



Rev: July 2011  
REPORT #40234

# NEEA Study: Examples of Deep Energy Savings in Existing Buildings

Final Phase 1 Report on a *Search for Examples of  
Commercial Building Energy Efficiency Retrofits,  
Renovations and Upgrades*

Prepared for:  
BetterBricks, the commercial initiative of the  
Northwest Energy Efficiency Alliance (NEEA)  
PHONE: 503-688-5400  
FAX: 503-688-5447  
EMAIL: [info@neea.org](mailto:info@neea.org)

Contact: Mark Rehley

Prepared by:  
New Buildings Institute (NBI)  
Vancouver, WA 98663  
[www.newbuildings.org](http://www.newbuildings.org)

Contact: Cathy Higgins

**nbi** new buildings  
institute

**This page intentionally left blank**

**Cover Photo:** *AIA Portland Center for Architecture - 2007 renovation of a 1880s urban office building (10,000 sf) resulting in 44% savings over ASHRAE 90.1-04 code (LEED baseline reference).*

# **Table of Contents**

<b>EXECUTIVE SUMMARY .....</b>	<b>1</b>
<b>INTRODUCTION .....</b>	<b>3</b>
<b>APPROACH .....</b>	<b>3</b>
SEARCH METHODOLOGY AND RESOURCES .....	4
<b>FINDINGS.....</b>	<b>6</b>
PERFORMANCE.....	10
TYPE .....	11
SIZE .....	12
ENERGY CONSERVATION MEASURES.....	13
<b>SEARCH INSIGHTS/CONCLUSIONS .....</b>	<b>14</b>
<b>NEXT STEPS.....</b>	<b>15</b>
<b>APPENDICES.....</b>	<b>1</b>
APPENDIX A: PROJECT OVERVIEW FORM .....	1
APPENDIX B: PROJECT DETAIL FORM.....	3
<b>TABLES</b>	
Table 1: Organizations & Firms Contacted .....	5
Table 2: Websites Researched .....	6
Table 3: Northwest Project Summary Table.....	7
Table 4: Non-Northwest Project Summary Table .....	8
<b>FIGURES</b>	
Figure 1: Source of Performance Data.....	10
Figure 2 : Baselines and Average Savings .....	11
Figure 3: Project Types.....	11
Figure 4: Number of Projects by Size.....	12
Figure 6: Energy Conservation Measures .....	13

## **Executive Summary**

This work was performed by New Buildings Institute (NBI) on behalf of the BetterBricks program of the Northwest Energy Efficiency Alliance (NEEA) for its Existing Building Renewal Initiative, which aims to accelerate market adoption of deep, integrated energy efficient retrofits. The report documents retrofit, renovation and upgrade projects of 50 commercial buildings with demonstrated or predicted performance of 30% or better than the average for comparable buildings.

NBI conducted a broad outreach and research effort resulting in a list of 50 buildings - 49 in North America and 1 in Australia – that exceeded referenced baselines by an average of 40%. The search entailed direct contacts, via email and phone, with 47 organizations involved in the design, construction, green building and energy efficiency industries. Persistent follow-up with these sources resulted in 18 of projects identified. In addition the research team reviewed 29 websites and reviewed over 500 projects with varied depth and quality of information, resulting in an additional 32 project examples.

The focus was on obtaining general project information including multiple efficiency measures, with a preferred emphasis on measured documentation of energy savings. Projects with estimated savings were also considered during this first phase in order to maximize the number available for review. While NEEA's focus was on medium and large offices, box retail, hospitals, lodging and multi-family, the majority of buildings found (88%) were offices. Occupied floor space ranged from 2,300 to 950,000 square feet.

The energy savings identified in the report fall into two categories: measured and estimated. Measured savings was identified through the use of metered data, utility bills, or Energy Star Portfolio Manager. Estimated savings was based on modeled data or in some instances designated when the source was not specified. In both cases savings are compared to a baseline of specific code or energy use under pre-existing conditions. Baselines vary based on age of project, program requirements and location. Average savings exceed 40%, with individual projects ranging from 27-85%.

Energy Conservation Measures (ECMs) associated with each project fall under the following categories: HVAC, Lighting, Daylighting, Controls and Envelope. The majority of projects applied more than two ECMs, with almost half selecting all five in order to achieve a significant level of savings. Projects most frequently applied HVAC measures and lighting measures; of those citing lighting measures, 50% specifically included daylighting and controls as part of their lighting retrofit packages.

Major insights from this data search included the finding that deep energy savings (>30-40%) can be mined from existing buildings, but documented examples are elusive, and inconsistent terminology and definitions on scope, measures, baseline definitions and percentage of energy savings make drawing comparisons among projects difficult. The fact that more-than-anticipated measured performance references were found is encouraging for ongoing efforts to increase data on actual energy use. There remains a strong need for some centralized or dominant resource for collection of information on building performance.

Phase 2 of this effort will focus on the selection of eight to ten study projects for further investigation. The purpose of the next phase is to do a 'deep dive' into these projects and create detailed profiles to be later developed as case studies for NEEA's Existing Building Renewal initiative. These profiles will provide insights on the integration of commonly found measures, approaches to deep savings and energy performance, owner motivation and areas of innovation.

## **Introduction**

This work is part of NEEA's regional Existing Building Renewal initiative to accelerate the market's adoption of deep, integrated energy efficient retrofits. This work is part one of a three phase project by NEEA to develop Case Studies that demonstrate deep energy savings. The Case Studies will help support the EBR by addressing some barriers to deep retrofits such as confidence in the outcomes, lack of knowledge on best practice strategies, and business rationale for pursuing efficiency upgrades.

This report documents commercial building retrofit, renovation and upgrade projects that have demonstrated or predicted performance of 30% or better than the average for comparable buildings, basic building characteristics, and some information regarding the strategies and technologies used. From the project listed here, NEEA will select 8-10 of the best opportunities for Phase 2 - a deeper dive into the performance, characteristics, efficiency measures and motivations to inform Northwest projects. The intended scope for Phase 3 involves pursuing more information on the financial, business and process information on 1-2 of the projects.

New Buildings Institute (NBI) spent three months determining the extent and availability of energy and building characteristic information available throughout the U.S. on existing buildings that have improved two or more energy measures through retrofits in the past 10 years. NEEA's focus was on medium and large offices, box retail, hospitals, lodging and multi-family but the majority of building found were offices.

*Note:* All data collected was self-reported and has not been verified. A statistical sampling approach was not used to gather project information and the data is not necessarily representative of the larger market.

