



Hawaii Energy - Technical Reference Manual No. 2011

Program Year 3 July 2011 to June 2012

Hawaii Energy Efficiency Program

Program Year 3

July 2011 through June 2012

Technical Reference Manual (TRM)

No. 2011

Measure Savings Calculations



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1 Introduction

METHODS AND ASSUMPTIONS

This reference manual provides methods, formulas and default assumptions for estimating energy and demand peak impacts from measures and projects that receive cash incentives from the Hawaii Energy Efficiency Program.

This reference manual is organized by program, end-use and measure. Each section provides mathematical equations for determining savings (algorithms), other program Technical Reference Manual (TRM) methodologies as well as default assumptions for all equation parameters that are not based on site-specific information. In addition, any descriptions of calculation methods or baselines are provided, as appropriate.

The parameters for calculating savings are listed in the same order for each measure. Algorithms are provided for estimating annual energy and demand impacts.

Data assumptions are based on Hawaii specific data, where available. Where Hawaii data was not available, data from neighboring regions is used where available and in some cases, engineering judgment is used.

Data sources used, in the general order of preference, included, but were not necessarily limited to the following:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007 Demand Management Programs – KEMA
- HECO IRP-4: Energy Efficiency Potential Study (HECO DSM Docket)
- 2004-2005 Database for Energy Efficiency Resources (CA DEER database)
- 2007-2008 Database for Energy Efficiency Resources (CA DEER database) Update
- Other EE Program Design Information (e.g. Efficiency Maine, Focus on Energy, etc.)
- SAIC Staff expertise
- Evergreen TRM Review – 2/23/12



2 Gross Customer-to-Net Program Savings Calculation

The algorithms shown with each measure calculate gross customer electric savings without counting the effects of line losses from the generator to the customer or free ridership.

The formulae for converting gross customer-level savings to net generation-level savings are as follows:

$$\text{Net Program kWh} = \text{Gross Customer Level } \Delta\text{kWh} \times (1 + \text{SLF}) \times \text{RR}$$

$$\text{Net Program kW} = \text{Gross Customer Level } \Delta\text{kW} \times (1 + \text{SLF}) \times \text{RR}$$

Where:

Net kWh = kWh energy savings at generation-level, net of free riders and system losses

Net kW = kWh energy savings at generation-level, net of free riders and system losses

Gross Cust. ΔkWh = Gross customer level annual kWh savings for the measure

Gross Cust. ΔkW = Gross customer level connected load kW savings for the measure

SLF = System Loss Factor

RR = Realization Rate that includes Free Riders and Engineering Verification

Hawaii Energy PY2009 Portfolio Energy (kWh) Reduction Impacts by Level					
	Gross Customer Level Savings	System Loss Factor (SLF)	Gross System Level Savings	Realization Rate (RR)	Net Program Level Savings (Net kWh)
Oahu	110,545,694	11.17%	122,893,648	73%	89,712,363
Hawaii	12,590,195	9.00%	13,723,313	73%	10,018,018
Maui	9,182,496	9.96%	10,097,072	73%	7,370,863
Lanai	61,712	9.96%	67,858	73%	49,537
Molokai	85,269	9.96%	93,762	73%	68,447
Total	132,465,366		146,875,654		107,219,227
% of Customer Level Savings			111%		81%

SLF – System Loss Factor

The system loss factors were provided by HECO, MECO and HELCO. They do not vary by measure, but by island, and are in the following Table 1.1:

Table 2.1

County Customer to System Loss Factor		
Oahu	Maui	Hawaii
11.17%	9.96%	9.00%



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RR - Realization Rate

The Realization Rate used was estimated using the following information from the HECO 2008 A&S report:

Table 2.2

Program	Realization Rate		Net System Level Energy Savings 2008	Gross System Level Energy Savings 2008
	Energy	Demand		
1. CIEE	0.6530	0.6640	45,798,527	70,135,569
2. CINC	0.5960	0.6100	17,469,147	29,310,648
3. CICR	0.7590	0.7550	28,749,233	37,877,777
4. ESH	0.8500	0.8500	32,203,749	37,886,763
5. REWH	0.7290	0.7310	8,237,872	11,300,236
6. RNC	0.8410	0.8850	8,267,217	9,830,222
7. RLI	1.0000	1.0000	7,899,869	7,899,869
TOTAL			148,625,614	204,241,087

The total Net Energy Savings divided by the total Gross Energy Savings for 2008 is 73%.

Therefore, the overall realization rate for HECO was 0.73 and Table 1.3 reflects the use of this for the other islands.

Table 2.3

County Customer Realization Rate		
Oahu	Maui	Hawaii
73%	73%	73%



3 Interactive Effects

The TRM provides specific savings algorithms for many prescriptive measures. When a customer installs a prescriptive measure, the savings are determined according to these algorithms. In some cases these algorithms include the effects of interactions with other measures or end.

For “custom” measures, Hawaii Energy performs site-specific customized calculations. In this case, Hawaii Energy takes into account interactions between measures (e.g., individual savings from installation of window film and replacement of a chiller are not additive because the first measure reduces the cooling load met by the second measure).

Hawaii Energy will calculate total savings for the package of custom measures being installed, considering interactive effects, either as a single package or in rank order of measures as described below.

If a project includes both prescriptive and custom measures, the prescriptive measures will be calculated in the normal manner. However, the prescriptive measures will be assumed to be installed prior to determining the impacts for the custom measures.

For commercial lighting measures, the following factors are applied for facilities with air conditioning.

Table 3.1

Building Type	Expected Level of Similarity	Energy Factor	Demand Factor
All Commercial	Low	1.056	1.075
Misc Commercial	Low	1.056	1.075
Cold Storage	Very High	1.423	1.22
Education	Low	1.061	1.039
Grocery	Low	1.043	1.114
Health	High	1.122	1.233
Hotel/Motel	High	1.115	1.236
Industrial	Low	1.043	1.074
Office	Low	1.068	1.102
Restaurant	Low	1.051	1.073
Retail	Low	1.054	1.085
Warehouse	Low	1.019	1.053



4 Persistence

Persistence factors may be used to reduce lifetime measure savings in recognition that initial engineering estimates of annual savings may not persist long term.

This might be because a measure is removed or stops functioning prior to the end of its normal engineering lifetime, because it is not properly maintained, it is overridden, it goes out of calibration (controls only), or for some other reason.

Some of the measure algorithm may contain an entry for persistence factor. The default value if none is indicated is 1.00 (100%). A value lower than 1.00 will result in a downward adjustment of lifetime savings and total resource benefits.

For any measure with a persistence value less than 1.00, the normal measure life ("Engineering Measure Life") will be reduced to arrive at an "Effective Useful Life" for the purposes of estimating the TRB of a measure or program.



5 Glossary

The following glossary provides definitions for necessary assumptions needed to calculate measure savings.

Attribution Factor (AF): The Attribution Factor is the amount of savings attributable to the program impact. It is calculated by subtracting from one the % free ridership.

Baseline Efficiency (η_{base}): The assumed standard efficiency of equipment, absent an Hawaii Energy program.

Coincidence Factor (CF): Coincidence factors represent the fraction of connected load expected to be “on” and using electricity coincident with the system peak period.

Connected Load: The maximum wattage of the equipment, under normal operating conditions, when the equipment is “on”.

Freeridership (FR): A program’s **free ridership rate** is the percentage of program participants deemed to be free riders. A **free rider** refers to a customer who received an incentive through an energy efficiency program who would have installed the same or a smaller quantity of the same high efficiency measure on their own within one year if the program had not been offered.

Full Load Hours (FLH): The equivalent hours that equipment would need to operate at its peak capacity in order to consume its estimated annual kWh consumption (annual kWh/connected kW).

High Efficiency (η_{effic}): The efficiency of the energy-saving equipment installed as a result of an efficiency program.

Incremental Cost: The cost difference between the installed cost of the high efficiency measure and the standard efficiency measure.

Lifetimes: The number of years (or hours) that the new high efficiency equipment is expected to function. These are generally based on engineering lives, but sometimes adjusted based on expectations about frequency of remodeling or demolition.

System Loss Factor (SLF): The marginal electricity losses from the generator to the customer meter – expressed as a percent of meter-level savings. The Energy Line Loss Factors vary by period. The Peak Line Loss Factors reflect losses at the time of system peak, and are shown for two seasons of the year (winter and summer). Line loss factors are the same for all measures.

Load Factor (LF): The fraction of full load (wattage) for which the equipment is typically run.

Operating Hours (HOURS): The annual hours that equipment is expected to operate.

Persistence (PF): The fraction of gross measure savings obtained over the measure life.

Realization Rate (RR): The fraction of gross measure savings realized by the program impact. It includes the gross verification adjustment and free ridership or attribution adjustment.

Spillover (SPL): Spillover refers to energy-efficient equipment installed in any facility in the program service area due to program influences, but without any financial or technical assistance from the Program. It is expressed as a percent or fraction of the gross savings attributable to program participation.

Total Resource Benefits (TRB): The present value of benefits from the program savings resulting from avoided energy and capacity costs for the utility and their ratepayers.



6 Load shapes and Demand Coincidence Factors

Load shapes for different types of equipment or systems were not needed because the savings values estimated in the KEMA 2008 impact evaluation already accounted for these load shapes. The coincidence factors were developed based on the calculated full load demand reduction and the KEMA values for each building type. The resulting coincidence factors were evaluated for reasonableness depending on the system type and the building type.



7 Total Resource Benefits – Avoided Costs and Measure Life

HECO provided avoided energy and capacity costs for future years shown in the table below:

Table 7.1

Year	\$/MWh	\$/kW
2006	\$109.62	\$180.20
2007	\$107.16	\$181.14
2008	\$102.19	\$181.14
2009	\$106.89	\$181.14
2010	\$98.90	\$0.00
2011	\$100.41	\$0.00
2012	\$104.04	\$0.00
2013	\$103.69	\$0.00
2014	\$108.86	\$0.00
2015	(\$139.65)	\$1,530.33
2016	(\$132.67)	\$1,704.00
2017	(\$118.95)	\$1,537.80
2018	(\$115.35)	\$1,412.69
2019	(\$109.01)	\$1,304.38
2020	(\$104.57)	\$1,207.27
2021	(\$100.02)	\$1,149.38
2022	(\$109.30)	\$1,112.04
2023	(\$111.41)	\$1,076.56
2024	\$137.80	(\$411.76)
2025	\$144.46	(\$744.16)

The avoided cost values for energy and capacity that was originally provided by HECO was deemed inappropriate to use for reasons that included a negative avoided cost value for energy in the year 2015 to 2023 and no capacity costs for years 2010 to 2014. Therefore, the avoided cost used for the program was estimated using an extrapolation of the HECO provided avoided energy in the first few years of data for energy and the capacity costs leveled over 20 years. The following table was developed from this extrapolation.



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Table 7.2

Year	\$/MWh	\$/kW
2006	109.62	180.20
2007	107.16	181.14
2008	102.19	181.14
2009	106.89	181.14
2010	98.90	279.79
2011	100.41	305.64
2012	104.04	338.65
2013	103.69	353.19
2014	108.86	370.59
2015	112.36	382.51
2016	113.45	386.22
2017	113.90	387.74
2018	114.30	389.12
2019	115.13	391.92
2020	114.76	390.68
2021	115.92	394.63
2022	117.01	398.34
2023	116.75	397.44
2024	117.91	401.41
2025	119.18	405.71

This table was deemed a good estimate of actual avoided energy and capacity costs as it was more in line with the avoided costs used in many other programs. Therefore, these avoided costs were used to calculate the Total Resource Benefits.



Effective Useful Life (EUL): Table 7.3

Version Date & Revision History

Draft date: February 24, 2010

Effective date: July 1, 2010

End date: TBD

Referenced Documents: Econorthwest TRM Review – 6/23/10
DEER (The Database for Energy Efficient Resources)

TRM Review Actions:

- 6/23/10 Rec. – Adopt DEER values in those cases where there is a greater than 20 percent difference between DEER and current TRM. – Adopted

Major Changes:

- Hawaii Energy will adopt DEER EUI values across the board and will follow DEER changes as they are updated unless obvious differences for Hawaii applications are identified.

The measure Effective Useful Life estimated for each measure is shown in the following table:



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Table 7.3

Measure Type	Measure ID	Equipment Description	DEER Effective Useful Life (EUL)
Appliances	a0730000005Jvi3	Ceiling Fan	5
	a0730000005JvjB	Central AC Maint	1
	a0730000005JvhQ	Clothes Washer	11
	a0730000004zRqn	COMPACT FLUORESCENT LIGHT	6.4
	a0730000005K0Xc	compact fluorescent light	2.8
	a0730000005Jvi8	Dishwasher	11
	a0730000005JviI	Ductless Split AC	15
	a0730000004zRqo	ENERGY STAR CEILING FAN	5
	a0730000004zRqp	ENERGY STAR CLOTHES WASHER	11
	a0730000004zRqv	ENERGY STAR DISHWASHER	11
	a0730000004zRqw	ENERGY STAR REFRIGERATOR	14
	a0730000005Jvht	Refrigerator	14
	a0730000004zRr5	refrigerator replacement (not E*)	14
Water Items	a0730000004zRr1	low flow showerhead	10
	a0730000004zRqx	faucet aerator	10
	a0730000004zRr2	LOW FLOW SHOWERHEAD – ELECTRIC WATER HEATER	10
	a0730000004zRr3	LOW FLOW SHOWERHEAD – HEAT PUMP WATER HEATER	10
	a0730000004zRr4	LOW FLOW SHOWERHEAD – SOLAR WATER HEATER	10
Water Heating	a0730000004zRr0	HIGH EFFICIENCY ELECTRIC RESISTANCE WATER HEATER	13
	a0730000004zRqy	HEAT PUMP WATER HEATER – ADD ON	10
	a0730000004zRrP	HEAT PUMP WATER HEATER – INTEGRAL	10
	a0730000005Jvim	HEWH 35 Gal or less HEWH .94 EFF	10
	a0730000005JviS	HEWH 36-45 Gal or less HEWH .93 EFF	10
	a0730000005Jvic	HEWH 46-64 Gal or less HEWH .92 EFF	10
	a0730000005Jviw	HEWH 66+ Gal HEWH .88 EFF	10
	a0730000004zRrT	SOLAR WATER HEATER	15
	a0730000005Jvhf	Solar Hot Water Heater	15



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Measure Type	Measure ID	Equipment Description	DEER Effective Useful Life (EUL)
Air Conditioning	a0730000004zRqz	HIGH EFFICIENCY AIR CONDITIONER	15
	a0730000004adko	HVAC – Chiller	20
	a0730000004adl4	HVAC – Fan Variable Frequency Drive	15
	a0730000004adl9	HVAC – Packaged/Split	15
	a0730000004adkx	HVAC – Pump Variable Frequency Drive	15
	a0730000004adkq	HVAC – Window AC	9
	a0730000004zRr6	SPLIT SYSTEM AIR CONDITIONER	15
	a0730000005Jvhe	Window AC	9
	a0730000004adlC	Window Film	10
	a0730000004zRr7	WINDOW ROOM AIR CONDITIONER	9
Motors	a0730000004adlD	Motors	15
Lighting	a0730000004adkf	L01 Comm CFL 15W 40W	2.8
	a0730000004adlB	L010 High Pressure Sodium indoor >200 W	14
	a0730000004adjq	L011 Pulse St MH <100 W	14
	a0730000004adkY	L012 Pulse St MH 100 W-200 W	14
	a0730000004adkc	L013 Pulse St MH >200 W	14
	a0730000004adjS	L014 Induction <100 W	2
	a0730000004adl1	L015 Induction >100W	2
	a0730000004adkV	L016 2' T8 or T8 w/EB T12, 28W/25W/high lumen 32W	14
	a0730000004adky	L017 3' T8 or T8 w/EB T12, 28W/25W/high lumen 32W	14
	a0730000004adl7	L018 4' T8 or T8 w/EB T12, 28W/25W/high lumen 32W	14
	a0730000004adkp	L019 8' T8 or T8 w/EB T12, 28W/25W/high lumen 32W	14
	a0730000004adki	L02 Comm CFL 20W 60W	14
	a0730000004adkT	L020 4' Super T8 w/HEEB T12, 28W/25W/high lumen 32W	14
	a0730000004adjt	L021 4' Super T8 w/HEEB T8, 28W/25W/high lumen 32W	14
	a0730000004adkz	L022 4' Super T8 w/HEEB New, 28W/25W/high lumen 32W	14
	a0730000004adkU	L023 2' T8/T12 delamp w/reflectors	14
	a0730000004adks	L024 4' T8/T12 delamp w/reflectors	14
	a0730000004adke	L025 8' T8/T12 delamp w/reflectors	14
	a0730000004adkv	L026 2' T8/T12 delamp no reflectors	14
	a0730000004adkZ	L027 4' T8/T12 delamp no reflectors	14
	a0730000004adjr	L028 8' T8/T12 delamp no reflectors	14
	a0730000004adl3	L029 2' T8 w/EB, replacement w/delamp	14



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Measure Type	Measure ID	Equipment Description	DEER Effective Useful Life (EUL)
Lighting	a0730000004adkg	L03 Reflected CFL	2.8
	a0730000004adkh	L030 2' T8 w/EB, delamp w/reflector	14
	a0730000004adku	L031 4' T8 w/EB, replacement w/delamp	14
	a0730000004adka	L032 4' T8 w/EB, delamp w/reflector	14
	a0730000004adkX	L033 8' T8 w/EB, replacement w/delamp	14
	a0730000004adl6	L034 8' T8 w/EB, delamp w/reflector	14
	a0730000004adkm	L035 2' T5 w/EB	14
	a0730000004adkt	L036 3' T5 w/EB	14
	a0730000004adkr	L037 4' T5 w/EB	14
	a0730000004adkn	L038 2' T5HO w/EB	14
	a0730000004adlA	L039 3' T5HO w/EB	14
	a0730000004adkw	L04 Cold Cathode CFL	2.8
	a0730000004adl2	L040 4' T5HO w/EB	14
	a0730000004adl8	L041 Metal Halide indoor <100 W	14
	a0730000004adkW	L042 Metal Halide indoor 100 W-200 W	14
	a0730000004adkj	L043 Metal Halide indoor >200 W	14
	a0730000004adkk	L05 Dimmable CFL	2.8
	a0730000004adkl	L06 Pin mount CFL	16
	a0730000004adl5	L07 LED Exit	16
	a0730000004adkb	L08 High Pressure Sodium indoor <100 W	14
	a0730000004adl0	L09 High Pressure Sodium indoor 100 W-200 W	14
	a0730000004adkd	Lighting – Sensor	8
Maintenance	a0730000004zRqm	AIR CONDITIONING SERVICES	1



8 (REEM) Residential Energy Efficiency Measures

8.1 High Efficiency Water Heating

8.1.1 Solar Water Heater

Measure ID: See Table 7.3

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End date: TBD

Referenced Documents:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007 Demand Management Programs – (KEMA 2005-07)
- Econorthwest TRM Review – 6/23/10
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 6/23/10 Rec. # 6 – For PY 2010, adjust claimed demand savings based on participant data from all service territories covered. Adjust Demand Savings based on participant data weighted average of KEMA results across all counties. Change from 0.50 to 0.46 kW. non-military – Adopted and incorporated into PY2010-1 TRM.
- 6/23/10 Rec. # 7 - For PY 2010, include a discussion of shell losses in the savings analysis and supporting documentation. Discussion included in PY2010-1 TRM.
- 10/5/11 – Currently Under Review.

Major Changes:

- Eliminated Military figure as no foreseeable military retrofit applications will be received.
- Demand change to weighted average from KEMA 2008. 0.46 kW
- Changed individual water usage from 13.3035 to 13.3

Measure Description:

Replacement of Electric Resistance Water Heater with a Solar Water Heater designed for a 90% Solar Fraction. The new Solar Water Heating systems most often include an upgrade of the hot water storage tank sized at 80 or 120 gallons.

Systems must comply with Hawaii Energy Solar Standards and Specifications which call out:

- Panel Ratings
- System Sizing
- Installation orientation de-rating factors
- Hardware and mounting systems

Shell Losses:

The increase in size from a 40 or 60 gallon to an 80 or 120 gallon standard electric resistance water heater would in and of itself increase the “shell” losses of the system. These shell losses are the result of a larger surface area exposing the warm water to the cooler environment and thus more heat lost to the environment through conduction through the tank. Engineering calculations by Econorthwest puts this at a 1% increase in losses. This is further reduced by 90% as the solar water system provides that fraction of the annual water heating requirements.



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Baseline Efficiencies:

Baseline usage is a 0.9 COP Electric Resistance Water Heater. The baseline water heater energy consumption is by a single 4.0kW electric resistance element that is controlled thermostatically on/off controller based of tank finish temperature set point. The tank standby loss differences between baseline and high efficiency case are assumed to be negligible.

Demand Baseline has been determined by field measurements by KEMA 2005-07 report. The energy baseline also comes from the KEMA 2005-07 report and is supported by engineering calculations shown in this TRM.

Building Types	Demand Baseline(kW)	Energy Baseline (kWh)
Residential	0.57	2,733

High Efficiency:

Solar Water Heater designed for a 90% Solar Fraction. The Solar Systems use solar thermal energy to heat the water 90% of the time and continue to utilize electricity to operate the circulation pump and provide heating through a 4.0 kW electric resistance element when needed.

Solar Contractors do not favor Photo-Voltaic powered DC circulation pumps as they have proven less reliable in the field than an AC powered circulation pump.

The electric resistance elements in the high efficiency case do not have load control timers on them.

The energy is the design energy of a 90% solar fraction system with circulation pump usage as metered by KEMA 2008.

The on peak demand is the metered demand found by KEMA 2008.

Building Types	Demand High Efficiency (kW)	Energy High Efficiency (kWh)	Circ. Pump %
Residential	0.07	379	28%

Energy Savings:

Solar Water Heater Gross Savings before operational adjustments:

Building Types	Demand Savings (kW)	Energy Savings (kWh)
Residential	0.46	2,354

Operational Factor	Adjustment Factor
Solar Fraction Performance (sfp)	0.94
Persistence Factor (pf)	0.93
Demand Coincidence Factor (cf)	1.0

Solar Water Heater Net Savings after operational adjustments:

Building Types	Demand Savings (kW)	Energy Savings (kWh)
Residential	0.46	2,065



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Savings Algorithms

Solar Water Heater - Non-Military Single Family Home

Energy per Day (BTU) = (Gallons per Day) x (lbs. per Gal.) x (Temp Rise) x (Energy to Raise Water Temp)

Hot Water needed per Person 13.3 Gallons per Day per Person

HE

Average Occupants x 3.77 Persons

KEMA 2008

Household Hot Water Usage 50.141 Gallons per Day

Mass of Water Conversion 8.34 lbs/gal

Finish Temperature of Water 130 deg. F Finish Temp

Initial Temperature of Water - 75 deg. F Initial Temp

Temperature Rise 55 deg. F Temperature Rise

Energy to Raise Water Temp 1.0 BTU / deg. F / lbs.

Energy per Day (BTU) Needed in Tank 23,000 BTU/Day

Energy per Day (BTU) Needed in Tank 23,000 BTU/Day

BTU to kWh Energy Conversion ÷ 3,412 kWh / BTU

Energy per Day (kWh) 6.7 kWh / Day

Days per Month x 30.4 Days per Month

Energy (kWh) per Month 205 kWh / Month

Days per Year x 365 Days per Year

Energy (kWh) Needed in Tank to Heat Water per Year 2,459 kWh / Year

Elec. Res. Water Heater Efficiency ÷ 0.90 COP

Base SERWH Energy Usage per Year at the Meter 2,732 kWh / Year

KEMA 2008 - HECO

Design Annual Solar Fraction 90% Water Heated by Solar System

Program Design

10% Water Heated by Remaining Backup Element

Energy Usage per Year at the Meter 2,732 kWh / Year

x 10% Water Heated by Remaining Backup Element

Back Up Element Energy Used at Meter 273 kWh / Year

Circulation Pump Energy 0.082 kW

KEMA 2008

Pump Hours of Operation x 1,292 Hours per Year

KEMA 2008

Pump Energy used per Year 106 kWh / Year

Back Up Element Energy Used at Meter 273 kWh / Year

72%

Pump Energy used per Year + 106 kWh / Year

28%

Design Solar System Energy Usage 379 kWh / Year

Base SERWH Energy Usage per Year at the Meter 2,732 kWh / Year

Design Solar System Energy Usage - 379 kWh / Year

Design Solar System Energy Savings 2,353 kWh / Year

Design Solar System Energy Savings 2,353 kWh / Year

Performance Factor 0.94 pf

HE

Persistence Factor x 0.93 pf

KEMA 2008

2,065 kWh / Year

KEMA 2008

Residential Solar Water Heater Energy Savings 2,065 kWh / Year Savings

Base SERWH Element Power Consumption 4.0 kW

Coincidence Factor x 0.143 cf

8.6 Minutes per hour

Base SERWH On Peak Demand 0.57 kW On Peak

KEMA 2008

Base SERWH On Peak Demand - 0.57 kW On Peak

Solar System Metered on Peak Demand - 0.11 kW On Peak

KEMA 2008

0.46 kW On Peak

Residential Solar Water Heater Demand Savings 0.46 kW Savings



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Operating Hours

See Table above.

Loadshape

TBD

Freeridership/Spillover Factors

TBD

Persistence

The persistence factor has been found to be 0.93 based in the KEMA 2005-07 report that found 7% of the systems not operational.

Lifetime

15 years

Measure Costs and Incentive Levels

Table 1 – SWH Measure Costs and Incentive Levels

Description	Unit Incentive	Incremental Cost
Non-Military	\$ 750	\$6,600

Component Costs and Lifetimes Used in Computing O&M Savings

TBD

Reference Tables

None



8.1.2 Solar Water Heating Loan Interest Buydown (LIB)

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: May 22, 2011

Effective date: November 1, 2011

End date: TBD

Referenced Documents:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007 Demand Management Programs – (KEMA 2005-07)
- Econorthwest TRM Review – 6/23/10
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 6/23/10 Rec. # 6 – For PY 2010, adjust claimed demand savings based on participant data from all service territories covered. Adjust Demand Savings based on participant data weighted average of KEMA results across all counties. Change from 0.50 to 0.46 kW. non-military – Adopted and incorporated into PY2010-1 TRM.
- 6/23/10 Rec. # 7 - For PY 2010, include a discussion of shell losses in the savings analysis and supporting documentation. Discussion included in PY2010-1 TRM.
- 10/5/11 – Currently Under Review.

Major Changes:

- Eliminated Military figure as no foreseeable military retrofit applications will be received.
- Demand change to weighted average from KEMA 2008. 0.46 kW
- Changed individual water usage from 13.3035 to 13.3

Measure Description:

The Solar Water Heating Loan Interest Buydown Program offers eligible borrowers an interest buy down of \$1,000 (with a minimum loan of \$5,000) toward the financing of a solar water heating system from a participating lender – see www.hawaiienergy.com for a list of participating lenders.

Replacement of Electric Resistance Water Heater with a Solar Water Heater designed for a 90% Solar Fraction. The new Solar Water Heating systems most often include an upgrade of the hot water storage tank sized at 80 or 120 gallons.

Systems must comply with Hawaii Energy Solar Standards and Specifications which call out:

- Panel Ratings
- System Sizing
- Installation orientation de-rating factors
- Hardware and mounting systems

Shell Losses:

The increase in size from a 40 or 60 gallon to an 80 or 120 gallon standard electric resistance water heater would in and of itself increase the “shell” losses of the system. These shell losses are the result of a larger surface area exposing the warm water to the cooler environment and thus more heat lost to the environment through conduction through the tank. Engineering calculations by Econorthwest puts this at a 1% increase in losses. This is further reduced by 90% as the solar water system provides that fraction of the annual water heating requirements.

Baseline Efficiencies:

Baseline usage is a 0.9 COP Electric Resistance Water Heater. The baseline water heater energy consumption is by a single 4.0 kW electric resistance element that is controlled thermostatically on/off



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controller based on tank finish temperature set point. The tank standby loss differences between baseline and high efficiency case are assumed to be negligible.

Demand Baseline has been determined by field measurements by KEMA 2005-07 report. The energy baseline also comes from the KEMA 2005-07 report and is supported by engineering calculations shown in this TRM.

Building Types	Demand Baseline(kW)	Energy Baseline (kWh)
Residential	0.57	2,733

High Efficiency:

Solar Water Heater designed for a 90% Solar Fraction. The Solar Systems use solar thermal energy to heat the water 90% of the time and continue to utilize electricity to operate the circulation pump and provide heating through a 4.0 kW electric resistance element when needed.

Solar Contractors do not favor Photo-Voltaic powered DC circulation pumps as they have proven less reliable in the field than an AC powered circulation pump.

The electric resistance elements in the high efficiency case do not have load control timers on them.

The energy is the design energy of a 90% solar fraction system with circulation pump usage as metered by KEMA 2008.

The on peak demand is the metered demand found by KEMA 2008.

Building Types	Demand High Efficiency (kW)	Energy High Efficiency (kWh)	Circ. Pump %
Residential	0.07	379	28%

Energy Savings:

Solar Water Heater Gross Savings before operational adjustments:

Building Types	Demand Savings (kW)	Energy Savings (kWh)
Residential	0.46	2,354

Operational Factor	Adjustment Factor
Solar Fraction Performance (sfp)	0.94
Persistence Factor (pf)	0.93
Demand Coincidence Factor (cf)	1.0

Solar Water Heater Net Savings after operational adjustments:

Building Types	Demand Savings (kW)	Energy Savings (kWh)
Residential	0.46	2,065



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Savings Algorithms

Solar Water Heater - Non-Military Single Family Home

Energy per Day (BTU) = (Gallons per Day) x (lbs. per Gal.) x (Temp Rise) x (Energy to Raise Water Temp)			
Hot Water needed per Person	13.3	Gallons per Day per Person	HE
Average Occupants	x	3.77	Persons
Household Hot Water Usage		50.141	Gallons per Day
Mass of Water Conversion		8.34	lbs/gal
Finish Temperature of Water		130	deg. F Finish Temp
Initial Temperature of Water	-	75	deg. F Initial Temp
Temperature Rise		55	deg. F Temperature Rise
Energy to Raise Water Temp		1.0	BTU / deg. F / lbs.
Energy per Day (BTU) Needed in Tank		23,000	BTU/Day
Energy per Day (BTU) Needed in Tank		23,000	BTU/Day
BTU to kWh Energy Conversion	÷	3,412	kWh / BTU
Energy per Day (kWh)		6.7	kWh / Day
Days per Month	x	30.4	Days per Month
Energy (kWh) per Month		205	kWh / Month
Days per Year	x	365	Days per Year
Energy (kWh) Needed in Tank to Heat Water per Year		2,459	kWh / Year
Elec. Res. Water Heater Efficiency	÷	0.90	COP
Base SERWH Energy Usage per Year at the Meter		2,732	kWh / Year
			KEMA 2008 - HECO
Design Annual Solar Fraction		90%	Water Heated by Solar System
		10%	Water Heated by Remaining Backup Element
			Program Design
Energy Usage per Year at the Meter		2,732	kWh / Year
	x	10%	Water Heated by Remaining Backup Element
Back Up Element Energy Used at Meter		273	kWh / Year
Circulation Pump Energy		0.082	kW
			KEMA 2008
Pump Hours of Operation	x	1,292	Hours per Year
			KEMA 2008
Pump Energy used per Year		106	kWh / Year
Back Up Element Energy Used at Meter		273	kWh / Year
			72%
Pump Energy used per Year	+	106	kWh / Year
			28%
Design Solar System Energy Usage		379	kWh / Year
Base SERWH Energy Usage per Year at the Meter		2,732	kWh / Year
Design Solar System Energy Usage	-	379	kWh / Year
Design Solar System Energy Savings		2,353	kWh / Year
Design Solar System Energy Savings		2,353	kWh / Year
Performance Factor		0.94	pf
			HE
Persistence Factor	x	0.93	pf
			KEMA 2008
		2,065	kWh / Year
			KEMA 2008

Residential Solar Water Heater Energy Savings	2,065 kWh / Year Savings
--	---------------------------------

Operating Hours

See Table above.

Loadshape

TBD

Freeridership/Spillover Factors

TBD



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Persistence

The persistence factor has been found to be 0.93 based in the KEMA 2005-07 report that found 7% of the systems not operational.

Lifetime

15 years

Measure Costs and Incentive Levels

Hawaii Energy will be allowed to claim credit for the fraction of the energy and demand savings and total resource benefits that is proportional to the share of customer incentive cost paid with PBFA funds.

The following distribution is provided for energy and demand impacts:

PBFA (Public Benefit Fee Administrator)	25%
ARRA (American Recovery and Reinvestment Act)	75%

Energy Savings 2065 kWh/year
Demand Savings 0.46 kW

Pre-Bonus Period (11/1/10 - 3/21/11)			PBF				ARRA			
	Unit Incentive	Incremental Cost	Unit Incentive	% Contribution	Energy Savings (kWh/year)	Demand Savings (kW)	Unit Incentive	% Contribution	Energy Savings (kWh/year)	Demand Savings (kW)
Military	\$ 1,000	\$ 4,400	\$ 250	25%	516	0.12	\$ 750	75%	1549	0.35
Non-Military	\$ 1,000	\$ 6,600	\$ 250	25%	516	0.12	\$ 750	75%	1549	0.35

Bonus Period (3/22/11 - 6/30/11)			PBF				ARRA			
	Unit Incentive	Incremental Cost	Unit Incentive	% Contribution	Energy Savings (kWh/year)	Demand Savings (kW)	Unit Incentive	% Contribution	Energy Savings (kWh/year)	Demand Savings (kW)
Military	\$ 1,750	\$ 4,400	\$ 250	14%	295	0.07	\$ 1,500	86%	1770	0.39
Non-Military	\$ 1,750	\$ 6,600	\$ 250	14%	295	0.07	\$ 1,500	86%	1770	0.39

Component Costs and Lifetimes Used in Computing O&M Savings

TBD

Reference Tables

None



8.1.3 Solar Water Heater Energy Hero Gift Packs

Measure ID:

Version Date & Revision History

Draft date: October 4, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007
- Demand Management Programs – KEMA (KEMA 2005-07)
- Econorthwest TRM Review – 6/23/10
- Energy and Peak Demand Impact Evaluation Report of the 2005-2007 Demand Management Programs – (KEMA 2005-07)
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- 11/22/11 – LED algorithm updated. See section 8.2.2 for changes.
- 11/22/11 – Akamai Power Strip kWh savings updated based on NYSERDA Measure Characterization for Advanced Power Strips.
- 11/22/11 – Updated content in headings *Description*, *Base Case*, *High Efficiency Case*, and *Energy Savings* in regard to LED lamps to match section 8.2.2.
- 11/29/11 – Low Flow Shower Head algorithm updated – previously claiming only 50% of total energy savings due to inaccurately calculating hot and cold water mix. Also updated *Energy Savings* table as necessary.
- 4/17/12 – Updated CFL and LED algorithms to refer to CFL and LED sections in TRM to ensure accuracy. Updated energy savings numbers to be consistent with EMV revisions.
- 8/1/12 – Updated Low Flow Shower Head algorithm to reduce demand savings from 40% to 20% as per EM&V review (Feb. 2012)

Description:

Potential gift pack components:

- Compact Fluorescent Lamp
- Akamai Power Strip
- LED Lamp
- Low Flow Shower Head

Base Case

- 60 W incandescent lamps
- Standard power strip or no power strip
- 25% 60W incandescent, 25% 40W incandescent, 25% 23W CFLs and 25% 13W CFLs (See LED TRM)
- Low Flow Shower Head rated at 2.5 gpm

High Efficiency Case

- 15W CFLs
- Akamai Power Strip
- 50% 7W LED Lamp and 50% 12.5W LED Lamp
- Low Flow Shower Head rated at 1.5 gpm



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Energy Savings

Measure	Energy Savings (kWh/year)	Demand Savings (kW)
3 CFL	109	0.016
Power Strip	78	0.009
LED	17	0.003
Low Flow Shower Head - Solar	42	0.022
TOTAL	246	0.05

Measure life

Measure	Measure Life (Years)
3 CFL	5
Power Strip	5
LED	5
Low Flow Shower Head	5

Savings Algorithms

CFL - Single and Multi Family Residential Home

Refer to TRM Compact Fluorescent Lamp (CFL) Section

Akamai Power Strips

Savings per Unit	56.5 kWh	102.8 kWh	NYSERDA Measure Characterization for Advanced Power Strips
Plugs per Unit	5 plugs	7 plugs	
Savings per Plug	11.3 kWh/plug	14.68571 kWh/plug	
Average Savings per Plug		13.0 kWh	
	x	6 plugs/unit	

Akamai Power Strip Energy Savings 78 kWh per Unit first year

Hours of Operation 8760 hours/year

Demand Savings 0.0089 kW

First Year Savings	78 kWh first year
Measure Life	x 5 year measure life
Lifetime Savings	389.78571 kWh lifetime

Total Resource Cost	\$ 30.96
Total Resource Benefit	÷ \$ 46.15
Total Resource Cost Ratio	1.5 TRB Ratio

Potential Akamai Power Strip Incentive	\$ 7.00
First Year Savings	÷ 66 kWh first year
	\$ 0.11 per kWh first year

Standard Power Strip Cost	\$ 14.49
Akamai Power Strip Cost	- \$ 30.96
Incremental Akamai Power Strip Cost	\$ 16.47

Incremental Akamai Power Strip Cost	\$ 16.47
Potential Akamai Power Strip Incentive	÷ \$ 7.00
Percentage of Incremental Cost	43%

Akamai Power Strip Cost	\$ 30.96
Potential Akamai Power Strip Incentive	÷ \$ 7.00
Percentage of Customer Measure Cost	23%



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LED - Single and Multi Family Residential Home

Refer to TRM Light Emitting Diode (LED) Section

Low Flow Showerhead w/Solar Water Heating

Energy per Day (BTU) = (Gallons per Day) x (lbs. per Gal.) x (Temp Rise) x (Energy to Raise Water Temp)

Hot Water needed per Person	13.3 Gallons per Day per Person	HE
Average Occupants	x 3.77 Persons	KEMA 2008
Household Hot Water Usage	50.2 Gallons per Day	
Mass of Water Conversion	8.34 lbs/gal	
Finish Temperature of Water	130 deg. F Finish Temp	
Initial Temperature of Water	- 75 deg. F Initial Temp	
Temperature Rise	55 deg. F Temperature Rise	
Energy to Raise Water Temp	1.0 BTU / deg. F / lbs.	
Energy per Day (BTU) Needed in Tank	23,006 BTU/Day	
Energy per Day (BTU) Needed in Tank	23,006 BTU/Day	
BTU to kWh Energy Conversion	÷ 3,412 BTU/kWh	
Energy per Day (kWh)	6.7 kWh / Day	
Days per Month	x 30.4 Days per Month	
Energy (kWh) per Month	205 kWh / Month	
Days per Year	x 365 Days per Year	
Energy (kWh) Needed in Tank to Heat Water per Year	2,460 kWh / Year	
Elec. Res. Water Heater Efficiency	÷ 0.90 COP	
Base SERWH Energy Usage per Year at the Meter	2,733 kWh / Year	KEMA 2008 - HECO
Design Annual Solar Fraction	90% Water Heated by Solar System 10% Water Heated by Remaining Backup Element	Program Design
Energy Usage per Year at the Meter	2,733 kWh / Year	
	x 10% Water Heated by Remaining Backup Element	
Back Up Element Energy Used at Meter	273 kWh / Year	
Circulation Pump Energy	0.082 kW	KEMA 2008
Pump Hours of Operation	x 1,292 Hours per Year	KEMA 2008
Pump Energy used per Year	106 kWh / Year	
Back Up Element Energy Used at Meter	273 kWh / Year	72%
Pump Energy used per Year	+ 106 kWh / Year	28%
Design Solar System Energy Usage	379 kWh / Year	
Utilization Factor	28%	Hot water used for showers (AMMA)
Hot Water Usage from Showers	106	
Base Case Showerhead	2.5 GPM	
High Efficiency Case Showerhead	1.5 GPM	
Savings = (1 - High Efficiency/Base)	40%	

Energy Savings 42 kWh / Year

Solar System Metered on Peak Demand	0.11 kW On Peak	KEMA 2008
Peak Coincidence Factor	0.20	William B., De Oreo, P.E., Peter W. Mayer. The End Uses of Hot Water in Single Family Homes from Flow Trace Analysis. Aquacraft, Inc. Water Engineering and Management.

