

Energy Trust of Oregon

2012 Resource Assessment Update

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Overview & Acknowledgements

In mid-2012, Energy Trust completed an annual update to its resource assessment, which identifies the amount and cost of achievable energy efficiency opportunities that exist by 2032 within its service territory. The results of this assessment are used to inform organizational strategic planning and utility resource planning. It shows what *additional* energy savings could be realized through future programmatic action. It does not include efficiency from future application of already-established building energy codes or appliance efficiency standards, nor from standard practices in equipment selection or facility design and operation.

This document provides the high level results of that update. As in the past, Energy Trust contracted with Stellar Processes to perform portions of the update, which built upon previous work from Stellar and Ecotope, Inc. The update also included contributions and review from Energy Trust's Planning department, and relied upon updated load forecasts and avoided cost information from Portland General Electric, Pacific Power, and Northwest Natural Gas.¹

The main goals of this update were to incorporate current load forecasts, as well as to review measure assumptions for key measures in each sector. In addition, all cost assumptions were updated to base year 2012 dollars.

The report from the prior 2011 update includes a more detailed description of the methodology, assumptions, and descriptions of the measures considered in the resource assessment. It is available at:
http://energytrust.org/library/reports/021611_ResourceAssessment.pdf.

Results Summary

The resource potential identified in this report is labeled either “technical” or “achievable”. The technical potential is the estimate of all energy savings that are technically possible, without consideration of any potential market barriers. Achievable potential is the portion of the technical potential that could realistically be accomplished over a 20 year period. Neither term gives any consideration as to whether a measure is cost-effective, but we have applied a preliminary, indicative screen of cost-effectiveness where noted in the report². Neither this

¹ Since Cascade Natural Gas load forecasts and avoided cost assumptions were already aligned with the most recent version of their Integrated Resource Plan, this update did not include new assumptions for that utility.

² The cost-effectiveness analysis in this report is based on forecasts of avoided costs from each utility. For integrated resource planning (IRP), each utility uses its own, slightly different, forecast. PGE, Northwest Natural, and PacifiCorp are in the midst of updating their IRP and thus their avoided costs. Thus, the “right” avoided costs for benefit/cost analysis vary based on the timing and the application of the data. The inferences in this report regarding the cost-effectiveness of efficiency resources should therefore be considered as “ballpark”. We include this information to help the reader assess broad patterns. Inferences

document, nor the supply curves themselves, consider the potential penetration rate (or deployment curve) for programs over the 20 year period. That is developed through a subsequent process as part of each IRP and Energy Trust budget process.

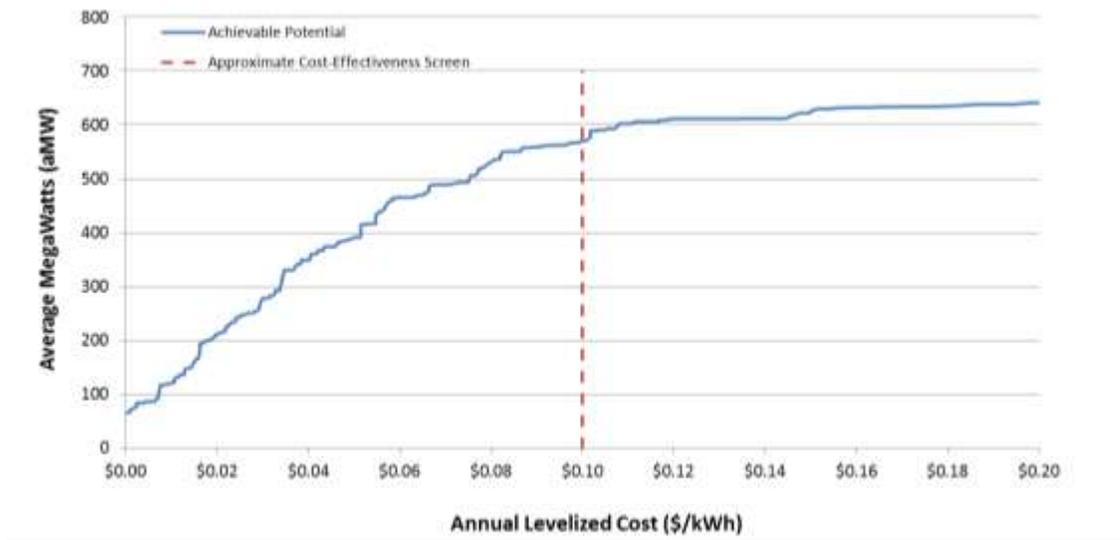
Electric Savings Potential

Updated utility load forecasts and a review of the assumptions used in key measures resulted in some changes to the resource assessment results.

The total amount of achievable potential estimated by the study is 669 aMW, over the 20-year analysis period. Figure 1 below depicts the electric supply curve for the updated resource assessment. This is the cumulative amount of efficiency resource available at varying levelized costs. Note that the entire range of potential is not shown for readability. Some potential has a net negative cost, due to O&M or other non-energy savings, and a small amount of potential has a levelized cost greater than \$0.20 per kWh.

The red dashed line represents the approximate location of the transition in cost effectiveness of the measures. Measures to the left of the line are cost effective, while those to the right are not.

Figure 1 – Achievable Electric Supply Curve



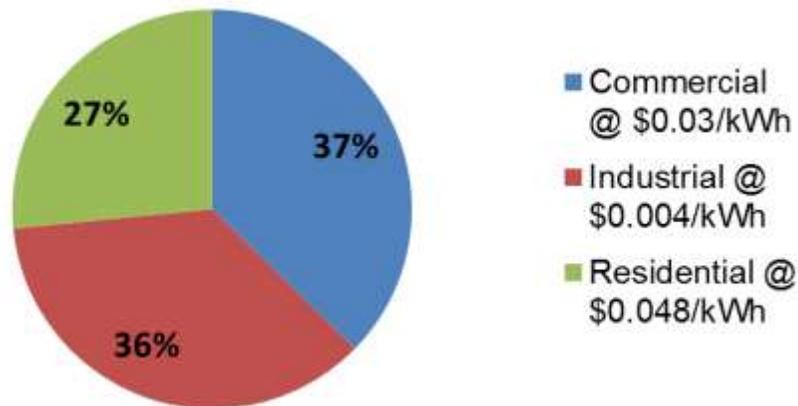
In comparison to the prior resource assessment, the results of this update are fairly similar. The total amount of achievable potential, the amount that is cost-

about the cost-effectiveness of individual measures should be made based on the more detailed studies of those measures that Energy Trust uses to make program eligibility decisions.

effective, and the levelized cost at which measures are cost effective are all fairly close to what was found in the 2011 study.

The distribution of this potential across the commercial, industrial, and residential sectors is shown in Figure 2, below.

Figure 2 – Cost-effective Achievable Electric Resource Potential and Average Levelized Cost by Sector



Total Cost Effective Achievable Potential = 556 aMW

This savings potential is far more evenly distributed than the 2011 resource assessment, where the commercial sector accounted for 50% of technical potential. The cause of this change is the increased amount of potential in the industrial and residential sectors, as well as a notable decline in the amount of remaining commercial potential. A more detailed explanation of these trends is provided in the sector-specific discussions below.

The levelized measure costs are also similar to expected trends. Residential measures are typically the most expensive, with commercial and industrial sectors being the lowest cost. These costs are the measure costs only and do not include program management and administrative costs.³ The low average cost of measures in the industrial sector is indicative of the fact that many measures have significant operations & maintenance benefits, or other non-energy benefits.

The total technical, achievable, and cost-effective achievable savings potential by sector is in Figure 3.

³ Program management and administrative costs are added for consideration of energy efficiency during the IRP process.

Figure 3 – Electric Savings (aMW) Potential by Sector

Sector	Technical	Achievable	Cost-Effective Achievable
Commercial	283	240	208
Industrial	256	201	201
Residential	270	228	148

The table below shows the cumulative Megawatt-hours of efficiency potential by sector and major measure category from 2013 - 2032.

Figure 4 – Total Achievable Electric Savings (aMW) by Sector and Measure Category

Measure Category	Commercial	Industrial	Residential
Appliances	-	-	43.5
Compressed Air	-	33.4	-
Cooking Equipment	9.1	-	-
Domestic Hot Water	3.4	-	16.4
Electronics & Chip Fabs	-	30.0	-
Industrial Fan Systems	-	20.4	-
HVAC Systems	48.1	-	61.8
Irrigation Systems	-	0.7	-
Lighting	155.8	29.9	77.1
Motors	12.4	6.5	-
Industrial Process Improvements	-	9.5	-
Industrial Pump Systems	-	33.1	-
Refrigeration Systems	5.3	8.5	-
Strategic Energy Management	-	23.1	-
Building Shell Improvements	5.8	-	-
Street & Traffic Lights	6.3	-	-
Home Weatherization	-	-	29.4
Total	246.0	195.1	228.2

Note that while irrigation systems, street lights, and traffic lights are not normally thought of as being a part of the industrial sector, they were included as part of that sector because the method of analysis aligns well with how other industrial opportunities are analyzed.

Industrial

The amount of resource potential in the compressed air, lighting, and irrigation categories in the industrial sector were increased in this update, due to program accomplishments that indicated that there was higher potential than what was

represented in the past. Measure lives for O&M measures were changed to three years in order to match current program assumptions. Penetration rates were also updated based upon recent program achievements.

Commercial

Changes to commercial measures included a combination of measure additions, adjustments to costs, penetration rates and performance, and removal of some measures subsumed by appliance efficiency standard and building efficiency code changes.⁴

Additions to the commercial sector included LED parking lot lighting not represented in the industrial model, new and replacement tankless water heating, lighting controls added as retrofit measures, and alignment with NWPCC in adding beverage machines, a retrocommissioning variant, and VSD on HVAC as retrofit. Penetration rates for chillers, insulation, EMS systems and custom HVAC controls were adjusted reflective of program results to date. Measures removed from the study included efficient PC monitors and several lighting measures subsumed by code.

Residential

The only significant new residential measure in this resource assessment update is the inclusion of specialty lighting. This representative group of measures includes compact fluorescent lamps (CFLs) for applications other than those that would be considered for general use CFLs. Examples include globes, candelabras, and 3-way lamps. These classes of lamps are exempt from federal EISA legislation. The achievable potential savings for these measures are substantial.

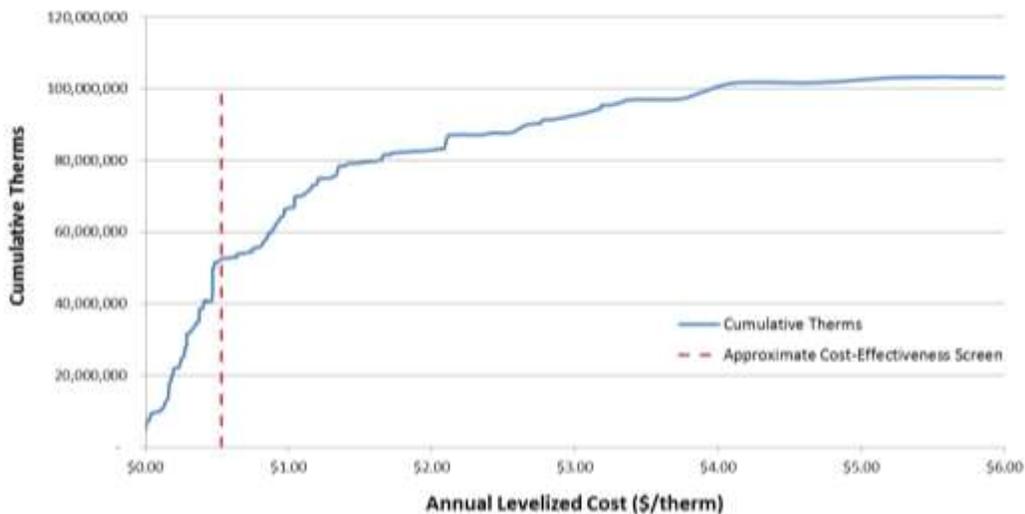
Several additional factors resulted in changes to the achievable potential. The first of these is updated savings estimates for some space heating measures. Additionally, updates were made to the incremental costs of a variety of measures based upon either new market information or expired state and federal tax credits. Baseline assumptions for several replacement measures were also updated. Lastly, saturation rates (percent of existing facilities or homes that already have an efficiency measure) were increased for some residential measures that have seen significant uptake in Energy Trust's service territory over the course of the last two years.

Gas Savings Potential

⁴ Future savings that are caused by appliance efficiency standards and building energy codes already in place at the time of this study (2012) are considered part of the "baseline" for the supply curves. The supply curves are designed to show what additional efficiency could be achieved through programmatic activity in the future.

As with the electric results described above, the assessment of gas efficiency potential began with an updated forecast of sales and avoided costs from Northwest Natural Gas. Due to expectations of lower gas costs through much of the time period analyzed in this study, the forecasts of gas costs avoided through efficiency actions were significantly reduced from prior levels. Figure 5 below shows the supply curve of achievable gas savings in the 20-year study period, and approximate levelized cost threshold for cost-effectiveness.

