TABLE 6–32: OTHER SMALL/MID COMMERCIAL ENERGY EFFICIENCY ACTIVITIES

Other Energy Efficiency Activity	(n=297)
Energy Star Rated Conventional Natural Gas Hot Water Heater	(n=65) 77%
Computerized Energy Control System (Owns Building)	(n=163) 15%
Operated at Local Facility	(n=24) 83%
Operated Remotely	(n=24) 17%
Energy Audit	15%
Don't Know	12%
Added Conservation Measures such as extra roof insulation or low-energy windows	34%
Don't Know	9%

Future Plans

Respondents who own their own building were asked about future plans for changes to the building shell or any anticipated lighting changes. All respondents were asked about any change in their natural gas usage due to longer business hours as summer approaches, and equipment replacement. Results are shown in Table 6–33.

9% of Small-Mid businesses who own their building anticipate building shell changes within the next 12 – 24 months, while 13% anticipate lighting changes. 11% of all respondents say they will need to replace equipment in the next 12 – 24 months, and of those 50% say the replacement will be natural gas-using equipment. 16% of all respondents anticipate end of life equipment replacement that will have positive opportunities for energy conservation or efficiency, and 61% of that equipment will use natural gas.

11% of all respondents say they expect natural gas usage changes due to longer business hours during summer months.

TABLE 6–33: SMALL/MID COMMERCIAL FUTURE ACTIVITIES

Future Activities	Small/Mid Size (Owns Building)
Building Shell Changes in next 12 – 24 Months	(n=177) 9%
Lighting Changes in next 12 – 24 Months	(n=180) 13%
Natural Gas Usage Changes due to longer summer hours	(n=288) 11%
Anticipate Equipment Replacement in next 12 – 24 Months	(n=280) 11%
Equipment Using Natural Gas	(n=30) 50%
Anticipating End of Life Equipment Replacement in next 12 – 24 months/positive to EE	(n=275) 16%
Equipment Using Natural Gas	(n=41) 61%

COMMERCIAL AND INDUSTRIAL SECTOR: LARGE SIZE AND INDUSTRIAL BUSINESSES

Economic Use

Business customers were asked their primary, secondary, and tertiary economic use of the business space.

Large Commercial

Looking at Table 6–34, 24% of these businesses use their primary space for Manufacturing/ Industrial, and another 24% use it for Educational Services; 19% say their primary space is used for Institutional purposes, 14% for Healthcare, and the remainder is for a variety of economic uses. Office space and storage are the most common secondary and tertiary uses.

TABLE 6–34: PRIMARY, SECONDARY, AND TERTIARY LARGE COMMERCIAL USES OF SPACE

Category	Large Commercial Primary	Large Commercial Secondary	Large Commercial Tertiary
	n=21	n=10	n=4
Commercial Office	10%	50%	
Retail Trade			
Manufacturing/Industrial	24%		
Healthcare	14%		
Warehouse (high bay)			25%
Restaurant/supermarket			
Storage (low bay)	5%	10%	
Education Services	24%		
Institutional	19%		
Hospitality	5%		
Automotive Services			
Arts, Entertainment, Recreation			
Other		30%	
Don't Know	-	10%	75%

Industrial

75% of primary Industrial usage is in Manufacturing/Industrial, and 11% is in Commercial Office; the remainder is in a variety of uses (see Table 6–35). Commercial Office space and storage are the most common secondary and tertiary uses.

TABLE 6–35: INDUSTRIAL USAGE—PRIMARY, SECONDARY, AND TERTIARY

Category	Industrial Primary	Industrial Secondary	Industrial Tertiary
	n=61	**n=41**	**n=13**
Commercial Office	11%	56%	38%
Retail Trade	2%	2%	
Mfg/Ind.	75%	2%	8%
Healthcare			
Warehouse (high bay)	7%	24%	8%
Restaurant/supermarket			
Storage (low bay)		5%	
Education Services			
Institutional		2%	
Hospitality			
Automotive Services	2%		
Arts, Entertainment, Recreation			
Other	2%	5%	8%
Don't Know	2%	2%	38%

Business Characteristics

Statistics outlining business characteristics for survey respondents are shown in Table 6–36. The average number of employees for Large Commercial businesses is 2,826.9; note the number of large Commercial businesses surveyed is just 21. Industrial businesses average 221.3 employees.

95% of Large Commercial and 82% of Industrial businesses own their own building(s). Of those who lease, none have gas included in their rent payment.

81% of Large Commercial businesses are housed in multiple buildings, while the percentage is more evenly divided between single and multiple buildings for the Industrial segment, at 45% in a single building, and 55% in multiple buildings.

Large Commercial businesses report that 84% of their business's space is occupied by the primary economic use of the building, and of those who have a secondary use it takes up 18% of the space; of those who have a tertiary use it is 5%. Industrial businesses report that 80% of their business's space is occupied by the primary economic use of the building, and of those who have a secondary use it utilizes 21% of the space; of those who have a tertiary use it is 14%. 56% of Large Commercial businesses have common space, defined as foyers, vestibules or other non-business related areas, and it utilizes 11% of the business's space, while 39% of Industrial businesses have such a space, but it utilizes only 6% of the business's space.

TABLE 6–36: LARGE COMMERCIAL/INDUSTRIAL BUSINESS CHARACTERISTICS

Business Characteristics	Large Commercial n=21	Industrial n=61
Average Number of Employees/S.D.	2826.9 σ6659.39	221.3 σ351.24
Ownership		
Own Building	95%	82%
Rent/Lease	5%	18%
Gas included inrent	0%	0%
Business Housed in		
Single Building	19%	45%
Multiple Buildings	81%	55%
Percentage of Space Taken By		
Primary Use	84%	80%
Secondary Use	(n=6) 18%	(n=37) 21%
Tertiary Use	(n=1) 5%	(n=7) 14%
Common Spaces Present	56%	39%
Percentage of Space	(n=9) 11%	(n=22) 6%

Building Characteristics

Large Commercial businesses are housed in older buildings (average age of 63.8 years), compared to Industrial businesses with an average building age of 45.8 years (shown in Table 6–37). Total

gross square footage is similar between the segments, with 322,636 square feet for Large Commercial, and 321,631 square feet for Industrial.

The Primary Large Commercial buildings average 4.6 floors above ground level and 0.8 below ground level, while the primary Industrial buildings are, on average, 2.6 floors above ground and 0.2 floors below ground.

The primary surface materials of the external walls of the building/complex that house Large Commercial businesses are brick (42%), metal (26%), concrete (16%), glass (5%), and other (11%). For Industrial businesses it is metal (38%), brick (27%), concrete block (15), concrete (13%), and other (8%).

No Large Commercial businesses have buildings or complexes with enclosed indoor parking, and just 2% of Industrial businesses do so.

TABLE 6–37: LARGE COMMERCIAL/INDUSTRIAL BUILDING CHARACTERISTICS

Building Characteristics	Large Commercial n=21	Industrial n=61
(Owns building)		
Age of Primary Building/S.D.	(n=19) 63.8 σ37.18	(n-45) 45.8 σ27.32
Total Gross Square Footage of building/complex (S.D.)	322,636 σ263640.75	321,631 σ309084.03
Floors		
Above Ground Level/S.D.	4.6 σ3.50	2.6 σ5.62
Below Ground Level/S..	0.8 σ0.63	0.2 σ0.41
Exterior Wall Construction (Owns Building)	n=19	n=48
Brick	42%	27%
Concrete Block	0%	15%
Metal	26%	38%
Wood	0%	-
Concrete	16%	13%
Glass	5%	-
Other	11%	8%

In Table 6–38, we see that Large Commercial businesses average 28.2% of external wall space in windows, while Industrial businesses have only 6.8%. Average number of panes for Large Commercial is 5.6; it is 3.5 panes on average for Industrial businesses. Most windows are clear (89% for Large Commercial and 72% for Industrial), with framing for Large and Industrial dominated by metal framed windows (78% and 84% respectively).

TABLE 6–38: LARGE COMMERCIAL/INDUSTRIAL WINDOW CHARACTERISTICS

Window Characteristics	Large Commercial n=21	Industrial n=61
Windows		
Percentage of External Wall	28.2%	6.8%
Average Number of Panes of/S.D.	5.6 σ10.88	3.5 σ3.73
Glass/S.D.	n=18	n=46
Characteristics		
Clear (No Glazing)	89%	72%
Tinted	-	20%
Reflective	6%	-
Opaque	6%	9%
Frames		
Metal	78%	84%
Wood	11%	4%
Vinyl		4%
Other	11%	7%

Table 6–39 shows percentage of space used for primary, secondary, tertiary, and common space, among those businesses who knew the economic use of their business. It also shows the percent of each space that is heated and cooled.

86% of Large Commercial business space for primary use is heated, although a lower percentage of the space is cooled (67%). 100% of secondary space is heated and cooled, while no tertiary space is heated or cooled, and 100% of common space (defined as foyers, vestibules or other non-business related areas) is heated, and 80% is cooled.

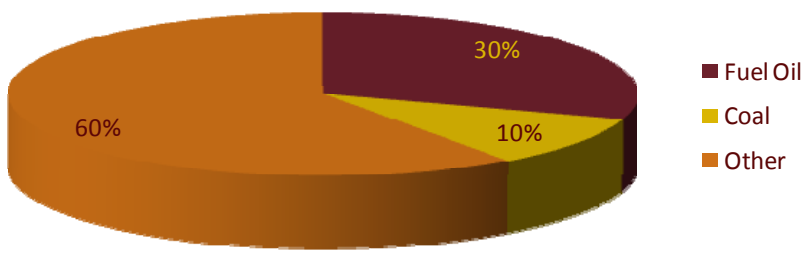
Among Industrial businesses, 91% of business space for primary use is heated, and a lower percentage of the space is cooled (46%). 90% of secondary space is heated and 78% cooled, and 100% of tertiary space is heated and 86% is cooled. 100% of common space is heated, and 78% is cooled.

TABLE 6–39: LARGE COMMERCIAL/INDUSTRIAL SPACE CONDITIONING CHARACTERISTICS

Space Conditioning Characteristics	Large Commercial	Industrial
% of Space for Primary Use	(n=20) 84%	(n=59) 80%
Heated	(n=21) 86%	(n=35) 91%
Cooled	(n=21) 67%	(n=59) 46%
% of Space for Secondary Space	(n=6) 18%	(n=37) 21%
Heated	(n=6) 100%	(n=20) 90%
Cooled	(n=6) 100%	(n=37) 78%
% of Space for Tertiary Space	(n=1) 5%	(n=7) 14%
Heated	(n=1) 0%	(n=4) 100%
Cooled	(n=1) 0%	(n=7) 86%
% of Space for Common Space	(n=9) 11%	(n=22) 6%
Heated	(n=10) 100%	(n=12) 100%
Cooled	(n=10) 80%	(n=23) 78%

A shown in Figure 6–6, almost 50% of the Large Commercial businesses (10 of 21) are not Nicor Gas heat customers; heat is provided by fuel oil (30%), coal (10%) and other (unspecified- 60%).

FIGURE 6–6: C&I FUEL FOR HEAT



Current Gas Usage

Heating and Cooling Systems

Large Commercial and Industrial businesses that use natural gas for space heating were asked what types of gas space heating units were used at the facility, how many units of each type of gas space heating they had, how much square footage (square feet) each unit heated, and the average age of each unit; the results are presented in Table 6–40.

80% of Large Commercial businesses have Steam Boilers with Steam Traps (each unit heating 9,500 square feet on average), while 42% of Industrial businesses use this type of heat (each unit heating 549 square feet); 30% of Large Commercial have Rooftop or Outdoor Package Units (each unit heating 8,000 square feet), while 33% of Industrial businesses have this type of heating (each unit

heating 6,150 square feet); 15% of Large Commercial have Indoor Gas Forced Air Furnaces (each unit heating 5,500 square feet), while 54% of Industrial businesses have this type of heating (each unit heating 5,125 square feet); 25% of Large Commercial have Indoor Unit Heaters (each unit heating 267 square feet), while 33% of Industrial have this type of heat (each unit heating 2,700 square feet); 25% of Large Commercial have Hot Water Boilers (each unit heating 6000 square feet) while 17% of Industrial businesses have this type of heat; 5% of Large Commercial have Combined Boiler and Water Heat (each unit heating 10,000 square feet), while 4% of Industrial businesses have this type of heat (each unit heating 5,000 square feet); 35% of Large Commercial businesses have Radiant Heaters (each unit heating 150 square feet), while 13% of Industrial businesses use this type of heat (each unit heating 600 square feet).

Steam Boilers with Steam Traps are the oldest heating systems, with units ranging from 20.1 to 34.4 years of age, followed by Radiant Heaters that average between 21.7 and 35.0 years of age, Indoor Unit Heaters from 17.7 to 27.5 years of age, Indoor Gas Forced Air Furnaces ranging between 11.0 and 20.0 years of age, Rooftop/Outdoor Package Units ranging between 8.3 and 23.5 year of age, Combined Boiler and Water heaters ranging from 5 to 10 years of age, and Hot Water Boilers ranging from 3 to 15.5 years of age.

Many natural gas space heating systems are older and present an efficient replacement opportunity for Nicor Gas.

TABLE 6–40: LARGE COMMERCIAL/INDUSTRIAL FURNACE CHARATERISTICS

Furnace Characteristics	Large Commercial n=20	Industrial n=24
Indoor Gas Forced Air Furnace	15%	54%
No. of Units/S.D.	4.5 σ0.71	3.2 σ1.88
Average S.F. heated/S.D.	5,500 σ6,363.96	5,125 σ3,193.18
Average Age of Unit #1/S.D.	20.0 σ-	17.0 σ12.29
Average Age of Unit #2/S.D.	11.0 σ12.73	16.5 σ12.97
Average Age of Unit #3/S.D.	11.5 σ0.71	17.7 σ12.91
Rooftop or Outdoor Package Unit	30%	33%
No. of Units/S.D.	5.8 σ3.35	3.1 σ2.54
Average S.F. heated/S.D.	8,000 σ4,000.00	6,150 σ4,263.21
Average Age of Unit #1/SD	18.0 σ12.36	11.2 σ9.72
Average Age of Unit #2/SD	16.5 σ11.56	8.3 σ10.12
Average Age of Unit #3/SD	21.0 σ7.94	10.0 σ8.66
Average Age of Unit #4/SD	23.5 σ9.19	11.0 σ7.94
Indoor Unit Heater	25%	33%
No. of Units/SD	7.7 σ4.04	2.7 σ1.70
Average S.F. heated/SD	267 σ288.68	2,700 σ1,483.24
Average Age of Unit #1/SD	25.0 σ22.91	17.7 σ8.45
Average Age of Unit #2/SD	25.0 σ22.91	17.7 σ12.01
Average Age of Unit #3/SD	26.7 σ22.55	18.0 σ16.97
Average Age of Unit #4/SD	27.5 σ31.82	DK
Hot Water Boiler	25%	17%
No. of Units/SD	1.8 σ0.50	2.3 σ2.31
Average S.F. heated/SD	6,000 σ5656.85	DK
Average Age of Unit of #1/SD	15.5 σ10.21	6.7 σ3.51
Average Age of Unit of #2/SD	10.7 σ4.04	3.0 σ-
Combined Boiler and Water Heater	5%	4%
No. of Units/SD	3.0 σ-	1.0 σ-
Average S.F. heated/SD	10,000 σ-	,5000 σ-
Average Age of Unit #1/SD	10.0 σ-	5.0 σ-
Average Age of Unit #2/SD	10.0 σ-	-
Radiant Heater	35%	13%
No. of Units/SD	8.3 σ2.89	2.7 σ1.15
Average S.F. heated/SD	150 σ70.71	600 σ346.41
Average Age of Unit #1/SD	32.5 σ24.75	21.7 σ7.64
Average Age of Unit #2/SD	35.0 σ21.21	21.7 σ7.64
Average Age of Unit #3/SD	35.0 σ21.21	30.0 σ-
Average Age of Unit #4/SD	35.0 σ21.21	30.0 σ-
Steam Boilers w/Steam Trap(s)	80%	42%
No. of Units/SD	4.0 σ1.83	2.4 σ1.01
Average S.F. heated/SD	9,500 σ1,000.00	549 σ637.81
Average Age of Unit #1/SD	34.4 σ16.44	20.1 σ17.33
Average Age of Unit #2/SD	30.0 σ17.69	24.5 σ15.43
Average Age of Unit #3/SD	26.6 σ15.68	24.3 σ16.17
Oter	5%	4%
Note: Where sample size is "1" standard deviation is not relevant and therefore is not provided ("σ-").		

Large Commercial and Industrial customers who own their buildings were asked about their chillers (see Table 6–41). 79% of the Large Commercial businesses have chillers, and 49% of Industrial businesses do so. The average age of chillers at Large Commercial businesses is 15.1 years, and at Industrial businesses is 13.4 years. The average tonnage is approximately 130% larger

for Large Commercial businesses (2,284 tons) than for Industrial (954 tons). Three-quarters of chillers are reported to be electric. Of those, chillers that are a gas system, approximately 1/2 are absorption systems.

While most of the chillers are electric powered, there are still gas powered chillers that could provide areas for energy efficient improvement. Controls might be one opportunity for efficient replacement if they are reaching the end of their useful lifetimes or re-commissioning if they are not.

TABLE 6–41: LARGE COMMERCIAL/INDUSTRIAL CHILLER CHARACTERISTICS

Chiller Characteristics	Large Commercial n=19	Industrial n=45
Chillers (Owns Building)	79%	49%
Tonnage/SD	2,284 σ1,938.82	954 σ1,497.89
Average Age/SD	15.1 σ12.96	13.4 σ9.12
Source of Power		
Electric	(n=13) 77%	(n=21) 76%
Gas	(n=13) 8%	(n=21) 14%
Hybrid	(n=13) 15%	(n=21) 10%
Type of Gas Chiller		
Absorption	(n=1) 0%	(n=2) 50%
Other (type not reported)	(n=1) 100%	(n=2) 50%

Hot Water Systems

Of those businesses that own their own buildings, 33% of Large Commercial respondents have gas hot water heaters, and 89% of Industrial businesses do so (see Table 6–42).

Of the Large Commercial businesses that have a gas hot water heater, 20% are conventional, 60% are indirect-fired storage tank/connected to a gas boiler, and 20% are "other." Of the industrial businesses that have a gas hot water heater, 64% are conventional, 17% are indirect-fired storage tank/connected to gas boiler, 8% are tankless on demand, and 11% are other.

Average age of primary gas water heaters are 18.0 for Large Commercial and 11.1 years of age for Industrial businesses. Large commercial customers have older gas water heaters and this may indicate an area for energy efficiency emphasis.

Of the 17 Industrial respondents with a multiple system, three did not know what type of unit it was, 47% said it was a conventional gas water heater, 18% said tankless on demand, and 18% said "other." The average age of the secondary natural gas water heater is 8.1 years, and three of the six conventional gas water heaters are Energy Star rated. Again, the water heaters may be reaching the

end of their useful lives over the next several years and thus, may be opportunities for efficiency upgrades in the near future.

TABLE 6–42: LARGE COMMERCIAL/INDUSTRIAL WATER HEATING CHARACTERISTICS

Water Heating Characteristics	Large Commercial n=18	Industrial n=44
Gas Hot Water Heater (Owns Building)	33%	89%
Single Unit	(n=5) 80%	(n=37)54%
Multiple Unit	(n=5) 20%	(n=37)46%
Type of Gas Hot Water Heater		
Conventional	(n=5) 20%	(n=36) 64%
Indirect-Fired Storage Tank/connected to gas boiler	(n=5) 60%	(n=36) 17%
Tankless, on-demand	-	(n=36) 8%
Other	(n=5) 20%	(n=36) 11%
Average Years of Age of Gas Water Heater/SD	18.0 σ18.59	11.1 σ11.94

Other Equipment

One-third of Large Commercial and Industrial customers who own their building have back up power supplies (32% each). Of those who do have backup power supplies, backup generators, reciprocating engines and turbines respectively, dominate the equipment mix. Details can be seen in Table 6–43.

Large Commercial customers are more likely than Industrial customers to have Heat Recovery equipment (58% versus 38% respectively). Steam heat recovery systems predominate, but there are significant percentages of Exhaust and Hot Water systems as well.

TABLE 6–43: LARGE COMMERCIAL/INDUSTRIAL MISCELLANEOUS EQUIPMENT

Miscellaneous Equipment	Large Commercial n=19	Industrial n=47
On Site Power Generation (Owns Building)	32%	32%
Back up Generator	100%	80%
Reciprocating Engine	67%	27%
Turbine	17%	13%
Prime Power	17%	7%
Other (type not reported)	-	7%
Heat Recovery Equipment (Owns Building)	58%	38%
Steam/SD	(n=10) 70%	(n=18) 50%
Exhaust/SD	(n=10) 30%	(n=18) 61%
Hot Water/SD	(n=10) 40%	(n=18) 39%
Other/SD	(n=10) 10%	(n=18) 39%

Industrial customers were asked about processes that used natural gas; those that were food service related as well as those with a Process Steam Boiler were presented with a series of follow up questions about number of units and age of units. Results are presented in Table 6–44.

41 out of 61 Industrial businesses used a process requiring natural gas. The leading use was Process Steam Boiler, at 68% (average number of units 2.6, age 21 years), followed by Drying and Curing at 41%, Oven at 27% (2.9 average units, 19.5 years of age), Running Compressors at 20%, Melting and Casting at 17%, Refrigeration at 15%, Fryer/Broiler at 15% (1.2 average units, 23.4 years of age), Heat Treating at 7%, Dishwasher Booster at 7% (1.7 average units, 11.0 years of age), Grill/Griddle at 5% (3.5 average units, 17.5 years of age), and Range at 5% (1.5 average units, 17.5 years of age).

The Industrial segment holds great opportunity for high energy efficient replacement of food preparation equipment. The average age of this equipment is old relative to typical normal life.