Residential Low Flow Shower Head Demand Savings 0.022 kW Savings



8.1.4 Heat Pump Water Heaters

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- From Salesforce Measures (Impact)
- October 2004 (KEMA Report)
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- Recognizing the growing product availability and sales efforts regarding residential heat pumps, increase educational efforts.
- Changed base SERWH element power consumption from 4.5 kW to 4.0 kW

Measure Description:

Residential heat pump rebates are available at \$175. Rebate applications for water heaters are provided by the retailers at the time of purchase or a customer can visit our website and download the form. Rebate applications must include an original purchase receipt showing brand and model number.

Baseline Efficiencies:

The base case is a standard electric resistance water heater (SERWH).

Measure	Demand Baseline (kW)	Energy Baseline (kWh/year)
SERWH	0.57	2,732

High Efficiency:

Measure	Demand Efficient Case (kW)	Efficient Case (kWh/year)
Heat Pump Water Heating	0.36	1,230

Energy Savings:

	Demand Savings (kW)	Energy Savings (kWh/year)
Savings	0.25	1,503



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Savings Algorithms

Heat Pump Water Heater

Energy per Day (BTU) = (Gallons per Day) x (lbs. per Gal.) x (Temp Rise) x (Energy to Raise Water Temp)

Hot Water needed per Person 13.3 Gallons per Day per Person

Average Occupants x 3.77 Persons

Household Hot Water Usage 50.1 Gallons per Day

Mass of Water Conversion 8.34 lbs/gal

Finish Temperature of Water 130 deg. F Finish Temp

Initial Temperature of Water - 75 deg. F Initial Temp

Temperature Rise 55 deg. F Temperature Rise

Energy to Raise Water Temp 1.0 BTU / deg. F / lbs.

Energy per Day (BTU) Needed in Tank 23,000 BTU/Day

Energy per Day (BTU) Needed in Tank 23,000 BTU/Day

BTU to kWh Energy Conversion ÷ 3,412 kWh / BTU

Energy per Day (kWh) 6.7 kWh / Day

Days per Month x 30.4 Days per Month

Energy (kWh) per Month 205 kWh / Month

Days per Year x 365 Days per Year

Energy (kWh) Needed in Tank to Heat Water per Year 2,459 kWh / Year

Elec. Res. Water Heater Efficiency ÷ 0.90 COP

Base SERWH Energy Usage per Year at the Meter 2,732 kWh / Year

HE
KEMA 2008

KEMA 2008 - HECO

Energy (kWh) Needed to Heat Water per Year 2,459 kWh / Year

Heat Pump Water Heating Efficiency ÷ 2.00 COP

Heat Pump Water Heating Energy Usage 1,230 kWh / Year

Base SERWH Energy Usage per Year at the Meter 2,732 kWh / Year

Heat Pump Water Heating Energy Usage - 1,230 kWh / Year

Residential Heat Pump Water Heating Savings 1,503 kWh / Year

Heat Pump Power Consumption 4.5 kW

Coincidence Factor x 0.08 cf
0.36 kW On Peak

4.80 Minutes per hour

Base SERWH Element Power Consumption 4.0 kW

Coincidence Factor x 0.143 cf

Base SERWH On Peak Demand 0.57 kW On Peak

8.6 Minutes per hour
KEMA 2008

Base SERWH On Peak Demand - 0.57 kW On Peak

Heat Pump Water Heater Demand - 0.36 kW On Peak
0.21 kW On Peak

KEMA 2008

Residential Solar Water Heater Demand Savings 0.21 kW Savings



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Operating Hours

See Table above.

Loadshape

TBD

Freeridership/Spillover Factors

TBD

Persistence

Lifetime

10 years (DEER)

Measure Costs and Incentive Levels

Description	Unit Incentive	Incremental Cost
Heat Pump Water Heater	\$ 175.00	\$ 4,000.00

Component Costs and Lifetimes Used in Computing O&M Savings

TBD

Reference Tables



8.2 High Efficiency Lighting

8.2.1 Compact Fluorescent Lamp (CFL)

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 24, 2010

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007
- Demand Management Programs – KEMA (KEMA 2005-07)
- Econorthwest TRM Review – 6/23/10
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 6/23/10 Rec. # 8 – Starting with PY2010, adjust the hours used per day for CFLs from 4.98 to 2.3 in order to be consistent with other literature. Conduct additional research to verify the most appropriate hours of operation for the Hawaii customer base, which can be incorporated into future years. – Adopted.
- 6/23/10 Rec. # 9 - Starting with PY 2010, adjust the peak coincidence factor from 0.334 to 0.12 to be consistent with the literature. Conduct additional research to verify the most appropriate coincidence factor for the Hawaii customer base, which can be incorporated into future years.- Adopted.
- 10/5/11 – Currently Under Review.
- 4/17/12 – Updated persistence factor to 0.96 and removed adjustment for mix of CFL sizes found in CA study as per EMV report February 23, 2012. Updated energy and demand savings accordingly.

Major Changes:

- Hours used per day for CFLs from 4.98 to 2.3 hrs.
- Peak coincidence factor from 0.334 to 0.12
- Persistence factor changed from 0.80 to 0.96 as per EMV
- Adjustment for mix of CFL sized found in CA study removed as per EMV

Measure Description:

The replacement of incandescent screw-in lamps to standard spiral compact fluorescent lamps in Residential Single Family and Multi-family homes.

Lamps must comply with:

- Energy Star
- UL

Baseline Efficiencies:

Baseline usage is a 60W A-Shaped incandescent lamp with the energy consumption as follows:

Building Types	Demand Baseline(kW)	Energy Baseline (kWh)
Single Family	0.060	50.4
Multi Family	0.060	50.4



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High Efficiency:

The high efficiency case is a 15W Spiral CFL with the energy consumption as follows:

Building Types	Demand High Efficiency (kW)	Energy High Efficiency (kWh)
Single Family	0.015	12.6
Multi Family	0.015	12.6

Energy Savings:

CFL Gross Savings before operational adjustments:

Building Types	Demand Savings (kW)	Energy Savings (kWh)
Single Family	0.005	36.3
Multi Family	0.005	36.3

CFL Net Savings after operational adjustments:

Operational Factor	Adjustment Factor
Persistence Factor (pf)	0.960
Demand Coincidence Factor (cf)	0.12

Building Types	Demand Savings (kW)	Energy Savings (kWh)
Single Family	0.005	36.3
Multi Family	0.005	36.3



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Savings Algorithms

CFL - Single and Multi Family Residential Home

60W Incandescent Lamp Demand	0.060 kW	
	2.30 Hours per Day	
	x 365 Days	839.5 Hours per Year
60W Incandescent Lamp Energy Usage	50.4 kWh per Year	
15W Compact Fluorescent Lamp Demand	0.015 kW	
	2.30 Hours per Day	
	x 365 Days	839.5 Hours per Year
15W Compact Fluorescent Lamp Energy Usage	12.6 kWh per Year	
60W Incandescent Lamp Energy Usage	50.4 kWh per Year	
15W Compact Fluorescent Lamp Energy Usage	- 12.6 kWh per Year	
CFL Savings Before Adjustments	37.8 kWh per Year	
	37.8 kWh per Year	
Persistence Factor	x 0.960 pf	4.0% Lamps not installed or replaced back
CFL Energy Savings	36.3 kWh per Year	

CFL Energy Savings 36.3 kWh / Year Savings

60W Incandescent Lamp Demand	0.060 kW	
15W Compact Fluorescent Lamp Demand	- 0.015 kW	
CFL Demand Reduction Before Adjustments	0.045 kW	
CFL Demand Reduction Before Adjustments	0.045 kW	
Coincidence Factor	0.120 cf	12.0% Lamps on between 5 and 9 p.m.
Persistence Factor	x 0.960 pf	4.0% Lamps not installed or replaced back
CFL Demand Savings	0.005 kW	

CFL Demand Savings 0.005 kW Savings



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Operating Hours

2.3 hours per day, 839.5 hours per year

Loadshape

TBD

Freeridership/Spillover Factors

TBD

Demand Coincidence Factor

Estimated coincidence factor of 0.12 cf assumes that 12% of the lamps purchased would be operating during the winter 5 p.m. to 9 p.m. weekday peak period.

Persistence

Estimated persistence factor of 0.96 pf which assumes 4% of the lamps purchased not installed or returned back to incandescent.

Lifetime

5 years

Measure Costs and Incentive Levels

Table 1 – Residential CFL Measure Costs and Incentive Levels

Description	Unit Incentive	Incremental Cost
Standard CFL - Res	\$ 1.00	\$ 2.50

Component Costs and Lifetimes Used in Computing O&M Savings

TBD

Reference Tables

None



8.2.2 Light Emitting Diode (LED)

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 24, 2010

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- 11/21/11 – Updated tables and text in the following headings:
 - Measure description
 - Baseline efficiencies
 - High efficiency
 - Energy savings
 - Savings algorithm

Updates made to capture a broader range of lamp types (two wattages per lamp type) and obtain more accurate savings calculations.

- 11/21/11 – Changed the following text under *Energy Savings* heading: 1) “LED Gross Savings before operational adjustments” was changed to “LED Savings before...” and 2) “CFL Net Savings after operational adjustments” was changed to “LED Savings after...”
- 11/21/11 – Under *Energy Savings* heading changed table to only one building type because savings are calculated the same between single and multi-family housing.
- Removed the 1.08 size adjustment factor.

Measure Description:

The replacement of a standard incandescent lamp (40W or 60W) or spiral compact fluorescent lamp (13W or 23W) with a light emitting diode (7W or 12.5 W) in both Residential Single Family and Multi-family homes.

Lamps must comply with:

- Energy Star
- UL

Baseline Efficiencies:

Baseline usage is a combination of standard incandescent lamp (40W or 60W) or spiral compact fluorescent lamp (15W or 23W) A-Shaped incandescent lamp with the energy consumption as follows:



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Baseline Efficiency					
Lamp Types	Demand Baseline (kW)	Hours per Day	Energy Baseline (kWh/year)	%	Totals
Incandescent	0.060	2.3	50.4	25%	12.59
CFL	0.015	2.3	12.6	25%	3.15
Incandescent	0.040	2.3	33.6	25%	8.40
CFL	0.023	2.3	19.3	25%	4.83
Demand Ave	0.035	Total Baseline Energy (kWh)			28.96

High Efficiency:

The high efficiency case is a 7W or 12.5W LED with the energy consumption as follows:

High Efficiency					
Lamp Types	Demand Baseline (kW)	Hours per Day	Energy Baseline (kWh/year)	%	Totals
LED	0.007	2.3	5.9	50%	2.94
LED	0.0125	2.3	10.5	50%	5.25
Demand Ave	0.010	Total High Efficiency Energy (kWh)			8.19

Energy Savings:

LED Savings before operational adjustments:

Total Baseline Energy (kWh)	29.0
Total High Efficiency Energy (kWh)	8.2
Annual Energy Savings (kWh)	20.8

LED Savings after operational adjustments:

Persistence Factor (pf) 0.80
Demand Coincidence Factor (cf) 0.12

Demand Savings (kW)	Energy Savings (kWh)
0.003	16.6



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Savings Algorithms

LED - Single and Multi Family Residential Home

Lamp Average Demand	0.035 kW	
	2.30 Hours per Day	
	x 365 Days	839.50 Hours per Year
Baseline Energy Usage	28.96 kWh per Year	
Enhanced LED Lamp Average Demand	0.010 kW	
	2.30 Hours per Day	
	x 365 Days	839.50 Hours per Year
Enhanced LED Lamp Energy Usage	8.19 kWh per Year	
Baseline Energy Usage	29.0 kWh per Year	
Enhanced LED Lamp Energy Usage	- 8.2 kWh per Year	
LED Savings Before Adjustments	20.78 kWh per Year	
	20.8 kWh per Year	
Persistence Factor	x 0.800 pf	20.0% Lamps not installed or replaced back
	16.6 kWh per Year	

LED Energy Savings 16.6 kWh / Year Savings

Baseline Lamp Demand	0.035 kW	
Enhanced LED Lamp Demand	- 0.007 kW	
LED Demand Reduction Before Adjustments	0.028 kW	
LED Demand Reduction Before Adjustments	0.028 kW	
Coincidence Factor	0.120 cf	12.0% Lamps on between 5 and 9 p.m.
Persistence Factor	x 0.800 pf	20.0% Lamps not installed or replaced back
	0.003 kW	

LED Demand Savings 0.003 kW Savings



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Operating Hours

2.3 hours per day, 839.5 hours per year

Loadshape

TBD

Freeridership/Spillover Factors

TBD

Demand Coincidence Factor

Estimated coincidence factor of 0.12 cf assumes that 12% of the lamps purchased would be operating during the winter 5 p.m. to 9 p.m. weekday peak period.

Persistence

Estimated persistence factor of 0.80 pf which assumes 20% of the lamps purchased not installed or returned back to incandescent.

Lifetime

5 years

Measure Costs and Incentive Levels

Table 1 – Residential LED Measure Costs and Incentive Levels

Description	Unit Incentive	Incremental Cost
LED - Res	\$ 10.00	\$ 35.00

Component Costs and Lifetimes Used in Computing O&M Savings

TBD

Reference Tables

None



8.2.3 Residential Daylighting

Measure ID:

Version Date & Revision History

Draft date:

Effective date: March 1, 2011

End date: June 30, 2012

Referenced Documents:

- <http://www.solatube.co.uk/Residential/solatube-product-info/unrivalled-performance/index.php>

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- New program measure

Measure Description:

A tubular daylighting device (TDD) is a non-operable device primarily designed to transmit daylight from a roof surface of a residential building to an interior ceiling surface via a tubular conduit. The device consists of an exterior glazed weathering surface, a light transmitting tube with a reflective inside surface and an interior sealing device, such as a translucent ceiling panel.

Baseline Efficiencies:

The baseline efficiency case is utilizing both incandescent and CFLs as a 50% mix for each. Two (2) incandescent lamps rated at 75 watts and two (2) CFLs rated at 18 watts each are utilized on average for the basecase.

Baseline Efficiency						
Lamp Types	Quantity	Demand Baseline (kW)	Total Demand Baseline (kW)	Hours per Day	Totals (kWh/year)	Lumens
Incandescent	2	0.075	0.150	2.3	125.93	2400
CFL	2	0.018	0.036	2.3	30.22	2350
Demand Ave			0.186		156.15	4750

High Efficiency:

High efficiency case is the installation of a tubular daylighting device (TDD)

Energy Savings:

Annual energy savings = 156.15 kWh/year

Demand savings = 0 kW (5PM-9PM)



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Savings Algorithms

Daylighting

Lamp Average Demand 0.186 kW
 2.3 Hours per Day
 x 365 Days 840 Hours per Year
 Baseline Energy Usage 156.15 kWh per Year

Incandescent	Compact Fluorescent Lamps
125.93 kWh/Year	30.22 kWh/Year
840 hours/year	840 hours/year
0.15 kW	0.036 kW
150 Watts	36 Watts
75 Watt Incandescent	18 Watt CFL
2.0 Lamps turned off	2.0 Lamps turned off
2,400 Lumens	2,350 Lumens

Lamp	Watts	Lumens	Type
A19	40	480	Incandescent
A19	60	880	Incandescent
A19	75	1200	Incandescent
A19	100	1750	Incandescent
A19	7	400	CFL
A19	13	800	CFL
A19	18	1175	CFL
A19	27	1675	CFL

Operating Hours

2.3 hours per day

Demand Coincidence Factor

Coincidence Factor = 0

No demand savings between 5PM – 9PM

Persistence

Persistence = 1

Lifetime

10 years

Measure Costs and Incentive Levels

Incentive = \$75/unit

Installed Cost = \$700



8.3 High Efficiency Air Conditioning

8.3.1 Ductless Split AC

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 24, 2010

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- HECO DSM Docket – Backup Worksheets - Global Energy (07-14-06)
- Econorthwest TRM Review – 6/23/10
- Energy Star Calculator
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- No changes recommended

Measure Description:

The selection of a new 12.0 EEER Ductless Split Air Conditioner versus or replacing a standard 9.8 EER Room Air Conditioner in Residential Single Family and Multi-family homes.

Appliances must comply with:

- Energy Star

Energy Star Air Conditioners – use at least 10% less energy than conventional models and often include timers for better temperature control, allowing you to use the minimum amount of energy you need to cool your room.

Baseline Efficiencies:

Base efficiency is a window a/c unit or central AC with 9.8 EER.

	Demand Baseline (kW)	Energy Baseline (kWh)	Notes
Non ES Qualifying Room AC	1.224	6,142	9.8 EER, 12,000 BTUh



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High Efficiency:

The high efficiency case Energy Star energy usage based on 2009 Energy Star Information for Ductless Split AC is as follows:

Energy Star Criteria is 12 EER

	Demand High Efficiency (kW)	Energy High Efficiency (kWh)	Notes
ES Qualifying Room AC	1.0	5,016	12.0 EER, 12,000 BTUh

Energy Savings:

Energy Star Ductless Split AC Gross Savings before operational adjustments:

	Demand Savings (kW)	Energy Savings (kWh)	Notes
ES Qualifying Room AC	0.224	1,126	9.8 to 12.0 EER, 12,000 BTUh

Energy Star Appliance Net Savings after operational adjustments:

Single Family versus Multi Family Factored Energy Savings	Adjustment Factor*	Energy Savings (kWh)
Single Family Home AC Energy Savings	46%	518
Multi Family Home AC Energy Savings	25%	276

Contribution Factored Measure Savings	Contribution	Net Energy Savings (kWh)
Single Family Contribution Energy Savings	40%	207
Multi Family Contribution Energy Savings	60%	166
Energy Star Room AC Measure Energy Savings	100%	373



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	Operational Factor	Adjustment Factor	Gross Unit Demand Savings (kW)	Adjusted for Home Unit Demand Savings (kW)
Single Family	Demand Coincidence Factor (cf)	1.00	0.224	0.224
Multi Family	Demand Coincidence Factor (cf)	0.74	0.224	0.167
Single & Multi Family	Persistence Factor (pf)	1.00		

Contribution Factored Demand Savings	Per Home Factored Demand Savings (kW)	Contribution	Measure Demand Savings (kW)
Single Family Contribution Demand Savings	0.224	40%	0.09
Multi Family Contribution Demand Savings	0.167	60%	0.10
Energy Star Ductless Split AC Measure Energy Savings		100%	0.19



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Savings Algorithms

Ductless Split - Single and Multi Family Residential Home

Base Case		
Conventional Room AC Built After 1994		
Average Unit Cooling Capacity	12,000 BTU / Hr	(Equals 1 Ton Cooling Capacity)
Energy Efficiency Ratio	9.8 EER	DOE Federal Test Procedure 10CFR 430, Appendix F
Full Load Demand	1,224.5 Watts	
Conversion	1,000.0 Watts / kW	
Full Load Demand	1.2 kW	
Conventional Room AC Full Load Demand	1.2 kW	
Honolulu Full Load Equivalent Cooling Hours	x 5,016.0 Hours per Year	EPA 2002
Conventional Room AC Annual Energy Consumption	6,142.0 kWh per Year	
Energy Star Qualified Ductless Split AC		
Average Unit Cooling Capacity	12,000 BTU / Hr	(Equals 1 Ton Cooling Capacity)
Energy Efficiency Ratio	12.0 EER	HECO DSM Docket 2006 - Global Energy Partners
Full Load Demand	1,000.0 Watts	(Energy Star Criteria = 10.8 EER)
Conversion	1,000.0 Watts / kW	
Full Load Demand	1.0 kW	
Energy Star Ductless Split AC Full Load Demand	1.0 kW	
Honolulu Full Load Equivalent Cooling Hours	x 5,016.0 Hours per Year	EPA 2002
Energy Star Ductless Split Annual Energy Consumption	5,016.0 kWh per Year	
Conventional Room AC Annual Energy Consumption	6,142.0 kWh per Year	
Energy Star Ductless Split Annual Energy Consumption	- 5,016.0 kWh per Year	
Energy Star Ductless Split Annual Energy Savings	1,126.0 kWh per Year	Energy Star Consumer Room AC Calculator Cadmus 4/2009
Energy Star Ductless Split Annual Energy Savings	1,126 kWh per Year	
Single Family Use Factor	x 0.46	2,307 Single Family Full Load Operating Hours (inferred)
Single Family ES Ductless Split AC Annual Energy Savings	518 kWh per Year	
Energy Star Ductless Split Annual Energy Savings	1,126 kWh per Year	
Multi Family Use Factor	x 0.25	1,229 Multi Family Full Load Operating Hours (inferred)
Multi Family ES Ductless Split AC Annual Energy Savings	276 kWh per Year	
Single Family Use Weighting	40%	HECO DSM Docket 2006 - Global Energy Partners
Multi Family Use Weighting	60%	HECO DSM Docket 2006 - Global Energy Partners
Single Family ES Ductless Split AC Annual Energy Savings	518 kWh per Year	
Single Family Use Weighting	x 40%	
Single Family Savings Contribution to Measure	207 kWh per Year	
Multi Family ES Ductless Split AC Annual Energy Savings	276 kWh per Year	
Multi Family Use Weighting	x 60%	
Multi Family Savings Contribution to Measure	166 kWh per Year	
Single Family Savings Contribution to Measure	207 kWh per Year	
Multi Family Savings Contribution to Measure	+ 166 kWh per Year	
	373 kWh per Year	
Persistence Factor	x 1 pf	100.0%
	373 kWh per Year	

Ductless Split AC Energy Savings 373 kWh / Year Savings

Conventional Room AC Full Load Demand	1.224 kW	0.225
Energy Star Ductless Split AC Full Load Demand	- 1.000 kW	0.167
Ductless Split AC Demand Reduction Before Adjustments	0.224 kW	
Single Family		
Ductless Split AC Demand Reduction Before Adjustments	0.224 kW	
On Peak Demand Coincidence Factor	x 1.00 cf	100.0% Single Family ACs on between 5 and 9 p.m.
Single Family Demand Savings	0.224 kW	
Single Family Use Weighting	x 40%	
Single Family Savings Contribution to Measure	0.090 kW	
Multi Family		
Ductless Split AC Demand Reduction Before Adjustments	0.224 kW	
On Peak Demand Coincidence Factor	x 0.74 cf	74.4% Multi Family ACs on between 5 and 9 p.m.
Multi Family Demand Savings	0.167 kW	
Multi Family Use Weighting	+ 60%	
Multi Family Savings Contribution to Measure	0.100 kW	
Single Family Savings Contribution to Measure	0.09 kW	
Multi Family Savings Contribution to Measure	x 0.10 kW	
Ductless Split AC Measure Demand Savings	0.19 kW	
Ductless Split AC Measure Demand Savings	0.190 kW	
Persistence Factor	x 1.0 pf	100.0% ACs installed and operational at EER Efficiency
	0.19 kW	

Single & Multi Family Ductless Split AC Demand Savings 0.19 kW Savings



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Operating Hours

Room AC = 5,016 hours per year EPA 2002
Single Family Room AC = 2,307 hours per year.
Multi Family Room AC = 1,229 hours per year

Loadshape

TBD

Freeridership/Spillover Factors

TBD

Demand Coincidence Factor

NA

Persistence

NA

Lifetime

12 years

Measure Costs and Incentive Levels

Table 1 – Residential CFL Measure Costs and Incentive Levels

Description	Unit Incentive	Incremental Cost
ES Ductless Split AC	\$110	\$ 1000 per ton

Component Costs and Lifetimes Used in Computing O&M Savings

TBD

Reference Tables

None



8.3.2 VRF Split System AC

Measure ID: See Table 7.3 (TBD)

Measure Code: Inverter VRF AC

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Description: Inverter driven variable refrigerant flow (VRF) air conditioning systems are direct expansion AC systems that utilize variable speed evaporator/condenser fans, and a combination of fixed and variable speed compressors along with most often multiple individual zone evaporators to provide the ability to more closely match the AC system's output with the building's cooling requirements.

Savings comes from:

- *Part Load Efficiencies:* Increased part-load efficiency operation
- *High Efficiency Motors:* Many systems use ECM motors
- *Higher Room Temperatures:* The capacity matching allows for better humidity control through longer cooling operation.
- *Reduction of Distribution Losses:* Duct losses are reduced with DX systems. This may be offset by dedicated outside air distribution systems when needed.

Payback Qualifications: VRF products need a payback requirement of 1 year or greater. The TRB/TRC must be greater than 1.

Energy and Demand Savings: VRF systems have demonstrated a 20-30% reduction in energy consumption as compared to standard DX equipment. The energy savings and demand tables that follow provide the savings by building type and system size for VRF systems.

The VRF applications have been new construction projects with no ability to perform pre and post measurements. Hawaii Energy will perform field pre and post field measurements to determine the measure effectiveness in the local environment



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Savings Algorithms

VRF Split System AC - Single and Multi Family Residential Home

Base Case

Conventional Room AC Built After 1994

Average Unit Cooling Capacity	12,000 BTU / Hr	(Equals 1 Ton Cooling Capacity)
Energy Efficiency Ratio	9.8 EER	DOE Federal Test Procedure 10CFR 430, Appendix F
Full Load Demand	1,224.5 Watts	
Conversion	1,000.0 Watts / kW	
Full Load Demand	1.2 kW	

Conventional Room AC Full Load Demand	1.2 kW	
Honolulu Full Load Equivalent Cooling Hours	x 5,016.0 Hours per Year	EPA 2002
Conventional Room AC Annual Energy Consumption	6,142.0 kWh per Year	

VRF Split System AC

Average Unit Cooling Capacity	12,000 BTU / Hr	(Equals 1 Ton Cooling Capacity)
Energy Efficiency Ratio	13.0 EER	Minimum Requirement (AHRI 1230)
Full Load Demand	923.1 Watts	(Energy Star Criteria = 10.8 EER)
Conversion	1,000.0 Watts / kW	
Full Load Demand	0.9 kW	

VRF Split AC Full Load Demand	0.923 kW	
Honolulu Full Load Equivalent Cooling Hours	x 5,016.0 Hours per Year	EPA 2002
VRF Split Annual Energy Consumption	4,630.2 kWh per Year	

Conventional Room AC Annual Energy Consumption	6,142.0 kWh per Year	
VRF Split Annual Energy Consumption	4,630.2 kWh per Year	
VRF Split Annual Energy Savings	1,511.9 kWh per Year	

VRF Split Annual Energy Savings	1,512 kWh per Year	
Single Family Use Factor	x 0.46	2,307 Single Family Full Load Operating Hours (inferred)
Single Family VRF Split AC Annual Energy Savings	695 kWh per Year	

VRF Split Annual Energy Savings	1,512 kWh per Year	
Multi Family Use Factor	x 0.25	1,135 Multi Family Full Load Operating Hours (inferred)
Multi Family VRF Split AC Annual Energy Savings	371 kWh per Year	

Single Family Use Weighting	40%	HECO DSM Docket 2006 - Global Energy Partners
Multi Family Use Weighting	60%	HECO DSM Docket 2006 - Global Energy Partners

Single Family VRF Split AC Annual Energy Savings	695 kWh per Year	
Single Family Use Weighting	x 40%	
Single Family Savings Contribution to Measure	278 kWh per Year	

Multi Family VRF Split AC Annual Energy Savings	370.5734266 kWh per Year	
Multi Family Use Weighting	x 60%	
Multi Family Savings Contribution to Measure	222 kWh per Year	

Single Family Savings Contribution to Measure	- 278 kWh per Year	
Multi Family Savings Contribution to Measure	+ 222 kWh per Year	
	501 kWh per Year	

	501	
Persistence Factor	x 1 pf	100.0%
	501 kWh per Year	

VRF Split AC Energy Savings 501 kWh / Year Savings

Conventional Room AC Full Load Demand	1.224 kW	0.225
VRF Split AC Full Load Demand	- 0.923 kW	0.167
VRF AC Demand Reduction Before Adjustments	0.301 kW	

Single Family		
VRF Split AC Demand Reduction Before Adjustments	0.301 kW	
On Peak Demand Coincidence Factor	x 1.00 cf	100.0% Single Family ACs on between 5 and 9 p.m.
Single Family Demand Savings	0.301 kW	
Single Family Use Weighting x	40%	
Single Family Savings Contribution to Measure	0.121 kW	

Multi Family		
VRF Split AC Demand Reduction Before Adjustments	0.301 kW	
On Peak Demand Coincidence Factor	x 0.74 cf	74.4% Multi Family ACs on between 5 and 9 p.m.
Multi Family Demand Savings	0.224 kW	
Multi Family Use Weighting +	60%	
Multi Family Savings Contribution to Measure	0.135 kW	

Single Family Savings Contribution to Measure	0.12 kW	
Multi Family Savings Contribution to Measure	x 0.13 kW	
VRF Split AC Measure Demand Savings	0.26 kW	

VRF Split AC Measure Demand Savings	- 0.255 kW	
Persistence Factor	x 1.0 pf	100.0% ACs installed and operational at EER Efficiency
	0.26 kW	

Single & Multi Family VRF Split AC Demand Savings 0.26 kW Savings



8.3.3 Ceiling Fans

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- ENERGY STAR Ceiling Fan Savings Calculator

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

This measure describes the installation of an ENERGY STAR ceiling fan that uses a high efficiency motor and contains compact fluorescent bulbs in place of a standard fan with integral incandescent bulbs.

Baseline Efficiencies:

The baseline equipment is assumed to be a standard fan with integral incandescent bulbs.

High Efficiency:

The efficient equipment must be an ENERGY STAR certified ceiling fan with integral CFL bulbs.

Energy Savings:

	Average Annual kWh savings per unit	Average Coincident Peak kW savings per unit
2010 - 2013	167	0.019
2014 on	97	0.012

$$\Delta \text{kWh} = ((\%_{\text{low}} * (\text{LowKW}_{\text{base}} - \text{LowKW}_{\text{ee}}) + \%_{\text{med}} * (\text{MedKW}_{\text{base}} - \text{MedKW}_{\text{ee}}) + \%_{\text{high}} * (\text{HighKW}_{\text{base}} - \text{HighKW}_{\text{ee}})) * \text{HOURS}_{\text{fan}}) + ((\text{IncKW} - \text{CFLKW}) * \text{HOURS}_{\text{light}} * \text{WHFe})$$

Where:

$\%_{\text{low}}$	= Percent of time on Low Speed	= 40%
$\%_{\text{med}}$	= Percent of time on Medium Speed	= 40%
$\%_{\text{high}}$	= Percent of time on High Speed	= 20%
$\text{LowWatt}_{\text{base}}$	= Low speed baseline ceiling fan wattage	= 0.0152 kW
$\text{LowWatt}_{\text{ee}}$	= Low speed ENERGY STAR ceiling fan wattage	= 0.0117 kW
$\text{MedWatt}_{\text{base}}$	= Medium speed baseline ceiling fan wattage	= 0.0348 kW
$\text{MedWatt}_{\text{ee}}$	= Medium speed ENERGY STAR ceiling fan wattage	= 0.0314 kW
$\text{HighWatt}_{\text{base}}$	= High speed baseline ceiling fan wattage	= 0.0725 kW
$\text{HighWatt}_{\text{ee}}$	= High speed ENERGY STAR ceiling fan wattage	= 0.0715 kW
$\text{HOURS}_{\text{fan}}$	= Typical fan operating hours (2.8/day, 365 days per year)	= 1022 hours
IncWatt	= Incandescent bulb kW (assumes 3 * 60W bulb)	= 0.180kW
CFLWatt	= CFL bulb kW (assumes 3 * 20W bulb)	= 0.060kW
$\text{HOURS}_{\text{light}}$	= Typical lighting operating hours (3.5/day, 365 days per year)	= 1277.5 hours
WHFe	= Waste Heat Factor for Energy to account for cooling savings from Efficient lighting.	= 1.07



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$$\begin{aligned}\Delta \text{kWh} &= ((0.4 * (0.0152 - 0.0117) + 0.4 * (0.0348 - 0.0314) + 0.2 * (0.0725 - 0.0715)) \\ &\quad * 1022) + ((0.18 - 0.06) * 1277.5 * 1.07) \\ &= \mathbf{167 \text{ kWh}}\end{aligned}$$

Baseline Adjustment

Federal legislation stemming from the Energy Independence and Security Act of 2007 will require all general-purpose light bulbs between 40 and 100W to be approximately 30% more energy efficient than current incandescent bulbs, in essence beginning the phase out of standard incandescent bulbs. In 2012 100W incandescents will no longer be manufactured, followed by restrictions on 75W in 2013 and 60W in 2014. The baseline for this measure will therefore become bulbs (improved incandescent or halogen) that meet the new standard. To account for these new standards, first year annual savings for this measure must be reduced beginning in 2014. This measure assumes 60W baseline bulbs, which in 2014 will become 43W and so the annual savings beginning in 2014 should therefore be:

$$\begin{aligned}\Delta \text{kWh} &= ((0.4 * (0.0152 - 0.0117) + 0.4 * (0.0348 - 0.0314) + 0.2 * (0.0725 - 0.0715)) \\ &\quad * 1022) + ((0.129 - 0.06) * 1277.5 * 1.07) \\ &= \mathbf{97 \text{ kWh}}\end{aligned}$$

In addition, since during the lifetime of a CFL, the baseline incandescent bulb will be replaced multiple times, the annual savings claim must be reduced within the life of the measure. Therefore, for bulbs installed in 2010, the full savings (167kWh) should be claimed for the first four years, but the reduced annual savings (97kWh) claimed for the remainder of the measure life. The savings adjustment is therefore equal to $97/167 = 58\%$.

Coincident Peak Demand Savings

$$\Delta \text{kW} = (\% \text{low} * (\text{LowKWbase} - \text{LowKWwee}) + \% \text{med} * (\text{MedKWbase} - \text{MedKWwee}) + \% \text{high} * (\text{HighKWbase} - \text{HighKWwee})) + ((\text{InckW} - \text{CFLKW}) * \text{WHFd}) * \text{CF}$$

Where:

$$\begin{aligned}\text{WHFd} &= \text{Waste Heat Factor for Demand to account for cooling savings from efficient lighting} \\ &= 1.21\end{aligned}$$

$$\begin{aligned}\text{CF} &= \text{Peak Coincidence Factor for measure} \\ &= 0.11\end{aligned}$$

$$\begin{aligned}\Delta \text{kW} &= ((0.4 * (0.0152 - 0.0117) + 0.4 * (0.0348 - 0.0314) + 0.2 * (0.0725 - 0.0715)) \\ &\quad + ((0.18 - 0.06) * 1.21) * 0.11\end{aligned}$$

$$\Delta \text{kW} = \mathbf{0.019 \text{ kW}}$$

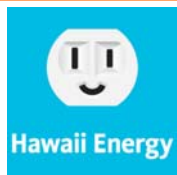
After 2014, this will be reduced to:

$$\begin{aligned}\Delta \text{kW} &= ((0.4 * (0.0152 - 0.0117) + 0.4 * (0.0348 - 0.0314) + 0.2 * (0.0725 - 0.0715)) \\ &\quad + ((0.129 - 0.06) * 1.21) * 0.11\end{aligned}$$

$$\Delta \text{kW} = \mathbf{0.012 \text{ kW}}$$

Operating Hours

See Table above.



