supply/commodity component of electricity rates, while strongly influenced by natural gas prices, does not move on a one-for-one basis with natural gas. Accordingly, even with electricity prices fully ‘market-based,’ the relative levels of gas costs and electricity costs will be fundamentally different today than they were just a few years ago, and certainty different than they were 10 years ago. The change in the relative magnitude of retail gas prices and retail electricity prices, which has overall hindered CHP economics, is detailed in Appendix 2-A.

Impact of Rising Fuel Prices on Project Paybacks

Impact assessment and cost-benefit studies to be commissioned by the OCE and performed in the future will provide a much more detailed analysis of the current costs and benefits of CHP than the analysis conducted below. However, we have made an attempt using the 2004 KEMA market potential study model and updated rates and market data to quantify the impact of changing energy prices on CHP production costs and payback periods, and thereby help demonstrate how first cost and fuel cost barriers may be perceived as having increased over the past two years. *Note: it is not our intent in this exercise to prepare a full payback analysis, and we do not necessarily concur with all aspects of the KEMA payback model; therefore the data in the following tables should not be interpreted in absolute terms. Rather, our purpose is simply to show relative results using a model with which the OCE is familiar and update for key input price variables.*

Table 2-10 below sets forth in summary fashion the key elements and results of a CHP payback analysis for a CHP system with an 800 kW engine. Table 2-10 includes the actual natural gas and electricity price assumptions from the KEMA study.

Table 2-10. 2004 KEMA Market Potential Study, Payback Analysis for CHP

	Commercial	Industrial
Gas Rate ($/Mcf)	$7.50	$4.70
Electricity Rate ($/kwh)	$0.091	$0.079
Size	800	800
Type	Engine	Engine
Annual Capacity Factor	80.0%	80.0%
Annual CHP Electricity (kwh)	5,606,400	5,606,400
Heat Rate (Btu/kwh)	11,050	11,050
Recoverable Heat (Btu/kwh)	4,323	4,323
Turnkey Cost	$780,000	$780,000
Turnkey Cost less Incentive	$546,000	$546,000
CHP O&M Costs	$61,670	$61,670
CHP Fuel Costs	$464,297	$290,959
Thermal Savings	$159,052	$99,672
Annual Utility Bill with CHP	$84,096	$56,064
Total Costs with CHP	$451,011	$309,021
Base Utility Bill w/o CHP	$510,182	$442,906
Annual Savings	$59,171	$133,885
Payback	13.2	5.8
Payback with Incentive	9.2	4.1
Gross CHP Production Cost($kwh)	$0.083	$0.052
Net CHP Production Cost ($/kwh)	$0.054	$0.034

As shown above, the 2004 KEMA study showed a calculated payback period of about 13 years for a commercial customer and about 6 years for an industrial customer in the base case. With a 30% incentive payment, these payback periods were reduced to 9 years and 4 years, respectively.

Table 2-11. Payback Using 2005 Rates

	Commercial	Industrial
Gas Rate ($/Mcf)	$13.00	$11.00
Electricity Rate ($/kwh)	$0.110	$0.095
Size	800	800
Type	Engine	Engine
Annual Capacity Factor	80.0%	80.0%
Annual CHP Electricity (kwh)	5,606,400	5,606,400
Heat Rate (Btu/kwh)	11,050	11,050
Recoverable Heat (Btu/kwh)	4,323	4,323
Turnkey Cost	$780,000	$780,000
Turnkey Cost less Incentive	$546,000	$546,000
CHP O&M Costs	$61,670	$61,670
CHP Fuel Costs	$804,781	$680,968
Thermal Savings	$275,690	$233,275
Annual Utility Bill with CHP	$84,096	$56,064
Total Costs with CHP	$674,857	$565,427
Base Utility Bill w/o CHP	$616,704	$532,608
Annual Savings	-$58,153	-$32,819
Payback	-13.4	-23.8
Payback with Incentive	-9.4	-16.6
Gross CHP Production Cost($kwh)	$0.144	$0.121
Net CHP Production Cost ($/kwh)	$0.094	$0.080

Table 2-12. Payback at Market Rates

	Commercial	Industrial
Gas Rate ($/Mcf)	$14.50	$12.50
Electricity Rate ($/kwh)	$0.140	$0.125
Size	800	800
Type	Engine	Engine
Annual Capacity Factor	80.0%	80.0%
Annual CHP Electricity (kwh)	5,606,400	5,606,400
Heat Rate (Btu/kwh)	11,050	11,050
Recoverable Heat (Btu/kwh)	4,323	4,323
Turnkey Cost	$780,000	$780,000
Turnkey Cost less Incentive	$546,000	$546,000
CHP O&M Costs	$61,670	$61,670
CHP Fuel Costs	$897,641	$773,827
Thermal Savings	$307,501	$265,085
Annual Utility Bill with CHP	$84,096	$56,064
Total Costs with CHP	$735,906	$626,476
Base Utility Bill w/o CHP	$784,896	$700,800
Annual Savings	$48,990	$74,324
Payback	15.9	10.5
Payback with Incentive	11.1	7.3
Gross CHP Production Cost($kwh)	$0.160	$0.138
Net CHP Production Cost ($/kwh)	$0.105	$0.091

Table 2-11 and Table 2-12 replicate the KEMA model, only updated for gas rates and electricity rates. Therefore, the model has updated values for CHP fuel costs, thermal savings, and Base Utility Bill without CHP (i.e., cost of electricity purchases under the status quo). Table 2-11 utilized actual reported New Jersey average gas and electricity rates for 2005 (rounded from Table 2-A-1 in Appendix 2-A). A comparison between Table 2-11 and Table 2-12 of gas and electricity rates demonstrates the phenomena of sharply rising natural gas rates and only modestly rising electricity rates. This combination, when plugged in to the KEMA model, results actually in net cost increases using CHP (i.e., negative savings).

In Table 2-12 we have replaced KEMA's future gas and electric rate projections with an estimate of future gas rates and electricity retail rates based on correlated futures and forwards market prices for gas and electricity, respectively, assuming a full migration of retail electricity prices to market, and including current regulated utility delivery charges. As shown, using these projected market-based utility rates, CHP returns to positive annual savings. However, payback periods are shown to be longer than those set forth in the KEMA study (see Table 2-10), and even including a program incentive payment at the maximum level of 30% of installed cost (a favorable assumption particularly for larger projects that are over the 1 MW incentive size cap), paybacks are shown to be near or beyond the outer limits generally deemed acceptable by most end-users. In fact, it appears that with fuel price increases factored in, payback periods may even be longer now, including the benefits of the incentives (again, generously assuming the maximum 30% incentive level), as compared to the payback periods in the 2004 KEMA study *before the effects of the incentives*. The appearance of having 'lost ground' economically may be driving the opinions of market actors that first cost, as well as operating cost, market barriers are increasing.

Even with existing real-time pricing for the larger customers, the challenges with respect to CHP economics are evident. The following figures present, in two different formats, graphic summaries of the PJM spot market price duration curves.

Figure 2-21. 2005 Price Duration Curve for PJM-West Locational Marginal Price (LMP)[119]

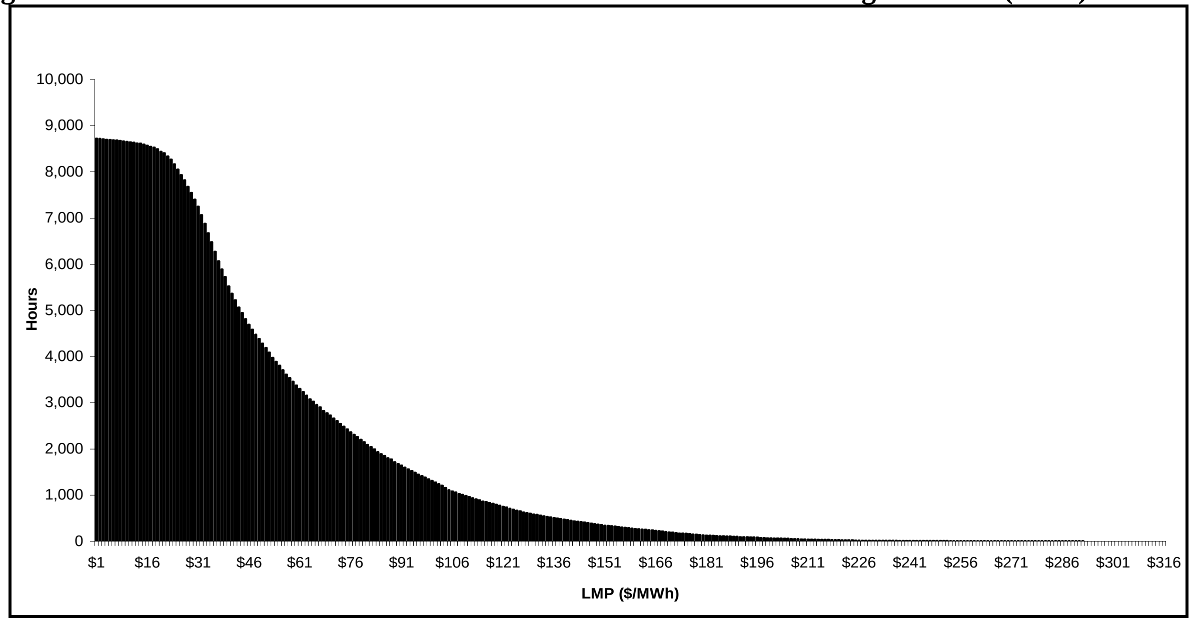


Figure 2-22. 2005 Frequency of Hourly PJM-West Spot-Market Energy Prices (Real-Time LMP)