## **Approach**

New Buildings Institute (NBI) conducted an extensive search for project information, performance data and case studies on existing building retrofits that have made energy efficiency improvements self-identified as 30% or better than a comparable baseline. To promote the greatest response for building projects that made substantial energy efficiency improvements, NBI also accepted other common industry terms, such as retrofit and upgrade. Projects implementing deeper multiple energy efficiency strategies tended to be focused on "whole building" or "whole space" upgrades of commercial buildings. This allowed NBI to identify projects that met NEEA's targets while capturing as wide a range of examples as possible. The broad outreach and multiple methods used resulted in a draft list of 50 national and international examples, exceeding the anticipated target of approximately 15 projects. The search methods and resources are outlined in the following section, and the criteria can be found in the NBI/NEEA Work Plan and in the Project Detail and Project Overview Forms in the Appendices.

## ***Search Methodology and Resources***

NBI began by developing a simple project webpage for potential project participants that provided three options for response to facilitate the submittal of information.

1. A contact information box to request a direct call for project information.
2. A Project Overview form with high-level questions to capture required project information from all contacts.
3. A Project Detail form that included more technical questions for those with extensive documentation, particularly focused on the assessment of measured performance information.

This webpage was promoted on (and directly linked from) NBI's homepage as one of its two "spotlight" features for two weeks. It encouraged visitors to NBI's website to "share examples of [their] existing building retrofits with us."

The Project Data Matrix.xls (Excel Workbook) was developed by NBI to track all project information for potential existing building retrofit examples via a series of data fields. Additional project information was archived by project name or located through the master resource list. This data matrix is a separate workbook outside of this report and not for public distribution but was delivered to NEEA in conjunction with this report.

NBI pursued and collected the project examples through the following methods:

1. Broad Industry E-Communication. NBI initiated the search with a project introduction via broadcast emails and E-newsletter announcements from the following organizations:
  - NBI Bulletin
  - BetterBricks
  - Building Energy Performance News (banner ad)
  - Preservation Green Lab
  - Utilities

The project introduction was also sent to *Sustainable Buildings Journal*, BuildingGreen, EcoMotion, Energy Center of Wisconsin, and the American Society of Heating, Cooling and Air-Conditioning Engineers (ASHRAE).

2. Organizations/Firms. NBI contacted 47 organizations/firms involved in the design, construction, green building and energy efficiency industries via email and phone. NBI identified these firms based on its experience, referrals from professional colleagues, organizations known to be active in efficiency and green building projects, and entities found through the outreach methods. Persistent direct contacts resulted in 18 projects identified for the current list. Collecting project information was challenging given that it takes time for respondents to gather and is not an immediate priority. Each resource required repeated contacts and a great deal of follow-up. Many well-intended

individuals have data that is yet to be delivered. Table 1 shows the organizations contacted and the number of projects identified.

**Table 1: Organizations & Firms Contacted**

Organization/Firm	# of Projects	Organization/Firm	# of Projects
Ecotope	2	CNT Energy	1
Opsis Architects	2	Integrated Design Associates, Inc	1
Green Buildings Services	3	Sustainable Systems LLC	1
Johnson Braund Design Group, Inc	1	Powermand	1
Tamastlikt Cultural Institute	1	Slaterpaul Architects	1
Integrated Design Lab-Boise	1	Sustainable Colorado	1
Optimum Energy	1	Rocky Mountain Institute	Pending
Seattle Daylighting Lab – Puget Sound	Pending	Preservation Green Lab	Pending
National Grid	Pending	PAE Consulting Engineers, Inc	Pending
General Administration State of WA	Pending	New Brunswick Power	Pending

**Total Projects Identified: 17**

Paladino	0	Efficiency Vermont	0
AIA, Federal Regulatory Relations	0	Sidel Systems USA	0
Tom Bassett-Dilley Architects	0	Moshier Studio	0
City of Charleston, South Carolina	0	Energy Resource Solutions	0
North Atlantic Energy Advisors	0	ZGF Architects	0
Solarc	0	SERA Architects	0
Flack & Kurtz	0	NBBJ	0
Warwick Energy Committee, MA	0	DeScipio Architecture	0
NEEP	0	Integrated Design Lab - Bozeman	0
Integrated Design Lab – Inland Northwest	0	Spokane Daylighting Lab	0
Integrated Design Lab – Puget Sound	0	Energy Studies Building Lab - Eugene	0
Lighting Design Lab - Seattle	0	Pacific Energy Center	0
Center for Energy Research/Education	0	Integrated Design Lab - Spokane	0

3. Website Search. NBI identified and reviewed 28 national websites with information on specific building energy efficiency improvements, case studies and awards. Staff researched over 500 projects with varying depths and quality of information, resulting in 32 project examples. Table 2 identifies these sites and the numbers of projects found.

**Table 2: Websites Researched**

Website	# of Projects	Website	# of Projects
HPB Magazine	5	High Performance Buildings Database	4
Cascadia Region Green Building Council	1	The Renewable Energy Trust Projects	1
Building Green NW Case Studies	1	US DOE Buildings Database	4
Midwest Regional Green Building Data	1	Resource Media	1
AIA COTE – Seattle Top 10 Awards	4	Urban Land Institute	4
USGBC Database – LEED Listings	6		

**Total Projects Identified: 32**

e-Bids	0	AIA COTE - National	0
NEEP Schools Case Study Database	0	Green Star	0
CoStar	0	Green Building Assoc. of Central PA	0
Building Perf Evaluation - Rutgers	0	City Of Portland	0
City of Seattle	0	USGBC Case Studies	0
NEEA/Better Bricks	0	Architectural Lighting	0
BOMA 360 Buildings	0	CA Green Building Directory	0
Wisconsin Green Building Alliance	0	Climate Works Foundation	0
Northern CA Chapter USGBC	0		

## **Findings**

While the stated preference throughout the data gathering process was to obtain measured documentation of energy savings, NBI specified in both the email solicitation and *Project Overview Form* that the primary focus was on project information, multiple efficiency measures and readily available data. Projects with estimated, rather than measured, savings were considered at this first phase in order to maximize the number available for review.

50 projects have been identified to date and are summarized in Table 3 below. More levels of information are available through the Project Data Matrix.xls, including the measure descriptions. Note in Tables 3 and 4 that the percentage savings are not directly comparable because the projects have varying baselines and newer codes have more aggressive efficiency requirements. “Pre-data” means measured energy use prior to the efficiency upgrades.