Figure 5 – Achievable Gas Supply Curve

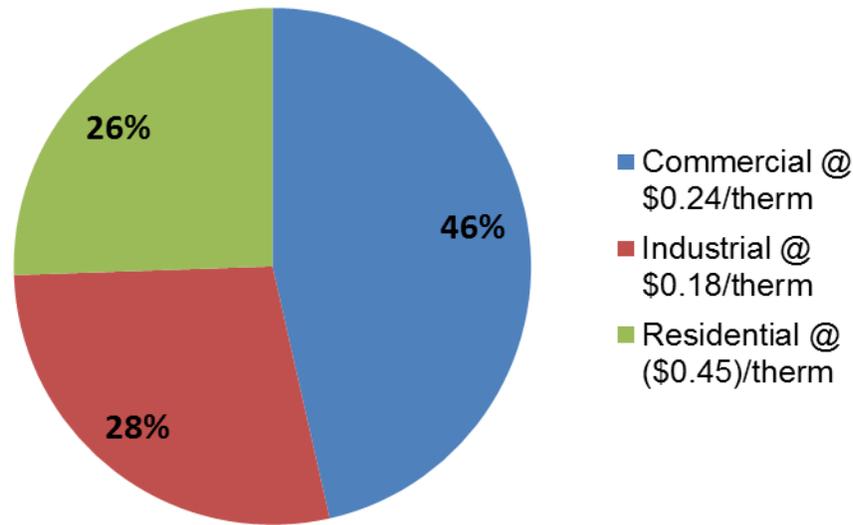


The total amount of achievable gas savings increased in this update. As can be seen in the figure above, however, only approximately half of the identified gas savings were determined to be cost-effective. In the 2011 report, the approximate cost-effectiveness limit was around \$1 per therm, levelized. Due to the lower gas avoided costs, the new cost-effectiveness limit is around \$0.53 per therm.

While little electric energy savings remain above the approximate cost threshold identified as cost effective, there is significant amount of gas potential above the cost-effectiveness limit identified in this study.

The amount of cost-effective gas potential by sector is shown below in Figure 6.

Figure 6 – Cost-effective Gas Resource Potential and Average Levelized Cost by Sector



Total Cost Effective Potential = 40,113,959 therms

As with the industrial sector above, the average levelized cost of gas in the residential sector is negative here due to non-energy benefits associated with measures like low-flow showerheads and clothes washers⁵. If these measures are excluded, the average levelized cost of the remaining cost-effective measures is approximately \$0.22 per therm.

Figure 7 – Gas Savings (therms) by Sector

Sector	Technical	Achievable	Cost-Effective Achievable
Commercial	41,846,447	35,569,480	18,628,906
Industrial	20,897,226	17,726,224	11,240,031
Residential	71,030,817	50,305,010	10,245,023

The table below shows the total achievable gas potential by sector and measure category. This represents all achievable savings, and has not been screened for cost-effectiveness.

⁵ The primary non-energy savings associated with these measures are reduced water, detergent, and sewer charges due to reduced water use.

Figure 8 – Achievable Gas Savings (therms) by Sector and Measure Category

Measure Category	Commercial	Industrial	Residential
HVAC	14.9	4.7	19.3
Cooking	2.9	0.0	0.0
Building Shell	9.2	2.5	0.0
Domestic Hot Water	8.6	2.6	12.1
Appliances	0.0	0.01	1.3
Industrial Process	0.0	8.0	0.0
Home Weatherization	0.0	0.0	17.5
Total	35.6	17.7	50.1

Industrial

Updates to the industrial sector resource assessment included updated sales forecasts from NW Natural. It should be noted here that this analysis omits gas users who have transport accounts, because firms that buy their gas on the open market do not pay into the funds that support Energy Trust’s gas efficiency work and are therefore ineligible for Energy Trust’s programs.

Inputs to the model were adjusted based upon recent program accomplishments. End-use consumption estimates for various industries were also reviewed based upon seasonal sales data from NW Natural as well as a series of informative reports developed by KEMA for PG&E, which covered several industrial sectors present in California.

Commercial

There were fewer adjustments to commercial gas measures than electric. Commercial gas measures were adjusted mainly to reflect code changes. Several boilers and unit heaters whose efficiency levels had become common practice were removed from the analysis. Adjustments to measures included cost updates for cooking measures and penetration rate adjustments for custom gas controls and gas fryers based on actual program results. The addition of tankless water heating added some potential but other small measures adjustments to penetration levels outweighed the additions.

Commercial measures most impacted by reduced avoided costs were on the new commercial side where the majority of single measures are no longer cost effective. This finding warrants additional research.

Residential

This updated resource assessment presents a significant decrease in the amount of cost-effective achievable potential in the residential sector. In addition to the much lower twenty-year avoided cost forecast, four additional factors have led to this drop in savings.

First, the achievable potential has been adjusted downward due to the levels of conservation acquired over the course of the last two years. With increased penetration rates of retrofit and replacement measures, one would expect the overall potential to decrease in the absence of new measures. Second, this resource assessment includes updates to the gas utilities' load and customer forecasts. The overall load and new customer and forecasts of fuel conversions to gas are lower for this twenty year time horizon (2013 – 2032) relative to the last (2011 – 2030). Third, after a third consecutive year of evaluation results based upon statistical billing analysis for residential gas weatherization measures, the savings estimates have been lowered for these measures within the resource assessment. The result is lower savings per installed measure. Last, there have been several modeling adjustments to better align the calibration of space heating measures to the amount of annual space heating load typically seen by the gas utilities.

In addition to these factors, there has been no new major gas measures included in this version of the resource assessment.

For further information on the resource assessment, see the detailed measure tables in the Appendix, or the 2011 Resource Assessment linked at the beginning of this document.

Appendix: Detailed Measure Tables

Commercial Sector, Electric Measures, 2032 Technical Potential

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Summer MW	Levelized Cost (\$/kWh)	BCR
ENERGY STAR Commercial Clothes Washer	Install high performance commercial clothes washers - coin op	Replace	Water Heat	10	958,395	-6,030,486	1,065	0.13	0.13	(\$0.6226)	6.93
ENERGY STAR Commercial Clothes Washer	Install high performance commercial clothes washers - coin op	New	Water Heat	10	126,860	-654,319	314	0.04	0.04	(\$0.2197)	6.58
Covered Parking Regional Average - New	Efficient Lighting, based on NWPPC	New	Lighting	8	8,894,705	-35,564,198	31,613	-	-	(\$0.1316)	5.64
Covered Parking Regional Average - NR	Efficient Lighting, based on NWPPC	Replace	Lighting	8	37,917,587	-74,964,760	68,740	-	-	(\$0.0841)	2.82
Surface Parking Regional Average - New	Efficient Lighting, based on NWPPC	New	Lighting	17	31,604,050	-45,540,718	24,962	-	-	(\$0.0503)	2.21
Water Heater Wrap	Insulate the surface of the storage water heater or an unfired storage tank to R-5 to reduce standby losses.	Retrofit	Water Heat	7	37,311		4,275	0.50	0.50	\$0.0015	44.49
ENERGY STAR Convection Oven	Replace with Energy Star in place of conventional	Replace	Cooking	12	373,532		10,993	1.29	1.29	\$0.0039	20.35
ENERGY STAR Fryer	Install Energy Star in place of conventional	New	Cooking	8	230,035		6,721	0.79	0.79	\$0.0053	13.21
Roof Insulation - Attic R0-30	Roof Insulation - Attic R0-30. Application: Buildings with uninsulated attics	Retrofit	Heating	45	164,138		1,508	0.52	0.05	\$0.0063	15.11
Chiller System Optimization	The "chiller system optimization" measure includes improvements in efficiency and reduction in parasitic losses in	Replace	Cooling	15	903,926		13,510	3.35	2.92	\$0.0065	13.07

Measure Name	Measure Description	Construct ion Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Sum mer MW	Levelized Cost (\$/kWh)	BCR
	pumps, fans, and other (non-chiller) electric motor-driven systems associated with chillers.										
High Bay High Intensity Discharge Medium Wattage to T8	458W> 224W, 1 lamp HID to 6 Lamp HPT8	New	Lighting	21	60,260	115,715	28,790	3.94	5.17	\$0.0067	13.78
Floating Head Control	Large Grocery - Add floating head control. This is considered measure for the independent grocery chains that are less likely to implement this feature.	New	Refrigeration	18	916,358		11,103	1.52	2.00	\$0.0072	12.46
Floating Head Control	Large Grocery - Add floating head control. This is considered measure for the independent grocery chains that are less likely to implement this feature.	Replace	Refrigeration	18	3,019,487		36,584	5.01	6.57	\$0.0072	12.46
Shower Heads	Install low flow shower heads (2.0 gallons per minute) to replace 3.4 GPM shower heads.	Retrofit	Water Heat	8	114,496		2,374	0.28	0.28	\$0.0075	9.38
Wall Insulation - Blown R11	Wall Insulation - Blown R11. Application: Old buildings	Retrofit	Heating	45	1,643,278		9,998	3.43	0.31	\$0.0095	10.00
Heat Pump, 2010 CEE Tier 1	Install high efficiency heat pump complying with 2010 CEE Tier 1 rather than 2010 code equipment. Base 10 seer 6.8 hspf to 13 seer / 8.1 hspf. From NWPPC 6th plan.	Replace	Heating	12	2,440,317		27,787	6.89	6.00	\$0.0100	8.02
Wall Insulation - Spray On for Metal Buildings	Wall Insulation - Spray On for Metal Buildings (Cellulose) Unfinished. Application: Old buildings	Retrofit	Heating	45	209,138		1,146	0.39	0.04	\$0.0106	9.01
Roof Insulation - Rigid R0-11	Roof Insulation - Rigid R0-11- not including re-roofing costs but including deck preparation.	Replace	Heating	45	686,974		3,627	1.25	0.11	\$0.0110	8.68

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Summer MW	Levelized Cost (\$/kWh)	BCR
	Application: Old buildings with flat roofs and no attics										
Rooftop Fleet Demand-Controlled Ventilation - No Heat Recovery	Big Box Retail with multiple units-Gang of 5-25000 sf. All ventilation air through every other unit with DCV control at 10% minimum and 100% maximum. Fan operates continuously for ventilation units and cycles on T-stat for the other units. Primary savings are reduced fan operation.	Retrofit	Ventilation	20	4,307,064		18,445	4.57	3.98	\$0.0123	7.30
Roof Insulation - Blanket R0-19	Roof Insulation - Blanket R0-19. Application: Buildings with open truss unfinished interior	Retrofit	Heating	45	321,651		1,434	0.49	0.04	\$0.0130	7.33
Economizer Diagnostic, Damper Repair & Reset	Applicable to single zone packaged systems. The outdoor make-up air damper and control are often set incorrectly or not functioning. This measure is the general checking. Savings derive from reduced cooling due to restored economizer function and reduced heating from reduced minimum outdoor air.	Retrofit	Cooling	10	29,521,674		201,672	50.01	43.56	\$0.0136	5.64
ENERGY STAR Convection Oven	Install Energy Star in place of conventional	New	Cooking	12	553,166		4,579	0.54	0.54	\$0.0138	5.72
Roof Insulation - Blanket R0-30	Roof Insulation - Blanket R0-30. Application: Buildings with open truss unfinished interior	Retrofit	Heating	45	361,857		1,505	0.52	0.05	\$0.0139	6.84
ENERGY STAR Fryer	Replace with Energy Star in place of conventional	Replace	Cooking	8	3,914,924		39,966	4.70	4.70	\$0.0153	4.62
LIGHTING- T12 to HP T8	162W> 49W	Retrofit	Lighting	21	31,603,483		240,131	32.88	43.15	\$0.0162	5.68

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Summer MW	Levelized Cost (\$/kWh)	BCR
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	45	1,186,591		4,150	1.42	0.13	\$0.0166	5.75
Transformers		Retrofit	Total	20	4,126,048		19,204	2.26	2.26	\$0.0175	5.04
Hot Food Holding Cabinet	Install Energy Star in place of conventional	New	Cooking	8	437,066		3,646	0.43	0.43	\$0.0187	3.77
Hot Food Holding Cabinet	Install Energy Star in place of conventional	Replace	Cooking	8	2,543,192		21,000	2.47	2.47	\$0.0189	3.73
Heat Pump, 2010 CEE Tier 1	Install high efficiency heat pump complying with 2010 CEE Tier 1 rather than 2010 code equipment. Base 10 seer 6.8 hspf to 13 seer / 8.1 hspf. From NWPPC 6th plan.	New	Heating	12	873,625		5,262	1.30	1.14	\$0.0189	4.24
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	45	2,242,201		6,119	2.10	0.19	\$0.0212	4.49
High Bay High Intensity Discharge Medium Wattage to T8	458W> 224W, 1 lamp HID to 6 Lamp HPT8	Retrofit	Lighting	21	13,986,747	227,321	73,943	10.13	13.29	\$0.0220	4.19
Roof Insulation - Attic 11-30	Roof Insulation - Attic 11-30. Application: Buildings with partially insulated attics	Retrofit	Heating	45	1,039,624		2,712	0.93	0.08	\$0.0222	4.29
ECM Fan Powered Boxes New	Install ECM motors in VAV fan powered terminals with PSC motors	New	Ventilation	20	3,626,035		16,269	4.03	3.51	\$0.0229	3.93
Ozone Laundry Treatment	Ozone treatment allows use of cold water	Retrofit	Water Heat	10	629,627	-95,972	3,042	0.36	0.36	\$0.0229	2.93