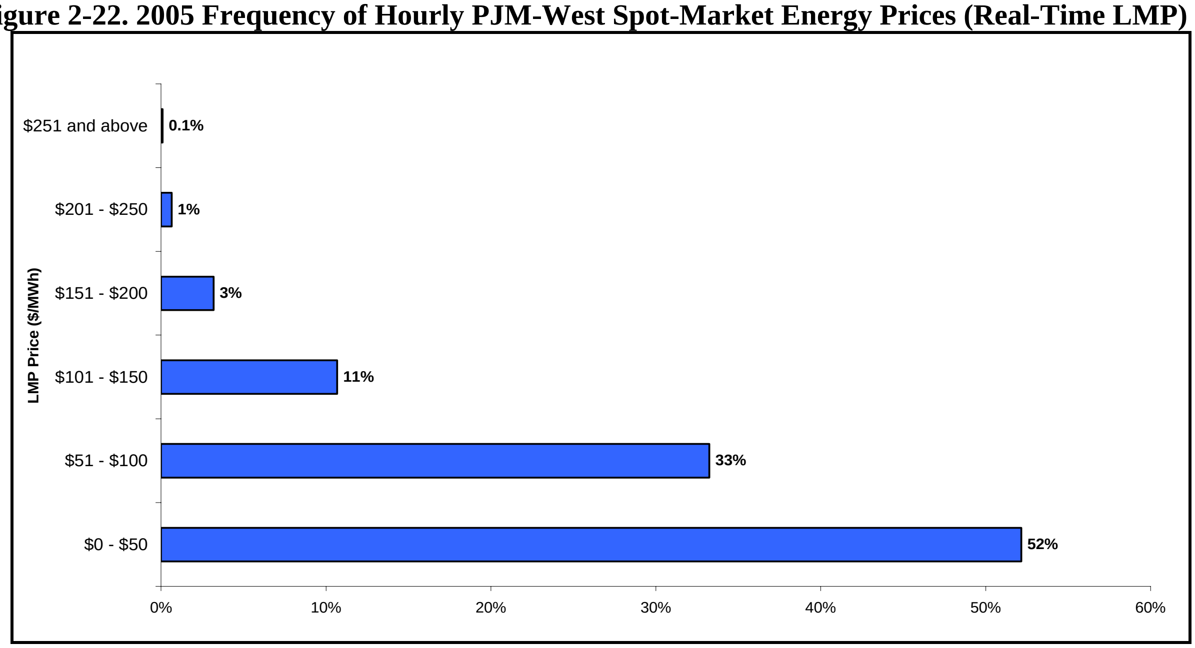


Figure 2-21 and Figure 2-22 portray how often different price levels are experienced in the spot energy market during the most recent annual period. The figures show that, despite the sharp increase in spot market prices overall during 2005, driven by surging natural gas prices, during more than 50% of the hours in the year the prevailing wholesale market price was still at or below $50/MWh. After adding grid ancillary services costs and adjusting for line losses and state sales tax ancillary services, this translates into a retail cost for energy produced on the grid (not including delivery charges or other fixed capacity

119 Source: Actual PJM 2005 real-time LMP database for PJM-West hub.

and transmission obligation charges) of less than or equal to about 6.5 cents per kWh.[120] Those hours when the retail-equivalent cost of electricity available on the grid is at or below 6.5 cents per kWh (in a substantial number of hours well below 6.5 cents) occur primarily during the off-peak hours. By comparison, with burner-tip industrial natural gas prices averaging over $11.00/MBtu in 2005 in New Jersey, and assuming a 12,000 Btu/kWh heat rate, electricity generated on-site would have been produced at an average cost during 2005 of about 13 cents per kWh (or about 9 cents per kWh after the thermal energy savings credit).

From a societal benefit-cost perspective these statistics highlight a potential issue, as it seems clear that in many off-peak hours energy is being produced at a substantially higher incremental cost at on-site CHP facilities (even net of the thermal savings credit) than the incremental cost of electricity generated on the grid. The impact of environmental externalities benefits can offset this somewhat, but there appears to be a substantial cost gap and it is not at all clear that the value of any externalities would completely close this gap.

From a participant perspective there is a greater chance that at current market prices CHP can still be cost-effective during the off-peak hours, because avoided wires charges would be factored in as well. However, certain components of the wires charges, specifically demand charges, are typically not incurred on an incremental basis during the off-peak hours. Moreover, even assuming full-loaded wires charges in the 3.0-3.5 cents per kWh range (typical order of magnitude of all-in delivery charges – including wires charges and demand charges – for New Jersey electric utility commercial and industrial tariffs), there were still a significant number of off-peak hours in 2005 when the retail-equivalent cost of grid-produced electricity was more than 3.0-3.5 cents per kWh cheaper than the net cost of CHP generation.

The above statistics help to demonstrate not only the open questions surrounding the societal cost-effectiveness of CHP and the challenging economics to potential developers of CHP systems under current market conditions, but also show how the advent of real-time pricing can lead some existing CHP system owners to re-evaluate system economics and operations. Specifically, evaluation has been undertaken by owners of existing CHP systems of whether it may be beneficial under certain market conditions to operate the CHP system as a peaking system, thereby relying on grid purchases and boiler production of hot water/steam during certain off-peak periods. While this can optimize operations from a financial perspective, it could have obvious implications with respect to overall efficiencies associated with CHP***. It is important to emphasize that such an assumed mode of operations would likely not make sense nor achieve target payback periods on a forward-looking basis when investment decisions are being made; however, the decision-making can be different once CHP system investment costs are 'sunk'.***

[120] Prices specific to New Jersey were somewhat higher due to the impact of congestion pricing, which can vary substantially depending on location (i.e., congestion premiums can vary significantly even within the State of NJ transmission zones depending on the specific transmission zone a project is located in), but have typically averaged from about 0.3-1.0 cents per kWh on an all-hours basis and between 0.2-0.5 cents per kWh during off-peak periods. PJM-West prices were used for Figures 2-21 and 2-22 because PJM-West is a recognized and widely used trading hub that is used not only for spot prices nut also for forward market products, because the data presented is intended for demonstrating an economic concept rather than quantifying precise project economics, and because the impacts of NJ-specific congestion are not material to the overall economic concept being presented. Each individual project would have to be evaluated in more detail based upon fuel costs, heat rates, O&M costs, and congestion pricing specific to the location, in order to determine the specific project economic viability and cost-effectiveness.

2.5.2 Are There New Program Elements That May Help Improve Customer Awareness and Acceptance?

During the survey phase of this effort a number of developers and manufacturers expressed dissatisfaction with certain specific implementation elements of the program that could create barriers to their future participation. These cited shortcomings included:

- Too small an application window
- Too lengthy a review process
- Lack of money for up-front design/analysis
- Lack of feedback during the review process
- Lack of a known contact point
- A ‘black-box’ approach that leads to an apparently unknown and inconsistent evaluation process
- Lack of feedback on rejected applications

Although some of these identified shortcomings may be due to interviewees that have had their application rejected, we did receive similar comments from multiple sources and these comments have been made by market participants in New York’s CHP program.

We also believe that some of these ‘customer service-type’ issues may be a byproduct of the ongoing transition of Clean Energy Program administration from the utilities to OCE or OCE-sponsored Market Managers. Based on the stakeholder interviews, the following became clear. Utility representatives and other key stakeholders are willing and prepared to respond to questions from applicants when they are approached. However, utility representatives have stepped back from a direct, organized, ‘proactive’ customer support role with respect to this program as program administration duties have been transitioned away from the utilities. The OCE is simply not currently staffed to fulfill this role for the many project applicants. The Rutgers CAES is not geared up to assume this role either, and it has also indicated a concern on the part of some with respect to project evaluators also playing a customer support role. As such, there is a void in this area, possibly awaiting the enlistment of a C&I Market Manager.

Developers and manufacturers also perceive a lack of awareness to be the leading barrier to customer participation in the program. This perception is supported on an anecdotal basis by the extreme difficulty we encountered in even finding someone to talk to at non-participant companies and entities in the state of types (i.e., SIC codes) that have participated in the CHP program, and that were thereby identified as potential candidates for CHP. However, with the limited amount of funding available, combined with the fact that the program has been substantially over-subscribed in past years, there is a real concern about whether an aggressive marketing campaign to make more end-users aware of the program would lead to more problems than solutions.

It was found during the interview process that even a number of end-users whose facilities were included in CHP applications had a surprising level of unfamiliarity with the projects proposed for their facilities. Interviewers were left with the impression in a number of cases that the applications were vendor-driven, without much end-user 'buy-in' at the front end. Even after the incentive award, the projects required additional internal due diligence. Most project cancellations during the 2004 cycle were ultimately driven by non-program business factors, such as insufficient savings/payback, change in expansion plans, or higher priorities for limited capital, rather than program-related issues.

Because the first CHP-funded projects have just recently become operational, there is very little real experience to be drawn with respect to post-installation customer support. However, it became evident during the stakeholder interview process that, after the required post-installation site inspection, there is no systemic or ongoing customer support or ongoing monitoring protocols in place. As such, there is some concern about the ability of facility managers, particularly for the smaller projects, to understand and maintain their CHP systems in an ongoing fashion.

The program is migrating toward larger projects in both the application phase and the award phase. This trend mirrors similar trends in the New York and California programs. Through the market actor survey process it was found that most manufacturers and developers are focusing on the larger sized systems. During the stakeholder interview and market actor survey process it was noted that small customers are less likely to have the level of awareness of CHP, and developers can only afford to do a limited amount of up-front feasibility work prior to a customer commitment. Moreover, initial feasibility analysis done on 'spec' may turn out to be overly optimistic, and can be more geared toward getting a customer's attention and support for submittal of an application. In short, while there are exceptions, there is a general lack of market attention, and a relative void in technical assistance, for the smaller-end customers.