**Table 3: Northwest Project Summary Table**

	Name	Location	Building Type	Size (Sq. ft.)	% Over Baseline	Baseline	Measured or Estimated	Project Completion
1	Home on the Range	Billings, MT	Office	8,300	79%	ASHRAE 90.1-1999	Measured	2006
2	Pringle Creek Painter's Hall	Salem, OR	Office, Assembly	3,600	68%	Other	Measured	2009
3	Jefferson Place	Boise, ID	Office, Retail	75,000	60%	Pre data	Estimated	Still in Design
4	King Street Station	Seattle, WA	Transportation	60,000	56%	ASHRAE 90.1-2007	Estimated	2010
5	St. Als RMC South Tower	Boise, ID	Health Care	412,000	56%	CB ECS	Estimated	Still in Design
6	Johnson Braund Design Group	Seattle, WA	Office	8,000	51%	Other	Measured	Ongoing
7	Beardmore Building	Priest River, ID	Office, Retail	22,000	46%	Pre data	Estimated	2008
8	Monterey Lofts Chief Seattle Club	Seattle, WA	Multi-unit Residential, Retail	28,000	46%	ASHRAE 90.1-2004	Estimated	2007
9	AIA Center for Architecture	Portland, OR	Office	10,000	44%	ASHRAE 90.1-2004	Estimated	2007
10	Tamastlikt Cultural Institute	Pendleton, OR	Interpretive Center, Office	45,000	42%	Pre data	Measured	2006
11	Gerding Theatre at the Armory	Portland, OR	Assembly, Office	55,000	40%	Pre data	Estimated	2006
12	Mercy Corps HQ	Portland, OR	Office	80,000	40%	ASHRAE 90.1-2004	Estimated	2009
13	Telus William Farrell Building	Vancouver, BC	Office	130,000	39%	Other	Estimated	2000
14	Klos Building	Billings, MT	Office	2,300	38%	ASHRAE 90.1-2004	Estimated	2008
15	Omicron AEC	Vancouver, BC	Office	15,400	38%	ASHRAE 90.1-1999	Estimated	2004
16	MacDonald – Miller Lower Building	Seattle, WA	Office	12,900	33%	Pre data	Measured	2008
17	Lovejoy Building	Portland, OR	Office	20,000	28%	ASHRAE 90.1-2004	Measured	2004
18	200 Market Building	Portland, OR	Office, Retail	389,000	28%	Pre data	Measured	2009
<b>Total Northwest Projects Identified: 18</b>								

**Table 4: Non-Northwest Project Summary Table**

	Name	Location	Building Type	Size (Sq. ft.)	% Over Baseline	Baseline	Measured or Estimated	Project Completion
19	Gilman Ordway	Falmouth, MA	Office, Laboratory	19,200	83%	ASHRAE 90.1-1999	Measured	2003
20	The Szencorp Building	Melbourne, Australia	Office	12,900	65%	Pre data	Measured	2005
21	Conservation Consultants Inc.	Pittsburgh, PA	Office	11,500	57%	ASHRAE 90.1-1999	Measured	2003
22	CNT	Chicago, IL	Office	14,900	56%	ASHRAE 90.1-1999	Measured	2003
23	Alliance Center	Denver, CO	Office	39,400	55%	CBECs	Measured	2006
24	Navy Building 850	Port Hueneme, CA	Military Base, Industrial, Office	17,000	55%	CA Title 24	Estimated	2001
25	NRDC Office	San Francisco, CA	Office	19,800	55%	CA Title 24	Estimated	2004
26	NRDC Office	Santa Monica, CA	Office	15,000	55%	CA Title 24	Estimated	2003
27	GUND Partnership Studio	Cambridge, MA	Office	12,300	53%	Pre data	Estimated	2008
28	Epping Town Hall	Epping, NH	Assembly, Office	10,000	50%	Pre data	Measured	2007
29	Viking Terrace Apartments	Worthington, MN	Multi-unit Residential	58,000	45%	Pre data	Measured	2007
30	Aventine	La Jolla, CA	Office	210,000	45%	Pre data	Measured	2008
31	The Christman Building	Lansing, MI	Office	64,200	44%	ASHRAE 90.1-1999	Estimated	2008
32	Skanska USA, NY HQ	New York, NY	Office	16,600	43%	Pre data	Estimated	2008
33	Block 225 Education Building	Sacramento, CA	Office, Retail	394,000	43%	ASHRAE 90.1-2004	Measured	2006
34	Exelon HQ	Chicago, IL	Office	220,000	43%	Pre data	Estimated	2007
35	Stop Waste HQ	Oakland, CA	Office	14,000	40%	CA Title 24	Measured	2007
36	IDeAz Z <sup>2</sup> Design Facility	San Jose, CA	Office	7,000	40%	CA Title 24	Measured	2007
37	Engine House No. 5	Denver, CO	Office	13,200	40%	ASHRAE 90.1-2007	Estimated	2010
38	Chicago Center for Green Tech.	Chicago, IL	Industrial, Assembly, Office	40,000	40%	ASHRAE 90.1-1999	Estimated	2003

	Name	Location	Building Type	Size (Sq. ft.)	% Over Baseline	Baseline	Measured or Estimated	Project Completion
39	L.L. Bean	Mansfield, MA	Retail	25,000	40%	Pre data	Measured	2008
40	The Barn at Fallingwater	Mill Run, PA	Office, Interpretive Center	13,000	38%	ASHRAE 90.1-1999	Estimated	2004
41	The Green Building	Louisville, KY	Office, Interpretive Center	10,000	37%	ASHRAE 90.1-2004	Estimated	2008
42	Owens Corning	Toledo, OH	Office	391,000	36%	CB ECS	Estimated	2006
43	Bazzani Assoc. HQ	Grand Rapids, MI	Office, Multi-unit Residential	9,500	35%	ASHRAE 90.1-1999	Measured	2003
44	Four Seasons Produce	Ephrata, PA	Industrial, Office	226,800	35%	Other	Measured	2009
45	Joe Serna Jr CA EPA HQ	Sacramento, CA	Office	950,000	34%	CA Title 24	Estimated	2003
46	Academy Square	Montclair, NJ	Office	20,000	32%	Pre data	Estimated	2010
47	Herman Miller	Zeeland, MI	Office	19,100	30%	ASHRAE 90.1-1999	Estimated	2002
48	ORNL Office Building 3156	Oak Ridge, TN	Office, Campus	6,900	30%	Pre data	Measured	2009
49	Cambridge City Hall Annex	Cambridge, MA	Assembly, Office	33,200	28%	ASHRAE 90.1-1999	Estimated	2004
50	Russ Building	San Francisco, CA	Office	500,000	27%	Pre data	Measured	Ongoing
<b>Total Non-Northwest Projects: 32</b>								
<b>Total Projects Identified: 50</b>								