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Summer MW	Levelized Cost (\$/kWh)	BCR
Windows - Add Low E to Vinyl Tint	Windows - Add Low E to Vinyl Tint. Application: Old buildings	Replace	Heating	20	813,638		2,873	0.99	0.09	\$0.0231	3.76
High Efficiency Chiller	Replace chillers or installing new chillers to purchase units with efficiencies averaging 0.53 kW/ton (CEE Tier 2), rather than the standard new unit, which has an efficiency of 0.66 kW/ton. Assumes 50/50 split between screw type and centrifugal. From NWPPC 6th plan. In practice, some fraction of chiller replacements may involve the early retirement of units with lower efficiencies (perhaps 0.90 kW/ton), and thus achieve higher savings in the first few years of the measure installation.	Replace	Cooling	24	7,773,112		22,273	2.62	2.62	\$0.0258	3.54
Energy Management System Retrofit	Many commercial establishments have no means of operating facility lighting, heating, air conditioning, refrigeration, etc., except to rely upon employees to manually switch equipment on/off before, during and after a typical work day. This is especially true in restaurants. A proper EMS installation in such facilities can reduce existing gas and electric energy usage by about 10% or more.	Retrofit	Total	20	36,353,283		108,383	12.75	12.75	\$0.0274	3.23
Ducts	Duct retrofit of both insulation and air sealing	Retrofit	Heating	15	948,133		3,281	0.81	0.71	\$0.0282	3.03
ENERGY STAR Griddle	Replace with Energy Star in place of conventional	Replace	Cooking	12	1,354,672		5,423	0.64	0.64	\$0.0285	2.77

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Summer MW	Levelized Cost (\$/kWh)	BCR
Exit signs	20W> 1 W, switch to LED sign (not photoluminescent b/c of cost)	Retrofit	Lighting	21	6,048,575		20,991	2.47	2.47	\$0.0290	3.08
Demand-Controlled 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	10	2,864,804		12,869	3.19	2.78	\$0.0291	2.64
CFL 9W to 39W hardwired	75W> 18W	New	Lighting	21	1,764,166	38,747,524	138,451	18.96	24.88	\$0.0298	3.09
Windows - Add Low E and Argon to Vinyl Tint	Windows - Add Low E and Argon to Vinyl Tint. Application: Old buildings	Replace	Heating	20	1,272,456		3,478	1.19	0.11	\$0.0299	2.91
ENERGY STAR Griddle	Install Energy Star in place of conventional	New	Cooking	12	409,117		1,447	0.17	0.17	\$0.0323	2.45
Rooftop heat/AC-Demand-Controlled Ventilation with Heat Recovery	Big Box Retail with multiple units. All baseline ventilation air through designated ventilation units with Heat recovery. All other units run with fan off and cycle on DCV control and T-stat. Primary savings are reduced fan operation. Main issue is unbalanced flows due to building exhaust so this is not applied to grocery. Due to higher fraction of units off electric savings are higher than H129. Due to HR heat savings are also much higher.	New	Ventilation	20	8,113,793		14,405	3.57	3.11	\$0.0337	2.67
Waste Water Heat Exchanger	Install HX on waste water	Retrofit	Water Heat	15	192,824		544	0.06	0.06	\$0.0346	2.42

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Summer MW	Levelized Cost (\$/kWh)	BCR
Lighting Scheduling Controls	Lighting scheduling and control. This measure includes the commissioning of any occupancy and sweep controls, and the review and proper setting of daylighting controls. Since these are largely a function of schedule settings (except in cases where day lighting controls are integrated into the energy management software), we have included only the impact of properly controlled lighting and occupancy.	Retrofit	lighting	15	49,968,111		123,716	14.55	14.55	\$0.0394	2.12
Domestic Hot Water Pipe Insulation	Add 1" insulation to pipes used for steam or hydronic distribution; particularly effective when pipes run through unheated spaces.	New	Water Heat	15	336,874		811	0.10	0.10	\$0.0406	2.06
High Bay High Intensity Discharge lighting Large wattage to T5	1080W> 701W	New	Lighting	21	3,650,668	432,527	9,416	1.29	1.69	\$0.0406	2.27
Faucet aerators	Add aerators to existing faucets to reduce flow from 2.2 gallons per minute to 1.5 GPM.	Retrofit	Water Heat	8	43,979		158	0.02	0.02	\$0.0433	1.63
Faucet aerators	Add aerators to existing faucets to reduce flow from 2.2 gallons per minute to 1.5 GPM.	New	Water Heat	8	63,234		219	0.03	0.03	\$0.0450	1.57
High Bay High Intensity Discharge lighting - Large wattage to T5	1080W> 701W	Retrofit	Lighting	21	11,855,859	639,863	24,185	3.31	4.35	\$0.0477	1.93
Variable Speed Drive on HVAC motors	Install ECM motors in VAV fan powered terminals with PSC motors	Replace	Ventilation	18	11,671,727		26,242	6.51	5.67	\$0.0491	1.80

Measure Name	Measure Description	Construct ion Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Sum mer MW	Levelized Cost (\$/kWh)	BCR
Water Source Heat Pump High Efficiency	Install high efficiency water source heat pump with 4.6 COP in place of 2010 code equipment (COP 4.2). Cost from NPPC 6th plan for under 5 ton units. Savings ratio of the COP and EER changes.	New	Heating	12	704,326		1,558	0.39	0.34	\$0.0516	1.56
Heat Pump Water Heat		Retrofit	Water Heat	15	4,789,749	183,705	9,115	1.07	1.07	\$0.0533	1.57
Lighting- T8 to HP T8	58W> 49W	Replace	Lighting	21	49,187,894	96,391,520	234,185	32.07	42.08	\$0.0552	1.67
Computerized Water Heater Control	Install intelligent controls on the hot water circulation loops.	Retrofit	Water Heat	15	884,212		1,541	0.18	0.18	\$0.0560	1.49
Windows - Tinted AL Code to Class 40	Windows - Tinted AL Code to Class 40. Application: Old buildings	Replace	Heating	20	648,214		937	0.32	0.03	\$0.0564	1.54
Sweep Control for lights	25% savings	New	Lighting	21	37,890,060		56,121	-	-	\$0.0586	1.56
Roof Insulation - Roofcut 0-22	Roof Insulation - Roofcut 0-22. Application: Buildings with uninsulated flat roofs at reroofing time	Replace	Heating	45	7,232		7	0.00	0.00	\$0.0633	1.50
Install Economizer	Economizer retrofit on unit with no economizer	Retrofit	Cooling	15	9,566,158		14,190	3.52	3.06	\$0.0658	1.30
Windows - Add Argon to Vinyl Low-e	Windows - Add Argon to Vinyl Low-e. Application: Old buildings	Replace	Heating	20	3,238,216		3,961	1.36	0.12	\$0.0667	1.30
Chiller Tower 6F approach	Install low approach cooling tower	Replace	Cooling	15	5,014,380		7,127	1.77	1.54	\$0.0687	1.24
Lighting Scheduling/Con trols	Lighting scheduling and control. This measure includes the commissioning of any occupancy and sweep controls, and the review and proper setting of daylighting controls. Since these are	New	lighting	15	33,148,799		45,459	5.35	5.35	\$0.0712	1.18

Measure Name	Measure Description	Construct ion Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Sum mer MW	Levelized Cost (\$/kWh)	BCR
	largely a function of schedule settings (except in cases where daylighting controls are integrated into the energy management software), we have included only the impact of properly controlled lighting and occupancy.										
Windows - Tinted Aluminum Code to Class 40	Windows - Tinted Aluminum Code to Class 40. Application: New Construction	New	Heating	20	743,561		812	0.28	0.03	\$0.0747	1.16
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	45	3,363,301		2,583	0.89	0.08	\$0.0754	1.26
Exterior LED Lighting	30% savings	New	Lighting	21	277,240,640	-39,384,658	236,427	-	-	\$0.0799	1.12
Waste Water Heat Exchanger	Install HX on waste water	New	Water Heat	15	3,167,253		3,804	0.45	0.45	\$0.0813	1.03
Roof Insulation - Blanket R11-41	Roof Insulation - Blanket R11-41. Application: Buildings with open truss unfinished interior	Retrofit	Heating	45	904,642		589	0.20	0.02	\$0.0890	1.07
Roof top cooling- 2010 CEE Tier 1 AC - 3 ton (at rep)	Install high efficiency cooling equipment complying with 2010 CEE Tier 1 rather than 2010 code equipment. Costing in 6th plan showed 2010 Tier 2 equipment was 6 times more expensive and therefor is not included here. Tier 2 costs should be tracked.	Replace	Cooling	20	4,063,516		3,704	0.92	0.80	\$0.0895	1.01
Rooftop cooling- 2010 CEE Tier 1 AC - 3 ton (new)	Install high efficiency cooling equipment complying with 2010 CEE Tier 1 rather than 2010 code equipment. Costing in 6th plan showed 2010 Tier 2 equipment was 6	New	Cooling	20	2,540,427		2,263	0.56	0.49	\$0.0916	0.98

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Summer MW	Levelized Cost (\$/kWh)	BCR
	times more expensive and therefor is not included here. Tier 2 costs should be tracked.										
Direct Digital 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	5	6,641,643		16,770	4.16	3.62	\$0.0920	0.64
Roof Insulation - Blanket R11-30	Roof Insulation - Blanket R11-30. Application: Buildings with open truss unfinished interior	Retrofit	Heating	45	804,126		491	0.17	0.02	\$0.0948	1.00
Cooling- 2010 CEE Tier 1 AC - 25 ton (at rep)	Install high efficiency cooling equipment complying with 2010 CEE Tier 1 rather than 2010 code equipment. Costing in 6th plan showed 2010 Tier 2 equipment was 6 times more expensive and therefor is not included here. Tier 2 costs should be tracked.	Replace	Cooling	20	6,988,849		5,946	1.47	1.28	\$0.0959	0.94
Cooling- 2010 CEE Tier 1 AC - 25 ton (new)	Install high efficiency cooling equipment complying with 2010 CEE Tier 1 rather than 2010 code equipment. Costing in 6th plan showed 2010 Tier 2 equipment was 6 times more expensive and	New	Cooling	20	4,369,284		3,633	0.90	0.78	\$0.0982	0.92

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Summer MW	Levelized Cost (\$/kWh)	BCR
	therefor is not included here. Tier 2 costs should be tracked.										
Windows - Non-Tinted AL Code to Class 40	Windows - Non-Tinted AL Code to Class 40. Application: Old buildings	Replace	Heating	20	2,362,369		1,901	0.65	0.06	\$0.1014	0.86
Rooftop Condensing Burner	Install condensing burner	New	Heating	10	4,614,037		5,843	-	-	\$0.1033	0.75
Windows - Tinted AL Code to Class 36	Windows - Tinted AL Code to Class 36. Application: Old buildings	Replace	Heating	20	1,620,536		1,276	0.44	0.04	\$0.1036	0.84
Cooling- 2010 CEE Tier 1 AC - 15 ton (at rep)	Install high efficiency cooling equipment complying with 2010 CEE Tier 1 rather than 2010 code equipment. Costing in 6th plan showed 2010 Tier 2 equipment was 6 times more expensive and therefor is not included here. Tier 2 costs should be tracked.	Replace	Cooling	20	4,063,516		3,156	0.78	0.68	\$0.1051	0.86
Windows - Non-Tinted Aluminum Code to Class 40	Windows - Non-Tinted AL Code to Class 40. Application: New Construction	New	Heating	20	1,848,097		1,431	0.49	0.04	\$0.1054	0.82
Cooling- 2010 CEE Tier 1 AC - 15 ton (new)	Install high efficiency cooling equipment complying with 2010 CEE Tier 1 rather than 2010 code equipment. Costing in 6th plan showed 2010 Tier 2 equipment was 6 times more expensive and therefor is not included here. Tier 2 costs should be tracked.	New	Cooling	20	2,540,427		1,929	0.48	0.42	\$0.1075	0.84