TABLE 6–44: LARGE COMMERCIAL/INDUSTRIAL OTHER GAS EQUIPMENT

Other Gas Equipment- Industrial	Respondents n=41	Average Number of units/SD	Average Age/SD
Other Gas Appliances – Industrial			
Food Service			
Oven	27%	2.9 σ2.88	19.5 σ10.37
Grill/Griddle	5%	3.5 σ3.54	17.5 σ10.61
Fryer/Broiler	15%	1.2 σ0.45	23.4 σ10.01
Range	5%	1.5 σ0.71	17.5 σ10.61
Dishwasher Booster	7%	1.7 σ0.58	11.0 σ1.41
Process Steam Boiler	68%	2.6 σ1.18	21.0 σ12.63
Has Steam Trap Maintenance Program	89%		
Drying and Curing	41%	NA	NA
Running Compressors	20%	NA	NA
Melting and Casting	17%	NA	NA
Heat Treating	7%	NA	NA
Refrigeration	15%	NA	NA

As seen in Table 6–45, 62% of Large Commercial businesses use a large amount of refrigeration, while just 10% of Industrial businesses do so. The most common type of refrigerators are refrigerated rooms (77% for Large Commercial, 83% for Industrial), followed by stand up models with doors (62% for Large Commercial, 50% for Industrial), floor units with opening tops (23% for Large Commercial and 17% for Industrial), and other (31% for Large Commercial, 17% for Industrial). Among those who have refrigerated rooms the average square footage is 4,115 for Large Commercial and 100,015 for Industrial.

TABLE 6–45: LARGE COMMERCIAL/INDUSTRIAL REFRIGERATION CHARACTERISTICS

Refrigeration Characteristics	Large Commercial n=21	Industrial n=60
Large Amount of Refrigeration	62%	10%
Type of Refrigerators	(n=13)	(n=6)
Stand up with Doors	62%	50%
Floor Units with Opening Tops	23%	17%
Refrigerated Rooms	77%	83%
Sq. Footage/sd	4,115	100,015 σ11,6763.66
Other/sd	σ6,587.08	17%
	31%	

Energy Efficiency Measures Adopted

Respondents who knew economic use and percentage of space used for primary, secondary, tertiary, and common space were asked if the space was heated/cooled, and if so, if heat and/or cooling setbacks or afterhours shutoff were ever used. Table 6–46 gives those results.

In the primary space, 44% of Large Commercial businesses used heat setback or afterhours shutoff (61% for Industrial) and 54% used cooling setbacks or afterhours shutoff (64% for Industrial); in the secondary space 83% of Large Commercial businesses used heat setbacks or afterhours shutoff (65% for Industrial) and 83% used cooling setbacks or afterhours shutoff (71% Industrial); in the tertiary space 75% of Industrial businesses used heating setbacks or afterhours shutoff, and 50% cooling setbacks or afterhours shutoff; in the common spaces 70% of Large Commercial businesses used heat setbacks or afterhours shutoff (82% Industrial), and 63% used cooling setbacks or afterhours shutoff (72% Industrial).

Three-quarters of businesses have a programmable thermostat for their heating system (74% Large Commercial and 73% Industrial). 55% of programmable thermostats in Large Commercial businesses are Energy Star rated, while 76% of those in Industrial businesses are. Two-thirds (67%) of Large Commercial businesses adjust their programmable thermostats by programming, while 75% of Industrial businesses do so.

Again, given the large use of programmable thermostats, there may be significant opportunity for re-commissioning activities within these sectors based their interest in controlling equipment.

TABLE 6–46: LARGE COMMERCIAL/INDUSTRIAL SPACE CONDITIONING TEMP CONTROL SATURATION

Space Conditioning Temperature Control	Large Commercial	Industrial
Primary Space		
Heat setback	(n=16) 44%	(n=28) 61%
AC setback	(n=13) 54%	(n=25) 64%
Secondary Space		
Heat setback	(n=6) 83%	(n=17) 65%
AC setback	(n=6) 83%	(n=28) 71%
Tertiary Space		
Heat setback	-	(n=4) 75%
AC setback	-	(n=6) 50%
Common Space		
Heat setback	(n=10) 70%	(n=11) 82%
AC setback	(n=8) 63%	(n=18) 72%
Programmable Thermostat for Heat System	(n=19) 74%	(n=33) 73%
Energy Star Rated	(n=11) 55%	(n=21) 76%
Adjust Thermostat		
Manually	(n=12) 33%	(n=24) 25%
Program	(n=12) 67%	(n=24) 75%

61% of Industrial businesses (among those that own their own building/complex and have a conventional gas water heater) have Energy Star rated water heaters, as seen in Table 6–47. Of those Industrial businesses who heat water with natural gas and have multiple unit systems (n=14), 57% have a secondary water heater that is a conventional natural gas unit, and of these 50% are Energy Star rated.

65% of Large Commercial businesses have computerized energy controls such as an EMS system, while 25% of Industrial businesses do so. Of those that do have such a system, 92% of Large Commercial businesses operate it at the local level (100% of Industrial); 8% operate it remotely. Again, re-commissioning might be a program option for Nicor Gas' offering with so much of the control at the local level.

71% of Large Commercial businesses have participated in an energy audit, and 57% have added energy conservation measures to their business such as extra roof insulation or low-energy windows. 51% of Industrial businesses have participated in an energy audit, and 43% have added energy conservation measures to their business such as extra roof insulation or low-energy windows.

TABLE 6–47: LARGE COMMERCIAL/INDUSTRIAL MISCELLANEOUS ENERGY EFFICIENCY ACTIVITIES

Miscellaneous Energy Efficiency Activities	Large Commercial (n=21)	Industrial (n=61)
Energy Star Rated Water Heater	DK	(n=18) 61%
Computerized Energy Control System	(n=20) 65%	(n=57) 25%
Operated at Local Facility	(n=13) 92%	(n=14) 100%
Operated Remotely	(n=13) 8%	(n=14) 0%
Energy Audit	71%	51%
Don't Know	5%	8%
Added Conservation Measures such as extra roof insulation or low-energy windows	57%	43%
Don't Know	5%	5%

Future Plans

Large Commercial respondents and Industrial-Heat respondents were asked about future plans or changes to their building shell and any anticipated lighting changes. All respondents were also asked about any change in their natural gas usage due to longer business hours during summer months, and equipment replacement. Responses are shown in Table 6–48.

40% of Large Commercial businesses and 9% of Industrial-Heat businesses anticipate building shell changes in the next 12 – 24 months, while 55% Large Commercial anticipate lighting changes (24% for Industrial-Heat). 40% of Large Commercial businesses say they will need to replace equipment in the next 12 – 24 months (15% for Industrial businesses), and of those 63% say the replacement will be natural gas using equipment (78% for Industrial businesses). 63% of Large Commercial businesses anticipate end of life equipment replacement that will provide opportunities for energy conservation or efficiency (29% for Industrial), and 82% of that equipment will use natural gas.

10% of Large Commercial businesses say they expect natural gas usage changes due to longer business hours as summer approaches, while 17% of Industrial businesses expect to do so.

TABLE 6–48: LARGE COMMERCIAL/INDUSTRIAL FUTURE PLANS

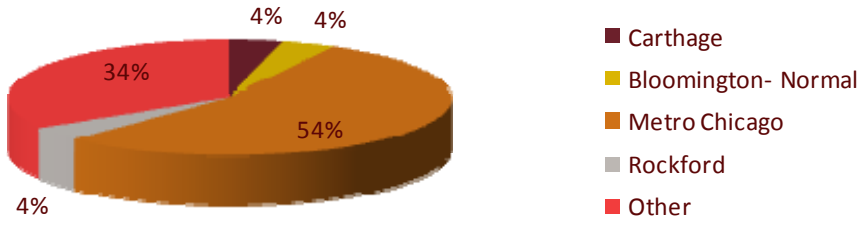
Future Activities	Large Commercial	Industrial (Heat)
Building Shell Changes in next 12 – 24 Months	(n=20) 40%	(n=34) 9%
Lighting Changes in next 12 – 24 Months	(n=20) 55%	(n=34) 24%
Natural Gas Usage Changes due to longer summer hours	(n=20) 10%	(n=35) 17%
Anticipate Equipment Replacement in next 12 – 24 Months	(n=20) 40%	(n=59) 15%
Equipment Using Natural Gas	(n=8) 63%	(n=9) 78%
Anticipating End of Life Equipment Replacement in next 12 – 24 months/positive to EE	(n=19) 63%	(n=59) 29%
Equipment Using Natural Gas	(n=11) 82%	(n=17) 82%
Anticipate Process Changes that Will Impact Nat. Gas Usage	NA	(n=59) 20%

RESIDENTIAL TRADE ALLIES

Company Characteristics

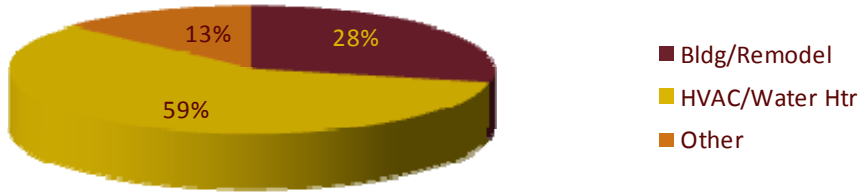
Of the 53 Residential Trade Allies surveyed, 54% are located in the Metro Chicago area, and two-thirds are within the Nicor service territory (please see Figure 6–7).

FIGURE 6–7: RESIDENTIAL TRADE ALLY BUSINESS LOCATIONS



Six of ten were classified as HVAC/Water Heater Suppliers, while three in ten are Builder/Remodelers (Figure 6–8).

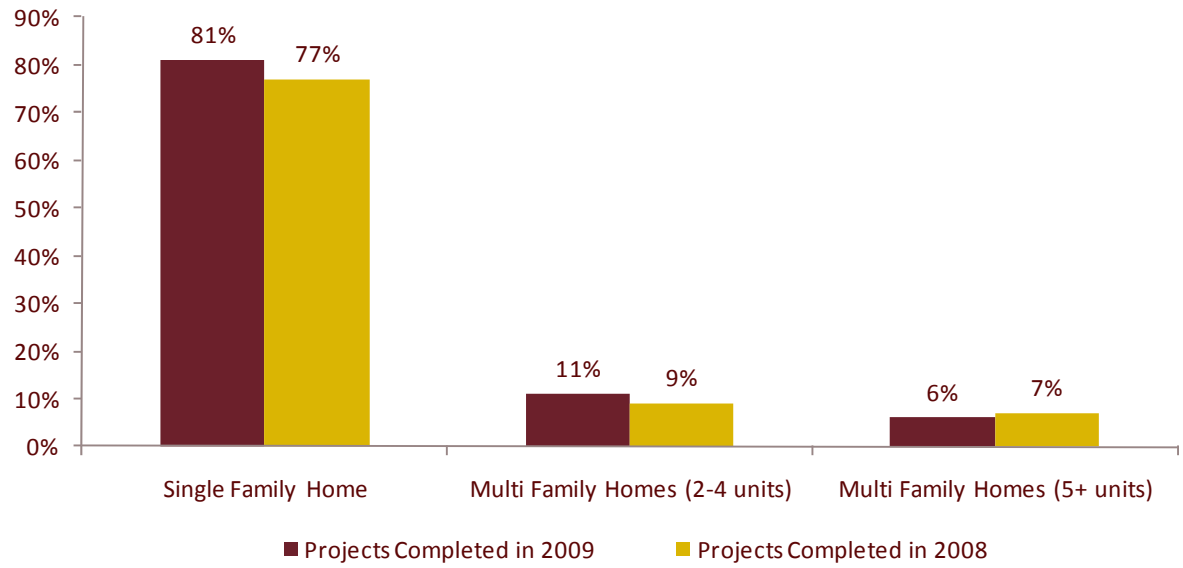
FIGURE 6–8: TYPES OF RESIDENTIAL TRADE ALLIES



Project Characteristics

As shown in Figure 6–9, the average number of projects completed in 2009 was 77.5 (56.7 σ), with a range of 3 to 150, and a median of 80. In 2008, the average number was 84.4 (57.07 σ), with a range of 3 to 150, and a median of 99.

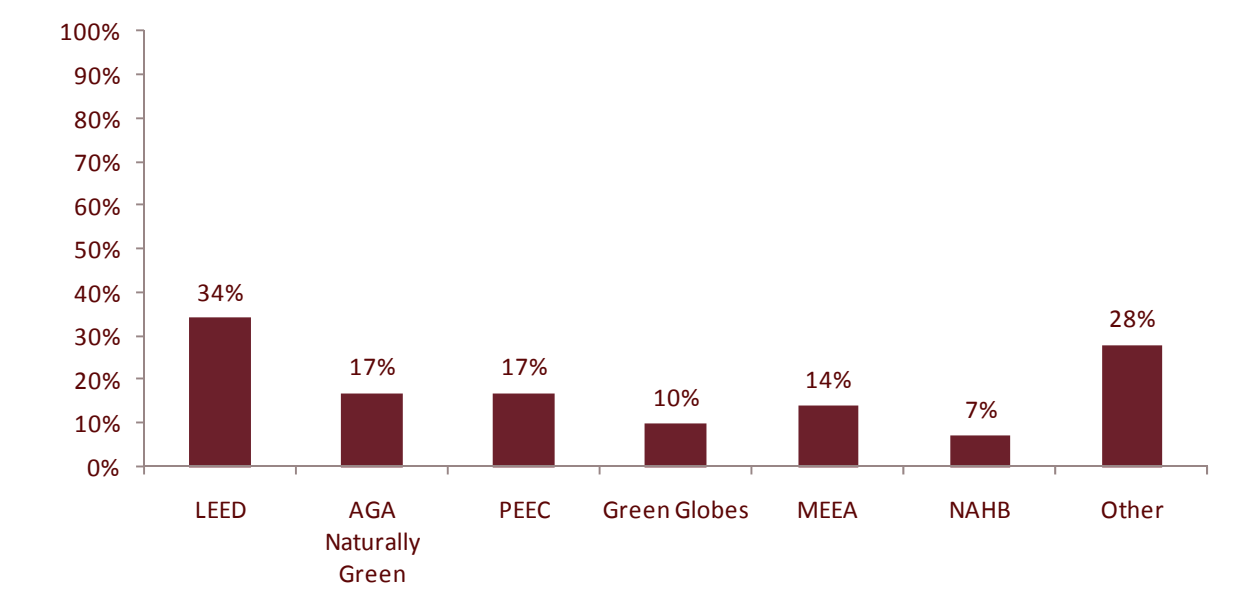
FIGURE 6–9: SIZE OF RESIDENTIAL TRADE ALLY PROJECTS



More than half of the Residential Trade Allies participate in a building certification program, with LEED the most frequently mentioned (see Figure 6–10).

Of the Single Family Home projects completed in 2008 and 2009, 52% were Energy Star Certified, and 40% of these were within the Nicor Gas service area. Those who have projects that are Energy Star Certified cite their reasons for participating as it is good for the environment, it allows them new marketing opportunities, and makes them eligible for the certification and national tax credits. The reasons given for not participating in the program by single family home builders include that it adds to the project cost, is too complicated, buyers are not interested, and upgrades are hard to get from suppliers in their area.

FIGURE 6–10: PARTICIPATION IN BUILDING CERTIFICATION PROGRAMS, RESIDENTIAL TRADE ALLIES



Energy Efficiency Measures Recommended

Eight out of ten surveyed residential trade allies recommended energy efficient measures for their existing or new home projects (see Table 6–49). The most commonly recommended measures included water heating, space heating and/or cooling, and some type of added insulation. When recommendations were not accepted, the primary reason given was cost.

TABLE 6–49: RESIDENTIAL TRADE ALLY MEASURE RECOMMENDATIONS

Measure Recommended	%
Energy Efficient Windows	30%
Energy Efficient Doors	25%
Attic Insulation	48%
Wall Insulation	41%
Floor Insulation	27%
Water Heater	91%
Space Heating and/or Cooling	80%

As seen in Table 6–50, those who recommended added insulation were also asked what R values they specified:

TABLE 6–50: RESIDENTIAL TRADE ALLY INSULATION R-VALUE RECOMMENDATIONS

R-Value	%
Attic-R Value	n=17
19	12%
30	29%
38	24%
39	12%
42	6%
49	6%
50	6%
60	6%
Walls-R Value	n=14
11	7%
12	14%
13	29%
15	14%
16	7%
19	29%
21	14%
Floors-R Value	n=9
4	22%
19	11%
21	11%
30	11%
38	11%

Roles and Responsibilities in Promoting Conservation, Energy Efficiency and Greenhouse Gas Reduction

Some Residential Trade Allies see their role as advising on energy efficient equipment. The statements listed below are typical of some of the comments received during the survey from these participants.

- "It's my responsibility to inform them what is available, what kind of money they can save and how I can help them with that."
- "Big priority, it is one of the big points I talk to customers about at every house I go to."
- "We view ourselves as being a source of information to educate homeowners as to what they need for their house and show them where they can save energy."

Some have based their business on this, and have a passion for it:

- "It's our business. I own an energy efficiency company; it's what I do for a living."
- "I'm certified by the National Association of Home Builders."
- "It's the right thing to do."

Others do not share this point of view and base their recommendations on the least costly measures, or are skeptics:

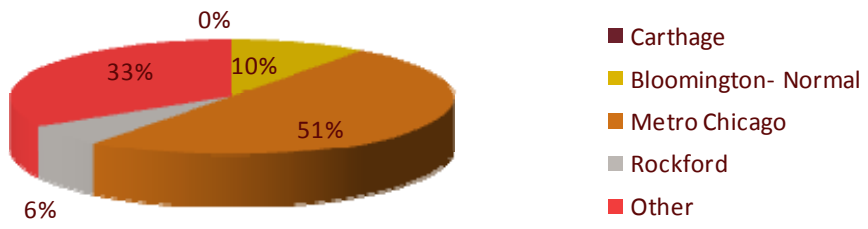
- "Our main concern is saving our customers money, more so than a global thing."
- "Until we see proven figures we don't subscribe to that theory."

COMMERCIAL TRADE ALLIES

Company Characteristics

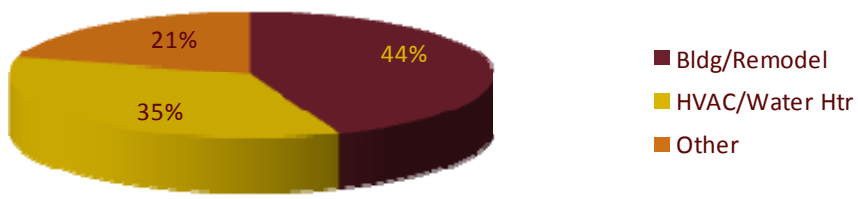
Of the 48 Commercial Trade Allies surveyed, 51% are located in the Metro Chicago area, and two-thirds are within the Nicor service territory, as shown in Figure 6–11.

FIGURE 6–11: COMMERCIAL TRADE ALLY BUSINESS LOCATIONS



Builders/Remodelers and HVAC/Water Heater businesses are well represented (Figure 6–12).

FIGURE 6–12: TYPES OF COMMERCIAL TRADE ALLIES

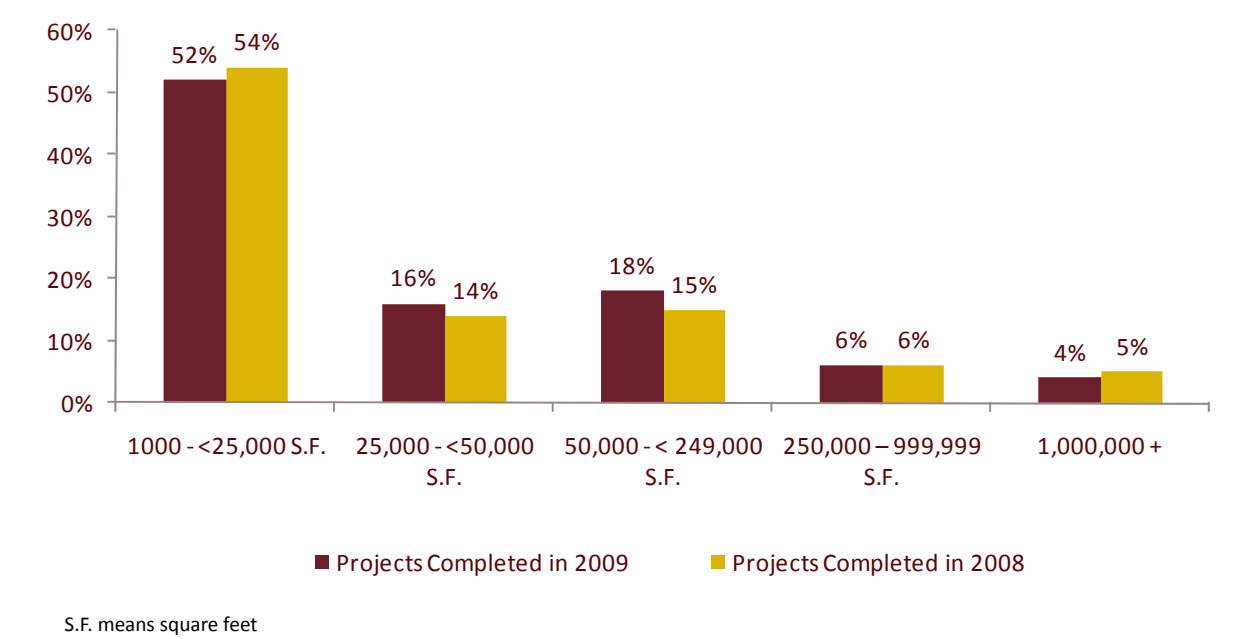


Project Characteristics

The average number of projects completed in 2009 was 56.6 with a range of between 1 and 150 projects, with a median of 33 (see Figure 6–13). In 2008, the average number was 68.4 with a range of 0 – 150 and a median of 50.

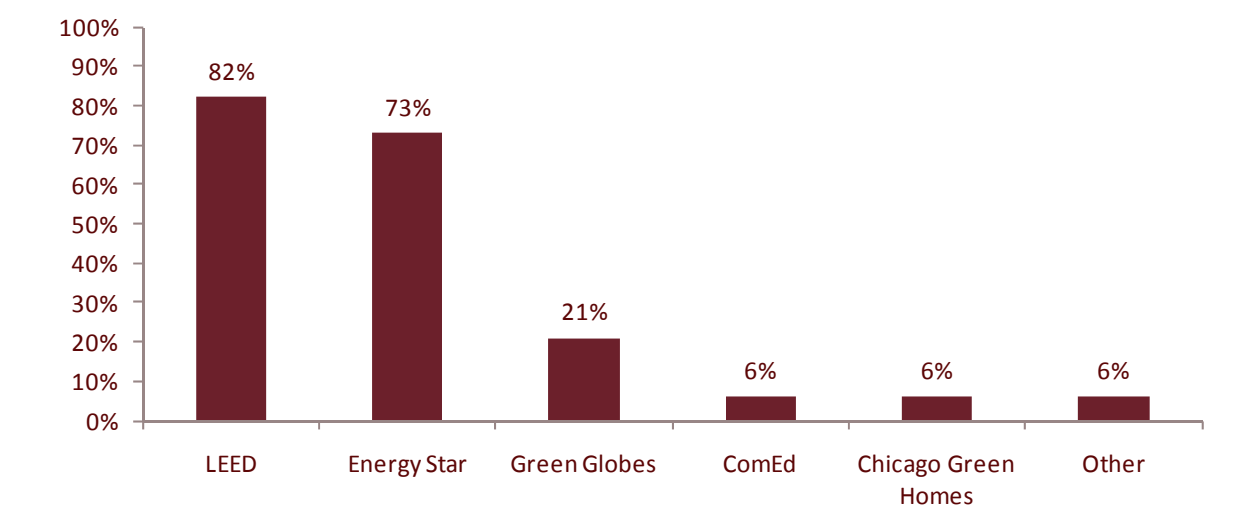
Of the projects completed in 2008 and 2009, 22% were characterized as high performance building projects, with one-third of them located in the Nicor Gas service area.

