Center for Energy and Environment

Direct Install Plus Multifamily Pilot Program Final Report



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Contents

Objectives of the Direct Install Plus pilot 1
Research on other programs 1
Program design and process 4
Recruitment of buildings 5
Benchmarking gas usage 6
Direct install results 8
Additional savings opportunities 10
Focus group findings 15
Additional feedback from program participants 16
Savings potential 17
Conclusions and recommendations 19
List of Documents in Appendix 22

On the cover

CEE multifamily team member Jim Fitzgerald collecting ventilation duct pressure measurements as part of diagnostics done for the pilot; CEE multifamily engineer Russ Landry interviewing a building manager and collecting boiler control readings in one of the pilot buildings.

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Objectives of the Direct Install Plus pilot

The multifamily sector is known as one that is particularly elusive for energy efficiency programs to address.[1] Although CenterPoint Energy has Conservation Improvement Program (CIP) offerings that apply to the multifamily sector, there is no sector-specific program designed to maximize participation and energy savings within the multifamily sector. CenterPoint was interested in seeing if the successful direct-install approach that has been used in the single-family sector (the Home Energy Squad program) could be used in the multifamily sector. From December 2012 – August 2013, the Center for Energy and Environment designed, recruited participants, and completed a pilot program for 10 multifamily buildings, with a total of 306 units. The purpose of the pilot was to determine the viability of a "direct-install plus" program design for the multifamily sector in Minnesota that, if viable, could eventually be incorporated into CenterPoint Energy's Conservation Improvement Program portfolio. The Direct Install Plus program design for multifamily buildings incorporates direct install of low-flow aerators and low-flow showerheads in individual units, in addition to a targeted investigation of additional simple building-wide savings opportunities, such as adjusting boiler controls. In addition (although not funded by CenterPoint Energy), the pilot included the direct install of compact florescent light bulbs, in order to test the opportunity of a joint gas-electric program. Multifamily is defined as residential buildings with five or more units that receive gas service from CenterPoint Energy.

The pilot was designed to address the following research questions:

- What is the approximate savings potential for a typical multifamily building (both gas and electric) for the direct install plus program design?
- What is reasonable co-pay to expect multifamily owners to pay for the service?
- What is a first order estimate of overall market potential for such a program (i.e., how many MF building owners would participate)?
- Are there additional savings opportunities, such as re-programming existing boiler controls or adding outside air re-set and cut-out controls, that can be incorporated into the direct install program design?

Research on other programs

CEE researched programs across the country to determine best practices in multifamily energy efficiency programs, and specifically direct install programs. This insight was used in refining the Direct Install Plus program design. Our research included phone interviews, online research, use of two different proprietary national databases of utility programs, use of a utility research service, and a two-day visit to Chicago to tour CNT Energy's "Multifamily Energy Savers" program (recently recognized by ACEEE as an "Exemplary Program"). Figure 1 summarizes the 21 programs CEE looked at during this research. A summary of major findings follows.

Providing a comprehensive and hand-holding process promotes implementation and customer satisfaction in multi-family programs. CNT Energy noted during our visit that comprehensive and hand-

[1] See, for example: "Engaging as Partners in Energy Efficiency: Multifamily Housing and Utilities," CNT Energy and American Council for an Energy Efficient Economy, 2012.

holding process of energy evaluation and energy retrofitting as a key to the program's success. Programs recommending adjustment, upgrades, or investment in new equipment are most successful in achieving program goals of implementation when they provide packaged services that streamline and simplify the process for participants. Successful strategies included: simple program application processes, providing participants with clear next steps and a singular point of contact to walk them through the process, meeting with contractors, providing quality assurance measures for retrofits, providing full-service measures that don't require a lot of customer staff time, and demonstrating dedication to persistence of savings.

Combining direct installs and whole building assessment is a common program structure. Free direct installation of energy saving product and whole building assessment together provide an energy saving package that is an attractive draw for participants. There is also significant savings potential from direct installs.

Charging zero copay is the predominant program design for direct install programs. Direct installation is a useful tool for encouraging program participation. However, feedback from programs in other regions indicates that charging a fee for direct install could result in dramatically less participation.

Follow-up services can increase the number of energy savings measures completed. Several programs CEE spoke with, namely National Grid and CNT Energy, provided comprehensive approaches that included follow-up services. Services included: procuring rebates, meeting with contractors, quality assurance inspections, and ongoing savings monitoring. Both programs noted that participants were more likely to seek out their program when considering large energy retrofits because these follow-up services ensured they were getting energy savings from the projects they implemented.

Promoting the program in-person and through trade groups is an effective marketing strategy. Multiple programs emphasized that word of mouth is the most frequent way participants hear about the programs. This can be promoted through professional organizations and local apartment associations.

Achieving buy-in from contractors, and training them, can increase program effectiveness. Since contractors are the ones installing more capital intensive efficiency upgrades, it is important to involve them in program as much as possible. For some measures, such as proper installation of boiler controls, on-site training is important to ensure that the equipment actually saves energy as designed.

Benchmarking is used by some leading programs to enhance performance. For example, Massachusetts's comprehensive low-income program requires enrollment in an energy benchmarking tool, in order to target participation among the highest energy users. This has reportedly helped them to dramatically increase the savings over what was originally projected for the program.