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Loadshape

TBD

Freeridership/Spillover Factors

TBD

Lifetime

5 years (DEER)

Measure Costs and Incentive Levels

Description	Unit Incentive	Incremental Cost
Ceiling Fan	\$ 40.00	\$ 86.00

Component Costs and Lifetimes Used in Computing O&M Savings

TBD



8.3.4 Solar Attic Fans

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description: Solar attic fan is assumed to reduce 10% of existing air conditioning load energy usage and no demand reduction from 5PM – 9PM.

Baseline Efficiencies:

The baseline case is no solar attic fan.

Base Case	Demand Baseline (kW)	Energy Baseline (kWh/year)
No Solar Attic Fan	1.00	5,016

High Efficiency:

High Efficiency Case	Efficient Case (kW)	Efficient Case (kWh/year)
Solar Attic Fan	1.00	4,514

Energy Savings:

Savings Type	Gross Customer Savings (kW)	Gross Customer Savings (kWh/year)
Gross Savings	0.00	502

Operational Factor	Adjustment Factor
Persistence Factor (pf)	0.00
Demand Coincidence Factor (cf)	0.00

Savings Type	Net Customer Savings (kW)	Net Customer Savings (kWh/year)
Net Savings	0.000	502



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Savings Algorithms

Solar Attic Fan - Single Family Residential Home

Energy Star Room AC Full Load Demand	1.0	kW
Honolulu Full Load Equivalent Cooling Hours	x	5,016
Energy Star Room AC Annual Energy Consumption		5,016 kWh per Year
Energy Reduction Percentage with Solar Attic Fan	10.0%	
Energy Usage with Solar Attic Fan		4,514 kWh / Year Savings
Energy Star Room AC Annual Energy Consumption	5,016	kWh / Year Savings
Energy Usage with Solar Attic Fan	-	4,514
Solar Attic Fan Annual Energy Savings		502 kWh / Year Savings
Solar Attic Fan Annual Energy Savings	502	kWh / Year Savings
Persistence Factor	x	1.0
Net Customer Level Savings		502 kWh / Year Savings

Solar Attic Fan Energy Savings 502 kWh / Year Savings

Energy Star Room AC Full Load Demand	1.00	kW
Peak Demand Reduction	0%	
AC Demand with Solar Attic Fan	1.00	kW
Energy Star Room AC Full Load Demand	1.00	kW
AC Demand with Solar Attic Fan	-	1.00
Gross Customer Demand Savings		- kW

Solar Attic Fan Demand Savings 0.000 kW Savings

Operating Hours

See Table above.

Loadshape

TBD

Freeridership/Spillover Factors

TBD

Persistence

1.0

Lifetime

5 years

Measure Costs and Incentive Levels

Description	Incentive	Incremental Cost
Solar Attic Fan	\$ 25.00	\$ 500.00



8.3.5 Whole House Fans

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- KEMA for the State of California Low-Income Energy Efficiency Program; calmac.org/publications/2001_LIEE_Impact_Evaluation.pdf
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 4/9/12 – Energy reduction percentage changed from .25 to .2 as per the EM&V report dated 23 Feb 2012. Added reference document from EM&V report.
- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

Baseline Efficiencies:

Base Case	Demand Baseline (kW)	Energy Baseline (kWh/year)
No Whole House Fan	1.00	5,016

High Efficiency:

High Efficiency Case	Efficient Case (kW)	Efficient Case (kWh/year)
Whole House Fan	0.15	3,762



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Energy Savings:

Savings Type	Gross Customer Savings (kW)	Gross Customer Savings (kWh/year)
Gross Savings	0.85	1,254

Operational Factor	Adjustment Factor
Persistence Factor (pf)	1.00
Demand Coincidence Factor (cf)	0.59

Savings Type	Net Customer Savings (kW)	Net Customer Savings (kWh/year)
Net Savings	0.50	1,254

Savings Algorithms

Whole House Fan - Single Family Residential Home

Energy Star Room AC Full Load Demand	1.0 kW
Honolulu Full Load Equivalent Cooling Hours	x 5,016 Hours per Year
Energy Star Room AC Annual Energy Consumption	5,016 kWh per Year
Energy Reduction Percentage with Whole House Fan	20.0%
Energy Usage with Whole House Fan	4,013 kWh / Year Savings
Energy Star Room AC Annual Energy Consumption	5,016 kWh / Year Savings
Energy Usage with Whole House Fan	- 4,013 kWh / Year Savings
Solar Attic Fan Annual Energy Savings	1,003 kWh / Year Savings
Solar Attic Fan Annual Energy Savings	1,003 kWh / Year Savings
Persistence Factor	x 1.0
Net Customer Level Savings	1,003 kWh / Year Savings

Whole House Fan Energy Savings 1,003 kWh / Year Savings

Energy Star Room AC Full Load Demand	1.00 kW
Whole House Fan Demand	- 0.15 kW
Gross Customer Demand Reduction	0.85 kW
Gross Customer Demand Reduction	0.850 kW
Gross Customer Demand Reduction	0.850 kW
Persistence Factor	1.000
Coincidence Factor	x 0.590

Net Whole House Fan Demand Savings 0.50 kW Savings

Operating Hours

See Table above.

Loadshape

TBD

Freeridership/Spillover Factors

TBD



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Persistence/Coincidence Factor

Operational Factor	Adjustment Factor
Persistence Factor (pf)	1.00
Demand Coincidence Factor (cf)	0.59

Lifetime

5 years

Measure Costs and Incentive Levels

Description	Incentive	Incremental Cost
Whole House Fans	\$ 75.00	\$ 1,000.00



8.4 High Efficiency Appliances

8.4.1 Energy Star Clothes Washer & Refrigerator

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 24, 2010

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- HECO DSM Docket – Backup Worksheets - Global Energy (07-14-06)
- Econorthwest TRM Review – 6/23/10
- Department of Energy Refrigerator Profile – Updated December 2009

TRM Review Actions:

- 6/23/10 Rec. # 11 – Revise savings to be consistent with ENERGY STAR estimates. – Adopted with modifications on refrigerator figures based on DOE Refrigerator profile and the addition of bounty, recycle with new figures.
- 6/23/10 Rec. # 12 – Split the claimed savings by appliance. – Adopted.
- 6/23/10 Rec. # 13 – Incorporate solar hot water heating into appliance savings values – Adopted.
- 6/23/10 Rec. # 14 – Revise demand savings values for ENERGY STAR appliances – Adopted.
- 10/4/11 – Removed dishwashers from appliance list.
- 4/9/12 – Baseline efficiency for non-ES Refrigerator changed from 537 to 540. Number changed to match ES data.
- 10/5/11 – Currently Under Review.

Major Changes:

- Split between ESH appliances
- Incorporation of three refrigerator categories (new, new with turn in, and bounty (turn in only))
- All ESH 313 kWh and 0.12 kW changed to:

○ New ES Refrigerator Only –	105 kWh, .017 kW
○ New ES Refrigerator with Turn-In –	822 kWh, .034 kW
○ Bounty (Turn in only) –	859 kWh, .034 kW
○ Washing Machine –	206 kWh, .028 kW

Measure Description:

The replacement of standard Clothes Washers and Refrigerators in Residential Single Family and Multi-family homes.

Appliances must comply with:

- Energy Star

Refrigerators – ENERGY STAR refrigerators utilize improvements in insulation and compressors.

Clothes Washers – Clothes washers that meet ENERGY STAR criteria use next generation technology to cut energy and water consumption by over 40% compared to conventional washers. Clothes washers come in either front-load or redesigned top-load designs. Both configurations include technical innovations that help save substantial amounts of energy and water.

- **No Central Agitator** Front-loaders tumble clothes through a small amount of water instead of rubbing clothes against an agitator in a full tub. Advanced top loaders use sophisticated wash systems to flip or spin clothes through a reduced stream of water. Both designs dramatically reduce the amount of hot water used in the wash cycle, and the energy used to heat it.



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- **High Spin Speeds** Efficient motors spin clothes two to three times faster during the spin cycle to extract more water. Less moisture in the clothes means less time and energy in the dryer.

Baseline Efficiencies:

Baseline energy usage based on 2009 Energy Star Information for the appliances are as follows:

	Demand Baseline (kW)	Energy Baseline (kWh)	Notes
Non ES Qualifying Refrigerator		540	19.0-21.4 Top Freezer
Non ES Qualifying Clothes Washer		787	392 Loads per Year

High Efficiency:

The high efficiency case Energy Star energy usage based on 2009 Energy Star Calculator Information and DOE Refrigerator Market Profile for the appliances is as follows:

	Demand High Efficiency (kW)	Energy High Efficiency (kWh)	Notes
ES Qualifying Refrigerator		435	19.0-21.4 Top Freezer
ES Qualifying Clothes Washer		563	392 Loads per Year



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Energy Savings:

Energy Star Appliance Gross Savings before operational adjustments:

	Demand Savings (kW)	Energy Savings (kWh)
ES Refrigerator	0.017	105
ES Refrigerator with Turn-In	0.034	822
Bounty (Turn in only)	0.034	859
ES Washing Machine	0.028	206

Energy Star Appliance Net Savings operational adjustments:

Operational Factor	Adjustment Factor
Persistence Factor (pf)	1.0
Demand Coincidence Factor (cf)	1.0

Savings Algorithms

Energy Star Dishwasher & Clothes Washers - Single and Multi Family Residential Home

Based on DOE/EPA Energy Star Calculator and Econorthwest adjustment factor

	Standard Efficiency (kWh)	Energy Star Qualified (kWh)	Energy Savings (kWh)	Solar Water Heater Penetration Adjustment Factor	Claimed Energy Savings	Notes
ES Qualifying Clothes Washer	787	563	224	92%	206	392 Loads per Year



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Energy Star Refrigerator and Turn In Refrigerator - Single and Multi Family Residential Home

Opportunity	Energy Usage		
New Non-ENERGY STAR	540	Table 2	
New ENERGY STAR Refrigerator	- 435	Table 2	
	105 kWh/Year	Table 1	
#1 - Purchase of ENERGY STAR Refrigerator	105	Table 1	
#2 - Removal of Old Unit from Service (off the grid)	+ 717	Table 1	
#1 + #2 = Purchase ES and Recycle old unit	822 kWh/Year		

	Energy Usage	Ratio	Contribution	
Post-1993 Refrigerator	640	55%	354.54	Table 3
Pre-1993 Refrigerator	1,131	45%	504.46	Table 3
			859 kWh/Year	

Table 1

Energy Savings Opportunities for Program Sponsors

Opportunity	Annual Savings			
	Per Unit		Aggregate U.S. Potential	
	kWh	\$	MWh	\$ million
1. Increase the number of buyers that purchase ENERGY STAR qualified refrigerators. <ul style="list-style-type: none"> 9.3 million units were sold in 2008. 70 percent were not ENERGY STAR. 6.5 million potential units per year could be upgraded. 	105	11.64	675,928	75
2. Decrease the number of units kept on the grid when new units are purchased. <ul style="list-style-type: none"> 8.7 million primary units were replaced in 2008. 44 percent remained in use, whether they were converted to second units, sold, or given away. 3.8 million units are candidates for retirement every year. 	717	79.53	2,746,062	305
3. Decrease the number of second units. <ul style="list-style-type: none"> 26 percent of households had a second refrigerator in 2008. 29.6 million units are candidates for retirement. 	859	95.28	25,442,156	2,822
4. Replace pre-1993 units with new ENERGY STAR qualified models. <ul style="list-style-type: none"> 19 percent of all units in use in 2008 were manufactured before 1993. 27.3 million total potential units are candidates for targeted replacement. 	730	81	19,946,440	2,212

Sources: See endnote 10.



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Table 2

Energy and Cost Comparison for Upgrading to ENERGY STAR

Purchase Decision	New Non-ENERGY STAR Qualified Refrigerator	New ENERGY STAR Qualified Refrigerator
Annual Consumption	540 kWh	435 kWh
	\$60	\$48
Annual Savings	–	105 kWh
	–	\$12
Average Lifetime	12 years	12 years
Lifetime Savings	–	1,260 kWh
	–	\$140
Price Premium	–	\$30 - \$100
Simple Payback Period	–	3-9 years

Note: Calculations based on shipment-weighted average annual energy consumption of 2008 models. An ENERGY STAR qualified model uses 20 percent less energy than a new non-qualified refrigerator of the same size and configuration.

Source: See endnote 10.

Table 3

Energy and Cost Comparison for Removing a Second Refrigerator from the Grid

Fate of Unit	Post-1993 Unit		Pre-1993 Unit	
	Remains on the Grid	Removed from the Grid	Remains on the Grid	Removed from the Grid
Annual Consumption	640 kWh	–	1,131 kWh	–
	\$71	–	\$125	–
Annual Savings	–	640 kWh	–	1,131 kWh
	–	\$71	–	\$125
Average Lifetime*	6	–	6	–
Lifetime Savings*	–	3,840 kWh	–	6,788 kWh
	–	\$426	–	\$753
Removal Cost	–	\$50 - \$100	–	\$50 - \$100
Simple Payback Period	–	1-2 years	–	<1 year

*Assumes unit has six years of functionality remaining.

Sources: See endnote 10.



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Operating Hours

Refrigerators = 8,760 hours per year

Clothes Washers = 392 Loads per Year

Loadshape

TBD

Freeridership/Spillover Factors

TBD

Demand Coincidence Factor

NA

Persistence

NA

Lifetime

(DEER) 11 years for clothes washer

(DEER) 14 years for refrigerator

Measure Costs and Incentive Levels

Residential Measure Costs and Incentive Levels

Description	Unit Incentive	Incremental Cost HECO DSM Docket 2006	Incremental Cost Energy Star 2009
ES Refrigerator	\$50	\$ 60.36	\$ 65
ES Clothes Washer	\$50	\$ 398.36	\$ 258

Component Costs and Lifetimes Used in Computing O&M Savings

TBD

Water Descriptions

	Base Water Usage (Gallons)	High Efficiency Water Usage (Gallons)	Water Savings (Gallons)	Notes
Refrigerator	n/a	n/a		19.0-21.4 Top Freezer
Clothes Washer	12,179	5,637	6,542	392 Loads per Year

Reference Tables

None



8.4.2 Pool VFD Controller Pumps

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 24, 2010

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Davis Energy Group (2008). Proposal Information Template for Residential Pool Pump Measure Revisions. Prepared for Pacific Gas and Electric Company; Page 2.
- Residential Retrofit High Impact Measure Evaluation Report. The Cadmus Group. February 8, 2010.

TRM Review Actions:

- 4/9/12 – Measure updated per EMV report February 23, 2012. Coincidence Factor of .0862 added. Added algorithm for Evergreen with 4.25 hours in place of 6 hours per day. Added Cadmus Group reference.
- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description

A variable speed residential pool pump motor in place of a standard single speed motor of equivalent horsepower.

Definition of Efficient Equipment

The high efficiency equipment is a variable speed residential pool pump.

Definition of Baseline Equipment

The baseline efficiency equipment is assumed to be a single speed residential pool pump.

$$\Delta \text{kWh} = (\text{kWBASE} \times \text{Hours}) \times 55\% \text{ BASE}$$

Where:

Unit	= variable speed pool pump
ΔkWh	= Average annual kWh reduction
Hours	= Average annual operating hours of pump
kWBASE	= connected kW of baseline pump
55%	= average percent energy reduction (Davis Energy Group, 2008)

Baseline Efficiency

The baseline efficiency case is a single speed pump.

Based Demand	0.70 kW
Base Energy Usage per day	2.97 kWh/day
Base Energy Usage per year	1085 kWh/year



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High Efficiency

The high efficiency case is variable speed pump.

Demand Reduction	10%
High Efficiency Demand	0.63 kW
Energy Savings	55%
High Efficiency Energy Usage	488 kWh/year

Energy and Demand Savings

Demand Savings	1.278 kW
Coincidence Factor	0.0862 kW

Energy Savings per year	597 kWh/year
Peak Demand Reduction	0.006 kW

Savings Algorithm

Average Pool Pump Horsepower	0.75 HP
Efficiency	0.8
Hours of operation per day	4.25 hours
Number of days pool in use	365 days per year
1 HP Equals	0.746 kW

Based Demand	0.70 kW
Base Energy Usage per day	2.97 kWh/day
Base Energy Usage per year	1085 kWh/year

Demand Reduction	10%
High Efficiency Demand	0.63 kW
Energy Savings	55%
High Efficiency Energy Usage	488 kWh/year

Demand Savings	1.278 kW
Coincidence Factor	0.0862 kW

Energy Savings per year	597 kWh/year
Peak Demand Reduction	0.006 kW

Lifetime of Efficient Equipment

The estimated useful life for a variable speed pool pump is 10 years.

Measure Cost

The incremental cost is estimated to be \$750 for a variable speed motor

Incentives

\$150



8.5 Energy Awareness, Measurement and Control Systems

8.5.1 Room Occupancy Sensors

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

Flex your Power – “Occupancy sensors can reduce lighting costs by up to 50% in rooms where lights are frequently left on when on one is around.”

According to the Federal Energy Management Program (FEMP) of the US Department of Energy, in a small, private office, an occupancy sensor can reduce energy use by almost 30% shaving 100kWh off the annual energy use. In a large open office area, energy use can be reduced by approximately 10%.

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

This measure is for wall switch sensors that controls the use of lighting in areas around the home with variable use such as laundry, storage, garage, bedrooms or spare areas.

Occupancy sensors must comply with:

- Energy Star
- UL Listing

Baseline Efficiencies:

The base case is an even split between two (2) 60W A-Shaped incandescent lamp and 15W Compact Fluorescent Lamp with the energy consumption as follows:

Lamp Types	Demand Baseline (kW)	Hours per Day	Energy Baseline (kWh/year)	%	Totals
Incandescent	0.060	2.30	50.4	50%	25.2 kWh
CFL	0.015	2.30	12.6	50%	6.3 kWh
Watts per Lamp					31.5 W
Lamps					2
Total Baseline Energy (kWh)					63.0 kWh



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High Efficiency:

The high efficiency case is 33% run time reduced.

Lamp Types	Demand Baseline (kW)	Hours per Day	Energy Baseline (kWh/year)	%	Totals
Incandescent	0.060	1.54	33.7	50%	16.9 kWh
CFL	0.015	1.54	8.4	50%	4.2 kWh
Watts per Lamp					21.1 W
Lamps					2
Total High Efficiency Energy (kWh)					42.2 kWh

Energy Savings:

Total Baseline Energy (kWh) 63.0 kWh
 Total High Efficiency Energy (kWh) 42.2 kWh
 20.8 kWh

Savings Algorithms

Room Occupancy Sensors - Single and Multi Family Residential Home

Two (2) - Lamp Demand	0.075 kW	Even split between 60W Incand. and 15W CFL
	2.30 Hours per Day	
	x 365 Days	839.5 Hours per Year
Baseline Energy Usage	<u>63.0 kWh per Year</u>	
Run Time Reduced (RTR)	0.76 Hours per Day	33%
	63.0 kWh per Year	
	x 0.330	33% Run Time Reduced
	<u>20.8 kWh per Year</u>	

Energy Savings 20.8 kWh / Year Savings

Two Lamp Demand Reduction Before Adjustments	0.075 kW	
Demand Reduction Before Adjustments	0.038 kW	
Coincidence Factor	0.120 cf	12.0% Lamps on between 5 and 9 p.m.
Persistence Factor	x 1.000 pf	100.0%
	<u>0.0046 kW</u>	

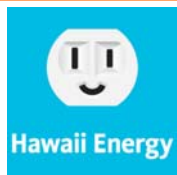
Demand Savings 0.0046 kW Savings

Operating Hours

2.3 hours per day

Loadshape

TBD



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Freeridership/Spillover Factors

TBD

Coincidence

CF = 0.12 (12% lamps on between 5PM – 9PM)

Persistence

PF =1.0

Lifetime

8 years (DEER)

Measure Costs and Incentive Levels

Measure	Incentive	Incremental Cost
Occupancy Sensor	\$ 20.00	\$ 30.00

Component Costs and Lifetimes Used in Computing O&M Savings

TBD

Reference Tables

None



8.5.2 Peer Group Comparison

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: September 18, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Study 1 - Environmental Defense Fund: Behavior and Energy Savings (Matt Davis) 2011 - Reports sent to a random subset of customers are shown to reduce energy demand by **1.8%** on average, with the effectiveness of individual programs ranging from 0.9% to 2.9%.
- Study 2 - Navigant Consulting Evaluation Report: OPOWER SMUD Pilot Year2 (February 20, 2011) - OPOWER is pleased to share the latest analysis of the nation's longest running behavioral energy program, our 35,000 household Home Energy Report deployment with Sacramento Municipal Utility District (SMUD). The analysis was led by Bill Provencher, Associate Director of the Navigant Consulting Energy Practice, and reviews data from April 2008 to October 2010. Navigant confirms the persistence, and even increase, of savings over the program's lifetime. The key findings of the updated report are:
 - Year 1 savings = **2.25%**
 - Year 2 savings = 2.89%, a 22% increase over Year 1
 - Highest savings occur during the peak season: 3.56% savings in July and August of 2009
 - No sign of impact deterioration over 30 months
- Study 3 - DBEDT / ARRA Hawaii Energy Residential Peer Group Pilot Program – This program was implemented in 2011 for 15,000 participants with 10,000 control group. The energy savings results for the program to date are as follows:
 - April 2011: 0.60%
 - May 2011: 1.10%
 - June 2011: 1.37%
 - August 2011: 1.50%
 - Average YTD: **1.14%**

TRM Review Actions:

- Continue to monitor participant vs control group energy usage comparison.
- 10/5/11 – Currently Under Review.

Major Changes:

- New PBFA 100% funded program.
- 11/22/11 – Removed detailed table from *Energy Savings* heading – not pertinent information.

Measure Description:

The Behavior/Feedback programs send monthly energy use reports to participating electric customers in order to change customers' energy-use behavior. These reports rank the customers within a group of 100 similar sized homes in their neighborhood. Customers are also directed to a website with energy efficient tips and recommendations on energy conservation.



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Energy Savings

The unit energy savings of 1.73% is deemed based on study results, forecasting and prior OPOWER program performances.

Peer Group Program - First Year Performance Average	
Study 1	1.80%
Study 2	2.25%
Study 3	1.14%
Average	1.73%

Example Algorithm Calculating Customer Level Impact

$$\begin{aligned}\Delta\text{kWh} &= (\text{Total Monthly Base Energy Usage})(\# \text{ of Participating Months})(\% \text{ Savings}) \\ \Delta\text{kW} &= \text{Annual } \Delta\text{kWh per Unit} / 3000 \text{ hours}\end{aligned}$$

Where:

Unit = One participant household

%Savings = Energy savings percent per program participant

Baseline Efficiency

The baseline efficiency case is the control group that does not receive behavior and feedback program reports.

High Efficiency

The high efficiency case is 60,000 active participants for the period from December 1, 2011 until June 30, 2012 who receives a behavior and feedback program report.

- 30,000 designated customers on Maui, Lanai and Molokai, with an effort to maximize the number of customers on Lanai and Molokai.
- 30,000 designated customers on the island of Hawaii.

Persistence

1 year

Measure Life

1 year



8.5.3 Whole House Energy Metering

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Hawaii Energy Historic Utility Billing Research – Residential Review 2010
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- Changed energy savings from 2% to 3.8% based on EM&V Review.

Measure Description:

Whole house metering systems allow the occupant to see in real time the energy usage in their home. This “dashboard” allows them to see what actions and equipment drive their energy usage and the associated costs of running them. These devices collect energy data for the whole house at the panel and transmit the information to a display unit “dashboard” which can be located anywhere in the house.

Baseline Efficiencies:

Building Types	Demand Baseline (kW)	Energy Baseline (kWh/year)
No Metering	1.50	12,000

High Efficiency:

Building Types	Efficient Case (kW)	Efficient Case (kWh/year)
Whole House Meter	1.47	11,544



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Energy Savings:

Building Types	Gross Customer Savings (kW)	Gross Customer Savings (kWh/year)
Gross Customer Savings	0.03	456

Operational Factor	Adjustment Factor
Persistence Factor (pf)	0.90
Demand Coincidence Factor (cf)	0.30

Building Types	Net Customer Savings (kW)	Net Customer Savings (kWh/year)
Net Customer Savings	0.01	410



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Savings Algorithms

Whole House Metering - Single Multi Family Residential Home

High Energy Usage Home (85th percentile) 1,000 kWh per home per month Hawaii Energy review - HECO 2010 Data

$$\begin{array}{r} \times \\ \hline 12 \end{array}$$

Baseline Household Energy Usage 12,000 kWh per Year

Energy Reduction 3.8%

Actively Informed Household Energy Usage 11,544 kWh per Year

Baseline Household Energy Usage 12,000 kWh per Year

Actively Informed Household Energy Usage - 11,544 kWh per Year

Gross Customer Level Energy Savings 456 kwh per Year

$$\begin{array}{r} \times \\ \hline 1,000 \end{array}$$

$$\begin{array}{r} \div \\ \hline 8,760 \end{array}$$

Average 24/7 Demand Reduction 52 Watts

Gross Customer Level Energy Savings 456 kwh per Year

Persistence Factor $\begin{array}{r} \times \\ \hline 0.9 \end{array}$

Net Customer Level Savings 410 kwh per Year

Whole House Metering Energy Savings 410 kWh / Year Savings

Baseline Household Demand 1.50 kW HECO 2008 Load Study

Peak Demand Reduction 1.75%

Actively Informed Household Demand 1.47 kW

Baseline Household Demand 1.50 kW

Actively Informed Household Demand - 1.47 kW

Gross Customer Demand Savings 0.026 kW

Gross Customer Demand Savings 0.026 kW

Persistence Factor $\begin{array}{r} \times \\ \hline 0.90 \end{array}$

Coincidence Factor $\begin{array}{r} \times \\ \hline 0.30 \end{array}$

0.007 kW

Whole House Metering Demand Savings 0.007 kW Savings



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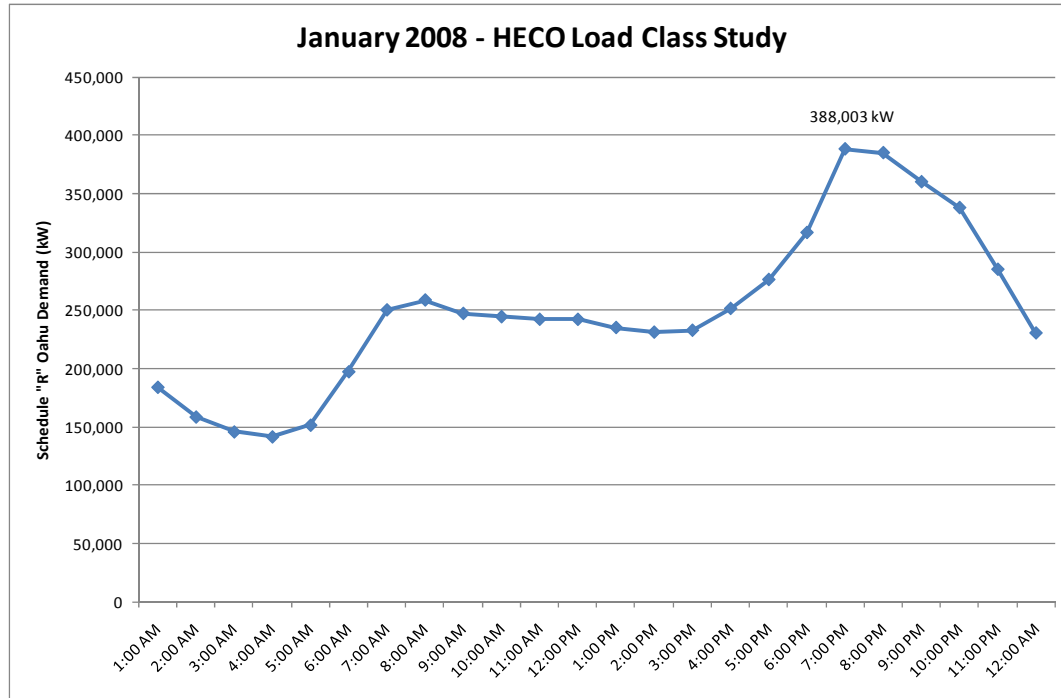
Program Year 3 July 2011 to June 2012

Operating Hours

8,760 hours per year

Loadshape

TBD



Freeridership/Spillover Factors

0.73

Persistence Factor

PF = 0.9

Coincidence Factor

CF= 0.3

Lifetime

5 years

Measure Costs and Incentive Levels

		Low	High
Measure Cost		\$100	\$450
Incremental Cost		\$100	\$450

Incentive Level

50% up to \$100



9 (CESH) Custom Energy Solutions for the Home

9.1 Target Cost Request for Proposals

9.1.1 Custom Packaged Proposals

Measure ID:

Version Date & Revision History

Draft date: October 4, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

Custom Packaged Proposals will be on a case-by-case review for approval. Hawaii Energy will utilize existing TRM figures, new engineering calculations, modeling simulations as well as pre and post metering as appropriate to the measures proposed.



10 (RESM) Residential Direct Installation

10.1 Residential Direct Installation

10.1.1 Real Time Metering

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

This program will be implemented to target residential properties that can influence the energy usage. A whole house meter will be installed by either a grassroots organization or a participating electrical contractor. After meter installation,

Energy Savings:

Meter data will not be shared with customers for the first month of operation to obtain baseline energy usage. After one month of operation, will be encouraged to take actions to reduce energy consumption and will have access to meter data.

Savings Algorithms



10.2 Residential Design and Audits

10.2.1 Efficiency Inside (New Home Construction Incentive)

Measure ID: See Table 7.3 (TBD)

Measure Code: Efficiency Inside

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Description: This measure provides developers with financial, technical and other assistance to promote the

construction of homes that require the least amount of air conditioning to meet customer demands.

It is assumed that all new homes will have Solar Water Heating, Energy Star Appliances, and CFLs.

The components are:

- *Energy Model Review* – Used to compare the projected home performance as compared to an IECC 2006 built home. At least 6 scenarios must be modeled (IECC 2006, Proposed Home, Proposed with Cool Roof, Proposed with 4.0 ACH @ 50Pa, Proposed other energy feature, Proposed home with all modeled features).
- *Construction Quality Control (CQC)* – Mandatory inspections of a sampling of units during construction to insure best construction practices are used to maximize design and to encourage field improvements. (Sampled)
- *Performance Testing (PT)* – A sampling of units tested to document the final result of the design and building practices.
- *Whole House Metering System* – Permanent devices to support home owner energy awareness and persistence of savings.

Savings comes from:

- *Lower Cooling Loads:* Through design and construction techniques.
- *Right Sizing of AC Systems:* Selection of smaller ACs match energy models load determination.
- *Energy Use Awareness:* Home equipped with metering will have greater user awareness that will drive energy use behavior.

Energy and Demand Savings: It is expected that the best built homes systems will provide a 20-30% reduction in energy consumption as compared to IECC 2006 code built homes. Net zero homes will provide 100% reductions.



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- **Energy Modeling:** Energy savings will be determined through the cooling reductions modeled. This will be a combination of the construction and AC equipment selection.
- **Net Zero:** Net zero homes with PV are allowed and the predicted PV system output will be included in energy savings.

Sample New Home Construction Worksheet



Efficiency Inside - Hawaii Energy New Residential Home Construction Incentive Program

Contractor	Project	Type	Units	Start	End	Modeled Scenarios	Scenario Energy Usage (kWh/year)	Over Baseline Savings (kWh/year)	Quality Inspections	Performance Tested	Adopted Recommendations	Solar Thermal Energy Star Appl.	CFLs	Low Wattage T8	Per Unit Incentive	Total Incentive	Project Status				
GC Pacific	60 Parkside	Multi	60	Oct-2011	Jun-2011	1. Baseline - IECC 2006			20%	20%					\$450	\$27,000	Approved	x			
						2. Energy Star Roof					Modeled										
						3. Insulation / HP Window options					Inspected										
						4. Air tightness (4.0 @ 50 pa)					Tested										
						5. AC Equipment Sizing & Technology					M&V										
						6. As Constructed		2,400			Paid										
Gentry Pacific		Single	120	Oct-2011	Jun-2011	1. Baseline - IECC 2006			20%	20%					\$600	\$72,000	Approved				
						2. Energy Star Roof					Modeled										
						3. Insulation / HP Window options					Inspected										
						4. Air tightness (4.0 @ 50 pa)					Tested										
						5. AC Equipment Sizing & Technology					M&V										
						6. As Constructed		3,200			Paid										
Haseko		Single	120	Oct-2011	Jun-2011	1. Baseline - IECC 2006			20%	20%					\$600	\$72,000	Approved				
						2. Energy Star Roof					Modeled										
						3. Insulation / HP Window options					Inspected										
						4. Air tightness (4.0 @ 50 pa)					Tested										
						5. AC Equipment Sizing & Technology					M&V										
						6. As Constructed		2,200			Paid										
DHHL		Single	19	Oct-2011	Jun-2011	1. Baseline - IECC 2006			20%	20%					\$600	\$11,400	Approved				
						2. Energy Star Roof					Modeled										
						3. Insulation / HP Window options					Inspected										
						4. Air tightness (4.0 @ 50 pa)					Tested										
						5. AC Equipment Sizing & Technology					M&V										
						6. As Constructed		15,000			Paid										
Totals			319	units				5,700 kWh/yr. per home reduction							\$182,400						



10.2.2 Tradewind Design

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

TBD

Baseline Efficiencies:

TBD

High Efficiency:

TBD

Energy Savings:

TBD

Savings Algorithms



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10.2.3 Hawaii Energy Hero Audits

Measure ID: See Table 7.3 (TBD)

Measure Code: Efficiency Inside

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- 11/22/11 – Akamai Power Strip kWh savings updated based on NYSERDA Measure Characterization for Advanced Power Strips. – NO LONGER RELEVANT.
- 4/17/12 – Removed gift pack information/data. Updated measure to match energy audit measure under “Residential Hard to Reach” in order to make savings consistent with an energy audit. This change was a complete revamp of the entire measure and did changed expected savings.
- 8/1/12 – Updated energy savings table to have consistent demand savings (0.0342 kW)

Measure Description:

- Work with grass roots organization(s) to develop a residential educational presentation and a high level household energy audit based on use of a Belkin Conserve Insight or Kill-A-Watt style single outlet energy monitor.
- Identify individuals/homes who accept participation in the program with an energy challenge commitment to reduce energy consumed within their household.
- Participants will receive the energy monitor and possibly other energy savings devices for the purpose of performing the energy audit, applying energy savings devices and achieving energy savings.
- Provide the energy monitors and possibly other energy savings devices along with funds to the grass roots organizations. The organizations will distribute energy monitors and devices, provide training to recipient households and perform a high level audit with selected individuals.

Energy Savings:

Monthly Usage (kWh/month)	625
Percent Savings (%)	4%
Hours per Year	8760

Savings	Energy Savings (kWh)	Demand Savings (kW)
Monthly Savings	25	0.0342
Yearly Savings	300	0.0342

Measure Costs and Incentive Levels

Description	Unit Incentive	Incremental Cost
Energy Hero Audits	\$ 100.00	\$ 400.00



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Savings Algorithm

CFL - Single and Multi Family Residential Home

Refer to TRM Compact Fluorescent Lamp (CFL) Section

Akamai Power Strips

Savings per Unit	56.5 kWh	102.8 kWh	NYSERDA Measure Characterization for Advanced Power Strips
Plugs per Unit	5 plugs	7 plugs	
Savings per Plug	11.3 kWh/plug	14.68571 kWh/plug	
Average Savings per Plug		13.0 kWh	
	x	6 plugs/unit	

Akamai Power Strip Energy Savings 78 kWh per Unit first year

Hours of Operation 8760 hours/year

Demand Savings 0.0089 kW

First Year Savings	78 kWh first year
Measure Life	x 5 year measure life
Lifetime Savings	389.78571 kWh lifetime

Total Resource Cost	\$ 30.96
Total Resource Benefit	÷ \$ 46.15
Total Resource Cost Ratio	1.5 TRB Ratio

Potential Akamai Power Strip Incentive	\$ 7.00
First Year Savings	÷ 66 kWh first year
	\$ 0.11 per kWh first year

Standard Power Strip Cost	\$ 14.49
Akamai Power Strip Cost	- \$ 30.96
Incremental Akamai Power Strip Cost	\$ 16.47

Incremental Akamai Power Strip Cost	\$ 16.47
Potential Akamai Power Strip Incentive	÷ \$ 7.00
Percentage of Incremental Cost	43%

Akamai Power Strip Cost	\$ 30.96
Potential Akamai Power Strip Incentive	÷ \$ 7.00
Percentage of Customer Measure Cost	23%



10.3 Residential System Tune-Ups

10.3.1 AC Annual Tune Up

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 21, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- Split Systems addition to central systems for AC tune-up
- Reduced savings percentage from 20% to 8% based on EM&V review.