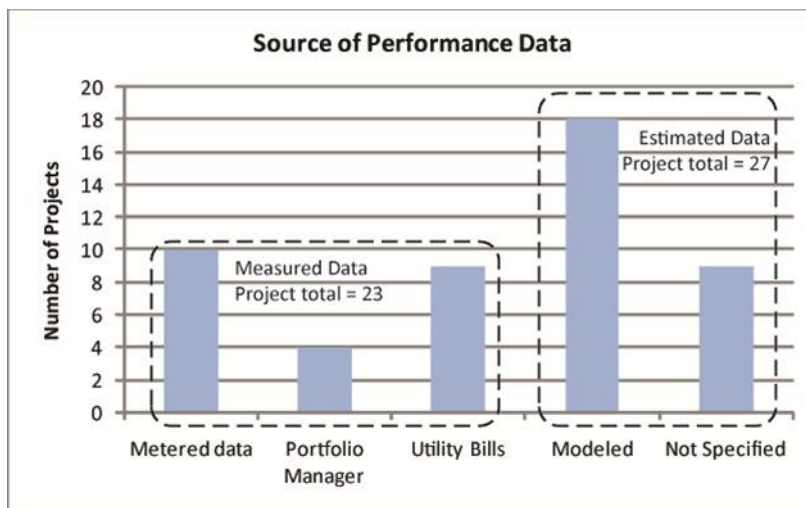
## Performance

The per-project energy savings identified in this report fall into two categories: measured and estimated. Only one source was available per project, so the types below are mutually exclusive and represent the totals for the data set. Figure 1 identifies measured, i.e. *actual* performance results, and estimated savings. The percentage of energy savings associated with each project was determined in one of two ways:

- Measured savings: these included projects reporting the use of metered data (whole building or at a subsystem level); utility bills alone; or utility bills run through Energy Star’s Portfolio Manager to calculate the project energy savings.
- Estimated savings: these included projects reporting the use of modeled data (the specific program used is cited when known in the full Project Data Matrix.xls) to determine their savings, or projects where the source was not specified.

In all cases, NBI determined savings compared to either a baseline of a specific code or to energy use under pre-existing conditions.

Figure 1: Source of Performance Data



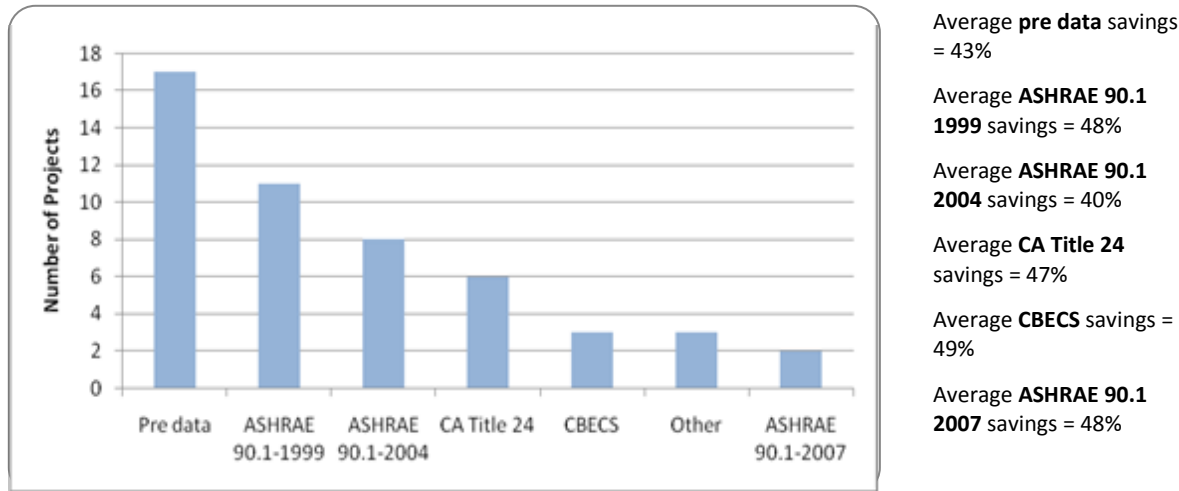
Projects used a number of means of determining levels of performance. Figure 1 represents the source of performance data used to arrive at the percentage of energy savings identified by each project.

The source of performance data and determined energy savings is described in a variety of ways. In cases where NBI staff entered data on specific projects from case studies and other project profiles, and the percentage of savings was interpreted as a result of energy modeling (unless it was stated explicitly that the savings were measured). The projects listed in Figure 1 as “Not Specified” came from case studies or databases that did not list the source of performance data; they are therefore included as “estimated” savings in Figure 1.

Characterizing the energy savings in this study was difficult due to the lack of a common baseline. Baselines vary due to age of the projects, program requirements and location. Figure 2 displays the different baselines used by projects as well as the average savings using each baseline. Average baseline savings exceeded 40% in all cases, with individual projects ranging from 27 to 85 percent.

Although the newer baselines represent incremental improvements over time, variations in building types and measures make it impossible to directly compare this set of projects by baseline. In general, this dataset provides a list of projects with seemingly high savings which can be further investigated, as planned, in Phase 2 of this research.