Figure 1: Summary of other direct install programs

Utility/Administrator	Program name	Co-pay	Electric Installs	Gas installs	Whole-building measures	Other features
National Grid (NY)	Energy-Wise Multifamily	Free	CFLs (up to 10/unit)	Showerheads, aerators, pipe wrap, tank wrap	Whole building energy assessment	Energy assessment; up to $300 fridge replacement rebate
National Grid (Mass)/Nstar, Multi-Family Market Integrator facilitated administration of program	Energy-Wise Multifamily	Free in-unit, common area lighting retrofits=$10/bulb	free light bulbs in dwelling units, $10/bulb in common areas, free tstats	Programmable thermostats	Targeted assessment (lighting, HVAC, motors/drives, refrigeration, DHW, bldg envelope, behavior)	0%loans offered for qualifying heating savings measures, $150 refrigerator rebate, facility gets rebate on 25%of insulation costs (if electric heat) or 50%(if gas heat)
National Grid (RI), program administered by RISE Engineering	Energy-Wise Multifamily	Free	CFLs	Showerheads, aerators, pipe wrap, tank wrap	Whole building energy assessment	Energy assessment, up to 50%of total project costs for building envelope weatherization and air sealing work may be covered, lighting, vfd's, boiler controls, etc.
Energy Trust of Oregon (OR)	Multifamily Properties	Free	Install CFLs, showerheads and aerators	Showerheads and aerators	Whole building energy assessment (includes insualtion, windows, water heating, lighting, clothes washers)	No cost energy assessment; 21,000 units in 2012
Pudget Sound Energy (WA)	Re-energize	Audit free; may qualify for other no-cost/low-cost measures	Install pipe insulation (for electric WH only), shower heads, LEDs and cfls, refrigerators (if existing refrigerator is pre-1992)	Showerheads	Whole building energy assessment (includes bldg envelope, appliances, DHW, space heating, lighting). Rebates available.	Free energy audit required for rebates
DTE/MI Consolidated Gas (MI)	Your Energy Savings (YES)? OR Multifamily Dwelling Program	Free in unit measures. Co-pay for common area.	Install cfl's	Pipe wrap, showerheads, aerators	Utility offers co-pay for common-area improvements such as lighting, lighting controls and sensors, boiler tune-up/controls	Energy assessment required prior to direct install
NIPSCO (IN)	Multifamily Direct Install	Free	CFLs	Aerator, showerhead, pipe wrap, thermostats	None - rebates only	
Com-Ed/Nicor Gas (IL)	Multi-family home energy savings	Free	Installs up to 8 cfl's, programmable thermostat, aerators and showerheads	Aerators and showerheads	None - rebates only	Provide recommendations and prescriptive rebate info to owners as well
Focus On Energy (WI)	Multi-family energy savings program	Free	Install CFLs, showerheads, aerators, pipe insulation	Showerheads, aerators, pipe insulation	Whole-building energy evaluation	Third party free energy assessment available, rebates for equipment, appliance, and common-area lighting
Consumers Energy (MI)	Multi-family direct install	Free	CFLs (up to 8/unit)	Showerheads and aerators (for gas WH only)	Whole building energy assessment	Turn-key service for common-area lighting, HVAC measures (controls, etc). Rebates for other measures.
PUD Snohomish Co. (WA)	Multi-family direct install	Free after rebate	Thermostat rebate, CFL rebate	None. Electric utility	Attic insulation if <R19, crawlspace floor insulation if <R11. Window replacement	Also rebate shell improvements
City of Palo Alto (Business water conservation)	Business Water Conservation Programs	Free	Showerheads, aerators, other water saving materials	Water conservation program	None - rebates only	Non-gas funded: water conservation program.
NYSEG (NY)	Energy Efficiency Program for Multi-Family Residences	Free	CFLs, showerheads, aerators, water heater wrap	None - water-saving measures only for electric DHW bldgs	None - rebates only	Electric-only; must have electric water heat; 5-50 units
Seattle City Light (WA)	Powerful Neighborhoods for Apartments and Condos	Free	CFLs (installed by utility), showerheads and aerators (left for owners or tenants to install)	Showerheads and aerators (left for owners or tenants to install)	Whole building audit is required	Rebates for window, insulation, and lighting upgrades (building must have electric heat to qualify for rebates)
Pacific Gas & Electric	East Bay Energy Partnership	Free	Common area lighting	Free audit of energy saving measures	Heating, ventilation, A/C assessment	Upgrade package+funding to offset recommended retrofit costs
Pacific Gas & Electric	El Dorado Energy Partnership	Free	CFLs, Programmable tstats		None - rebates only	
Anaheim Public Utilities, CA	Home Utility Check up	Free	Up to five CFLs, showerheads and aerators	Showerheads, Aers	Whole building energy assessment	
SoCal Gas	Energy Smart, or Multi-family home tune-up	Free	N/A	Showerheads, Aers	None, low-income program only	
BC Hydro (elec) and FortisBC (gas and elec)	Energy Saving Kit	Free, Low income and high energy use only	CFLS, refrigerator thermometer, efficient nightlight, aerators, showerheads, pipe wrap	Aerators, showerheads, pipe wrap, window plastic, outlet gaskets, foam weatherstripping	None - rebates only	High use only, based on benchmarking. Landlords can order kits for building residents to install themselves, receive rebate for install costs.
BC Hydro (elec) and FortisBC (gas and elec)	Energy Conservation Assistance Program	Free, Low income and high energy use only	EnergyStar refrigerator, CFLs	Aerators, showerheads, pipe wrap, water heater blankets, outlet gaskets, weatherstripping, caulking	Whole-building energy evaluation	High use only; eligibility based on benchmarking. Measures determined based on use. Landlords can also order kits for self install
PEPCO electric, Maryland, D.C.	Energy Wise rewards	Free	Thermostats/switches for A/C Demand-Response	n/a	T-stats/switches only	

Program design and process

The Direct Install Plus program design involves the direct installation of energy-saving materials in individual units of multifamily buildings, as well as identifying and assisting in the completion of additional, targeted energy savings opportunities. Direct installs include high-efficiency showerheads, high-efficiency bath and kitchen faucet aerators, and compact florescent light bulbs (CFLs). All of this is free to the participant (for the pilot). The direct installation is intended to attract the attention of the building owner/manager through the promise of immediate energy savings, then build on this relationship, and through additional owner engagement, convince them to invest in additional energy savings opportunities. A turn-key, full-service assistance approach is utilized to minimize owner/manager time commitment, and make it as easy as possible to make decisions to invest in energy efficiency.

The process employed in the pilot to implement this concept involved five basic steps as follows.

1. ***Intake.*** This consisted of an application form that was signed by the building owner, which gave basic building characteristics, contact information, and agreement to perform the direct install.
2. ***An initial building assessment***. The assessment is to determine additional savings opportunities and confirm direct installs could be completed. CEE staff entered a sample of individual units to confirm the direct installs could be completed. An interview was conducted with the building owner/manager to identify building concerns. The heating and other relevant systems were checked for savings opportunities by CEE's multifamily building assessors, with engineering support assistance. While building owner permission is sufficient to install CFLs in the overhead fixtures, individual permission is needed for installing CFLs in resident-owned lamps. Therefore, CEE created a display for residents, encouraging them to individually sign up to let CEE crews install CFLs in their resident-owned lamps. If they didn't want all of their bulbs replaced, they could put CEE-provided stickers on the bulbs they wanted replaced. The display was put up at least a week prior to the direct install visit, to allow residents time to sign up. A notice form was also provided to the building owner, for their use in providing notice to residents that crews would be entering their units to install products. In a mature program, this step may be able to be eliminated and combined with the installation.
3. ***Installation of energy saving products.*** A separate visit was scheduled for the direct installs. Depending on the building size, up to 12 CEE staff participated in conducting the direct installs, to make it as time-efficient for the building management as possible, since they generally needed to be on-site to handle access to the individual units. CFLs were installed in resident-owned lamps if they gave their permission, either by signing up in advance, or (if they were there in person) by verbal agreement. For some buildings, in-unit diagnostics in some of the units were conducted during the direct install as well. In-unit diagnostics are necessary for the evaluation of buildings with central ventilation systems. It consists of taking pressure measurements of kitchen and/or bath exhaust fans.
4. ***Presentation of a final report to the building owner.*** The final report included an energy benchmark analysis, a summary of work done, and identification of additional energy saving opportunities and payback analysis.

5. ***Follow-up assistance for completing additional savings opportunities***. This assistance was customized for each participant, and could include on-site training on setting boiler controls, identifying contractors to complete work, assistance in writing work scopes, and any other assistance that is necessary to move the project to completion.

Recruitment of buildings

CEE worked with the Minnesota Muli-Housing Association (MHA) to recruit buildings for the pilot. CEE is an active member of MHA and has developed a good working relationship with the organization. Involving them in the recruitment benefited the pilot in several ways. First, MHA is a very strong industry association, with over 2,100 members representing about 2/3 of the buildings in the state. They could be a valuable partner in implementing a multifamily program. Second, they helped to provide access to and recruit some of the industry thought leaders into the program. This helped ensure that the opinions and judgments of the pilot participants would more broadly represent the viewpoints of multifamily customers served by CenterPoint Energy.

CEE sought a range of ownership types, building size and building age in selecting participants for the pilot. The final participants, 10 buildings in all (306 units), represent fairly well the mix of buildings in Minnesota. See Figure 2 for a comparison of Minnesota multifamily buildings compared to pilot participants. Figure 3 presents the detailed characteristics of the program participants.