FIGURE 6–13: COMMERCIAL TRADE ALLY PROJECT SIZES



Two-thirds participated in some type of building certification program (shown in Figure 6–14); LEED and Energy Star were the most frequently mentioned.

FIGURE 6–14: COMMERCIAL TRADE ALLY PARTICIPATION IN BUILDING CERTIFICATION PROGRAMS



Energy Efficiency Measures Recommended

We see in Table 6–51 that eight out of ten recommended some kind of energy efficiency measures for existing buildings or new construction. Most popular are gas water heating, Energy Star labeled thermostats, and gas space heating.

TABLE 6–51: COMMERCIAL TRADE ALLY RECOMMENDED MEASURES FOR EXISTING BUILDINGS

Energy Efficiency Measure	%
Gas space heating	64 (n=22)
Steam Boilers >= 82% AFUE rating	41%
Furnace >= 92% AFUE rating	32%
Forced Hot Water Boilers >=85% AFUE rating	32%
Forced Hot Water Boilers >=90% AFUE rating	32%
Furnace >=90% AFUE rating	23%
Combined Boiler and Water Heating unit >= 90% AFUE rating	18%
Other	59%
Gas water heating	90% (n=32)
Indirect-fire storage tank models connected to gas heating system	38%
Tankless on-demand models with min.82 EF and electronic ignition	25%
Energy Star rated storage water heater min. 62 EF	34%
Other	47%
Natural gas, low intensity infrared heating units	64%
Energy Star labeled thermostats	74%
Building Envelope measures	49%
Other equipment	67% (n=21)
High efficiency natural gas-fired fryers	5%
High efficiency natural gas-fired large vat fryers	5%
High efficiency natural gas-fired warmers	10%
Other	90%

When asked about specific energy efficient building envelope measures, one-third offered a response, with windows and insulation most frequently cited (as seen in Table 6–52). When recommendations are not implemented by customers, the overwhelming reason was due to cost, primarily because payback periods did not justify the initial expense, or because the initial cost did not fit into the project budget. One Trade Ally mentioned that their primary barrier is "code acceptance of new technologies" by the state and local regulators.

TABLE 6–52: COMMERCIAL TRADE ALLY RECOMMENDED MEASURESFOR BUILDING ENVELOPE

Energy Efficiency Measure	%
Insulation	**38%**
Wall	19%
Minimum R19	6%
Roof	13%
Ceilings	13%
Minimum R38	6%
Blue jeans insulation (green technology)	6%
Foam	6%
Rigid	6%
Windows	**50%**
Glass with shading	19%
High Performance glass	6%
High efficiency	25%
Dual pane	6%
HVAC	**13%**
Capacity controls	6%
Weatherization	13%
Fields around doors/windows	6%
Roof	**19%**
R35 minimum	6%
Cool roof (white, light color)	6%
Reflective	6%
Lighting	**13%**
Shell	**31%**
Brick	6%
Precast concrete	6%
Stucco	6%
Sealing top edge	6%
Slab edge construction	6%
Partition building	6%
Warehouse doors	6%
Thermal brakes	6%
Other	**25%**
Blower door testing	13%
Gasketing exterior outlets	6%
Heat recovery	6%
To the state's requirements	6%

Roles and Responsibilities in Promoting Conservation, Energy Efficiency and Greenhouse Gas Reduction

Some Trade Allies see their role as one of advising and informing customers about their options, and matching customer requirements and budgets with appropriate recommendations. The following represent some of the comments expressed during the survey:

- "It's our responsibility to tell the owner what his options are and what his payback is going to be."
- "Sitting with the clients and planning out what their requirements and budgets are, and assisting in developing a strategy to meet the budget of the client and requirements."

A few expressed their passion for promoting these goals:

- "That's all I breathe and live."
- "I'm a LEED accredited professional."
- "As engineers and designers, we design to reduce carbon dioxide emissions and reduce overall energy consumption. I think we are in the forefront for that."

Several were skeptical, or didn't see any role or responsibility for themselves:

- "I don't see any (role/responsibility)."
- "Not the least bit interested in greenhouse gas reduction. I think it's an absolute joke."

One-half offered advice on how Nicor Gas could help educate customers about energy efficiency. Details can be found in Table 6–53.

TABLE 6–53: COMMERCIAL TRADE ALLY ADVICE OFFERED

Advice Offered	%
Information Provided	56%
Incentive programs	12%
Cost saving methods	8%
Brochures/pamphlets	8%
Average usage per home	8%
More information	4%
Support	24%
More programs for promotion of EE	8%
General	24%
More incentives/rebates	8%

Several asked for very specific information to assist them in providing the energy efficiency message to their clientele:

- "Some type of database with different buildings in it and their square footage and how much gas they use."
- "Comprehensive comparison between different forms of energy such as electrical and point-of-use renewables."
- "Cost savings from one system to another."
- "They can supply charts as far as how much gas is going to be saved in the long run."
- "Have their guys come out and size gas systems instead of leaving it to a contractor to figure out."

One ally asked that Nicor Gas allow for co-branding of their educational and marketing materials.

How Nicor Gas can Help Improve Efforts to Educate Customers about Energy Efficiency

Roughly half of the trade allies offered advice on how Nicor Gas could help educate customers about energy efficiency (see Table 6–54).

TABLE 6–54: COMMERCIAL TRADE ALLY ADVICE ON IMPROVING EDUCATION

Advice Offered	%
Information Provided	54%
Incentive programs	4%
Cost saving methods	8%
Brochures/pamphlets	17%
Average usage per home	4%
More information (unspecified)	8%
Support	29%
More programs for promotion of EE	8%
Training programs	8%
General	25%
More incentives/rebates	4%

Several Trade Allies asked for help presenting the energy savings potential:

- "Just explaining the savings involved in upgrading their old inefficient equipment."
- "Their efforts should concentrate on the end user, on their customers as opposed to myself, the contractor."

Some want very specific information:

- "Information about the correct sizing of duct work."
- "If we had a cross reference table for furnaces to gas for 60 versus 90."

One person felt strongly that Nicor Gas should not be involved in promoting energy efficiency:

- "Just because the system says high efficiency, it does not mean high efficiency. All the systems have to be tested and adjusted for optimal efficiency. 90% of all systems are oversized and about 90% of all homes have airflow problems. Until these are addressed, there will be no result from an energy efficiency program. Nicor and Nicor Gas Services should sell energy and stay out of the heating and air conditioning business."

7. Market Saturation within Regions

The project team reviewed the survey data within the four general regions assigned by Nicor Gas staff to the respondent data. Given the number of surveys completed within each region, the team is limited as to what conclusions can be drawn for specific service territory areas.

The groups with sufficient sample sizes to detect significant findings were found within Residential and Small-Mid Business. There was a sample size of just two respondents for Carthage in the Residential population, so only Bloomington Normal, Chicago Metro, and Rockford are compared. In the Small-Mid Business population only Chicago Metro and Rockford had sufficient sample to detect significant differences, and there were no differences.

Rockford (31%) is more likely than Chicago Metro (10%) to have Single Family-No Heat customers. The Bloomington-Normal (31%) region is more likely than either Chicago Metro (4%) or Rockford (13%) to have customers who live in mobile homes. Metro Chicago (30%) is more likely to have Multi Family- Heat than either Bloomington Normal (10%) or Rockford (16%), and is also more likely to have Multi Family-No Heat (16%) than Bloomington Normal (0%) or Rockford (1%).

Bloomington Normal has a higher percentage of single story houses (71%) than Chicago Metro (48%), and Chicago Metro has a higher percentage of two story houses (40%) than Bloomington Normal (24%). Houses in Rockford are more likely to have a basement (67%) versus those in Bloomington Normal (43%) or Chicago Metro (52%). Houses in Bloomington Normal (68%) and Rockford (64%) are more likely to be made of wood than those in Chicago Metro (41%), while those in Chicago Metro (47%) are more likely to be made of brick than those in Bloomington Normal (11%) and Rockford (23%).

Houses in the Bloomington Normal region are more likely to have insulation in their walls (100%) than houses in Chicago Metro (91%). Houses in Rockford are more likely to have a secondary heating source (19%) than those in Chicago Metro (9%).

A higher percentage of Bloomington Normal houses have their hot water heated with something other than natural gas (20%) than do houses in Chicago Metro (9%). Houses that use natural gas to heat water in Chicago Metro are more likely to have a central hot water system (15%) than those in Rockford (3%); however Rockford is more likely to have tankless on demand units (9%) than Chicago Metro (1%).

There is a higher average number of programmable thermostats in the Chicago Metro (0.8) than in Rockford (0.6). A higher percentage of households have done some kind of weatherization on their own in Bloomington Normal (52%) than in Chicago Metro (30%).

Chicago Metro has a higher percentage of households that have a natural gas dryer present (74%) than either Bloomington Normal (44%) or Rockford (51%). Chicago Metro households are also more likely to use natural gas for cooking (86%) than those in Bloomington Normal (67%) or Rockford (69%).

There is higher awareness of Energy Star in Chicago Metro (77%) and Rockford (83%) than in Bloomington Normal (60%).

Average income is higher in Chicago Metro ($74,699) than in Rockford ($53,722).

Customers in Bloomington Normal have a preference for receiving program information about energy efficiency as a piece of mail addressed to them (61%) than do Chicago Metro customers (44%), while Chicago Metro customers prefer email (23%) compared with Bloomington Normal (5%).

8. Energy Efficiency Measures Analyses

Utilizing the information gained through the Market Assessment Survey and analyses presented in this Report, the project team initiated a review of available and reasonable energy efficiency measures that might prove to be useful for implementation within the Nicor Gas service territory. Whether the measure has not gained market acceptance due to lack of knowledge by the consumers, the cost is prohibitive based on consumer economic criteria, or the measure lacks market availability, these issues were considered when reviewing each measure.

A lengthy list of possible energy efficiency measures were developed based on the project team's professional experience, the Nicor Gas staff recommendations, and other utility programs around the country. Each market sector-Residential, Commercial, and Industrial were addressed and measures lists provided to the project advisory team for further assessment. Note: The commercial measures were assessed in combination with the industrial after the technical screen was accomplished since there is so much overlap in application between the sectors.

The lists were presented to the team within a technical screening matrix by market sector. This screening matrix consisted of a review of measure characteristics based upon measure technical purpose and impact as well as Nicor Gas energy efficiency goals and objectives. The technical screening criteria included the following: total energy reduction potential, winter energy reduction potential, measure offered in other regional utility programs, measure is available in the marketplace, measure cost is low for buyer, the infrastructure is already in place to deliver, and are there environmental impacts associated with the measure use or disposal. Each category was reviewed and scored by the project team and Nicor Gas staff experts based on a scale of 1 to 3 where 1 represented low potential/low applicability and 3 representing high potential/high applicability. The purpose of the screen was to jointly determine what the top measures might be for further study for Nicor Gas and which measures could be eliminated that were not applicable for Nicor Gas customers.

The advisory project members from Nicor Gas and the project team scored each measure within each market segment individually and all members' scores were accumulated and average scores calculated. The average scores were then sorted from high to low to determine what the top third, middle third, and low third of the measures were. The initial idea was that the project team would economically screen the top third of the measures, but upon detailed team discussion, most of the measures proceeded to the economic screen.

The appendices include the basic scoring matrix per market segment.

ENERGY EFFICIENCY MEASURES ASSESSED

The following tables show the summarized list of measures addressed in the market potential study for the market segments (residential, commercial, and industrial). They are ordered here based on their relative benefit-cost ratio-BCR), assessed as individual measures rather than programs. Program groupings and analysis took place later in the process.

The Benefit-Cost Ratio was computed on a measure-by-measure basis to provide the project team with a sense of where concentration should be placed when developing measure cost and impact data. The BCR computed was the Total Resource Cost (TRC) ratio, which is required by the Illinois Commerce Commission for review of energy efficiency programs. The analytical process involved use of the standard California Public Utilities Commission algorithm for computing the TRC[6] but did not include the inputs that are applicable to program analysis such as incentive amounts, administrative costs, environmental impacts, etc. as they are not relevant in a measure analysis. The project team computed the BCR for each measure to aid in finding which measures are so cost-beneficial that they probably will need no or little incentive to promote in the Nicor Gas service territory and to allow us to rank each measure for comparison to other measures. This is useful for validating measure impacts and costs as well as in later grouping measures into programs. The team also computed and ranked the measures to allow for a systematic listing of measures for the report reviewer. No measures were excluded for further analysis due to the BCR initially computed and all measures analyzed are shown in ranked lists for the separate market segments listed below.

TABLE 8–1: RESIDENTIAL MEASURES SORTED BY BCR

Residential Measures	Description	BCR
Solar Pool Cover	Insulating Cover on Pool	17.85
Upgrade Gas Hearth	Upgrade hearth from 0.59 EF to 0.72 EF	6.51
Multi-Family Corridor Ventilation Retrofit	Install timer controls on corridor ventilation, applies to recent construction, such as condos. Retrofit.	5.72
Combo heat and hot water replacement.	Replace furnace with combo water heater and hydrocoil system	5.48
High Efficiency Gas Furnace. Replacement	Upgrade furnace to Annual Fuel Utilization rating (AFUE) 0. 95, applies to replacement market.	5.43
Multi-Family Corridor Ventilation New	Install timer controls on corridor ventilation. New construction.	5.40
Combo heat and hot water replacement. New.	Replace furnace with combo water heater and hydrocoil system for new construction.	4.62
Efficient clothes washer. New.	Replace clothes washer with Energy Star unit rated at Modified Energy Factor (MEF) 2.0, applies to new market.	4.45
Efficient clothes washer. Replacement.	Replace clothes washer with Energy Star unit rated at Modified Energy Factor (MEF) 2.0, applies to replacement market.	4.09
Energy Star Package: Includes Insulation, Ducts, Domestic Hot Water, Lights Gas	Full package promoted by Energy Star. Gas measures include insulation, duct sealing, efficient water heater. Also includes electric lighting.	3.89

[6] *California Standard Practice Manual: Economic Analysis Of Demand-Side Programs and Projects*, October 2001, California Energy Commission, California Public Utilities Commission, October 2001, updated July 2007.

Residential Measures	Description	BCR
Retrofit Duct Sealing	Blower door assisted duct sealing for 15% improvement in delivery efficiency.	3.76
Retrofit Programmable Thermostat	Implement night setback with programmable thermostat	3.69
Heat Recovery Ventilation	Heat Recovery Ventilation (HRV) with a low volume continuous operating system, e.g. Panasonic. Also includes blower door assisted air sealing beyond current practice.	3.50
High Efficiency Clothes Washer.New.	Replace clothes washer with Energy Star unit rated at Modified Energy Factor (MEF) 2.2, applies to new market.	3.17
High Efficiency Clothes Washer. Replacement	Replace clothes washer with Energy Star unit rated at Modified Energy Factor (MEF) 2.2., applies to replacement market.	2.99
Low Flow Shower	Install low flow shower reduction from 2.50 gpm to 2.00 gpm. Includes program delivery cost.	2.99
Solar Pool Heat	Install solar pool heating panels.	2.84
Weatherization-Insulation Upgrade Floor >R19	Install under floor batt insulation, applies to crawl space applications.	2.24
Weatherization Air Sealing	Blower door assisted air sealing program.	2.03
Upgrade to forced draft tank. New	Upgrade water heater to forced draft unit, such as AO Smith VERTEX, applies to new market.	1.75
Upgrade to forced draft tank. Replacement.	Upgrade water heater to forced draft unit, such as AO Smith VERTEX, applies to replacement market.	1.66
Window U=.2. New	Upgrade windows from U 0.32 to U 0.20. New Construction.	1.65
Combo heat and hot water replacement using Polaris heater. Replacement.	Replace furnace and water heater with combo Polaris water heater and hydrocoil system at time of furnace replacement..	1.41
Condensing Tankless Water Heater. New	Replace water heater with condensing tankless on-demand heater, such as Navien unit, applies to new market.	1.40
Condensing Tankless Water Heater. Replacement	Replace water heater with condensing tankless on-demand heater, such as Navien unit, applies to replacement market.	1.33
EnergyStar Dishwasher. Replacement.	Replace dishwasher with Energy Star unit, applies to replacement market.	1.26
EnergyStar Dishwasher. New	Replace dishwasher with Energy Star unit, applies to new market.	1.22
Domestic Hot Water Pipe Wrap, Heat Traps	Install heat trap and pipe insulation to exposed pipe in vicinity of water heater.	1.20
Near Net Zero House Design	House design for highest possible savings, with goal of being “net zero” energy consumption if photovoltaic panels are added. Applies to new construction.	1.20
Combo heat and hot water replacement using Polaris heater. New.	Replace furnace and water heater with combo Polaris water heater and hydrocoil system at time of new construction.	1.18
Duct Sealing after furnace	Blower door assisted duct sealing for 15% improvement in delivery efficiency. Assumes furnace has already been upgraded to Annual Fuel Utilization rating (AFUE) rating of 0.92.	1.05
Weatherization Insulation Upgrade Attic >R38	Install blown cellulose insulation to R38 level.	1.02
Plumbing Package	Install low-flow shower, aerators and pipe wrap measures as package.	0.93
Weatherization Upgrade Wall to R11	Install blown cellulose insulation to R11 level, application limited to walls without current insulation.	0.91
Tankless Gas heater. New	Replace water heater with tankless on-demand heater, such as Takagi or Rinnai unit, applies to new market.	0.90
Low Flow Faucet Aerator	Install low flow faucet aerators, reduction from 1.20 gal. per min. to 1.00 gal. per min.	0.87
Tankless Gas heater. Replacement	Replace water heater with tankless on-demand heater, such as Takagi or Rinnai unit, applies to replacement market.	0.85

Residential Measures	Description	BCR
Weatherization Upgrade Window >CL 20	Retrofit replacement of existing windows with average U 0.78 with U 0.20.	0.79
Heat Recovery Ventilation , Energy Star	Heat Recovery Ventilation (HRV) with a low volume continuous operating system, e.g. Panasonic. Applies to home already meeting requirements for Energy Star Package.	0.69
High Efficiency Gas Furnace. New	Upgrade furnace to Annual Fuel Utilization rating (AFUE) 0. 95, applies to new market.	0.65
Water Heater Upgrade. New	Upgrade water heater from Energy Factor rating (EF) 0. 58 to 0.62, applies to new market.	0.61
Weatherization Upgrade Window >CL 30	Retrofit replacement of existing windows with average U 0.78 with U 0.30.	0.58
Water Heater Upgrade. Replacement.	Upgrade water heater from Energy Factor rating (EF) 0. 58 to 0.62, applies to replacement market.	0.56
Efficient Replacement Boiler	Replace boiler with Energy Star unit with Annual Fuel Utilization rating (AFUE) 0. 85, applies to replacement market.	0.46
Solar hot water heater (50 gal) - With gas backup. New	Add solar water heater to gas water heater in new construction.	0.33
Solar hot water heater (50 gal) - With gas backup. replacement	Add solar water heater to gas water heater at time of replacement.	0.33
Replace DHW with Heat Pump WH	Replace gas water heater with electric heat pump water heater.	0.30
Retrofit Boiler	Retrofit replacement of boiler with Energy Star unit with Annual Fuel Utilization rating (AFUE) 0. 85.	0.27
Solar Siting	Urban planning to maximize passive solar gains. Applies to new homes that are already well insulated.	0.05
Residential Zoned Controls	Retrofit heating system with computer operated zonal controls.	0.03

TABLE 8–2: COMMERCIAL MEASURES SORTED BY BCR

Measure Name	Measure Description	Construction Type	Measure End Use	BCR
Energy Star Convection Oven	Replace with Energy Star in place of conventional	Replace	Cooking	100.00
Energy Star Convection Oven	Install Energy Star in place of conventional	New	Cooking	100.00
Retrofit HVAC System Commissioning	HVAC system commissioning. Includes testing and balancing, damper settings, economizer settings, and proper HVAC heating and compressor control installation. This measure includes the proper set-up of single zone package equipment in simple HVAC systems. The majority of the Commercial area is served by this technology.	Retrofit	Heating	42.41
Efficient Energy Star Dishwasher	Install Energy Star in place of conventional dishwasher	New	Water Heat	14.28
Efficient Energy Star Dishwasher	Retrofit with Energy Star in place of conventional dishwasher	Retrofit	Water Heat	14.28
Ozone Laundry Treatment	Ozone treatment allows use of cold water	Replace	Water Heat	14.00