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Summer MW	Levelized Cost (\$/kWh)	BCR
LED lighting-Surface Parking Regional Average	Efficient Lighting, based on NWPPC	Replace	Lighting	17	88,116,970	-27,840,510	49,521	-	-	\$0.1096	0.86
Heat Pump Water Heat		New	Water Heat	15	4,819,818	184,858	4,268	0.50	0.50	\$0.1145	0.73
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	10	3,465,395		3,921	-	-	\$0.1156	0.67
Computerized Water Heater Control	Install intelligent controls on the hot water circulation loops.	New	Water Heat	15	1,495,321		1,088	0.13	0.13	\$0.1342	0.62
Windows - Tinted Aluminum Code to Class 36	Windows - Tinted AL Code to Class 36. Application: New Construction	New	Heating	20	1,858,902		1,128	0.39	0.04	\$0.1345	0.65
Cooling- 2010 CEE Tier 1 AC - 7.5 ton (at rep)	Install high efficiency cooling equipment complying with 2010 CEE Tier 1 rather than 2010 code equipment. Costing in 6th plan showed 2010 Tier 2 equipment was 6 times more expensive and therefore is not included here. Tier 2 costs should be tracked.	Replace	Cooling	20	4,063,516		2,255	0.56	0.49	\$0.1471	0.61

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Summer MW	Levelized Cost (\$/kWh)	BCR
Cooling- 2010 CEE Tier 1 AC - 7.5 ton (new)	Install high efficiency cooling equipment complying with 2010 CEE Tier 1 rather than 2010 code equipment. Costing in 6th plan showed 2010 Tier 2 equipment was 6 times more expensive and therefor is not included here. Tier 2 costs should be tracked.	New	Cooling	20	2,540,427		1,378	0.34	0.30	\$0.1505	0.60
Windows - Non-Tinted AL Code to Class 36	Windows - Non-Tinted AL Code to Class 36. Application: Old buildings	Replace	Heating	20	5,905,923		2,876	0.99	0.09	\$0.1676	0.52
Windows - Non-Tinted AL Code to Class 36	Windows - Non-Tinted AL Code to Class 36. Application: New Construction	New	Heating	20	4,620,243		2,138	0.73	0.07	\$0.1763	0.49
Windows - Non-Tinted AL Code to Class 45	Windows - Non-Tinted AL Code to Class 45. Application: Old buildings	Replace	Heating	20	1,570,975		685	0.24	0.02	\$0.1871	0.46
Cooling- 2010 CEE Tier 3 AC - 3 ton (at rep)	Install high efficiency cooling equipment complying with 2010 CEE Tier 3 rather than 2010 code equipment. SEER 9.5 > 12.5. Not cost effective relative to Tier 1 costs. From NWPPC 6th plan.	Replace	Cooling	20	1,090,604		467	0.12	0.10	\$0.1907	0.47
Cooling- 2010 CEE Tier 3 AC - 7.5 ton (at rep)	Install high efficiency cooling equipment complying with 2010 CEE Tier 3 rather than 2010 code equipment. SEER 9.5 > 12.5. Not cost effective relative to Tier 1 costs. From NWPPC 6th plan.	Replace	Cooling	20	1,090,604		467	0.12	0.10	\$0.1907	0.47
Cooling- 2010 CEE Tier 3 AC - 15 ton (at rep)	Install high efficiency cooling equipment complying with 2010 CEE Tier 3 rather than 2010 code equipment. SEER 9.5 > 12.5. Not cost effective relative to Tier 1 costs. From	Replace	Cooling	20	1,090,604		467	0.12	0.10	\$0.1907	0.47

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Summer MW	Levelized Cost (\$/kWh)	BCR
	NWPPC 6th plan.										
Cooling- 2010 CEE Tier 3 AC - 25 ton (at rep)	Install high efficiency cooling equipment complying with 2010 CEE Tier 3 rather than 2010 code equipment. SEER 9.5 > 12.5. Not cost effective relative to Tier 1 costs. From NWPPC 6th plan.	Replace	Cooling	20	1,875,732		803	0.20	0.17	\$0.1907	0.47
Lighting-High Intensity Discharge to Ceramic Metal Halide	100W> 44W	New	Lighting	21	19,142,844	15,020,231	14,377	1.97	2.58	\$0.1929	0.48
Cooling- 2010 CEE Tier 3 AC - 3 ton (new)	Install high efficiency cooling equipment complying with 2010 CEE Tier 3 rather than 2010 code equipment. SEER 9.5 > 12.5. Not cost effective relative to Tier 1 costs. From NWPPC 6th plan.	New	Cooling	20	681,823		285	0.07	0.06	\$0.1951	0.46
Cooling- 2010 CEE Tier 3 AC - 7.5 ton (new)	Install high efficiency cooling equipment complying with 2010 CEE Tier 3 rather than 2010 code equipment. SEER 9.5 > 12.5. Not cost effective relative to Tier 1 costs. From NWPPC 6th plan.	New	Cooling	20	681,823		285	0.07	0.06	\$0.1951	0.46
Cooling- 2010 CEE Tier 3 AC - 15 ton (new)	Install high efficiency cooling equipment complying with 2010 CEE Tier 3 rather than 2010 code equipment. SEER 9.5 > 12.5. Not cost effective relative to Tier 1 costs. From NWPPC 6th plan.	New	Cooling	20	681,823		285	0.07	0.06	\$0.1951	0.46
Cooling- 2010 CEE Tier 3 AC - 25 ton (new)	Install high efficiency cooling equipment complying with 2010 CEE Tier 3 rather than	New	Cooling	20	1,172,669		490	0.12	0.11	\$0.1951	0.46

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Summer MW	Levelized Cost (\$/kWh)	BCR
	2010 code equipment. SEER 9.5 > 12.5. Not cost effective relative to Tier 1 costs. From NWPPC 6th plan.										
Daylight Control (overhead)	5% savings	New	Lighting	10	184,380,174		119,236	16.33	21.43	\$0.2088	0.37
Lighting- High Intensity Discharge to Ceramic Metal Halide	100W> 44W	Replace	Lighting	21	42,160,759	36,502,936	29,645	4.06	5.33	\$0.2147	0.43
Solar Hot Water	Install solar water heaters on large use facility such as multifamily or lodging	Retrofit	Water Heat	15	7,934,486	450,889	3,338	0.39	0.39	\$0.2453	0.34
Mini-Split Heat Pump	Use SEER 18 mini-split in place of PTHP	Replace	Heating	12	1,453,147		637	0.16	0.14	\$0.2602	0.31
Ground Source Heat Pump - Air Source HP Base	Install GSHP in place of air source heat pumps.	Replace	Heating	18	11,388,912	-243,882	3,429	0.85	0.74	\$0.2824	0.33
High Efficacy LED Display lighting	72W> 39W	New	Lighting	21	128,868	40,938,912	9,218	1.26	1.66	\$0.3582	0.26
Daylight perimeter zone	10% savings	New	Lighting	10	50,353,561		18,351	2.51	3.30	\$0.3662	0.21
Occupancy Sensors	5% savings	New	Lighting	15	33,418,896		8,748	-	-	\$0.3803	0.23
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)	New	Heating	7	22,013,991		9,858	2.44	2.13	\$0.3887	0.18

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Total Savings (MWh)	Winter MW	Summer MW	Levelized Cost (\$/kWh)	BCR
	suggests higher savings than the other documented commissioning on more complex systems.										
Indirect/Direct Evaporative Cooling >60 ton	Install indirect/direct evaporative cooling in commercial building HVAC system in large systems <60 ton range. Original ETO evaluation evaluated at 20, 150 and 300tons with all being essentially equivalent	Replace	Cooling	18	67,342,114		13,213	3.28	2.85	\$0.4428	0.20
Indirect/Direct Evaporative Cooling >60 ton	Install indirect/direct evaporative cooling in commercial building HVAC system in large systems <60 ton range. Original ETO evaluation evaluated at 20, 150 and 300tons with all being essentially equivalent	New	Cooling	18	37,890,809		7,266	1.80	1.57	\$0.4531	0.19
Solar Hot Water	Install solar water heaters on large use facility such as multifamily or lodging	New	Water Heat	15	13,207,935	750,561	2,383	0.28	0.28	\$0.5720	0.15
Indirect/Direct Evaporative Cooling ~20 ton	Install indirect/direct evaporative cooling in commercial building HVAC system in 20 to 60 ton range	Replace	Cooling	18	147,310,875		13,213	3.28	2.85	\$0.9687	0.09
Indirect/Direct Evaporative Cooling ~20 ton	Install indirect/direct evaporative cooling in commercial building HVAC system in 20 to 60 ton range	New	Cooling	18	82,886,145		7,266	1.80	1.57	\$0.9912	0.09
Windows - Tinted AL Code to Class 45	Windows - Tinted AL Code to Class 45. Application: Old buildings	Replace	Heating	20	287,281,095		570	0.20	0.02	\$41.1541	0.00
Heat Reclaim	Large Grocery - Heat recovery to space heating. Assumes floating head control exists and must be changed to allow HR.	Replace	Refrigeration	18	7,980,032		5,692	0.78	1.02	\$0.0577	1.55

Commercial Sector, Gas Measures, 2032 Technical Potential

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Gas Impacts (kTherms)	Levelized Cost (\$/th)	BCR
ENERGY STAR Commercial Clothes Washer	Install high performance commercial clothes washers - coin op	Replace	Water Heat	10	1,009,178	-6,371,525	28	(\$6.7735)	6.71
ENERGY STAR Commercial Clothes Washer	Install high performance commercial clothes washers - coin op	New	Water Heat	10	99,318	-528,924	10	(\$3.5147)	5.94
ENERGY STAR Steam Cooker	Replace with Energy Star in place of conventional	Replace	Cooking	10	167,367	-420,493	20	(\$1.6545)	2.97
ENERGY STAR Steam Cooker	Install Energy Star in place of conventional	New	Cooking	10	86,048	-216,188	11	(\$1.5864)	2.99
ENERGY STAR Dishwasher	Install Energy Star in place of conventional	New	Water Heat	12	715,044	-3,535,896	330	(\$0.3306)	10.91
ENERGY STAR Dishwasher	Retrofit with Energy Star in place of conventional	Retrofit	Water Heat	12	541,701	-2,678,714	250	(\$0.3306)	10.91
Water heater Wrap	Insulate the surface of the storage water heater or an unfired storage tank to R-5 to reduce standby losses.	Retrofit	Water Heat	7	38,172		237	\$0.0280	18.08
ENERGY STAR Convection Oven	Replace with Energy Star in place of conventional	Replace	Cooking	12	199,884		284	\$0.0802	6.23
Roof Insulation - Attic R0-30	Roof Insulation - Attic R0-30. Application: Buildings with uninsulated attics	Retrofit	Heating	45	641,877		274	\$0.0841	6.55
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	Retrofit	Heating	5	9,318		21	\$0.1034	5.05

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Gas Impacts (kTherms)	Levelized Cost (\$/th)	BCR
	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.								
ENERGY STAR Fryer	Install Energy Star in place of conventional	New	Cooking	8	393,266		567	\$0.1082	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	45	2,919,532		739	\$0.1248	4.41
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	10	1,134,560		1,109	\$0.1338	3.89
Shower Heads	Install low flow shower heads (2.0 gallons per minute) to replace 3.4 GPM shower heads.	Retrofit	Water Heat	8	112,978		109	\$0.1614	3.13
Wall Insulation - Blown R11	Wall Insulation - Blown R11. Application: Old buildings	Retrofit	Heating	45	7,237,686		2,053	\$0.1665	3.31
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	45	5,042,828		839	\$0.1905	2.89

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Gas Impacts (kTherms)	Levelized Cost (\$/th)	BCR
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	15	951,390		450	\$0.2067	2.53
Wall Insulation - Spray On for Metal Buildings	Wall Insulation - Spray On for Metal Buildings (Cellulose) Unfinished. Application: Old buildings	Retrofit	Heating	45	877,903		232	\$0.2274	2.42
Domestic Hot Water Condensing Tankless (repl)	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	15	7,434,239		2,880	\$0.2521	1.99
Roof Insulation - Blanket R0-19	Roof Insulation - Blanket R0-19. Application: Buildings with open truss unfinished interior	Retrofit	Heating	45	1,350,196		287	\$0.2671	2.06
Windows - Add Low E to Vinyl Tint	Windows - Add Low E to Vinyl Tint. Application: Old buildings	Replace	Heating	20	3,421,401		311	\$0.2688	1.98
Energy star Convection Oven	Install Energy Star in place of conventional	New	Cooking	12	388,170		164	\$0.2698	1.85
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	45	10,561,842		1,494	\$0.2740	2.01