Measure Description:

- Demonstrate the benefits of tune-ups
- Educate customer of potential savings and system longevity
- Utilize the participating contractors to contact the customers and have them arrange for the service work
- Participating contractors will use the Hawaii Energy Checklist to inspect and record the pre and post conditions
- Participating contractor's invoice must show that checklist requirements have been met and signed by the servicing technician
- Customers can have two incentives per location annually

Baseline Efficiencies:

Building Types	Demand Baseline (kW)	Energy Baseline (kWh/year)
Residential Household	2.77	4,367

High Efficiency:

With AC Annual Tune Up

Building Types	Efficient Case (kW)	Efficient Case (kWh/year)
Residential Household	2.70	4,043



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Energy Savings:

Building Types	Gross Customer Savings (kW)	Gross Customer Savings (kWh/year)
Residential Household	0.07	323

Operational Factor	Adjustment Factor
Persistence Factor (pf)	1.00
Demand Coincidence Factor (cf)	0.20

Building Types	Net Customer Savings (kW)	Net Customer Savings (kWh/year)
Residential Household	0.000	323
On Peak Run Time Reduction Peak Demand Savings	0.07	



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Savings Algorithms

Home AC Tune Up - Single Multi Family Residential Home

Average AC unit Size	3 ton unit
Average AC Unit EER	13.0 EER
EER to kW Conversion	12
	\div 13.0 EER
Average AC Unit kW/Ton	0.92 kW/Ton

Equivelant Full Load Run Hours (EFLRH) 1460 hrs./Year 4.0 hrs. per Day

Average AC unit Size	3 ton unit
Average AC Unit kW/Ton	0.92 kW/Ton
Equivelant Full Load Run Hours (EFLRH)	\times 1,460 hrs./Year
Post Tune Up - Average AC Unit Energy Consumption	4,043 kWh/Year

Incorrect Refrigerant Charge

Clogged AHU Filter

Dirty Condenser Coil

Pre Tune Up AC Operational Problems EFLRH Adjustment Factor 8%

Updated number based on EMV 23 Feb 12. 20% changed to 8%.

Post Tune Up - Average AC Unit Energy Consumption	4,043 kWh/Year
Pre Tune Up AC Operational Problems EFLRH Adjustment Factor	\div 108%
Pre Tune Up - Average AC Unit Energy Consumption	4,367 kWh/Year

1,577 hrs. per year

4.3 hrs. per Day

Pre Tune Up - Average AC Unit Energy Consumption	4,367
Post Tune Up - Average AC Unit Energy Consumption	4,043
Post Tune Up - Average AC Unit Energy Savings	323 kWh/Year

Post Tune Up - Average AC Unit Energy Savings	323 kWh/Year
Persistence Factor	\times 1.0
Net Customer Level Savings	323 kWh/Year

AC Tune Up Energy Savings 323 kWh / Year Savings

Average AC unit Size	3 ton unit
Average AC Unit kW/Ton	0.92 kW/Ton
Average AC Unit Demand	2.77 kW

Average AC Unit Demand	2.77 kW
Persistence Factor	\times 1.00
Pre Tune Up Coincidence Factor	\times 0.33
Pre Tune Up On Peak Demand	0.925 kW

Updated number based on EMV 23 Feb 12. 0.25 changed to 0.33.

AC Unit Demand will not change. A reduction in operational hours will occur once tune up is completed. This lowers Coincidence Factor

Pre Tune Up Coincidence Factor	0.33
Post Tune Up Run Time Reduction Adjustment Factor	\times 92%
Post Tune Up Coincidence Factor	0.31

Average AC Unit Demand	2.77
Persistence Factor	\times 1.00
Post Tune Up Coincidence Factor	\times 0.31
Post Tune Up On Peak Demand	0.851 kW

Pre Tune Up On Peak Demand	0.92
Post Tune Up On Peak Demand	$-$ 0.85
AC Tune Up Demand Savings	0.074 kW

AC Tune Up Demand Savings 0.074 kW Savings



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Operating Hours

Loadshape

TBD

Freeridership/Spillover Factors

TBD

Coincidence Factor

CF = 0.30

Persistence

PF = 0.90

Lifetime:

1 Year

Measure Costs and Incentive Levels

Description	Unit Incentive	Incremental Cost
Home AC Tune Up	\$ 50.00	\$ 300.00

Component Costs and Lifetimes Used in Computing O&M Savings

TBD

Reference Tables

None



10.3.2 Solar Water Heating Tune-up

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 21, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- KEMA "Impact Evaluation Report of the 2001-2003 Demand Side Management Programs" October 2004. Page 2-36 "Inoperable systems are those that use more than an average of 5 kWh per day, and problem systems use between 2-5 kWh per day."

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- New

Measure Description:

- Demonstrate the benefits of tune-ups
- Educate customer of potential savings and system longevity
- Utilize the participating contractors to contact the customers and have them arrange for the service work
- Participating contractors will use the Hawaii Energy Checklist to inspect and record the pre and post conditions
- Participating contractor's invoice must show that checklist requirements have been met and signed by the servicing technician
- Customers can have two incentives per location annually

Baseline Efficiencies:

	Energy (kWh)	Demand (kW)
Baseline	577	0.079

High Efficiency:

	Energy (kWh)	Demand (kW)
High Efficiency	328	0.05

Energy/Demand Savings:

	Energy (kWh)	Demand (kW)
Energy Savings	249	0.029

KEMA 2005-2007 Energy and Peak Demand Impact Evaluation Report

Samples	Group	kWh per Unit	On Peak Demand	Total kWh	On Peak Demand
260	All	577	0.079	150,020	20.5
18	Failed	3,925	0.469	70,644	8.4
242	Operating	328	0.050	79,376	12.1



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Operating Hours

10 hours

Loadshape

TBD

Freeridership/Spillover Factors

TBD

Demand Coincidence Factor

Persistence

Lifetime

5 years

Measure Costs and Incentive Levels

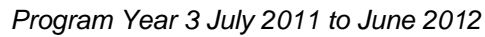
Description	Unit Incentive	Incremental Cost
Solar Water Heating Tune Up	\$ 50.00	\$ 300.00

Component Costs and Lifetimes Used in Computing O&M Savings

TBD

Reference Tables

None





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Savings Algorithm

Solar Water Heater - Single Family Home

Energy per Day (BTU) = (Gallons per Day) x (lbs. per Gal.) x (Temp Rise) x (Energy to Raise Water Temp)			
Hot Water needed per Person	13.3	Gallons per Day per Person	HE
Average Occupants	x	3.77	Persons
Household Hot Water Usage		50.2	Gallons per Day
Mass of Water Conversion		8.34	lbs/gal
Finish Temperature of Water		130	deg. F Finish Temp
Initial Temperature of Water	-	75	deg. F Initial Temp
Temperature Rise		55	deg. F Temperature Rise
Energy to Raise Water Temp		1.0	BTU / deg. F / lbs.
Energy per Day (BTU) Needed in Tank		23,006	BTU/Day
Energy per Day (BTU) Needed in Tank		23,006	BTU/Day
BTU to kWh Energy Conversion	÷	3,412	kWh / BTU
Energy per Day (kWh)		6.7	kWh / Day
Days per Month	x	30.4	Days per Month
Energy (kWh) per Month		205	kWh / Month
Days per Year	x	365	Days per Year
Energy (kWh) Needed in Tank to Heat Water per Year		2,460	kWh / Year
Elec. Res. Water Heater Efficiency	÷	0.90	COP
Base SERWH Energy Usage per Year at the Meter		2,733	kWh / Year
			KEMA 2008 - HECO
Design Annual Solar Fraction		90%	Water Heated by Solar System
		10%	Water Heated by Remaining Backup Element
			Program Design
Energy Usage per Year at the Meter		2,733	kWh / Year
	x	10%	Water Heated by Remaining Backup Element
Back Up Element Energy Used at Meter		273	kWh / Year
Circulation Pump Energy		0.082	kWh
Pump Hours of Operation	x	1,292	Hours per Year
Pump Energy used per Year		106	kWh / Year
			KEMA 2008
Back Up Element Energy Used at Meter		273	kWh / Year
Pump Energy used per Year	+	106	kWh / Year
Design Solar System Energy Usage		379	kWh / Year
			72%
Base SERWH Energy Usage per Year at the Meter		2,733	kWh / Year
Design Solar System Energy Usage	-	379	kWh / Year
Design Solar System Energy Savings		2,354	kWh / Year
Design Solar System Energy Savings		2,354	kWh / Year
Performance Factor		0.94	pf
Persistence Factor	x	0.93	pf
		2,066	kWh / Year
			HE
			KEMA 2008
			KEMA 2008

Residential Solar Water Heater Energy Savings 2,066 kWh / Year Savings

Base SERWH Element Power Consumption		4.0	kW
Coincidence Factor	x	0.143	cf
Base SERWH On Peak Demand		0.57	kW On Peak
			8.6 Minutes per hour
			KEMA 2008
Base SERWH On Peak Demand	-	0.57	kW On Peak
Solar System Metered on Peak Demand	-	0.11	kW On Peak
		0.46	kW On Peak
			KEMA 2008

Residential Solar Water Heater Demand Savings 0.46 kW Savings

Solar Inspection (WAP) Cost	\$ 75.00
Solar Water Heating Incentive	\$ 750.00
Percentage Savings = Cost/Incentive	10% Savings

Solar Inspection Energy Savings	206.6 kWh / Year Savings
Solar Inspection Demand Savings	0.046 kW Savings



11.1.2 Energy Hero Gift Packs

Measure ID: See Table 7.3 (TBD)

Measure Code: Energy Hero Gift Packs

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007
- Demand Management Programs – KEMA (KEMA 2005-07)
- Econorthwest TRM Review – 6/23/10
- Energy and Peak Demand Impact Evaluation Report of the 2005-2007 Demand Management Programs – (KEMA 2005-07)
- US DOE: Federal Energy Management Program (2010). Cost Calculator for Faucets & Shower Heads.
http://www1.eere.energy.gov/femp/technologies/eep_faucets_showerheads_calc.html#output
- http://www.aquacraft.com/Download_Reports/DISAGGREGATED-HOT_WATER_USE.pdf

TRM Review Actions:

- 10/06/11 – Added additional items to possible gift pack components list and corresponding data. Items included: LED lamp, low flow shower head for standard electric water heating systems, low flow shower head for solar heating systems, and faucet aerators.
- 10/06/11 – Currently Under Review.

Major Changes:

- 10/06/11 – Added additional items to possible gift pack components list (including data)
- 11/22/11 – LED algorithm updated. See section 8.2.2 for changes.
- 11/22/11 – Akamai Power Strip kWh savings updated based on NYSERDA Measure Characterization for Advanced Power Strips.
- 11/22/11 – Updated content in headings *Base Case*, *High Efficiency Case*, and *Energy Savings* in regard to LED lamps to match section 8.2.2.
- 11/29/11 – Low Flow Shower Head algorithms updated – previously claiming only 50% of total energy savings due to inaccurately calculating hot and cold water mix. Also updated *Energy Savings* table as necessary.
- 11/29/11 – Faucet Aerator algorithm updated – recalculated to follow low flow shower head algorithm, and include solar and non-solar calculations. Also updated *Energy Savings* table as necessary.
- 8/1/12 – Updated Low Flow Shower Head w/solar algorithm to reduce demand savings from 40% to 20% as per EM&V review (Feb. 2012)
- 8/1/12 – Updated Low Flow Shower Head algorithm to reduce demand savings from 40% to 20% as per EM&V review (Feb. 2012)
- 8/1/12 – Updated Faucet Aerator algorithm to using calculations method recommended by the EM&V review (Feb. 2012)
- 8/1/12 – Updated Faucet Aerator w/solar algorithm to align with Faucet Aerator w/o solar – based on the EM&V review (Feb. 2012)



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Description:

Potential gift pack components:

- Compact Fluorescent Lamp (15W)
- Akamai Power Strip
- LED Lamp (7W)
- Low Flow Shower Head – Solar Water Heater (1.5 gpm)
- Low Flow Shower Head – Standard Electric Water Heater (1.5 gpm)
- Faucet Aerator (2.2 gpm)

Base Case

- 60 W incandescent lamps
- Standard power strip or no power strip
- 25% 60W incandescent, 25% 40W incandescent, 25% 23W CFLs and 25% 13W CFLs (See LED TRM)
- Low Flow Shower Head – Solar Water Heater (1.5 gpm)
- Low Flow Shower Head – Standard Electric Water Heater (1.5 gpm)
- Faucet Aerator (1.5 gpm)

High Efficiency Case

- Replace 60 W incandescent lamps with CFLs rated at 15W
- Replace existing standard power strip or no power strip with Akamai Power Strip
- Replace existing non-LED lamp with LED lamp (50% 7W and 50% 12.5W)
- Replace 2.5 gpm Low Flow Shower Head with Low Flow Shower (Solar) Head rated at 1.5 gpm
- Replace 2.5 gpm Low Flow Shower Head with Low Flow Shower (Electric) Head rated at 1.5 gpm
- Replace 2.2 gpm Faucet Aerator with Low Flow Faucet Aerator rated at 1.5 gpm

Energy Savings

Measure	Energy Savings (kWh/year)	Demand Savings (kW)
3 CFL	109	0.016
Power Strip	78	0.009
LED	17	0.003
Low Flow Shower Head - Solar	42	0.022
Low Flow Shower Head - Electric Water Heater	306	0.114
Faucet Aerator - Solar	6.5	0.00017
Faucet Aerator - Electric Water Heater	65	0.0017
TOTAL	623	0.16

Measure life

Measure	Measure Life (Years)
3 CFL	5
Power Strip	5
LED	5
Low Flow Shower Head	5
Faucet Aerator	5



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Savings Algorithms

CFL - Single and Multi Family Residential Home

Refer to TRM Compact Fluorescent Lamp (CFL) Section

Akamai Power Strips

Savings per Unit	56.5 kWh	102.8 kWh	NYSERDA Measure Characterization for Advanced Power Strips
Plugs per Unit	5 plugs	7 plugs	
Savings per Plug	11.3 kWh/plug	14.68571 kWh/plug	
Average Savings per Plug		13.0 kWh	
	x	6 plugs/unit	

Akamai Power Strip Energy Savings 78 kWh per Unit first year

Hours of Operation 8760 hours/year

Demand Savings 0.0089 kW

First Year Savings	78 kWh first year
Measure Life	x 5 year measure life
Lifetime Savings	389.78571 kWh lifetime

Total Resource Cost	\$ 30.96
Total Resource Benefit	÷ \$ 46.15
Total Resource Cost Ratio	1.5 TRB Ratio

Potential Akamai Power Strip Incentive	\$ 7.00
First Year Savings	÷ 66 kWh first year
	\$ 0.11 per kWh first year

Standard Power Strip Cost	\$ 14.49
Akamai Power Strip Cost	- \$ 30.96
Incremental Akamai Power Strip Cost	\$ 16.47

Incremental Akamai Power Strip Cost	\$ 16.47
Potential Akamai Power Strip Incentive	÷ \$ 7.00
Percentage of Incremental Cost	43%

Akamai Power Strip Cost	\$ 30.96
Potential Akamai Power Strip Incentive	÷ \$ 7.00
Percentage of Customer Measure Cost	23%

LED - Single and Multi Family Residential Home

Refer to TRM Light Emitting Diode (LED) Section



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Low Flow Showerhead w/Solar Water Heating

Energy per Day (BTU) = (Gallons per Day) x (lbs. per Gal.) x (Temp Rise) x (Energy to Raise Water Temp)

Hot Water needed per Person	13.3 Gallons per Day per Person	HE
Average Occupants	x 3.77 Persons	KEMA 2008
Household Hot Water Usage	50.2 Gallons per Day	
Mass of Water Conversion	8.34 lbs/gal	
Finish Temperature of Water	130 deg. F Finish Temp	
Initial Temperature of Water	- 75 deg. F Initial Temp	
Temperature Rise	55 deg. F Temperature Rise	
Energy to Raise Water Temp	1.0 BTU / deg. F / lbs.	
Energy per Day (BTU) Needed in Tank	23,006 BTU/Day	
Energy per Day (BTU) Needed in Tank	23,006 BTU/Day	
BTU to kWh Energy Conversion	÷ 3,412 BTU/kWh	
Energy per Day (kWh)	6.7 kWh / Day	
Days per Month	x 30.4 Days per Month	
Energy (kWh) per Month	205 kWh / Month	
Days per Year	x 365 Days per Year	
Energy (kWh) Needed in Tank to Heat Water per Year	2,460 kWh / Year	
Elec. Res. Water Heater Efficiency	÷ 0.90 COP	
Base SERWH Energy Usage per Year at the Meter	2,733 kWh / Year	KEMA 2008 - HECO
Design Annual Solar Fraction	90% Water Heated by Solar System 10% Water Heated by Remaining Backup Element	Program Design
Energy Usage per Year at the Meter	2,733 kWh / Year	
	x 10% Water Heated by Remaining Backup Element	
Back Up Element Energy Used at Meter	273 kWh / Year	
Circulation Pump Energy	0.082 kW	KEMA 2008
Pump Hours of Operation	x 1,292 Hours per Year	KEMA 2008
Pump Energy used per Year	106 kWh / Year	
Back Up Element Energy Used at Meter	273 kWh / Year	72%
Pump Energy used per Year	+ 106 kWh / Year	28%
Design Solar System Energy Usage	379 kWh / Year	
Utilization Factor	28%	Hot water used for showers (AMMA)
Hot Water Usage from Showers	106	
Base Case Showerhead	2.5 GPM	
High Efficiency Case Showerhead	1.5 GPM	
Savings = (1 - High Efficiency/Base)	40%	

Energy Savings 42 kWh / Year

Solar System Metered on Peak Demand	0.11 kW On Peak	KEMA 2008
Peak Coincidence Factor	0.20	William B., De Oreo, P.E., Peter W. Mayer. The End Uses of Hot Water in Single Family Homes from Flow Trace Analysis. Aquacraft, Inc. Water Engineering and Management.

Residential Low Flow Shower Head Demand Savings 0.022 kW Savings



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Low Flow Showerhead w/Standard Electric Resistance Water Heater (SERWH)

Energy per Day (BTU) = (Gallons per Day) x (lbs. per Gal.) x (Temp Rise) x (Energy to Raise Water Temp)

Hot Water needed per Person	13.3 Gallons per Day per Person	HE
Average Occupants	<u>x 3.77</u> Persons	KEMA 2008
Household Hot Water Usage	50.2 Gallons per Day	
Mass of Water Conversion	8.34 lbs/gal	
Finish Temperature of Water	130 deg. F Finish Temp	
Initial Temperature of Water	<u>- 75</u> deg. F Initial Temp	
Temperature Rise	55 deg. F Temperature Rise	
Energy to Raise Water Temp	<u>1.0</u> BTU / deg. F / lbs.	
Energy per Day (BTU) Needed in Tank	23,006 BTU/Day	
Energy per Day (BTU) Needed in Tank	23,006 BTU/Day	
BTU to kWh Energy Conversion	<u>÷ 3,412</u> BTU/kWh	
Energy per Day (kWh)	6.7 kWh / Day	
Days per Month	<u>x 30.4</u> Days per Month	
Energy (kWh) per Month	205 kWh / Month	
Days per Year	<u>x 365</u> Days per Year	
Energy (kWh) Needed in Tank to Heat Water per Year	2,460 kWh / Year	
Elec. Res. Water Heater Efficiency	<u>÷ 0.90</u> COP	
Base SERWH Energy Usage per Year at the Meter	2,733 kWh / Year	KEMA 2008 - HECO
Utilization Factor	28%	Hot water used for showers (AMMA)
Base SERWH Energy Usage per Year at the Meter	765 kWh / Year	Energy Usage for showers
Base Case Showerhead	2.5 GPM	
High Efficiency Case Showerhead	1.5 GPM	
Savings = (1 - High Efficiency/Base)	40%	

Energy Savings 306 kWh / Year

SERWH Element Power Consumption	4.0 kW
Coincidence Factor	<u>x 0.143</u> cf
SERWH On Peak Demand	0.57 kW On Peak

Peak Coincidence Factor 0.20

William B., De Oreo, P.E., Peter W. Mayer. The End Uses of Hot Water in Single Family Homes from Flow Trace Analysis. Aquacraft, Inc. Water Engineering and Management.

Residential Low Flow Shower Head Demand Savings 0.114 kW Savings



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Faucet Aerator w/Solar Water Heating

Base Usage	10.9 gal/day/person	EPA Data
Base Flow Rate	\div 2.2 gpm	EPA Watersense Data
Faucet Run Time / day	4.95 min	
Proposed Flow Rate	1.5 gpm	
Faucet Run Time / day	\times 4.95 min	
	7.43 gal/day	
Base Flow Rate	10.9 gal/day	
Proposed Usage	$-$ 7.43 gal/day	
Water Savings	3.48 gal/day	
Faucet Temperature	80 F	Ohio and Connecticut Programs
Initial Temperature	$-$ 75 F	Hawaii TRM
Temperature Rise	5 F	
Water Density	8.34 lbs/gal	
Energy Conversion	3412 kWh/Btu	
Energy to Raise Water Temp	1.0 BTU / deg. F / lbs.	
Water Heating Energy Saved	0.042469959 kWh	
People per Household	3.77 people	
Days per Year	\times 365 days	
Annual Energy Needed	58.44 kWh	
Water Heater Efficiency	0.9	
	65 gross kWh saved by faucet aerator	
Design Annual Solar Fraction	90% water heated by solar system 10% water heated by backup element	HE Program Design

Annual Energy Savings w/ Solar 6.5 kWh

	14.3% faucet use during peak hours
\times	4.95 min / day
	0.708 minutes
\div	240 minutes during peak period
	0.002949375 coincidence factor
	10.9 base gal / day / person
\times	3.77 person / household
\times	365 days / year
\div	2.2 GPM
\div	60 min / hour
	114 hours
	6.5 kWh savings
\div	114 hours
	0.06 average kW
\times	0.00295 coincidence factor
	0.00017 peak kW savings

Peak kW Savings 0.00017 kW



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Faucet Aerator w/Standard Electric Resistance Water Heater (SERWH)

Base Usage	10.9 gal/day/person	EPA Data
Base Flow Rate	\div 2.2 gpm	EPA Watersense Data
Faucet Run Time / day	4.95 min	
Proposed Flow Rate	1.5 gpm	
Faucet Run Time / day	\times 4.95 min	
	7.43 gal/day	
Base Flow Rate	10.9 gal/day	
Proposed Usage	$-$ 7.43 gal/day	
Water Savings	3.48 gal/day	
Faucet Temperature	80 F	Ohio and Connecticut Programs
Initial Temperature	$-$ 75 F	Hawaii TRM
Temperature Rise	5 F	
Water Density	8.34 lbs/gal	
Energy Conversion	3412 kWh/Btu	
Energy to Raise Water Temp	1.0 BTU / deg. F / lbs.	
Water Heating Energy Saved	0.0425 kWh	
People per Household	3.77 people	
Days per Year	\times 365 days	
Annual Energy Needed	58.44 kWh	
Water Heater Efficiency	0.9	
Annual Energy Savings	65 kWh	

$$\begin{aligned}
 &14.3\% \text{ faucet use during peak hours} \\
 &\times 4.95 \text{ min / day} \\
 &0.708 \text{ minutes} \\
 &\div 240 \text{ minutes during peak period} \\
 &\mathbf{0.0029 \text{ coincidence factor}}
 \end{aligned}$$

$$\begin{aligned}
 &10.9 \text{ base gal / day / person} \\
 &\times 3.77 \text{ person / household} \\
 &\times 365 \text{ days / year} \\
 &\div 2.2 \text{ GPM} \\
 &\div 60 \text{ min / hour} \\
 &\mathbf{114 \text{ hours}}
 \end{aligned}$$

$$\begin{aligned}
 &65 \text{ kWh savings} \\
 &\div 114 \text{ hours} \\
 &0.57 \text{ average kW} \\
 &\times 0.0029 \text{ coincidence factor} \\
 &0.0017 \text{ peak kW savings}
 \end{aligned}$$

Peak kW Savings	0.0017 kW
------------------------	------------------



11.1.3 CFL Exchange

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 24, 2010

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007
- Demand Management Programs – KEMA (KEMA 2005-07)
- Econorthwest TRM Review – 6/23/10

TRM Review Actions:

- 6/23/10 Rec. # 8 – Starting with PY2010, adjust the hours used per day for CFLs from 4.98 to 2.3 in order to be consistent with other literature. Conduct additional research to verify the most appropriate hours of operation for the Hawaii customer base, which can be incorporated into future years. – Adopted.
- 6/23/10 Rec. # 9 - Starting with PY 2010, adjust the peak coincidence factor from 0.334 to 0.12 to be consistent with the literature. Conduct additional research to verify the most appropriate coincidence factor for the Hawaii customer base, which can be incorporated into future years.- Adopted.
- 10/5/11 – Currently Under Review.

Major Changes:

- Hours used per day for CFLs from 4.98 to 2.3 hrs.
- Peak coincidence factor from 0.334 to 0.12
- Updated persistence factor from 0.8 to 1.0. Lamps are replaced in a one-for-one fashion therefore all lamps will be used.

Measure Description:

The replacement of incandescent screw-in lamps to standard spiral compact fluorescent lamps in Residential Single Family and Multi-family homes.

Lamps must comply with:

- Energy Star
- UL

Baseline Efficiencies:

Baseline usage is a 60W A-Shaped incandescent lamp with the energy consumption as follows:

Building Types	Demand Baseline(kW)	Energy Baseline (kWh)
Single Family	0.060	50.4
Multi Family	0.060	50.4

High Efficiency:

The high efficiency case is a 15W Spiral CFL with the energy consumption as follows:

Building Types	Demand High Efficiency (kW)	Energy High Efficiency (kWh)
Single Family	0.015	12.6
Multi Family	0.015	12.6



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Energy Savings:

CFL Gross Savings before operational adjustments:

Building Types	Demand Savings (kW)	Energy Savings (kWh)
Single Family	0.045	37.8
Multi Family	0.045	37.8

CFL Net Savings after operational adjustments:

Operational Factor	Adjustment Factor
Persistence Factor (pf)	1.0
Demand Coincidence Factor (cf)	0.12

Building Types	Demand Savings (kW)	Energy Savings (kWh)
Single Family	0.005	37.8
Multi Family	0.005	37.8

Savings Algorithms

CFL Exchange - Single and Multi Family Residential Home

60W Incandescent Lamp Demand	0.060 kW	
	2.30 Hours per Day	
	x 365 Days	839.5 Hours per Year
60W Incandescent Lamp Energy Usage	50.4 kWh per Year	
15W Compact Fluorescent Lamp Demand	0.015 kW	
	2.30 Hours per Day	
	x 365 Days	839.5 Hours per Year
15W Compact Fluorescent Lamp Energy Usage	12.6 kWh per Year	
60W Incandescent Lamp Energy Usage	50.4 kWh per Year	
15W Compact Fluorescent Lamp Energy Usage	- 12.6 kWh per Year	
CFL Savings Before Adjustments	37.8 kWh per Year	
Persistence Factor	37.8 kWh per Year	
	x 1.000 pf	0.0% Lamps not installed or replaced back
CFL Energy Savings	37.8 kWh per Year	

CFL Energy Savings 37.8 kWh / Year Savings

60W Incandescent Lamp Demand	0.060 kW	
15W Compact Fluorescent Lamp Demand	- 0.015 kW	
CFL Demand Reduction Before Adjustments	0.045 kW	
CFL Demand Reduction Before Adjustments	0.045 kW	
Coincidence Factor	0.120 cf	12.0% Lamps on between 5 and 9 p.m.
Persistence Factor	x 1.000 pf	0.0% Lamps not installed or replaced back
CFL Demand Savings	0.005 kW	

CFL Demand Savings 0.005 kW Savings



11.1.4 Hawaii Energy Hero Audits

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 21, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- Increased focus and penetration of direct install and educational outreach
- Updated energy savings table to have consistent demand savings (0.0342 kW)

Measure Description:

- Work with grass roots organization(s) to develop a residential educational presentation and a high level household energy audit based on use of a Belkin Conserve Insight or Kill-A-Watt style single outlet energy monitor.
- Identify individuals/homes who accept participation in the program with an energy challenge commitment to reduce energy consumed within their household.
- Participants will receive the energy monitor and possibly other energy savings devices for the purpose of performing the energy audit, applying energy savings devices and achieving energy savings.
- Provide the energy monitors and possibly other energy savings devices along with funds to the grass roots organizations. The organizations will distribute energy monitors and devices, provide training to recipient households and perform a high level audit with selected individuals.

Energy Savings:

Monthly Usage (kWh/month)	625
Percent Savings (%)	4%
Hours per Year	8760

Savings	Energy Savings (kWh)	Demand Savings (kW)
Monthly Savings	25	0.0342
Yearly Savings	300	0.0342

Measure Costs and Incentive Levels

Description	Unit Incentive	Incremental Cost
Energy Hero Audits	\$ 100.00	\$ 400.00



11.2 Landlord / Tenant, AOA Measures

11.2.1 Hawaii Energy Hero Landlord Program

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

TBD

Baseline Efficiencies:

TBD

High Efficiency:

TBD

Energy Savings:

TBD

Savings Algorithms



11.2.2 Tiered / Split Incentives

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

TBD

Baseline Efficiencies:

TBD

High Efficiency:

TBD

Energy Savings:

TBD

Savings Algorithms



11.2.3 Townhome Targeted Program

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

TBD

Baseline Efficiencies:

TBD

High Efficiency:

TBD

Energy Savings:

TBD

Savings Algorithms



12 (BEEM) Business Energy Efficiency Measures

12.1 High Efficiency Lighting

12.1.1 Compact Fluorescent Lighting (CFL)

Measure ID: See Table 7.3

Measure Code: L01, L02, L03, L04, L05, L06

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Econorthwest TRM Review – 6/23/10
- The California Energy Commission California Commercial End Use Summary
<http://www.energy.ca.gov/ceus/>
- DEER - The Database for Energy Efficient Resources
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 6/23/10 Rec. 15 – For PY 2010, revise lighting hours of operation and peak coincidence factors, conduct additional research to evaluate the assumed hours of operation and coincidence factor for Hawaii customer base. - Adopted
- 6/23/10 Rec. # 16 – Consider developing commercial CFL measure categories by lamp size - Adopted.
- 10/5/11 – Currently Under Review.
- 8/1/12 – Added military housing CFL algorithm.

Major Changes:

- Wholesale replacement of prior TRM using DEER operational data and CEUS Commercial CFL Data
- Added interactive effect factors for energy and demand Table 3.

Description: A compact fluorescent lamp is a type of fluorescent lamp. Many CFL's are designed to replace an incandescent lamp and can fit in the existing light fixtures formerly used for incandescent lamps. CFLs typically replace 100 watts or less of incandescent.

CFL retrofit savings are determined by the delta wattage between the incandescent and CFL lamp, annual hours of operation, and the percent of peak period the lamps are on. The average delta wattage is typically a readily available value. The annual hours, persistence factor and peak percent are utilized based on DEER data.

Although the breakdown of lamp sizes installed is reasonable, the savings for this measure could be broken up based on lamp size. This would allow greater flexibility in matching claimed savings to actual projects completed. Savings for each wattage category are based on the savings for typical CFL lighting replacement projects from DEER, with the DEER wattage categories are shown below:

	CFL Wattage Reduction		
	< 16W	16-26W	> 26W
Average Savings (W)	32	60	76

Military Residential Values	kWh/year	kW
CFLs	45.3	0.004



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Energy Savings: Using the DEER operational hours the energy savings are (see Table 3 for Interactive Effect):

Building Type	CFL Energy Reduction		
	< 16W	16-26W	> 26W
All Commercial	131.5	246.5	312.3
Misc. Commercial	131.5	246.5	312.3
Cold Storage	126.5	237.1	300.4
Education	80.7	151.2	191.5
Grocery	177.0	332.0	420.5
Health	196.8	369.0	467.4
Hotel/Motel	150.2	281.6	356.7
Misc. Industrial	130.4	244.5	309.7
Office	85.4	160.1	202.7
Restaurant	160.5	300.8	381.1
Retail	128.0	240.0	304.0
Warehouse	126.5	237.1	300.4

Military Housing CFL energy savings: 45.3 kWh

Demand Savings: Using the CEUS coincidence factors the demand savings are (see Table 3 for Interactive Effect):

Building Type	CFL Demand Reduction		
	< 16W	16-26W	> 26W
All Commercial	0.015	0.029	0.036
Misc. Commercial	0.009	0.017	0.022
Cold Storage	0.015	0.029	0.036
Education	0.006	0.011	0.014
Grocery	0.026	0.048	0.061
Health	0.020	0.037	0.047
Hotel/Motel	0.018	0.034	0.043
Misc. Industrial	0.015	0.029	0.036
Office	0.015	0.029	0.036
Restaurant	0.023	0.043	0.054
Retail	0.018	0.034	0.043
Warehouse	0.014	0.026	0.032

Military Housing CFL demand savings: 0.004 kW



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CFL Operational Hours and Peak Coincidence Factors:

Commercial Lighting Factors

Building Type	Hours of Operation¹	Peak Coincidence Factor²
All Commercial	4,325	0.50
Misc. Commercial	4,325	0.30
Cold Storage	4,160	0.50
Education	2,653	0.20
Grocery	5,824	0.85
Health	6,474	0.65
Hotel/Motel	4,941	0.60
Misc. Industrial	4,290	0.50
Office	2,808	0.50
Restaurant	5,278	0.75
Retail	4,210	0.60
Warehouse	4,160	0.45

¹ The Database for Energy Efficient Resources (DEER)

² California Commercial End Use Summary (CEUS)



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Saving Algorithm:

CFL - Commercial Use (16-26W All Commercial Example Calculation)

Incandescent Lamp Demand	0.083 kW	
	11.85 Hours per Day	
	x 365 Days	4,325.0 Hours per Year
Incandescent Lamp Energy Usage	359.0 kWh per Year	
Compact Fluorescent Lamp Demand	0.023 kW	
	11.85 Hours per Day	
	x 365 Days	4,325.0 Hours per Year
Compact Fluorescent Lamp Energy Usage	99.5 kWh per Year	
Incandescent Lamp Energy Usage	359.0 kWh per Year	
Compact Fluorescent Lamp Energy Usage	- 99.5 kWh per Year	
CFL Savings Before Adjustments	259.5 kWh per Year	
Persistence Factor	x 0.950 pf	5.0% Lamps not installed or replaced back
	246.5 kWh per Year	

CFL Energy Savings 246.5 kWh / Year Savings

Incandescent Lamp Demand	0.083 kW	
Compact Fluorescent Lamp Demand	- 0.023 kW	
CFL Demand Reduction Before Adjustments	0.060 kW	
CFL Demand Reduction Before Adjustments	0.060 kW	
Coincidence Factor	0.500 cf	50.0% Lamps on between 5 and 9 p.m.
Persistence Factor	x 0.950 pf	5.0% Lamps not installed or replaced back
	0.029 kW	

CFL Demand Savings 0.029 kW Savings



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Military CFL - Single and Multi Family Residential Home

60W Incandescent Lamp Demand	0.060 kW	
	3.45 Hours per Day	Updated number based on EMV 23 Feb 12. 2.3 hours (residential number) multiplied by 1.5.
	x 365 Days	1,259.3 Hours per Year
60W Incandescent Lamp Energy Usage	75.6 kWh per Year	
15W Compact Fluorescent Lamp Demand	0.015 kW	
	3.45 Hours per Day	
	x 365 Days	1,259.3 Hours per Year
15W Compact Fluorescent Lamp Energy Usage	18.9 kWh per Year	
60W Incandescent Lamp Energy Usage	75.6 kWh per Year	
15W Compact Fluorescent Lamp Energy Usage	- 18.9 kWh per Year	
CFL Savings Before Adjustments	56.7 kWh per Year	
Persistence Factor	56.7 kWh per Year	
	x 0.800 pf	20.0% Lamps not installed or returned
CFL Energy Savings	45.3 kWh per Year	

CFL Energy Savings 45.3 kWh / Year Savings

60W Incandescent Lamp Demand	0.060 kW	
15W Compact Fluorescent Lamp Demand	- 0.015 kW	
CFL Demand Reduction Before Adjustments	0.045 kW	
CFL Demand Reduction Before Adjustments	0.045 kW	
Coincidence Factor	0.120 cf	12.0% Lamps on between 5 and 9 p.m.
Persistence Factor	x 0.800 pf	20.0% Lamps not installed or returned
CFL Demand Savings	0.004 kW	

CFL Demand Savings 0.004 kW Savings

Measure

2.8 years (DEER)

Unit Incentive/Incremental Cost

Description	Unit Incentive	Incremental Cost
CFL	\$ 1.00	\$ 2.50



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Military CFL - Single and Multi Family Residential Home

60W Incandescent Lamp Demand	0.060 kW	
	3.45 Hours per Day	Updated number based on EMV 23 Feb 12. 2.3 hours (residential number) multiplied by 1.5.
	x 365 Days	1,259.3 Hours per Year
60W Incandescent Lamp Energy Usage	75.6 kWh per Year	
15W Compact Fluorescent Lamp Demand	0.015 kW	
	3.45 Hours per Day	
	x 365 Days	1,259.3 Hours per Year
15W Compact Fluorescent Lamp Energy Usage	18.9 kWh per Year	
60W Incandescent Lamp Energy Usage	75.6 kWh per Year	
15W Compact Fluorescent Lamp Energy Usage	- 18.9 kWh per Year	
CFL Savings Before Adjustments	56.7 kWh per Year	
Persistence Factor	56.7 kWh per Year	
	x 0.800 pf	20.0% Lamps not installed or returned
CFL Energy Savings	45.3 kWh per Year	

CFL Energy Savings 45.3 kWh / Year Savings

60W Incandescent Lamp Demand	0.060 kW	
15W Compact Fluorescent Lamp Demand	- 0.015 kW	
CFL Demand Reduction Before Adjustments	0.045 kW	
CFL Demand Reduction Before Adjustments	0.045 kW	
Coincidence Factor	0.120 cf	12.0% Lamps on between 5 and 9 p.m.
Persistence Factor	x 0.800 pf	20.0% Lamps not installed or returned
CFL Demand Savings	0.004 kW	

CFL Demand Savings 0.004 kW Savings



12.1.2 T12 to T8 with Electronic Ballast

Measure ID: See Table 7.3

Measure Code: L016, L017, L018, L019

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007
- Demand Management Programs – KEMA (KEMA 2005-07).
- Econorthwest TRM Review – 6/23/10
- DEER - The Database for Energy Efficient Resources
- The California Energy Commission California Commercial End Use Summary
<http://www.energy.ca.gov/ceus/>
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 6/23/10 Rec. #18 – Break down T8 savings by lamp length – Adopted
- 10/5/11 – Currently Under Review.