Figure 2: Characteristics of Minnesota multifamily buildings compared to pilot participants

Characteristic	State average	Number in pilot	Percentage in pilot
Decade built			
<1930	23%	2	20%
1930s	4%	-	-
1940s	3%	-	-
1950s	6%	-	-
1960s	29%	3	30%
1970s	20%	2	30%
1980s	7%	-	-
1990s	4%	1	10%
2000+	5%	1	10%
Size (as percentage of total units)			
5-9 units	13%	2	5%
10-19 units	21%	3	12%
20+ units	66%	5	82%
Type of ownership			
Individual investor	48%	4	40%
Partnership (limited or general)	38%	6	60%
Real estate or other corporation	4%	-	0%
Non-profit institution	7%	-	0%
Public Housing	4%	-	0%
Metering arrangement (gas)			
House and tenant meters	11%	-	0%
House meter only	87%	10	100%
Tenant meters only	2%	-	0%

Figure 3: Characteristics of buildings enrolled in pilot

	Pilot buildings identified by randomly-assigned letter (number of units in building in parentheses)									
	A (12)	**B (81)**	**C (36)**	**D (12)**	**E (43)**	**F (12)**	**G (8)**	**H (46)**	**I (8)**	**J (48)**
Year built	1902	1972	1963	1969	2001	1990	1963	1970	1911	1974
Number of stories	2	14	2	3	4	3	1 *(split entry)*	4	2	3
Primary tenant type	Low income	Students/ small families	Small families	Small families	Small families	Small families	Small families	Seniors	Small families	Couples/ small families
City	Mpls	Mpls	Robbinsdale	Mpls	Mpls	Glencoe	Anoka	Hopkins	Mpls	Hopkins
Heating type	Central single-zone hot water boiler	Central multi-zone hot water boiler	Central multi-zone hot water boiler	Central multi-zone hot water boiler	Packaged in-unit gas forced air	Central multi-zone hot water boiler	Central multi-zone hot water boiler	Central multi-zone hot water boiler	Central single-zone hot water boiler	Central multi-zone hot water boiler
Building management	Single property owner/ mgr	Large multi-property mgmt company	Mid-size multi-property mgmt company	Large multi-property mgmt company	Large multi-property mgmt company	Mid-size property owner/ mgr	Single property owner/ mgr	Large multi-property mgmt company	Single property owner/ mgr	Mid-size multi-property mgmt company

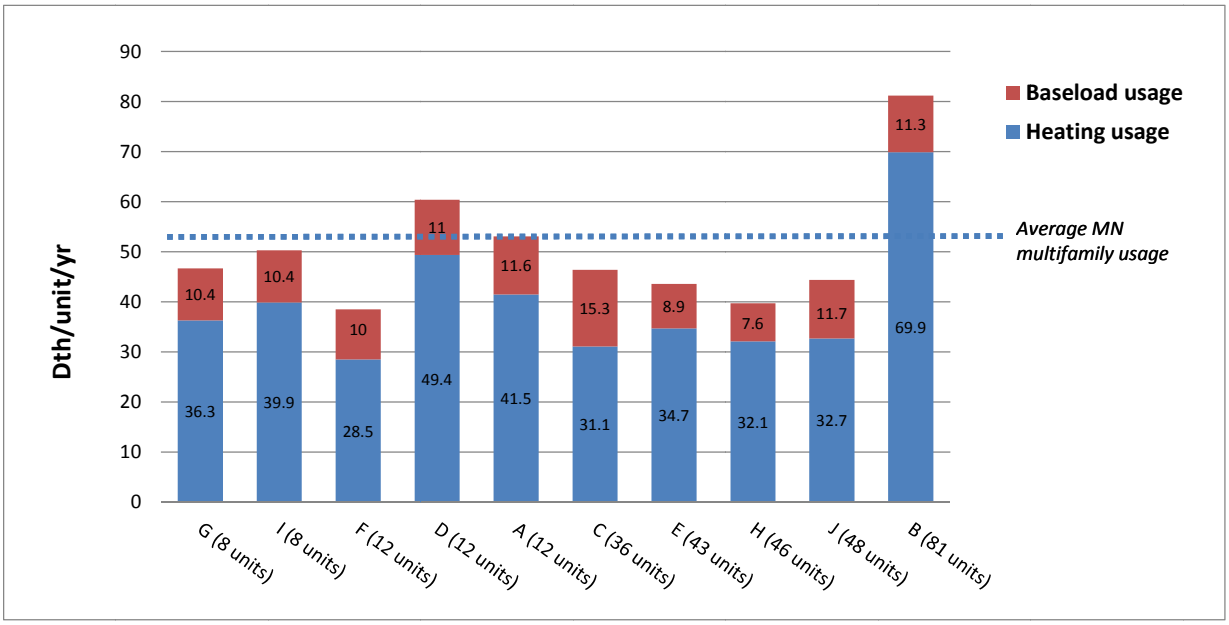
Benchmarking gas usage

As part of the pilot, CEE wanted to test the usefulness of providing benchmarking of energy usage to the program participants. It was thought that this might be a valuable marketing tool, as well as helping to identify buildings where there may be more energy savings opportunity. In addition, the use of a benchmarking tool could facilitate the ex-post evaluation of energy savings. CEE used the EnergyScoreCards tool for this purpose. This tool was chosen for several reasons. First, it would leverage a Conservation Applied Research and Development (CARD) grant funded by the Minnesota Division of Energy Resources, which is currently underway to test the effectiveness of EnergyScoreCards in reducing energy usage in Minnesota multifamily buildings. Therefore, data on Minnesota multifamily buildings exists in the EnergyScoreCards database. Secondly, as CEE is a member of the research team for this project, EnergyScoreCards offered the use of the tool for free for the pilot, as long as CEE entered the data manually. The normal charge would have been about $400 per building per year.

A summary of weather-normalized usage for each of the pilot participants is presented in Figure 4, sorted by size of building. CEE gathered and input gas usage data for the last 18 months of usage into the EnergyScoreCards software. The average Minnesota multifamily building's usage is approximately 53 Dth/unit,[2] although this can vary by building size and other characteristics. Seven of the ten pilot buildings had energy usage below this average.

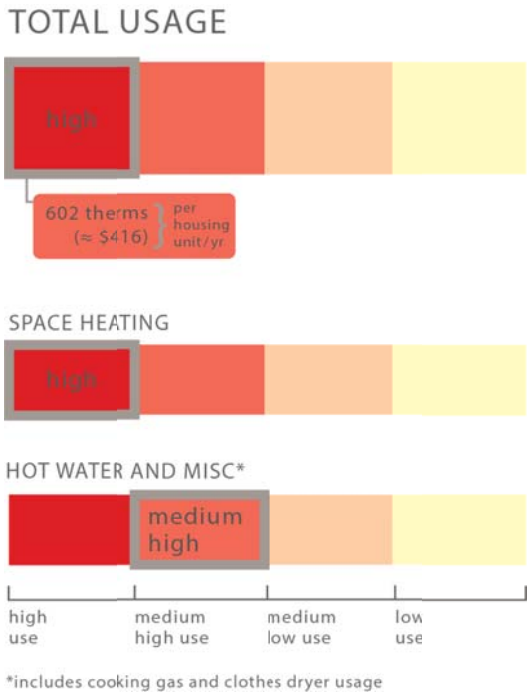
[2] Energy Center of Wisconsin, "Minnesota Multifamily Rental Characterization Study," July 2013.

Figure 4: Pilot participants' gas energy usage compared to MN average (ordered by building size)



EnergyScoreCards is a sophisticated tool that can benchmark energy usage in similar buildings, based a variety of user-entered characteristics. It can also estimate weather-normalized energy savings for installed measures. For each building, a grade (A, B, C or D) is given for overall gas usage, heating usage, and baseload usage. This can be useful for targeting heating or DHW opportunities. However, for the purposes of producing the report, CEE felt that a more compelling visualization of this basic information would add more value to the report. Therefore, CEE took the basic information from the EnergyScoreCards software, and created a graphic that was used in the report provided to pilot participants. This is presented in Figure 5.