**Figure 2 : Baselines and Average Savings**



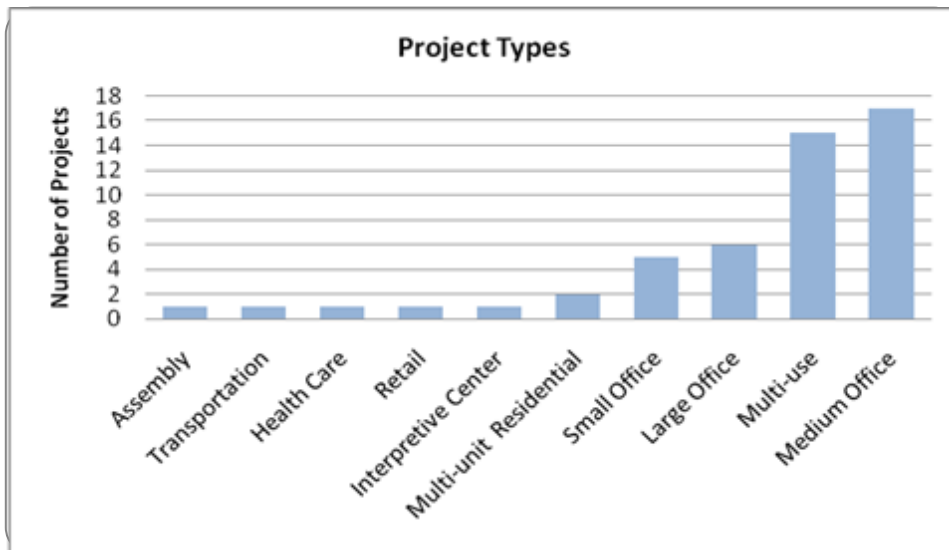
### Type

The Project Data Matrix.xls contains all the pertinent information gathered, including percentage of energy savings, comparative baseline and energy conservation measures (ECMs). The majority of projects (82%) are offices or a combination that includes offices. Of the six projects identified as retail, only one is “box” type retail (LL Bean); the others are combined with office or multi-unit. The Health Care project is a hospital rather than a clinic (as evidenced by its size), but NBI used the Department of Energy (DOE) building type label of Health Care in the matrix. For this search, NBI included a few projects not identified as priority types because the extent of savings or the information provided may be useful to NEEA.

The result of project search is:

- 50 projects are included in the Project Data Matrix.xls.
- 18 of these are located in the Northwest.
- 10 different project types are represented, as indicated in Figure 3.

Figure 3: Project Types



Small, medium and large office projects are distinguished separately per the AIA 2030 Challenge<sup>1</sup>:

Small: ≤ 10,000 sq. ft.

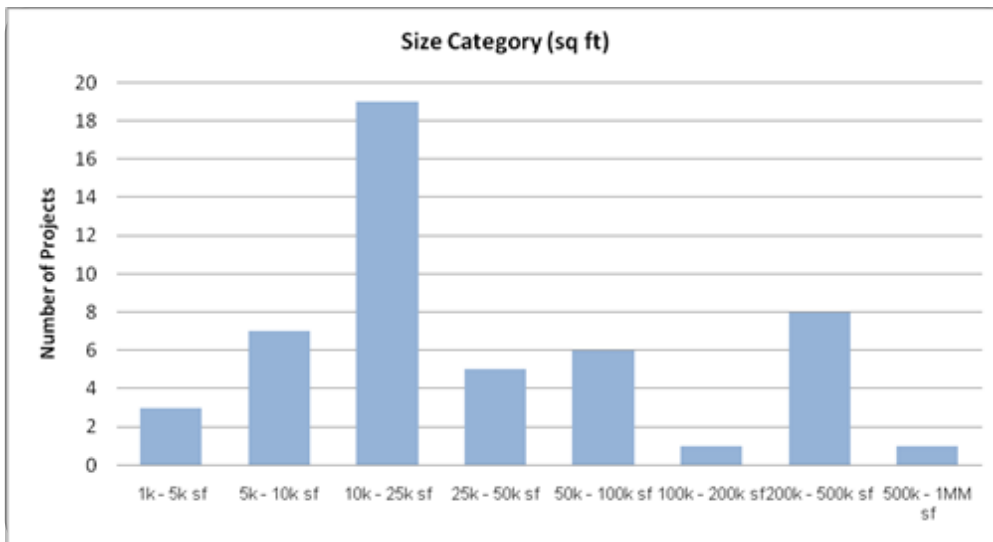
Medium: 10,001 sq. ft. - 100,000 sq. ft.

Large: >100,000 sq. ft.

### Size

Projects ranged in size from 2,300 – 950,000 sq. ft., with the 38% (19) in the 10,000 - 25,000 sq. ft. range; 68% are less than 50,000 sq. ft.

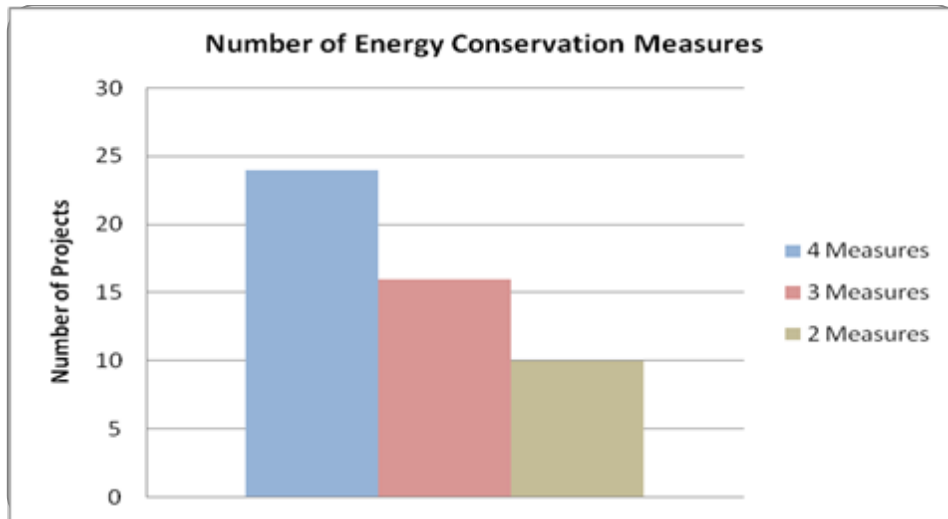
Figure 4: Number of Projects by Size



<sup>1</sup> AIA 2030 Commitment Reporting Tool, Version 1.1; Revised December 9, 2010.

## Energy Conservation Measures

A list of Energy Conservation Measures (ECMs) associated with each project is documented in the Project Data Matrix.xls and is included below. Projects had to apply at least two ECMs. As Figure 5 indicates, the majority of projects (80%) applied more than two ECMs, with almost half selecting all four ECMs in order to achieve a significant level of savings.