Given the above, we have the following recommendations, a number of which are borrowed from the New York CHP program as cited by numerous market actors we interviewed:

- Consider setting aside a portion of program funds for site-specific CHP technical and economic feasibility studies for smaller-end customers, similar to the program run by NYSERDA. Because the total incentives budget is already limited, we would advise against re-allocating more than 5% of the total program budget (i.e., $250k) to this purpose. However if an alternative funding source could be identified to pay for small end-user CHP support that would not draw monies away from incentives budget, the OCE should consider a budget greater than $250k for this purpose.

- Consider establishing a primary program contact point at the OCE (could be OCE staff or an OCE contractor), akin to a customer service representative, for program applicants to contact with questions or for status reports throughout the application and evaluation process. For developer-submitted applications, an end-user contact should be established as well in an attempt to engender greater end-user interest and 'ownership' of the project. This role may appropriately be assumed by the Market Manager once the Market Manager has been retained and has taken over program implementation responsibilities.

- Make additional efforts to explain to applicants at the front end the evaluation criteria that will be applied to selecting awardees. Ideally, the specific evaluation criteria would reflect the specific goals of the program for a particular cycle and would be publicized well in advance of the application deadline in order to provide developers an opportunity to identify and compose project proposals that address the published goals and evaluation criteria.

- A more systematic approach should be implemented to provide project applicants that are not selected with more information concerning the basis for the rejection. This appears to happen currently on a more informal, *ad hoc* basis in response to inquiries. Consideration should be given to the approach taken in New York to issue rejection letters that provide reasoning for the rejection, a specific contact point for a telephonic debriefing, and if necessary the opportunity for an in-person meeting to receive an explanation of shortcomings with the proposal. This can lead to a higher degree of confidence in the program, and an opportunity for developers to craft more acceptable projects in the future. This is another role that may well be appropriately filled by the Market Manager once on-board and operating.

- Consider lengthening the open application period by an additional four weeks.
- Make award announcements within 8 weeks of the close of the application period.
- Develop a protocol for ongoing technical support post-installation, particularly for the smaller-sized customers. The long-term acceptability and reputation of the program could be damaged if participating end-users become dissatisfied with the operation of their systems.

2.6 Incentive Level Assessment

2.6.1 Should the CHP Program Incentive Levels Be Changed?

As described in Section 2.1, current program incentive levels are set as follows:

Eligible Technology	Incentive ($/watt) (Up to 1.0 MW)	Maximum % of Project Cost	Minimum System Size
Level 1 • Fuel cells not fueled by Class I renewable fuel	$4.00/watt * Incentives not to exceed $1 million per applicant	60%	None
Level 2 • Microturbines • Internal Combustion Engines • Gas Combustion Turbines	$1.00/watt	30% * Maximum increased to 40% where a cooling application is included	None
Level 3 • Heat Recovery or Other Mechanical Recovery Electric Generation Equipment	$0.50/watt	30%	None

Also, as described in Section 2.3, virtually all of the application and award activity has been associated with Level 2; i.e., gas-fired microturbines, internal combustion engines, and combustion turbines.

Based on stakeholder interviews and market actor surveys, there are a number of significant barriers to installation of fuel cells in terms of cost, operational problems, and high O&M costs; as such, none of the end-users surveyed indicated that fuel cells were even being considered. The relatively few operating fuel cells in the state were funded several years ago when gas-fired fuel cells were still eligible for CORE program incentive payments that were significantly higher than the CHP program incentive levels.

A common theme among key stakeholders interviewed was that there was a recognition of problems associated with existing fuel cell technologies, and there was no perceived concern with the lack of fuel cell applications, nor was there any indication of a strong desire to proactively address this situation through significant program changes. It would appear that a significant increase in the incentive levels would be required to generate any renewed market interest in gas-fired fuel cells at this time. However, at the current overall funding level for the program, such an increase, if successful in drawing applications, would draw limited funds away from more commercially viable CHP applications. It is recommended that incentive levels for fuel cells not be changed at this time.

With respect to gas-fired CHP applications, as described in Section 2.3, the incentive levels are very similar to those that have been adopted and utilized in the New York and California programs since those programs' inceptions approximately five years ago. California did just recently implement a reduction in the incentive payments for 2006 for non-renewable fueled CHP systems, to $0.80/watt for microturbines and small gas turbines, and to $0.60/watt for internal combustion engines and large gas turbines (still subject to a cap of 30% of eligible project cost and the maximum project size is 5.0 MW).

As described in Section 2.5, there has been a degradation overall in CHP project economics since the CHP pilot program inception in 2004. As a result, market actors perceive that key market barriers, including first cost and operating costs, have actually increased over the past two years since the program was initiated. Project payback periods set forth in typical CHP applications tended to be longer than the typical internal payback period requirements indicated by survey respondents. Numerous participating end-users indicated that the incentive was crucial to pushing their CHP projects through the internal approval process. Moreover, the very first projects funded in 2004 through the inaugural program funding cycle are just now coming online. There is an indication that some developers and manufacturers have increased the level of interest and commitment of resources to the state as a result of the available incentives, but the overall level of CHP activity in the state appears modest at best, particularly when compared to historical activity levels (primarily the 1980s and 1990s).

It does not make sense at this point in light of these circumstances described above to reduce the OCE CHP incentive levels, as was recently done in California. Such a reduction would serve to build further economic barriers to CHP during what is already a challenging time.

It appears that for many if not most projects, additional incentives may be required to bring typical project payback periods down to levels that meet the capital investment payback thresholds for most end-users. However as stated above, the very first CHP program-funded projects are just now coming on-line. In addition, the OCE will be commissioning an impact assessment in the near future which should begin to provide a first assessment of actual operating projects. Moreover, as noted earlier in this report, there are some initial findings out of California studies which suggest that CHP projects funded through state-sponsored programs may be achieving significantly lower system efficiencies than planned, and that the overall cost-effectiveness of the CHP program from a societal perspective may be questionable.

In light of these open questions it would not be appropriate at this stage to increase the incentive levels. An increase in incentive levels would either reduce the total number of CHP projects that could be funded out of the existing budget, or would require a re-allocation of funds from other energy efficiency programs. Neither of these outcomes would be appropriate at this stage.

The program already has a substantial excess of applicants over awardees, resulting in numerous denied applications. If incentive levels were increased and fewer total applicants were granted incentive awards, there would be a greater number of denied applications.

An increase in the rejection rate would send the wrong signal and would be detrimental to efforts to attract vendors and manufacturers and build a confident, thriving CHP market in the state. Conversely, a decision that would siphon funds away from other EE programs in the state's portfolio cannot be justified until there is more evidence that this would create a better yield of energy savings and other benefits from CHP projects than could have been produced from additional penetration in the other elements of the OCE's program portfolio.

The Energy Policy Act of 2005 included, among other things, Energy Efficiency Tax Incentives applicable to fuel cells and microturbines. Specifically, it provides a 30% business tax credit for fuel cells and a 10% tax credit (up to $0.20/watt) for microturbines with system size less than 2000 kW, for tax years 2006 and 2007. As such, an additional 10% net reduction in first cost is available for smaller-sized CHP systems.

In some instances the OCE has reduced incentive payments under programs such as CORE, to offset the receipt of tax credits available to businesses in order to keep the overall level of technology support unchanged. We recommend that the OCE not implement an offsetting program incentive reduction in this instance. As described above and in previous sections, overall CHP project economics have actually declined in the face of rising natural gas prices since the inception of the program in 2004. Moreover, project economics are most challenging in the markets targeted by the tax incentives, i.e., in fuel cells and in smaller CHP applications. The tax credits should be seen as an additional tool to provide an added impetus (through a further reduction in payback period) to investment in target markets that are facing particularly challenging economics and which are receiving less market attention overall, *without any additional cost to the state's ratepayers or at the expense of other EE programs.*

2.6.2 Should the CHP Minimum Efficiency Levels Be Changed?

The CHP program currently includes a minimum 60% average annual fuel efficiency, including recaptured mechanical energy, based on total energy input and total utilized output. The 60% minimum efficiency levels are similar to those set for the New York and California CHP programs.

Further, the evaluation process gives a substantial weighting to overall system efficiency so that, all else being equal, a project with a higher overall efficiency is more likely to be granted an incentive award than a project with lower claimed energy efficiency. In fact, the overall energy efficiencies for the projects selected for incentive awards in the 2005 cycle ranges averaged over 75%.

Particularly because of the heavy weighting in the evaluation criteria on system energy efficiency, and also because the efficiency requirement is in line with that used in other states, there does not appear to be a need at this time for a change in the minimum efficiency requirement. The most efficient projects have tended to receive the awards, and those awardees have had (claimed) efficiencies well above the minimum required, so there does not appear to a problem with the criteria.

As stated previously, a California study found that actual measured system efficiencies can be substantially less that the efficiencies claimed in the corresponding application. This poses a real concern. There is very little operational data currently in place for CHP-funded projects in New Jersey because only a few projects have been installed and are running, and of those few projects, the total operational time can be measured in months. Over the next year there should be a number of additional CHP-funded projects operational. It is critical that the upcoming Impact Assessment conduct on-site measurement of operating CHP projects to ascertain as accurately as possible the actual energy efficiencies of these funded projects. This information will be useful in assisting future cost-benefit studies and in identifying potentially overly optimistic fuel consumption and heat recovery assumptions.