Major Changes:

- Wholesale replacement of prior TRM using DEER operational data and CEUS Commercial Data
- Added interactive effect factors for energy and demand Table 3.

Description: This measure involves the replacement of an existing T12 lamp with a new high efficiency T8 lamp, and savings are calculated assuming standard T12 lamps and magnetic ballasts. The average watt savings per lamp for replacing 2', 3', 4', and 8' lamps is calculated by weighting the average toward those replacements that most likely to occur; largely 4' 2 lamp and 4' 4 lamp fixtures. Based on the assumed fixture distribution, the average savings per lamp is 18.6W.

Base Efficiency

The base case efficiency is either an existing T12 lamp with magnetic ballast.

High Efficiency

The high efficiency case is a T8 lamp with electronic ballast.



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Demand Savings: Using the CEUS coincidence factors the demand savings are (see Table 3 for Interactive Effect):

Building Type	Demand Savings (kW)			
	2' Lamp	3' Lamp	4' Lamp	8' Lamp
All Commercial	0.0040	0.0070	0.0100	0.0200
Misc. Commercial	0.0020	0.0040	0.0060	0.0120
Cold Storage	0.0040	0.0070	0.0100	0.0200
Education	0.0020	0.0030	0.0040	0.0080
Grocery	0.0070	0.0110	0.0160	0.0340
Health	0.0050	0.0080	0.0130	0.0260
Hotel/Motel	0.0050	0.0080	0.0120	0.0240
Misc. Industrial	0.0040	0.0070	0.0100	0.0200
Office	0.0040	0.0070	0.0100	0.0200
Restaurant	0.0060	0.0100	0.0140	0.0300
Retail	0.0050	0.0080	0.0120	0.0240
Warehouse	0.0040	0.0060	0.0090	0.0180

Energy Savings: Using the DEER operational hours the energy savings are (see Table 3 for Interactive Effect):

Building Type	Energy Savings (kWh/year)			
	2' Lamp	3' Lamp	4' Lamp	8' Lamp
All Commercial	35.9	56.4	83.2	170.8
Misc. Commercial	35.9	56.4	83.2	170.8
Cold Storage	34.5	54.3	80.0	164.3
Education	22.0	34.6	51.0	104.8
Grocery	48.3	76.0	112.0	230
Health	53.7	84.5	124.5	255.7
Hotel/Motel	41.0	64.5	95.0	195.2
Misc. Industrial	35.6	56.0	82.5	169.5
Office	23.3	36.6	54.0	110.9
Restaurant	43.8	68.9	101.5	208.5
Retail	34.9	54.9	81.0	166.3
Warehouse	34.5	54.3	80.0	164.3

Incentive

Equipment Description	All Commercial Demand (kW) Savings	All Commercial Energy Savings (kWh)	Current Incentive
2'T12 - 2'T8	0.004	35.9	\$4.80
3'T12 - 3'T8	0.007	56.4	\$5.20
4'T12 - 4'T8	0.01	83.2	\$5.60
8'T12 - 8'T8	0.02	170.8	\$7.20



12.1.3 T8 to T8 Low Wattage

Measure ID: See Table 7.3

Measure Code: L020, L021

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007
- Demand Management Programs – (KEMA 2005-07).
- Econorthwest TRM Review – 6/23/10
- DEER-The Database for Energy Efficient Resources
- The California Energy Commission California Commercial End Use Summary
<http://www.energy.ca.gov/ceus/>
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 6/23/10 Rec. #no number– Adjust with DEER/CEUS usage characteristics – Adopted
- 10/5/11 – Currently Under Review.

Major Changes:

- Adjustment of hours and coincidence factors of prior TRM using DEER operational data and CEUS Commercial Data
- Added interactive effect factors for energy and demand Table 3.

Description:

This measure involves the replacement of 4' standard T8 with low wattage T8 fixtures and electronic ballasts.

Base Efficiency

The baseline T8 fixtures are assumed to be standard T8 (32W) lamps with standard magnetic ballasts.

High Efficiency

The high efficiency case is super T8 low wattage (25W/28W) lamps with high performance electronic ballasts.

Energy and Demand Savings:

The Base Watts and New Watts values are taken from Appendix B of the KEMA Report Table B-2. Appendix G of the KEMA report gives the same value for all Building Types. The following table shows the savings for low wattage T8 lamps and ballast compared to standard T8 lamps.



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Energy and Demand Savings and Incentive Levels: Using the DEER operational hours (Energy) and the CEUS coincidence factors (Demand) the savings are the following (see Table 3 for Interactive Effect):

T8 to low wattage T8 with HEEB		
Building Type	Demand (kW) Savings	Energy (kWh) Savings
All Commercial	0.009	78.1
Misc. Commercial	0.005	78.1
Cold Storage	0.009	75.1
Education	0.004	47.9
Grocery	0.015	105.1
Health	0.012	116.9
Hotel/Motel	0.011	89.2
Misc. Industrial	0.009	77.4
Office	0.009	50.7
Restaurant	0.014	95.3
Retail	0.011	76.0
Warehouse	0.008	75.1

Commercial Lighting Factors

Building Type	Hours of	Peak
All Commercial	4,325	0.50
Misc. Commercial	4,325	0.30
Cold Storage	4,160	0.50
Education	2,653	0.20
Grocery	5,824	0.85
Health	6,474	0.65
Hotel/Motel	4,941	0.60
Misc. Industrial	4,290	0.50
Office	2,808	0.50
Restaurant	5,278	0.75
Retail	4,210	0.60
Warehouse	4,160	0.45

¹ The Database for Energy Efficient Resources (DEER)

² California Commercial End Use Summary (CEUS)

Incentive

Equipment Description	All Commercial Demand (kW) Savings	All Commercial Energy Savings (kWh)	Current Incentive	c /kWh
4'T12 - LW 4'T8	0.01	78.1	\$8.40	\$0.11
4'T8 - LW 4'T8	0.006	78.1	\$5.60	\$0.07



12.1.4 Delamping

Measure ID: See Table 7.3

Measure Code: L023, L024, L025

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007
- Demand Management Programs – KEMA (KEMA 2005-07).
- Econorthwest TRM Review – 6/23/10
- DEER-The Database for Energy Efficient Resources
- The California Energy Commission California Commercial End Use Summary
<http://www.energy.ca.gov/ceus/>
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 6/23/10 Rec. #20 – Break down the savings by lamp size. – Adopted
- 10/5/11 – Currently Under Review.

Major Changes:

- Adjustment of hours and coincidence factors of prior TRM using DEER operational data and CEUS Commercial Data
- Added interactive effect factors for energy and demand Table 3.

Description: The ballasts are re-wired for de-lamping.

Base Efficiency

The base case is no delamping

High Efficiency

The savings for this measure are determined by calculating the average watt reduction by removing either a 32 W T8, or a standard 40 W or reduced wattage 34 W T12 lamp from a standard ballast fixture, magnetic energy saving ballast fixture, or electric ballast fixture. This measure covers 2', 4' and 8' fixtures.

Incremental Cost

\$4 per lamp



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Energy and Demand Savings – see Table 3 for Interactive Effect.

Delamping Avg. Wattage Reduction				
	2' Lamp	3' Lamp	4' Lamp	8' Lamp
Average	18.5	27.5	34.5	77.0

Delamping Energy Reduction				
Building Type	2' Lamp	3' Lamp	4' Lamp	8' Lamp
All Commercial	80.0	118.9	149.2	333.0
Misc. Commercial	80.0	118.9	149.2	333.0
Cold Storage	77.0	114.4	143.5	320.3
Education	49.1	73.0	91.5	204.3
Grocery	107.7	160.2	200.9	448.4
Health	119.8	178.0	223.4	498.5
Hotel/Motel	91.4	135.9	170.5	380.5
Misc. Industrial	79.4	118.0	148.0	330.3
Office	51.9	77.2	96.9	216.2
Restaurant	97.6	145.1	182.1	406.4
Retail	77.9	115.8	145.2	324.2
Warehouse	77.0	114.4	143.5	320.3

Delamping Demand Reduction				
Building Type	2' Lamp	3' Lamp	4' Lamp	8' Lamp
All Commercial	0.009	0.014	0.017	0.039
Misc. Commercial	0.006	0.008	0.010	0.023
Cold Storage	0.009	0.014	0.017	0.039
Education	0.004	0.006	0.007	0.015
Grocery	0.016	0.023	0.029	0.065
Health	0.012	0.018	0.022	0.050
Hotel/Motel	0.011	0.017	0.021	0.046
Misc. Industrial	0.009	0.014	0.017	0.039
Office	0.009	0.014	0.017	0.039
Restaurant	0.014	0.021	0.026	0.058
Retail	0.011	0.017	0.021	0.046
Warehouse	0.008	0.012	0.016	0.035

Commercial Lighting Factors

Building Type	Hours of Operation ¹	Peak Coincidence Factor ²
All Commercial	4,325	0.50
Misc. Commercial	4,325	0.30
Cold Storage	4,160	0.50
Education	2,653	0.20
Grocery	5,824	0.85
Health	6,474	0.65
Hotel/Motel	4,941	0.60
Misc. Industrial	4,290	0.50
Office	2,808	0.50
Restaurant	5,278	0.75
Retail	4,210	0.60
Warehouse	4,160	0.45

¹ The Database for Energy Efficient Resources (DEER)

² California Commercial End Use Summary (CEUS)



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Equipment Description	All Commercial Demand (kW) Savings	All Commercial Energy Savings (kWh)	Current Incentive
Delamping 2'	0.009	80	\$2.50
Delamping 3'	0.014	118.9	N/A
Delamping 4'	0.017	149.2	\$5.00
Delamping 8'	0.039	333	\$7.50



12.1.5 Delamping with Reflectors

Measure ID: See Table 7.3

Measure Code: L023, L024, L025

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- New Buildings Institute, Advanced Lighting Guidelines, 2003
- Energy and Peak Demand Impact Evaluation Report of the 2005-2007
- Demand Management Programs – KEMA (KEMA 2005-07).
- Econorthwest TRM Review – 6/23/10
- DEER-The Database for Energy Efficient Resources
- The California Energy Commission California Commercial End Use Summary
<http://www.energy.ca.gov/ceus/>
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 6/23/10 Rec. #20 – Break down the savings by lamp size. – Adopted
- 10/5/11 – Currently Under Review.

Major Changes:

- Adjustment of hours and coincidence factors of prior TRM using DEER operational data and CEUS Commercial Data
- Added interactive effect factors for energy and demand Table 3.

Description: Putting reflectors on the ballasts allows for more light, with less lamps. The ballasts are re-wired for de-lamping.

Base Case

The base efficiency case is no delamping with reflectors.

High Efficiency

The savings for this measure are determined by calculating the average watt reduction by removing either a 32 W T8, or a standard 40 W or reduced wattage 34 W T12 lamp from a standard ballast fixture, magnetic energy saving ballast fixture, or electric ballast fixture.



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Energy and Demand Savings:

The wattage per lamp varies greatly depending on the size of the lamp. See Table 3 for Interactive Effect.

Building Type	Demand Savings (kW)			
	2' Lamp	3' Lamp	4' Lamp	8' Lamp
All Commercial	0.0090	0.0140	0.0170	0.0390
Misc. Commercial	0.0060	0.0080	0.0100	0.0230
Cold Storage	0.0090	0.0140	0.0170	0.0390
Education	0.0040	0.0060	0.0070	0.0150
Grocery	0.0160	0.0230	0.0290	0.0650
Health	0.0120	0.0180	0.0220	0.0500
Hotel/Motel	0.0110	0.0170	0.0210	0.0460
Misc. Industrial	0.0090	0.0140	0.0170	0.0390
Office	0.0090	0.0140	0.0170	0.0390
Restaurant	0.0140	0.0210	0.0260	0.0580
Retail	0.0110	0.0170	0.0210	0.0460
Warehouse	0.0080	0.0120	0.0160	0.0350

Building Type	Energy Savings (kWh/year)			
	2' Lamp	3' Lamp	4' Lamp	8' Lamp
All Commercial	80.0	118.9	149.2	333
Misc. Commercial	80.0	118.9	149.2	333
Cold Storage	77.0	114.4	143.5	320.3
Education	49.1	73.0	91.5	204.3
Grocery	107.7	160.2	200.9	448.4
Health	119.8	178.0	223.4	498.5
Hotel/Motel	91.4	135.9	170.5	380.5
Misc. Industrial	79.4	118.0	148.0	330.3
Office	51.9	77.2	96.9	216.2
Restaurant	97.6	145.1	182.1	406.4
Retail	77.9	115.8	145.2	324.2
Warehouse	77.0	114.4	143.5	320.3

Incentives

Equipment Description	All Commercial Demand (kW) Savings	All Commercial Energy Savings (kWh)	Current Incentive
Delamping w/ Refl. 2'	0.009	80	\$5.00
Delamping w/ Refl. 3'	0.014	118.9	N/A
Delamping w/ Refl. 4'	0.017	149.2	\$10.00
Delamping w/ Refl. 8'	0.039	333	\$15.00



12.1.6 LED Refrigerated Case Lighting

Measure ID:

Version Date & Revision History

Draft date: October 3, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- 8/13/12 – Measure updated as per EM&V report. The kWh calculations were updated to use new COP and hours per year numbers, and kW numbers were updated respectively.

Measure Description:

This measure involves the replacement of a 40W T8 fluorescent lamp with a 23W LED linear lamp fixtures.

Baseline Efficiencies:

40W F40 T8 Linear Fluorescent Lamp

High Efficiency:

23W LED Linear Lamp

Energy Savings:

223.6 kWh

Demand Savings:

036 kW



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Savings Algorithms

LED Refrigerated Case Lighting

Base: 40W F40 T8 Linear Fluorescent Lamp	0.040 kW	
	17 Hours per Day	
	x 365 Days	6205 Hours per Year
40W F40 T8 kWh/Year	<u>248.2 kWh per Year</u>	
Enhanced: 29W LED Linear Lamp	0.023 kW	
	17 Hours per Day	
	x 365 Days	6205 Hours per Year
LED Fixture kWh/Year	<u>142.7 kWh per Year</u>	
40W F40 T8 kWh/Year	248.2 kWh per Year	
LED Fixture kWh/Year	- 142.7 kWh per Year	
Lamp kWh Savings	<u>105.5 kWh per Year</u>	
Lamp kWh Reduction	105.5 kWh per Year	
% of Lighting Savings reduced from Compressor Load	x 100%	
Cooling Energy Reduced from System	<u>105.5 kWh per Year</u>	
Refrigerator Compressor Efficiency	x 1.12 COP	
Compressor kWh Savings	<u>118.1 kWh per Year</u>	
Lamp kWh Savings	105.5 kWh per Year	
Compressor kWh Savings	+ 118.1 kWh per Year	
Total kWh Savings Per Year	<u>223.6 kWh per Year</u>	

223.6 Annual Energy Savings (kWh)

Annual Energy Savings	223.6 kWh
Compressor kW Savings	÷ 6205 Hours per Year
Total kW Savings Per Year	<u>0.036 kW</u>

0.036 Annual Demand Savings (kW)



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12.1.7 LED

Measure ID:

Measure Code: LED

Version Date & Revision History

Draft date: November 30, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- The Database for Energy Efficient Resources (DEER)
- California Commercial End Use Summary (CEUS)
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- 11/30/11 – Moved *LED Product Customized Process* measure to addendum (section 16.2.1) and created new prescriptive *LED* measure.
- Added interactive effect factors for energy and demand Table 3.

Measure Description: Light Emitting Diodes (LED) are a lighting technology that utilizes solid-state technology to produce light, opposed to fluorescent or incandescent lighting sources. In general, LED technology will provide energy levels 15% of a comparable incandescent lamp (15W to a 100W equivalent).

Baseline & High Efficiency:

25% Dimmable Demand Reduction

Lamp	Base Case Incandescent Demand (kW)	Percent Incandescent Base	Base Case CFL Demand (kW)	Percent CFL Base	Base Mix Demand (kW)	Enhanced Case LED Demand (kW)	LED Demand Savings (kW)	Dimmable LED Demand Savings (kW)
MR16	0.0500	100%	n/a	0%	0.0500	0.0065	0.0435	0.0326
PAR20 8 deg.	0.0600	80%	0.0150	20%	0.0510	0.0086	0.0424	0.0318
PAR20 25 deg.	0.0550	80%	0.0130	20%	0.0466	0.0090	0.0376	0.0282
PAR30 Short Neck	0.0750	80%	0.0200	20%	0.0640	0.0163	0.0477	0.0358
PAR30 Long Neck	0.0750	80%	0.0200	20%	0.0640	0.0163	0.0477	0.0358
PAR38 25 deg.	0.0750	80%	0.0200	20%	0.0640	0.0203	0.0437	0.0328
A-19	0.0600	20%	0.0150	80%	0.0240	0.0078	0.0162	0.0122

Energy Savings by Building/Usage Type (see Table 3 for Interactive Effect):

			Dimmable Commercial Lighting													
			MR16		PAR20 8 deg.		PAR20 25 deg.		PAR30 Short Neck		PAR30 Long Neck		PAR38 25 deg.		A-19	
Building Type	Hours of Operation ¹	Peak Coincidence Factor ²	Energy Savings (kWh/year)	Demand Savings (kW)	Energy Savings (kWh/year)	Demand Savings (kW)	Energy Savings (kWh/year)	Demand Savings (kW)	Energy Savings (kWh/year)	Demand Savings (kW)	Energy Savings (kWh/year)	Demand Savings (kW)	Energy Savings (kWh/year)	Demand Savings (kW)	Energy Savings (kWh/year)	Demand Savings (kW)
All Commercial	4,325	0.50	188.1	0.0218	183.4	0.0212	162.6	0.0188	206.3	0.0239	206.3	0.0239	189.0	0.0219	70.1	0.0081
Misc. Commercial	4,325	0.30	188.1	0.0131	183.4	0.0127	162.6	0.0113	206.3	0.0143	206.3	0.0143	189.0	0.0131	70.1	0.0049
Cold Storage	4,160	0.50	181.0	0.0218	176.4	0.0212	156.4	0.0188	198.4	0.0239	198.4	0.0239	181.8	0.0219	67.4	0.0081
Education	2,653	0.20	115.4	0.0087	112.5	0.0085	99.8	0.0075	126.5	0.0095	126.5	0.0095	115.9	0.0087	43.0	0.0032
Grocery	5,824	0.85	253.3	0.0370	246.9	0.0360	219.0	0.0320	277.8	0.0405	277.8	0.0405	254.5	0.0371	94.3	0.0138
Health	6,474	0.65	281.6	0.0283	274.5	0.0276	243.4	0.0244	308.8	0.0310	308.8	0.0310	282.9	0.0284	104.9	0.0105
Hotel/Motel	4,941	0.60	214.9	0.0261	209.5	0.0254	185.8	0.0226	235.7	0.0286	235.7	0.0286	215.9	0.0262	80.0	0.0097
Misc. Industrial	4,290	0.50	186.6	0.0218	181.9	0.0212	161.3	0.0188	204.6	0.0239	204.6	0.0239	187.5	0.0219	69.5	0.0081
Office	2,808	0.50	122.1	0.0218	119.1	0.0212	105.6	0.0188	133.9	0.0239	133.9	0.0239	122.7	0.0219	45.5	0.0081
Restaurant	5,278	0.75	229.6	0.0326	223.8	0.0318	198.5	0.0282	251.8	0.0358	251.8	0.0358	230.6	0.0328	85.5	0.0122
Retail	4,210	0.60	183.1	0.0261	178.5	0.0254	158.3	0.0226	200.8	0.0286	200.8	0.0286	184.0	0.0262	68.2	0.0097
Warehouse	4,160	0.45	181.0	0.0196	176.4	0.0191	156.4	0.0169	198.4	0.0215	198.4	0.0215	181.8	0.0197	67.4	0.0073

¹ The Database for Energy Efficient Resources (DEER)

² California Commercial End Use Summary (CEUS)



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Non-Dimmable Commercial Lighting																
Building Type	Hours of Operation ¹	Peak Coincidence Factor ²	MR16		PAR20 8 deg.		PAR20 25 deg.		PAR30 Short Neck		PAR30 Long Neck		PAR38 25 deg.		A-19	
			Energy Savings (kWh/year)	Demand Savings (kW)	Energy Savings (kWh/year)	Demand Savings (kW)	Energy Savings (kWh/year)	Demand Savings (kW)	Energy Savings (kWh/year)	Demand Savings (kW)	Energy Savings (kWh/year)	Demand Savings (kW)	Energy Savings (kWh/year)	Demand Savings (kW)	Energy Savings (kWh/year)	Demand Savings (kW)
All Commercial	4,325	0.50	141.1	0.0163	137.5	0.0159	122.0	0.0141	154.7	0.0179	154.7	0.0179	141.8	0.0164	52.5	0.0061
Misc. Commercial	4,325	0.30	141.1	0.0098	137.5	0.0095	122.0	0.0085	154.7	0.0107	154.7	0.0107	141.8	0.0098	52.5	0.0036
Cold Storage	4,160	0.50	135.7	0.0163	132.3	0.0159	117.3	0.0141	148.8	0.0179	148.8	0.0179	136.3	0.0164	50.5	0.0061
Education	2,653	0.20	86.6	0.0065	84.4	0.0064	74.8	0.0056	94.9	0.0072	94.9	0.0072	87.0	0.0066	32.2	0.0024
Grocery	5,824	0.85	190.0	0.0277	185.2	0.0270	164.2	0.0240	208.4	0.0304	208.4	0.0304	190.9	0.0279	70.8	0.0103
Health	6,474	0.65	211.2	0.0212	205.9	0.0207	182.6	0.0183	231.6	0.0233	231.6	0.0233	212.2	0.0213	78.7	0.0079
Hotel/Motel	4,941	0.60	161.2	0.0196	157.1	0.0191	139.3	0.0169	176.8	0.0215	176.8	0.0215	161.9	0.0197	60.0	0.0073
Misc. Industrial	4,290	0.50	140.0	0.0163	136.4	0.0159	121.0	0.0141	153.5	0.0179	153.5	0.0179	140.6	0.0164	52.1	0.0061
Office	2,808	0.50	91.6	0.0163	89.3	0.0159	79.2	0.0141	100.5	0.0179	100.5	0.0179	92.0	0.0164	34.1	0.0061
Restaurant	5,228	0.75	172.2	0.0245	167.8	0.0239	148.8	0.0212	188.8	0.0268	188.8	0.0268	173.0	0.0246	64.1	0.0091
Retail	4,210	0.60	137.4	0.0196	133.9	0.0191	118.7	0.0169	150.6	0.0215	150.6	0.0215	138.0	0.0197	51.2	0.0073
Warehouse	4,160	0.45	135.7	0.0147	132.3	0.0143	117.3	0.0127	148.8	0.0161	148.8	0.0161	136.3	0.0147	50.5	0.0055

¹ The Database for Energy Efficient Resources (DEER)

² California Commercial End Use Summary (CEUS)

Equipment Qualifications: Incentivized LED lamps must be Energy Star labeled.

Incentives

Type	LED Incentive	Dimmable LED Incentive
MR16	\$17.50	\$20.00
PAR20 8 deg.	\$17.50	\$20.00
PAR20 25 deg.	\$17.50	\$20.00
PAR30 Short Neck	\$17.50	\$20.00
PAR30 Long Neck	\$17.50	\$20.00
PAR38 25 deg.	\$17.50	\$20.00
A-19	\$5.00	\$7.50



12.1.8 LED Exit Signs

Measure ID: See Table 7.3

Measure Code: L07

Version Date & Revision History

Draft date: January, 2010

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007 Demand Management Programs – KEMA (KEMA 2005-07).
http://www.energystar.gov/ia/business/small_business/led_exitsigns_techsheets.pdf
- Econorthwest TRM Review – 6/23/10

TRM Review Actions:

- 6/23/10 No Changes
- 10/5/11 – Currently Under Review.

Major Changes:

- No changes

Measure Description:

Replacement of Incandescent Exit Signs with LED Exit Signs. Savings are equal across all building use types.

Baseline Efficiencies:

Demand Baseline has been determined by technical specifications of an incandescent exit sign, which typically holds two 20 W bulbs (40 W). The Energy Baseline is based on 24/7 operation of the sign (8,760 hours).

Building Types	Demand Baseline(kW)	Energy Baseline (kWh)
All Types	0.040	351

High Efficiency:

The typical technical specification on an LED Exit Sign (through energystar.gov) claims “less than 5W” of Demand. The Energy High Efficiency figure is based on 24/7 operation (8,760 hours).

Building Types	Demand High Efficiency (kW)	Energy High Efficiency (kWh)
All Types	0.005	44

Final Savings:

The Impact Evaluation Report by KEMA states that LED exit signs are expected to have high realization ratios and that measured savings were typically 100% of claimed savings. These figures match the suggested savings by the KEMA report.

Building Types	Demand Savings (kW)	Energy Savings (kWh)
All Types	0.035	307



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Saving Algorithm:

Exit Signs - Businesses

Incandescent Exit Sign	0.040 kW	
	24.00 Hours per Day	
	x 365 Days	8,760 Hours per Year
Incandescent Exit Sign	350.4 kWh per Year	
LED Exit Sign	0.005 kW	
	24.00 Hours per Day	
	x 365 Days	8,760 Hours per Year
LED Exit Sign	43.8 kWh per Year	
Incandescent Exit Sign	350.4 kWh per Year	
LED Exit Sign	- 43.8 kWh per Year	
Savings Before Adjustments	306.6 kWh per Year	
Persistence Factor	306.6 kWh per Year	
	x 1.000 pf	0.0% Lamps not installed or replaced back
	307 kWh per Year	

CFL Energy Savings

307 kWh / Year Savings

Incandescent Exit Sign	0.040 kW	
LED Exit Sign	- 0.005 kW	
Demand Reduction Before Adjustments	0.035 kW	
Demand Reduction Before Adjustments	0.035 kW	
Coincidence Factor	1.000 cf	100.0% Lamps on between 5 and 9 p.m.
Persistence Factor	x 1.000 pf	0.0% Lamps not installed or replaced back
	0.035 kW	

CFL Demand Savings

0.035 kW Savings

Incentive
\$25



12.1.10 HID Pulse Start Metal Halide

Measure ID: See Table 7.3

Measure Code: L011, L012, L013

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007
- Demand Management Programs – KEMA (KEMA 2005-07).
- Econorthwest TRM Review – 6/23/10
- DEER-The Database for Energy Efficient Resources
- The California Energy Commission California Commercial End Use Summary
<http://www.energy.ca.gov/ceus/>
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 6/23/10 Rec. #17 – Break down savings by wattage ranges pulse start metal halides- Adopted
- 10/5/11 – Currently Under Review.

Major Changes:

- Wholesale replacement of prior TRM using DEER operational data and CEUS Commercial Data
- Added interactive effect factors for energy and demand Table 3.
- Updated document regarding persistence and coincident factors based on EM&V review.

Referenced Documents:

Description: Traditional probe-start metal halide lamps do not use an igniter and require three electrical contacts to ignite the gas and remain lit. Recently developed pulse-start metal halide lamps use only two contacts and use an igniter located inside the ballast pod. Pulse-start lamps offer higher light output per unit of electric power. Multiple Wattages of Pulse-Start Metal Halides are installed. The most common have rated wattages between 100 and 250, with the majority of installations being 250 W.

Incremental Cost

\$150 (320W PS Replacing 400W HID)

Base Case

Probe start metal halide

High Efficiency

Lower wattage pulse start metal halide



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Energy Savings

The savings for pulse start metal halide fixtures are calculated based on a wattage savings for the replacement of a metal halide fixture with a smaller wattage pulse start metal halide fixture. Based on the wattages provided, it appears that it was assumed that a 175W metal halide fixture would be replaced with a 100W pulse start metal halide fixture, 250W metal halide fixture would be replaced with either a 150W or 175W pulse start metal halide fixture, and a 400W metal halide would be replaced with a 250W pulse start metal halide fixture. Based on the expected fixture wattages and breakdown of fixture installations, an average savings of 123W per fixture was assumed.

Measure	Metal Halide (W)	Pulse Start Metal Halide (W)
Equivalent Replacement	175	100
	250	150 or 175
	400	250

Savings

	Pulse Start Wattage Reduction		
	<=100W	101-200W	201-350W
Average	48	70	109



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Energy Savings: Using the DEER operational hours the energy savings are (see Table 3 for Interactive Effect):

Building Type	Pulse Start Energy Reduction		
	<=100W	101-200W	201-350W
All Commercial	209.0	302.0	471.4
Misc. Commercial	209.0	302.0	471.4
Cold Storage	201.1	290.4	453.4
Education	128.2	185.2	289.2
Grocery	281.5	406.6	634.8
Health	312.9	452.0	705.7
Hotel/Motel	238.8	345.0	538.6
Misc. Industrial	207.4	299.5	467.6
Office	135.7	196.0	306.1
Restaurant	255.1	368.5	575.3
Retail	203.5	293.9	458.9
Warehouse	201.1	290.4	453.4

Demand Savings: Using the CEUS coincidence factors the demand savings are (see Table 3 for Interactive Effect):

Building Type	Pulse Start Demand Reduction		
	<=100W	101-200W	201-350W
All Commercial	0.024	0.035	0.055
Misc. Commercial	0.015	0.021	0.033
Cold Storage	0.024	0.035	0.055
Education	0.010	0.014	0.022
Grocery	0.041	0.059	0.093
Health	0.031	0.045	0.071
Hotel/Motel	0.029	0.042	0.065
Misc. Industrial	0.024	0.035	0.055
Office	0.024	0.035	0.055
Restaurant	0.036	0.052	0.082
Retail	0.029	0.042	0.065
Warehouse	0.022	0.031	0.049



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Pulse Start Operational Hours and Peak Coincidence Factors:

Commercial Lighting Factors

Building Type	Hours of Operation¹	Peak Coincidence Factor²
All Commercial	4,325	0.50
Misc. Commercial	4,325	0.30
Cold Storage	4,160	0.50
Education	2,653	0.20
Grocery	5,824	0.85
Health	6,474	0.65
Hotel/Motel	4,941	0.60
Misc. Industrial	4,290	0.50
Office	2,808	0.50
Restaurant	5,278	0.75
Retail	4,210	0.60
Warehouse	4,160	0.45

¹ The Database for Energy Efficient Resources (DEER)

² California Commercial End Use Summary (CEUS)



12.1.12 Induction

Measure ID: See Table 7.3
Measure Code: L011, L012, L013

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2011
End date: June 30, 2012

Referenced Documents:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007
- Demand Management Programs – KEMA (KEMA 2005-07).
- Econorthwest TRM Review – 6/23/10
- DEER-The Database for Energy Efficient Resources
- The California Energy Commission California Commercial End Use Summary
<http://www.energy.ca.gov/ceus/>
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- Wholesale replacement of prior TRM using DEER operational data and CEUS Commercial Data
- Added interactive effect factors for energy and demand Table 3.

Description:

This measure involves the installation of induction lighting to replace high intensity discharge (HID) lighting. The calculation breaks down the savings into two different size bins; induction fixtures that are less than 100W, and those that are greater than 100W.

Base Case

- (For Induction Lighting < 100W) - 45 W Induction lamp compared to 75W Metal Halide lamp
- (For Induction Lighting > 100W) – 150W Induction lamp compared to 250W Metal Halide lamp

High Efficiency Case

The high efficiency case is utilizing induction Lighting



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Energy and Demand Savings

See Table 3 for Interactive Effect.

Commercial Lighting Factors			< 100W		> 100W	
Building Type	Hours of Operation ¹	Peak Coincidence Factor ²	Energy Savings (kWh/year)	Demand Savings (kW)	Energy Savings (kWh/year)	Demand Savings (kW)
All Commercial	4,325	0.50	163	0.019	567	0.066
Misc. Commercial	4,325	0.30	163	0.011	567	0.039
Cold Storage	4,160	0.50	157	0.019	545	0.066
Education	2,653	0.20	100	0.008	348	0.026
Grocery	5,824	0.85	220	0.032	763	0.111
Health	6,474	0.65	244	0.025	848	0.085
Hotel/Motel	4,941	0.60	186	0.023	647	0.079
Misc. Industrial	4,290	0.50	162	0.019	562	0.066
Office	2,808	0.50	106	0.019	368	0.066
Restaurant	5,278	0.75	199	0.028	691	0.098
Retail	4,210	0.60	159	0.023	552	0.079
Warehouse	4,160	0.45	157	0.017	545	0.059

¹ The Database for Energy Efficient Resources (DEER)

² California Commercial End Use Summary (CEUS)



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Savings Algorithm

Induction Lighting < 100 W

Base Case (Metal Halide)	75 Watts
Ballast Factor	1.18
Demand	88.69 Watts
Demand	0.09 kW
Hours of Operation	4325 hours/year
Base Case Energy Usage	383.57 kWh/year
Base Case Demand	0.09 kW

High Efficiency Case (Induction)	49 Watts
Ballast Factor	1.00
Demand	49.00 Watts
Demand	0.05 kW
Hours of Operation	4325 hours/year
High Efficiency Energy Usage	211.93 kWh/year

Energy Savings Before Adjustments	171.65 kWh/year
Persistence Factor	x 0.95
Energy Savings	163.07 kWh/year

Induction Lighting < 100 W Energy Savings 163.07 kWh/year

Base Case Demand	0.09 kW
High Efficiency Demand	- 0.05 kW
Demand Reduction Before Adjustments	0.04 kW

Demand Reduction Before Adjustments	0.04 kW
Coincidence Factor	0.50 kW
Persistence Factor	x 0.95 kW
	0.019 kW

Induction Lighting < 100 W Demand Savings 0.019 kW



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Savings Algorithm

Induction Lighting > 100 W

Base Case (Metal Halide)	250 Watts
Ballast Factor	1.18
Demand	295.90 Watts
Demand	0.30 kW
Hours of Operation	4325 hours/year
Base Case Energy Usage	1,279.77 kWh/year
Base Case Demand	0.30 kW

High Efficiency Case (Induction)	158 Watts
Ballast Factor	1.00
Demand	158.00 Watts
Demand	0.16 kW
Hours of Operation	4325 hours/year
High Efficiency Energy Usage	683.35 kWh/year

Energy Savings Before Adjustments	596.42 kWh/year
Persistence Factor	x 0.95
Energy Savings	566.60 kWh/year

Induction Lighting > 100 W Energy Savings 566.60 kWh/year

Base Case Demand	0.30 kW
High Efficiency Demand	- 0.16 kW
Demand Reduction Before Adjustments	0.14 kW

Demand Reduction Before Adjustments	0.14 kW
Coincidence Factor	0.50 kW
Persistence Factor	x 0.95 kW
	0.066 kW

Induction Lighting > 100 W Demand Saving 0.066 kW



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Incentive

Existing:

Induction lighting < 100 W = \$45

Induction lighting > 100 W = \$60

New Construction:

Induction lighting < 100 W = \$25

Induction lighting > 100 W = \$35

Incremental Cost

Induction lighting < 100 W = \$200

Induction lighting > 100 W = \$800

Measure Life

2 year (DEER) – Is this correct or typo from DEER list?



12.1.13 Sensors

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

Occupancy sensors can reduce lighting costs by up to 50% in rooms where lights are frequently left on when no one is around."

According to the Federal Energy Management Program (FEMP) of the US Department of Energy, in a small, private office, an occupancy sensor can reduce energy use by almost 30% shaving 100kWh off the annual energy use. In a large open office area, energy use can be reduced by approximately 10%.

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- TRM measure previously discussed using smart-strips with occupancy sensors. Changed to occupancy sensors for lighting as intended in the annual plan. Updated energy conservation numbers accordingly.

Measure Description:

This measure is for wall switch sensors that controls the use of lighting in areas around the home with variable use such as laundry, storage, garage, bedrooms or spare areas.