Measure Name	Measure Description	Construction Type	Measure End Use	BCR
Fleet Demand Control Ventilation	Applies to Big Box Retail with multiple roof top units units-Gang of 5~25000 sf. Dedicate one unit to provide all outside ventilation air and leave other units to operate on return air. All ventilation air through a single unit with a DCV control at 20% minimum and 100% maximum. Fan operates continuously for that unit and cycles on demand for the other units. This optimizes conditioning of outside air for whole facility.	Retrofit	Heating	13.55
Hot Water Boiler Tune	Tune up in accordance with Minneapolis Energy Office protocol. Can include derating the burner, adjusting the secondary air, adding flue restrictors, cleaning the fire-side of the heat exchanger, cleaning the water side, or installing turbulators. Other modifications may include uprating the burner to reduce oxygen or derating the burner to reduce stack temperature. Note: In gas systems, excess air and stack temperatures are often within reasonable ranges, so the technical potential for this measure is limited. Combining this measure with the vent damper and power burner measures increases both applicability and cost effectiveness, and was assumed for this analysis.	Retrofit	Heating	12.90
Hot Water Temperature Reset	Controller automatically resets the delivery temperature in a hot water radiant system based on outside air temperature. The reset reduces the on-time of the heating equipment and the occurrence of simultaneous heating and cooling through instantaneous adjustments.	Retrofit	Heating	11.50
Waste Water Heat Exchanger	Install Heat Exchanger on waste water	New	Water Heat	9.71
Waste Water Heat Exchanger	Install Heat Exchanger on waste water	Retrofit	Water Heat	9.16
Steam Balance	Single-pipe steam systems are notorious for uneven heating, which wastes energy because the thermostat must be set to heat the coldest spaces and overheating other spaces. Steam balances corrects these problems by: 1) Adding air venting on the main line or at the radiators; 2) Adding boiler cycle controls; 3) Adding or subtracting radiators. Energy savings accrue from lowering the overall building temperature.	Retrofit	Heating	8.07
Roof Insulation - Attic R0-30	Roof Insulation - Attic R0-30. Application: Buildings with uninsulated attics	Retrofit	Heating	7.50
Domestic Hot Water Shower Heads	Install low flow shower heads (2.0 gallons per minute) to replace 3.4 GPM shower heads.	Retrofit	Water Heat	6.68
High Efficiency Unit Heater (replace)	Install power draft units (80% seasonal Eff.) in place of natural draft (64% seasonal Eff.)	Replace	Heating	5.86
Computerized Water Heater Control	Install intelligent controls on the hot water circulation loops.	New	Water Heat	5.83
Computerized Water Heater Control	Install intelligent controls on the hot water circulation loops.	Retrofit	Water Heat	5.64
Domestic Hot Water Wrap	Insulate the surface of the storage water heater or an unfired storage tank to R-5 to reduce standby losses.	Retrofit	Water Heat	4.96
Wall Insulation - Blown R11	Wall Insulation - Blown R11. Application: Old buildings	Retrofit	Heating	4.77

Measure Name	Measure Description	Construction Type	Measure End Use	BCR
Demand Control Ventilation	Applicable to single zone packaged systems with large make -up air fractions either because of intermittent occupancy or because of code requirements. In most cases the outdoor air is reset to 5% or less with CO2 build-up modulating ventilation.	Retrofit	Heating	4.66
Roof Insulation - Rigid R0-11	Roof Insulation - Rigid R0-11-not including re-roofing costs but including deck preparation. Application: Old buildings with flat roofs and no attics	Replace	Heating	4.62
Heat Reclaim	Large Grocery - Heat recovery to space heating. Assumes floating head control exists and must be changed to allow HR.	New	Refrigeration	4.13
Heat Reclaim	Large Grocery - Heat recovery to space heating. Assumes floating head control exists and must be changed to allow HR.	Replace	Refrigeration	4.04
Energy Star Commercial Clothes Washer	Install high performance commercial clothes washers - residential sized units	Replace	Water Heat	3.92
Wall Insulation - Spray On for Metal Buildings	Wall Insulation - Spray On for Metal Buildings (Cellulose) Unfinished. Application: Old buildings	Retrofit	Heating	3.82
Vent Damper	Install vent damper downstream of the draft relief to prevent airflow up the stack, while allowing warm air from the boiler to spill into the conditioned space as heat or into the boiler room to reduce jacket losses. This measure is most cost-effective when combined with the boiler tune up and power burner measures.	Retrofit	Heating	3.42
Replace Space Conditioning Boiler with efficient unit	Install near condensing boiler. Assumed seasonal combustion efficiency of 82% over base of 75%	Replace	Heating	3.26
Roof Insulation - Blanket R0-19	Roof Insulation - Blanket R0-19. Application: Buildings with open truss unfinished interior	Retrofit	Heating	3.18
Roof Insulation - Rigid R0-22	Roof Insulation - Rigid R0-22-- not including re-roofing costs but including deck preparation and ~4" rigid. Application: Old buildings with flat roofs and no attics	Replace	Heating	3.05
Roof Insulation - Blanket R0-30	Roof Insulation - Blanket R0-30. Application: Buildings with open truss unfinished interior	Retrofit	Heating	2.97
Condensing Furnace (new)	Condensing / pulse package or residential-type furnace with a minimum AFUE of 92%.	New	Heating	2.91
New Space conditioning boiler.	Install near condensing boiler. Assumed seasonal combustion efficiency of 82% over base of 75%	New	Heating	2.48
Combo Hi-Efficiency Boiler (new)	Replace existing boiler with unit meeting 85% combustion efficiency.	New	Heating	2.39
Replace space conditioning Boiler with condensing unit	Install condensing boiler. Assumed seasonal combustion efficiency of90% over base of 75%	Replace	Heating	2.33
Windows - Add Low E to Vinyl Tint	Windows - Add Low E to Vinyl Tint. Application: Old buildings	Replace	Heating	2.32
Domestic Hot Water High Efficiency Boiler (new)	Replace existing boiler with unit meeting 85% combustion efficiency.	New	Water Heat	2.32
Domestic Hot Water Faucets	Add aerators to existing faucets to reduce flow from 3.4 gallons per minute to 2.0 GPM.	Retrofit	Water Heat	2.30

Measure Name	Measure Description	Construction Type	Measure End Use	BCR
Domestic Hot Water High Efficiency Boiler (replacement)	Replace existing boiler with unit meeting 85% combustion efficiency.	Replace	Water Heat	2.29
Domestic Hot Water Condensing Tank (new)	Costs and savings are incremental over a Code-rated tank (combustion efficiency of 80%) for a condensing tank with a minimum combustion efficiency of 94% and an R-16 tank wrap.	New	Water Heat	2.11
Combo High Efficiency Boiler (replacement)	Replace existing boiler with unit meeting 85% combustion efficiency for combined heat and hot water boiler.	Replace	Heating	2.08
Roof Insulation - Rigid R11-22	Roof Insulation - Rigid R11-22 2" rigid added to an existing foam roof insulation at re-roof, includes some surface prep. Application: Old buildings with flat roofs, no attics, and some insulation	Replace	Heating	2.06
Roof Insulation - Attic 11-30	Roof Insulation - Attic 11-30. Application: Buildings with partially insulated attics	Retrofit	Heating	2.06
Destratification Fan	Destratification fan reduces heat load	Retrofit	Heating	2.03
Hot Food Holding Cabinet	Install Energy Star in place of conventional	Replace	Cooking	2.00
Ducts	Duct retrofit of both insulation and air sealing	Retrofit	Heating	1.96
Domestic Hot Water Condensing Tank (replacement)	Costs and savings are incremental over a Code-rated tank (combustion efficiency of 80%) for a condensing tank with a minimum combustion efficiency of 94% and an R-16 tank wrap.	Replace	Water Heat	1.90
Replace space conditioning Boiler with condensing unit	Install condensing boiler. Assumed seasonal combustion efficiency of 90% over base of 75%	New	Heating	1.90
Hot Food Holding Cabinet	Install Energy Star in place of conventional	New	Cooking	1.84
Energy Star Griddle	Install Energy Star in place of conventional	New	Cooking	1.76
Windows - Add Low E and Argon to Vinyl Tint	Windows - Add Low E and Argon to Vinyl Tint. Application: Old buildings	Replace	Heating	1.75
Energy Star Griddle	Replace with Energy Star in place of conventional	Replace	Cooking	1.75
Power burner	Replace standard burner with a power burner to optimize combustion and reduce standby losses in the stack. Note: Costs and savings assume that this measure will be performed in conjunction with a boiler tune up when appropriate.	Retrofit	Heating	1.73
Domestic Hot Water Condensing Boiler (new)	Replace with boiler using condensing or pulse technology to achieve steady-state combustion efficiencies of 89% to 94% (this analysis used 90% efficiency for savings calculations).	New	Water Heat	1.69
Domestic Hot Water Condensing Boiler (replacement)	Replace with boiler using condensing or pulse technology to achieve steady-state combustion efficiencies of 89% to 94% (this analysis used 90% efficiency for savings calculations)., for combined heat and hot water boiler.	Replace	Water Heat	1.67
Domestic Hot Water Pipe Insulation	Add 1" insulation to pipes used for steam or hydronic distribution; particularly effective when pipes run through unheated spaces.	Retrofit	Water Heat	1.42

Measure Name	Measure Description	Construction Type	Measure End Use	BCR
Combo Condensing Boiler (new)	Replace with boiler using condensing or pulse technology to achieve steady-state combustion efficiencies of 89% to 94% (this analysis used 90% efficiency for savings calculations).	New	Heating	1.37
Hi-Efficiency Unit Heater (new)	Install power draft units (80% seas. Efficiency) in place of natural draft (64% seas. Efficiency)	New	Heating	1.28
Solar Hot Water	Install solar water heaters on large use facility such as multifamily or lodging	New	Water Heat	1.25
Solar Hot Water	Install solar water heaters on large use facility such as multifamily or lodging	Retrofit	Water Heat	1.21
Combo Condensing Boiler (replacement)	Replace with boiler using condensing or pulse technology to achieve steady-state combustion efficiencies of 89% to 94% (this analysis used 90% efficiency for savings calculations), for combined heat and hot water boiler.	Replace	Heating	1.20
Windows - Tinted AL Code to Class 45	Windows - Tinted AL Code to Class 45. Application: Old buildings	Replace	Heating	1.16
Condensing Unit Heater From Power Draft (new)	Install condensing power draft units (90% seasonal Efficiency) in place of power draft (80% seasonal Efficiency)	New	Heating	1.13
Windows - Tinted AL Code to Class 40	Windows - Tinted AL Code to Class 40. Application: Old buildings	Replace	Heating	1.11
Domestic Hot Water Recirculating Controls	Install electronic controller to hot water boiler system that turns off the boiler and circulation pump when the hot water demand is reduced (usually in residential type occupancies) or can be reset to meet the hot water load. (Steel boilers also require a mixing valve to prevent water temperatures from dropping below required levels).	Retrofit	Water Heat	1.08
HVAC controls	Control set up and algorithm. This assumes the development of an open source control package aimed at describing scheduling and control points throughout the HVAC system, properly training operators so that scheduling can be maintained and adjusted as needed, and providing operator back up so that temperature reset, pressure reset, and minimum damper settings are set at optimum levels for the current occupancy.	New	Heating	1.03
Condensing Unit Heater from power draft (replacement)	Install condensing power draft units (90% seasonal Efficiency) in place of power draft (80% seasonal Efficiency)	Replace	Heating	0.99
Steam Trap Maintenance	Set up a in-house steam trap maintenance program with equipment, training, and trap replacement. An alternative procedure is to just pay for an outside contractor to conduct a steam survey.	Retrofit	Heating	0.89
Condensing Unit Heater from NaturalDraft (new)	Install condensing power draft units (90% seas. Eff) in place of natural draft (64% seas. Eff)	New	Heating	0.88
Roof Insulation - Roofcut 0-22	Roof Insulation - Roofcut 0-22. Application: Buildings with uninsulated flat roofs at reroofing time	Replace	Heating	0.83
Windows - Tinted AL Code to Class 40	Windows - Tinted AL Code to Class 40. Application: New Construction	New	Heating	0.82
Condensing Unit Heater from Natural draft (replace)	Install condensing power draft units (90% seas. Eff) in place of natural draft (64% seas. Eff)	Replace	Heating	0.77

Measure Name	Measure Description	Construction Type	Measure End Use	BCR
Condensing Furnace	Condensing / pulse package or residential-type furnace with a minimum AFUE of 92%.	Replace	Heating	0.73
Energy Star Steam Cooker	Install EStar in place of conventional	New	Cooking	0.73
Energy Star Steam Cooker	Replace with EStar in place of conventional	Replace	Cooking	0.73
Windows - Add Argon to Vinyl Lowe	Windows - Add Argon to Vinyl Lowe. Application: Old buildings	Replace	Heating	0.72
Rooftop Condensing Burner	Install condensing burneron rooftop unit (currently at prototype stage, no product yet on the market)	Retrofit	Heating	0.69
Roof Insulation - Rigid R11-33	Roof Insulation - Rigid R11-33: add 4' of insulation at reroof. Application: Old buildings with flat roofs, no attics, and some insulation	Replace	Heating	0.63
Warm Up Control	This measure is designed to implement a shutdown of outside air when the building is coming off night setback. Usually the capability for this is available in a commercial t-stat but either the extra control wire is not attached or the unit itself has not been set up to receive the signal. Cost is based on labor cost to enable this ability in existing controllers	Retrofit	Heating	0.63
Integrated Building Design	Generic, based on design to LEED considerations.	New	Heating	0.59
Windows - Tinted AL Code to Class 36	Windows - Tinted AL Code to Class 36. Application: Old buildings	Replace	Heating	0.57
HVAC System Commissioning	HVAC system commissioning. Includes testing and balancing, damper settings, economizer settings, and proper HVAC heating and compressor control installation. This measure includes the proper set-up of single zone package equipment in simple HVAC systems. The majority of the Commercial area is served by this technology. Work done in Eugene (Davis, et al, 2002) suggests higher savings than the other documented commissioning on more complex systems.	New	Heating	0.54
Windows - Non-Tinted AL Code to Class 40	Windows - Non-Tinted AL Code to Class 40. Application: Old buildings	Replace	Heating	0.47
Roof Insulation - Blanket R11-41	Roof Insulation - Blanket R11-41. Application: Buildings with open truss unfinished interior	Retrofit	Heating	0.46
Windows - Non-Tinted AL Code to Class 40	Windows - Non-Tinted AL Code to Class 40. Application: New Construction	New	Heating	0.46
Roof Insulation - Blanket R11-30	Roof Insulation - Blanket R11-30. Application: Buildings with open truss unfinished interior	Retrofit	Heating	0.44
Windows - Tinted AL Code to Class 36	Windows - Tinted AL Code to Class 36. Application: New Construction	New	Heating	0.43
Windows - Non-Tinted AL Code to Class 36	Windows - Non-Tinted AL Code to Class 36. Application: Old buildings	Replace	Heating	0.29
Windows - Non-Tinted AL Code to Class 36	Windows - Non-Tinted AL Code to Class 36. Application: New Construction	New	Heating	0.28
Windows - Non-Tinted AL Code to Class 45	Windows - Non-Tinted AL Code to Class 45. Application: Old buildings	Replace	Heating	0.26

Measure Name	Measure Description	Construction Type	Measure End Use	BCR
Energy Star Commercial Clothes Washer	Install high performance commercial clothes washers for coin operated laundromats	New	Water Heat	0.05

TABLE 8–3: INDUSTRIAL MEASURES SORTED BY BCR

Conservation Measure	Measure Description	BCR
Process Boiler Maintenance	Tune up in accordance with Minneapolis Energy Office protocol. Can include derating the burner, adjusting the secondary air, adding flue restrictors, cleaning the fire-side of the heat exchanger, cleaning the water side, or installing turbulators. Other modifications may include uprating the burner to reduce oxygen or derating the burner to reduce stack temperature. Note: In gas systems, excess air and stack temperatures are often within reasonable ranges, so the technical potential for this measure is limited. Combining this measure with the vent damper and power burner measures increases both applicability and cost effectiveness, and was assumed for this analysis. Applies to process boiler.	18904.28
Domestic Hot Water Wrap	Insulate the surface of the storage water heater or an unfired storage tank to R-5 to reduce standby losses.	2518.53
Process Boiler Water Treatment	Chemical treatment to reduce scale and increase heat transfer	1688.32
Process Boiler Controls	Automatic draft controls	909.09
Process Boiler Load Control	Controller automatically resets	787.88
Process Boiler Steam Trap Maintenance	Set up a in-house steam trap maintenance program with equipment, training, and trap replacement. An alternative procedure is to just pay for an outside contractor to conduct a steam survey. Applies to process boiler.	270.06
Process Boiler Insulation	Insulate the surface to R-5 to reduce standby losses.	180.50
Domestic Hot Water Pipe Insulation	Add 1" insulation to pipes used for steam or hydronic distribution; particularly effective when pipes run through unheated spaces.	70.02
Domestic Hot Water Condensing Tank (Replacement)	Costs and savings are incremental over a Code-rated tank (combustion efficiency of 80%) for a condensing tank with a minimum combustion efficiency of 94% and an R-16 tank wrap.	53.81
Domestic Hot Water Hi-efficiency Boiler (Replacement)	Replace existing boiler with unit meeting 85% combustion efficiency.	28.56
Ozone Treated Laundry	Use of O3 allows less hot water	13.91
Domestic Hot Water Condensing Tank (Retrofit)	Replace older tanks with condensing tanks with combustion efficiency of 94% and tank insulation with an R-value of 16 or greater.	11.96
Heat Recovery to Hot Water	Utilize heat recovery where option exists	11.86
Domestic Hot Water Condensing Boiler (Replacement)	Replace with boiler using condensing or pulse technology to achieve steady-state combustion efficiencies of 89% to 94% (this analysis used 90% efficiency for savings calculations).	8.94

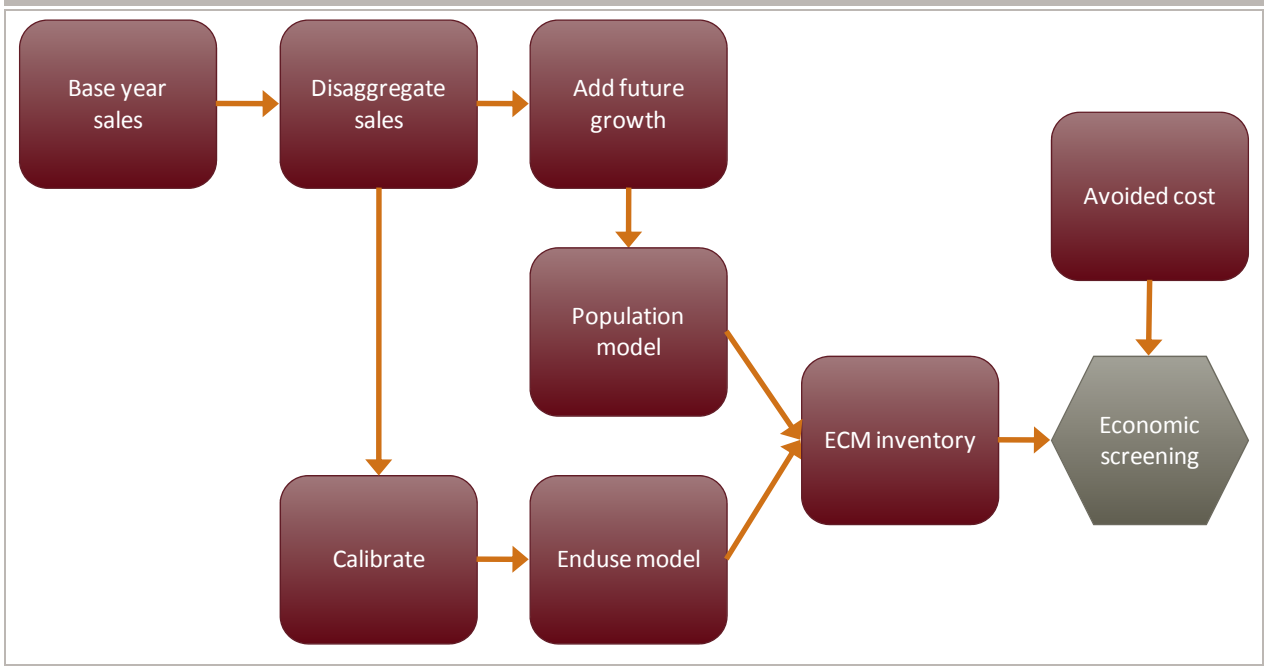
Conservation Measure	Measure Description	BCR
Hot Water Temperature Reset	Controller automatically resets the delivery temperature in a hot water radiant system based on outside air temperature. The reset reduces the on-time of the heating equipment and the occurrence of simultaneous heating and cooling through instantaneous adjustments.	6.87
Hot Water Boiler Tune	Tune up in accordance with Minneapolis Energy Office protocol. Can include derating the burner, adjusting the secondary air, adding flue restrictors, cleaning the fire-side of the heat exchanger, cleaning the water side, or installing turbulators. Other modifications may include uprating the burner to reduce oxygen or derating the burner to reduce stack temperature. Note: In gas systems, excess air and stack temperatures are often within reasonable ranges, so the technical potential for this measure is limited. Combining this measure with the vent damper and power burner measures increases both applicability and cost effectiveness, and was assumed for this analysis. Applies to hot water boiler.	6.81
Domestic Hot Water Std. Boiler (Retrofit)	Replace existing boiler with unit meeting 80% combustion efficiency.	6.08
Wall Insulation - Blown R11	Wall Insulation - Blown R11. Application: Old buildings	5.65
Wall Insulation - Spray On for Metal Buildings	Wall Insulation - Spray On for Metal Buildings (Unfinished Cellulose) Application: Old buildings	5.08
Hi-Efficiency Clothes Washer (Retrofit)	Install high performance commercial clothes washers	4.22
Hi-Efficiency Clothes Washer (Replacement)	Install high performance commercial clothes washers	4.22
Roof Insulation - Blanket R0-19	Roof Insulation - Blanket R0-19. Application: Buildings with open truss unfinished interior	4.10
Hi-Efficiency Unit Heater (Replacement)	Install power draft units (80% seasonal efficiency) in place of natural draft (64% seasonal efficiency)	4.09
Combo Hi-efficiency Boiler (Replacement)	Replace existing boiler with unit meeting 85% combustion efficiency.	4.07
Roof Insulation - Blanket R0-30	Roof Insulation - Blanket R0-30. Application: Buildings with open truss unfinished interior	3.82
Steam Balance	Single-pipe steam systems are notorious for uneven heating, which wastes energy because the thermostat must be set to heat the coldest spaces and overheating other spaces. Steam balances corrects these problems by: 1) Adding air venting on the main line or at the radiators; 2) Adding boiler cycle controls; 3) Adding or subtracting radiators. Energy savings accrue from lowering the overall building temperature.	3.71
Domestic Hot Water Hi-efficiency Boiler (Retrofit)	Replace existing boiler with unit meeting 85% combustion efficiency.	3.65
Domestic Hot Water Condensing Boiler (Retrofit)	Replace with boiler using condensing or pulse technology to achieve steady-state combustion efficiencies of 89% to 94% (this analysis used 90% efficiency for savings calculations).	2.85
Vent Damper	Install vent damper downstream of the draft relief to prevent airflow up the stack, while allowing warm air from the boiler to spill into the conditioned space as heat or into the boiler room to reduce jacket losses. This measure is most cost-effective when combined with the boiler tune up and power burner measures.	2.81
Combo Condensing Boiler (Replacement)	Replace with boiler using condensing or pulse technology to achieve steady-state combustion efficiencies of 89% to 94% (this analysis used 90% efficiency for savings calculations).	2.21

Conservation Measure	Measure Description	BCR
Steam Trap Maintenance	Set up a in-house steam trap maintenance program with equipment, training, and trap replacement. An alternative procedure is to just pay for an outside contractor to conduct a steam survey.	2.05
Waste Water Heat Exchanger	Install heat exchanger where copious warm water is discarded	2.01
High efficiency Space Conditioning Boiler Replacement	Install near condensing boiler. Assumed seasonal combustion efficiency of 82% over base of 75%	1.98
Roof Insulation - Rigid R11-22 (Replacement)	Roof Insulation - Rigid R11-22 2" rigid added to an existing foam roof insulation at re-roof, includes some surface prep. Application: Old buildings with flat roofs, no attics, and some insulation	1.58
Upgrade Process Heat	Replace furnace, reheaters	1.38
Condensing Unit Heater from National draft (Replacement)	Install condensing power draft units (90% seasonal efficiency) in place of natural draft (64% seasonal efficiency)	1.31
Condensing Space Conditioning Boiler Replacement	Install condensing boiler. Assumed seasonal combustion efficiency of 88% over base of 75%	1.27
Power burner	Replace standard burner with a power burner to optimize combustion and reduce standby losses in the stack. Note: Costs and savings assume that this measure will be performed in conjunction with a boiler tune up when appropriate.	1.18
Combo Condensing Boiler (Retrofit)	Replace with boiler using condensing or pulse technology to achieve steady-state combustion efficiencies of 89% to 94% (this analysis used 90% efficiency for savings calculations), for combined boiler.	0.82
Chiller heat recovery (Electronics)	Utilize heat recovery where option exists for heat recovery form chiller	0.81
Combo High Efficiency Boiler (Retrofit)	Replace existing boiler with unit meeting 85% combustion efficiency.	0.78
High Efficiency Unit Heater (Retrofit)	Install power draft units (80% seasonal efficiency) in place of natural draft (64% seasonal efficiency)	0.67
Condensing Unit Heater from power draft (Replacement)	Install condensing power draft units (90% seasonal efficiency) in place of power draft (80% seasonal efficiency)	0.65
Space Conditioning Condensing Boiler Retro	Install condensing boiler. Assumed seasonal combustion efficiency of 88% over base of 69.5%	0.60
Roof Insulation - Blanket R11-41	Roof Insulation - Blanket R11-41. Application: Buildings with open truss unfinished interior	0.60
Space Conditioning High Efficiency Boiler Retro	Install near condensing boiler. Assumed seasonal combustion efficiency of 82% over base of 69.5%	0.57
Roof Insulation - Blanket R11-30	Roof Insulation - Blanket R11-30. Application: Buildings with open truss unfinished interior	0.56
Roof Insulation - Rigid R11-33 (Replacement)	Roof Insulation - Rigid R11-33: add 4' of insulation at reroof. Application: Old buildings with flat roofs, no attics, and some insulation	0.52
Condensing Furnace (Replacement)	Condensing / pulse package or residential-type furnace with a minimum AFUE of 92%.	0.50
Ducts	Duct retrofit of both insulation and air sealing	0.45
Solar Hot Water	Install solar water heaters on large use facility such as multifamily or lodging	0.30

MARKET SECTOR DEVELOPMENT

Development of the technical energy efficiency potential estimates require a number of steps that were applied to the list of measures previously screened. The general steps followed are shown in Figure 8–1:

FIGURE 8–1: STEPS IN THE ENGINEERING ANALYSIS



These steps are described below. The process used for the *residential market sector* is as follows.