2.7 OCE Program Goals Assessment

The stated goal of the program from the 'Program Descriptions and Budget' document is as follows:

> Meet the objective of the New Jersey Clean Energy Program to use energy efficiency and clean distributed generation to provide reliability solutions for New Jersey. The program's goals are to reduce overall system peak demand and to encourage use of emerging technologies.

Moreover, it is stated that specific energy savings goals are 'not applicable'.

The CHP program was implemented as a pilot program. Unlike some of the other, more established EE programs, there are no specific goals, nor are there specific targets for such indicators as the number or capacity of systems installed, the number of participating developers or manufacturers, or the specific amount of energy savings. In part, market penetration associated with the program is budget-limited; that is, there have been far more applicants for incentives than incentive funds available. As such the total number of projects or amount of capacity funded through the program is not necessarily the best and only indicator of the success of the program. The number and total capacity of projects is, in and of itself, more reflective of the amount of incentive money available than the overall ‘success’ of the program.

The stated CHP pilot program goals are very broad and reflect overarching policy. It is not deemed appropriate for this study to recommend policy goal changes.

We do offer observations with respect to the results of the program thus far vis-à-vis the policy goals.

With regard to overall system peak reduction, certainly installed CHP capacity brought online under the program should reduce system peak demand (assuming that the installed capacity is operational at the time of system peak). To date, there is about 2.2 MW of project-funded capacity installed and another approximately 20 MW of capacity from active projects still in various stages of development from the 2004 and 2005 program cycles. While there will be some diminution of this capacity value in terms of system peak reduction due to some unit outages and the effects of warmer ambient air temperatures at times of system peak, the reduction in overall system peak demand should be on this general order of magnitude of about 20 MW from the first two years, at a total program incentive cost of about $10 million.

The projects funded thus far have been distributed throughout the state, and while there has been somewhat of a concentration in the PSE&G territory, there has not either by design or by happenstance been concentration in any more localized geographic area. While the 20 MW of active CHP program-funded capacity is not insignificant, it represents about 0.1% of the forecasted combined 2006 coincident peak load of New Jersey transmission zones (19,374 MW). [121] The current value of capacity in the PJM region is quite low, although it is anticipated that capacity values in New Jersey specifically may increase in the future if locational-based capacity market mechanisms are implemented. Nonetheless, there may be greater potential value associated with DG, including on-site CHP, if localized distribution capacity investment can be avoided as a result of CHP projects.

Because of the manner in which local distribution systems are planned, using contingency planning, and because some distribution circuits have excess capacity while others are fairly well constrained, it is questionable how much distribution capacity investment is avoided with the installation of individual CHP projects scattered throughout the state. To obtain greater benefit from the limited CHP program funding, the OCE should consider targeting a portion of the fund towards projects in specifically-identified load pockets and/or locally-constrained distribution areas.

An identified overarching goal of the program is to encourage use of emerging technologies. However, it appears that the trend with respect to both applicants and awardees during the limited 2-year span of the program is toward larger, more conventional projects. This result is the same as would be expected to occur in a market devoid of incentives or subsidies, and likely reflects, among other factors, the tightening economics for CHP overall. Simply put, the larger, more conventional projects have the best chance of achieving even marginally acceptable paybacks under the current challenging energy market conditions.

[121] Source: PJM Coincident Peak Forecast 2006-07 as posted under the Planning/Resource Adequacy Planning section of PJM website: www.pjm.com.

CHP application evaluators can only evaluate and rank the projects brought to the table through the application process. As such, if applications for smaller or emerging technology projects are not submitted, weighting criteria alone can not be used to help favor targeted project sizes or technologies that address the policy goals.

Finally, another way to potentially squeeze more benefit out of limited program budgets is to encourage applications for and awards to projects that have potential for replication elsewhere in the state. Specifically, funding should be directed at projects that can be demonstrated to work for a particular entity with multiple, homogenous locations using the same or similar project design, thus achieving economic, technical, and ‘knowledge’ economies of scale. As described earlier in this report, however, based upon completed surveys there appears to be little replication happening in the New Jersey market, and most of their incentive awardees report that they have few other locations in the state. It is premature to conclude from this that replication opportunities do not exist in the state. Rather, we believe that multiple, homogenous sites that are candidates for replication are most likely to be associated with smaller-sized end-users. As such, the absence of CHP replication is likely more a function of the relative lack of attention on this market niche.

In summary, the CHP pilot program currently has broad policy goals, but in its implementation has not funded as broad a spectrum of projects as may be desired. A number of market niches that are of interest and could provide benefits consistent with the OCE’s policy goals are not being penetrated. If the OCE maintains funding at current levels, it should consider re-allocating at least a portion of the program budget toward projects that meet specific program goals or address target market niches.

Specific areas of focus suggested for consideration by the OCE include:

- Reduced attrition rate (attrition % = # of projects not completed / # projects awarded).
- Demonstration projects for preferred CHP technologies.
- Projects that may lend themselves to replication (i.e., projects at sites that have numerous homogenous locations throughout the state). This could be combined with a follow-up impact assessment/case study/education initiative aimed specifically at the energy managers of the other homogenous locations.
- Small-sized projects that the market may be neglecting due to a combination of lack of end-user awareness/focus and lack of economies. To that end, such an effort could be combined with an education and technical assistance initiative sponsored by the OCE.
- A more targeted focus on localized distribution system constraints. Electric distribution utilities could be asked to report on constrained distribution pockets, current planning and design criteria, and the impact of single versus multiple DG applications in targeted areas. Such an effort could lead to conclusions on whether the realization of actual distribution cost savings in addition to broad system peak reduction benefits requires more geographic focus on program criteria or evaluation.
- Number of days to complete review of proposals and announce incentive awardees.

As indicated previously in this report, there are at present no specific program goals for the CHP pilot program. Moreover, specific goals are problematic at this juncture because, as described, the number of participating projects is generally budget-limited (with the number of applicants far exceeding available funds). As such, no matter what program adjustments are made, the ‘success’ of the program in terms of traditional measures such as the number of participants and amount of savings, is limited by the amount of incentive monies available.

The amount of installed capacity and reported energy (gas and electricity) savings achieved with the limited budget could be stretched and maximized by focusing on large projects. This is because of the 1 MW maximum incentive payment. By way of extreme example, if the $1 million maximum incentive payment ($1/watt times 1,000,000 watts max size) was made for each of five 5 MW projects, it could be said that the $5M total budget achieved 25 MW of new CHP capacity. This would translate into a program cost of $0.20/watt installed capacity. This is intended as an extreme example, as in reality there are likely a limited number of yet-untapped CHP opportunities of this size in the state; moreover, an effective incentive as low as $0.20/watt may not be enough incentive in all cases to influence a CHP investment decision. However, there is certainly a market trend overall towards larger projects, and evidence from the 2005 CHP program funding cycle that projects larger than 1 MW that receive less than the full $1.00/watt incentive award are being developed. By comparison, by targeting only projects of 1 MW and smaller would yield only 5 MW of installed capacity with the same $5 million budget (assuming the $1/watt incentive did not exceed 30% of installed cost for any recipient projects).

On the surface, there would seem to be substantial appeal to targeting larger than 1 MW projects, in order to achieve the largest possible installed capacity and energy savings with the $5 million incentive budget. However, these results could be misleading and, moreover, may not be consistent with the overarching CEP goal of market transformation. As described earlier in this report, larger CHP projects have substantial economies of scale in terms of installed cost, and also have O&M and heat rate advantages. As described, these advantages translate into the lowest payback periods. It is therefore appropriate, as the program incentive scheme intends (by limiting incentives to the first 1,000 kW), that such projects receive the lowest incentive on a $/watt basis. However, the largest-size end of the market is also clearly the most established market niche, as trends in the New Jersey program as well as those in CA and NY have been towards larger projects, and manufacturers and vendors have indicated a clear marketing focus on the larger scale projects. As such, while the project economics are currently challenging even at the larger-size end of the project spectrum, the least amount of market transformation is required at this end of the market, and the largest possibility for free-ridership exists. Conversely the smallest-size end of the market faces the most financial challenges, seems clearly to have the least amount of interest among vendors and manufacturers, and, as a result, is the best candidate for market transformation efforts.

Accordingly, as the OCE begins the effort to move towards adopting more specific program goals for the CHP pilot program, it is recommended that such goals be differentiated by market segment. Accomplishing market segment-specific goals should be done without compromising on efficiency or other key program requirements and evaluation criteria (i.e., meeting goals for specific market segments should not simply rely on ‘set-asides,’ if at all possible), but rather should rely upon tools such as those identified above, including outreach, feasibility study assistance, technical assistance, and ongoing support. The specific goals recommended are as follows:

- At least 5 CHP applicants annually with installed capacity of 100 kW or less (stretch goal: 10 applicants).
- At least 3 CHP incentive awardees annually with installed capacity 100 kW or less (stretch goal: 5 winners).
- At least 10 CHP applicants annually with installed capacity of 500 kW or less (stretch goal 15 applicants).

- At least 6 CHP incentive awardees annually with installed capacity 500 kW or less (stretch goal: 9 winners).
- For each program funding cycle, at least one demonstrated example of a replicated project installed within 18 months of installation of funded project (stretch goal: 2 documented replications per program cycle).
- For each program funding cycle, at least one application for a technology not previously funded (stretch goal: 2 applications).
- Evaluation complete and announcement of incentive winners within 90 days of close of application period.
- Project attrition rate of 40% or less (stretch goal: 30% or less).
- Actual achieved CHP system efficiencies, as demonstrated via impact assessments or other monitoring programs, no less than the 60% minimum program requirement, **and** no more than 7.5% less than the application technical worksheet (as verified through evaluation process) reported system efficiencies. *E.g., if system efficiency reported in technical worksheet is 75%, actual measured efficiency should be no less than 67.5%* . (Stretch goal: no more than 5% less than reported).