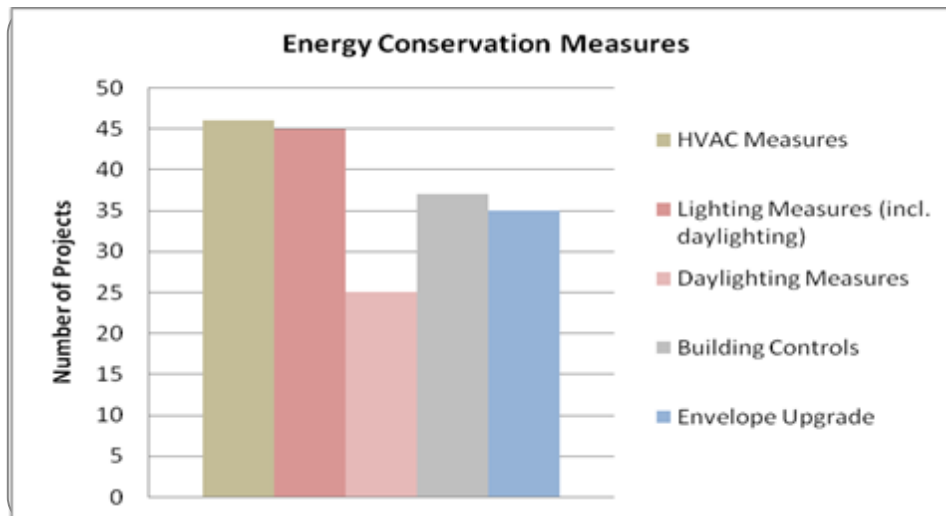


The energy conservation measures are identified as follows:

- **HVAC:** Replacement or alteration to mechanical equipment. Includes active and passive heating and cooling methods.
- **Lighting:** Replacement and/or alteration to the lighting system, including the incorporation of task lighting, lighting controls and daylighting.
  - **Daylighting:** A sub-set of lighting defined as an energy feature rather than a view or aesthetic feature. Acceptable daylighting measures incorporated exterior and interior shading and/or light sensors.
- **Controls:** Includes the addition of an Energy Monitoring System (EMS), Building Automation System (BAS), Building Management System (BMS) and/or lighting/occupancy controls.
- **Envelope:** Upgrade in insulation, including cool roof, addition of high-efficiency windows, including the use of tinting.

The projects most frequently applied HVAC measures and lighting measures (92% and 90% of projects respectively). Of those citing lighting measures, 50% specifically included daylighting as part of their lighting retrofit packages.

Figure 5: Energy Conservation Measures



## Search Insights/Conclusions

Insights from this search for data on existing buildings are provided from the perspective and experience of the NBI research team. Many of these insights come not only from this project, but are based on other efforts of the research team and reported by others in the efficiency industry when pursuing information for building case studies. As is said: “If it were easy, it would already be done.” Experience gained from this study will provide guidance on strategies to increase the availability of performance information.

- No centralized or dominant resource exists for the collection of information on building performance. This creates a major challenge to obtaining detailed, consistent and reliable building characteristics, measure descriptions, and energy use and savings data.
- Case studies provide the most readily available information, but the formats and depths of information varied widely.
  - Out of over 500 web-based case studies reviewed, only 6% (n=32) met the base criteria of an existing building retrofit since 2000 with multiple efficiency measures and with available baseline and energy savings (either estimated or measured) information.
  - Case study sites with a strong focus on energy information (High Performance Buildings [HPB] database, U.S. Green Building Council (USGBC), DOE and ASHRAE *High Performance Buildings*) were the most helpful, while others that focus on the architectural or construction story (American Institute of Architects [AIA], Urban Land Institute) offer less-accessible energy data (or lack it altogether).
- Even the NBI “Overview” form overwhelmed and was seldom used by most participants.
  - Flexibility in format and information required was important.
  - NBI’s direct outreach and offer to complete the data form aided participation.

- Inconsistency required greater interpretation of the submitted information.
- Providing an incentive for submitting information would increase participation by busy individuals.
  - Incentives could be either a stipend for time spent, or an opportunity for the respondent's project to be showcased or awarded in some manner.
  - Even when the project team offered a small stipend as an incentive, project and energy information within most firms was not readily available or consistently maintained.
  - Seeking firms or contractors that are active in green building committees, have served as project advisors, or have other industry affiliations would increase the likelihood they share a public-purpose interest in increasing knowledge on building performance.
  - Creating and maintaining some form of "open gate" for the submission of basic project performance information would be valuable.
- Inconsistent terminology and definitions on the scopes, measure, baseline definitions, and percentage of energy savings resulted in difficulties drawing comparisons among projects.
- Percentage savings is used to represent an accomplishment; the specifics (baseline, measured vs. estimated, etc.) are less detailed and less important in the eyes of the market.
- The fact that more measured performance references (nearly half of all projects) were found than anticipated (team estimated that maybe 10-25% of projects would have measured results) is encouraging for further efforts to increase data on actual energy use. .
- NBI was most successful in identifying projects implemented in offices, which are the most active building type in many green and efficiency programs. Collecting information from box retail, hospitals and lodging might require more direct inquiries via industry or trade connections.

## **Next Steps**

NEEA will select 8 to 10 of the projects outlined in this study for further investigation. The purpose of the next phase is to:

1. Provide insights on what measures are commonly found
2. Contribute to the NEEA EBR Initiative road map document
3. Establish projects for consideration as Case Studies, and
4. Seek evidence for integration of measures and approaches to deep savings.

Follow-up on the selected projects will result in a Project Profile that includes:

1. Results of the renewal project – including obtaining energy data where possible
2. Motivations that got the project started

3. Common practices that helped achieve the savings results, and
4. Areas of innovation that increased the results or removed barriers to the project.