Base year Sales Data

Base year sales data from different sources did were expectedly different. As shown in Table 8–4, the published I-21 Form did not completely agree with the 2009 sales data by rate schedule obtained from the forecasting group. Some of the rate schedules were aggregated in order to produce sums that better agreed with the I-21 Form. The "Top 200" file data was useful in our analyses in that it explicitly accounted for the largest commercial and industrial (C&I) firms.

TABLE 8–4: COMPANY THERM SALES BY RATE SCHEDULE

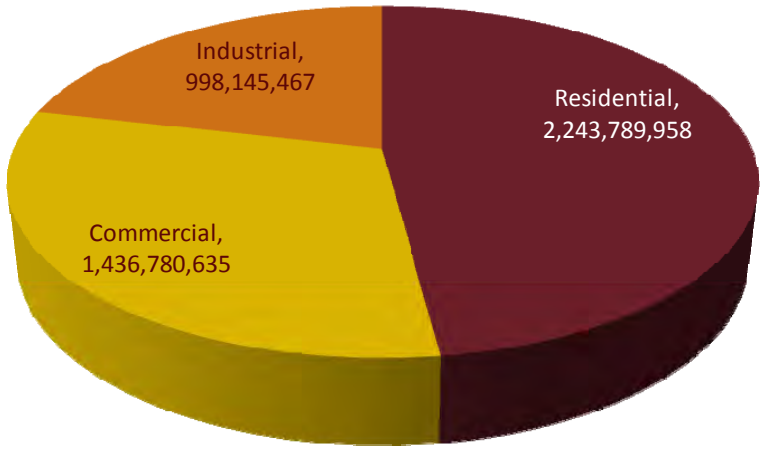
RS_Code	Description	I-21 Therms	Forecast Therms	Top 200 Firms Therms
RATE1	Rate 1: Residential General	2,251,580,416	3,692,457	
RATE2	Rate 2: Residential Water heat		186,706	
RATE3	Rate 3: Residential Heating		2,239,732,182	
RATE4	Rate 4: Commercial Service	850,943,074	37,765,340	2,246,375
RATE5	Rate 5: Seasonal Use Commercial Service	12,391,874	5,259,397	
RATE13	Rate 13: Residential A/C		178,612	
RATE14	Rate 14: Non-Residential Heat - Use for SB Only		864,885,457	5,241,582
RATE15	Rate 15: General Heat and A/C		228,692	
RATE16	Rate 16: General A/C			
RATE17	Rate 17: Contract Service	241,547,708	261,944,480	241,548,292
RATE18	Rate 18: School Heat and A/C			
RATE19	Rate 19: Contract Service	5,941,260	13,822,886	5,709,934
RATE74	Rate 74: General Transportation Service	593,335,322	71,785,325	7,876,355
RATE75	Rate 75: Seasonal Use Transportation Service	17,162,674	13,992,023	
RATE76	Rate 76: Large General Transportation Service	316,523,033	168,203,921	147,806,678
RATE77	Rate 77: Large Volume Transportation Service	407,561,111	341,843,175	346,341,772
RATE81	Rate 81: Energy Transportation Service			
RATE94	Rate 94: General Transportation Service with Heat		538,501,022	23,314,299
RATE95	Rate 95: Transportation A/C		473,197	
RATE96	Rate 96: Large General Transportation Service with Heat		161,368,093	181,368,164
	Other Utilities	62,230,190		
	Total	**4,759,216,662**	**4,723,862,965**	**961,453,451**

Allocation of base year sales to market sector is shown in Table 8–5. The first summary shows C&I sales as aggregated to small and large customer groups similar to the I-21 Form. The second summary shows C&I sales further split into commercial and industrial business types as discussed in the summary.

TABLE 8–5: BASE YEAR SALES BY MARKET SECTOR

Market Sector	Base Year Sales (therms)
Residential	2,243,789,958
Small/Medium Commercial and Industrial	908,138,886
Contract Sales Commercial and Industrial	275,767,366
Large (Transport) Commercial and Industrial	1,296,166,755
Total – All Sectors	4,723,862,965
Commercial and Industrial Breakdown	
Commercial	1,436,780,635
Industrial	998,145,467
Missing or Not Useable	45,146,905
Total Commercial and Industrial	**2,480,073,007**

FIGURE 8–2: BASE YEAR SALES BY MARKET SECTOR



Disaggregation of Residential Sector Sales

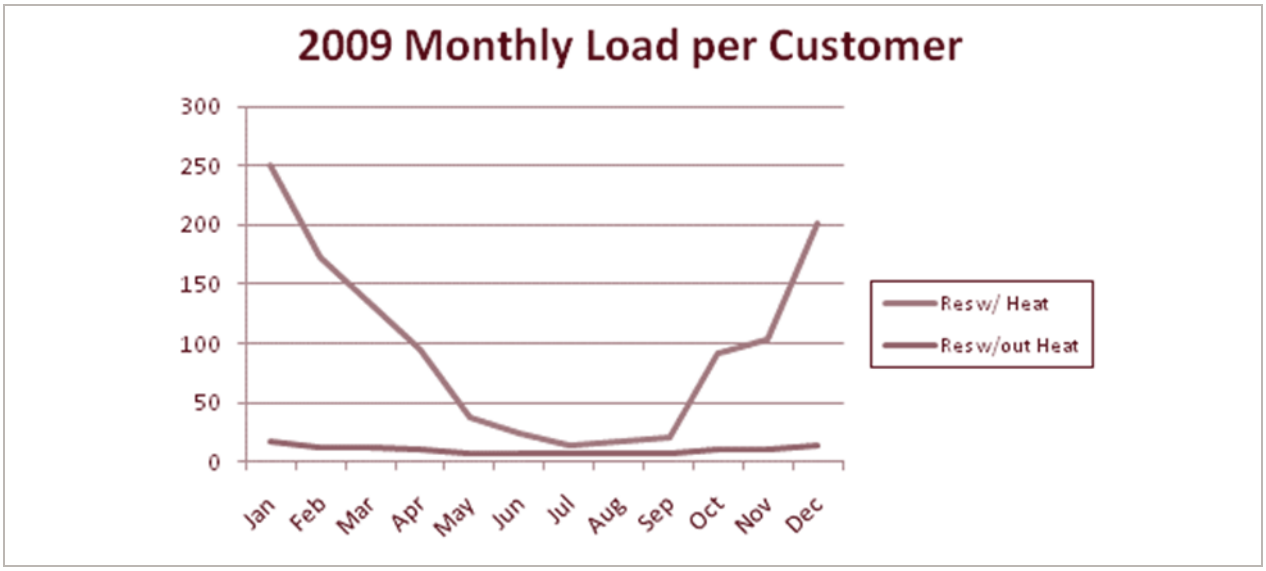
In the case of the residential sector, forecast sales were aggregated into market sectors as shown in Table 8–6. This table shows a total of about 2 billion therms sold to about 2 million customers. Note that some of the Nicor Gas sub-territories represent a very small portion of the customer base. For that reason, there was usually insufficient information to permit specific analysis by sub-territory. The breakout of customers into Single Family, Manufactured Home and Multifamily was developed from the telephone survey results, with some adjustment where data was insufficient, based upon the most recent census data available. The fractions found for the residential building types were 62% single Family (SF), 11% Manufactured Home (MH) and 27% Multifamily (Apartment).

TABLE 8–6: RESIDENTIAL SECTOR SALES DATA BY NICOR GAS REGION

	House Type	Quincy	Bloomington	Metro	Rockford	Total
Therm Sales, Res w Heat		4,929,286	93,692,499	1,935,955,564	205,154,834	2,239,732,182
Therm Sales, Res w/o Heat		16,935	124,315	3,539,130	377,396	4,057,776
Therm Sales, All		4,946,221	93,816,814	1,939,494,693	205,532,229	2,243,789,958
Number of Customers						
Res with Heat	SF	3,548	61,742	1,010,310	125,844	1,201,445
	MH	614	10,689	174,906	21,786	207,995
	Apartment	1,540	26,790	438,367	54,603	521,300
Number of Customers						
Res w/out Heat	SF	43	425	19,287	1,163	20,918
	MH	7	74	3,339	201	3,621
	Apartment	18	185	8,369	505	9,076
Number of Customers						
All Residential	SF	3,591	62,168	1,029,597	127,007	1,222,363
	MH	622	10,763	178,245	21,988	211,617
	Apartment	1,558	26,974	446,736	55,108	530,376
Percent and Total		**0.3%**	**5.1%**	**84.2%**	**10.4%**	**1,964,356**

The forecasted sales data included seasonal load shapes by rate schedule. Using degree-day history for 2009 as a basis for proportioning, we were able to create monthly load profiles. Figure 8-3 shows the average monthly consumption for customers with and without the gas space heat rate indicator.

FIGURE 8–3: LOAD PROFILE FOR RESIDENTIAL CUSTOMERS



Calibration of Residential End-use Consumption Estimates

From the Table 8–6 load profiles, we derived an average consumption of 1,142 therms per household. The forecasted sales data also provided seasonal load factors from which we could

compute consumption on a monthly basis for each rate class. The simulation models we used for impact analyses were developed to match to these overall monthly consumption values.

Table 8–7 on page 101 summarizes the building characteristics that were developed from the survey data and used in the simulation models.

Figure 8–4 shows the match of the weighted average building prototype to the monthly consumption computed from the forecasted sales data. Figure 3 shows the same information graphed against average monthly load with Figure 4 showing this average monthly load graphed against average monthly temperature.

FIGURE 8–4: MATCH OF AVERAGE PROTOTYPE TO MONTHLY CONSUMPTION

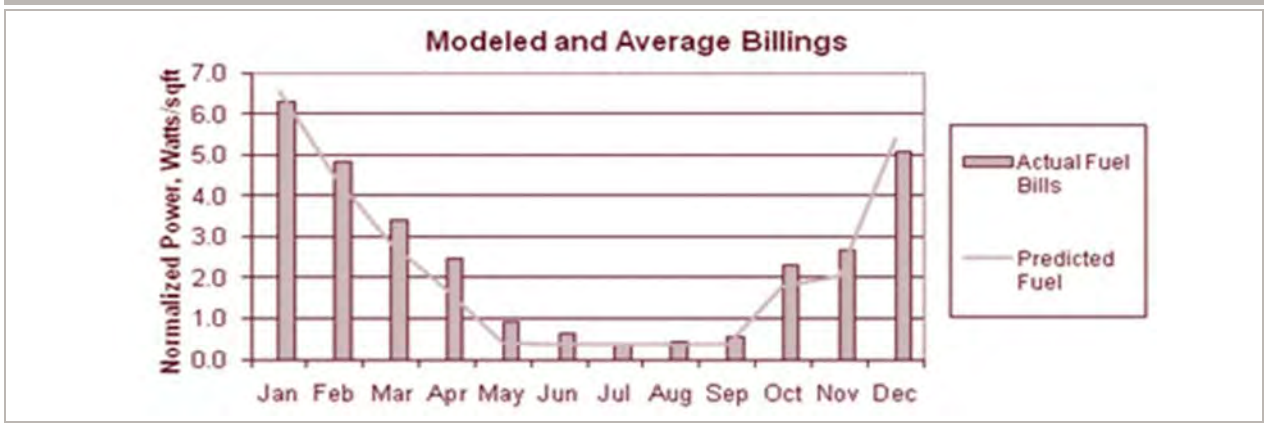
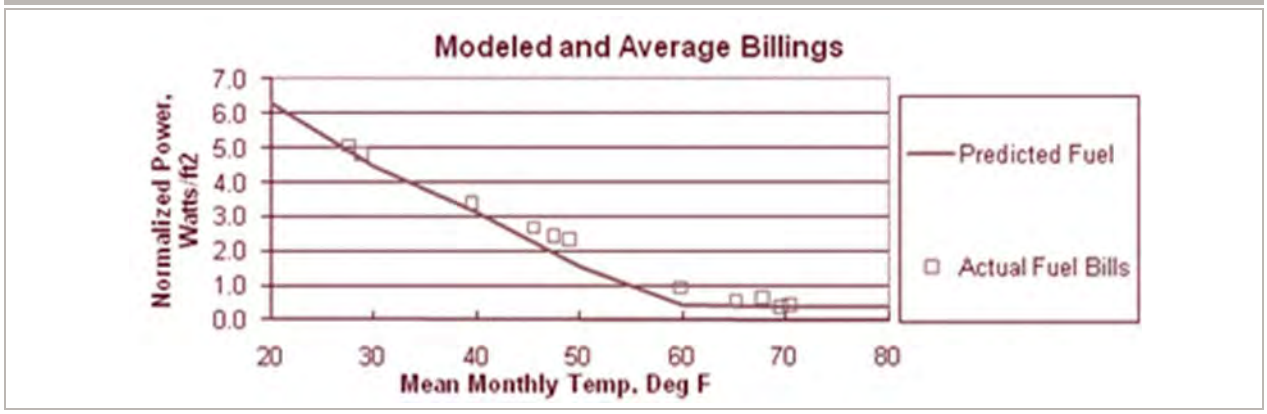


FIGURE 8–5: MATCH OF AVERAGE PROTOTYPE TO SEASONAL CONSUMPTION



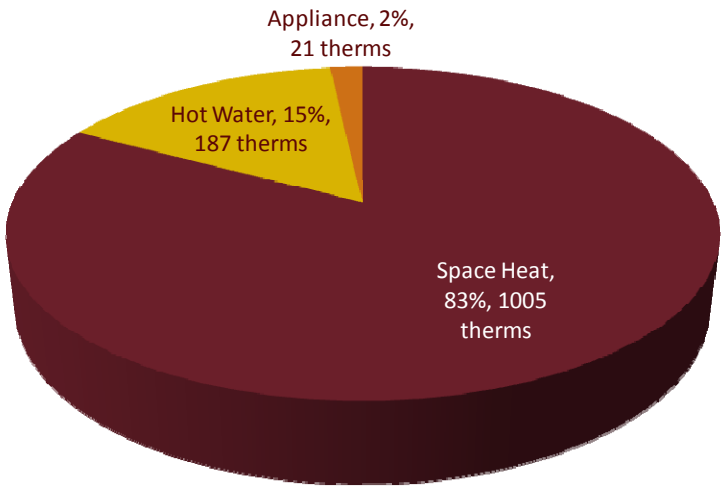
Overall, the weighted average consumption of the prototype buildings is 1,213 therms, which is within 5% of the target consumption of 1,142 therms. We judged this to be close enough for the study purposes. The building prototype models were then used to estimate the application and savings from the various conservation measures.

TABLE 8–7: RESIDENTIAL PROTOTYPE MODEL SUMMARY

	Single Family				Manufactured Home			Multifamily							
Nominal Description	**Earlier than 1975**	**1975-1989**	**1990-2003**	**2004+**	**pre 1980**	**to 1990**	**post 1990**	**Earlier than 1975**	**1975-1989**	**1990-2003**	**2004+**	**SF Average**	**MH Average**	**Apartment Average**	**Weighted Average**
Floor area, sqft	1516	1771.6	2312	2400	1125	1125	1125	1200	1200	1200	1200	1,756	1,125	1,200	1,536
Wall Description	R6	R11	R19	R21	R11	R11	R11	R0	R11	R19	R21				
Ceiling Description	R11	R11	R30	R38	R19	R30	R38	R11	R19	R30	R38				
Basement Wall	R0	R0	R0	R0											
Basement fraction	41%	42%	42%	33%											
Crawl Floor Description	R19	R0	R11	R11	R0	R11	R11	R0	R11	R11	R19				
Crawl Floor Fraction	26%	24%	23%	40%	100%	100%	100%	100%	100%	100%	100%				
Finished Basement Description	R6	R6	R6	R6											
Finished Basement fraction	33%	34%	35%	27%											
Window U value	1.00	0.78	0.78	0.50	0.78	0.78	0.34	0.78	0.50	0.34	0.34				
Door Description	R2.5	R2.5	R2.5	R2.5	R2.5	R2.5	R2.5	R2.5	R2.5	R2.5	R5				
Total UA	793	905	946	628	518	441	332	299	216	193	131				
Total Usage, therms	1,670	1,736	1,759	1,069	1,044	867	581	656	413	366	252	1,639	747	426	1,213
Appliance therms	23	23	23	23	23	23	23	16	16	16	16	23	23	16	21
DHW therms	224	224	224	224	224	224	224	157	157	157	157	211	175	140	187
Space Heat therms	1,423	1,489	1,512	822	797	620	334	483	240	193	80	1,405	549	271	1,005
Weight	58%	18%	20%	4%	26%	37%	37%	28%	22%	42%	8%	62%	11%	27%	

The same building prototype models also provide estimates of how the consumption is distributed to the residential end-uses, as shown in Figure 8-6.

FIGURE 8–6: RESIDENTIAL END-USE CONSUMPTION

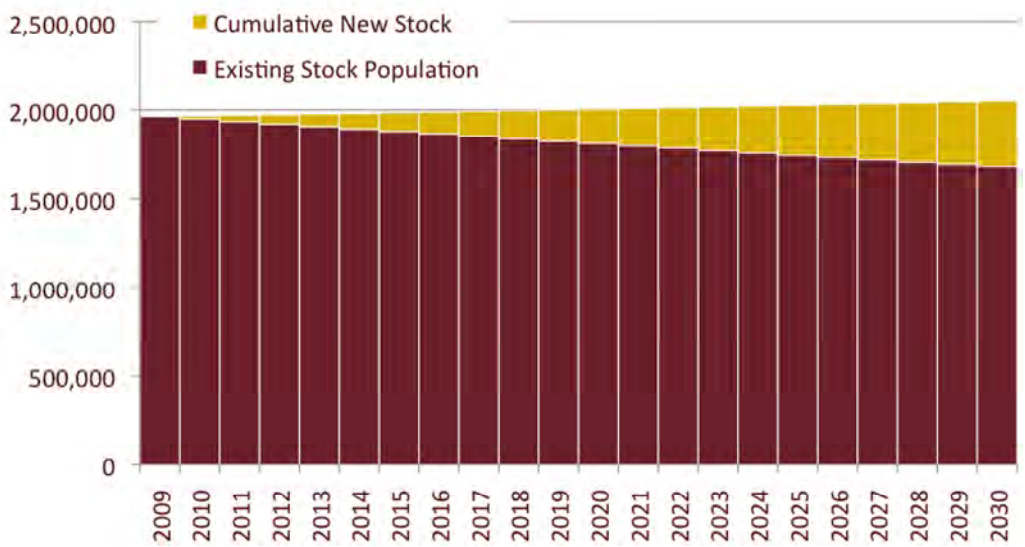


Future Residential Growth

Residential growth is relatively easy to address. Forecasting provided estimates of the number of customers that would be added in future years for each of the sub-territories. This provides an estimate of the total number of future customers. We further assumed that there would be a small turnover rate (0.75%) of the existing building stock, based on our previous experience. Some of the older buildings will be rebuilt or remodeled as new buildings. The distinction between existing and new buildings is relevant for program planning. We assume that new structures will be built to a more stringent building code and will be more energy efficient than their predecessors. That is, new baseline consumption will be more efficient than that for the older buildings. However, the new construction process is also a one-time opportunity to capture long-term savings. Many measures are economically feasible if included in construction, but not as retrofits.

Figure 8–7 shows the estimated population forecast. The forecasted increase in residential customers is relatively small.