Figure 5: Example of gas consumption benchmarking graphic used in report for pilot participants



Direct install results

The direct install portion of the service included installing CFL lamps in all possible apartment light fixtures, kitchen and bathroom high efficiency aerators in faucets, and high efficiency showerheads. If residents signed up for additional CFL lamps in their personal light fixtures, CEE would install those as well. Few residents (less than ten percent) signed up for CFLs in advance via the display poster (see Appendix). However, if residents were home during our visit, CEE had them sign up for additional CFLs on the spot. Almost all individuals were willing to sign up when asked in person. CEE was able to install lighting upgrades in about 38% of the resident-owned lamps, which accounted for about 17% of the total lighting within the apartments.

Showerheads and aerators were installed in more than 80% of the total fixtures, and CFLs in 75% of the total apartment light fixtures, as shown in Figure 6. There were circumstances where CEE could not install product where there was energy savings potential. Generally, this happened when residents declined the upgrade because they thought it would not meet their needs, but there were also occasions where the fixture was not compatible with CEE's product or in too much disrepair to risk altering. It is notable that in the senior housing facility almost half of the residents declined the showerhead replacement. In fact, the instances where CEE could not install product are concentrated within a few buildings in the pilot—where resident type, age of the fixture, or lack of maintenance had a role in the outcome.

Figure 6: Total installed measures per building (per unit numbers in parenthesis) and percent not installed

Building	Bathroom aerators	Kitchen aerators	Showerheads	CFLs: in-unit building fixtures*	CFLs: resident fixtures
A (14 units)	4 (0.3)	12 (0.9)	6 (0.4)	20 (1.4)	9 (0.6)
% not installed	*50%*	*0%*	*0%*	*55%*	*31%*
B (81 units)	112 (1.4)	57 (0.7)	70 (0.9)	798 (9.8)	94 (1.2)
% not installed	*6%*	*15%*	*3%*	*26%*	*71%*
C (36 units)	31 (0.9)	28 (0.8)	31 (0.9)	402 (11.2)	38 (1.1)
% not installed	*8%*	*19%*	*7%*	*10%*	*34%*
D (12 units)	11(0.9)	11 (0.9)	6 (0.5)	122 (10.2)	3 (0.3)
% not installed	*8%*	*16%*	*50%*	*23%*	*75%*
E (43 units)	65 (1.5)	37 (0.9)	57 (1.3)	513 (11.9)	55 (1.3)
% not installed	*0%*	*12%*	*9%*	*18%*	*48%*
F (12 units)	5(0.4)	18 (1.5)	10 (0.8)	152 (12.6)	7 (0.6)
% not installed	*26%*	*25%*	*9%*	*7%*	*53%*
G (8 units)	6(0.8)	6 (0.75)	4 (0.5)	22 (2.75)	9 (1.1)
% not installed	*25%*	*25%*	*50%*	*41%*	*25%*
H (46 units)	33 (0.7)	27 (0.6)	20 (0.4)	496 (10.8)	61 (1.3)
% not installed	*36%*	*30%*	*28%*	*7%*	*60%*
I (8 units)	9 (1.1)	6 (0.75)	9 (1.1)	48 (6.0)	1 (0.1)
% not installed	*0%*	*25%*	*25%*	*34%*	*90%*
J (48 units)	41(0.9)	37 (0.8)	38 (0.8)	405 (8.4)	29 (0.6)
% not installed	*10%*	*10%*	*16%*	*33%*	*69%*
Total (avg/unit)	**317 (1.0)**	**239 (0.78)**	**251 (0.82)**	**2,978 (8.5)**	**306 (1.0)**
% not installed avg	17%	18%	20%	25%	56%

*Includes bulbs replaced in hallway/common areas. Few hallway/common area light fixtures had existing incandescent bulbs (approximately 70 bulbs distributed over 4 buildings; less than 2% of total installs).

For two of the pilot buildings (in a total of 55 units), in addition to the low-flow showerhead, CEE installed a "smartstart" valve that reduces water flow to a trickle when it reaches showering temperature, until a cord attached to the valve is pulled, thereby restoring water flow. This can save energy by reducing hot water waste when the resident is waiting for the water to heat up prior to entering the shower. See the Appendix for more information on this technology. The smartstart technology was installed to gain experience with this type of technology, which is commonly used in California direct install programs. CEE intends to interview building managers 12 months or so after the install to gauge the level of resident acceptance of this technology. Note that the (potential) additional savings from this measure was not included in the savings estimates presented below.

Figures 7 and 8 show the type and location of bulbs installed. CEE offered six types of CFL bulbs that are compatible with the most common types of fixtures. The majority (73%) of CFL installs were the basic spiral type.

Figure 7: Installed CFLs by type

CFL type	Total installed	Percent of total installs
Spiral (14W)	2,400	73%
Globe (9W)	560	17%
Spiral (23W)	149	5%
3-way (14/23/32W)	105	3%
A-lamp (14W)	35	1%
Flood (14W)	35	1%
Total:	**3,284**	

Figure 8: Location of installed CFLs

Install location	Amount installed	Average installs per unit
Kitchen	432	1.4
Utility/Laundry	9	0.03
Living, Dining or Family room	390	1.3
Office	5	0.02
Bathroom	1243	4.1
Hall	540	1.8
Closet	91	0.3
Bedroom	574	1.9

Figure 9 presents savings from the direct installs. For gas savings, savings per measure values were used from the current Home Energy Squad program for single-family residences, as there are currently no deemed savings values specifically for multifamily for claiming savings. As a sensitivity analysis, CEE estimated multifamily-specific savings using actual measured flow rates in a sampling of the units and data from the ECW study. By this calculation, savings from showerheads were 27% lower and savings from bathroom aerators were 7% higher than the single-family deemed savings values.[3] In calculating

[3] Average measured flow rates in the pilot buildings (n=48) for showerheads was 2.11 gpm for pre, and 1.31 for post. Note that because of lower water pressure than is assumed for the rated flow rate, the average measured flow rate is about 13% lower than the rated flow rate (of 1.5 gpm for

CFL savings, CEE used Xcel Energy's average savings per bulb from its current Triennial Plan for 2013. Although not accounted for in this calculation, it is noteworthy that lighting usage per bulb, and therefore savings, in multifamily housing is 18% higher than in single family housing, according to a 2012 residential lighting study by KEMA and Pacific Northwest National Lab.[4]

Figure 9: Estimated savings from direct installs

Measure	Savings per measure	Average savings per unit	Total savings
Bathroom aerator (1.5 GPM)	0.82 Dth	0.84 Dth	259.9 Dth
Kitchen aerator (1.5 GPM)	0.82 Dth	0.64 Dth	196.0 Dth
Showerhead (1.5 GPM)	2.79 Dth	2.36 Dth	700.3 Dth
Total gas savings/unit		**3.84 Dth**	**1,156.2 Dth**
Total electric savings (CFLs)	36 kWh	**386 kWh**	**118,224 kWh**

CEE worked to minimize building owner's investment of staff resources, provide convenient and streamlined services, and maintain flexibility in scheduling and process to accommodate the busy schedules of building owners and managers. In addition to the security and quality assurance staff provided during the install, CEE kept a single staff person in charge of communicating and coordinating with the building management start to finish. CEE also provided documents for communicating with residents regarding our visit and changes to the building. Lastly, CEE provided building owners/managers with a list of faucet leaks or running toilets that were noticed during the install. Building owners and managers valued this because leaks are often not reported by residents and the water utility bill is on average a larger cost than gas or electric utilities.

Overall install time averaged around 90 minutes per unit. In order to address building manager security concerns, install crews had an additional CEE staff person monitoring product and open apartment units. Further, to ensure quality work and prevent costly call-backs, each crew had a staff person dedicated to testing all products before locking up apartments and moving on. CFL installation accounted for approximately two thirds or more of time within each apartment. Labor time for scheduling, prep, and coordinating the install was approximately 2-4 labor hours per building.