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Gas Impacts (kTherms)	Levelized Cost (\$/th)	BCR
Demand-Controlled 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	10	9,842,344		1,042	\$0.2776	1.88
Roof Insulation - Blanket R0-30	Roof Insulation - Blanket R0-30. Application: Buildings with open truss unfinished interior	Retrofit	Heating	45	1,518,970		301	\$0.2862	1.92
Duct insulation, air sealing	Duct retrofit of both insulation and air sealing	Retrofit	Heating	15	3,373,965		336	\$0.3072	1.70
ENERGY STAR Fryer	Replace with Energy Star in place of conventional	Replace	Cooking	8	2,417,700		1,161	\$0.3247	1.55
Roof Insulation - Attic 11-30	Roof Insulation - Attic 11-30. Application: Buildings with partially insulated attics	Retrofit	Heating	45	4,060,415		492	\$0.3643	1.51
Windows - Add Low E and Argon to Vinyl Tint	Windows - Add Low E and Argon to Vinyl Tint. Application: Old buildings	Replace	Heating	20	5,350,762		432	\$0.3747	1.42
Hot Food Holding Cabinet	Install Energy Star in place of conventional	New	Cooking	8	747,205		294	\$0.3961	1.27
Hot Food Holding Cabinet	Install Energy Star in place of conventional	Replace	Cooking	8	1,570,573		606	\$0.4040	1.25
Destratification Fan	Destrat fan reduces heat load	Retrofit	Heating	12	6,239,397		1,747	\$0.4074	1.28
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	12	446,274		124	\$0.4121	1.26

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Gas Impacts (kTherms)	Levelized Cost (\$/th)	BCR
Ozone Laundry Treatment	Ozone treatment allows use of cold water	Retrofit	Water Heat	10	560,448	-85,555	136	\$0.4555	1.08
ENERGY STAR Griddle	Install Energy Star in place of conventional	New	Cooking	12	450,776		106	\$0.4831	1.03
Domestic Hot Water Condensing Tankless (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	15	4,392,161		881	\$0.4867	1.03
Combination Space/Water heat High Efficiency Boiler (repl)	Replace existing boiler with unit meeting OR Code requirements of 80% combustion efficiency.	Replace	Heating	20	2,551,271		396	\$0.5260	1.01
Windows - Tinted AL Code to Class 40	Windows - Tinted AL Code to Class 40. Application: Old buildings	Replace	Heating	20	2,504,359		84	\$0.5337	1.00
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	15	3,542,066		642	\$0.5385	0.93
Combination Space/Water Heat High Efficiency Boiler (new)	Replace existing boiler with unit meeting OR Code requirements of 80% combustion efficiency.	New	Heating	20	843,760		126	\$0.5444	0.94
ENERGY Star Griddle	Replace with Energy Star in place of conventional	Replace	Cooking	12	730,311		151	\$0.5525	0.90
Space Conditioning High Efficiency Boiler (replace)	Install near condensing boiler. Assumed seasonal combustion efficiency of 85% over base of 80%	Replace	Heating	20	1,217,948		156	\$0.6372	0.84
Windows - Tinted Aluminum Code to Class 40	Windows - Tinted AL Code to Class 40. Application: New Construction	New	Heating	20	2,183,193		85	\$0.6548	0.78
Domestic Hot Water High	Replace existing boiler with unit meeting OR Code requirements	New	Water Heat	20	1,981,273		231	\$0.6988	0.73

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Gas Impacts (kTherms)	Levelized Cost (\$/th)	BCR
Efficiency Boiler (new)	of 80% combustion efficiency.								
Domestic Hot Water Condensing Tank (repl)	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	15	5,995,354		778	\$0.7526	0.67
Condensing Furnace (new)	Condensing / pulse package or residential-type furnace with a minimum AFUE of 92%. Base case: AFUE 80	New	Heating	18	3,478,604		375	\$0.8062	0.62
Roof Insulation - Roofcut 0-22	Roof Insulation - Roofcut 0-22. Application: Buildings with uninsulated flat roofs at reroofing time	Replace	Heating	45	13,555		1	\$0.8312	0.66
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	12	9,655,825		1,275	\$0.8642	0.60
Space Conditioning Condensing Boiler Replace	Install condensing boiler. Assumed seasonal combustion efficiency of 92% over base of 80%	Replace	Heating	20	4,504,633		419	\$0.8780	0.61
Domestic Hot Water Pipe Ins	Add 1" insulation to pipes used for steam or hydronic distribution; particularly effective when pipes run through unheated spaces.	New	Water Heat	15	435,561		46	\$0.9261	0.54
Faucets Aerators	Add aerators to existing faucets to reduce flow from 2.2 gallons per minute to 1.5 GPM.	Retrofit	Water Heat	8	43,636		7	\$0.9351	0.54
Combination space/water heat condensing Boiler	Replace with boiler using condensing or pulse technology to achieve steady-state	Replace	Heating	20	10,152,836		878	\$0.9440	0.56

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Gas Impacts (kTherms)	Levelized Cost (\$/th)	BCR
(repl)	combustion efficiencies of 89% to 94% (this analysis used 92% efficiency for savings calculations).								
Faucets	Add aerators to existing faucets to reduce flow from 2.2 gallons per minute to 1.5 GPM.	New	Water Heat	8	46,105		8	\$0.9566	0.53
Combination space/water heat Condensing Boiler (new)	Replace with boiler using condensing or pulse technology to achieve steady-state combustion efficiencies of 89% to 94% (this analysis used 92% efficiency for savings calculations).	New	Heating	20	3,288,105		280	\$0.9568	0.53
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	45	15,842,763		472	\$0.9695	0.57
Domestic Hot Water Recirculation 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	10	1,085,989		142	\$1.0021	0.50
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 92% efficiency for savings calculations).	New	Water Heat	20	6,612,732		513	\$1.0518	0.49

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Gas Impacts (kTherms)	Levelized Cost (\$/th)	BCR
Windows - Tinted Aluminum Code to Class 36	Windows - Tinted AL Code to Class 36. Application: Old buildings	Replace	Heating	20	6,260,898		148	\$1.1191	0.48
Space Conditioning Boiler (new)	Install condensing boiler. Assumed seasonal combustion efficiency of 88% over base of 75%	New	Heating	20	15,450,773		1,085	\$1.1626	0.44
Domestic How Water High Efficiency Boiler (repl)	Replace existing boiler with unit meeting OR Code requirements of 80% combustion efficiency.	Replace	Water Heat	20	3,147,344		210	\$1.2227	0.44
Waste Water Heat Exchanger	Install HX on waste water	Retrofit	Water Heat	15	299,037		24	\$1.2367	0.41
Waste Water Heat Exchanger	Install HX on waste water	New	Water Heat	15	2,239,782		169	\$1.2922	0.39
Windows - Add Argon to Vinyl Lowe	Windows - Add Argon to Vinyl Lowe. Application: Old buildings	Replace	Heating	20	8,680,365		568	\$1.3086	0.41
Rooftop Condensing Burner	Install condensing burner	New	Heating	10	14,573,384		709	\$1.3475	0.39
Direct Digital 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	5	24,058,283		2,603	\$1.3488	0.37
Windows - Tinted AL Code to Class 36	Windows - Tinted AL Code to Class 36. Application: New Construction	New	Heating	20	5,457,984		136	\$1.3710	0.37

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Gas Impacts (kTherms)	Levelized Cost (\$/th)	BCR
Condensing Unit Heater from natural draft (replace)	Install condensing power draft units (90% seas. Eff) in place of natural draft (80% seas. Eff)	Replace	Heating	18	20,816,687		1,085	\$1.6669	0.32
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	10	1,387,753	5,292,627	507	\$1.7213	0.30
Computerized Water Heater Control	Install intelligent controls on the hot water circulation loops.	Retrofit	Water Heat	15	1,151,688		65	\$1.7321	0.29
Roof Insulation - Blanket R11-41	Roof Insulation - Blanket R11-41. Application: Buildings with open truss unfinished interior	Retrofit	Heating	45	3,797,425		118	\$1.8256	0.30
Roof Insulation - Blanket R11-30	Roof Insulation - Blanket R11-30. Application: Buildings with open truss unfinished interior	Retrofit	Heating	45	3,375,489		98	\$1.9386	0.28
Windows - Non-Tinted AL Code to Class 40	Windows - Non-Tinted AL Code to Class 40. Application: New Construction	New	Heating	20	6,087,594		258	\$1.9965	0.25
Windows - Non-Tinted AL Code to Class 40	Windows - Non-Tinted AL Code to Class 40. Application: Old buildings	Replace	Heating	20	8,546,157		346	\$2.0589	0.26
Domestic Hot Water Condensing Boiler (repl)	Replace with boiler using condensing or pulse technology to achieve steady-state combustion efficiencies of 89% to 94% (this analysis used 92% efficiency for savings calculations).	Replace	Water Heat	20	11,903,985		466	\$2.0856	0.26
Computerized Water Heater Control	Install intelligent controls on the hot water circulation loops.	New	Water Heat	15	1,002,558		42	\$2.3247	0.22

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Gas Impacts (kTherms)	Levelized Cost (\$/th)	BCR
Warm Up Control	This measure is designed to implement a shut down 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	10	9,869,213		475	\$2.7158	0.19
Condensing Furnace (repl)	Condensing / pulse package or residential-type furnace with a minimum AFUE of 92%.	Replace	Heating	18	25,817,533		754	\$2.9744	0.18
Windows - Non-Tinted AL Code to Class 36	Windows - Non-Tinted AL Code to Class 36. Application: New Construction	New	Heating	20	15,218,984		392	\$3.2513	0.16
Windows - Non-Tinted AL Code to Class 36	Windows - Non-Tinted AL Code to Class 36. Application: Old buildings	Replace	Heating	20	21,365,393		528	\$3.3495	0.16
Windows - Non-Tinted AL Code to Class 45	Windows - Non-Tinted AL Code to Class 45. Application: Old buildings	Replace	Heating	20	5,683,194		127	\$3.7338	0.14
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	7	87,140,792		1,672	\$5.3095	0.09

Measure Name	Measure Description	Construction Type	Measure End Use	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M (\$)	Gas Impacts (kTherms)	Levelized Cost (\$/th)	BCR
Solar Hot Water	Install solar water heaters on large use facility such as multifamily or lodging	Retrofit	Water Heat	15	10,282,289	584,306	143	\$7.4404	0.07
Solar Hot Water	Install solar water heaters on large use facility such as multifamily or lodging	New	Water Heat	15	8,877,159	504,458	92	\$9.9779	0.05
Condensing Unit Heater from power draft (replace)	Install condensing power draft units (90% seas. Eff) in place of power draft (80% seas. Eff)	Replace	Heating	18	746,991,773		723	\$89.7224	0.01
Windows - Tinted AL Code to Class 45	Windows - Tinted AL Code to Class 45. Application: Old buildings	Replace	Heating	20	630,213,655		15	\$173.3159	0.00
Heat Reclaim	Large Grocery - Heat recovery to space heating. Assumes floating head control exists and must be changed to allow HR.	New	Refrigeration	18	2,500,404		262	\$0.2296	2.19
Heat Reclaim	Large Grocery - Heat recovery to space heating. Assumes floating head control exists and must be changed to allow HR.	Retrofit	Refrigeration	18				na	na
Heat Reclaim	Large Grocery - Heat recovery to space heating. Assumes floating head control exists and must be changed to allow HR.	Replace	Refrigeration	18	6,095,430		603	\$0.2521	2.00

Industrial Sector, Electric Measures, 2032 Technical Potential

Conservation Measure	Potential Savings (MWh/yr)	Measure Life (years)	Initial Cost (1000\$)	Annual O&M Cost (1000\$)	Levelized Cost (\$/kWh)	BCR	Loadshape	Annual Non-Energy Benefit (\$1000)	Measure Type
Air Compressor Demand Reduction	231,702	3	\$14,836	\$6,463	\$0.051	1.21	IndShift3		Air Compressor
Air Compressor Equipment1		15			\$0.047	2.09	IndShift3		Air Compressor
Air Compressor Equipment2	37,192	15	\$2,523	\$1,037	\$0.035	2.59	IndShift3		Air Compressor
Air Compressor Optimization	69,338	15	\$22,559	\$1,934	\$0.003	2.84	IndShift3	\$3,934	Air Compressor
HighBay Lighting 1 Shift	14,391	10	\$2,553		\$0.023	3.55	IndShift1		Lighting
HighBay Lighting 2 Shift	10,293	10	\$1,068		\$0.014	6.01	IndShift2		Lighting
HighBay Lighting 3 Shift	81,178	10	\$4,701		\$0.008	10.55	IndShift3		Lighting
Efficient Lighting 1 Shift	18,812	10	\$1,066		\$0.007	11.10	IndShift1		Lighting
Efficient Lighting 2 Shift	13,455	10	\$446		\$0.004	18.81	IndShift2		Lighting
Efficient Lighting 3 Shift	106,115	10	\$1,964		\$0.002	33.02	IndShift3		Lighting
Lighting Controls	59,295	10	\$9,665		\$0.021	5.67	IndShift3		Lighting
Motors: Rewind 20-50 HP	6,402	15	\$1,833		\$0.028	3.05	IndShift3		Motors
Motors: Rewind 51-100 HP	2,475	15	\$610		\$0.024	3.54	IndShift3		Motors
Motors: Rewind 101-200 HP	4,879	15	\$893		\$0.018	4.77	IndShift3		Motors
Motors: Rewind 201-500 HP	3,166	15	\$378		\$0.012	7.32	IndShift3		Motors
Motors: Rewind 501-5000 HP	3,275	15	\$287		\$0.009	9.98	IndShift3		Motors
Efficient Centrifugal Fan	4,588	15	\$662		\$0.014	6.45	SIC26		Fans
Fan Energy Management	29,100	3		\$917	\$0.032	1.95	SIC20		Fans
Fan Equipment Upgrade	71,290	15	\$5,134	\$2,246	\$0.039	2.24	IndShift3		Fans
Fan System Optimization	94,401	15	\$10,925	\$3,568	\$0.008	2.70	SIC24	\$3,910	Fans
Pump Energy Management	104,285	3	\$156	\$1,274	\$0.013	1.94	SIC26	(\$1)	Pumps
Pump Equipment Upgrade	126,086	15	\$11,449	\$3,359	\$0.036	2.05	SIC26	\$0	Pumps
Pump System Optimization	110,636	15	\$27,054	\$4,386	(\$0.034)	3.04	SIC20	\$10,773	Pumps
Transformers-Retrofit	19,230	10	\$13,226		\$0.090	1.10	IndShift3		Transformer
Transformers-New	7,854	32	\$6,074		\$0.050	2.36	IndShift3		Transformer
Synchronous Belts	17,985	10	\$3,001		\$0.022	3.90	IndShift3		Motors