FIGURE 8–7: RESIDENTIAL POPULATION FORECAST



Residential Potential by Program Option

The resource energy efficiency potential can be summarized by the type of program that would be required to capture the savings. Table 8–8 shows a potential set of program offerings.

TABLE 8–8: RESIDENTIAL SECTOR PROGRAM SUMMARY (ANNUAL THERMS)

Residential Programs	Space Heat	Hot Water	Appliances	Technical Potential	Achievable Potential	Achievable Savings of End-use
New Construction -- Space Heat	10,799,716			10,799,716	9,179,759	36%
Energy Star Appliances			861,697	861,697	732,442	3%
DHW Rebates		5,812,588		5,812,588	4,940,700	1%
Prescriptive Rebates	60,136,500		400,166	60,536,666	51,456,166	3%
Weatherization	29,107,307			29,107,307	24,741,211	1%
Total	**100,043,523**	**5,812,588**	**1,261,863**	**107,117,974**	**91,050,278**	**4%**

Disaggregation of Commercial and Industrial Sectors

As in the residential market sector, we aggregated the forecast sales by rate schedule into groups that matched the grouping for the commercial and industrial sectors in the I-21 form. That is, we combined rate schedules into a small/medium customer group and a large customer group. The "Top 200" file provided explicit information for the largest customers. For these customers, we had both the appropriate business category (NAICS or SIC code) and the sub-territory. The "Top 200" group explicitly accounts for about one billion out of total C&I sales of 2.3 billion therms. For the remaining sales, the forecast provides sales by sub-territory for the overall rate classes. However, we did not have sufficient information from the surveys to be able to assign business types. For the

remaining sales of about 1.3 billion therms, we applied estimates of the business breakdown based on our previous work.

The distinctions of "commercial" or "industrial" are not apparent in the rate schedules. For this study, there is a difference in the assumed end-uses between commercial and industrial customers. We define "commercial" facilities to be buildings that are dominated by seasonal space heat. We define "industrial" to be manufacturing facilities dominated by flat process loads that are not related to building structure. Within any rate schedule, there could be either type of customer. For example, a large hospital or college campus could be a large customer but the consumption would match to a commercial business use. Within the small/medium group, our estimate of business types includes more commercial types and for the large customer group it includes more industrial types. However, all business types are represented in either group. Note that a significant amount of sales were not used in this analysis. These represented sales to construction projects, utilities or other segments that could not be classified.

TABLE 8–9: BREAKDOWN OF C&I SECTORS

Total C&I Sectors			
Commercial Sector Type	**Annual therms**	**Industrial Sector Type**	**Annual therms**
Small Office	223,725,659		
Large Office	97,963,293		
Restaurant	184,615,093		
Retail	142,225,260	Utility	28,788,249
Grocery	62,749,994	Food	132,621,508
Warehouse	182,668,303	Light Manf	96,962,578
School	132,938,394	Stone,Clay, Glass	44,487,335
College	63,867,684	Metals	171,294,150
Hospital	73,867,183	Chemical	359,144,201
Other Health	40,062,469	Fertilizer	95,228,637
Lodging	63,650,668	Other	49,866,869
Other	8,352,246	Agriculture	19,751,940
Not Used	160,094,389		
Commercial Total	**1,436,780,635**	**Industrial Total**	**998,145,467**

FIGURE 8–8: COMMERCIAL SECTOR SALES BY BUSINESS TYPE

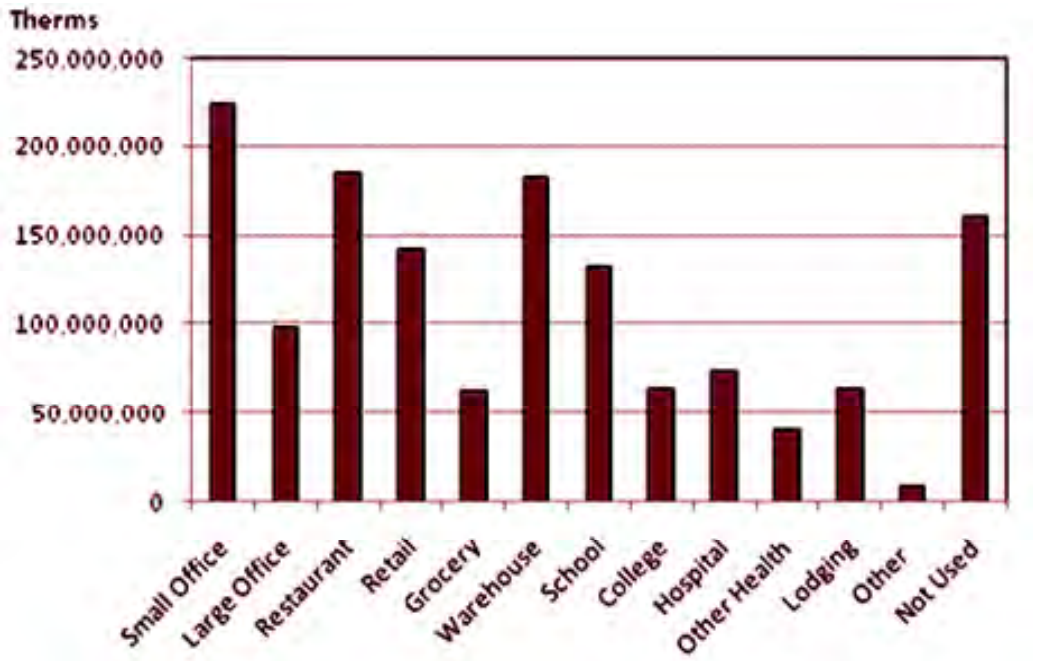
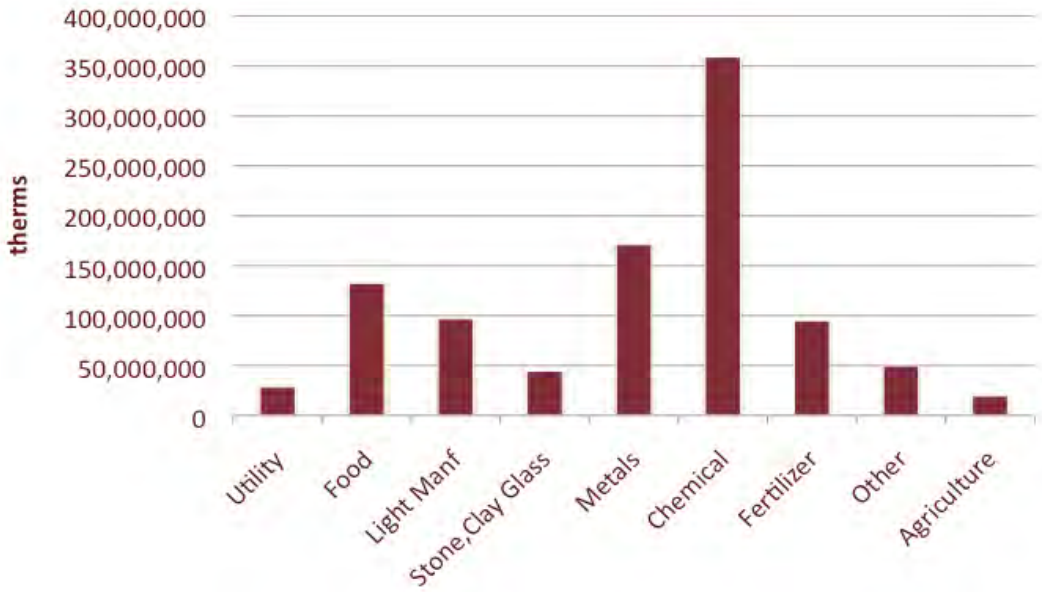


FIGURE 8–9: INDUSTRIAL SECTOR SALES BY BUSINESS TYPE



Calibration of Commercial Sector End-use Consumption Estimates

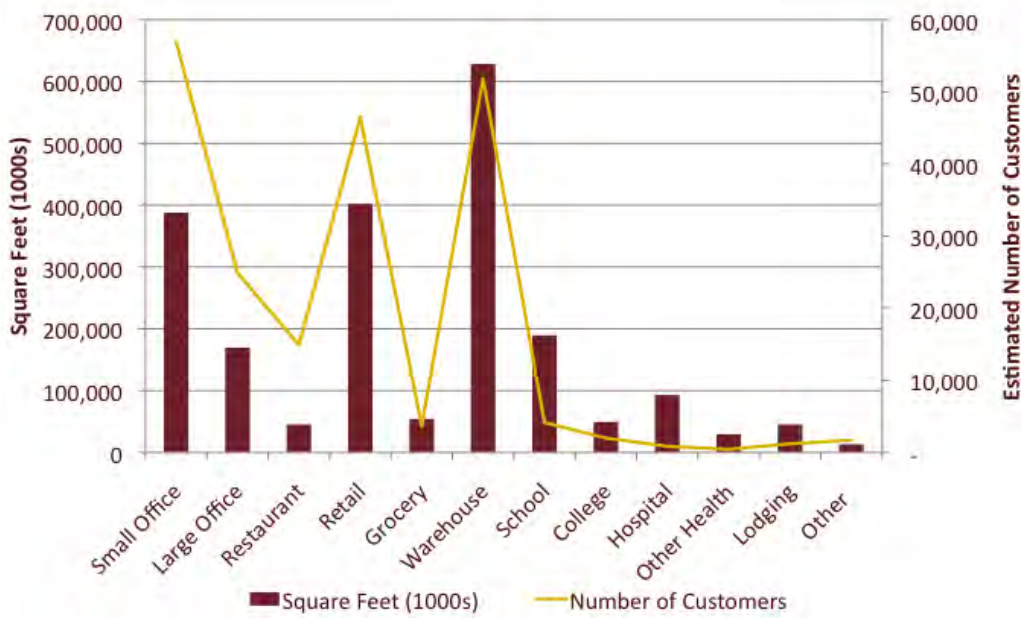
To calibrate commercial sector sales, it was not possible to develop simulation models because we did not have sufficient data to develop seasonal load profiles by business type. Instead, we calibrated on the basis of the overall sector using assumed Energy Usage Indices (EUIs-energy use intensity measured as energy use per square foot) for each business type as shown in Table 8–10. Sales to utility or unclassified facilities are not included in the population considered to be applicable to conservation programs. (Note that, for convenience, the sales units in Table 8–10 are changed to MMBTU, not therms.)

TABLE 8–10: COMMERCIAL SECTOR CALIBRATION ASSUMPTIONS

Business Type	Sales, Year 2009 MmBtu	Existing Gas EUI, kBtu/sf	Estimated Square Footage (1000 SF)	Estimated Number of Customers
Small Office	22,372,566	57.7	387,793	56,936
Large Office	9,796,329	57.8	169,425	24,875
Restaurant	18,461,509	409.1	45,132	14,913
Retail	14,222,526	35.4	401,993	46,473
Grocery	6,274,999	115.7	54,244	3,683
Warehouse	18,266,830	29.1	628,331	51,783
School	13,293,839	70.2	189,479	4,142
College	6,386,768	129.1	49,470	1,988
Hospital	7,386,718	79.5	92,865	850
Other Health	4,006,247	135.2	29,638	448
Lodging	6,365,067	141.1	45,119	1,200
Other	835,225	62.8	13,297	1,702
Applicable Sales	127,668,625		2,106,787	208,993
Not Used	16,009,439			
Total Commercial Sector	**143,678,063**			

The resulting allocations of commercial square footage and the estimated number of customers are shown in Figure 8-10.

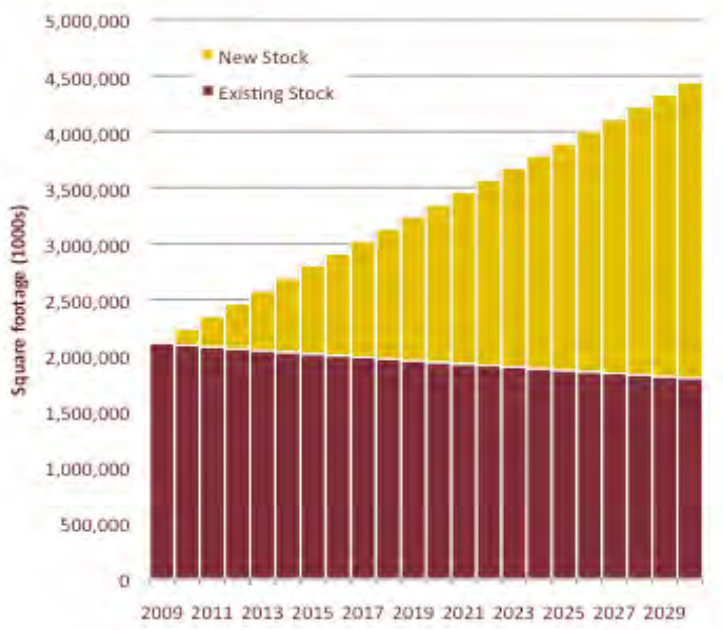
FIGURE 8–10: COMMERCIAL SECTOR CUSTOMER ALLOCATIONS BY BUSINESS TYPE



Future Commercial Growth

Estimating future commercial growth required making some assumptions. Forecasting provided an estimate of the numbers of future new customers and their consumption rates. Of course, their consumption rate is based on capacity growth – we require a forecast of energy consumption. We assumed that an energy load factor of 0.5 applies to the consumption rate, based on our previous work. This assumption results in an estimated growth of 3.5% annually. This is a reasonable estimate of growth, but note that it results in the customer base doubling over a 20-year period (see Figure 8-11).

FIGURE 8–11: COMMERCIAL SECTOR GROWTH



Commercial Sector Potential by Program Option

The resource potential can be summarized by the type of programs that would be required to capture the savings. Table 8–11 shows a likely set of program offerings.

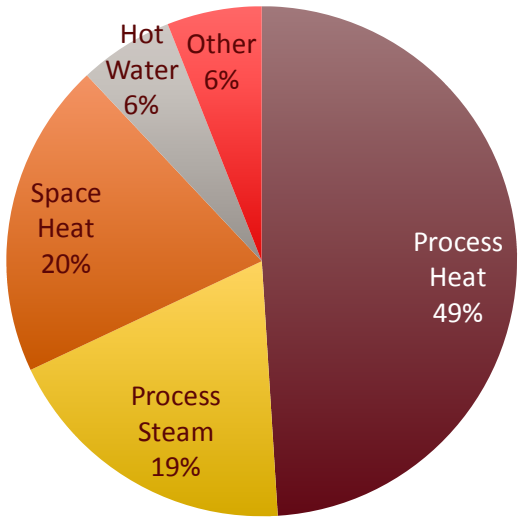
TABLE 8–11: COMMERCIAL SECTOR PROGRAM SUMMARY (1000 ANNUAL THERMS)

Commercial Programs	Heating	Water Heat	Cooking	Sum
Custom Rebate	30,714	19,138		49,851
EnergyStar Rebate		4,184	1,506	5,690
Prescriptive Rebate	69,961	24,651		94,613
Retro-Commissioning	2,541			2,541
New Construction	3,991	1,969		5,960
Technical Potential	**107,207**	**49,943**	**1,506**	**158,656**
Achievable Potential	**91,126**	**42,451**	**1,280**	**134,858**
Achievable Savings of End-use	**9%**	**9%**	**1%**	**8%**

Industrial Sector End-use Consumption Estimates

For the industrial sector, calibration is not an issue. For this sector, we estimate the end-uses as a fraction of the therm sales. The resulting estimates are shown in Figure 8-12. Process Heat includes Drying, Baking, Melting operations that consume gas directly. Process Steam includes industrial processes that first utilize a boiler to produce steam. Space Heat and Hot Water are smaller parts of consumption. The "Other" category is gas used as feedstock for fertilizer production.

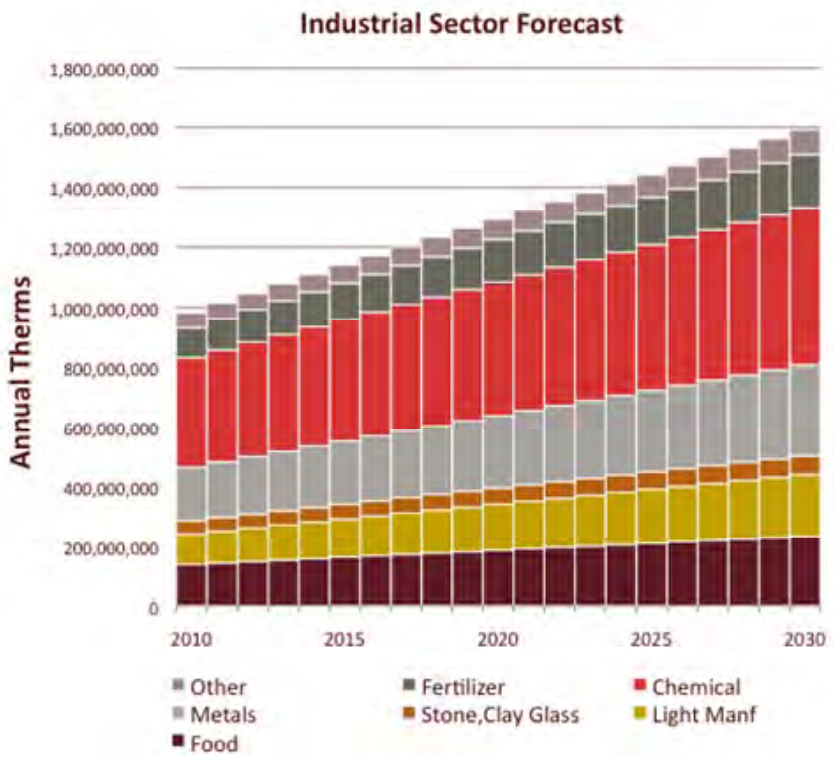
FIGURE 8–12: INDUSTRIAL SECTOR CONSUMPTION BY END-USE



Future Industrial Growth

For industrial sector growth (Figure 8-13), we applied the same methodology as for the commercial sector. That is, we assumed the same growth applies to both the C&I sectors and merely apportioned the new growth into commercial and industrial sectors according to the ratio of existing sales. This means that the industrial sector is forecast to grow similarly to the commercial sector. We recognize that this is probably not an accurate forecast; most economic forecasts would assume little growth or even a decline in much of the industrial sector. But, we used this basis for growth to maintain continuity in the methodology.

FIGURE 8–13: INDUSTRIAL SECTOR SALES FORECAST



Industrial Potential by Program Option

The resource potential can be summarized by the type of program that would be required to capture the savings. Table 8–12 shows a set of hypothetical program offerings.

TABLE 8–12: INDUSTRIAL SECTOR PROGRAM SUMMARY (ANNUAL THERMS)

Industrial Programs	Process Heat	Process Steam	Space Heat	Hot Water	Total
Custom Rebate	22,004,216	7,458,245	3,156,399	1,283,540	33,902,399
Prescriptive Rebate		15,437,237	2,311,169	7,549,323	25,297,729
Weatherization			8,836,981		8,836,981
Technical Potential	22,004,216	22,895,482	14,304,549	8,832,863	68,037,109
Achievable Potential	18,703,583	19,461,159	12,158,867	7,507,933	57,831,543
Achievable Savings of End-use	6%	17%	10%	23%	10%

Summary of End-use Estimates by Sector

TABLE 8–13: END-USE SUMMARY

Baseline Consumption, Annual therms						
Sector	Space Heat	Hot Water	Appliance	Industrial Process	Other	Total
Residential	1,419,572,241	223,253,430	23,789,725			1,666,615,396
Commercial	1,062,577,375	478,541,015	189,346,679			1,730,465,068
Industrial	121,824,186	33,253,364		407,899,251	36,312,883	599,289,685
Technical Potential, Annual therms						
Sector	**Space Heat**	**Hot Water**	**Appliance**	**Industrial Process**	**Other**	**Total**
Residential	93,447,523	5,812,588	1,261,864			100,521,974
Commercial	107,207,381	49,942,698	1,505,820			158,655,899
Industrial	11,135,652	3,302,089		53,599,368		68,037,109
Percent Saved						
Sector	**Space Heat**	**Hot Water**	**Appliance**	**Industrial Process**	**Other**	**Total**
Residential	7%	3%	5%			6%
Commercial	10%	10%	1%			9%
Industrial	9%	10%		13%	0%	11%

Long-run avoided cost

In order to screen measures, it was necessary to have an estimate of the long-run avoided cost for Nicor Gas. That is, if the company has to annually purchase a therm (instead of saving it), we estimated the net present value of those costs over the lifetime of the savings taking into account the seasonal cost of an incremental purchase.

The first task to develop the avoided costs is to define the discount rate to be used in the analysis. As shown in Table 8–14, we assumed a rate of 8.09% nominal or 5.45% real. The real present value used in the analysis is in 2010 dollars.

TABLE 8–14: DISCOUNT RATE ASSUMPTIONS

Discount Rate	Value
Nominal Rate	8.090%
Assumed Inflation[7]	2.500%
Real Rate	5.454%

We consulted with Nicor Gas staff to determine the best methodology to forecast future gas prices. In general, the procedure was to start with a forecast of gas prices for Henry Hub[8]. We then added small amounts to develop an estimate of city gate price in Chicago, a pipeline charge, a distribution charge and a state tax. The sum represents the utility avoided cost.

We also added an environmental cost as shown in Table 8–15. Including an environmental cost of $55/ton for CO_2 results in a cost adder of 10 cents per therm.

[7] Source: Global Insight 2nd and 3rd Quarter 2009 for 30 year Projections for US economy.
[8] Natural Gas Price Forecast, Wood Mackenzie, Long Term View, Apr 2010.

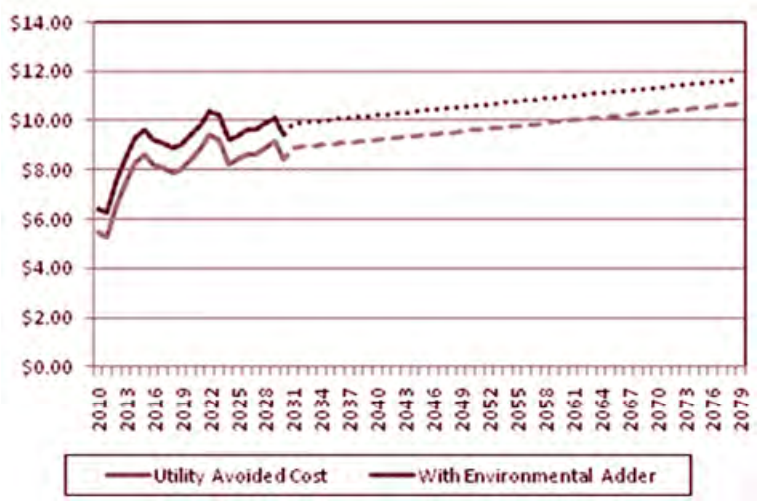
TABLE 8–15: ENVIRONMENTAL COST ADDER

Carbon Externality Adder	
32	lbsC/Mmbtu
1%	loss rate
3.67	lbs CO2/ lbs C
$15	/ton C
$55	/ton CO2

Environmental Compliance Cost		
	$/ton	***$/Therrm***
Carbon	$ 15	$ 0.089
NOX	$ 2,000	$ 0.01
Total		$ 0.100

The gas price forecast only extends to year 2030. However, we have measures that are longer-lived and used a trended estimate for the later years. The final results for the avoided cost forecast are shown in .