Additional savings opportunities

CEE conducted a targeted building assessment (typically 3 hours) intended to identify additional whole-building savings opportunities, generally with a 5-year or less simple payback. The 5-year payback

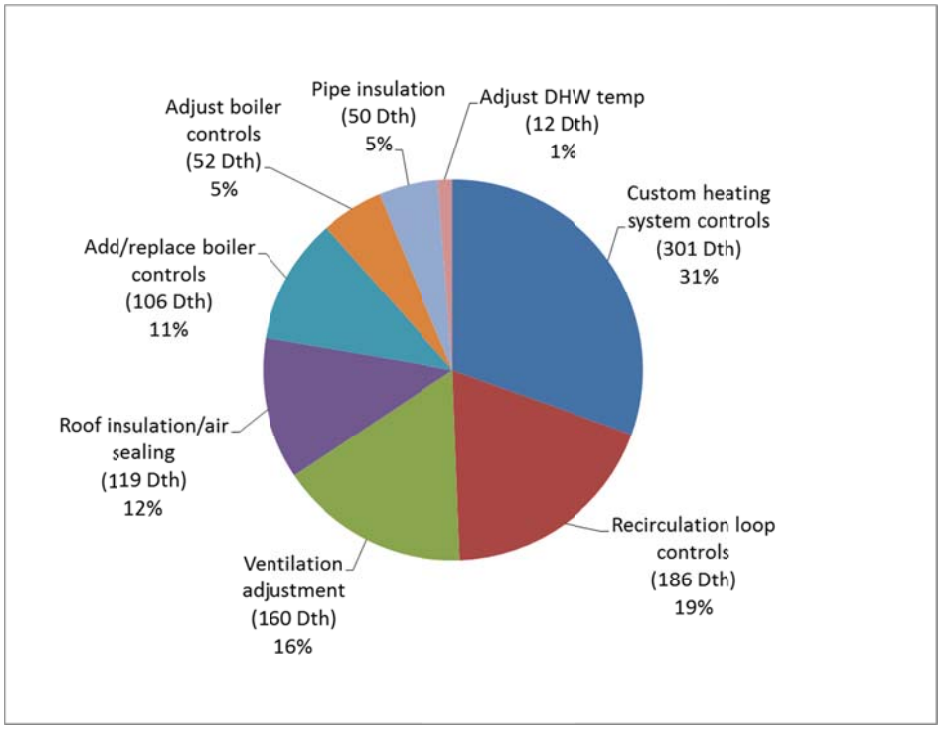
the installed low-flow showerheads). Average measured flow rates for aerators (n= 48, primarily bathroom aerators) was 1.95 gpm for pre, and 1.28 gpm for post. Using the pre measurements for showerheads from the larger sample size of the ECW study (2.35 gpm) and the post measurements from the pilot (ECW did not do post measurements), and the algorithm for savings from the ECW study, average savings in multifamily would be somewhat lower than for single family, at 2.04 Dth. Similarly for bathroom aerators (using ECW for pre, CEE for post, and the ECW algorithms), the savings would slightly higher than used for single-family, at 0.88 Dth. Note that the ECW algorithm appears to have a fairly optimistic assumption for heating and distribution losses (the cited web links in the ECW study were broken so CEE could not confirm all the technical assumptions used); it is possible that a more realistic assumption here would result in a higher savings estimate.

[4] This study found that average usage in multifamily dwellings is 1.67 hours/day vs 1.43 hours/day in single family dwellings (KEMA and Pacific Northwest National Lab, "Residential Lighting End-Use Consumption Study: Estimation Framework and Initial Estimates," prepared for Solid-State Lighting Program, Building Technologies Program, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, December 2012).

criterion was based on the focus group findings (discussed below) suggesting this was the economic cut-off for most market-rate multifamily building owners. CEE looked for energy saving opportunities in the following areas: boiler controls settings, distribution pipe insulation levels, domestic hot water settings, hot water recirculation loop controls, central ventilation systems and general building operation process/protocol. Upon identifying 1-3 opportunities (typically), CEE estimated energy savings resulting from upgrading, adjusting, or adding new equipment. In many instances, CEE obtained contractor estimates on behalf of the participants for recommended work. Note that unless inefficient heating systems were at their end of useful lives CEE did not generally include this recommendation as an immediate next step, as this does not typically fit within the 5-year payback criterion. In a full program, buildings with inefficient heating systems near the end of their useful lives could be identified, and flagged for future contact about this large savings opportunity.

There were nine basic categories of additional savings opportunities found in the pilot buildings, with a total savings potential of 986 Dth, as presented in Figure 10 and discussed further below. Figure 11 presents the detailed opportunities by building. Nearly half of the opportunity comes from heating controls (custom heating controls, adjusting existing controls or add/replace boiler controls). Recirculation loop controls for domestic hot water heating is the second largest opportunity, followed by ventilation system adjustments, which also had electric savings (2,160 kWh). The total "influenced savings" reported in Figure 11 (60 Dth) includes the non-capital measures of adjusting existing boiler controls and domestic hot water temperature settings.

Figure 10: Total savings potential of additional savings opportunities by type of measure



Ventilation adjustment (over ventilation). Three buildings in the pilot had central ventilation systems. For these buildings, CEE completed flow measurements on intakes and exhausts of all ventilation orifices to determine savings potential related to over-ventilating and duct leakage.

CEE was able to measure any in-unit ventilation registers during the direct install. Measuring other areas, for example hallway supply registers or rooftop intakes, required an additional visit for flow measurement. One of the three buildings was over-ventilating. CEE recommended EC style replacement ventilating fans with speed control to reduce ventilation flow. For this recommendation, there was savings associated with both lower ventilation flows (gas savings) and increased fan efficiency (electric savings). Adding flow restrictors on the fan inlets would balance and distribute flow to ensure proper ventilation throughout the building.

Boiler reset and cutout controls (new and adjust existing). CEE recommended boiler controls adjustments in two buildings and boiler controls replacement in two more. Based upon previous research, CEE has determined an optimal range of settings for most boiler reset and cutout controls. CEE worked with the boiler operator to not only adjust the control, but become proficient with the control. CEE also left step-by-step adjustment instructions posted next to the control for future reference. Savings associated with these controls ranged from 4-14% of heating costs, depending upon the existing settings and operation of the boiler.

Custom heating system controls and upgrades. The largest building in the pilot has firetube boilers that could not be reset to lower temperatures without harming the boilers--though the building was obviously overheating and had high utility costs. For this situation, CEE recommended adding a reset control to a mixing valve system. The valves would mix supply and return water in two locations so that the outgoing boiler water temp could be lower, while still maintaining warm enough return water to the boiler to keep the boiler safe. CEE combined this recommendation with replacing single-speed circulator pumps with variable frequency drive pumps. Slowing water circulation would enable more effective heat transfer at lower boiler water temps. CEE met with two HVAC contractors and developed a work scope and budget for completing this work. Though this was an expensive retrofit with a longer than 10 year payback, the building management is interested in completing this work because it can solve overheating and thus resident comfort issues the building was experiencing.

Domestic hot water recirculation loop controls. Three buildings in the pilot have recirculation pumps that circulate hot water 24 hours per day. These pumps ensure that residents have quick access to hot water when they need it. Distribution losses from domestic hot water systems can account for up to 34% of hot water costs for buildings that do not have insulated distribution pipes.[5] CEE recommended adding a control to the recirculation loop that shuts the pump off during periods of low use to reduce distribution losses. The control CEE recommended senses demand and thus does not compromise hot water availability at any time (which is a common problem with other control technologies, such as timer-based controls). CEE conservatively estimated an average 10% reduction in water heating costs, resulting, typically, in a 3 year or less payback for this control system.