# Appendices

Existing Building Retrofit Examples - Project Overview Form			
<b>Project Type Definitions</b>			
	1) Equipment Upgrades / Retrofits / Remodels	Projects that involve non-structural improvements to an existing space and target <b>two or more</b> system improvements such as the upgrade of lighting, HVAC, kitchen, and laundry equipment.	
	2) Tenant Improvement	An interior build-out for a new tenant of a commercial space that includes efficiency upgrades or <b>re-design for systems</b> such as lighting, HVAC, kitchen and laundry equipment.	
	3) Major Renovation or Addition	Major construction projects that include the replacement of 50% of both lighting and HVAC equipment or projects that increase a building's total square footage and include efficiency upgrades such as lighting, HVAC, kitchen, and laundry equipment.	
	Building Types: All commercial building types are of interest. Priorities are: offices, hospitals, big and small box retail, lodging and multi-family, schools, medical clinics, libraries		
<b>CONTACT INFORMATION</b>			Please share any information that is readily available.
	Name		When completed, "Save" document and send to: <a href="mailto:Mark.Lyles@newbuildings.org">Mark Lyles at ebre@newbuildings.org</a>
	Phone		
	E-mail Address		
	Connection with Project?		
	May we follow up for additional information?		Thank you for your time in assisting us with our search!
<b>GENERAL BUILDING INFORMATION</b>			Authorization to publish Name of Owner/Building/Team (yes/no)
	Building Name		
	Owner (Company Name)		
	Development Team		
	Year/Vintage of Building		
	Total Building Size (square feet)		Excluding parking or other non-conditioned space
	Number of Stories		
	City		
	State/Province		
	Zip/Postal code		
		<b>PRIMARY BUILDING ACTIVITY (LARGEST % OF FLOOR SPACE)</b>	<b>SECONDARY BUILDING ACTIVITY</b>
	Building Use Type		
	Define if "Other"		
	Square footage/percentage of space applicable to this activity		
<b>GENERAL EFFICIENCY PROJECT INFORMATION</b>			
	Project Type		Refer to top of page for Project Type Definitions
	Whole Building or Partial?		
	Area of Project (square feet)		The SF affected by the change
		<b>Month</b>	<b>Year</b>
	Efficiency Project Completion Date		(approximate dates OK)
	Was the project done while the building / space was occupied by tenants?		Yes/No
	Project Awards/Publications		Please attach any Case Studies and or links to further project information
	Do you have information on occupant satisfaction?		If "yes" please attach
	Total Project Cost		
	Cost per Square Foot		
	Can you provide incremental costs?		Yes/No
<b>Energy Use / Savings Information:</b>			
1. If you already have this information in another electronic format, you may send that.			<a href="mailto:ebre@newbuildings.org">ebre@newbuildings.org</a>
2. If you have entered your building's monthly energy use in <b>EPA's Portfolio Manager</b> to generate an Energy Star rating, you can easily share that data with us by just logging onto your account, selecting the "Share Facilities" link under "Work with Facilities" and entering NBI-ABPROJECT for the user name to share with. Notify us via email if you choose to do this:			
3. Contact NBI for instructions if you want us to obtain historic usage records directly from your utility service provider for this study.			
4. If Actual Data is available (from utility bills or end-metering) please let us know			
<b>ENERGY SAVINGS</b>			
	Select Baseline		
	Percent Savings over Baseline		
	Actual or estimated Savings?		Actual = based on measured data after the project
	If estimated, source of savings calculations		
		<b>Amount</b>	<b>Units</b>
	Electricity Savings		
	Gas Savings		
	Total Energy Savings		
	Are energy savings available at a sub-system level?		Yes/No

## Appendix A: Project Overview Form

GREEN FEATURES / ENERGY CONSERVATION MEASURES		Enter "Y" for features used in the Efficiency Improvement	
<b>HVAC</b>		<b>BUILDING SHELL</b>	
Natural Ventilation		Increased Insulation	
Evaporative Cooling		Cool Roofs	
Night Venting		Green Roofs	
Underfloor air distribution		Passive Thermal Energy Storage	
Increased Ventilation Rate		Active Thermal Storage	
Operable Windows		Thermal Mass	
Energy recovery		Other (please specify)	
High Efficiency HVAC		<b>CONTROLS</b>	
Radiant Floor heating		CO2 sensors	
Radiant Cooling Panels		Metering	
Ground Source Heat Pumps		Energy Monitoring Systems	
Ice Storage		Occupancy sensors / Lighting controls	
Heat Recovery		Commissioning	
Economizers			
Other (please specify)			
<b>LIGHTING AND WINDOWS</b>			
Top Lighting (skylights)		As associated with a daylighting strategy	
Side Lighting (clerestory)			
High performance glass			
High efficiency lighting			
Exterior window shading			
Interior window blinds			
Occupancy sensors / Lighting controls			
Other (please specify)			
<b>RENEWABLE ENERGY GENERATION</b>			
Solar PV			
Active Solar			
Passive Solar			
Solar Hot Water Heaters			
Other (please specify)			
<b>Notes on Measures - Please include any clarifications or additional narrative on the technical measures or design strategies:</b>			

## Appendix B: Project Detail Form

EXISTING BUILDING RETROFIT EXAMPLE - Project Detail Form	
<b>Intent</b>	
The purpose of this data gathering effort is to identify, document, and potentially publish in a database, information and performance data on existing commercial building projects that have demonstrated or predicted performance 30-50% or better than their baseline consumption.	
<b>Project Type Definitions</b> (note: more than one may apply and can be selected on the "Building Data tab)	
1) Equipment Upgrades / Retrofits / Remodels	Projects that involve non-structural improvements to an existing space and target <b>two or more</b> system improvements such as the upgrade of lighting, HVAC, kitchen, and laundry equipment.
2) Tenant Improvement	An interior build-out for a new tenant of a commercial space that includes efficiency upgrades <b>or re-design for systems</b> such as lighting, HVAC, kitchen and laundry equipment.
3) Major Renovation or Addition	Major construction projects that include the replacement of 50% of both lighting and HVAC equipment or projects that increase a building's total square footage and include efficiency upgrades such as lighting, HVAC, kitchen, and laundry equipment.
Building Types:	All commercial building types are of interest. Priorities are: offices, hospitals, big and small box retail, lodging and multi-family, schools, medical clinics, libraries
<b>Project Worksheet Instructions</b>	
Please provide information that you have readily available on the three worksheets. If you have additional information available please return the form with the initial information and indicate how we should follow up. Projects should have been completed and occupied with at least one year of energy-use data. If this is not available please provide estimated savings.	