Occupancy sensors must comply with:

- Energy Star
- UL Listing

Baseline Efficiencies:

The base case is two (2) 32W T8 fluorescent lamp.

High Efficiency:

The high efficiency case is 33% reduced run time from the base case.

Energy Savings:

Energy savings is calculated at 67.8 kWh per year per sensor.



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Savings Algorithms

Room Occupancy Sensors - Commercial

4' T8 Lamp	0.032 kW	
Two (2) - Lamp	<u>2.0</u>	
	0.064	
Ballast Factor	<u>0.880</u>	
	0.056 kW	
	10.00 Hours per Day	
	x 365 Days	839.5 Hours per Year
Baseline Energy Usage	<u>205.6 kWh per Year</u>	
Run Time Reduced (RTR)	3.30 Hours per Day	33%
	205.6 kWh per Year	
	x 0.33	33% Run Time Reduced
	<u>67.8 kWh per Year</u>	

Energy Savings 67.8 kWh / Year Savings

Two Lamp Demand Reduction Before Adjustments	0.056 kW	
Coincidence Factor	0.120 cf	12.0% Lamps on between 5 and 9 p.m.
Persistence Factor	x 1.000 pf	100.0%
	<u>0.0068 kW</u>	

Demand Savings 0.0068 kW Savings

Operating Hours

10 hours per day

Loadshape

TBD



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Freeridership/Spillover Factors

TBD

Coincidence

CF = 0.12 (12% lamps on between 5PM – 9PM)

Persistence

PF = 1.0

Lifetime

8 years (DEER)

Measure Costs and Incentive Levels

Measure	Incentive	Incremental Cost
Occupancy Sensor	\$ 20.00	\$ 30.00

Component Costs and Lifetimes Used in Computing O&M Savings

TBD



12.1.14 Daylighting

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

This measure is currently evaluated and incentivized through the custom program.



12.2 High Efficiency HVAC

12.2.1 Chiller

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Econorthwest TRM Review – 6/23/10
- IECC 2006

TRM Review Actions:

- 6/23/10 Rec. #23 – Utilize IECC 2006 Efficiencies as the Baseline Efficiency and Efficient Packaged Unit 15% better than IECC 2006 – Adopted
- 6/23/10 Rec. #24 - break down the savings by chiller type and size. Conduct additional research for future program years to calibrate claimed savings for Hawaii customer base.- Adopted

Major Changes:

- Chiller efficiency selected at 15% improvement over IECC 2006.

Description: The replacement of chillers with Energy Efficiency above the code efficiency values in place at the time of permitting the project. In multiple unit chiller plants, a review of operational chillers will be conducted to determine what fraction of installed chillers will be incentivized. This is to avoid paying for standby units.

High Efficiency Chiller - 15% higher than IECC 2006

		IECC 2006 IPLV (kW/Ton)	Hawaii Energy Premium Efficiency (kW/Ton)
Reciprocating	All	0.70	0.60
Rotary Screw and Scroll	< 150 tons	0.68	0.58
	150-300 tons	0.63	0.54
	> 300 tons	0.57	0.48
Centrifugal	< 150 tons	0.67	0.57
	150-300 tons	0.60	0.51
	> 300 tons	0.55	0.47



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Energy Savings:

High Efficiency Chiller - 15% higher than IECC 2006 - Energy Reduction (kWh/Ton)

Building Type	Recipricating All	Rotary Screw or Scroll			Centrifugal		
		<150	150-300	>300	<150	150-300	>300
All Commercial	312.5	303.6	281.2	254.4	299.1	267.8	245.5
Misc. Commercial	312.5	303.6	281.2	254.4	299.1	267.8	245.5
Cold Storage	536.7	521.3	483.0	437.0	513.7	460.0	421.7
Education	307.9	299.1	277.1	250.7	294.7	263.9	241.9
Grocery	536.7	521.3	483.0	437.0	513.7	460.0	421.7
Health	435.7	423.3	392.1	354.8	417.0	373.5	342.3
Hotel/Motel	312.4	303.5	281.2	254.4	299.0	267.8	245.5
Misc. Industrial	435.7	423.3	392.1	354.8	417.0	373.5	342.3
Office	520.1	505.3	468.1	423.5	497.8	445.8	408.7
Restaurant	349.0	339.0	314.1	284.2	334.1	299.2	274.2
Retail	273.9	266.1	246.5	223.1	262.2	234.8	215.2
Warehouse	536.7	521.3	483.0	437.0	513.7	460.0	421.7

Demand Savings:

High Efficiency Chiller - 15% higher than IECC 2006 - Demand Reduction (kW/Ton)

Building Type	Recipricating All	Rotary Screw or Scroll			Centrifugal		
		<150	150-300	>300	<150	150-300	>300
All Commercial	0.064	0.062	0.058	0.052	0.061	0.055	0.050
Misc. Commercial	0.064	0.062	0.058	0.052	0.061	0.055	0.050
Cold Storage	0.072	0.070	0.065	0.059	0.069	0.062	0.057
Education	0.084	0.082	0.076	0.068	0.080	0.072	0.066
Grocery	0.056	0.054	0.050	0.045	0.053	0.048	0.044
Health	0.071	0.069	0.064	0.058	0.068	0.061	0.056
Hotel/Motel	0.055	0.053	0.049	0.044	0.052	0.047	0.043
Misc. Industrial	0.064	0.062	0.058	0.052	0.061	0.055	0.050
Office	0.048	0.047	0.043	0.039	0.046	0.041	0.038
Restaurant	0.056	0.054	0.050	0.045	0.053	0.048	0.044
Retail	0.069	0.067	0.062	0.056	0.066	0.059	0.054
Warehouse	0.063	0.061	0.057	0.051	0.060	0.054	0.050

Measure Life

20 years (DEER)

Incentive

\$50 / Ton



12.2.2 VFD – Chilled Water

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007
- Demand Management Programs – KEMA (KEMA 2005-07).
- Econorthwest TRM Review – 6/23/10
- IECC 2006

TRM Review Actions:

- 6/23/10 Rec. #25 - Breakdown the savings by building types. Conduct additional research for future program years to calibrate claimed savings for Hawaii customer base – Adopted
- 10/5/11 – Currently Under Review.

Major Changes:

- Energy savings separated into building type breakdown.

Description: The installation of variable frequency drives on chilled and/or condenser water pumps used in HVAC systems.

Qualification

- Require pre-notification before projects begin.
- The program reserves the right to perform on-site verifications, both pre- and post-installation.
- Existing equipment must not have a VFD. (i.e. – incentives are not available for replacement)
- For existing facilities, motor hp must be between 3 and 100.
- For new facilities, motor hp must be between 3 and 50.
- The VFDs must actively control and vary the pump speed.

Energy and Demand Savings

Energy Savings = 902.7 kWh per HP

Demand Savings = 0.245 kW per HP



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HVAC Pump Motor VFD

DSMIS Values for All Commercial

kW = 0.245 per HP

kWh = 902.7 per HP

KEMA 2008 Values for All Commercial (HECO):

kW = none available

kWh = none available

Base Pump Motor Use:

Base HP =	10 HP	Example
Motor Efficiency =	92%	Estimated Typical
Average Load =	75%	Estimated Typical
HP to kW conversion =	0.746	

kW load = $HP \times 0.746 \times \% \text{ Load/eff}$ = 6.1 kW

Hours of operation = 6000 hours Estimated

kWh Used Annually = kW load * Hours = 36,489

Pump Motor Savings with VFD:

Energy Savings percentage = 24.74% Needed to meet the kWh savings from DSMIS

kWh savings = % savings * kWh annual use = 9,027 kWh

kW average savings = kWh savings/Hours = 1.50 kW

kW savings = average kW savings * CF = 2.45 kW Based on DSMIS value of 245 watts per HP

CF needed = kW savings (program) / kW average = 1.63

Incentive
\$80/HP



12.2.3 VFD – AHU

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Energy and Peak Demand Impact Evaluation Report of the 2005-2007
- Demand Management Programs – KEMA (KEMA 2005-07).
- Econorthwest TRM Review – 6/23/10
- IECC 2006
- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 6/23/10 Rec. #25 - Breakdown the savings by building types. Conduct additional research for future program years to calibrate claimed savings for Hawaii customer base – Adopted
- 10/5/11 – Currently Under Review.

Major Changes:

- Energy savings separated into building type breakdown.
- Updated energy and demand savings based on EM&V review.

Description: The installation of variable frequency drives on fans used in HVAC systems.

Values for this measure are not called out in the KEMA report. The DSMIS values for this measure are 200 watts and 760.9 kWh per horsepower. The primary assumption used for the savings calculation is that the percentage savings of the energy used before the VFD is applied. This percent savings is shown in the calculations below as about 21%. Based on information from the EPRI Adjustable Speed Drive directory and comparing energy use for outlet damper, inlet damper and VFD controls the average savings for this profile would be 50% for replacement of an outlet damper and 33% for replacement of an inlet damper. See table below.

Percentage of Full Load Power				Power Savings %	
% Flow	Outlet Dampers	Inlet Dampers	VFD	Outlet Savings	Inlet Savings
100	111	109	105	6	4
90	107	93	73	34	20
80	104	82	57	47	25
70	99	75	44	55	31
60	94	69	32	62	37
50	87	65	21	66	44
40	80	63	14	66	49
30	72	60	8	64	52
Average				50	33

Therefore, the 21% of base case savings used in to match the DSMIS values in the calculations below appears to be reasonable and possibly conservative. The actually savings for the customer will depend on many factors related to their type of building, system and hours of operation.



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VFD AHU – Energy and Demand Savings:

Building Type	Hours	Demand Savings (kW/HP)	Energy Savings (kWh/HP)
All Commercial	3,720	0.20	471.69
Misc. Commercial	3,720	0.20	471.69
Cold Storage	6,389	0.20	810.12
Education	3,665	0.20	464.72
Grocery	6,389	0.20	810.12
Health	5,187	0.20	657.71
Hotel/Motel	3,719	0.20	471.57
Misc. Industrial	5,187	0.20	657.71
Office	6,192	0.20	785.14
Restaurant	4,155	0.20	526.85
Retail	3,261	0.20	413.49
Warehouse	6,389	0.20	810.12

Example Calculation:

HVAC Fan Motor VFD

DSMIS Values for All Commercial

kW = 0.200 per HP

kWh = 760.9 per HP

KEMA 2008 Values for All Commercial (HECO):

kW = none available

kWh = none available

Base Pump Motor Use:

Base HP =	10 HP	Example
Motor Efficiency =	92%	Estimated Typical
Average Load =	75%	Estimated Typical
HP to kW conversion =	0.746	

kW load = $HP \times 0.746 \times \% \text{ Load/eff}$ = 6.1 kW

Hours of operation = 3,720 hours Estimated

kWh Used Annually = kW load * Hours = 22,623 22623.26

Pump Motor Savings with VFD:

Energy Savings percentage = 20.85% Needed to meet the kWh savings from DSMIS

kWh savings = % savings * kWh annual use = 4,717 kWh

kW average savings = kWh savings/Hours = 1.268 kW

kW savings = average kW savings * CF = 2.0 kW Based on DSMIS value of 200 watts per HP

CF needed = kW savings (program) / kW average = 1.58



12.2.4 Garage Demand Ventilation Control

Measure ID: See Table 7.3 (TBD)

Measure Code:

Version Date & Revision History

Draft date: October 3, 2011

Effective date: October 1, 2011

End date: June 30, 2012

Referenced Documents:

- ASHRAE Standard 62
- International Mechanical Code
- Department of Health (DOH) Title 11 Chapter 39 (Air Conditioning and Ventilation)

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- New program offering.
- 11/22/11 – Under *Description*, the phrase “City Codes” was changed to “Codes” for accuracy.

Description:

Demand-controlled ventilation (DCV) using carbon monoxide (CO) sensing is a combination of two technologies: Sensors that monitor CO levels in the parking garage, and an air-handling system that uses data from the sensors to regulate the amount of ventilation air admitted. CO sensors continually monitor the air in a parking garage. Given a predictable activity level, automobiles will exhaust CO at a predictable level. Thus CO production in the parking garage will closely track activity. Given these two characteristics, a CO measurement can be used to measure and control the amount of outside air that is being introduced to dilute the CO generated by automobiles. The result is that ventilation rates can be measured and controlled to a specific cfm/ft². This is in contrast to the traditional method of ventilating at a fixed rate regardless of occupancy.

City codes for enclosed parking areas require ventilation during all hours of operation to protect against an unhealthful build-up of carbon monoxide (CO). As a result, exhaust fans generally run 100% of operating hours. Although some buildings use timers to cut fan run time, it is important to note that the use of timers may not meet code compliance and health considerations. To achieve major energy savings and meet all health requirements, carbon monoxide sensors have now been authorized by code and mandated in some jurisdictions for new construction. Sensors measure CO levels, activating fans only when necessary to maintain CO at an acceptable level, saving upwards to 90% of energy cost.

Program Requirements:

1. Pre-notification before equipment is purchased and installed.
2. New construction is not eligible.
3. Incentive amount not to exceed Installed Cost.
4. Failure of devices causes the exhaust fans to operate in the ON position

Energy and Demand Savings:

All assumptions, data and formulas used in the calculations must be clearly documented. Standard engineering principles must be applied, and all references cited. Pre and post monitoring will be conducted to determine measured energy and demand savings.



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Savings Algorithms

Gross energy and demand savings estimates for custom projects are calculated using engineering analysis and project-specific details including pre and post monitoring. A physical fan motor audit will be performed as well as spot amperage checks and logging of pre and post operational times.

Baseline Efficiency

The baseline efficiency case assumes compliance with the efficiency requirements as mandated by the Hawaii State Energy Code or industry accepted standard practice.

High Efficiency

The high efficiency case is the installation of a parking garage ventilation demand control device utilizing carbon monoxide sensors.

Persistence Factor

PF = 1 since all custom projects require verification of equipment installation.

Incentives

- \$0.18/kWh
- Incentives is limited to 100% of incremental costs.
- Installations are subject to inspection for up to 5 years. Removal will be cause for incentive forfeiture.

Measure Life

5 years



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Example

						100%	1.0%						
						8,760 hr/yr.	88 hr/yr.						
Zone	New Fan Tag	Fan Location	Old Fan Tag	HP	Measured kW	6/7 to 6/15			Notes				
1	GEF-1	1-B	PEF-2	10.0	7.2	63,072	631	100.0%	Data logger installed	7.5	0.3	96.5%	
	GSF-1	1-B	PSF-4	5.0	3.4	29,784	298			3.7	0.3	91.2%	
	GSF-2	1-B	PSF-4	5.0	3.4	29,784	298			3.7	0.3	91.2%	
2	GEF-3	2-B	PEF-2	10.0	7.7	67,452	675		Data logger installed	7.5	(0.2)	103.2%	
	GSF-3	2-B	PSF-4	10.0	7.5	65,700	657	100.0%		7.5	(0.0)	100.5%	
3	GEF-6	3-B	PEF-2	10.0	7.4	64,824	648	99.9%	Data logger installed	7.5	0.1	99.2%	
	GSF-4	3-B	PSF-2	10.0	7.4	64,824	648	100.0%		7.5	0.1	99.2%	
4	GEF-9	4-B	PEF-1	7.5	4.5	39,420	394	100.0%	Data logger installed	5.6	1.1	80.4%	
	GEF-10	4-B	PEF-4	3.0	2.6	22,776	228			2.2	(0.4)	116.2%	
5	GEF-7	4-A	PEF-1	7.5	4.5	39,420	394		Data logger installed	5.6	1.1	80.4%	
	GSF-5	4-A	PSF-3	7.5	5.8	50,808	508	100.0%		5.6	(0.2)	103.7%	
6	GEF-11	5-A	PEF-1	7.5	4.9	42,924	429		Data logger installed	5.6	0.7	87.6%	
	GSF-6	5-A	PSF-3	7.5	5.8	50,808	508	100.0%		5.6	(0.2)	103.7%	
7	GEF-13	6-A	PEF-2	10.0	7.5	65,700	657		Data logger installed	7.5	(0.0)	100.5%	
	GSF-7	6-A	PSF-3	7.5	5.0	43,800	438	100.0%		5.6	0.6	89.4%	
8	GEF-2	1-B	PEF-1	7.5	3.6	31,536	315		Data logger installed	5.6	2.0	64.3%	
	GEF-4	2-A	PEF-2	10.0	7.4	64,824	648			7.5	0.1	99.2%	
	GEF-5	3-A	PEF-3	5.0	3.1	27,156	272			3.7	0.6	83.1%	
	GEF-8	4-A	PEF-3	5.0	3.1	27,156	272			3.7	0.6	83.1%	
	GEF-12	5-A	PEF-1	7.5	4.9	42,924	429	99.9%		5.6	0.7	87.6%	
GEF-14					6-A	PEF-4	3.0	2.4		2.2	(0.2)	107.2%	
TOTALS					156.0	109.1	kW						
					Coincidence Factor	1.0			Pre-Project	955,716	9,557	116.4	7.3
					On Peak Demand Savings	109.1	kW		Post-Project	(9,557)			
					Energy Savings per Year	946,159	kWh						

109.1 kW
Demand Cost per Unit \$ 12.60 /kW month
Demand Cost Savings \$ 1,375 /month
12 months
\$ 16,496 /Year

946,159 kWh/yr.
Energy Cost per Unit \$ 0.21 /kWh
Energy Cost Savings \$ 200,586 /yr.

Incentive \$ 0.18

Demand Cost Savings \$ 16,496
Energy Cost Savings \$ 200,586
\$ 217,082 /yr.

Project Cost	\$ 152,323
Incentive not to exceed 100% of project cost	170,308.6
Incentive	152,323.0



12.2.5 Package Unit AC

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Econorthwest TRM Review – 6/23/10
- Econorthwest Email Correspondence – 1/23/12
- IECC 2006, pg. 34

TRM Review Actions:

- 6/23/10 Rec. #21 – Utilize IECC 2006 Efficiencies as the Baseline Efficiency and Efficient Packaged Unit 15% better than IECC 2006 – Adopted
- 6/23/10 Rec. #22 - Break down packaged AC savings based on equipment size. – Adopted
- 10/5/11 – Currently Under Review.

Major Changes:

- Package chiller unit AC efficiency selected at 15% improvement over IECC 2006.
- 12/12/11 – kW/ton and EER values updated to match IECC 2006 package unit values as per Econorthwest's direction, high efficiency numbers adjusted accordingly. Energy & demand savings updated accordingly.

Description: The replacement of package and split unit air conditioners with Energy Efficiency above the Hawaii Model Energy Code.

Package Units

Unit Size (Btu/Hr.)	IECC 2006 Efficiency		Hawaii Energy Premium Efficiency	
	(kW/ton)	SEER/EER	(kW/ton)	SEER/EER
< 65,000	1.364	9.7 SEER	1.159	11.2 SEER
65,000 to 134,999	1.165	10.3 EER	0.990	11.8 EER
135,000 to 239,999	1.237	9.7 EER	1.052	11.2 EER
240,000 to 759,999	1.263	9.5 EER	1.074	10.9 EER
> 760,000	1.304	9.2 EER	1.109	10.6 EER



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Energy Savings

Package Unit AC - 15% higher than IECC 2006 - Energy Reduction - kWh

Building Type	< 65,000	65,001 to 135,000	135,001 to 240,000	240,001 to 760,000	> 760,000
All Commercial	608.7	520.1	552.2	563.9	582.3
Misc. Commercial	608.7	520.1	552.2	563.9	582.3
Cold Storage	1,045.4	893.2	948.5	968.4	1,000.0
Education	599.7	512.4	544.1	555.5	573.7
Grocery	1,045.4	893.2	948.5	968.4	1,000.0
Health	848.8	725.2	770.0	786.2	811.9
Hotel/Motel	608.5	519.9	552.1	563.7	582.1
Misc. Industrial	848.8	725.2	770.0	786.2	811.9
Office	1,013.2	865.7	919.2	938.6	969.2
Restaurant	679.9	580.9	616.8	629.8	650.3
Retail	533.6	455.9	484.1	494.3	510.4
Warehouse	1,045.4	893.2	948.5	968.4	1,000.0

Demand Savings

Package Unit AC - 15% higher than IECC 2006 - Demand Reduction - kW

Building Type	< 65,000	65,001 to 135,000	135,001 to 240,000	240,001 to 760,000	> 760,000
All Commercial	0.102	0.087	0.093	0.095	0.098
Misc. Commercial	0.061	0.052	0.056	0.057	0.059
Cold Storage	0.102	0.087	0.093	0.095	0.098
Education	0.041	0.035	0.037	0.038	0.039
Grocery	0.174	0.149	0.158	0.161	0.166
Health	0.133	0.114	0.121	0.123	0.127
Hotel/Motel	0.123	0.105	0.111	0.114	0.117
Misc. Industrial	0.102	0.087	0.093	0.095	0.098
Office	0.102	0.087	0.093	0.095	0.098
Restaurant	0.153	0.131	0.139	0.142	0.147
Retail	0.123	0.105	0.111	0.114	0.117
Warehouse	0.092	0.079	0.084	0.085	0.088



12.2.6 Inverter Variable Refrigerant Flow (VRF) Split Air Conditioning Systems

Measure ID: See Table 7.3 (TBD)

Measure Code: Inverter VRF AC

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- Original TRM values was divided by .8 but have been corrected to be multiplied by 1.2 in order to obtain a 20% increase in efficiency.

Description: Inverter driven variable refrigerant flow (VRF) air conditioning systems are direct expansion AC systems that utilize variable speed evaporator/condenser fans, and a combination of fixed and variable speed compressors along with most often multiple individual zone evaporators to provide the ability to more closely match the AC system's output with the building's cooling requirements. Savings comes from:

- *Part Load Efficiencies:* Increased part-load efficiency operation
- *High Efficiency Motors:* Many systems use ECM motors
- *Higher Room Temperatures:* The capacity matching allows for better humidity control through longer cooling operation.
- *Reduction of Distribution Losses:* Duct losses are reduced with DX systems. This may be offset by dedicated outside air distribution systems when needed.

Payback Qualifications: VRF products need a payback requirement of 1 year or greater. The TRB/TRC must be greater than 1.

Energy and Demand Savings: VRF systems have demonstrated a 20-30% reduction in energy consumption as compared to standard DX equipment. The energy savings and demand tables that follow provide the savings by building type and system size for VRF systems. These figures are conservatively determined to be 20% greater than provided by the "Standard" Package Unit AC measures that require EERs 15% greater than IECC 2006 requirements.

The VRF applications have been new construction projects with no ability to perform pre and post measurements. Hawaii Energy will perform field pre and post field measurements to determine the measure effectiveness in the local environment



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Variable Refrigerant Flow AC

20% better than Non-VRF with efficiencies 15% over IECC 2006 - Energy Reduction

Building Type	< 65,000	65,001 to 135,000	135,001 to 240,000	240,001 to 760,000	> 760,000
All Commercial	494.5	636.5	676.7	676.7	698.8
Misc. Commercial	494.5	636.5	676.7	676.7	698.8
Cold Storage	849.2	1,093.1	1,162.1	1,162.1	1,200.0
Education	487.2	627.0	666.6	666.6	688.4
Grocery	849.2	1,093.1	1,162.1	1,162.1	1,200.0
Health	689.5	887.4	943.4	943.4	974.3
Hotel/Motel	494.4	636.2	676.4	676.4	698.5
Misc. Industrial	689.5	887.4	943.4	943.4	974.3
Office	823.1	1,059.4	1,126.3	1,126.3	1,163.0
Restaurant	552.2	710.9	755.8	755.8	780.4
Retail	433.4	557.9	593.2	593.2	612.5
Warehouse	849.2	1,138.6	1,162.1	1,162.1	1,200.0

Variable Refrigerant Flow AC

Same as Non-VRF with efficiencies 15% over IECC 2006 - Demand Reduction

Building Type	< 65,000	65,001 to 135,000	135,001 to 240,000	240,001 to 760,000	> 760,000
All Commercial	0.069	0.089	0.095	0.095	0.098
Misc. Commercial	0.042	0.053	0.057	0.057	0.059
Cold Storage	0.069	0.089	0.095	0.095	0.098
Education	0.028	0.036	0.038	0.038	0.039
Grocery	0.118	0.151	0.161	0.161	0.166
Health	0.090	0.116	0.123	0.123	0.127
Hotel/Motel	0.083	0.107	0.114	0.114	0.117
Misc. Industrial	0.069	0.089	0.095	0.095	0.098
Office	0.069	0.089	0.095	0.095	0.098
Restaurant	0.104	0.134	0.142	0.142	0.147
Retail	0.083	0.107	0.114	0.114	0.117
Warehouse	0.062	0.080	0.085	0.085	0.088



12.3 High Efficiency Water Heating

12.3.1 Commercial Solar Water Heating

Measure ID: See Table 7.3 (TBD)

Measure Code: High Efficiency Water Heating – Solar Water Heating

Version Date & Revision History

Draft date: May 30, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

Replacement of a Standard Electric Resistance Water Heater (SERWH) or heat pump with a Solar Water Heater. Solar equipment must comply with Solar Rating and Certification Corporation (SRCC) standards.

Baseline Efficiencies:

Baseline usage is a 0.9 COP Electric Resistance Water Heater or heat pump with a COP of 3.5.

The baseline water heater energy consumption is by a single 4.0 kW electric resistance element that is controlled thermostatically on/off controller based of tank finish temperature set point. The tank standby loss differences between baseline and high efficiency case are assumed to be negligible.

The baseline water heater energy consumption by a heat pump is 6.0 kW.

Energy Savings

Base Case	Annual Energy Savings (kWh/year) (per 5,000 BTU capacity derated)	Demand Savings (kW)
Standard Electric Resistance Water Heater (COP = 0.9)	429	0.46
Heat Pump (COP 3.5)	32	0.75



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Savings Algorithm (Standard Electric Water Heater) – BASE CASE

Commercial Solar Water Heating - Standard Electric Water Heater (SERWH) - BASE CASE

Energy per Day (BTU) Needed in Tank	5,000 BTU/Day	
Energy per Day (BTU) Needed in Tank	5,000 BTU/Day	
BTU to kWh Energy Conversion	÷ 3,412 kWh / BTU	
Energy per Day (kWh)	1.5 kWh / Day	
Days per Month	x 30.4 Days per Month	
Energy (kWh) per Month	45 kWh / Month	
Days per Year	x 365 Days per Year	
Energy (kWh) Needed in Tank to Heat Water per Year	535 kWh / Year	
Elec. Res. Water Heater Efficiency	÷ 0.90 COP	
Base SERWH Energy Usage per Year at the Meter	594 kWh / Year	
Design Annual Solar Fraction	90% Water Heated by Solar System 10% Water Heated by Remaining Backup Element	Program Design
Energy Usage per Year at the Meter	594 kWh / Year	
	x 10% Water Heated by Remaining Backup Element	
Back Up Element Energy Used at Meter	59 kWh / Year	
Circulation Pump Energy	0.082 kW	KEMA 2008
Pump Hours of Operation	x 1,292 Hours per Year	KEMA 2008
Pump Energy used per Year	106 kWh / Year	
Back Up Element Energy Used at Meter	59 kWh / Year	36%
Pump Energy used per Year	+ 106 kWh / Year	64%
Design Solar System Energy Usage	165 kWh / Year	
Design Solar System Energy Usage	165 kWh / Year	
Performance Factor	0.94 pf	HE
Persistence Factor	x 0.93 pf	KEMA 2008
Residential Solar Water Heater Energy Savings	145 kWh / Year	KEMA 2008
Base SERWH Energy Usage per Year at the Meter	594 kWh / Year	
Design Solar System Energy Usage	- 165 kWh / Year	
	429 kWh / Year	

Energy Savings 429 kWh/year (Per 5,000 BTU panel installed derated)

SERWH Element Power Consumption	4.0 kW	
Coincidence Factor	x 0.143 cf	8.6 Minutes per hour
SERWH On Peak Demand	0.57 kW On Peak	KEMA 2008
Solar System Metered on Peak Demand	0.11 kW On Peak	KEMA 2008
Commercial Solar Water Heating Demand Savings	0.46 kW Savings	



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Savings Algorithm (Heat Pump) – BASE CASE

Commercial Solar Water Heating - Heat Pump - BASE CASE

Energy per Day (BTU) Needed in Tank 5,000 BTU/Day

Energy per Day (BTU) Needed in Tank 5,000 BTU/Day
BTU to kWh Energy Conversion $\div 3,412$ kWh / BTU

Energy per Day (kWh) 1.5 kWh / Day

Days per Month $\times 30.4$ Days per Month

Energy (kWh) per Month 45 kWh / Month

Days per Year $\times 365$ Days per Year

Energy (kWh) Needed in Tank to Heat Water per Year 535 kWh / Year

Heat Pump Efficiency $\div 3.50$ COP

Base Heat Pump Energy Usage per Year at the Meter 153 kWh / Year

Design Annual Solar Fraction 90% Water Heated by Solar System Program Design
10% Water Heated by Remaining Backup Element (Heat Pump)

Energy Usage per Year at the Meter 153 kWh / Year
 $\times 10\%$ Water Heated by Remaining Backup Element (Heat Pump)

Back Up Element Energy Used at Meter 15 kWh / Year

Circulation Pump Energy 0.082 kW KEMA 2008
Pump Hours of Operation $\times 1,292$ Hours per Year KEMA 2008
Pump Energy used per Year 106 kWh / Year

Back Up Element Energy Used at Meter 15 kWh / Year 13%
Pump Energy used per Year $+ 106$ kWh / Year 87%

Design Solar System Energy Usage 121 kWh / Year

Design Solar System Energy Usage 121 kWh / Year
Performance Factor 0.94 pf HE
Persistence Factor $\times 0.93$ pf KEMA 2008
Residential Solar Water Heater Energy Savings 106 kWh/ Year KEMA 2008

Base Heat Pump Energy Usage per Year at the Meter 153 kWh / Year

Design Solar System Energy Usage $- 121$ kWh / Year
32 kWh / Year

Energy Savings 32 kWh/year (Per 5,000 BTU panel installed derated)

SERWH Element Power Consumption 4.0 kW
Coincidence Factor $\times 0.143$ cf 8.6 Minutes per hour
SERWH On Peak Demand 0.57 kW On Peak KEMA 2008

Solar System Metered on Peak Demand 0.11 kW On Peak KEMA 2008

Commercial Solar Water Heating Demand Savings 0.46 kW Savings

Incentive

\$50 per 5,000 BTU panel output after derated based on orientation and tilt factor.

Measure Life

15 years



12.3.2 Heat Pump

Measure ID: See Table 7.3 (TBD)

Measure Code: High Efficiency Water Heating – Heat Pump

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- Adjust the assumptions so the description and calculations are consistent.

Measure Description

This measure relates to the installation of a heat pump water heater (HPWH) in place of a standard electric water heater. HPWHs can be added to existing domestic hot water (DHW) systems to improve the overall efficiency. HPWHs utilize refrigerants (like an air source heat pump) and have much higher coefficients of performance (COP) than standard electric water heaters. HPWHs remove waste heat from surrounding air sources and preheat the DHW supply system. HPWHs come in a variety of sizes and the size of HPWH will depend on the desired temperature output and amount of hot water needed by application. The savings from water heater heat pumps will depend on the design, size (capacity), water heating requirements, building application and climate. This measure could relate to either a retrofit or a new installation.

Definition of Efficient Equipment

In order for this characterization to apply, the efficient equipment is assumed to be a heat pump water heater with or without an auxiliary water heating system.

Definition of Baseline Equipment

In order for this characterization to apply, the baseline equipment is assumed to be a standard electric storage tank type water heater with a thermal efficiency of 98%. This measure does not apply to natural gas-fired water heaters.

Deemed Lifetime of Efficient Equipment

The expected measure life is assumed to be 10 years

Deemed Measure Cost

Due to the complexity of heat pump water heater systems, incremental capital costs should be determined on a case by- case basis. High capacity heat pump water heaters will typically have a supplemental heating source such as an electric resistance heater. For new construction applications, the incremental capital cost for this measure should be calculated as the difference in installed cost of the entire heat pump water heater system including any auxiliary heating systems and a standard electric storage tank water heater of comparable capacity. For retrofit applications, the total installed cost of heat pump water heater should be used.



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Savings Algorithm

Heat Pump Water Heater

Energy per Day (BTU) = (Gallons per Day) x (lbs. per Gal.) x (Temp Rise) x (Energy to Raise Water

Hot Water needed per Person	13.3	Gallons per Day per Person	HE
Average Occupants	x	3.77	Persons
Household Hot Water Usage		50.1	Gallons per Day

KEMA 2008

Mass of Water Conversion 8.34 lbs/gal

Finish Temperature of Water	130	deg. F Finish Temp
Initial Temperature of Water	-	75
Temperature Rise		55

deg. F Temperature Rise

Energy to Raise Water Temp 1.0 BTU / deg. F / lbs.

Energy per Day (BTU) Needed in Tank 12,000 BTU/Ton

Energy per Day (BTU) Needed in Tank 12,000 BTU/Ton

BTU to kWh Energy Conversion ÷ 3,412 kWh / BTU

Energy per Day (kWh) 3.5 kWh / Ton

Days per Month x 30.4 Days per Month

Energy (kWh) per Month 107 kWh / Month

Days per Year x 365 Days per Year

Energy (kWh) Needed in Tank to Heat Water per Year 1,283 kWh / Ton

Elec. Res. Water Heater Efficiency ÷ 0.98 COP

Base SERWH Energy Usage per Year at the Meter 1,309 kWh / Ton

KEMA 2008 - HECO

Energy (kWh) Needed to Heat Water per Year 1,283 kWh / Ton

Heat Pump Water Heating Efficiency ÷ 3.50 COP

Heat Pump Water Heating Energy Usage 367 kWh / Ton

Base SERWH Energy Usage per Year at the Meter 1,309 kWh / Ton

Heat Pump Water Heating Energy Usage - 367 kWh / Ton

Commercial Heat Pump Water Heating Savings 943 kWh / Ton

Hours per Day 10

Hours per Year 3,650

Heat Pump Power Consumption 0.3 kW

Coincidence Factor x 0.08 cf 4.80 Minutes per hour

0.02 kW On Peak

Base SERWH Element Power Consumption 0.4 kW

Coincidence Factor x 0.143 cf

Base SERWH On Peak Demand 0.05 kW On Peak

8.6 Minutes per hour
KEMA 2008

Base SERWH On Peak Demand - 0.05 kW On Peak

Heat Pump Water Heater Demand - 0.02 kW On Peak

0.03 kW On Peak

KEMA 2008

Commercial Solar Water Heater Demand Savings 0.03 kW Savings per Ton

Incentive

\$65/ton



12.4 High Efficiency Water Pumping

12.4.1 Domestic Water Booster Packages

Measure ID: See Table 7.3 (TBD)

Measure Code:

Version Date & Revision History

Draft date: May 23, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- The increased incentive was based on previous paid booster pump installations and measured energy/demand savings. Previous Incentive Level = \$0.06/kWh. New Incentive Levels = \$0.08/kWh
- The energy and demand impacts are based on HECO's evaluation from past projects and monitoring.

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- Effective 7/1/10 through 3/6/11
VFD Installation: \$1,600
HP Reduction: \$65 x Number of reduced HP
- Effective 3/7/11 through 6/30/11
VFD Installation: \$3,000
HP Reduction: \$80 x Number of reduced HP
- Updated the TRM algorithm. Clarified energy savings to calculate per HP.

Description:

The purpose of this measure is to reduce energy consumption through more efficient domestic water booster systems by installing a VFD and/or reducing pump HP. Pump improvements can be done to optimize the design and control of water pumping systems. The measurement of energy and demand savings for commercial and industrial applications will vary with the type of pumping technology, operating hours, efficiency and current and proposed controls. Depending on the specific application, slowing the pump, trimming or replacing the impeller, or replacing the pump may be suitable options for improving pumping efficiency.

Base Efficiency

The baseline equipment is assumed to be a non-optimized existing pumping system.

High Efficiency

In order for this characterization to apply, the efficient equipment is assumed to be an optimized pumping system meeting applicable program efficiency requirements. The proposed Booster Pump System must be a more efficient design than the existing system. (i.e. Installed with VFD.). All pump motors must meet NEMA Premium Efficiency standards.

Qualification

- Booster Pump applications require pre-notification before equipment is purchased and installed.
- The new Booster Pump System's total horsepower must be equal to or less than that of the existing system.



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- The system horsepower reduction must be between 0 to 129 hp. For projects with greater than 129hp, please contact the program
- Booster Pump applications do not apply to New Construction.

Energy and Demand Savings:

Source of Savings (per HP)	Yearly kWh Reduction	kW Reduction
Reduced HP	3921	0.373
Installation of VFD	588	0.056

Savings Algorithm:

Domestic Water Booster Packages

REDUCED HP

Motor Energy Consumption	0.746 kW / hp
Run Time	x 8760 hrs / year
Percent Run Time	x 60% percent run / day
Yearly Savings per HP Reduction	3921 Total kWh savings / hp / year
3921 kWh Reduction / HP / Year	

Demand Savings per HP	0.746 kW savings per hp
Coincidence Factor	x 50% peak coincidence factor
Peak Demand Savings	0.373 kW savings per hp during peak hour (5 p.m. to 9 p.m.)
0.373 Peak kW Reduction / HP	

INSTALLATION OF VFD

Motor Energy Consumption	0.746 kW / hp
Percent Load Reduction with VFD	x 15% percent load reduction
Demand Savings per HP	0.112 kW savings per hp
Run Time	x 8760 hrs / year
Energy Savings per hp with VFD	980.24 kWh savings / hp / year
Percent Run Time	x 60% pump percent run time
Total Energy Savings per hp with VFD	588 Total kWh savings / hp / year

EM&V review comments recommend 500 - 700 kWh savings (Feb. 23, 2012)

588.15 kWh Reduction / HP / Year

Demand Savings per HP	0.112 kW savings per hp
Coincidence Factor	x 50% peak coincidence factor
Peak Demand Savings	0.056 kW savings per hp during peak hour (5 p.m. to 9 p.m.)
0.056 Peak kW Reduction / HP	

Incentives:

VFD Installation: \$3,000

HP Reduction: \$80 x Number of reduced HP



12.4.2 VFD Pool Pump Packages

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 24, 2010

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- 12/15/11 – Updated algorithm average pump size from 1.5 HP pump to 1 HP pump. Updated baseline and high efficiency calculations accordingly.