Domestic hot water tank temperature settings. CEE recommended adjusting water heater settings (measured above 130 degrees) to set points near 120 degrees. Three buildings in the pilot had high hot water settings that were adjusted down.

[5] Heschong Mahone Group, "California Utilities Statewide Codes and Standards Team. Multifamily Central DHW and Solar. Water Heating" for California Energy Commission, Oct. 2011.

Attic/roof cavity air sealing and insulating. One of the smaller pilot buildings was built in the early 1900s and had a roof cavity space that had little insulation and a leaky building shell. CEE performed a blower door air tightness test to confirm and quantify the air leakage of this building. Two qualified contractors provided cost estimates to seal and insulate this building.

Pipe insulation. Several buildings had opportunities for pipe insulation for the central boiler distribution piping.

Figure 11: Details of additional savings opportunities in pilot buildings

Building	Savings opportunities	Estimate of savings (Dth or kWh)	Total gas savings, per unit (Dth)	Moving forward with recommendations?
A (14 units)	1-Adjust water heater temperature settings 2-Heating pipe and hot water pipe insulation 3-Attic insulation and air sealing	5 Dth 50 Dth 119 Dth	12.4	Adjustment: Yes Capital: Not at this time, building zoning classification due to change
B (81 units)	1-Upgrade and reduce rooftop exhaust ventilators 2-Add recirculation loop controls to domestic hot water system 3-Add 3-way mixing valve and reset controls to boiler heating loop	160 Dth/2,160 kWh 90 Dth 301 Dth	6.8	Adjustment: N/A Capital: Yes
C (36 units)	No recommended upgrades	N/A	0	Adjustment: N/A Capital: N/A
D (12 units)	1-Adjust water heater temperature settings 2-Replace non-functional boiler reset/cutout control and adjust to optimize control savings	3 Dth 85 Dth	2.4	Adjustment: Yes Capital: Yes
E (43 units)	1-Add recirculation loop controls to domestic hot water system	40 Dth	0.9	Adjustment: N/A Capital: No, building enrolled in RUBS (ratio utility billing system)
F (12 units)	1-Replace under-functioning boiler reset control and adjust to optimze control savings	21 Dth	1.8	Adjustment: N/A Capital: Not at this time, building changed ownership during pilot
G (8 units)	1-Adjust water heater temperature settings 2-Adjust existing boiler reset/cutout control for increased energy savings	4 Dth 13 Dth	2.1	Adjustment: Yes Capital: N/A
H (46 units)	No recommended upgrades	N/A	0	Adjustment: N/A Capital: N/A
I (8 units)	No recommended upgrades	N/A	0	Adjustment: N/A Capital: N/A
J (48 units)	1-Adjust existing boiler reset/cutout control for increased energy savings 2-Add recirculation loop controls to domestic hot water system	39 Dth 56 Dth	2.0	Adjustment: Yes Capital: Yes
Total gas savings opportunity		**986 Dth**	**3.22**	
Gas savings from measures participants are planning to complete		**756 Dth**	**2.47**	
Total savings from non-capital "influenced savings" measures		**60 Dth**	**0.20**	

The gas savings opportunities identified in the pilot buildings by CEE were generally consistent with the shorter (5 year or less) payback savings opportunities in the Energy Center of Wisconsin's (ECW's) Multifamily Characterization Study, with the following exceptions:

- ***Ventilation adjustment***. This was a large opportunity found by CEE, but not identified in the ECW study. A CARD (Conservation Applied Research and Development) research grant funded by the MN Department of Commerce that CEE is currently working on will help to further define this opportunity.
- ***Domestic hot water recirculation loop controls.*** This also was not identified in the ECW study, but appears to have a large savings opportunity with a relatively short payback, for some buildings at least. Further investigation is warranted to look into actual energy savings.
- ***Boiler vent damper.*** The savings measure was identified as a short payback item (5-year) in the ECW study, which came out after we had done the majority of assessments in the pilot. CEE is familiar with boiler vent dampers, and has done past research on their effectiveness,[6] but CEE did not generally recommend this item, as past experience has shown that while this measure may be effective on steam systems, hot water systems can suffer from reliability issues, and achieve less energy savings.

CEE developed a report for each participant that could be read at a glance but provided analytical sophistication (see Appendix). The report included estimates of savings from the direct install as well as the highlighted cost-effective investments related to space heating, domestic hot water heating, and ventilation. A detailed financial analysis was prepared for each recommendation, including energy savings, payback, savings to investment ratio and internal rate of return. CEE presented the report in person, including relevant CEE staff (those involved with diagnostics, for example) as well as decision-making parties for each building. The goal of this meeting was to clearly communicate the energy savings potential of the building to the decision-makers and implementers of each building. CEE finished each meeting by offering CEE's ongoing assistance with completing recommendations; including obtaining and reviewing estimates, applying for rebates, and optimizing control settings upon installation (if applicable).

On average, the building assessment, follow up diagnostics, and report generation took about 16 labor hours, ranging from 5 to 50 hours, depending on the complexity of the building. Generally, larger buildings (45 + units) had more HVAC complexity that required more analysis (25-50 hours). The medium-sized buildings (25-45 units) in the pilot had simpler, more predictable systems that CEE could analyze in less time (8-10 hours). Smaller buildings were more variable in energy issues depending upon construction type, management type, and HVAC systems. There were 5 buildings under 14 units in size in the pilot. Two required blower door diagnostics, one required ventilation analysis, and one was heated partially with electric baseboards paid by the residents, causing a split-incentive and unattractive paybacks. As a result of this variability, the small buildings in the pilot on average required more time than mid-size building (15-20 hours, approximately). In a mature program, streamlined processes could be developed to minimize the time requirement, particularly for the smaller buildings.

[6] See: "The Best Boiler And Water Heating Retrofits," Home Energy Magazine, Mary Sue Lobenstein and M. Hewett, Sept/Oct 1995.

Building owners reported that they intended to complete 77% of the upgrades recommended (on a savings basis). CEE is actively engaged with most of these building owners in completing these upgrades. While mostly motivated to complete the upgrades because of good energy savings potential, some of the owners were motivated by the non-energy benefits, even for recommendations with longer paybacks. Some of the non-energy benefits provided by these upgrades included: overheating/comfort issues (for boiler adjustments), odors (for ventilation improvements), moisture problems (for ventilation improvements), and costs associated with troubleshooting each of these. Other building reported not intending to complete upgrades, even with aggressive payback periods, because there were barriers beyond the initial cost investment, such as skepticism regarding "green" technologies. One building was sold during the pilot, and though CEE has tried to get in touch new owner, they have not yet shown any interest. A second building owner received information during the pilot that his neighborhood may be rezoned in the coming few years, due to its proximity to downtown, and was holding out to possibly sell the building to a developer who may tear down the building, and thus became uninterested in energy upgrade recommendations.

Focus group findings

CEE, with the help of a professional market research consultant, conducted a focus group on April 9, 2013 with 8 of the pilot program participants (all were invited). The focus group was conducted after recruiting the program participants, but before they completed the pilot. The purpose of the focus group was to both help with the implementation of the pilot, as well as to provide insights into the design and implementation of a full program by: 1) better understanding multifamily building owners' and managers' thoughts, pain points, and motivations around energy efficiency; 2) identifying and understand multifamily building owners' thoughts, liking, perceptions, and reactions to the new Multifamily Direct Install Plus energy efficiency program; and 3) defining specific communications concepts that will best explain the program and its benefits. The focus group was recorded, and a full report produced by CEE's market research consultant.