Steps
1.) "Save-as" this document to include project name in the file name
2.) Click the tabs at the bottom of this window to start. Fields that require your input are highlighted yellow.
3.) If you already have the requested monthly fuel usage data in a different electronic format, you may send that to us in lieu of transferring the information to this spreadsheet.
4.) Save and return this completed file to <b>Mark Lyles:</b> at <a href="mailto:ebre@newbuildings.org">ebre@newbuildings.org</a> Please include your building's name in the file name

We would also appreciate copies of other available background documents, such as: Summary of initial energy modeling (e.g. from LEED submittal) Case studies Sample reports from an Energy Management System Completed Measurement and Verification (M&V) report
Questions? Give us a call. Thanks! at <b>360-567-0950 x106</b>

BUILDING DATA			
<b>CONTACT INFORMATION</b>			
Name			
Phone			
E-mail Address			
Connection with Project?			
<b>GENERAL BUILDING INFORMATION</b>			Authorization to publish Name of Owner/Building (yes/no)
Building Name			
Owner (Company Name)			
Year/Vintage of Building			
Total Building Area (square feet)			Excluding parking or other non-conditioned space
Number of Stories			
City			
State/Province			
Zip/Postal code			
Climate Zone (If known)			Please specify if National or California
<b>GENERAL EFFICIENCY PROJECT INFORMATION</b>			
Project Type			Refer to "Instruction" page for Project Type Definitions
Whole Building or Partial			
Area of Project (square feet)			Sq. Ft. affected by the change
	Month	Year	(approximate dates OK)
Efficiency Project Start Date			
Efficiency Project Completion Date			
Occupancy Date			When the building was at least 50% occupied
Was the project done while the building/space was occupied by tenants?			Yes/No
Owner			
Architect			
Mech. Engineer			
Daylighting Consultant			
Lighting Consultant			
Modeler			
Other Key Team Members			
Project Awards/Publications			Please attach any Case Studies and or links to further project information
Do you information on occupant satisfaction?			If "yes" please attach
Total Project Cost			
Cost per Square Foot			
Can you provide incremental costs?			Yes/No

BUILDING USE		
	PRIMARY BUILDING ACTIVITY (LARGEST % OF FLOOR SPACE)	SECONDARY BUILDING ACTIVITY
Building Use		
Define if "Other"		
Square footage/percentage of space applicable to this activity		
Average # of employees		
Hours Occupied per Week (Avg.)		

GREEN FEATURES / ENERGY CONSERVATION MEASURES	
HVAC	Enter "Y" for features used in the building
Natural Ventilation	
Evaporative Cooling	
Night Venting	
Underfloor air distribution	
Increased Ventilation Rate	
Operable Windows	
Energy recovery	
High Efficiency HVAC	
Radiant Floor heating	
Radiant Cooling Panels	
Ground Source Heat Pumps	
Ice Storage	
Heat Recovery	
Economizers	
Other (please specify)	
BUILDING SHELL	
Increased Insulation	
Cool Roofs	
Green Roofs	
Passive Thermal Energy Storage	
Active Thermal Storage	
Thermal Mass	
Other (please specify)	
LIGHTING AND WINDOWS	
Top Lighting	
Side Lighting (clerestory)	
High performance glass	
High efficiency lighting	
Exterior window shading	
Interior window blinds	
Occupancy sensors / Lighting controls	
Other (please specify)	
CONTROLS	
CO2 sensors	
Metering	
Energy Monitoring Systems	
Occupancy sensors / Lighting controls	
Commissioning	
RENEWABLE ENERGY GENERATION	
Solar PV	
Active Solar	
Passive Solar	
Solar Hot Water Heaters	
Other (please specify)	
Notes on Measures - Please include any clarifications or additional narrative on the technical measures or design:	

As associated with a daylighting strategy

**CONTINUE TO TAB "2 ENERGY USE"**

<b>Building Name:</b> 0		
ENERGY DATA INFORMATION OVERVIEW		
	PRIMARY FUEL	SECONDARY FUEL
HVAC		
Domestic hot water heating		
Other (plug loads, etc.)		
ENERGY USAGE		
At a minimum, project must have at least one year of occupied performance data starting from when the project was completed. Modeling figures may also be used if noted.		
<ol style="list-style-type: none"> <li>If you already have this information in another electronic format, you may send that.</li> <li>Contact NBI for instructions if you prefer us to obtain historic usage records directly from your utility service provider for this study.</li> <li>If you have already entered your building's monthly energy use in EPA's Portfolio Manager to generate an Energy Star rating, you can easily share that data with us by just logging onto your account, selecting the "Share Facilities" link under "Work with Facilities" and entering NBI-ABPROJECT for the user name to share with.</li> <li>If Actual Data is available (from utility bills or end-metering) complete cells 20-50. If only estimated data is available skip to cells 54-65.</li> </ol>		
<a href="mailto:ebre@newbuildings.org">ebre@newbuildings.org</a>		

Actual Data or Estimated Data		If using "estimated" data please skip to cell 54-65	
12 Month Start Date	DD/MM/YYYY		
12 Month End Date	DD/MM/YYYY		
<b>12 MONTH TOTAL BUILDING ENERGY CONSUMPTION (not cost) - FROM UTILITY BILLS</b>		<b>Fill out this section if actual data is available</b>	
	amount		units
Total Electricity Used			
Total Gas Used			
If using data from whole building utility bills please enter on the "Whole Bldg Data" tab.			
<b>12 MONTH BUILDING ENERGY CONSUMPTION - END-USE METERING</b>			
	amount		units
Electricity Purchased			
Natural Gas Purchased			
Other			
<b>12 MONTH ON-SITE RENEWABLE GENERATION</b>			
	amount	units	
PV			
Solar Thermal			
Other			
<b>12 MONTH END USE BREAKDOWN</b>			
	amount	units	
Heating			
Cooling			
Lighting			
Fans and pumps			
Plug loads and Equipment			
Vertical Transport			
Domestic hot water			
Other			
Data Source			
If using whole building meter data (no "Tenant Improvements") please complete "Whole Bldg Data" tab before entering data in tab 3			
<b>ESTIMATED ENERGY USE BREAKDOWN</b>		<b>Fill out this section if only estimated data is available</b>	
	amount		units
Cooling			
Heating			
Lighting			
Fans and Pumps			
Plug Loads and Equip.			
Vertical Transport			
Domestic hot water			
Other			
Data Source			

<b>Building Name:</b> 0	
<b>ENERGY SAVINGS</b>	
Select baseline to which the project was compared and enter calculated energy savings. If saving were calculated through a utility sponsored program cite the program and provide supporting documentation if available. <b>Actual Savings</b> is the difference between baseline use and actual use on Tab 2. <b>Estimated Savings</b> is difference between baseline use and an estimate of post efficiency upgrade use.	
Actual or Estimated Savings?	
<b>BASELINE</b>	
Select baseline	

<b>BASELINE ENERGY USE PROJECTION</b>		
	amount	units
Cooling		
Heating		
Connected Lighting		
Fans and Pumps		
Plug Loads and Equip		
Vertical Transport		
Domestic hot water		
other		
Data Source		
<b>SAVINGS</b>		
	amount	units
Total Calculated Energy Savings		
Calculated Gas Savings		
Calculated Electricity Savings		
Percent better than Baseline		
Actual or Estimate		
Source of Savings Calculation		

This information is based on pre-construction conditions