Conservation Measure	Potential Savings (MWh/yr)	Measure Life (years)	Initial Cost (1000\$)	Annual O&M Cost (1000\$)	Levelized Cost (\$/kWh)	BCR	Loadshape	Annual Non-Energy Benefit (\$1000)	Measure Type
Elec Chip Fab: Eliminate Exhaust	16,452	15	\$3,705		\$0.022	6.07	IndShift3		Hi Tech
Elec Chip Fab: Exhaust Injector	62,585	15	\$21,717		(\$0.121)	7.09	IndShift3	\$9,710	Hi Tech
Elec Chip Fab: Solidstate Chiller	160,933	15	\$63,062		(\$0.104)	5.94	IndShift3	\$22,849	Hi Tech
Elec Chip Fab: Reduce Gas Pressure	34,645	15			(\$0.016)	100.00	IndShift3	\$563	Hi Tech
Clean Room: Change Filter Strategy	26,535	1	\$179		\$0.007	11.49	IndShift3		Hi Tech
Clean Room: Clean Room HVAC	26,864	15	\$5,020		\$0.018	7.01	IndShift3		Hi Tech
Clean Room: Chiller Optimize	47,399	10	\$4,159		\$0.011	9.76	IndShift3		Hi Tech
Food: Cooling and Storage	31,420	15	\$8,154		\$0.025	3.64	ReferWareh		Food
Food: Refrig Storage Tuneup	17,084	3	\$951		\$0.021	3.01	ReferWareh		Food
Metal: New Arc Furnace	3,618	10	\$258		(\$2.372)	264.24	IndShift3	\$8,615	Metal
Kraft: Effluent Treatment System	531	15	\$29		\$0.005	16.06	IndShift3		Pulp
Kraft: Efficient Agitator	2,388	15	\$147		\$0.006	14.22	IndShift3		Pulp
Paper: Efficient Pulp Screen	2,263	15	\$300		\$0.013	6.59	IndShift3		Paper
Paper: Premium Fan	8,769	15	\$1,168		\$0.013	6.55	IndShift3		Paper
Paper: Material Handling	5,333	15	\$5,479		\$0.100	1.85	IndShift3		Paper
Paper: Large Material Handling	4,207	15	\$5,556		\$0.129	1.55	IndShift3		Paper
Paper: Premium Control Large Material	16,938	15	\$6,111		\$0.035	2.71	IndShift3		Paper
Material Handling1		15			\$0.078	1.59	SIC24		Material Handling
Material Handling2	6,453	15	\$2,899		\$0.044	2.55	SIC24		Material Handling
Material Handling Variable Frequency Drive1		15			\$0.062	1.98	SIC24		Material Handling
Material Handling Variable Frequency Drive2	28,085	15	\$6,957		\$0.024	3.96	SIC24		Material Handling
Wood: Replace Pneumatic Conveyor	31,651	15	\$336		(\$0.063)	143.99	SIC24	\$2,035	Wood
Panel: Hydraulic Press	2,707	15	\$398		\$0.014	5.93	SIC24		Wood
Cold Storage Retrofit	14,712	15	\$3,114		\$0.021	4.12	ReferWareh		Cold Storage
Cold Storage Tuneup	4,505	3	\$231		\$0.019	3.26	ReferWareh		Cold Storage
Grocery Distribution Center Retrofit	14,712	15	\$3,248		\$0.022	3.95	ReferWareh		Cold Storage

Conservation Measure	Potential Savings (MWh/yr)	Measure Life (years)	Initial Cost (1000\$)	Annual O&M Cost (1000\$)	Levelized Cost (\$/kWh)	BCR	Loadshape	Annual Non-Energy Benefit (\$1000)	Measure Type
Grocery Distribution Center Tuneup	4,505	3	\$231		\$0.019	3.26	ReferWareh		Cold Storage
Plant Energy Management	164,742	10	\$3,380	\$4,967	\$0.033	2.47	IndShift3		Plant Management
Energy Project Management	77,831	10	\$9,949	\$2,371	\$0.047	1.85	IndShift3		Project Management
Integrated Plant Energy Management	100,779	10	\$22,386	\$3,812	(\$0.006)	2.62	IndShift3	\$7,338	Integrated Management
Irrigation: Ditch > Pipe	2,631	10	\$156	(\$1)	\$0.008	1.07	IrrgAGR	(\$1)	Irrigation
Irrigation: Nozzles	2,047	3	\$363		\$0.065	1.89	IrrgAGR	\$0	Irrigation
Irrigation: Pump Systems Repair	2,047	7	\$2,771	(\$0)	\$0.236	1.30	IrrgAGR	\$0	Irrigation
Irrigation: Pump Systems Adjust	5,117	3	\$880	(\$0)	\$0.063	1.92	IrrgAGR	\$0	Irrigation
Irrigation: Water Management	2,047	5	\$294	\$0	\$0.033	1.67	IrrgAGR	\$0	Irrigation
Replace Rural Light: 150HPS>LED117W	274	23	\$354	(\$0)	\$0.097	1.55	Streetlight		Streetlight
Retrofit Rural Area MV>LED117W	809	6	\$1,046		\$0.257	0.29	Flat		Streetlight
Replace Traffic Light: Red Ball 8-inch	45	6	\$5	(\$0)	\$0.021	5.09	Flat		Streetlight
Replace Traffic Light: Red Ball 12-inch	46	6	\$4	(\$0)	\$0.015	5.89	Flat		Streetlight
Replace Traffic Light: Yellow Ball 8-inch	194	6	\$848	(\$1)	\$0.864	0.82	Flat		Streetlight
Replace Traffic Light: Yellow Ball 12-inch	198	6	\$580	(\$0)	\$0.579	0.74	Flat		Streetlight
Replace Traffic Light: Green Ball 8-inch	66	6	\$12	(\$0)	\$0.037	3.21	Flat		Streetlight
Replace Traffic Light: Green Ball 12-inch	67	6	\$9	(\$0)	\$0.027	3.59	Flat		Streetlight
Replace Traffic Light: Red Arrow	47	6	\$13	(\$0)	\$0.054	3.14	Flat		Streetlight
Replace Traffic Light: Green Arrow	67	6	\$19	(\$0)	\$0.056	3.12	Flat		Streetlight
Replace Traffic Light: Yellow Bi-Modal Arrow	193	6	\$100	(\$0)	\$0.102	1.76	Flat		Streetlight
Replace Traffic Light: Green Bi-Modal Arrow	67	6	\$24	(\$0)	\$0.070	2.49	Flat		Streetlight
Replace Traffic Light: White Walking Person	133	6	\$29	(\$0)	\$0.042	2.46	Flat		Streetlight
Replace Traffic Light: Orange Hand	96	6	\$21	(\$0)	\$0.043	2.45	Flat		Streetlight
Replace Traffic Light: Orange	96	6	\$56	(\$0)	\$0.114	1.35	Streetlight		Streetlight

Conservation Measure	Potential Savings (MWh/yr)	Measure Life (years)	Initial Cost (1000\$)	Annual O&M Cost (1000\$)	Levelized Cost (\$/kWh)	BCR	Loadshape	Annual Non-Energy Benefit (\$1000)	Measure Type
Countdown									
Replace Streetlight: 100WHPS>LED78W	40,844	17	\$48,979	(\$0)	\$0.108	1.29	Streetlight		Streetlight
Replace Streetlight: 100WHPS>LED60W	5,130	23	\$5,589	(\$0)	\$0.082	2.04	Streetlight		Streetlight
Replace Streetlight: 150HPS>LED117W	8,813	23	\$11,402	(\$0)	\$0.098	1.55	Streetlight		Streetlight
Replace Streetlight: 150HPS>LED111W	6,152	14	\$6,320	(\$0)	\$0.105	1.40	Streetlight		Streetlight
Retrofit Streetlight: 100WHPS>LED78W		17		(\$0)	\$0.124	0.77	Streetlight		Streetlight
Retrofit Streetlight: 100WHPS>LED60W		23		(\$0)	\$0.086	1.00	Streetlight		Streetlight
Retrofit Streetlight: 150HPS>LED117W		23		(\$0)	\$0.103	0.90	Streetlight		Streetlight
Retrofit Streetlight: 150HPS>LED111W		14		(\$0)	\$0.126	0.77	Streetlight		Streetlight

Industrial Sector, Gas Measures, 2032 Technical Potential

Conservation Measure	Potential Savings (th/yr)	Annual O&M Cost (\$)	Levelized Cost (\$/th)	Initial Cost (k\$)	BCR
Chiller heat recovery (Electronics)	63,526	\$0	\$1.229	\$800	0.41
Combination Space/Water Heat Condensing Boiler (repl)	850,250	\$0	\$0.637	\$6,641	0.80
Combination Space/Water Heat Condensing Boiler (retro)	0	\$0	\$1.714	\$0	na
Combination Space/Water Heat High Efficiency Boiler (repl)	435,494	\$0	\$0.347	\$1,849	1.46
Combination Space/Water Heat High Efficiency Boiler (retro)	0	\$0	\$1.804	\$0	na
Condensing Furnace (repl)	993,121	\$0	\$2.776	\$28,232	0.18
Condensing Unit Heater from Natural draft (replace)	0	\$0	\$1.066	\$0	na
Condensing Unit Heater from power draft (replace)	349,124	\$0	\$2.157	\$8,666	0.23
Heat Recovery to Hot Water	1,908,228	(\$256,523)	\$0.157	\$5,701	1.75
Domestic Hot Water Condensing Boiler (repl)	464,824	\$0	\$0.158	\$899	3.22
Domestic Hot Water Condensing Boiler (retro)	0	\$0	\$0.495	\$0	na
Domestic Hot Water Condensing Tank (repl)	378,933	\$0	\$0.026	\$100	19.32
Domestic Hot Water Condensing Tank (retro)	0	\$0	\$0.116	\$0	na
Domestic Hot Water High efficiency Boiler (repl)	238,081	\$0	\$0.049	\$144	10.28
Domestic Hot Water High Efficiency Boiler (retro)	0	\$0	\$0.386	\$0	na
Domestic Hot Water Pipe Ins	57,122	\$0	\$0.020	\$12	25.15
Domestic Hot Water Standard. Boiler (retro)	8,463	\$0	\$0.232	\$24	2.19
Domestic Water Heater Wrap	25,388	\$0	\$0.001	\$0	100.00
Duct sealing and insulation	1,568,478	\$0	\$3.092	\$49,659	0.16
Higj Efficiency Unit Heater (replace)	943,579	\$0	\$0.343	\$3,723	1.47
High Efficiency Unit Heater (retro)	0	\$0	\$2.087	\$0	na
High Efficiency Clothes Washer (retro)	5,661	(\$68,804)	(\$11.387)	\$44	2.05
High Efficiency Clothes Washer (repl)	5,661	(\$68,804)	(\$11.387)	\$44	2.05
Hot Water Temperature Reset	1,892,653	\$0	\$0.194	\$2,805	2.56
Hot Water Boiler Tune	1,040,949	\$0	\$0.179	\$801	2.78
Power burner	1,534,359	\$0	\$1.153	\$15,498	0.43