Here is summary of the major findings of the focus group report:

- ***Energy costs are top of mind for multifamily building owners***. They regularly track these expenses and seek to find ways to reduce them, as energy costs are one of their top expenses that they can control (note that all buildings in the pilot were centrally heated). Cost and reduction of expenses is their primary motivation for implementing energy efficiency measures. This is a positive finding for marketing a multifamily program.
- ***Multifamily building owners tend to lump water utility bills along with gas and electric utility bills***. Emphasizing that some of the direct install measures save water as well as energy could be an important benefit.
- ***Building owners tend to think that they've already done all of the low-cost installs, and typically do not see much value doing them.*** As one participant put it "the showerheads, aerators, CFLs are old news and did not add much value to this program for me." This is particularly interesting, because in this case the perception is far from the reality; CEE verified that existing fixtures were at least 2.0 GPM prior to installing low-flow fixtures (1.5 GPM), and over 80% of fixtures in the pilot were replaced.

- ***Building owners are skeptical of savings claims, and seek trustworthy sources of information***. This is particularly true for smaller owners, larger management companies may have specialized vendors that they can turn to. A major pain point of implementing efficiency was seen as a perceived trade-off between energy efficiency and durability or increased maintenance issues.
- ***Owners recognize the importance of resident behavior in influencing energy costs***. They seek ways to educate and influence their residents in saving energy - a program design that included effective efforts at resident behavior change would be desirable to multifamily building owners.
- ***All program participants responded very favorably to the Direct Install Plus program concept***. A key caveat is that many felt that they had already done the direct-install component or didn't need this as much as help with more major opportunities to save energy; therefore a program design that includes a direct install component as part of a larger effort would attract more interest.
- ***Participants responded most favorably to four potential program benefits***. To reach the broadest market, these benefits would be part of the program, and would be included in a marketing plan for the program. These benefits include (in order of priority):
    - The program can help you save money on utility bills and earn more profit (by reducing energy and water use);
    - The program can provide you with expertise, education and help with prioritization of projects;
    - The program provides a comprehensive solution customized for your building; and
    - The program provides convenience – many key elements bundled together and brought right to your building.

Additional feedback from program participants

CEE conducted an interview of all participants after presenting the final report for their building. The purpose of the interview was to gain feedback on their experience with the pilot program, and insights on the potential expansion of the program to a broader market.

Participants rated the program highly overall, giving it on average a 7 out of 10 in helping them reduce energy use in their building. Suggested improvements included adding more water conservation measures and window improvement options, and more rebate money associated with energy saving in multifamily. Specifically, participants recommended adding ways to reduce window draftiness, running toilets, providing LED lighting options, and better boiler replacement incentives. Five of ten participants wanted to see more “cutting edge” direct install products, including LED light bulbs, toilet flappers, or water pressure reducers. Three participants hoped for more savings or better payback as a result of implementing recommendations from the program.

Helpful aspects of the program included the flexibility, efficiency, and level of professionalism maintained through the program. Participants saw great value in program staff's knowledge and experience with saving energy on their HVAC systems, specifically with regards to boiler controls and ventilation systems. Participants also noted that they appreciated CEE-provided signage and resident engagement, diagnostic testing, and the kick off/focus group meeting. The most valuable part of the program, as noted by every participant, was CEE’s investigation into energy improvements for the space heating, hot water and ventilation systems. The report was highly regarded as a useful tool to both

understand existing usage of the building and to determine cost-effective steps to take towards energy savings. Participants liked that CEE obtained estimates for them and met with contractors – they appreciated this "turn-key" service. Largely, they saw the program as well-organized and worth their time. 9 of 10 participants thought this program should be offered to all multifamily buildings and would participate in a similar program again.

All participants agreed that if there were a copay for this program, they would have to dig in much further to investigate whether the program actually saves enough money to make it worthwhile. Two participants reported that they would not consider the program if it required a fee. Four participants suggested a copay that would achieve a 2 year or less payback—where savings could be demonstrated by case studies of other buildings. All participants agreed that a copay for the program would decrease participation rate by at least 50%. Participants noted the following barriers to paying for the program: staff labor for the time commitment of the program is a hidden cost, the direct installs could be done themselves, newer buildings and well-run buildings already have lower utility costs, or that some buildings pass utility costs onto tenants through the ratio utility billing system and are less motivated to save energy. A full summary of the interview responses from program participants is included in the Appendix.

Savings potential

There are estimated to be about 99,000 multifamily units in CenterPoint Energy territory.[7] How much of this market can be reached by a Direct Install Plus program will depend on how aggressively the program is marketed, and the size, if any, of the copayment. Based on the performance of similar programs in other states, the potential market penetration could be quite large for a mature program. For example, NIPSCO reported participation in its direct install program at nearly 35,000 units in 2012. NIPSCO is a natural gas company serving roughly the same number of customers as CenterPoint Energy (782,000 customers vs. CenterPoint's 805,000). Similarly, in Michigan, Consumer's Energy (1.7 million customers) reports participation of 70,000 units, and Consolidated Energy (1.4 million customers) reports participation of 48,000 units, both in 2011. Each of these programs have built up participation to these levels over multiple years. Although the total percentage of multifamily units that these programs are reaching is unknown, if the market is similar to Minnesota, market penetration is well above 10% in a single year. Thus there is justification in assuming that CenterPoint could reach a large customer base within a few years, with a zero copay program and aggressive marketing.

Some caution should be used in extrapolating results from other states to Minnesota. Feedback from the pilot participants indicates that the perceived benefits of the direct install portion of the program may be less for Minnesota building owners than perhaps in other states, due to Minnesota building owner's perception that they have already "done" these activities.

There is a fair amount of uncertainty in extrapolating the savings calculations to a full program based on the 10 buildings in the pilot. This is particularly true for the deeper savings opportunities, as the building

[7] CenterPoint Energy serves 54% of residential and 57% of commercial gas customers in the state; given approximately 187,000 gas-heated multifamily units in the state (ECW 2013) and assuming the portion of multifamily units in CPE territory is roughly proportional to the percent of residential customers in the state results in an estimate of 99,000 units. Note that this figure excludes 5+ unit townhomes (there are about 36,000 gas-heated townhome units in MN), which are generally individually heated.

stock is varied, and more opportunities may be discovered with expansion to a full program. However, where data on other programs is available, our savings estimates appear reasonable. The average savings from the pilot is 3.8 Dth gas and 386 kWh from the direct installs; and 2.5 Dth from additional opportunities that the building owners have committed to complete.

CEE developed savings estimates for a mature Direct Install Plus program based on three scenarios to provide an upper and lower bound, as well as a most likely scenario, presented in Figure 12. A mature program assumes 18 – 36 months ramp-up time to achieve these savings estimates, consistent with other states. The "low estimate" represents both a low market penetration and a low savings per unit. A value of 0.3% annual market penetration was assumed, which would be consistent with what program participants suggested participation might be with charging a copayment. Only smaller segments of the multifamily market are likely to respond to such an offering. Savings are conservatively assumed to be half of that from the pilot. This results in total estimated annual savings of 940 Dth and 60 MWh.

For the high estimate, an aggressive market penetration of 10% is assumed, which is consistent with extremely aggressive programs in other leading states. The gas savings from the direct installs are assumed to be the same (because it would be harder to get the install percentage much higher than it already is), but we assume double the savings from additional savings opportunities. On the electric side, we assume 30% higher savings, either from installing more measures, or from installing a higher percentage of CFLs. It is also likely that electric savings from pursuing additional opportunities could be achieved, similar to the results found for gas savings. However, this was not a focus of the pilot, so we do not consider any such potential savings in our scenarios. This results in total estimated annual savings of 88,000 Dth and 5,000 MWh.