FIGURE 8–14: FORECAST AND TRENDED AVOIDED COST



We also are interested in the seasonal impact on the gas prices. For example, the value of space heat savings (highly seasonal) is different from those of water heat savings (fairly flat) or those of swimming pool savings (entirely in the summer). We applied an estimate of the market price by season based on market studies as shown in Figure 8–15. Although the ratio averages to 1.00 for the year, it shows that prices are higher during the space heat season and somewhat reduced during the summer.

FIGURE 8–15: SEASONAL MARKET PRICES

The next step was to apply monthly load factors for the types of end-uses addressed by the conservation measures. We also extended the savings over the measure lifetime and computed the net present value of the discounted worth of this avoided cost. Table 8–16 shows some examples of the procedure applied to different load shapes and lifetimes. The Net Present Value (NPV) of Benefits is used as the economic screening criterion for testing measure cost-effectiveness. The levelized value shows the equivalent annual cost per therm. In general, measures are competing against a gas price of about $0.90 per therm, although it varies by end-use and lifetime.

TABLE 8–16: SUMMARY OF AVOIDED COST BENEFITS FOR EXAMPLE MEASURES

Gas Load Profile	Lifetime	NPV Avoided Cost	NPV Enviro Adder	NPV of Benefits	Levelized $/therm
Hot Water	10	$5.60	$0.75	$6.35	$0.841
Com Weatherization	20	$9.88	$1.20	$11.07	$0.923
Solar Hot Water	20	$9.20	$1.20	$10.39	$0.866
FLAT	10	$5.47	$0.75	$6.23	$0.824
Existing Space Heat	10	$5.47	$0.75	$6.23	$0.824
Existing Space Heat	30	$11.71	$1.46	$13.17	$0.901
New Space Heat	20	$10.29	$1.20	$11.49	$0.958
New Space Heat	30	$12.86	$1.46	$14.32	$0.980
Solar Pool	10	$5.09	$0.75	$5.85	$0.774
Residential Clothes Washer	10	$5.50	$0.75	$6.25	$0.827

MEASURE TECHNICAL AND ACHIEVABLE (RESOURCE) POTENTIALS

As described earlier, based on the market saturation data collected from the Nicor Gas customer survey, and other information known about the Nicor Gas customer base from company forecasts,

rate schedules, and insights from company staff, the project team was able to develop estimates of technical and achievable potentials for each measure.

The potentials developed for this study are of two types. First is a *Technical Potential*. The technical potential is an estimate of all energy savings that could be achieved immediately without the negative influence of any market barriers such as cost and lack of consumer awareness. As such, it provides a snapshot of everything that *could* be done if an infinite flow of money was provided to the Nicor Gas customers, and as such, it is an estimate of the *maximum* energy efficiency impacts that are technically possible for the customer base. Since technical potential does not present what can be saved through the offering of utility or other market programs (i.e., it would be impossible to get every customer to install every possible measure) and some measures cost more than Nicor Gas or their customers would be willing to pay for their application, the second potential has been computed and is referred to as the *Achievable Potential*. Achievable potential is computed for all measures, although when noted in the report and tables, there are analyses that report the achievable potential for the economic measures only, those measures that pass the benefit-cost ratio hurdle rate of 0.99 and greater. The achievable potential represents a more realistic assessment of what could be expected than that for technical potential, taking into account the fact that there are a multitude of barriers to acceptance of measures for some customers- price, maintenance, looks, hard to find, and many others.

The potentials have been developed for each measure based upon imposing each measure's energy impact on building prototypes that represent the Nicor Gas customer base for the residential market sector and by imposing each measure impact on the EUI's for the Commercial & Industrial market sectors. This is done in lieu of imposing the measures on each *individual customer buildings*- something that would be impossible to do, or on each possible EUI across the sectors. Therefore, building prototype/EUI analysis is the method commonly applied for this work and is utilized here.

Building prototypes are examples of buildings, construction, size, and other characteristics that have been deemed to *generally* represent the Nicor Gas customer base buildings. The project team reviewed the survey data, census information and other available data to determine what the prototype characteristics should be for each customer class. From this review, the team determined that 3 residential dwellings and 12 commercial/industrial buildings could serve as a good representation of the customer base. The team generally applied results to the industrial sector rather than modeling the industrial market since each customer facility is very individualistic and would have to be modeled on a case-by-case basis to determine precise impact estimates. The following serves to describe what those building types were.

TABLE 8–17: AVERAGE FLOOR AREA IN SQUARE FEET FOR BUILDING CHARACTERISTICS

Category	Building Type	Area in Square Feet
Residential	Single Family	1,756
	Manufactured Home	1,125
	Apartment	1,200
Commercial	Small Office	6,811
	Large Office	6,811
	Restaurant	3,026
	Retail	8,650
	Grocery	14,729
	Warehouse	12,134
	School	45,746
	College	24,879
	Hospital	109,281
	Other Health	66,191
	Lodging	37,606
	Other	7,813

The building characteristics for the residential building types were entered into a building simulation model, in this case, EZSim[9], and with base assumptions regarding energy-using equipment and end-uses produces building energy profiles. Altering the equipment to higher efficiency versions produces new, efficient case energy profiles. Comparison of the base profile to the efficient case provides the impact due to the efficiency measure installation. Some of the analyses (residential) were accomplished computing specific measure impacts in this manner while others (commercial and industrial) were computed through calculation and calibration of EUI (energy use intensity) impacts. The EUI's allow for greater generalization of the impacts for the commercial and industrial buildings and are applied on a building square footage basis. As such, EUI methods are still based on the prototype building analyses.

The building prototype analyses produce *end-use* load shapes (the building energy signatures) that represent the impact for the measures within end-use groupings of measures (measure groupings such as heating measures, hot water measures, etc). This method of analysis allows for impact analysis on a measure by measure basis and also includes the ability to assess the additional impact from the interaction of measures within a building. These interactions can become substantial and, if not included in the measure by measure analysis, will produce impacts that are not correct.

The determination of what the amount of achievable potential is when compared to what we know is the amount of technical potential has been the subject of discussion around the nation. Market

[9] EZSim, a DOE-2 PC based model developed by Stellar Processes, Inc.

Potential studies for other Illinois utilities[10] have used anywhere from 30% to 80% of technical potential to represent the achievable potential impacts that are probable based upon national utility information. The issue of interest in this study is what can be achievable assuming a vigorous and sustained long-term utility program. The above listed values are quite reasonable, but reflect a mixture of utilities mainly offering mature programs, i.e., programs that have been offered for some substantial period of time and have already influenced the transformation of the market to a good degree. Members of the project team have personal experience with offering utility programs and are familiar with situations where utilities are just beginning their energy efficiency program offerings to their customers and, as such, have immature markets such as is found for Nicor Gas. And, we also know that when programs are first introduced to the customer base, they are usually widely accepted and participation is quite positive. Thus, we feel that a higher value of achievable potential makes sense as an estimate for what is possible for Nicor Gas. We believe that a value of 85% of technical potential (the "realization rate") is achievable and is a reasonable estimate for Nicor Gas–and, therefore, was used in our analysis.[11,12]

The achievable potential represents a "stretch goal" for all possible "best practices" of program delivery. The percentage of technical potential assumption for achievable potential is an explicit input and can vary in subsequent analyses when historical Nicor Gas program information is available. The following table, therefore, serves as the estimate of the total technical and achievable potential impacts available for each measure within the Nicor Gas service territory for the buildings found within the customer base. Also shown in the tables, again, is the BCR associated with each measure so as to determine what measures are economic and to indicate what the total economic potential impact is for those economic measures in total.

Residential

TABLE 8–18: LIST OF RESIDENTIAL MEASURES AND PROGRAMS

Measure Name	Program	Benefit Cost Ratio (BCR)	Technical Potential (annual therms in thousands)	Achievable Potential (annual therms in thousands)
Solar Pool Cover	Prescriptive Rebate	17.85	29	25
Upgrade Gas Hearth	Prescriptive Rebate	6.51	492	418

[10] Cadmus Group, Inc. studies for Commonwealth Edison (February 17, 2009) and Ameren (March 12, 2009) and Commonwealth Edison (February 17, 2009)

[11] 85% is used by the Northwest Power Planning Council for programs in the Pacific Northwest, based on results from a "community blitz" program [Hood River Conservation Project]. The Northwest Power Planning Council developed a white paper on the subject. Their paper demonstrates that, over the last two decades, programs have achieved 85% of initial savings estimates. This value represents the achievable percentage of technical potential over 20 years of measure use. The programs have accomplished that goal, not by capturing 85% market penetration, but due to the fact that new technology brought more efficient products and consequently, more savings per customer than initially expected. However, based on review of other programs around the country, the assumption is reasonable for this study where the general market for impact is immature with few energy efficiency programs having been previously offered in this utility service territory.

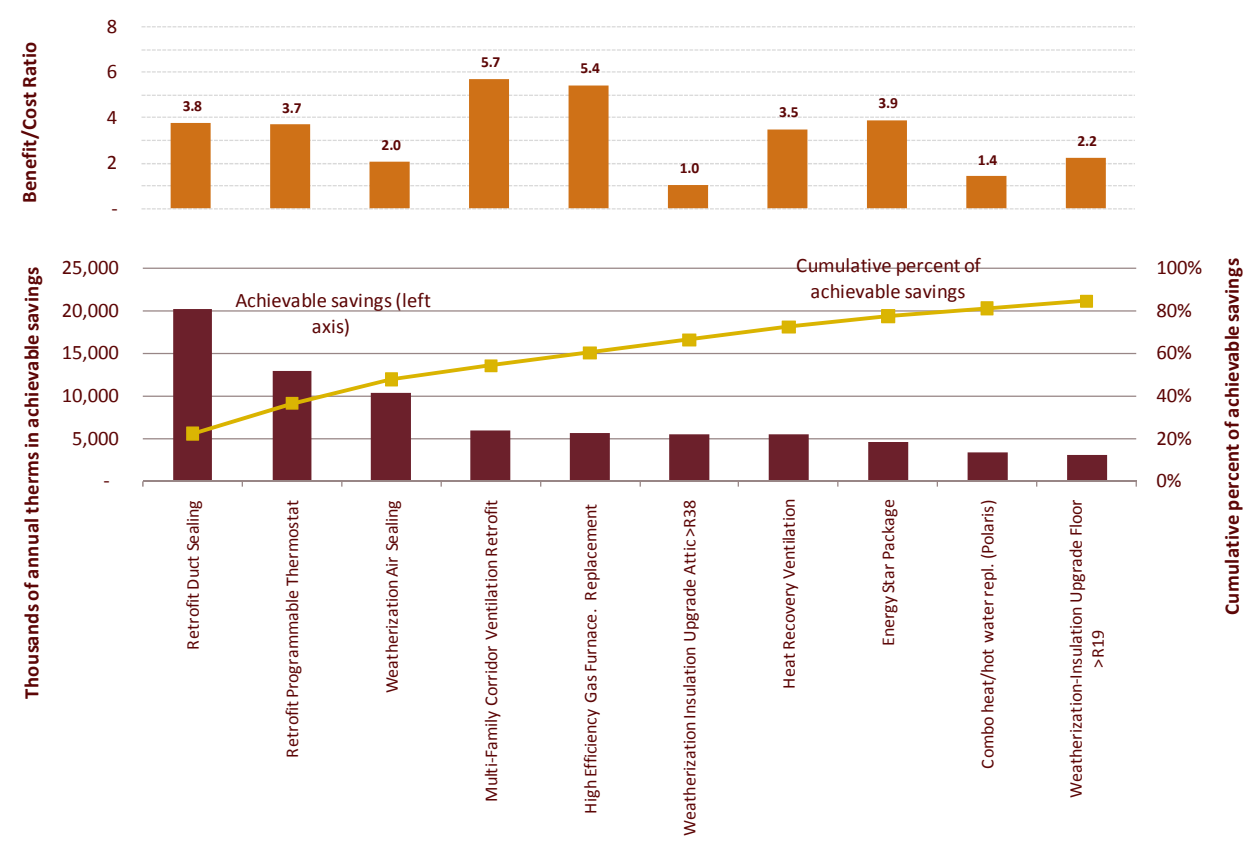
[12] http://www.nwcouncil.org/energy/powerplan/6/supplycurves/I937/CouncilMethodology_outline%20_2_.pdf

Measure Name	Program	Benefit Cost Ratio (BCR)	Technical Potential (annual therms in thousands)	Achievable Potential (annual therms in thousands)
Multi-Family Corridor Ventilation Retrofit	Prescriptive Rebate	5.72	6,937	5,897
Combo heat and hot water replacement.	New & Replacement DHW Rebate	5.48	1,761	1,497
High Efficiency Gas Furnace. Replacement	Prescriptive Rebate	5.43	6,596	5,607
Multi-Family Corridor Ventilation New	New Home	5.40	791	673
Combo heat and hot water replacement. New.	New & Replacement DHW Rebate	4.62	704	599
Efficient clothes washer. New.	Energy Star Rebate	4.45	30	25
Efficient clothes washer. Replacement.	Energy Star Rebate	4.09	452	384
Energy Star Package: Includes Insulation, Ducts, Domestic Hot Water, Lights Gas	Energy Star Home Package	3.89	5,404	4,594
Retrofit Duct Sealing	Weatherization	3.76	23,690	20,137
Retrofit Programmable Thermostat	Weatherization	3.69	15,232	12,947
Heat Recovery Ventilation	Prescriptive Rebate	3.50	6,455	5,487
High Efficiency Clothes Washer.New.	Energy Star Rebate	3.17	15	13
High Efficiency Clothes Washer. Replacement	Energy Star Rebate	2.99	296	252
Low Flow Shower	Weatherization	2.99	277	235
Solar Pool Heat	Prescriptive Rebate	2.84	371	316
Weatherization-Insulation Upgrade Floor >R19	Weatherization	2.24	3,617	3,075
Weatherization Air Sealing	Weatherization	2.03	12,080	10,268
Upgrade to forced draft tank. New	New & Replacement DHW Rebate	1.75	160	136
Upgrade to forced draft tank. Replacement.	New & Replacement DHW Rebate	1.66	1,039	883
Window U=.2. New	New Home	1.65	197	167
Combo heat and hot water replacement using Polaris heater. Replacement.	New & Replacement DHW Rebate	1.41	3,903	3,318
Condensing Tankless Water Heater. New	New & Replacement DHW Rebate	1.40	437	372
Condensing Tankless Water Heater. Replacement	New & Replacement DHW Rebate	1.33	1,036	881
EnergyStar Dishwasher. Replacement.	Energy Star Rebate	1.26	68	58
EnergyStar Dishwasher. New	Energy Star Rebate	1.22	0.857	0.729
Domestic Hot Water Pipe Wrap, Heat Traps	Prescriptive Rebate	1.20	2,864	2,434
Near Net Zero House Design	New Home	1.20	3,613	3,071
Combo heat and hot water replacement using Polaris heater. New.	New & Replacement DHW Rebate	1.18	90	76
Duct Sealing after furnace	Prescriptive Rebate	1.05	2,009	1,707
Weatherization Insulation Upgrade Attic >R38	Weatherization	1.02	6,473	5,502
Plumbing Package	Prescriptive Rebate	0.93	2,899	
Weatherization Upgrade Wall to R11	Weatherization	0.91	2,923	

Measure Name	Program	Benefit Cost Ratio (BCR)	Technical Potential (annual therms in thousands)	Achievable Potential (annual therms in thousands)
Tankless Gas heater. New	New & Replacement DHW Rebate	0.90	533	
Low Flow Faucet Aerator	Prescriptive Rebate	0.87	89	
Tankless Gas heater. Replacement	New & Replacement DHW Rebate	0.85	1,808	
Weatherization Upgrade Window >CL 20	Weatherization	0.79	38,048	
Heat Recovery Ventilation , Energy Star	Prescriptive Rebate	0.69	1,170	
High Efficiency Gas Furnace. New	Prescriptive Rebate	0.65	390	
Water Heater Upgrade. New	New & Replacement DHW Rebate	0.61	367	
Weatherization Upgrade Window >CL 30	Weatherization	0.58	27,274	
Water Heater Upgrade. Replacement.	New & Replacement DHW Rebate	0.56	1,241	
Efficient Replacement Boiler	Prescriptive Rebate	0.46	98	
Solar hot water heater (50 gal) - With gas backup. New	Prescriptive Rebate	0.33	59	
Solar hot water heater (50 gal) - With gas backup. replacement	Prescriptive Rebate	0.33	756	
Replace DHW with Heat Pump WH	Prescriptive Rebate	0.30	428	
Retrofit Boiler	Prescriptive Rebate	0.27	198	
Solar Siting	Prescriptive Rebate	0.05	106	
Residential Zoned Controls	Prescriptive Rebate	0.03	171	
Total			**179,495**	**85,444**

Figure 8–16 shows the top 10 economic residential measures (in achievable savings), along with their Benefit/Cost Ratios. By far the single most effective measure is Retrofit Duct Sealing, with over 20 million annual therms in achievable savings and an attractive BCR at 3.7. Of the 50 measures listed in Table 8-1, these ten account for 87% of all achievable savings.

FIGURE 8–16: MOST EFFECTIVE RESIDENTIAL MEASURES



Commercial

TABLE 8–19: LIST OF COMMERCIAL MEASURES AND PROGRAMS

Measure Name	Program	Benefit Cost Ratio (BCR)	Technical Potential (annual therms in thousands)	Achievable Potential (annual therms in thousands)
Energy Star Convection Oven	EnergyStar Rebate	100.00	379	322
Energy Star Convection Oven	EnergyStar Rebate	100.00	606	515
Retrofit HVAC System Commissioning	Retro-Commissioning	42.41	2,541	2,160
Efficient Energy Star Dishwasher	EnergyStar Rebate	14.28	877	746
Efficient Energy Star Dishwasher	EnergyStar Rebate	14.28	3,276	2,785
Ozone Laundry Treatment	Custom Rebate	14.00	13,323	11,324
Fleet Demand Control Ventilation	Custom Rebate	13.55	4,795	4,076
Hot Water Boiler Tune	Prescriptive Rebate	12.9.0	166	141
Hot Water Temperature Reset	Prescriptive Rebate	11.50	5,526	4,697
Waste Water Heat Exchanger	Custom Rebate	9.71	3,976	3,380
Waste Water Heat Exchanger	Custom Rebate	9.16	1,746	1,484
Steam Balance	Custom Rebate	8.07	2,855	2,427
Roof Insulation - Attic R0-30	Prescriptive Rebate	7.50	789	671

Measure Name	Program	Benefit Cost Ratio (BCR)	Technical Potential (annual therms in thousands)	Achievable Potential (annual therms in thousands)
Domestic Hot Water Shower Heads	Prescriptive Rebate	6.68	956	813
High Efficiency Unit Heater (replace)	Prescriptive Rebate	5.86	1,908	1,622
Computerized Water Heater Control	Prescriptive Rebate	5.83	982	835
Computerized Water Heater Control	Prescriptive Rebate	5.64	4,192	3,563
Domestic Hot Water Wrap	Prescriptive Rebate	4.96	566	481
Wall Insulation - Blown R11	Prescriptive Rebate	4.77	6,246	5,309
Demand Control Ventilation	Prescriptive Rebate	4.66	15,001	12,751
Roof Insulation - Rigid R0-11	Prescriptive Rebate	4.62	551	469
Heat Reclaim	Custom Rebate	4.13	3,991	3,392
Heat Reclaim	Custom Rebate	4.04	2,537	2,157
Energy Star Commercial Clothes Washer	Custom Rebate	3.92	31	26
Wall Insulation - Spray On for Metal Buildings	Prescriptive Rebate	3.82	2,409	2,047
Vent Damper	Prescriptive Rebate	3.42	721	612
Replace Space Conditioning Boiler with efficient unit	Prescriptive Rebate	3.26	104	88
Roof Insulation - Blanket R0-19	Prescriptive Rebate	3.18	3,320	2,822
Roof Insulation - Rigid R0-22	Prescriptive Rebate	3.05	628	533
Roof Insulation - Blanket R0-30	Prescriptive Rebate	2.97	3,483	2,960
Condensing Furnace (new)	Prescriptive Rebate	2.91	1,570	1,335
New Space conditioning boiler.	Prescriptive Rebate	2.48	896	762
Combo Hi-Efficiency Boiler (new)	Prescriptive Rebate	2.39	291	247
Replace space conditioning Boiler with condensing unit	Prescriptive Rebate	2.33	300	255
Windows - Add Low E to Vinyl Tint	Prescriptive Rebate	2.32	130	110
Domestic Hot Water High Efficiency Boiler (new)	Prescriptive Rebate	2.32	590	502
Domestic Hot Water Faucets	Prescriptive Rebate	2.30	127	108
Domestic Hot Water High Efficiency Boiler (replacement)	Prescriptive Rebate	2.29	328	279
Domestic Hot Water Condensing Tank (new)	Prescriptive Rebate	2.11	3,274	2,783
Combo High Efficiency Boiler (replacement)	Prescriptive Rebate	2.08	177	151
Roof Insulation - Rigid R11-22	Prescriptive Rebate	2.06	1,092	928
Roof Insulation - Attic 11-30	Prescriptive Rebate	2.06	1,140	969
Destratification Fan	Custom Rebate	2.03	17,320	14,722
Hot Food Holding Cabinet	EnergyStar Rebate	2.00	67	57
Ducts	Prescriptive Rebate	1.96	1,791	1,522
Domestic Hot Water Condensing Tank (replacement)	Prescriptive Rebate	1.90	1,923	1,634
Replace space conditioning Boiler with condensing unit	Prescriptive Rebate	1.90	2,146	1,824
Hot Food Holding Cabinet	EnergyStar Rebate	1.84	142	121
Energy Star Griddle	EnergyStar Rebate	1.76	162	137