Conservation Measure	Potential Savings (th/yr)	Annual O&M Cost (\$)	Levelized Cost (\$/th)	Initial Cost (k\$)	BCR
Process Boiler Controls	162,866	\$0	\$0.002	\$3	326.50
Process Boiler Insulation	1,091,138	\$1,335	\$0.009	\$84	67.28
Process Boiler Load Control	545,569	\$0	\$0.002	\$10	282.97
Process Boiler Maintenance	272,785	\$142	\$0.001	\$0	100.00
Process Boiler Steam Trap Maintenance	886,550	\$32,206	\$0.036	\$0	100.00
Process Boiler Water Treatment	136,392	\$0	\$0.001	\$1	606.36
Roof Insulation - Blanket R0-19	507,253	\$0	\$0.350	\$2,668	1.48
Roof Insulation - Blanket R0-30	532,200	\$0	\$0.375	\$3,001	1.38
Roof Insulation - Blanket R11-30	184,792	\$0	\$2.562	\$7,114	0.20
Roof Insulation - Blanket R11-41	221,750	\$0	\$2.402	\$8,004	0.22
Roof Insulation - Rigid R11-22 repl	499,825	\$0	\$0.908	\$6,818	0.57
Roof Insulation - Rigid R11-33 repl	246,512	\$0	\$2.761	\$10,227	0.19
Solar Hot Water	58,991	\$0	\$4.697	\$3,395	0.11
Space Conditioning Condensing Boiler Replace	490,072	\$0	\$1.111	\$6,670	0.46
Space Conditioning Condensing Boiler Retro	0	\$0	\$2.357	\$0	na
Space Conditioning High Efficiency Boiler Replace	283,359	\$0	\$0.712	\$2,472	0.71
Space Conditioning High Efficiency Boiler Retro	0	\$0	\$2.490	\$0	na
Steam Balance (Wood Prod)	47,974	\$0	\$0.374	\$184	1.33
Steam Trap Maint (Wood Prod)	59,302	\$0	\$0.648	\$294	0.77
Upgrade Process Heat	210,955	(\$68,804)	\$1.007	\$2,117	0.54
Vent Damper	926,002	(\$68,804)	\$0.482	\$3,887	1.05
Wall Insulation - Blown R11	337,855	\$0	\$0.254	\$1,287	2.05
Wall Insulation - Spray On for Metal Buildings	370,947	\$0	\$0.282	\$1,573	1.84
Waste Water Heat Exchanger	60,242	\$0	\$0.700	\$517	0.72
Ozone Treated Laundry	0	\$0	\$0.179	\$0	na

Residential Sector, Electric Measures, 2032 Technical Potential

Measure Description	Program	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M Impact (\$)	Total Electric Savings (kWh)	Winter Peak Savings (kW)	Summer Peak Savings (kW)	Level Cost (\$/kWh)	BCR
Elec High Efficiency Washer	New Appl	14	3,419,343	-6,228,106	2,673,789	387	324	(\$0.095)	100.00
Elec High Efficiency Washer	ReplaceAppl	14	34,680,980	-63,169,108	33,916,670	4,908	4,111	(\$0.080)	100.00
Elec ETO Dishwasher	New Appl	12	4,748,825	-8,333,259	5,809,578	841	704	(\$0.068)	100.00
Elec ETO Dishwasher	ReplaceAppl	12	9,578,341	-16,808,113	13,031,833	1,886	1,579	(\$0.062)	100.00
Elec MEF 2.46 Clothes Washer	ReplaceAppl	14	77,341,654	-76,868,202	51,157,117	7,403	6,200	\$0.001	1.52
Elec MEF 2.46 Clothes Washer	New Appl	14	10,167,249	-10,105,010	5,534,071	801	671	\$0.001	1.44
Manufactured Home Duct Sealing, Elect Resistance, Zone B	RetroEquip	20	484,390	0	4,936,164	1,242	35	\$0.008	10.35
Common Area Lighting (Multifamily Only)	RetroLights	7	2,230,310	0	52,837,093	6,216	6,216	\$0.012	7.83
Manufactured Home Duct Sealing, Heat Pump, Zone B	RetroEquip	20	524,756	0	3,545,572	593	149	\$0.012	6.95
Manufactured Home Duct Sealing, Elect Resistance, Z A	RetroEquip	20	1,896,392	0	11,809,803	2,972	83	\$0.013	6.32
Retail Lights (2 lamps) to 2014	RetroLights	7	3,915,412	0	49,941,990	5,875	5,875	\$0.017	4.24
Energy Star New Manufactured Home	New	30	1,874,985	0	5,395,945	902	226	\$0.023	3.86
Single Family Weatherization (ceiling, floor, wall) ER, Z B	Retro	45	3,476,606	0	8,659,211	2,179	61	\$0.023	3.91
Manufactured Home Duct Sealing, Heat Pump, Z A	RetroEquip	20	2,054,424	0	7,206,789	1,205	302	\$0.023	3.61
Weatherization, single family Floor Insulation, Zone B	Retro	45	1,411,437	0	3,436,346	574	144	\$0.024	3.87
Refrigerator Recycle	ReplaceAppl	9	4,666,674	0	27,817,732	3,272	3,272	\$0.024	2.80
Retail Lights (2 lamps) after 2014	RetroLights	7	3,101,759	0	25,224,959	2,967	2,967	\$0.025	2.70
Eco Rated New Manufactured Home	New	30	2,368,727	0	5,941,542	993	249	\$0.027	3.36
Single Family Duct Sealing, Zone B	RetroEquip	20	10,995,436	0	33,563,176	5,611	1,407	\$0.027	3.14
Single Family Window replace (U=.30), Electric Resistance Zone B	Replace	45	1,365,387	0	2,875,402	724	20	\$0.028	3.31

Measure Description	Program	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M Impact (\$)	Total Electric Savings (kWh)	Winter Peak Savings (kW)	Summer Peak Savings (kW)	Level Cost (\$/kWh)	BCR
Weatherization, Single Family Wall Insulation, Zone B	Retro	45	1,260,212	0	2,625,677	439	110	\$0.028	3.32
Weatherization, Single Family Ceiling Insulation, Zone B	Retro	45	966,835	0	1,804,724	302	76	\$0.031	2.97
Hot Water Tank upgrade (50 gal)-20 yr warranty	NewDHW	20	468,167	0	1,247,884	181	151	\$0.034	2.57
Low Power Mode Appliances	NewAppl	12	23,540,913	0	83,018,341	9,766	9,766	\$0.034	2.17
Single Family Weatherization (ceiling, floor, wall) ER?, Zone A	Retro	45	31,929,320	0	54,011,834	13,591	378	\$0.034	2.66
Single Family Window replace (U=.30), Electric Resistance, Zone A	Replace	45	2,506,696	0	3,897,547	981	27	\$0.037	2.44
Commissioning (Heat Pump), Zone B	RetroEquip	8	3,505,845	0	14,674,746	2,453	615	\$0.037	1.80
Low Power Mode Appliances	ReplaceAppl	12	59,831,376	0	197,417,802	23,224	23,224	\$0.038	1.99
Weatherization- Single family Floor Insulation, Zone A	Retro	45	14,388,111	0	20,605,830	3,445	864	\$0.040	2.28
Commissioning (HP), Zone A	RetroEquip	8	8,036,607	0	29,961,367	5,009	1,256	\$0.042	1.60
Single Family Duct Sealing, Zone A	RetroEquip	20	20,723,882	0	40,162,817	6,714	1,683	\$0.042	1.99
Water Heater Tank upgrade (50 gal)-10 yr warranty	ReplaceDHW	10	445,530	0	1,301,787	188	158	\$0.045	1.56
Water Heater Tank upgrade (50 gal)-20 yr warranty	ReplaceDHW	20	251,969	0	455,590	66	55	\$0.045	1.82
Single Family Window replace (U=.30), Heat Pump Zone B	Replace	45	409,751	0	520,179	87	22	\$0.046	2.02
Weatherization Single Family Wall Insulation, Zone A	Retro	45	12,846,527	0	15,744,704	2,632	660	\$0.047	1.95
Add 6 LED lamps (using incandescent base) after 2015	NewLights	10	1,637,454	0	5,022,390	591	591	\$0.049	1.47
Add 16 LED lamps (using incandescent base) after 2015	NewLights	10	2,591,565	0	7,586,276	892	892	\$0.052	1.38
Weatherization (ceiling, floor) Electric Resistance, Zone B	Retro	45	149,705	0	165,563	42	1	\$0.052	1.74
Weatherization- Single Family Ceiling Insulation, Zone A	Retro	45	9,855,856	0	10,821,915	1,809	454	\$0.053	1.75
ENERGY STAR New Home Builder Option Package 1 - Heat Pump	New	45	63,453,433	0	62,959,749	10,525	2,638	\$0.058	1.58

Measure Description	Program	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M Impact (\$)	Total Electric Savings (kWh)	Winter Peak Savings (kW)	Summer Peak Savings (kW)	Level Cost (\$/kWh)	BCR
Water Heater Tank upgrade (50 gal)-10 yr warranty	NewDHW	10	1,298,467	0	2,966,262	429	360	\$0.059	1.20
Specialty Lights to 2014	RetroLights	7	96,064,958	0	292,622,203	34,424	34,424	\$0.061	1.01
Single Family Weatherization, Air Sealing, Zone B	Retro	20	789,884	0	1,024,623	258	7	\$0.063	1.32
Single Family Weatherization Air Sealing, Zone A	Retro	20	8,468,445	0	10,908,009	2,745	76	\$0.063	1.31
Single Family Weatherization (ceiling, floor) Electric Resistance, Zone A	Retro	45	266,906	0	242,140	61	2	\$0.064	1.42
Energy Star Television	ReplaceAppl	12	13,012,343	0	23,706,714	2,789	2,789	\$0.067	1.08
Full lighting (all high efficacy)	NewLights	7	567,039	0	1,448,420	170	170	\$0.073	0.84
50% LED after 2020	RetroLights	10	37,864,931	0	70,066,256	8,242	8,242	\$0.075	0.92
Common Area Lighting (Multifamily Only)	NewLights	7	1,047,543	0	2,396,844	282	282	\$0.077	0.80
Single Family Window replace (U=.30), Heat Pump Zone A	Replace	45	694,759	0	508,938	85	21	\$0.079	1.17
Specialty Lights after 2014	RetroLights	7	84,524,724	0	193,754,302	22,793	22,793	\$0.080	0.76
Tier II Heat pump water heater	NewDHW	12	5,381,322	0	7,489,418	1,084	908	\$0.082	0.89
Tier II Heat pump water heater	ReplaceDHW	12	51,962,127	0	72,297,526	10,463	8,762	\$0.082	0.89
ENERGY STAR Refrigerator	NewAppl	22	8,543,313	0	7,667,489	902	902	\$0.088	0.93
100% LED after 2020	RetroLights	10	54,823,828	0	85,151,258	10,017	10,017	\$0.088	0.77
ENERGY STAR New Single Family Home Builder Option Package 1 – ER	New	45	20,503,990	0	13,080,333	3,291	91	\$0.091	1.00
Room Air Conditioning (Zone A)	NewHVAC	18	34,949	0	31,952	0	15	\$0.095	0.82
Single Family Weatherization (ceiling, floor) Heat Pump, Zone B	Retro	45	162,180	0	98,088	16	4	\$0.096	0.96
New Multifamily Construction	New	45	54,175,996	0	31,925,953	8,033	223	\$0.098	0.93
Single Family Electric Resistance to Mini-split ductless heat pump Zone B-C	RetroEquip	18	76,213,049	0	65,059,920	10,876	2,726	\$0.102	0.81
Single Family Electric Resistance to Mini-split ductless heat pump Zone A	RetroEquip	18	142,478,239	0	121,627,765	20,333	5,097	\$0.102	0.81