Figure 12: Estimate of annual savings from a mature Direct Install Plus program under three scenarios

	Low estimate	High estimate	Mid estimate
Market penetration	0.3%	10%	2.0%
Total units	297	9,900	1,980
Total buildings	14	471	94
Assumed per unit savings - Dth	3.2	8.8	6.0
Assumed per unit savings - kWh	190	500	345
Total estimated gas savings (Dth)	**940**	**88,000**	**11,900**
Total estimated electric savings (MWh)	**60**	**5,000**	**680**

For the mid estimate, market penetration is assumed to be one-fifth that of the high estimate. This is because although other states have achieved very high market penetration, feedback from pilot participants indicated that while there might be high interest, the interest of multifamily owners may be less than that in other states. Still, the mid estimate assumes zero copayment, and an aggressive marketing plan would be necessary to achieve this level of market penetration (a 2% annual market penetration is extremely high for any program). Savings estimates for the mid scenario are the average between the low and the high estimate. This results in total estimated annual savings of 11,900 Dth and 680 MWh.

Conclusions and recommendations

1. ***There is opportunity for significant energy savings through a Direct Install Plus program serving the multifamily sector.*** In spite of the split incentive problem, most multifamily building owners in Minnesota pay the in-unit gas bills, and are quite interested in reducing gas bills. A program targeting centrally-metered buildings has significant potential. A direct install program also offers an opportunity to install lighting upgrades with significant electric savings potential. The highest performing multifamily direct install programs in other states have provided 5% or more of total gas savings in their energy efficiency program portfolios, with annual market penetration over 10% of all multifamily units in their service territory. It is estimated that a similar high-performing program in CenterPoint Energy territory, with aggressive marketing and a well-thought-out program design, could serve around 100 multifamily buildings per year and result in an order of magnitude savings of 12,000 Dth and 700 MWh per year. This would likely take several years to build up to this level of performance. Based on the level of effort done in the pilot, it is expected that this could be cost-effectively done at a similar or less cost than the current Home Energy Squad single-family direct install program.

2. ***Making the service free to building owners will achieve the highest participation, and is a good entry point for promoting deeper upgrades.*** This is the approach of nearly all other utility programs across the country, and is frequently used to promote deeper savings opportunities. For example, here is the comment of the program administrator from Com-Ed's direct install program: "Our free direct install program is a great way to get our foot in the door and get face time with property managers. It is very popular with building owners as well as tenants. This helps build trust and leads to interest in our other program offers." CEE interviews with program participants suggest that even a low co-pay will dramatically reduce participation. This is because even if the cost is not high, it is another hoop to jump through to get approval and write the check. Given the staff commitment necessary for participating in the program (which is also a cost) and general skepticism about how advantageous low-flow fixtures will be (both energy savings and tenant complaints), building owners and managers tend to discount the actual value of the service, and need a payback of one year or less. For example here is the comment of one pilot participant: "If you said the average cost savings [of the direct installs] is $1000 and copay was $300—and if we had a nice looking brochure with case studies with cost savings, I would be convinced. With some hard data I would trust your organization enough to participate with a copay that has a quick payback." So, for example, if on average building owners saved about 3.5 Dth per unit, the maximum they might be willing to pay might the value of 1 or 2 Dth per unit bill savings over a year's time. If a copay was to be used, a simple tiered rate by building size is the recommended approach. Using the discounted-value-of-savings methodology, this could result in the following copay amounts; $100 for buildings under 20 units, $200 for 21-50 unit buildings, and $400 for larger than 50 unit buildings.[8] In general though, our research suggests that the benefit to the utility of a small copay will bring will come at the price of dramatically reduced program participation.

[8] This assumes a willingness to pay for savings of roughly 1 Dth per unit, at $6/Dth. Only willingness to pay for one year of savings is assumed, since given the skepticism of savings associated with direct install items, they will want to see a short payback period (one year). It should be noted that as multifamily building owners are interested in the gas measures, as in centrally heated systems they pay for the gas, but the electric measures provide them no benefit, as these savings go to their tenants. Thus when setting the copay, only the value of energy savings from gas measures in the units should be considered.

3. ***Including the identification and follow-through of additional savings opportunities can roughly double the savings potential of a direct install only program.*** The opportunities, outside of replace-on-fail efficiency upgrades, will need to have short payback periods (5 years or less) for them to be attractive to multifamily building owners, although they may pursue other longer-payback opportunities if they provide other benefits, such as improving tenant comfort. Pilot participants are planning on completing projects that will save on average 2.5 Dth per unit, or about 77% of all the targeted opportunities that were identified in the building assessment. This high conversion rate suggests that building owners are accepting of a program design that identifies and helps them complete such projects. It is expected that a mature program could identify and capitalize on additional savings opportunities that were not within the scope of the pilot, further increasing program savings.

4. ***Effectively pursuing additional savings opportunities will require additional assistance beyond the building assessment.*** Although CEE pilot participants committed to completing 77% of the savings opportunities identified, for the most part they wouldn't have done that without CEE assistance in completing the upgrades. Boiler controls are one of the largest opportunities, and typically required at least one follow-up appointment to train the building maintenance person in the correct programming of the controls. For the largest single savings opportunity in the pilot, CEE did detailed design work to help the building owner to get bids to complete the project.

5. ***It is recommended that programming boiler controls be a separate measure in a full program.*** CEE found that higher savings can occur by assisting the building manager with programming the boiler controls (an activity akin to a commissioning/re-commissioning activity), than is typically assumed for deemed energy savings. This makes sense, as in CEE's experience many boiler control installers do not bother to customize the controls programming to the building. Sometimes these default settings are not even for Minnesota's climate zone, and will result in sub-optimal performance. Without a type of commissioning service for the boiler controls, as provided by CEE in this program, higher savings are not likely to be realized. While it takes extra time to do this customized commissioning activity, savings can often be double than what they are for deemed savings. In addition to assisting with the programming, CEE provided a reference sheet (customized for the type of control used) and training to the building operator, to ensure persistence of savings. This measure can apply to both existing controls, as well as new controls.

6. ***The program implementation should have a focus on excellent customer service.*** Because word-of-mouth is reported by other programs as one of the most important marketing channels, it is important for the success of the program that it provides high customer satisfaction.

7. ***Benchmarking energy usage can be a valuable marketing tool for the program.*** Program participants found the benchmarking tool used in the pilot to be valuable. In addition, prior to completing the program, participants indicated that they were very interested in seeing their energy use compared to similar buildings. However, CEE believes that the method used in the pilot may be too expensive to implement on a broader scale as part of a Direct Install Plus program. The service used in the pilot provides a high degree of sophistication, but our experience is that the simplification that CEE provided in the report was well-received by the program participants. A simplified benchmarking tool could be an important program feature in developing a high-

performing program, and it is worthy of further investigation to figure out how this could be accomplished.

8. ***A joint gas-electric program would be the most cost-effective program design and capture the largest total energy savings***. Building owners are motivated by the gas savings opportunities and not the electric savings from installation of CFLs (because their residents pay for electric), and there were few CFL installation opportunities in owner-paid common areas. Thus, they would not participate without the gas savings, and there would be little possibility of installing in-unit CFLs without the inclusion of the gas measures because of the split incentive problem. However, there are significant electric savings opportunities from installing the CFLs, and from a program delivery standpoint, there can be cost-savings because the installation crew already has access to the individual units. CEE was able to install an average of over 9 CFLs per unit.

List of Documents in Appendix

A. Example of report to building owner used for pilot

B. Example of ventilation diagnostics summary of results for building owner

C. Poster encouraging residents to sign-up for CFLs installed in resident-owned lamps

D. Evolve ladybug data sheet (installed in 2 buildings)

E. Focus group report

F. Participant evaluation interviews summary