These goals were developed by determining the targeted categories/niches of technologies as described above; reviewing historic applications and awards for 2004 and 2005; and setting goals for each of those categories/niches that exceed the historic levels of applications and/or awards. The goals should be reviewed on an annual basis, based upon actual results and changes in market trends.

If and when the program penetration is not budget-limited, the goals should be expanded to include specific total MW and MWh production and electricity and natural gas savings targets. However, at present, such goals would not be appropriate. First, market penetration is capped by the budget limitation. Second, setting goals to maximize total capacity, energy production, and even savings would likely run cross-purposes to other program goals such as increased penetration in the smaller project size market niches, by encouraging funding of the largest possible projects.

2.8 Conclusions and Summary of Findings and Recommendations

The CHP program is a pilot program that provides incentives to defray a portion of the up-front installed cost of CHP systems. The pilot program has a limited amount of allocated funds of $5 million annually. The pilot program has only been in place for two years, and in 2005 has completed its second round of applications, evaluation, and incentive awards. Several CHP projects from the 2004 round have become operational just in the last several months, and several more projects should be fully operational in the near future (see Section 2.3.1).

There was a substantial oversubscription of applications in 2004, with 73 applicants and 24 ultimate awards. There was subsequently a large attrition rate for projects from the 2004 awardee list; there are currently nine projects from the 2004 round that are still active (in development, under construction, or operational) representing about 5 MW of distributed generation capacity. The high attrition rate in 2004 appears to have been caused by a combination of poor project economics, caused in part by rising natural gas prices, and the speculative nature of some of the applicant projects. In the 2005 round, although still oversubscribed, there were substantially fewer applications. This appears to be the combined effect of a more rigorous application process and the impact on the project economics and the overall CHP market associated with rising natural gas prices. There were 10 projects originally selected for incentive awards; one project subsequently dropped out and was replaced by three smaller projects that were next on the list. In total, there are 12 active projects in development from the 2005 round. The 2005 applicant and awardee projects are significantly larger on average than the 2004 applicant and awardee projects (see Section 2.3.1).

The projects being funded and developed through the pilot CHP program represent a small portion of the CHP market potential in the state as identified in the 2004 market potential study performed for the OCE by KEMA (see Section 2.3). Moreover, while there is some CHP market activity in the state outside of the CHP pilot program, based on interviews with developers and manufacturers this activity is at a very modest level (see Section 2.5).

Program end-user and developer participants that have received awards and continued with project development expressed appreciation for the program and financial assistance, and many indicate that the incentive was critical to successful project development, both in terms of project economics and of generating momentum within the end-users' internal decision-making process. As such, the program has certainly had a positive impact (see Section 2.5).

A number of developers and manufacturers expressed dissatisfaction with certain specific implementation elements of the program that could create barriers to their future participation. These shortcomings include: too small an application window; too lengthy a review process; lack of money for up-front design/analysis; lack of feedback during the review process; lack of a known contact point; a 'black-box' approach that leads to an apparently unknown and inconsistent evaluation process; and lack of feedback on rejected applications. Some of these 'customer service-type' issues may be a byproduct of the ongoing transition of Clean Energy program administration from the utilities to OCE or OCE-sponsored Market Managers. Developers and manufacturers also perceive a lack of awareness to be the leading barrier to customer participation in the program. Attempts to locate and interview nonparticipating end-users anecdotally support this notion, as it was found extremely difficult even to find someone to talk to at companies and entities in the state of types (i.e., SIC codes) matching those companies and entities that have participated in the CHP program and thereby were identified as business types that are candidates for CHP (see Section 2.5).

It was found during the interview process that even a number of end-users whose facilities were included in CHP applicants had a surprising level of unfamiliarity with the projects proposed for their facilities. It appears from the interviews with market actors that in a number of cases the applications were vendor-driven without much end-user 'buy-in' at the front end. Even after the incentive award, the projects required additional due diligence. Most project cancellations during the 2004 cycle were ultimately driven by non-program business factors, such as insufficient savings/payback, change in expansion plans, or higher priorities for limited capital, rather than program-related issues (see Section 2.5).

Market actors in all categories indicated that several key CHP market barriers, notably initial cost, operating cost, and permitting, have increased over the past two years. This is counter to the intent of the program to reduce the first cost barrier; however, it appears that the escalation in natural gas prices that has occurred in the past two years has had the effect of offsetting the benefits of the incentive program. On the other hand, developers and manufacturers indicated that the utility tariffs, interconnection policies, and levels of utility assistance in New Jersey are generally supportive of CHP relative to other states. There appears to be a modest increase in the level of resource commitment by developers and manufacturers to the CHP Program in New Jersey as a result of the pilot program; however, the modest level of program funds is still sited as a limiting factor (see Section 2.5).

The program is still relatively new and of limited scope, and projects funded by the program are just starting to come online. As such, there is much still to be learned. Moreover, unlike most other clean energy programs, there are only a limited number of states that offer similar CHP incentive programs that can offer comparisons and lessons learned. However, the programs in New York and California have been in place for a few more years than New Jersey's program, and have undergone somewhat more reflection and evaluation, from which information can be drawn (see Section 2.1.3).

Despite the short life of and limited experience with the CHP program, based upon this initial market assessment, there are a number of recommendations for this program, including the following.

Suggested modifications to program implementation (See Section 2.5.2 for more details):

- Consider setting aside a portion of program funds for site-specific CHP technical and economic feasibility studies for smaller-end customers, similar to the program run by NYSERDA. Because the total incentives budget is already limited, we would advise against re-allocating more than 5% of the total program budget (i.e., $250k) to this purpose. However, if an alternative funding source could be identified to pay for small end-user CHP support that would not draw monies away from incentives budget, the OCE should consider a budget greater than $250k for this purpose.

- Consider establishing a primary program contact point at the OCE (could be OCE staff or an OCE contractor), akin to a customer service representative, for program applicants to contact with questions or for status reports throughout the application and evaluation process. For developer-submitted applications, an end-user contact should be established as well in an attempt to engender greater end-user interest and 'ownership' of the project. This role may appropriately be assumed by the Market Manager once the Market Manager has been retained and taken over program implementation responsibilities.

- Make additional efforts to explain to applicants at the front end the evaluation criteria that will be applied to selecting awardees. Ideally, the specific evaluation criteria would reflect the specific goals of the program for a particular cycle and would be publicized well in advance of the application deadline in order to provide developers an opportunity to identify and compose project proposals that address the published goals and evaluation criteria.

- The OCE or its evaluation contractor should employ standardized long-term gas price assumptions for all applications *for comparison and evaluation purposes only.* The OCE or its contractor should utilize current market prices for this purpose, and should make it clear that the standardized price assumption is for evaluation purposes only, and is not an actual prediction of future prices and should not be relied upon for that purpose.

- A more systematic approach should be implemented to provide project applicants that are not selected with more information concerning the basis for the rejection. This appears to happen currently on a more informal, *ad hoc* basis in response to inquiries. Consideration should be given to the approach taken in New York to issue rejection letters that provide reasoning for the rejection, a specific contact point for a telephonic debriefing, and if necessary the opportunity for an in-person meeting to receive an explanation of shortcomings with the proposal. This can lead to a higher degree of confidence in the program, and an opportunity for developers to craft more acceptable projects in the future. This is another role that may well be appropriately filled by the Market Manager once on board and operating.

- Consider lengthening the open application period by an additional four weeks.

- Make award announcements within 8 weeks of the close of the application period.
- Develop a protocol for ongoing technical support post-installation, particularly for the smaller-sized customers. The long-term acceptability and reputation of the program could be damaged if participating end-users become dissatisfied with the operation of their systems.

Possible adjustment in focus at current funding levels to reflect policy goals:

While it appears that there has been some increased commitment of resources in the state on the part of CHP developers as a result of the program, overall market activity in the state still appears to be quite modest as compared to market potential, despite the introduction of the pilot program. The impact of rising natural gas prices on project economics has certainly been felt in this regard, and the relatively modest current funding level undoubtedly has constrained the market impact of the program. Overall the average size of the projects participating in the program increased between 2004 and 2005, apparently reflecting a combination of greater customer awareness at the larger customer end, and a focus by developers on projects with better economies of scale in the face of declining economic conditions (i.e., rising natural gas prices).

The pilot program currently reflects its broad policy goals. If the OCE maintains funding at current levels, it should consider at least a partial shift in emphasis to a more focused approach in terms of both goals and target markets. In other words, the OCE should consider allocating at least a portion of the program budget toward projects that meet specific program goals or address target market niches. In this manner the market impact on addressing specific, focused goals or focused market niches may be greater (i.e., try to get greater bang for the buck in a targeted area) (see Section 2.7) .

In light of the above the following are suggested as more specific, targeted program goals:

- At least 5 CHP applicants annually with installed capacity of 100 kW or less (stretch goal: 10 applicants).
- At least 3 CHP incentive awardees annually with installed capacity 100 kW or less (stretch goal: 5 winners).
- At least 10 CHP applicants annually with installed capacity of 500 kW or less (stretch goal 15 applicants).
- At least 6 CHP incentive awardees annually with installed capacity 500 kW or less (stretch goal: 9 winners).
- For each program funding cycle, at least 1 demonstrated example of a replicated project installed within 18 months of installation of funded project. (stretch goal: 2 documented replications per program cycle).
- For each program funding cycle, at least one application for a technology not previously funded (stretch goal: 2 applications).
- Evaluation complete and announcement of incentive winners within 90 days of close of application period.
- Project attrition rate of 40% or less (stretch goal: 30% or less).