Measure Description

A variable speed commercial pool pump motor in place of a standard single speed motor of equivalent horsepower.

Definition of Efficient Equipment

The high efficiency equipment is a variable speed commercial pool pump.

Definition of Baseline Equipment

The baseline efficiency equipment is assumed to be a single speed commercial pool pump.

$$\Delta \text{kWh} = (\text{kWBASE} \times \text{Hours}) \times 55\%$$

Where:

Unit	= 2-speed or variable speed pool pump
ΔkWh	= Average annual kWh reduction
Hours	= Average annual operating hours of pump
kWBASE	= connected kW of baseline pump
55%	= average percent energy reduction from switch to 2-speed or variable speed pump (1)

Baseline Efficiency

The baseline efficiency case is a single speed pump.

High Efficiency

The high efficiency case is a 2-speed or variable speed pump.

Energy and Demand Savings

Demand Savings: 0.093 kW / HP

Energy Savings: 1123 kWh per year / HP

(1) Davis Energy Group (2008). Proposal Information Template for Residential Pool Pump Measure Revisions. Prepared for Pacific Gas and Electric Company; Page 2.



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Savings Algorithm

Commercial Pool Pump

Pool Pump Horsepower	1 HP
Efficiency	0.8
Hours of operation per day	6 hours
Number of days pool in use	365 days per year
1 HP Equals	0.746 kW

Baseline

Pump Size	1.00 HP
kW / HP	$\times \quad 0.75 \text{ kW / HP}$
	0.75 kW
Efficiency	$\div \quad 0.80$
Based Demand	0.93 kW
Hours of operation	$\times \quad 6 \text{ hours/day}$
Base Energy Usage per day	5.60 kWh/day
Base Energy Usage per year	2042 kWh/year

High Efficiency

Base Demand	0.93 kW
Demand Reduction	10%
High Efficiency Demand	0.839 kW
Base Energy Usage	2042 kWh/year
Energy Reduction	55%
High Efficiency Energy Usage	919 kWh/year

Demand Savings	0.093 kW per HP
-----------------------	------------------------

Energy Savings per year	1123 kWh/year per HP
--------------------------------	-----------------------------

Deemed Lifetime of Efficient Equipment

The estimated useful life for a variable speed pool pump is 10 years.

Deemed Measure Cost

The incremental cost is estimated to be \$350 for a two speed motor and \$1,500 for a variable speed motor

Incremental Cost

\$161 per motor. – (from: 2001 DEER Update Study, CCIG-CRE-02, p. 4-84, Xenergy, Oakland, CA.

Incentives

\$80/HP



12.5 High Efficiency Motors

12.5.1 CEE Listed Premium Efficiency Motors

Measure ID: See Table 7.3 (TBD)

Measure Code:

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- 11/22/11 – Removed the following sentence from *Measure Description*: “Therefore, this measure should be suspended at that time.”

Measure Description

This measure relates to the installation of premium efficiency three phase Open Drip Proof (ODP) and Totally Enclosed Fan-Cooled (TEFC) motors less than or equal to 450 HP, meeting minimum qualifying efficiency for the following HVAC applications: supply fans, return fans, exhaust fans, chilled water pumps, and boiler feed water pumps. On December 9, 2010, new federal efficiency standards will take effect requiring motors in this size category to meet National Electric Manufacturers Association (NEMA) premium efficiency levels.

Baseline

2007 EISA nominal efficiency (as defined in NEMA MG1 Table 12-12) motors.

Demand	0.746 kW
Base Efficiency	80%
Base Demand	0.933 kW
Base Energy	1531.6 kWh/year

High Efficient Condition

The CEE Motors List includes motors that are 1-200 hp NEMA Design A/B, 460 volts, TEFC or ODP and 1200rpm, 1800 rpm, or 3600 rpm. To be eligible to be included, a motor's nominal efficiency must be at least one full NEMA band higher than the 2007 EISA nominal efficiency (as defined in NEMA MG1 Table 12-12) and the motor and corresponding nominal efficiency must be listed in a publicly available document, such as product catalog or cut sheet amounting to an advertised claim of performance, or the reporting entity must wish it to be treated as publicly available (and expressly claim to achieve performance based upon the noted test procedure).

Demand	0.746 kW
High Efficiency	82.50%
High Efficiency Demand	0.904 kW
High Efficiency Energy	1485.2 kWh/year



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Energy Savings

Based on per HP

Demand Savings	0.0283 kW
Energy Savings	46.4 kWh/year

Savings Algorithm

$$\Delta \text{kWh} = \text{HP} \times 0.746 \times ((1/\eta_{\text{BASE}}) - (1/\eta_{\text{EE}})) \times \text{LF} \times \text{HOURS}$$

Where:

HP	= Motor Horse Power
	= Actual installed
η_{BASE}	= Efficiency of baseline motor. Based on EPACT 92 for installed HP
η_{EE}	= Efficiency of premium efficiency motor
	= Actual installed
LF	= Load factor of motor = 0.75
HOURS	= Annual motor run hours

1	HP	equals	0.746 kW
Hours of Operation		6 per day	
Hours of Operation		2190 per year	
Load Factor		0.75	

Demand	0.746 kW
Base Efficiency	80%
Base Demand	0.933 kW
Base Energy	1531.6 kWh/year

Demand	0.746 kW
High Efficiency	82.50%
High Efficiency Demand	0.904 kW
High Efficiency Energy	1485.2 kWh/year

Demand Savings	0.0283 kW
Energy Savings	46.4 kWh/year



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MOTOR INCENTIVES REFERENCE TABLE							
Motor Size (hp)	3600 RPM		1800 RPM		1200 RPM		Incentive Per Motor
	ODP	TEFC	ODP	TEFC	ODP	TEFC	
1	77.0	77.0	85.5	85.5	82.5	82.5	\$15
1.5	84.0	84.0	86.5	86.5	86.5	87.5	\$23
2	85.5	85.5	86.5	86.5	87.5	88.5	\$30
3	85.5	86.5	89.5	89.5	88.5	89.5	\$45
5	86.5	88.5	89.5	89.5	89.5	89.5	\$50
7.5	88.5	89.5	91.0	91.7	90.2	91.0	\$75
10	89.5	90.2	91.7	91.7	91.7	91.0	\$100
15	90.2	91.0	93.0	92.4	91.7	91.7	\$120
20	91.0	91.0	93.0	93.0	92.4	91.7	\$160
25	91.7	91.7	93.6	93.6	93.0	93.0	\$200
30	91.7	91.7	94.1	93.6	93.6	93.0	\$210
40	92.4	92.4	94.1	94.1	94.1	94.1	\$240
50	93.0	93.0	94.5	94.5	94.1	94.1	\$300
60	93.6	93.6	95.0	95.0	94.5	94.5	\$360
75	93.6	93.6	95.0	95.4	94.5	94.5	\$450
100	93.6	94.1	95.4	95.4	95.0	95.0	\$600
125	94.1	95.0	95.4	95.4	95.0	95.0	\$750
150	94.1	95.0	95.8	95.8	95.4	95.8	\$900
200	95.0	94.4	95.8	96.2	95.4	95.8	\$1,200
250	95.0	95.8	95.8	96.2	95.4	95.8	\$1,500
300	95.4	95.8	95.8	96.2	95.4	95.8	\$1,800
350	95.4	95.8	95.8	96.2	95.4	95.8	\$2,100
400	95.8	95.8	95.8	96.2	95.8	95.8	\$2,400
450	95.8	95.8	96.2	96.2	96.2	95.8	\$2,700

Measure Life

15 years

Incremental Cost

1 to 5HP (\$35.20 per HP)

7.5 to 20HP (\$17.30 per HP)

25 to 100HP (\$10.28 per HP)

125 to 250HP (\$5.95 per HP)



12.6 Commercial Industrial Processes

12.6.1 Waste Water Process Improvements

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

TBD

Baseline Efficiencies:

TBD

High Efficiency:

TBD

Energy Savings:

TBD

Savings Algorithms



12.6.2 Air Compressor Technologies and Operations

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

TBD

Baseline Efficiencies:

TBD

High Efficiency:

TBD

Energy Savings:

TBD

Savings Algorithms



12.6.3 Demand Control Kitchen Ventilation (DCKV)

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Detailed Energy Savings Report, Melink Corporation,
http://www.melinkcorp.com/Intellihood/Energy_Analysis.pdf

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

Kitchen ventilation with DCKV hood exhaust. Demand ventilation uses temperature and/or smoke sensing to adjust ventilation rates. This saves energy comparing with the traditional 100% on/off kitchen ventilation system.

Baseline Efficiencies:

Kitchen ventilation without DCKV. Usage per HP:

$$\text{Basecase} = (\text{HP} \times .746 \text{ kW/HP} \times \text{Hours per Year}) / \text{efficiency}$$

Basecase fan motor usage per HP (kWh/year)	4827
Basecase fan motor demand (kW)	0.83

High Efficiency:

Usage per HP:

Enhanced case fan motor usage per HP (kWh/year)	2194
Enhanced case fan motor demand (kW)	0.38

Energy Savings:

The demand control kitchen ventilation savings were determined using the method described in the Melink Detailed Energy Savings Report.

Energy Savings from fan motor per HP (kWh/year)	2633
Demand Savings from fan motor per HP (kW)	0.45



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Savings Algorithms

% Rated RPM	% Run Time	Time HRS/YR	Output KW/HP	System Efficiency	Input KW/HP	KWH/HP/YR
H	I	J=GXI	K	L	M=K/L	N=JXM
100	5%	291.2	0.746	0.9	0.829	241
90	20%	1164.8	0.544	0.9	0.604	704
80	25%	1456	0.382	0.9	0.424	618
70	25%	1456	0.256	0.9	0.284	414
60	15%	873.6	0.161	0.9	0.179	156
50	10%	582.4	0.093	0.9	0.103	60
40	0%	0	0.048	0.9	0.053	0
30	0%	0	0.02	0.9	0.022	0
20	0%	0	0.015	0.9	0.017	0
10	0%	0	0.01	0.9	0.011	0
Total kWh/HP/YR						2194

Basecase = (HP x .746 KW/HP x Hours per Year)/efficiency

Basecase fan motor usage per HP (kWh/year)	4827
Basecase fan motor demand (kW)	0.83

Enhanced case fan motor usage per HP (kWh/year)	2194
Enhanced case fan motor demand (kW)	0.38

Energy Savings from fan motor per HP (kWh/year)	2633
Demand Savings from fan motor per HP (kW)	0.45

Operating Schedule

16	HR/DAY
7	DAY/WK
52	WK/YR
<hr/>	
5824	



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Demand Coincidence Factor

TBD

Persistence

TBD

Lifetime

15 Years (Hawaii Energy assumption)

Measure Costs and Incentive Levels

Measure Cost: \$1,200 - \$1,700 per HP based on business vertical and site complications (provided my Melink)

Incentive Levels: \$300/installed HP



12.7 Building Envelope Improvements

12.7.1 Window Tinting

Measure ID: See Table 7.3 (TBD)

Measure Code:

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Basis for a Prescriptive Window Film Rebate Program (Attachment G) prepared for HECO (XENERGY Inc.) November 5, 1999

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- Rebate increased from \$0.35 to \$1.00 per square foot
- Changed from 0.4 shading coefficient (SC) to 0.5 SC

Description:

- *Warranty* – Film must have a minimum five-year manufacturer's warranty and one-year installer's warranty
- *Conditioned Space* – Rebates shall be paid on actual square footage of glass in a conditioned space
- *Eligible Types* – Windows may be clear or factory tinted, single or double pane, but must not have reflected glass. All orientations are eligible.
- *Unshaded* – Windows significantly shaded by buildings, trees or awnings are not eligible for rebates.
- *Replacement Film* – Replacement of deteriorated window film is eligible for 50% of the rebate if the customer did not receive a rebate for the existing film.

Equipment Qualifications:

Shading Coefficient < 0.5

Solar Heat Gain Coefficient (SHGC) < 0.435

SC = 0.87*SHGC

Payback Qualifications:

None

Energy and Demand Savings:

Savings	Hotel	Office	Other	Average
Energy Savings (kWh/ft2)	5.6	4.5	4.5	4.9
Demand Savings (kW/ft2)	0.0014	0.0008	0.0016	0.0013



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Incentives:

Description	Unit Incentive	Incremental Cost
Window Film per square feet	\$ 1.00	\$ 3.00

Persistence Factor

1.0

Coincidence Factor

1.0

Lifetime

10 years (DEER)



12.7.2 Cool Roof Technologies

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Evergreen TRM Review – 2/23/12

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Description

This section covers installation of “cool roof” roofing materials in commercial buildings. The cool roof is assumed to have a solar absorptance of 0.3(1) compared to a standard roof with solar absorptance of 0.8(2). Energy and demand saving are realized through reductions in the building cooling loads. The approach utilizes DOE-2.2 simulations on a series of commercial prototypical building models. Energy and demand impacts are normalized per thousand square feet of roof space.

Definition of Efficient Equipment

The efficient condition is a roof with a solar absorptance of 0.30.

Definition of Baseline Equipment

The baseline condition is a roof with a solar absorptance of 0.80

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 15 years (3)

Deemed Measure Cost

The full installed cost for retrofit applications is \$8,454.67 per one thousand square feet (4).

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Coincidence Factor

The coincidence factor is 0.74(5).

REFERENCE SECTION

Calculation of Savings

Energy Savings

$$\Delta \text{kWh} = \text{SF} / 1000 * \Delta \text{kWhkSF}$$

(1) Maximum value to meet Cool Roof standards under California's Title 24

(2) Itron. 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study. December 2005.

(3) 2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05, “Effective/Remaining Useful Life Values”, California Public Utilities Commission, December 16, 2008

(4) 2005 Database for Energy-Efficiency Resources (DEER), Version 2005.2.01, “Technology and Measure Cost Data”, California Public Utilities Commission, October 26, 2005



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(5) Coincidence factor supplied by Duke Energy for the commercial HVAC end-use. Pending verification based on information from the utilities.

Hawaii Building Example:

$$\Delta \text{kWh} = 0.25 \text{ kWh / square feet}$$

Coincident Peak Demand Savings

$$\Delta \text{kW} = \Delta \text{kW} \times \text{CF}$$

Where:

$$\text{CF} = \text{The coincident peak factor, or 0.50}$$

Demand Savings per square feet

$$\begin{aligned} \Delta \text{kW} &= 0.0001 \times 0.50 \\ &= 0.00005 \text{ kW} \end{aligned}$$

Baseline Adjustment

There are no expected future code changes to affect this measure.

Deemed O&M Cost Adjustment Calculation

There are no expected O&M costs or savings associated with this measure.

Unit energy, demand, and gas savings data is based on a series of prototypical small commercial building simulation runs.

Incentive

\$1.00/Square Foot (Roof Surface Area)



12.8 Energy Star Business Equipment

12.8.1 Refrigerators w/Recycling

Measure ID: See Table 7.3

Version Date & Revision History

Draft date: February 24, 2010

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- HECO DSM Docket – Backup Worksheets - Global Energy (07-14-06)
- Econorthwest TRM Review – 6/23/10
- Department of Energy Refrigerator Profile – Updated December 2009

TRM Review Actions:

- 6/23/10 Rec. # 11 – Revise savings to be consistent with ENERGY STAR estimates. – Adopted with modifications on refrigerator figures based on DOE Refrigerator profile and the addition of bounty, recycle with new figures.
- 6/23/10 Rec. # 12 – Split the claimed savings by appliance. – Adopted.
- 6/23/10 Rec. # 14 – Revise demand savings values for ENERGY STAR appliances – Adopted.
- 10/5/11 – Currently Under Review.

Major Changes:

- Split between ESH appliances
- Incorporation of three refrigerator categories (new, new with turn in, and bounty (turn in only))
- All ESH 313 kWh and 0.12 kW changed to:
 - New ES Refrigerator Only – 105 kWh, .017 kW
 - New ES Refrigerator with Turn-In – 822 kWh, .034 kW

Measure Description:

The replacement of standard Refrigerators for business locations.

Appliances must comply with:

- Energy Star

Refrigerators – ENERGY STAR refrigerators utilize improvements in insulation and compressors.

Baseline Efficiencies:

Baseline energy usage based on 2009 Energy Star Information for the appliances are as follows:

	Demand Baseline (kW)	Energy Baseline (kWh)	Notes
Non ES Qualifying Refrigerator		537	19.0-21.4 Top Freezer



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High Efficiency:

The high efficiency case Energy Star energy usage based on 2009 Energy Star Calculator Information and DOE Refrigerator Market Profile for the appliances is as follows:

	Demand High Efficiency (kW)	Energy High Efficiency (kWh)	Notes
ES Qualifying Refrigerator		435	19.0-21.4 Top Freezer

Energy Savings:

Energy Star Appliance Gross Savings before operational adjustments:

	Demand Savings (kW)	Energy Savings (kWh)
ES Refrigerator	0.017	105
ES Refrigerator with Turn-In	0.034	822

Energy Star Appliance Net Savings operational adjustments:

Operational Factor	Adjustment Factor
Persistence Factor (pf)	1.0
Demand Coincidence Factor (cf)	1.0

Savings Algorithms

Energy Star Refrigerator and Turn In Refrigerator - Single and Multi Family Residential Home

Opportunity	Energy Usage			
New Non-ENERGY STAR	540	Table 2		
New ENERGY STAR Refrigerator	- <u>435</u>	Table 2		
	105 kWh/Year	Table 1		
#1 - Purchase of ENERGY STAR Refrigerator	105	Table 1		
#2 - Removal of Old Unit from Service (off the grid)	+ <u>717</u>	Table 1		
#1 + #2 = Purchase ES and Recycle old unit	822 kWh/Year			
	<u>Energy Usage</u>	<u>Ratio</u>	<u>Contribution</u>	
Post-1993 Refrigerator	640	55%	354.54	Table 3
Pre-1993 Refrigerator	1,131	45%	<u>504.46</u>	Table 3
			859 kWh/Year	



Table 1

Energy Savings Opportunities for Program Sponsors

Opportunity	Annual Savings			
	Per Unit		Aggregate U.S. Potential	
	kWh	\$	MWh	\$ million
1. Increase the number of buyers that purchase ENERGY STAR qualified refrigerators. <ul style="list-style-type: none"> 9.3 million units were sold in 2008. 70 percent were not ENERGY STAR. 6.5 million potential units per year could be upgraded. 	105	11.64	675,928	75
2. Decrease the number of units kept on the grid when new units are purchased. <ul style="list-style-type: none"> 8.7 million primary units were replaced in 2008. 44 percent remained in use, whether they were converted to second units, sold, or given away. 3.8 million units are candidates for retirement every year. 	717	79.53	2,746,062	305
3. Decrease the number of second units. <ul style="list-style-type: none"> 26 percent of households had a second refrigerator in 2008. 29.6 million units are candidates for retirement. 	859	95.28	25,442,156	2,822
4. Replace pre-1993 units with new ENERGY STAR qualified models. <ul style="list-style-type: none"> 19 percent of all units in use in 2008 were manufactured before 1993. 27.3 million total potential units are candidates for targeted replacement. 	730	81	19,946,440	2,212

Sources: See endnote 10.



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Table 2

Energy and Cost Comparison for Upgrading to ENERGY STAR

Purchase Decision	New Non-ENERGY STAR Qualified Refrigerator	New ENERGY STAR Qualified Refrigerator
Annual Consumption	540 kWh	435 kWh
	\$60	\$48
Annual Savings	–	105 kWh
	–	\$12
Average Lifetime	12 years	12 years
Lifetime Savings	–	1,260 kWh
	–	\$140
Price Premium	–	\$30 - \$100
Simple Payback Period	–	3-9 years

Note: Calculations based on shipment-weighted average annual energy consumption of 2008 models. An ENERGY STAR qualified model uses 20 percent less energy than a new non-qualified refrigerator of the same size and configuration.

Source: See endnote 10.

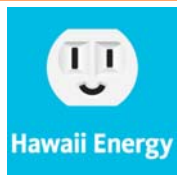
Table 3

Energy and Cost Comparison for Removing a Second Refrigerator from the Grid

Fate of Unit	Post-1993 Unit		Pre-1993 Unit	
	Remains on the Grid	Removed from the Grid	Remains on the Grid	Removed from the Grid
Annual Consumption	640 kWh	–	1,131 kWh	–
	\$71	–	\$125	–
Annual Savings	–	640 kWh	–	1,131 kWh
	–	\$71	–	\$125
Average Lifetime*	6	–	6	–
Lifetime Savings*	–	3,840 kWh	–	6,788 kWh
	–	\$426	–	\$753
Removal Cost	–	\$50 - \$100	–	\$50 - \$100
Simple Payback Period	–	1-2 years	–	<1 year

*Assumes unit has six years of functionality remaining.

Sources: See endnote 10.



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Operating Hours

Refrigerators = 8,760 hours per year

Loadshape

TBD

Freeridership/Spillover Factors

TBD

Demand Coincidence Factor

NA

Persistence

NA

Lifetime

14 years

Measure Costs and Incentive Levels

Residential Measure Costs and Incentive Levels

Description	Unit Incentive	Incremental Cost HECO DSM Docket 2006	Average Incremental Cost Energy Star 2009
ES Refrigerator	\$50	\$ 60.36	\$ 65
ES Refrigerator w/turn in	\$125		\$130*

***Estimated value**

Component Costs and Lifetimes Used in Computing O&M Savings

TBD

Reference Tables

None



12.9 Energy Awareness, Measurement and Control Systems

12.9.1 Condominium Submetering Pilot

Measure ID: See Table 7.3 (TBD)

Measure Code:

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Description:

Equipment Qualifications:

This program is to assist master-metered condominiums and their Association of Apartment Owners (AOAO) efforts to reduce energy consumption and implement the current submetering proposal as one that will insure both equity and fairness in allocating energy costs as well as encouraging energy conservation through direct feedback of personal energy use to tenants.

The combination of billing submeters, along with education, peer group comparisons and special equipment offerings, will assist the tenant achieve significant energy conservation and efficiency.

Requirements:

- The metering system must remain in place and billing to occur for a period of at least five (5) years or a pro-rated portion of the incentive will be recovered by Hawaii Energy. Provide Hawaii Energy with energy meter data for analysis purposes.
- A joint educational and monitoring program will be undertaken with AOAO to assist in the verification of savings and development of an ongoing energy incentive offering for other condominiums in Hawaii.

Baseline

The base case is no submetering

Building Types	Demand Baseline (kW)	Energy Baseline (kWh/year)
Condominium	1.50	7,200



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High Efficiency

The high efficiency case is with submetering

Building Types	Efficient Case (kW)	Efficient Case (kWh/year)
Condominium	1.38	6,480

Energy and Demand Savings:

Building Types	Gross Customer Savings (kW)	Gross Customer Savings (kWh/year)
Condominium	0.12	720

Operational Factor	Adjustment Factor
Persistence Factor (pf)	1.00
Demand Coincidence Factor (cf)	1.00

Building Types	Net Customer Savings (kW)	Net Customer Savings (kWh/year)
Condominium	0.12	720

It is expected there will be at least 10% reduction in energy usage and 8% reduction in peak demand during (5PM – 9PM), however, there is no minimum reduction in electrical use to be required by AOAO to retain the incentive.



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Savings Algorithm:

Submetering (Condominium)

Average Tenant Energy Usage	600 kWh per home per month
	x 12
Baseline Household Energy Usage	7,200 kWh per Year
Energy Reduction	10.0%
Actively Informed Household Energy Usage	6,480 kWh per Year
Baseline Household Energy Usage	7,200 kWh per Year
Actively Informed Household Energy Usage	- 6,480 kWh per Year
Gross Customer Level Energy Savings	720 kwh per Year
	x 1,000 Watts per kW
	÷ 8,760 Hours per Year
Average 24/7 Demand Reduction	82 Watts
Gross Customer Level Energy Savings	720 kwh per Year
Persistence Factor	x 1.0
Net Customer Level Savings	720 kwh per Year

Submetering Energy Savings 720 kWh / Year Savings

Baseline Household Demand	1.50 kW	HECO 2008 Load Study
Peak Demand Reduction	8.00%	
Actively Informed Household Demand	1.38 kW	
Baseline Household Demand	1.50 kW	
Actively Informed Household Demand	- 1.38 kW	
Gross Customer Demand Savings	0.120 kW	
Gross Customer Demand Savings	0.120 kW	
Persistence Factor	x 1.00	
Coincidence Factor	x 1.00	
	0.120 kW	

Whole House Metering Demand Savings 0.12 kW Savings

Incentives/Incremental Cost

- \$150 per unit metered, payable to the AOA for distribution to owners on a percentage of ownership basis to comply with condominium regulations.
- Incentive payment will be made upon billing individual tenants.
- Incentive payment cannot exceed 50% of total project cost.
- The payment of the incentive will be based on the AOA securing the approval, installing and utilizing the submeters for billing purposes.

Description	Incentive	Incremental Cost
Condominium Submeter	\$250	\$750



12.9.2 Small Business Submetering Pilot

Measure ID: See Table 7.3 (TBD)

Measure Code:

Version Date & Revision History

Draft date: October 3, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Description:

Equipment Qualifications:

This program is to assist master-metered small businesses to reduce energy consumption that will insure both equity and fairness in allocating energy costs as well as encouraging energy conservation through direct feedback of personal energy use to business tenants.

The combination of billing submeters, along with education, peer group comparisons and special equipment offerings, will assist the tenant achieve significant energy conservation and efficiency.

Requirements:

- The metering system must remain in place and billing to occur for a period of at least five (5) years or a pro-rated portion of the incentive will be recovered by Hawaii Energy. Provide Hawaii Energy with energy meter data for analysis purposes.
- A joint educational and monitoring program will be undertaken with the businesses to assist in the verification of savings and development of an ongoing energy incentive offering for other condominiums in Hawaii.

Baseline

The base case is no submetering

Building Types	Demand Baseline (kW)	Energy Baseline (kWh/year)
Small Business	3.00	10,800



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High Efficiency

The high efficiency case is with submetering

Building Types	Efficient Case (kW)	Efficient Case (kWh/year)
Small Business	2.76	9,720

Energy and Demand Savings:

Building Types	Gross Customer Savings (kW)	Gross Customer Savings (kWh/year)
Small Business	0.24	1,080

Operational Factor	Adjustment Factor
Persistence Factor (pf)	1.00
Demand Coincidence Factor (cf)	1.00

Building Types	Net Customer Savings (kW)	Net Customer Savings (kWh/year)
Small Business	0.24	1,080

It is expected there will be at least 10% reduction in energy usage and 8% reduction in peak demand during (5PM – 9PM), however, there is no minimum reduction in electrical use to be required to retain the incentive.



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Savings Algorithm:

Small Business Submetering

Average Tenant Energy Usage 900 kWh per business per month (Schedule G)

	x	12	
Baseline Business Energy Usage		<u>10,800</u>	kWh per Year

Energy Reduction 10.0%

Actively Informed Business Energy Usage 9,720 kWh per Year

Baseline Business Energy Usage 10,800 kWh per Year

Actively Informed Business Energy Usage	-	9,720	kWh per Year
Gross Customer Level Energy Savings		<u>1,080</u>	kWh per Year

	x	1,000	Watts per kW
	÷	<u>8,760</u>	Hours per Year

Average 24/7 Demand Reduction 123 Watts

Gross Customer Level Energy Savings 1,080 kWh per Year

Persistence Factor	x	1.0	
Net Customer Level Savings		<u>1,080</u>	kWh per Year

Submetering Energy Savings 1,080 kWh / Year Savings

Baseline Business Demand 3.00 kW

Peak Demand Reduction 8.00%

Actively Informed Business Demand 2.76 kW

Baseline Business Demand 3.00 kW

Actively Informed Business Demand	-	2.76	kW
Gross Customer Demand Savings		<u>0.240</u>	kW

Gross Customer Demand Savings 0.240 kW

Persistence Factor	x	1.00	
Coincidence Factor	x	<u>1.00</u>	
		0.240	kW

Small Business Demand Savings 0.24 kW Savings



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Incentives/Incremental Cost

- Incentive payment will be made upon billing individual tenants.
- Incentive payment cannot exceed 50% of total project cost.

Description	Incentive	Incremental Cost
Condominium Submeter	\$250	\$750



13 (CBEEM) Custom Business Energy Efficiency Measures

13.1 Customized Project Measures

13.1.1 Customized Project Measures

Measure ID: See Table 7.3 (TBD)

Measure Code:

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- Measure life > 5 years has \$0.08/kWh incentive and a \$100/kW day-peak demand incentive

Description: The Custom project measure is offered for energy efficiency projects involving complex site-specific applications that require detailed engineering analysis and/or projects which do not qualify for incentives under any of the prescriptive rebate offering. Projects offered through the custom approach must pass a cost-effectiveness test based on project-specific costs and savings.

Measure Life	Reduction in Energy Use Incentive	Evening Peak Demand Reduction (5:00 p.m. to 9:00 p.m. weekdays)	Day Peak Demand Reduction (12:00 p.m. to 2:00 p.m. weekdays)	First Year Energy Savings (kWh)	Demand Savings (kW)
< 5 years	\$0.05 /kWh	\$125 / kW	*\$100 / kW		
> 5 years	\$0.08 /kWh	\$125 /kW	*\$100 /kW		

Program Requirements:

- Approval is required prior to the start of work on any customized project.
- Total resource benefit ratio is greater than or equal to 1.
- Incremental simple payback greater than one year or six months for LED projects.

Requirements for Non ENERGY STAR[®] LED Lamps

- Five year manufacturer warranty or three year manufacturer warranty with LM79 and LM80 (1,000 hour) tests
- UL Listed



Energy and Demand Savings:

All assumptions, data and formulas used in the calculations must be clearly documented. Standard engineering principles must be applied, and all references cited. Energy saving calculations shall also reflect the interactive effects of other simultaneous technologies to prevent the overstatement of the actual savings. Proposed base and enhanced cases must be performed by a qualified person or firm. In some cases, a professional engineer may be required to provide verification of the analysis.

Savings Algorithms

Gross energy and demand savings estimates for custom projects are calculated using engineering analysis and project-specific details. Custom analyses typically include a weather dependent load bin analysis, whole building energy model simulation, or other engineering analysis and include estimates of savings, costs, and an evaluation of the project's cost-effectiveness.

Baseline Efficiency

The baseline efficiency case assumes compliance with the efficiency requirements as mandated by the Hawaii State Energy Code or industry accepted standard practice.

High Efficiency

The high efficiency scenario is specific to the custom project and may include one or more energy efficiency measures. Energy and demand savings calculations are based on projected changes in equipment efficiencies and operating characteristics and are determined on a case-by-case basis. The project must be proven cost-effective and pass total resource benefit and have a payback greater than or equal to 1.

Persistence Factor

PF = 1 since all custom projects require verification of equipment installation.

Incentives

- Incentives is limited to 50% of incremental costs.
- Installations are subject to inspection for up to 5 years. Removal will be cause for incentive forfeiture.



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13.1.2 Customized Project Measures – American Recovery & Reinvestment Act (ARRA)

Measure ID: See Table 7.3 (TBD)

Measure Code:

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- Measure life > 5 years has \$0.08/kWh incentive and a \$100/kW day-peak demand incentive

ELIGIBILITY

Government and non-profit organization energy efficiency projects that are not already ARRA funded.

Measure Life	Reduction in Energy Use Incentive	Evening Peak Demand Reduction (5:00 p.m. to 9:00 p.m. weekdays)	Day Peak Demand Reduction (12:00 p.m. to 2:00 p.m. weekdays)	First Year Energy Savings (kWh)	Demand Savings (kW)
< 5 years	\$0.05 /kWh	\$125 / kW	*\$100 / kW		
> 5 years	\$0.08 /kWh	\$125 /kW	*\$100 /kW		
Total Project Cost	Reduction in Energy Use Incentive	Evening Peak Demand Reduction Incentive (5:00 p.m. to 9:00 p.m. weekdays)	Day Peak Demand Reduction Incentive (12:00 p.m. to 2:00 p.m. weekdays)		
Incentive Program	Incentive Amount		% of Total Project Cost		
Custom (PBF)					
Supplemental Custom (ARRA)					
Total			25%		

* HVAC application only

Requirements for Customized Incentives

- Program approval is required prior to the start of work on any customized project.
- Total resource benefit ratio that is greater than 1
- Incremental simple payback greater than one year or six months for LED projects
- SEP and Hawaii Energy incentive limited to 25% of total project cost
- Hawaii Energy custom incentives limited to 50% of incremental costs
- Total projects cost must exceed \$60,000
- Installations are subject to inspection for up to five years. Removal will be cause for incentive forfeiture.



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Requirements for Non ENERGY STAR[®] LED Lamps

- Five year manufacturer warranty or three year manufacturer warranty with LM79 and LM80 (1,000 hour) tests
- UL Listed

PROCESS

1. Call to discuss project with us.
2. Submit completed application and work sheet.
3. Provide supporting information:
 - Layouts • Energy Models • Drawings • Technical attachments • Vendor literature

Energy and Demand Savings:

All assumptions, data and formulas used in the calculations must be clearly documented. Standard engineering principles must be applied, and all references cited. Energy saving calculations shall also reflect the interactive effects of other simultaneous technologies to prevent the overstatement of the actual savings. Proposed base and enhanced cases must be performed by a qualified person or firm. In some cases, a professional engineer may be required to provide verification of the analysis.

Savings Algorithms

Gross energy and demand savings estimates for custom projects are calculated using engineering analysis and project-specific details. Custom analyses typically include a weather dependent load bin analysis, whole building energy model simulation, or other engineering analysis and include estimates of savings, costs, and an evaluation of the project's cost-effectiveness.

Baseline Efficiency

The baseline efficiency case assumes compliance with the efficiency requirements as mandated by the Hawaii State Energy Code or industry accepted standard practice.

High Efficiency

The high efficiency scenario is specific to the custom project and may include one or more energy efficiency measures. Energy and demand savings calculations are based on projected changes in equipment efficiencies and operating characteristics and are determined on a case-by-case basis. The project must be proven cost-effective and pass total resource benefit and have a payback greater than or equal to 1.

Energy Savings

Hawaii Energy will be allowed to claim credit for the fraction of the energy and demand savings and total resource benefits that is proportional to the share of customer incentive cost paid with PBFA funds.

Persistence Factor

PF = 1 since all custom projects require verification of equipment installation.

Incentives

- SEP and Hawaii Energy incentive limited to 25% of total project cost
- Total project cost must exceed \$60,000



13.1.3 Target Cost per kWh Request Proposals

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

TBD

Baseline Efficiencies:

TBD

High Efficiency:

TBD

Energy Savings:

TBD

Savings Algorithms



14 (BESM) Business Energy Services and Maintenance

14.1 Business Direct Installation

14.1.1 Small Business Direct Lighting Retrofits

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

The program targets customers within the small business market. Typically this market has limited time and expertise within their organizations to research lighting technology options, obtain financing and contract with lighting contractors to replace their older less efficient lighting technologies. The Small Business Lighting Retrofit provides a “Turnkey” program consisting of audits, fixed pricing, installation by participating Hawaii Energy contractors and 4 month financing of lighting retrofits.

Program Requirements:

Small Business Customers receiving eclectic power under a Schedule “G” rate, or are similar to Schedule “G” but are under master-metered accounts, are eligible under this program.