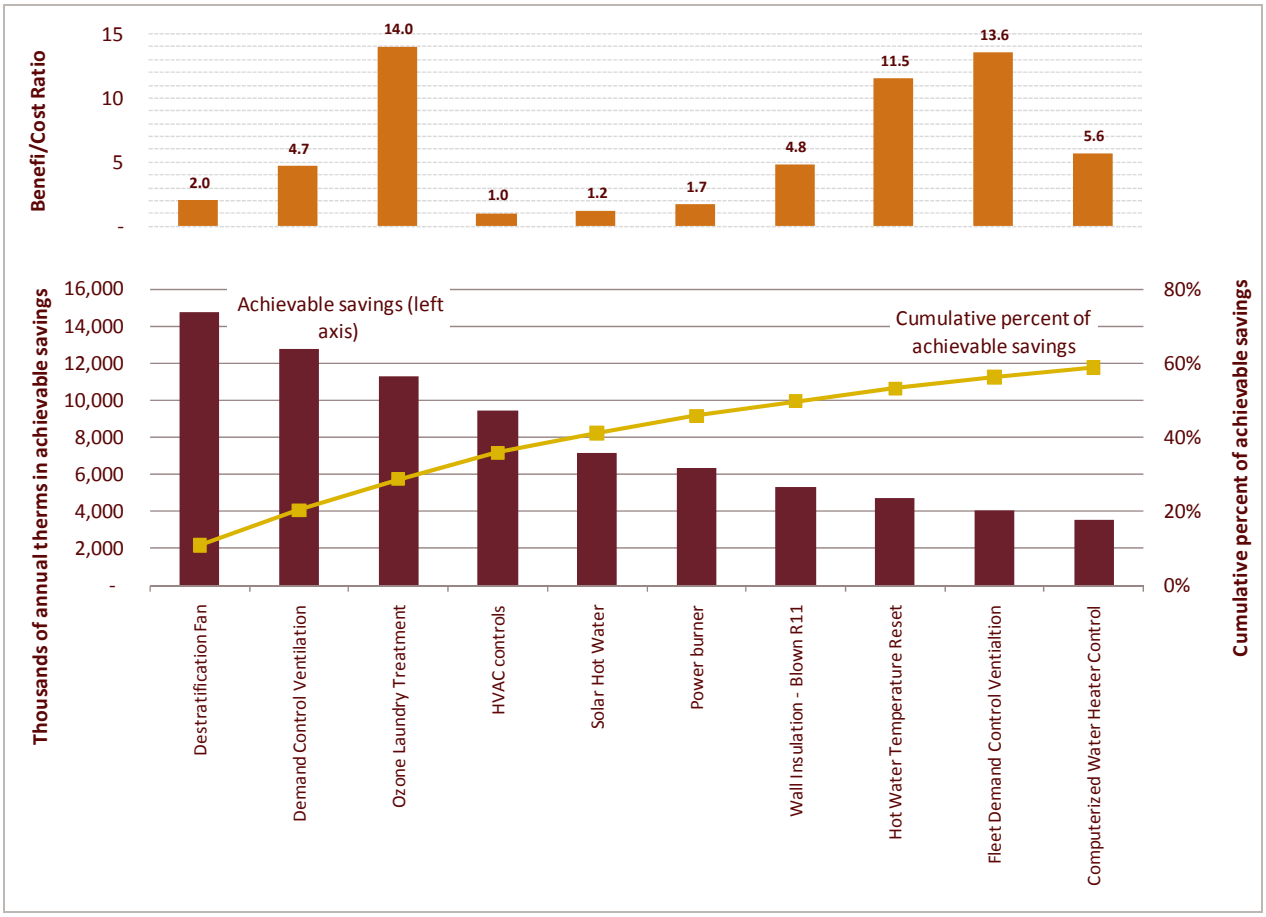
Measure Name	Program	Benefit Cost Ratio (BCR)	Technical Potential (annual therms in thousands)	Achievable Potential (annual therms in thousands)
Windows - Add Low E and Argon to Vinyl Tint	Prescriptive Rebate	1.75	181	154
Energy Star Griddle	EnergyStar Rebate	1.75	150	128
Power burner	Prescriptive Rebate	1.73	7,435	6,319
Domestic Hot Water Condensing Boiler (new)	Prescriptive Rebate	1.69	1,309	1,112
Domestic Hot Water Condensing Boiler (replacement)	Prescriptive Rebate	1.67	727	618
Domestic Hot Water Pipe Insulation	Prescriptive Rebate	1.42	271	230
Combo Condensing Boiler (new)	Prescriptive Rebate	1.37	645	548
Hi-Efficiency Unit Heater (new)	Prescriptive Rebate	1.28	585	497
Solar Hot Water	Custom Rebate	1.25	1,969	1,674
Solar Hot Water	Custom Rebate	1.21	8,409	7,147
Combo Condensing Boiler (replacement)	Prescriptive Rebate	1.20	393	334
Windows - Tinted AL Code to Class 45	Prescriptive Rebate	1.16	9	7
Condensing Unit Heater From Power Draft (new)	Prescriptive Rebate	1.13	1,438	1,222
Windows - Tinted AL Code to Class 40	Prescriptive Rebate	1.11	43	37
Domestic Hot Water Recirculating Controls	Custom Rebate	1.08	1,092	928
HVAC controls	Custom Rebate	1.03	11,152	9,480
Condensing Unit Heater from power draft (replacement)	Prescriptive Rebate	0.99	904	768
Steam Trap Maintenance	Custom Rebate	0.89	3,226	
Condensing Unit Heater from NaturalDraft (new)	Prescriptive Rebate	0.88	2,157	
Roof Insulation - Roofcut 0-22	Prescriptive Rebate	0.83	1	
Windows - Tinted AL Code to Class 40	Prescriptive Rebate	0.82	71	
Condensing Unit Heater from Natural draft (replace)	Prescriptive Rebate	0.77	1,357	
Condensing Furnace	Prescriptive Rebate	0.73	938	
Energy Star Steam Cooker	EnergyStar Rebate	0.73	144	
Energy Star Steam Cooker	EnergyStar Rebate	0.73	161	
Windows - Add Argon to Vinyl Lowe	Prescriptive Rebate	0.72	183	
Rooftop Condensing Burner	Custom Rebate	0.69	3,234	
Roof Insulation - Rigid R11-33	Prescriptive Rebate	0.63	418	
Warm Up Control	Custom Rebate	0.63	2,010	
Integrated Building Design	Custom Rebate	0.59	18,493	
Windows - Tinted AL Code to Class 36	Prescriptive Rebate	0.57	75	
HVAC System Commissioning	Custom Rebate	0.54	6,524	
Windows - Non-Tinted AL Code to Class 40	Prescriptive Rebate	0.47	125	
Roof Insulation - Blanket R11-41	Prescriptive Rebate	0.46	1,360	
Windows - Non-Tinted AL Code to Class 40	Prescriptive Rebate	0.46	219	

Measure Name	Program	Benefit Cost Ratio (BCR)	Technical Potential (annual therms in thousands)	Achievable Potential (annual therms in thousands)
Roof Insulation - Blanket R11-30	Prescriptive Rebate	0.44	1,134	
Windows - Tinted AL Code to Class 36	Prescriptive Rebate	0.43	116	
Windows - Non-Tinted AL Code to Class 36	Prescriptive Rebate	0.29	192	
Windows - Non-Tinted AL Code to Class 36	Prescriptive Rebate	0.28	332	
Windows - Non-Tinted AL Code to Class 45	Prescriptive Rebate	0.26	46	
Energy Star Commercial Clothes Washer	Custom Rebate	0.05	1	
Total			**201,172**	**134,857**

In Figure 8–17, we see that there is a broader dispersion of commercial measures that can contribute meaningfully to efficiency programs. Still, 80% of all potential is accounted for by the Top 20 measures (only the top 10 are shown). There were 90 commercial measures considered for this study, meaning the breakdown is roughly 80/20—less concentrated than for residential but still suggesting that the focus on the most impactful measures is warranted.

Some measures, like HVAC Controls and Solar Water Heating, come very close to the BCR cutoff of 0.99, suggesting that there is less economic headroom to make those measures attractive through programs. Others, however, like Ozone Laundry Treatment and Demand Control Ventilation, offer both depth of savings potential and attractive BCRs.

FIGURE 8–17: MOST EFFECTIVE COMMERCIAL MEASURES



Industrial

TABLE 8–20: LIST OF INDUSTRIAL MEASURES AND PROGRAMS

Measure Name	Program	Benefit Cost Ratio (BCR)	Technical Potential (annual therms in thousands)	Achievable Potential (annual therms in thousands)
Process Boiler Maintenance	Custom Rebate	18904.28	971	826
Domestic Hot Water Wrap	Prescriptive Rebate	2518.53	64	54
Process Boiler Water Treatment	Custom Rebate	1688.32	194	165
Process Boiler Controls	Custom Rebate	909.09	448	381
Process Boiler Load Control	Custom Rebate	787.88	1,942	1,651
Process Boiler Steam Trap Maintenance	Custom Rebate	270.06	3,156	2,683
Process Boiler Insulation	Custom Rebate	180.50	3,885	3,302
Domestic Hot Water Pipe Insulation	Prescriptive Rebate	70.02	144	122
Domestic Hot Water Condensing Tank (Replacement)	Prescriptive Rebate	53.81	246	209

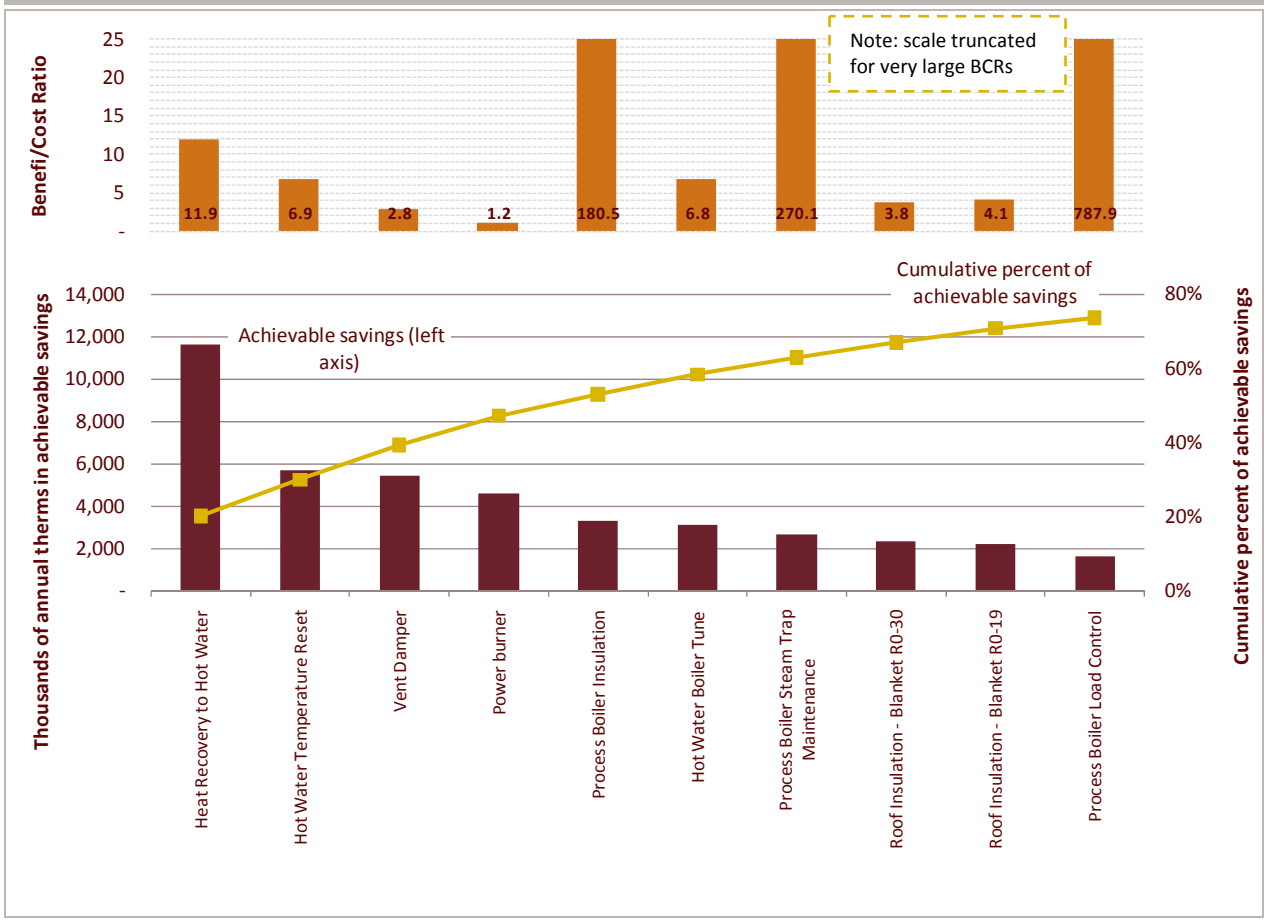
Measure Name	Program	Benefit Cost Ratio (BCR)	Technical Potential (annual therms in thousands)	Achievable Potential (annual therms in thousands)
Domestic Hot Water Hi-efficiency Boiler (Replacement)	Prescriptive Rebate	28.56	135	115
Ozone Treated Laundry	Custom Rebate	13.91	1,284	1,091
Domestic Hot Water Condensing Tank (Retrofit)	Prescriptive Rebate	11.96	855	727
Heat Recovery to Hot Water	Custom Rebate	11.86	13,683	11,630
Domestic Hot Water Condensing Boiler (Replacement)	Prescriptive Rebate	8.94	227	193
Hot Water Temperature Reset	Custom Rebate	6.87	6,667	5,667
Hot Water Boiler Tune	Prescriptive Rebate	6.81	3,667	3,117
Domestic Hot Water Std. Boiler (Retrofit)	Prescriptive Rebate	6.08	21	18
Wall Insulation - Blown R11	Weatherization	5.65	1,824	1,551
Wall Insulation - Spray On for Metal Buildings	Weatherization	5.08	1,023	870
Hi-Efficiency Clothes Washer (Retrofit)	Custom Rebate	4.22	610	519
Hi-Efficiency Clothes Washer (Replacement)	Custom Rebate	4.22	244	207
Roof Insulation - Blanket R0-19	Weatherization	4.10	2,597	2,208
Hi-Efficiency Unit Heater (Replacement)	Prescriptive Rebate	4.09	1,707	1,451
Combo Hi-efficiency Boiler (Replacement)	Prescriptive Rebate	4.07	767	652
Roof Insulation - Blanket R0-30	Weatherization	3.82	2,725	2,316
Steam Balance	Custom Rebate	3.71	18	15
Domestic Hot Water Hi-efficiency Boiler (Retrofit)	Prescriptive Rebate	3.65	580	493
Domestic Hot Water Condensing Boiler (Retrofit)	Prescriptive Rebate	2.85	755	642
Vent Damper	Custom Rebate	2.81	6,361	5,407
Combo Condensing Boiler (Replacement)	Prescriptive Rebate	2.21	1,497	1,273
Steam Trap Maintenance	Custom Rebate	2.05	1,023	869
Waste Water Heat Exchanger	Custom Rebate	2.01	1,118	950
High efficiency Space Conditioning Boiler Replacement	Prescriptive Rebate	1.98	141	120
Roof Insulation - Rigid R11-22 (Replacement)	Weatherization	1.58	668	567
Upgrade Process Heat	Custom Rebate	1.38	537	456
Condensing Unit Heater from National draft (Replacement)	Prescriptive Rebate	1.31	604	513
Condensing Space Conditioning Boiler Replacement	Prescriptive Rebate	1.27	244	207
Power burner	Prescriptive Rebate	1.18	5,405	4,594
Combo Condensing Boiler (Retro)	Prescriptive Rebate	0.82	5,361	
Chiller heat recovery (Electronics)	Custom Rebate	0.81	81	

Measure Name	Program	Benefit Cost Ratio (BCR)	Technical Potential (annual therms in thousands)	Achievable Potential (annual therms in thousands)
Combo High Efficiency Boiler (Retro)	Prescriptive Rebate	0.78	3,530	
High Efficiency Unit Heater (Retro)	Prescriptive Rebate	0.67	6,033	
Condensing Unit Heater from power draft (Replace)	Prescriptive Rebate	0.65	446	
Space Conditioning Condensing Boiler Retro	Prescriptive Rebate	0.60	384	
Roof Insulation - Blanket R11-41	Weatherization	0.60	1,613	
Space Conditioning High Efficiency Boiler Retro	Prescriptive Rebate	0.57	222	
Roof Insulation - Blanket R11-30	Weatherization	0.56	4,645	
Roof Insulation - Rigid R11-33 (Replace)	Weatherization	0.52	569	
Condensing Furnace (Replace)	Prescriptive Rebate	0.50	1,765	
Ducts	Custom Rebate	0.45	13,243	
Solar Hot Water	Custom Rebate	0.30	281	
Total			**106,209**	**57,832**

Of the most effective Industrial measures (see Figure 8–18), only one (Power Burner) hovers near the 1 BCR level. All others have comfortable, even substantial (greater than 25) ratios. There were 51 Industrial measures examined; of these, the top 10 (around 20% by counts) represent around 75% of all achievable savings.

At nearly 12 million annual therms of potential savings and a BCR of just under 12, Heat Recovery to Hot Water stands out as the most appealing single measure in the Industrial space.

FIGURE 8–18: MOST EFFECTIVE COMMERCIAL MEASURES



ECONOMIC POTENTIAL BY MEASURE

The final analysis that was accomplished to determine what Nicor Gas can expect to achieve *at a minimum* through the offering of energy efficiency programs developed to meet cost-benefit criteria is to compute the total achievable impact for all measures that initially passed the BCR of 1.0 and greater. However, to allow for marginal measures based on the BCR, the project team determined that the measures which were found to be above 0.99 in the BCR analysis were included within the economic potential calculations. Likely these measures found to have BCRs close but just lower than 1.0 would be included within a utility program with higher scoring measures of similar nature for consistency of application. The good economics for the higher scoring measures would "cover" costs for the marginal measures. The results for the analysis of the economic potential per measure for the first 3 years of energy efficiency program offerings are shown in the above tables per market segment, marked above the line indicating a measure BCR of 0.99 and above. The analysis indicates that Nicor Gas may expect to achieve a 5% impact on Residential sales, 9% impact on Commercial

sales, and a 10% impact on Industrial sales after the initial 3 years of program offering, represented by year 2013.

APPROXIMATE PROGRAM POTENTIAL

The project team assigned a set of draft generic programs to the measures that passed the economic screening criterion (Benefit Cost Ratio of at least 0.99). The programs are based upon similar program types found around the nation today and represent likely program types for Nicor Gas in the short term. For these draft programs, the team summarized technical and achievable potential per program, as well as percent savings by end use, in the following tables. Since these programs are very general in nature and do not specifically account for marketing strategy or administrative costs, no program-specific cost data or customer participation was included within this summary analysis. This information provides a useful context in that it illustrates that estimated savings fall within reasonable bounds relative to current consumption. All tables are based on target year 2013 which represents the end of the first cycle of the Nicor Gas energy efficiency program offerings. All tables are shown in annual therms. Based on the context of this summary analysis, it should be assumed that the achievable potential estimates represent the economic potential for the generic programs.

TABLE 8–21. RESIDENTIAL SECTOR PROGRAM SUMMARY-2013

Residential Programs/End Use	Heating	Water Heating	Appliances	TOTAL
Achievable Potential	9,180	-	-	**9,180**
Energy Star Appliances				
Technical Potential*	-	-	862	**862**
Achievable Potential	-	-	732	**732**
Achievable Potential	-	4,941	-	**4,941**
Prescriptive Rebates				
Technical Potential*	60,136	-	400	**60,536**
Achievable Potential	51,116	-	340	**51,456**
Achievable Potential	24,741	-	-	**24,741**
TOTAL POTENTIAL				
Technical Potential*	**100,043**	**5,813**	**1,262**	**100,522**
as a pct of sector sales	*4.8%*	*0.3%*	*0.1%*	***5.1%***
Achievable Potential	**85,037**	**4,941**	**1,073**	**91,050**
as a pct of sector sales	*4.1%*	*0.2%*	*0.1%*	*4.4%*

* For economic measures only (those with 0.99 Cost/Benefit Ratios or higher)

TABLE 8–22. COMMERCIAL SECTOR PROGRAM SUMMARY-2013

Commercial Programs/End Use	Space Heating	Water Heating	Cooking	TOTAL
Achievable Potential	26,107	16,267	-	**42,374**
EnergyStar Rebate				
Technical Potential*	-	4,184	1,506	**5,690**
Achievable Potential	-	3,557	1,280	**4,837**
Achievable Potential	59,467	20,954	-	**80,421**
Retro-Commissioning				
Technical Potential*	2,541	-	-	**2,541**
Achievable Potential	2,160	-	-	**2,160**
Achievable Potential	3,392	1,674	-	**5,066**
TOTAL POTENTIAL				
Technical Potential*	**107,207**	**49,943**	**1,506**	**158,656**
as a pct of sector sales	*6.2%*	*2.9%*	*0.1%*	***9.2%***
Achievable Potential	**91,126**	**42,451**	**1,280**	**134,858**
as a pct of sector sales	*5.3%*	*2.5%*	*0.1%*	*7.8%*

* for economic measures only (those with 0.99 Cost/Benefit Ratios or higher)

TABLE 8–23. INDUSTRIAL SECTOR PROGRAM SUMMARY-2013

Industrial Programs/End Use	Process Heat	Process Steam	Space Heat	Hot Water	TOTAL
Achievable Potential	18,704	6,340	2,683	1,091	**28,817**
Prescriptive Rebate					
Technical Potential*	-	15,437	2,311	7,549	**25,298**
Achievable Potential	-	13,122	1,964	6,417	**21,503**
Achievable Potential	-	-	7,511	-	**7,511**
TOTAL POTENTIAL					
Technical Potential*	**22,004**	**22,895**	**14,305**	**8,833**	**68,037**
as a pct of end use	*3.7%*	*3.8%*	*2.4%*	*1.5%*	***11.4%***
Achievable Potential	**18,704**	**19,461**	**12,159**	**7,508**	**57,832**
as a pct of end use	*3.1%*	*3.2%*	*2.0%*	*1.3%*	***9.7%***

* for economic measures only (those with 0.99 Cost/Benefit Ratios or higher)

END-USE POTENTIALS

To determine what the possible technical and achievable potential is for each gas end use (heating, water heating, etc.) for all economic measures, the project team has provided an analysis that includes the expected impact when assessing the measures within their end uses. This information is provided as an overview of potential impacts on utility system load through the application of energy efficiency programs. The results of this analysis are presented in the summary tables above.#