- Actual achieved CHP system efficiencies, as demonstrated via impact assessments or other monitoring programs, no less than the 60% minimum program requirement, **and** no more than 7.5% less than the application technical worksheet (as verified through evaluation process) reported system efficiencies. *E.g., if system efficiency reported in technical worksheet is 75%, actual measured efficiency should be no less than 67.5%* . (Stretch goal: no more than 5% less than reported.)

Energy Savings Reporting:

Energy savings and environmental benefits associated with the CHP pilot program are currently reported using methodologies that are based on those used for other EE and renewables programs. However, these methodologies do not recognize the unique nature of CHP systems. It is suggested that CHP energy savings should be reported differently to better reflect the unique nature of CHP, as neither a ‘pure’ EE application or renewable application, and the true nature of the net energy savings associated with CHP, as follows (see Section 2.4 for more details).

- At this early stage of the program and project completion, installed capacity can continue to be reported as a demand reduction. However, for the longer term, as a sufficient number of projects come online and meaningful performance data can be obtained, an impact assessment should include an evaluation of CHP plant output coincident at the system peak. This would include effects of both higher ambient temperatures on maximum electric output, as well as the effect of peak-coincident forced outages, to obtain a truer picture of the impact of installed CHP program-funded systems on peak demand reduction.

- On-site CHP system output from program awardees should continue to be reported, as on-site generation is an important contribution to system diversity and is indicative of overall program impact. However, CHP system output should not be reported as electricity savings. Moreover, CHP output that is predominantly fueled by natural gas cannot be considered as renewable energy generation. Rather, CHP output should be reported as a separate category of DG generation. *Reported electricity savings from CHP would be appropriate in the case of the application of absorption chillers as part of a CHP system that would displace electricity previously consumed through use of centrifugal chillers*.

- Thermal savings for CHP systems should be stated on a consistent basis by all applicants, and in turn by all LDCs to the OCE, as the reduction in fuel related to the recapture of thermal energy (e.g., reduction in boiler gas associated with the recapture of waste heat from the CHP engine or turbine). The reduction in boiler natural gas displaced by CHP waste heat recapture should be reported consistently as Dth savings.

    - A case can be made that there can be an increase in net fuel use associated with replacement of grid-generated electricity by electric generation from gas turbines or engines with higher heat rates, that could offset natural gas savings associated with thermal energy-generated electricity. As such, overall net energy savings could be calculated and reported on a ‘Btu’ basis, to reflect the interchangeability of different types of fuels associated with CHP, the dual-energy impact nature of CHP, and the net decrease in overall energy consumption associated with efficiency gains related to CHP. However, this would add an additional layer of complexity in reporting that is premature at this early stage.

    - Studies done on the CHP program in California raise questions regarding the planned electrical conversion efficiencies, heat recapture rates and capacity factors of CHP systems, which in turn has raised questions regarding the actual versus planned overall system operating efficiencies. While in the short term, due to the small number and limited operating histories of funded CHP projects in New Jersey, use of actual instead of planned thermal energy recapture savings in this regard is not feasible; for the longer term an impact assessment should investigate and a monitoring system should be implemented in order to refine the reported efficiencies utilized in reporting thermal savings.

- In sum, for initial reporting purposes it is sufficient to report: 1) CHP generation capacity at peak (in MW); 2) CHP generation (in MWh); 3) any electricity savings due to absorption chillers (in MWh); and 4) natural gas savings due to boiler gas savings (in Dth).

- For many CHP applications there can be substantial electric-side emissions benefits, due to the superior emissions rates of many new CHP engines and turbines as compared to the average emissions rates of grid units on the margin (in addition to the gas-side emissions benefits associated with offset boiler emissions). However, the CHP engines and turbines do produce emissions of various pollutants, and these should be offset against the displaced grid emissions to reflect net electric-side emissions benefits. The emission signature provided in the technical worksheets for each project applicant, which is subject to technical review by the evaluation team, can be used for this 'offsetting'.

- The manner in which gas emissions savings are reported, by multiplying the typical boiler emissions rate by the displaced boiler gas combustion, appears appropriate. This approach does, of course, depend on an accurate reporting of displaced boiler natural gas combustion.

Specific suggested savings calculation protocols are provided in Appendix 2-B at the end of this chapter. Only two other states have a CHP incentive program similar to NJ. Moreover, as described earlier in this report, those other states (NY and CA) do not have detailed energy savings protocols for their CHP programs, but rather report primarily gross CHP electricity production and system capacity. As a result, we found little to draw from in the way of pre-existing energy savings protocols from other state programs. Accordingly, the recommended protocols in Appendix 2-B have been developed from a combination of professional judgment and generally accepted energy engineering formulae.

Non-energy benefits:

- Electric distribution utilities could be asked to report on constrained distribution pockets, current planning and design criteria, and the impact of single versus multiple DG applications in targeted areas. Such an effort could lead to conclusions on whether the realization of actual distribution cost savings requires more geographic focus on program criteria or evaluation. A possible end result could be to target a particular constrained area for potential multiple CHP applications and awards, in order to maximize distribution savings benefits associated with the incentive program.

- Gas transportation capacity market prices have increased substantially, particularly for winter peaking months. Gas utilities should review current tariffs applicable to electric generation/CHP to ascertain whether additional discounts may be justified in light of these increased market prices for transportation capacity and the benefits that baseload CHP provides in terms of spreading transportation costs evenly throughout the year. Any such additional discounts should be cost-based to avoid subsidies by other customers.

- Consideration should be given to whether gas utilities could offer a longer-term price-hedged commodity portfolio to CHP customers.

Considerations relevant to potential changes in program funding levels:

As described above, CHP is unique and distinct in a number of ways from other EE and renewables programs. These unique characteristics impact not only the reporting of energy savings but also the evaluation of the cost-effectiveness of CHP from the various perspectives. In addition, the program is relatively new in its implementation (only two years) and there is virtually no experience to date with the actual operation of program-participating CHP systems. Increasing gas prices, while offset to varying degrees by corollary increases in electric prices and the value of thermal savings, have certainly impacted project economics and the market overall. While higher energy prices have undoubtedly improved the economics and benefit-cost ratios of other, more traditional EE applications, the impact on CHP is substantially more complex (see Section 2.6).

- There are sufficient open questions related to the overall impact and cost-effectiveness of the CHP Program relative to other, more established EE programs, to warrant caution in considering a significant re-allocation at this time of finite funds away from other programs. The OCE should continue to gather additional information, consider some of the program modifications set forth above, and look carefully toward the results of impact assessments and cost-benefits studies before making decisions with respect to major changes in funding levels for the CHP Program.

- At this relatively early stage in program life and pending the results of future impact assessments and cost-benefit studies, the incentive levels should not be modified at this time. We further recommend not altering (i.e., reducing) incentive levels to reflect the impacts of federal tax credits implemented for microturbines and fuel cells for tax years 2006 and 2007, since the availability of the tax credits can serve to offset the general decline in project economics since the CHP incentive levels were established in 2004.

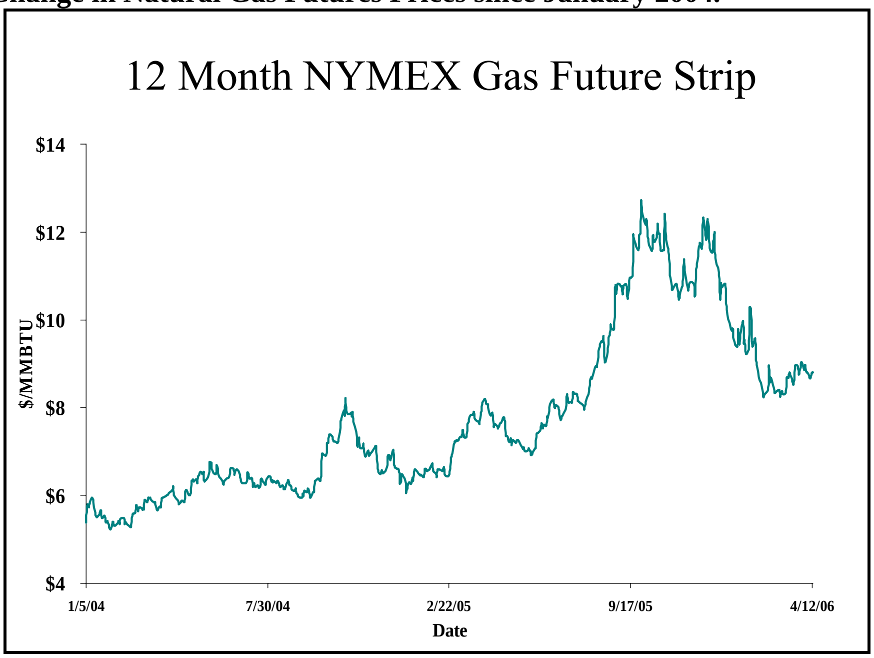
- At this relatively early stage in program life and pending the results of future impact assessments and cost-benefit studies, the minimum CHP system efficiency levels should not be modified at this time. The evaluation weighting process adequately encourages systems with higher efficiency, and selected projects have tended to be those applicants with the highest system efficiency. However, the impact assessment should include a close review of operating CHP projects and should be utilized to critically evaluate whether efficiency levels claimed in applications are accurate. In addition, while not recommended at this time for program savings reporting purposes, in future benefit-cost studies the societal impacts should take into consideration the efficiency (i.e., heat rate) of grid generation that is displaced by CHP to determine net changes in fossil fuel Btu's consumed as a result of the CHP program.