Measure Description	Program	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M Impact (\$)	Total Electric Savings (kWh)	Winter Peak Savings (kW)	Summer Peak Savings (kW)	Level Cost (\$/kWh)	BCR
Single Family Heat Pump, (Upgrade), Zone B	ReplaceEquip	18	1,231,429	0	1,049,156	175	44	\$0.102	0.81
Single Family Heat Pump, (Upgrade), Zone A	ReplaceEquip	18	1,973,531	0	1,681,415	281	70	\$0.102	0.81
ENERGY STAR Refrigerator	ReplaceAppl	22	14,013,292	0	10,950,221	1,288	1,288	\$0.102	0.80
Single Family Room Air Conditioning (Zone B)	RetroEquip	18	425,792	0	348,192	0	159	\$0.106	0.73
Single Family Heat Pump, (Electric Resistance Base), Zone B	RetroEquip	18	60,504,780	4,405,503	52,335,406	8,749	2,193	\$0.108	0.76
Tier I Heat pump water heater	NewDHW	12	4,776,724	0	4,642,788	672	563	\$0.117	0.62
Tier I Heat pump water heater	ReplaceDHW	12	46,124,120	0	44,701,360	6,469	5,418	\$0.118	0.62
Single Family Windows U=.30, Electric Resistance, Zone B	Retro	45	16,981,855	0	8,000,469	2,013	56	\$0.123	0.74
Single Family Heat Pump, (Electric Resistance Base), Zone A	RetroEquip	18	137,680,521	10,024,861	87,623,890	22,049	613	\$0.146	0.55
Single Family Windows U=.30, Heat Pump, Zone B	Retro	45	33,155,683	0	12,982,173	2,170	544	\$0.148	0.62
Single Family Weatherization (ceiling, floor) Heat Pump, Zone A	Retro	45	289,149	0	109,924	18	5	\$0.152	0.60
Single Family Windows U=.3, Electric Resistance, Zone A	Retro	45	136,182,788	0	51,732,983	13,017	362	\$0.152	0.60
Solar Domestic Hot Water (50 gal) - electric backup	ReplaceDHW	20	32,550,492	0	16,811,556	2,276	7,142	\$0.158	0.53
All LED (from 2020 base) after 2020	NewLights	10	3,721,250	0	3,192,145	376	376	\$0.160	0.40
Room Air Conditioning (Z A)	RetroEquip	18	1,076,997	0	572,586	0	261	\$0.163	0.48
Single Family Heat Recovery Ventilation Electric Resistance, Z A	Retro	18	99,740,516	0	52,494,873	13,209	367	\$0.165	0.49
ENERGY STAR lighting (18 lamps)	NewLights	7	1,066,094	1,931,078	3,251,056	382	382	\$0.165	0.36
Solar Domestic Hot Water (50 gal) - electric backup	NewDHW	20	35,231,512	0	17,410,935	2,357	7,397	\$0.165	0.51
Single Family ENERGY STAR Heat Recovery Ventilation	New	18	24,987,032	0	12,114,925	2,025	508	\$0.179	0.46
Single Family Heat Recovery Ventilation Electric Resistance,	Retro	18	22,494,710	0	9,888,592	2,488	69	\$0.198	0.41

Measure Description	Program	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M Impact (\$)	Total Electric Savings (kWh)	Winter Peak Savings (kW)	Summer Peak Savings (kW)	Level Cost (\$/kWh)	BCR
Zone B									
Evaporative Cooling (Direct/indirect) (Zone A)	NewHVAC	18	4,760,388	0	1,915,154	0	873	\$0.216	0.36
Evaporative Cooling (Direct/indirect) (Zone A)	RetroEquip	18	13,706,518	0	5,113,470	0	2,332	\$0.233	0.33
Room Air Conditioning (Zone B)	NewHVAC	18	319,224	0	118,422	0	54	\$0.234	0.33
Single Family Windows U=.30, Heat Pump, Zone A	Retro	45	61,779,321	0	13,905,910	2,325	583	\$0.257	0.36
Single Family Air Conditioner Tune - up (Zone B)	RetroEquip	18	3,249,942	0	1,011,184	0	461	\$0.279	0.28
Add 6 LED lamps (using CFL base) after 2015	NewLights	10	971,837	0	451,564	53	53	\$0.289	0.22
Add 16 LED lamps (using CFL base) after 2015	NewLights	10	2,591,565	0	1,174,066	138	138	\$0.296	0.21
Evaporative Cooling (Direct/indirect) (Zone B)	RetroEquip	18	8,515,846	7,963,263	4,545,845	0	2,073	\$0.315	0.25
Single Family Heat Recovery Ventilation Heat Pump Zone B	Retro	18	23,469,985	0	6,029,024	1,008	253	\$0.338	0.24
Single Family Air Conditioner Tune - up (Zone A)	RetroEquip	18	5,208,471	0	1,239,863	0	565	\$0.365	0.21
Single Family Heat Recovery Ventilation Heat Pump Zone A	Retro	18	43,731,862	0	10,300,698	1,722	432	\$0.369	0.22
Evaporative Coling (Direct/indirect) (Zone B)	NewHVAC	18	1,679,144	0	253,099	0	115	\$0.576	0.13
Single Family High SEER Central Air Conditioning, (SEER 15) (Zone A)	NewHVAC	18	50,805,046	0	7,133,855	0	3,254	\$0.619	0.13
Single Family High SEER Central Air Conditioning, (SEER 15) (Zone B)	RetroEquip	18	21,937,107	0	2,865,831	0	1,307	\$0.665	0.12
Single Family High SEER Central Air Conditioning, (SEER 15) (Zone A)	RetroEquip	18	35,157,180	0	3,835,825	0	1,749	\$0.796	0.10
Single Family High SEER Central Air Conditioning, (SEER 15) (Zone B)	NewHVAC	18	14,411,622	0	958,536	0	437	\$1.306	0.06

Residential Sector, Gas Measures, 2032 Technical Potential

Measure Description	Program	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M Impact (\$)	Gas Savings (therms)	Level Cost (\$/th)	BCR
Low Flow Showerhead	Replace GasDHW	15	4,741,660	-72,148,017	4,115,947	(\$1.599)	100.00
Gas 2.20 MEF Clothes Washer	New Appl	14	4,804,693	-8,751,430	118,629	(\$0.612)	100.00
Gas 2.20 MEF Clothes Washer	ReplaceAppl	14	22,507,615	-40,996,130	432,226	(\$0.540)	100.00
Gas ETO Dishwasher	New Appl	12	2,272,856	-3,991,871	34,336	(\$0.431)	100.00
Gas ETO Dishwasher	ReplaceAppl	12	6,210,870	-10,908,300	72,978	(\$0.419)	100.00
Gas 2.46 MEF Clothes Washer	ReplaceAppl	14	50,193,972	-49,886,707	557,711	\$0.006	1.51
Gas 2.46 MEF Clothes Washer	New Appl	14	21,429,782	-21,298,598	306,140	\$0.007	1.46
Efficient Gas Hearth	Replace GasDHW	20	328,758	0	773,549	\$0.035	15.36
Single Family Windows, replacement (U=.30)	Retro Gas	45	5,718,868	0	2,057,341	\$0.161	3.42
Single Family Windows, replacement (U=.25)	Retro Gas	45	18,612,557	0	3,754,567	\$0.287	1.92
Single Family AFUE 92 furnace to condensing combination space/water heat hydrocoil, Zone C	New GasEquip	25	65,932	0	13,333	\$0.358	1.51
Single Family NW Energy Star New Home Builder Option Package Ducts Inside	New Gas	35	58,452,354	0	3,235,833	\$0.375	1.46
Single Family AFUE 92 to condensing combination space/water heat hydrocoil, Z B	New GasEquip	25	65,932	0	12,014	\$0.397	1.36
Single Family AFUE 92 to condensing combo hydrocoil, Zone A	New GasEquip	25	476,546	0	82,601	\$0.418	1.29
Single Family NW Energy Star New Home Builder Option Package Equipment Upgrade	New Gas	25	157,808,839	0	10,449,176	\$0.468	1.16
Weatherization Single Family Ceiling Insulation, Zone B	Retro Gas	45	1,579,233	0	155,618	\$0.588	0.94
Weatherization Single Family insulation (ceiling, floor), Zone A	Retro Gas	45	636,794	0	62,210	\$0.593	0.93
Weatherization Single Family Duct Sealing, Zone B	Retro Gas	20	452,197	0	61,108	\$0.604	0.88
Single Family Heat Recovery Ventilator, Zone B	Retro Gas	18	2,848,699	1,143,835	461,631	\$0.751	0.70
Manufactured Home Duct Sealing, Zone A	Retro Gas	20	352,777	0	37,249	\$0.773	0.69
Weatherization Single Family Ceiling Insulation, Zone C	Retro Gas	45	472,182	0	34,121	\$0.801	0.69

Measure Description	Program	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M Impact (\$)	Gas Savings (therms)	Level Cost (\$/th)	BCR
Single Family Heat Recovery Ventilator, Zone A	Retro Gas	18	18,329,086	7,359,656	2,652,646	\$0.841	0.63
Single Family Near Net Zero New Home	New Gas	45	3,406,079	0	228,538	\$0.850	0.65
Weatherization Single Family Ceiling Insulation, Zone A	Retro Gas	45	15,282,645	0	1,003,969	\$0.882	0.62
Energy Star 0.67 EF Water Heater	Replace GasDHW	12	6,521,584	0	821,826	\$0.905	0.55
Energy Star 0.67 EF Water Heater	New GasDHW	12	1,263,929	0	159,276	\$0.905	0.55
NW Energy Star Single Family New Home Builder Option Package Environmental Upgrade	New Gas	35	57,876,592	0	1,331,608	\$0.942	0.58
Weatherization Single Family Wall Insulation, Zone B	Retro Gas	45	2,058,437	0	125,976	\$0.946	0.58
Multifamily Corridor Ventilation	New Gas	15	3,010,946	0	304,595	\$0.965	0.54
Multifamily Corridor Ventilation	Retro Gas	15	13,554,117	0	1,371,167	\$0.965	0.54
Energy Star 0.67 EF water heater after 2015	New GasDHW	12	7,665,640	0	840,070	\$1.041	0.48
Energy Star 0.67 EF water heater after 2015	Replace GasDHW	12	23,306,373	0	2,554,123	\$1.041	0.48
Single Family AFUE 95 Furnace, Zone B	Replace GasEquip	25	2,054,871	228,451	155,828	\$1.061	0.51
Tankless Gas Water Heater	New GasDHW	15	1,123,921	0	102,445	\$1.071	0.47
Single Family Heat Recovery Ventilator , Zone C	Retro Gas	18	851,745	342,000	96,260	\$1.078	0.49
Weatherization Single Family Floor Insulation, Zone B	Retro Gas	45	2,305,449	0	121,036	\$1.103	0.50
Tankless Gas Water Heater after 2015	New GasDHW	15	9,117,035	0	741,593	\$1.200	0.42
Single Family AFUE 95 Furnace, Zone A	Replace GasEquip	25	22,039,457	2,450,240	1,469,297	\$1.206	0.45
Weatherization Single Family Air Sealing, Zone B	Retro Gas	20	494,025	0	32,112	\$1.256	0.42
Weatherization Single Family Wall Insulation, Zone C	Retro Gas	45	615,461	0	27,622	\$1.290	0.43
Weatherization Single Family Duct Sealing, Zone C	Retro Gas	20	452,197	0	28,110	\$1.313	0.41
Weatherization Single Family Wall Insulation, Zone A	Retro Gas	45	19,920,027	0	812,737	\$1.420	0.39
Condensing Tankless Water Heater	New GasDHW	15	1,156,033	0	77,613	\$1.454	0.35
Single Family AFUE 95 Furnace, Zone C	Replace GasEquip	25	2,054,871	228,451	111,305	\$1.485	0.36
Weatherization Single Family Floor Insulation, Zone C	Retro Gas	45	689,316	0	26,539	\$1.504	0.37
Weatherization Single Family Duct Sealing, Zone A	Retro Gas	20	3,570,308	0	192,990	\$1.510	0.35
Condensing Tankless Gas Water Heater after 2015	New GasDHW	15	10,775,294	0	642,259	\$1.638	0.31
Weatherization Single Family Floor Insulation, Zone A	Retro Gas	45	22,310,431	0	780,865	\$1.655	0.33
Weatherization Single Family Air Sealing, Zone A	Retro Gas	20	4,780,807	0	207,168	\$1.883	0.28

Measure Description	Program	Average Lifetime (years)	Total Incremental Cost (\$)	Total O&M Impact (\$)	Gas Savings (therms)	Level Cost (\$/th)	BCR
Single Family Windows, retrofit (U=.25)	Retro Gas	45	151,678,080	0	4,160,207	\$2.112	0.26
Single Family Windows, retrofit (U=.30)	Retro Gas	45	105,818,199	0	2,311,907	\$2.651	0.21
Solar Domestic Hot Water (50 gal) - gas backup	New GasDHW	20	5,420,834	0	154,881	\$2.856	0.17
Solar Domestic Hot Water - gas	Replace GasDHW	20	5,376,276	0	153,464	\$2.859	0.17
Solar Domestic Hot Water - Gas after 2015	New GasDHW	20	51,566,622	0	1,323,222	\$3.180	0.16
Solar Domestic Hot Water - gas afer 2015	Replace GasDHW	20	31,662,720	0	811,670	\$3.184	0.16
Condensing Tankless Water Heat	Replace GasDHW	15	12,906,082	0	385,104	\$3.273	0.15
Tankless Gas Water Heat	Replace GasDHW	15	24,846,782	0	730,133	\$3.323	0.15
Single Family Heat Recovery Ventilation, ENERGY STAR	New Gas	18	15,696,061	0	398,449	\$3.423	0.15
Condensing Tankless Water Heat after 2015	Replace GasDHW	15	76,999,465	0	1,941,726	\$3.872	0.13
Tankless Gas Water Heat after 2015	Replace GasDHW	15	142,727,288	0	3,374,459	\$4.130	0.12
Manufactured Home Duct Sealing, Zone B	Retro Gas	20	334,450	0	218	\$125.312	0.00
Manufactured Home Duct Sealing, Zone C	Retro Gas	20	335,942	0	150	\$183.084	0.00