APPENDIX 2-A

MARKET PRICES AND RETAIL PRICING CONDITIONS IMPACTING CHP

As shown in Figure 2-A-1 below, the NYMEX natural gas futures strip have experienced significant volatility since the beginning of 2004 (i.e., around the time of the initiation of the CHP pilot program). From levels of about $5.50/MBtu at the beginning of 2004, the 12-month strip rose steadily to over $7/MBtu by early 2005, and then spiked to levels exceeding $12/MBtu in the aftermath of Hurricanes Katrina and Rita in late summer and fall 2005. Prices have receded somewhat after the mild winter 2005-2006, but the 12-month strip remains at levels close to $9/MBtu.

Figure 2-A-1. Change in Natural Gas Futures Prices since January 2004.



Further out (i.e., for CYs 2007, 2008, and 2009) natural gas futures prices remain in the $9-10/MBtu range. In years beyond those (i.e., CY 2009 and 2010), futures prices settle back down closer to the $8/MBtu range. Nonetheless, these price trends reflect, among other factors, a fundamentally tighter demand-supply balance than had existed several years ago, related in part to the proliferation and resultant impacts of natural gas-fired electric generation.

Obviously, as the price of natural gas rises, the cost of CHP fuel goes up directly, but the value of the thermal savings also goes up directly. Because the volume of fuel burned in the CHP engines and turbines tends to be greater than the volume of boiler fuel displaced via heat recapture, the net impact will still be an overall negative before taking into account the changes in electricity purchase savings. Changes in natural gas market prices absolutely influence the market price for electricity, so this must be taken into account in some manner when attempting to assess the overall economics of a CHP project. However, the manner, magnitude, and timing of changes in the retail cost of electricity as a result of changing natural gas prices can vary significantly by the size and type of end use customer.

Table 2-A-1 below provides an historical picture of average retail electricity prices and natural gas prices (to the burner-tip) for commercial and industrial end-use customers in New Jersey.

Table 2-A-1. Average New Jersey Retail Rates for Electricity and Gas (Source: EIA)

Year	Commercial Electricity Prices ($/kWh)	Industrial Electricity Prices ($/kWh)	Commercial Natural Gas Prices ($/MBtu)	Industrial Natural Gas Prices ($/MBtu)
2005	$.1109	$.0963	$13.12	$11.48
2004	$.0996	$.0903	$10.94	$8.65
2003	$.0911	$.0799	$9.74	$7.29
2002	$.0890	$.0772	$6.26	$4.91
2001	$.0909	$.0833	$7.91	$6.69
2000	$.0914	$.0858	$5.92	$5.12
1999	$.0974	$.0768	$3.99	$3.14
1998	$.1009	$.0794	$3.70	$2.97

As shown, retail natural gas prices for C&I customers increased three- to four-fold from 1998 to 2005. By comparison, retail electricity prices for C&I customers were relatively flat, with the first noticeable jump at all just having taken place in the last two years (an approximate 20% increase between 2003 and 2005). On its face, this historical data strongly suggests that overall CHP project economics have likely declined markedly over the past eight years.

The sharp increase in retail natural gas prices over the past 8 years are primarily a product of sharply rising wholesale commodity prices (while retail gas prices are regulated by the BPU, the commodity component of rates largely reflects a pass-through of wholesale market prices for natural gas). Increases in interstate transportation and local distribution costs have contributed to a much lesser degree.

Retail electricity prices remained stable for most of this period for a variety of reasons. First, as of 1998 electric utility rates were bundled and fully regulated (i.e., based on ‘cost-of-service’ rather than on market). Second, natural gas-fired share of total electricity generation was lower in the late 1990s than it is today. The most significant factor, however, was the manner in which the New Jersey Legislature and the BPU adopted electric industry restructuring plans for the various utilities. Specifically, a combination of price caps and rate reductions were implemented during a four-year transition period from August 1999 through July 2003. As such, while wholesale market prices began to rise along with natural gas prices, retail prices were held firm, and in fact were even reduced by about 10% between 1999 and 2003. After the price caps expired in August 2003, retail electricity prices were increased, with the power supply component set from that point forward on a market basis rather than on a cost-of-service basis. As such, the power supply component of commercial and industrial retail electricity prices is now set based on the wholesale cost of wholesale power (the ‘wires’ or delivery component of retail rates remain fully regulated based upon ‘cost-of-service’ principles). However as described below, there is a substantial difference between the largest customers and the small-to-mid sized customers in the timing and manner in which the wholesale market cost of power is reflected in retail electricity rates.

As shown in the following figures, wholesale market prices for power have become closely correlated with natural gas prices, particularly during on-peak periods.

Figure 2-A-2. Forward Market Price for On-Peak Block of Power for Calendar Year 2006 (CAL06) versus NYMEX Natural Gas Futures Strip

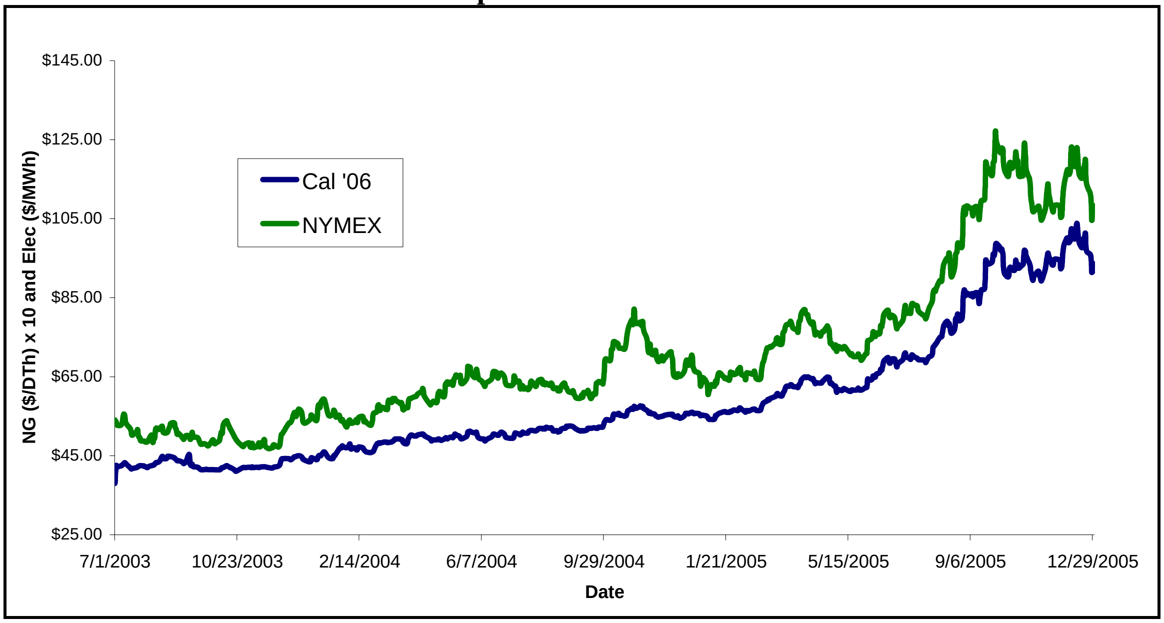


Figure 2-A-2 shows the close correlation between movements in the forward market price for a block of on-peak power deliverable in 2006 and the NYMEX futures strip price (the CAL06 forward contract began trading in January 2003 and ceased trading at year-end 2005). As such, rising natural gas futures prices will increase quote for a fixed price for power for a future period.

Similarly, short-term natural gas prices affect the wholesale spot prices for electricity.

Table 2-A-2 shows the correlation that short-term natural gas prices have with the spot price of electricity again, particularly during the on-peak period (the monthly fluctuations also reflect the interplay with actual weather conditions and the influence of power plant outages). Changes in off-peak prices tend to be less extreme, and while there is some natural gas influence, off-peak prices tend to be more a reflection of costs of other types of fuel, most notably coal, and other factors.

Spot market prices are generally set in any hour based upon the bid price of the marginal generating unit on the grid. As shown back in Figure 2-8, in more than 50% of the hours in a year (primarily during off-peak hours), coal-fired generating units are on the margin in PJM. Natural gas and petroleum-fired generating units are on the margin typically 30-40% of the hours in a year (primarily during on-peak hours).

Table 2-A-2. Average Monthly Real-Time PJM-West Spot Market Prices for Electric Energy vs. Monthly NYMEX Settle Prices for Natural Gas

Month	PJM Electricity All Hours ($/MWh)	PJM Electricity On Peak ($/MWh)	PJM Electricity Off Peak ($/MWh)	NYMEX Natural Gas Closing Prices ($/MMBtu)
Jan-03	$42.87	$50.75	$32.68	$4.988
Feb-03	$48.31	$55.70	$38.29	$5.660
Mar-03	$54.85	$70.84	$41.78	$9.133
Apr-03	$35.19	$48.76	$22.51	$5.146
May-03	$32.10	$42.43	$21.39	$5.123
Jun-03	$29.76	$39.99	$17.98	$5.945
Jul-03	$41.28	$51.18	$28.10	$5.291
Aug-03	$39.74	$52.38	$26.62	$4.693
Sept-03	$29.51	$36.58	$20.94	$4.927
Oct-03	$27.47	$35.03	$20.22	$4.430
Nov-03	$29.30	$37.21	$22.21	$4.459
Dec-03	$35.92	$41.25	$28.02	$4.860
Average	**$37.19**	**$46.84**	**$26.73**	**$5.388**

Month	PJM Electricity All Hours ($/MWh)	PJM Electricity On Peak ($/MWh)	PJM Electricity Off Peak ($/MWh)	NYMEX Natural Gas Closing Prices ($/MMBtu)
Jan-04	$55.01	$58.67	$48.28	$6.150
Feb-04	$44.22	$51.31	$37.37	$5.775
Mar-04	$39.21	$45.37	$32.40	$5.150
Apr-04	$42.06	$50.35	$32.89	$5.365
May-04	$48.04	$57.09	$36.75	$5.935
Jun-04	$38.05	$51.04	$24.84	$6.680
Jul-04	$43.64	$52.15	$33.55	$6.141
Aug-04	$38.59	$47.40	$29.30	$6.048
Sept-04	$41.96	$50.52	$31.52	$5.082
Oct-04	$37.81	$46.98	$29.01	$5.723
Nov-04	$36.91	$43.79	$29.15	$7.626
Dec-04	$41.83	$45.26	$38.37	$7.976
Average	**$42.28**	**$49.99**	**$33.62**	**$6.138**

Month	PJM Electricity All Hours ($/MWh)	PJM Electricity On Peak ($/MWh)	PJM Electricity Off Peak ($/MWh)	NYMEX Natural Gas Closing Prices ($/MMBtu)
Jan-05	$49.53	$55.27	$44.58	$6.213
Feb-05	$42.05	$49.28	$35.37	$6.288
Mar-05	$49.97	$58.09	$41.49	$6.304
Apr-05	$44.49	$55.39	$33.35	$7.323
May-05	$43.64	$56.75	$30.98	$6.748
Jun-05	$53.72	$70.55	$33.89	$6.123
Jul-05	$66.34	$88.22	$44.09	$6.976
Aug-05	$82.83	$101.29	$56.55	$7.647
Sep-05	$76.82	$101.56	$48.05	$10.847
Oct-05	$77.63	$102.21	$52.05	$14.196
Nov-05	$62.01	$77.48	$45.00	$13.684
Dec-05	$81.97	$96.35	$70.61	$11.634
Average	**$60.92**	**$76.04**	**$44.67**	**$8.665**

Month	PJM Electricity All Hours ($/MWh)	PJM Electricity On Peak ($/MWh)	PJM Electricity Off Peak ($/MWh)	NYMEX Natural Gas Closing Prices ($/MMBtu)
Jan-06	$54.57	$61.40	$45.60	$11.431
Feb-06	$56.39	$61.52	$51.90	$8.400
Mar-06	$58.30	$62.18	$51.66	$7.112
YTD Average	**$56.42**	**$61.70**	**$49.72**	**$8.981**

All of the above factors are important in attempting to ascertain on a going-forward basis the likely correlation between changes in natural gas prices and changes in retail electricity prices, for purposes of potential CHP system users and developers determining the economics of a proposed project.

As discussed above, until relatively recently there was not much of a link between natural gas prices and retail electricity prices. As such, in the face of rising natural gas costs to commercial and industrial customers through the late 1990s and the first half of this decade, CHP economics have undoubtedly been degraded substantially, as compared to previous periods in the 1980s and early 1990s when retail electricity prices were at relatively high levels and natural gas prices remained low. This degradation of CHP economics is no doubt reflected in relatively modest levels of new CHP installations during the first half of the current decade (refer back to Figure 2-1 through Figure 2-4). The reverse relationship between gas prices and electricity prices in the 1980s and 1990s (i.e., low gas prices and relatively high electricity prices) was no doubt a strong factor in the boom of CHP installations during the 1980s and 1990s (again, refer back to Figure 2-1 through Figure 2-4).

APPENDIX 2-B

SUGGESTED PROTOCOLS FOR CHP ENERGY SAVINGS REPORTING AND CALCULATION

1. CHP Demand Savings:

Demand Savings should represent CHP generating capacity available to reduce peak loads on the system:

Peak Demand Impact (kW) = (Unit Output Power (kW) @ 95 degrees F) X (1-Forced Outage Rate)

Where: Unit Output Power (kW) as reported in applicant technical worksheet and as verified, as necessary, from manufacturer specifications

Forced Outage Rate (FOR) reflects percentage of unit output power unavailable during peak (all unavailability assumed to be forced outage, as planned maintenance outages would not be assumed to occur at peak). FOR initially set at 5%. FOR may be adjusted in the future as more CHP units come on-line and sufficient operational data becomes available based through Impact Assessment or other monitoring and measurement programs.

2. CHP Electricity Generation:

CHP Electricity Generation does not represent electricity savings. It is a category of distributed generation output.

CHP Electricity Generation (MWh) = (Reported Generation (kWh)) / 1,000

Where: Reported Generation as reported on monthly basis in applicant technical worksheet and as verified, as necessary during evaluation process, by review of rated unit power outputs, hours of operation, assumed outage rates, and comparison of end-user loads to output capability (i.e., does assumed output capability exceed load, necessitating cycling of turbine or engine to less-than-full output levels?). Technical Worksheet amounts should be replaced in the future with actual generation as metered and reported to LDC and/or through Impact Assessment.

3. Electricity Savings:

CHP Electricity Savings represents the reduction in electricity consumption by end-user for chilling purposes resulting from recovered thermal output for use in absorption chiller.

Electricity Savings (kWh) = (Useful Recovered Heat for Cooling) / (3413Btu/kWh/1,000,000)

Where: Useful Recovered Heat for Cooling is sum of recovered 1) Process Cooling MMBtu; and 2) Space Cooling MMBtu as reported in applicant technical worksheet, as verified as necessary during evaluation process to assure appropriate assumptions for heat recovery, chiller loadings and conversion efficiency (COP) of absorption unit. Technical Worksheet amounts should be adjusted in the future as necessary to reflect findings of Impact Assessment with regard to claimed versus actual thermal recovery and conversion to useful cooling energy.

4. Natural Gas Savings:

Natural Gas Savings represents the reduction in natural gas consumption by end-users used to produce process heat, space heating and domestic hot water resulting from recovered thermal output from CHP system.

Natural Gas Savings (Dth) = (Useful Recovered Heat for Heating (MMBtu)) / (Boiler Efficiency)

Where: Useful Recovered Heat (MMBtu) for Heating is sum of recovered 1) Process Heating MMBtu; 2) Space Heating MMBtu; and 3) Domestic Hot Water MMBtu as reported in applicant technical worksheet, as verified as necessary during evaluation process. Technical Worksheet amounts should be adjusted in the future as necessary to reflect findings of Impact Assessment with regard to claimed versus actual thermal recovery.

Boiler Efficiency is the efficiency of the current boiler(s) as reported in applicant technical worksheet.

APPENDIX 2-C

LIST OF CHP LITERATURE REVIEWED FOR SECTION 2.1.3

"Analysis of CHP Potential at Federal Sites," Prepared by the U.S. Dept. of Energy, Office of Energy Efficiency and Renewable Energy February 2002 http://www.ornl.gov/~webworks/cppr/y2001/rpt/112644.pdf.

"Assessment of California CHP Market and Policy Options for Increased Penetration," Report 1012075, Cosponsors Public Interest Energy Research Program and EPRI July 2005 < http://epri.com>.

"CPUC Self-Generation Incentive Program Preliminary Cost-Effectiveness Evaluation Report", Prepared by Itron, Inc. September 14, 2005.

"Baseline Analysis for the CHP Market in Indiana," Prepared by: Midwest CHP Application Center, University of Illinois at Chicago – Energy Resources Center Sept. 2005. www.chp.centermw.org/pdfs/IN_Baseline_Final_10242005.pdf.

Brown & Elliott, "State Opportunities for Action: Update of States' Combined Heat & Power Activities," Report Number IE032, ACEEE Oct. 2003 http://aceee.org.

"CHP Baseline Analysis for the Iowa Market," Prepared by: Midwest CHP Application Center, University of Illinois at Chicago – Energy Resources Center Sept. 2005 www.chp.centermw.org/pdfs/IA_Baseline_Report_Final_102405.pdf.

"CHP Financial, Tax and Operative Incentives," Northeast CHP Application Center, University of Massachusetts Amherst 2005, http://www.northeastchp.org/nac/policymakers/incentives.htm.

"CHP Potential at Federal Sites, Prepared by U.S. Dept. of Energy Office of Energy Efficiency and Renewable Energy May 2002 www.eere.energy.gov/femp/pdfs/**federal_chp_**mkt_assmt.pdf.

"Combined Heat and Power in the Pacific Northwest: Market Assessment, Report B-REP-04-5427-004, Task 1 – Final Report," Submitted by Energy and Environmental Analysis, Inc. July 2004 http://www.chpcenternw.org/NwChpDocs/Chp_Market-Assessment_In_PNW_EEA_08_2004.pdf.

"Combined Heat and Power Market Potential for New York State, Final Report 02-12," Prepared by NYSERDA Oct. 2002 http://www.nyserda.org/programs/pdfs/CHPFinalReport2002WEB.pdf.

"Funding and Regulatory/Rates Opportunities," Combined Heat and Power Partnership, U.S. Environmental Protection Agency 2006 www.epa.gov/chp/funding/micalternativeenergypropertyta.htm.

"Output-Based Environmental Regulations: An Effective Policy to Support Clean Energy Supply," Combined Heat and Power Partnership, US EPA 2005 http://www.epa.gov/CHP/pdf/OBR_final_9-1-05.pdf .

"Output-Based Regulations: A Handbook for Air Regulators," Prepared by ERG for US EPA, April 2004 http://www.epa.gov/chp/pdf/output_rpt.pdf.

"Partner Resources, Funding and Regulatory Rate Opportunities," Combined Heat and Power Partnership, US EPA, www.epa.gov/chp/funding_opps-reg.htm.