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Program Year 3 July 2011 to June 2012

Savings Algorithms



Small Business Direct Install Lighting Retrofit Pilot Program Summary Sheet

Business Name:		Contractor Name:	
Contact Name:		Auditor Name:	
Address:		Address:	
Phone:		Phone:	
Fax:		Fax:	
Email:		Email:	

Total Watts Saved	Energy Savings	Energy Cost Savings	Hawaii Energy Participating Contractor NTE Pricing	Hawaii Energy Cash Incentive	Net Customer Cost	Simple Payback	4 Month Monthly Payment	Monthly Savings % of Payment
1,323 W	3,324 kWh/yr.	\$ 776 / yr.	\$ 2,300	\$ 833	\$ 1,467	23	367	18%

Step 1	
I2	
Oahu	Island of Project Location
\$ 0.234 /kWh	2010 "G" Marginal Cost of Electricity

Measure Code	Existing Technology	New Technology	Step 2		Step 3		Step 4												Hawaii Energy Participating Contractor NTE Pricing (\$)	Hawaii Energy Cash Incentive (\$)	Net Customer Cost (\$)	Simple Payback (Months)	6 Month Monthly Payment (\$/month)	Monthly Savings % of Payment (%)										
			Total Units (each)	M-F Hours per Day	Sat. Hours per Day	Sun. Hours per Day	Annual Hours of Operation (hrs/year)	On-Peak Fraction (%)	Wkdays Hours on S and 9 p.m. (hrs)	Wkdays Hours on 10-12/13/14 (hrs)	Wkdays Hours on 1-4/5/6/7/8 (hrs)	Total Watts Saved (Watts)	Energy Savings (kWh/Year)	Energy Cost Savings (\$/year)	Hawaii Energy Participating Contractor NTE Pricing (\$)	Hawaii Energy Cash Incentive (\$)	Net Customer Cost (\$)	Simple Payback (Months)							6 Month Monthly Payment (\$/month)	Monthly Savings % of Payment (%)								
																											a	b1a	b1b	b2a	c	d	e	f
8L1-4L2	8 ft. 1 Lamp F96	4 ft. 2 lamp F25/28 N	1	8	0	0	2,503	-	0%	46	115	5	27	5	75	5	62	5	13	6	5	2.24	100%											
8L2-4L2	8 ft. 2 Lamp F96	4 ft. 2 lamp F25/28 H	1	8	0	0	2,503	-	0%	57	143	5	33	5	84	5	53	5	31	11	5	5.17	54%											
8L2HO-4L2R	8 ft. 2 Lamp F96 HO	4 ft. 2 lamp F25/28 N, Reflect.	1	8	0	0	2,503	-	0%	46	115	5	27	5	85	5	27	5	58	26	5	9.67	23%											
8L2HO-4L4	8 ft. 2 Lamp F96 HO	4 ft. 4 lamp F25/28 N	1	8	0	0	2,503	-	0%	92	230	5	54	5	138	5	53	5	85	19	5	14.17	32%											
4L4-4L4	4 ft. 4 lamp F40	4 ft. 4 lamp F25/28 N	1	8	0	0	2,503	-	0%	92	230	5	54	5	83	5	51	5	32	7	5	5.33	84%											
4L4-4L2R	4 ft. 4 lamp F40	4 ft. 2 lamp F25/28 N, Reflect.	1	8	0	0	2,503	-	0%	46	115	5	27	5	65	5	27	5	38	17	5	6.33	35%											
4L3-4L3	4 ft. 3 lamp F40	4 ft. 3 lamp F25/28 N, Reflect.	1	8	0	0	2,503	-	0%	69	173	5	40	5	74	5	38	5	35	11	5	6.00	56%											
4L3-4L2R	4 ft. 3 lamp F40	4 ft. 2 lamp F25/28 N, Reflect.	1	8	0	0	2,503	-	0%	46	115	5	27	5	65	5	27	5	38	17	5	6.33	35%											
4L3-4L2	4 ft. 2 lamp F40	4 ft. 2 lamp F25/28 N	1	8	0	0	2,503	-	0%	46	115	5	27	5	35	5	27	5	8	4	5	1.33	168%											
4L1-4L1	4 ft. 1 lamp F40	4 ft. 1 lamp F25/28 N	1	8	0	0	2,503	-	0%	23	58	5	13	5	30	5	14	5	16	14	5	2.67	42%											
4L4-4L4	4 ft. 4 lamp F32	4 ft. 4 lamp F25/28 N	1	8	0	0	2,503	-	0%	92	230	5	54	5	83	5	34	5	49	11	5	8.17	55%											
4L4-4L2	4 ft. 4 lamp F32	4 ft. 2 lamp F25/28 N	1	8	0	0	2,503	-	0%	46	115	5	27	5	65	5	53	5	12	5	5	2.00	112%											
4L3-4L3	4 ft. 3 lamp F32	4 ft. 3 lamp F25/28 N	1	8	0	0	2,503	-	0%	69	173	5	40	5	74	5	26	5	48	14	5	8.00	42%											
4L3-4L2	4 ft. 3 lamp F32	4 ft. 2 lamp F25/28 N	1	8	0	0	2,503	-	0%	46	115	5	27	5	65	5	25	5	40	18	5	6.67	34%											
4L2-4L2	4 ft. 2 lamp F32	4 ft. 2 lamp F25/28 N	1	8	0	0	2,503	-	0%	46	115	5	27	5	35	5	27	5	8	4	5	1.33	168%											
4L1-4L1	4 ft. 1 lamp F32	4 ft. 1 lamp F25/28 N	1	8	0	0	2,503	-	0%	23	58	5	13	5	35	5	9	5	26	23	5	4.33	26%											
1L400-4L6	HID Pendant 1 lamp 400W	4 foot 6 lamp F25/28 N	1	8	0	0	2,503	-	0%	138	345	5	81	5	360	5	76	5	284	42	5	47.33	14%											
1L250-4L4	HID Pendant 1 lamp 250W	4 foot 4 lamp F25/28 N	1	8	0	0	2,503	-	0%	92	230	5	54	5	330	5	51	5	279	62	5	46.50	10%											
1L175-4L4	HID Pendant 1 lamp 175W	4 foot 4 lamp F25/28 N	1	8	0	0	2,503	-	0%	92	230	5	54	5	330	5	51	5	279	62	5	46.50	10%											
UBL2-2L2	4 ft. U-Bend 2 lamp F840	2 ft. 2 lamp F17 N	1	8	0	0	2,503	-	0%	32	80	5	19	5	40	5	22	5	18	12	5	3.00	52%											
UBL2-2L2R	4 ft. U-Bend 2 lamp F840	2 ft. 2 lamp F17 L, Reflector	1	8	0	0	2,503	-	0%	27	68	5	16	5	50	5	30	5	20	15	5	3.33	39%											
100-23	100 Watt Incandescent	23 Watt CFL	1	8	0	0	2,503	-	0%	23	58	5	13	5	10	5	4	5	6	5	5	1.00	112%											
75-19	75 Watt Incandescent	19 Watt CFL	1	8	0	0	2,503	-	0%	19	48	5	11	5	8	5	4	5	4	4	5	0.67	139%											
60-13	60 Watt Incandescent	13 Watt CFL	1	8	0	0	2,503	-	0%	13	33	5	8	5	6	5	4	5	2	3	5	0.33	196%											
Exit	40W Incandescent	2 Watt LED	1	24	24	24	6,768	-	0%	2	18	5	4	5	75	5	38	5	37	109	5	6.17	4%											
OverHeight	Cost Adder for fixtures above or out of the reach of a 10' Ladd		0																															
			1,323 W																3,324 kWh/yr.		\$ 776 / yr.		\$ 2,300		\$ 833		\$ 1,467		23		\$ 366.86		18%	

WORKBOOK INPUTS

Measure Code	Existing per Unit Watts	Unit New Watts	Unit Watts Saved	Hawaii Energy Participating Contractor Pricing		Hawaii Energy Cash Incentive		Public Benefit Fee Investment	
	(Watt/unit)	(Watt/unit)	(Watt/unit)	(\$/unit)	(\$/unit)	(\$)	(\$)	(\$/kWh)	
8L1-4L2	85	46	39	\$	75	\$	62	\$	0.53
8L2-4L2	142	57	85	\$	84	\$	53	\$	0.37
8L2HO-4L2R	170	46	124	\$	85	\$	27	\$	0.23
8L2HO-4L4	170	92	78	\$	138	\$	53	\$	0.23
4L4-4L4	168	92	76	\$	83	\$	51	\$	0.22
4L4-4L2R	168	46	122	\$	65	\$	27	\$	0.23
4L3-4L3	126	69	57	\$	74	\$	38	\$	0.22
4L3-4L2R	126	46	80	\$	65	\$	27	\$	0.23
4L2-4L2	84	46	38	\$	35	\$	27	\$	0.23
4L1-4L1	42	23	19	\$	30	\$	14	\$	0.24
4L4-4L4	112	92	20	\$	83	\$	34	\$	0.15
4L4-4L2	112	46	66	\$	65	\$	53	\$	0.46
4L3-4L3	84	69	15	\$	74	\$	26	\$	0.15
4L3-4L2	84	46	38	\$	65	\$	25	\$	0.22
4L2-4L2	56	46	10	\$	35	\$	27	\$	0.23
4L1-4L1	28	23	5	\$	35	\$	9	\$	0.16
1L400-4L6	475	138	337	\$	360	\$	76	\$	0.22
1L250-4L4	300	92	208	\$	330	\$	51	\$	0.22
1L175-4L4	225	92	133	\$	330	\$	51	\$	0.22
UBL2-2L2	84	32	52	\$	40	\$	22	\$	0.27
UBL2-2L2R	84	27	57	\$	50	\$	30	\$	0.44
100-23	100	23	77	\$	10	\$	4	\$	0.07
75-19	75	19	56	\$	8	\$	4	\$	0.08
60-13	60	13	47	\$	6	\$	4	\$	0.12
Exit	40	2	38	\$	75	\$	38	\$	2.17
OverHeight				\$	8				0



14.2 Business Design, Audits and Commissioning

14.2.1 Central Plant Optimization Competition Program

Measure ID: See Table 7.3 (TBD)

Measure Code:

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Description:

This program is designed to improve building operations through a systematic approach of installing critical metering, performing retro-commissioning activities to identify and optimize system operations, and then measuring and sharing results.

Claimed Savings

Energy and Demand savings (100%) will be claimed upfront and 50% payment of claimed energy savings will be paid at \$0.10/kWh upon implementation (1 month after start of Operational Period).

Adjustment of Incentive Funding

- **Return of Incentive Funds for Decreased Energy Savings**
If overfunded, customer shall return the difference between the actual and estimated claimed energy saving to the Program.
- **Additional Funding for Increased Energy Savings**
If underfunded, payment will be made to customer (up to 100% of investment).



Process

A baseline energy usage will be determined based on both metering and engineering calculations. Post meter installation review along with spot measurements will be conducted.

Initial Meeting

Application

Preliminary Systems Review

- Consultant Price Proposal
- Consultant Perform Systems Review
 - Consultant Provide Metering and Commissioning Plan

Metering and Commissioning Plan

- Approve Metering Plan
- Approve Metering Budget
- Metering Installation
- Design/Oversight/Test Metering/Base Meter Readings – 2 weeks

System Commissioning Plan

- Approve Commissioning Plan
- Investigation
- Analysis/Documentation
- Field Commissioning/Tuning
- Development of Sequence of Operations
- Recommend Operational Improvements
- Recommended System Upgrades
- Maintenance and Operations Plan
- Operational Training
- System Commissioning Budget

Final Metering and Commissioning Report & Documentation Submittal

Operational Performance Period

- Start Operation Period (after commissioning, training)
 - Estimated Performance Assessment 1 – (1 month after start of Operational Period)
 - Estimated Performance Assessment 2 – (6 month after start of Operational Period)
 - Estimated Performance Assessment 3 – (End of Operational Period)
- End Operational Period (1 – year after start of operational period)
- Review Savings Achievement

[illegible]



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Incentives and Responsibilities:

Incentive	Amount	Responsibilities
Commissioning Contract	50% incentive up to \$0.20 per sq. ft.	<ul style="list-style-type: none"> • Preliminary Systems Review • Metering Plan • Development of Sequence of Operations • Operational Improvements • System Upgrade Improvements • Maintenance and Operations Plan • Operational Training • Owner commitment to participate in the Optimization Competition
Metering System	100% incentive for approved metering equipment and data collection systems	<ul style="list-style-type: none"> • Access to performance data for five years. • Owner commitment to perform operational and system upgrade recommendations with less than 2 year paybacks up to the cost of the metering incentive within two years or forfeit metering incentive
Energy Reduction	\$0.10 per kWh saved for one year	<ul style="list-style-type: none"> • 50% upon implementation • 25% for performance at sixth month • 25% for performance at one year

*Total incentives not to exceed customer cost.



14.2.2 Building Engineer Challenge

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

TBD

Baseline Efficiencies:

TBD

High Efficiency:

TBD

Energy Savings:

TBD

Savings Algorithms



14.2.3 Cooling Tower Optimization

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

TBD

Baseline Efficiencies:

TBD

High Efficiency:

TBD

Energy Savings:

TBD

Savings Algorithms



14.2.4 Decision Maker – Real Time Submetering

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

TBD

Baseline Efficiencies:

TBD

High Efficiency:

TBD

Energy Savings:

TBD

Savings Algorithms



Hawaii Energy - Technical Reference Manual No. 2011

Program Year 3 July 2011 to June 2012

14.2.5 Package & Split Annual Tune-Up

Measure ID: See Table 7.3 (TBD)

Measure Code:

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- Recalculated energy savings by building type as recommended by EM&V review comments (Feb 2011 comments)

Description:

- Demonstrate the benefits of tune-ups
- Educate customer on savings potential
- Utilize the Participating Contractors to contact the customers and have them arrange for the service work
- Participating Contractors will use the Hawaii Energy PTAC/Split AC Maintenance Checklist to inspect and perform the pre and post conditions of their maintenance work
- Participating Contractor's invoice must show that checklist requirements have been met and signed by the servicing technician
- Customers can have 2 incentives per location annually
-

Energy and Demand Savings:

Building Type	Demand Savings (kW/ton)	Energy Savings (kWh/ton)
All Commercial	0.055	325
Misc. Commercial	0.033	325
Cold Storage	0.055	558
Education	0.022	320
Grocery	0.093	558
Health	0.071	453
Hotel/Motel	0.065	325
Misc. Industrial	0.055	453
Office	0.055	540
Restaurant	0.082	363
Retail	0.065	285
Warehouse	0.049	558

Incentives:

Description	Unit Incentive	Incremental Cost
Package and Split Annual Tune Up	\$ 100.00	\$ 400.00



14.2.6 Energy Study

Measure ID:

Measure Code:

Version Date & Revision History

Draft date: September 20, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Description: The Energy Study is an indirect impact product that offers Hawaii businesses with analysis services to identify energy saving opportunities. The goal of the energy study is to provide a method for commercial and industrial customers to learn how their business uses energy today and to identify measures that will help them save energy and reduce operating costs in the future. The focus is on a customer's core energy efficiency opportunities.

Program Requirements:

- Program approval is required prior to the start of work on the energy study
- The program reserves the right to review all materials that result from a program-supported study including, but not limited to, final reports, consultant recommendations, and metered data
- The study must be performed by a qualified person or firm. A brief summary of the consultant's qualifications should be submitted with the application. In some cases, a professional engineer may be required to provide verification of the analysis
- At any time, customers may contact program staff to discuss a project, get assistance in preparing an application, or with any program-related questions

Energy and Demand Savings:

All assumptions, data and formulas used in energy efficiency calculations must be clearly documented. Standard engineering principles must be applied, and all references cited. Energy saving calculations shall also reflect the interactive effects of other simultaneous technologies to prevent the overstatement of the actual savings.

Savings Algorithms

Gross energy and demand savings estimates for energy studies are calculated using engineering analysis and project-specific details. Energy study analyses typically include estimates of savings, costs, and an evaluation of the cost-effectiveness of potential projects/upgrades.



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Program Year 3 July 2011 to June 2012

Energy Study

The Energy Study shall include the following information and be presented in the following format:

- 1) Executive Summary
 - a) Energy Conservation Measures (ECMs) Proposed
 - b) Summary of Baseline and Enhanced Case Assumptions
 - c) Actionable Recommendations in "loading order."
- 2) Technical Information and Analysis
 - a) Energy Consumption Analysis
 - i) Two years of billing data (weatherized and compared to some pertinent operating metric)
 - b) Description of the project
 - c) Proposed Energy Conservation Measures (ECM)
 - i) Descriptive Name
 - ii) Schematic System Drawing
 - iii) Current Peak Demand (kW), Energy Usage (kWh), Effective Full Load Run Hours
 - iv) Proposed Peak Demand (kW), Energy Usage (kWh), Effective Full Load Run Hours
 - v) % Change for above
 - vi) Estimated Installation Cost
 - vii) Project timeline
 - viii) Measure Life
 - ix) Simple Payback
 - d) Base case information
 - i) Short term/spot baseline thermal, fluid, and electrical measurements for major equipment to be changed with ECMs
 - ii) Permanent metering data (This metering will qualify for additional cost assistance)
 - iii) Sizing/Performance Reviews (Pump Curves, Cooling Bin Data etc.)
 - e) Enhanced case information
 - i) How will performance be measured in the future.
 - ii) Description of where energy savings occurs (lower run time, more efficient operations etc.)
 - f) Estimated energy and demand savings associated with your proposed project
 - i) Applicable figures and tables
 - ii) Simple payback period and/or life cycle costs
 - g) Estimated costs including design, materials, and installation
- 3) Appendix
 - a) Raw and Analyzed Data (Cooling Models, Field Data, Pictures, Metering Data etc.)
 - b) Building Plans (Mechanical, Electrical Schedules, Layouts etc.)

Incentives

- Incentives are limited to 50% of the cost of the study up to \$15,000



14.2.7 Design Assistance

Measure ID:

Measure Code:

Version Date & Revision History

Draft date: September 20, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- 12/22/11 – Program requirement changed to require project be in planning or initial design phase.

Description: Design Assistance is available to building owners and their design teams to encourage the implementation of energy efficient building systems. Considering energy efficiency during the initial phases of planning and design greatly increase the feasibility of implementation. Incentives for energy efficiency are project-specific and offered as upfront assistance for additional costs incurred during the design phase. The long-term benefits include energy use reduction for the state of Hawaii and a reduction in operating costs, equipment lifecycle improvement for building owners, and improved comfort for building users.

Program Requirements:

- Application with written pre-approval from Hawaii Energy
- Project in planning or initial design phase
- Total resource benefit ratio greater than or equal to 1

Energy and Demand Savings:

A base case and enhanced case model must be produced with a clear comparison. All assumptions, data, and formulas used in energy efficiency calculations must be clearly documented. Standard engineering principles must be applied, and all references cited. Energy saving calculations shall also reflect the interactive effects of other simultaneous technologies to prevent the overstatement of actual savings. Proposed base and enhanced cases must be performed by a qualified person or firm. In some cases, a professional engineer may be required to provide verification of the analysis.

Savings Algorithms

Gross energy and demand savings estimates for design assistance are calculated using engineering analysis and project-specific details. Custom analyses typically include a weather dependent load bin analysis, whole building energy model simulation, or other engineering analysis and include estimates of savings, costs, and an evaluation of the project's cost-effectiveness.

Baseline Efficiency

The baseline efficiency case assumes compliance with the efficiency requirements as mandated by the Hawaii State Energy Code or industry accepted standard practice.



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High Efficiency

The high efficiency scenario is specific to each project and may include one or more energy efficiency measures. Energy and demand savings calculations are based on comparing a base case analysis and enhanced case analysis on equipment efficiencies and operating characteristics and are determined on a case-by-case basis. The energy efficiency measures must be proven cost-effective, pass total resource benefit, and have a payback greater than or equal to 1.

Persistence Factor

PF = 1 since all custom projects require verification of equipment installation.

Incentives

- Incentive applications are processed on a first-come, first-serve basis
- Incentives are limited to a maximum of \$15,000



14.2.8 Energy Project Catalyst

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

TBD

Baseline Efficiencies:

TBD

High Efficiency:

TBD

Energy Savings:

TBD

Savings Algorithms



14.2.9 Technology & Project Demonstration Assistance

Measure ID:

Measure Code:

Version Date & Revision History

Draft date: September 20, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Description: The Technology and Product Demonstration incentive program seeks emerging technologies that are past the “proof-of-concept” stage and are ready to be demonstrated in an industrial or commercial setting. The objective is to produce proven technical and economic performance data from these demonstrations, which could facilitate the successful deployment of the technologies into the Hawaii marketplace.

Program Requirements:

- Proposals should reflect a comprehensive understanding of the current state of technologies in the chosen area and must provide clear market connections for the proposed technology and potential benefits to electricity ratepayers in Hawaii
- Applicants must propose a team with demonstrated capabilities to successfully complete technology development projects
- Projects must advance state-of-the-art technologies that are not adequately covered by the competitive U.S. market
- After a successful demonstration at an industrial or commercial site, there must be plans for a 1-2 year time frame to commercially deploy the demonstrated technology
- Applicants should address plans for gaining customer acceptance, market development, and deployment in their proposals

Incentives

- Though the program expects to pay an incentive of approximately \$1.00 per kWh saved all applications will be considered on an individual basis and its merit.



15 (BHTR) Business Hard to Reach

15.1 Energy Efficiency Equipment Grants

15.1.1 Community and Grass Roots Project Support

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

TBD

Baseline Efficiencies:

TBD

High Efficiency:

TBD

Energy Savings:

TBD

Savings Algorithms



15.1.2 Small Business Direct Installation

Measure ID: See Table 7.3 (TBD)

Measure Code:

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Description: This program provides small business owners with an economical, quick and easy switch to more energy efficient lighting. The program is designed to address the needs of small business owners and help them overcome the barriers of time, trust and technical knowledge to make lighting technology changes.

Requirements: Schedule G



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Program Year 3 July 2011 to June 2012

Savings Algorithms



Small Business Direct Install Lighting Retrofit Pilot Program

Summary Sheet

Business Name:		Contractor Name:	
Contact Name:		Auditor Name:	
Address:		Address:	
Phone:		Phone:	
Fax:		Fax:	
Email:		Email:	

Total Watts Saved	Energy Savings	Energy Cost Savings	Hawaii Energy Participating Contractor NTE Pricing	Hawaii Energy Cash Incentive	Net Customer Cost	Simple Payback	4 Month Monthly Payment	Monthly Savings % of Payment
1,323 W	3,324 kWh/yr.	\$ 776 / yr.	\$ 2,300	\$ 833	\$ 1,467	23	367	18%

Step 1	
I2	
Oahu	Island of Project Location
\$ 0.234 /kWh	2010 "G" Marginal Cost of Electricity

			Step 2				Step 3		Step 4														
Measure Code	Existing Technology	New Technology	Total	M-F	Sat.	Sun.	Annual	Wkdays	On-Peak Fraction	Total	Energy	Energy Cost	Hawaii Energy Participating Contractor NTE Pricing	Hawaii Energy Cash Incentive	Net Customer Cost	Simple Payback	6 Month Monthly Payment	Monthly Savings % of Payment					
			Units	Hours per Day	Hours per Day	Hours per Day	Hours of Operation	Hours on between 5 p.m. and 9 p.m.		Watts Saved	Savings	Savings	Cost Savings	Contractor NTE Pricing	Cash Incentive	Customer Cost	Payback	Payment	Savings				
			(each)				(hrs/year)	(hrs)		(Watts)	(kWh/Year)	(\$/year)	(\$)	(\$)	(\$)	(\$)	(Months)	(\$/month)	(%/month)				
			a	b1a	b1b	b2a	b2b (b1a+b1b)/2	c	c2 = c / 4	d = a x c	e = b x (d/1000)	f = e x 2	g = a x p	h = a x q	i = a x (p-q)	j = (f/i) x 12	k = i / 6	l = (f/i) x 12					
8L1-4L2	8 ft. 1 Lamp F96	4 ft. 2 lamp F25/28 N	1	8	0	0	2,503	-	0%	46	115	5	27	75	62	5	13	6	2.24	100%			
8L2-4L2	8 ft. 2 Lamp F96	4 ft. 2 lamp F25/28 H	1	8	0	0	2,503	-	0%	57	143	5	33	84	53	11	11	5	5.17	54%			
8L2HO-4L2R	8 ft. 2 Lamp F96 HO	4 ft. 2 lamp F25/28 N, Reflect.	1	8	0	0	2,503	-	0%	46	115	5	27	75	58	26	5	9.67	23%				
8L2HO-4L4	8 ft. 2 Lamp F96 HO	4 ft. 4 lamp F25/28 N	1	8	0	0	2,503	-	0%	92	230	5	54	138	53	85	19	5	14.17	32%			
4L4-4L4	4 ft. 4 Lamp F40	4 ft. 4 lamp F25/28 N	1	8	0	0	2,503	-	0%	92	230	5	54	138	83	51	32	7	5.33	84%			
4L4-4L2R	4 ft. 4 Lamp F40	4 ft. 2 lamp F25/28 N, Reflect.	1	8	0	0	2,503	-	0%	46	115	5	27	75	65	57	38	17	6.33	35%			
4L3-4L3	4 ft. 3 Lamp F40	4 ft. 3 lamp F25/28 N, Reflect.	1	8	0	0	2,503	-	0%	69	173	5	40	74	38	35	36	11	6.00	56%			
4L3-4L2R	4 ft. 3 Lamp F40	4 ft. 2 lamp F25/28 N, Reflect.	1	8	0	0	2,503	-	0%	46	115	5	27	75	65	57	38	17	6.33	35%			
4L2-4L2	4 ft. 2 Lamp F40	4 ft. 2 lamp F25/28 N	1	8	0	0	2,503	-	0%	46	115	5	27	75	35	5	8	4	1.33	168%			
4L1-4L1	4 ft. 1 Lamp F40	4 ft. 1 lamp F25/28 N	1	8	0	0	2,503	-	0%	23	58	5	13	30	14	5	16	14	2.67	42%			
4L4-4L4	4 ft. 4 lamp F32	4 ft. 4 lamp F25/28 N	1	8	0	0	2,503	-	0%	92	230	5	54	138	83	34	69	11	8.17	55%			
4L4-4L2	4 ft. 4 lamp F32	4 ft. 2 lamp F25/28 N	1	8	0	0	2,503	-	0%	46	115	5	27	75	65	53	12	5	2.00	112%			
4L3-4L3	4 ft. 3 lamp F32	4 ft. 3 lamp F25/28 N	1	8	0	0	2,503	-	0%	69	173	5	40	74	26	48	14	8.00	42%				
4L3-4L2	4 ft. 3 lamp F32	4 ft. 2 lamp F25/28 N	1	8	0	0	2,503	-	0%	46	115	5	27	75	65	53	40	18	5.67	34%			
4L2-4L2	4 ft. 2 lamp F32	4 ft. 2 lamp F25/28 N	1	8	0	0	2,503	-	0%	46	115	5	27	75	35	5	8	4	1.33	168%			
4L1-4L1	4 ft. 1 lamp F32	4 ft. 1 lamp F25/28 N	1	8	0	0	2,503	-	0%	23	58	5	13	35	35	9	5	26	23	4.33	26%		
1L400-4L6	HID Pendant 1 lamp 400W	4 foot 6 lamp F25/28 N	1	8	0	0	2,503	-	0%	138	345	5	81	360	5	76	284	42	47.33	14%			
1L250-4L4	HID Pendant 1 lamp 250W	4 foot 4 lamp F25/28 N	1	8	0	0	2,503	-	0%	92	230	5	54	330	51	279	62	5	46.50	10%			
1L175-4L4	HID Pendant 1 lamp 175W	4 foot 4 lamp F25/28 N	1	8	0	0	2,503	-	0%	92	230	5	54	330	51	279	62	5	46.50	10%			
UBL2-2L2	4 ft. U-Bend 2 lamp FB40	2 ft. 2 lamp F17 N	1	8	0	0	2,503	-	0%	32	80	5	19	40	5	38	12	3	0.00	52%			
UBL2-2L2R	4 ft. U-Bend 2 lamp FB40	2 ft. 2 lamp F17 L, Reflector	1	8	0	0	2,503	-	0%	27	68	5	16	50	5	30	5	20	15	3.33	39%		
100-23	100 Watt Incandescent	23 Watt CFL	1	8	0	0	2,503	-	0%	23	58	5	13	10	4	5	6	5	1.00	112%			
75-19	75 Watt Incandescent	19 Watt CFL	1	8	0	0	2,503	-	0%	19	48	5	11	8	5	4	4	4	0.67	139%			
60-13	60 Watt Incandescent	13 Watt CFL	1	8	0	0	2,503	-	0%	13	33	5	8	5	4	5	2	3	0.33	190%			
Exit	40W Incandescent	2 Watt LED	1	24	24	24	6,768	-	0%	2	18	5	4	75	38	37	109	5	6.17	4%			
OverHeight	Cost Adder for Fixtures above or out of the reach of a 10' Ladd		0																				
										1,323 W	3,324 kWh/yr.	\$ 776 / yr.	\$ 2,300	\$ 833	\$ 1,467	23	\$ 366.86	18%					

WORKBOOK INPUTS

WORKBOOK INPUTS												
Measure Code	Existing per Unit Watts		Unit New Watts		Unit Watts Saved		Hawaii Energy Participating Contractor Pricing		Hawaii Energy Cash Incentive		Public Benefit Fee Investment	
	(Watt/unit)		(Watt/unit)		(Watt/unit)		(\$/unit)		(\$)		(\$/kWh)	
	m	n		o = m-n		p		q		r		s
8L1-4L2		85		46		39	\$	75	\$	62	\$	0.53
8L2-4L2		142		57		85	\$	84	\$	53	\$	0.37
8L2HO-4L2R		170		46		124	\$	85	\$	27	\$	0.23
8L2HO-4L4		170		92		78	\$	138	\$	53	\$	0.23
4L4-4L4		168		92		76	\$	83	\$	51	\$	0.23
4L4-4L2R		168		46		122	\$	65	\$	27	\$	0.23
4L3-4L3		126		69		57	\$	74	\$	38	\$	0.23
4L3-4L2R		126		46		80	\$	65	\$	27	\$	0.23
4L2-4L2		84		46		38	\$	35	\$	27	\$	0.23
4L1-4L1		42		23		19	\$	30	\$	14	\$	0.24
4L4-4L4		112		92		20	\$	83	\$	34	\$	0.13
4L4-4L2		112		46		66	\$	65	\$	53	\$	0.46
4L3-4L3		84		69		15	\$	74	\$	26	\$	0.15
4L3-4L2		84		46		38	\$	65	\$	25	\$	0.22
4L2-4L2		56		46		10	\$	35	\$	27	\$	0.23
4L1-4L1		28		23		5	\$	35	\$	9	\$	0.18
1L400-4L6		475		138		337	\$	360	\$	76	\$	0.22
1L250-4L4		300		92		208	\$	330	\$	51	\$	0.22
1L175-4L4		225		92		133	\$	330	\$	51	\$	0.22
UBL2-2L2		84		32		52	\$	40	\$	22	\$	0.27
UBL2-2L2R		84		27		57	\$	50	\$	30	\$	0.44
100-23		100		23		77	\$	10	\$	4	\$	0.07
75-19		75		19		56	\$	8	\$	4	\$	0.08
60-13		60		13		47	\$	6	\$	4	\$	0.12
Exit		40		2		38	\$	75	\$	38	\$	2.17
OverHeight							\$	8				



15.2 Landlord, Tenant, AOA Measures

15.2.1 Energy Hero Landlord

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

TBD

Baseline Efficiencies:

TBD

High Efficiency:

TBD

Energy Savings:

TBD

Savings Algorithms



16 Addendum

16.1 Residential

16.2 Commercial

16.2.1 LED Product Customized Process

Measure ID: See Table 7.3 (TBD)

Measure Code: LED - Custom

Version Date & Revision History

Draft date: February 24, 2011

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- Illuminating Engineers Society (IES) LM79 /LM80
- ENERGY STAR LED Website http://www.energystar.gov/index.cfm?c=ssl.pr_why_es_com

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Description: Light Emitting Diodes (LED) are a lighting technology that utilizes solid-state technology to produce light, opposed to fluorescent or incandescent lighting sources. In general, LED technology will provide energy levels 15% of a comparable incandescent lamp (15W to a 100W equivalent). LED lighting projects (Fixtures and Lamps) are handled under a customized incentive basis.

Equipment Qualifications: The program has developed minimum qualifications as a measure to protect the consumers who are purchasing LED products and insure energy savings potential and persistence.

- *Power and Photometric Measurements:* IES LM79 testing performed and results submitted and understood by the customer. Provides color temperature and power input vs. light output data.
- *Lumen Maintenance:* IES LM80 testing performed and results submitted and understood by the customer. Provides % lumen maintenance over operating hours. (If not available at time of project than product requires a 5 year warranty)
- *Safety:* UL listed products. UL number provided with application.
- *Warranty Protection:* Minimum 3 year warranty with clear description of how warranty is executed.

or

- Energy Star Listing
(http://www.energystar.gov/index.cfm?fuseaction=iledl.display_products_html)
and for all projects
- *Program Persistence Requirement:* Acknowledge that the lamps must be in place for a period of 5 years. If replaced with higher usage technologies the rebate will be required to be refunded.



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- **Purchaser Due Diligence:** Customers are informed to utilize third-party education such as the US DOE Calipers reports (<http://www1.eere.energy.gov/buildings/ssl/caliper.html>)

Payback Qualifications: For LED products the payback requirements are allowed to be six months or greater.

This is 6 months lower than the standard customized payback requirement of 1 year or greater. The TRB/TRC must be greater than 1.

Energy and Demand Savings: A simple worksheet is utilized to compare pre and post lighting configurations. The existing lamp counts, wattage (with ballasts as appropriate) and operating hours are used to determine the existing "base case" energy usage. The "enhanced case" is then determined using the same information for the proposed LED technology.

A review is performed to insure LED wattages are in the expected range for the equivalent light output of the existing technology.

Project: Customer Name
Application Number: 2CBEM111111
Date: 12/16/2010
Technology Type: F32 T8 to LED
Input by: Kimo Kilowatt

Existing / Base

Location	Fixture Type	Fixture Qty	Lamps Per Fixture	Lamp Wattage	Total Wattage	M - F Hours of Operation	Sat. Hours of Operation	Sun. Hours of Operation	Annual Hours of Operation	Peak Demand Hours	Peak Demand kW	Total Demand Max kW	Annual Energy kWh/Year
Campus Upper Building	T8 F32	1	190	29	5,510	12	4	-	3,337	2.0	2.8	5.5	18,388
					-				-		-	-	-
					-				-		-	-	-
					-				-		-	-	-
Total									834	2.0	2.8	5.5	18,388

Notes:

Retrofit / Enhanced

Location	Fixture Type	Fixture Qty	Lamps Per Fixture	Lamp Wattage	Total Wattage	M - F Hours of Operation	Sat. Hours of Operation	Sun. Hours of Operation	Annual Hours of Operation	Peak Demand Hours	Peak Demand kW	Total Demand Max kW	Annual Energy kWh/Year
Campus Upper Building	LED	1	190	14	2,660	12	4	0	3,337	2	1	2.7	8,877
					-				-				
Total									1,669	2.0	1.3	2.7	8,877

Notes:

Reduction Percentage -52% -52%

Project Summary

Average Energy Savings Per Year	9510.86 kWh/Year
Demand Savings	1.43 kW

Cost Breakdown

Material Cost	\$7,990
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16.2.2 Refrigeration – Vending Misers

Measure ID: See Table 7.3 (TBD)

Measure Code:

Version Date & Revision History

Draft date: March 2, 2011

Effective date: July 1, 2010

End date: TBD

Referenced Documents:

(1) USA Technologies Energy Management Product Sheets (2006).
http://www.usatech.com/energy_management/energy_productsheets.php. Accessed 9/1/09.

TRM Review Actions:

- n/a

Measure Description

Controls can significantly reduce the energy consumption of vending machine lighting and refrigeration systems. Qualifying controls must power down these systems during periods of inactivity but, in the case of refrigerated machines, must always maintain a cool product that meets customer expectations. This measure applies to refrigerated beverage vending machines, non-refrigerated snack vending machines, and glass front refrigerated coolers. This measure should not be applied to ENERGY STAR® qualified vending machines, as they already have built-in controls.

Algorithms for Calculating Primary Energy Impact

Unit savings are deemed based on the following algorithms and assumptions:

$$\Delta kWh = (kW_{rated})(Hours)(SAVE)$$

$$\Delta kW = \Delta kWh / Hours$$

Where:

kW_{rated} = Rated kW of connected equipment. See Table below for default rated kW by connected equipment type.

Hours = Operating hours of the connected equipment: default of 8,760 hours

SAVE = Percent savings factor for the connected equipment. See table below for values.

Vending Machine and Cooler Controls Savings Factors(1)

Equipment Type	kW_{RATED}	SAVE (%)	ΔkW	ΔkWh
Refrigerated Beverage Vending Machines	0.40	46	0.184	1612

Baseline Efficiency

The baseline efficiency case is a standard efficiency refrigerated beverage vending machine, non-refrigerated snack vending machine, or glass front refrigerated cooler without a control system capable of powering down lighting and refrigeration systems during periods of inactivity.

High Efficiency

The high efficiency case is a standard efficiency refrigerated beverage vending machine, non-refrigerated snack vending machine, or glass front refrigerated cooler with a control system capable of powering down lighting and refrigeration systems during periods of inactivity.



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Hours

It is assumed that the connected equipment operates 24 hours per day, 7 days per week for a total annual operating hours of 8,760.

Measure Life

5 Years

Incentive

\$50/unit



16.2.3 Refrigeration – ECM Evaporator Fan Motors for Walk-in Coolers and Freezers

Measure ID:

Version Date & Revision History

Draft date:

Effective date: July 1, 2011

End date: June 30, 2012

Referenced Documents:

- 2007 Arkansas Deemed Savings Quick Start Programs
http://www.aepefficiency.com/oklahoma/ci/downloads/Deemed_Savings_Report.pdf

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:

An electronically commutated motor (ECM) is a fractional horsepower direct current (DC) motor used most often in commercial refrigeration applications such as display cases, walk-in coolers/freezers, refrigerated vending machines, and bottle coolers. ECMs generally replace shaded pole (SP) motors and offer at least 50% energy savings. Analysis efforts summarized in this report focused on the most prevalent use of ECMs – refrigeration, where motor sizes are typically listed in watts (10-140 W).

Measure/Technology Review

Five of the primary data sources reviewed for this effort contained data for ECMs in refrigeration and HVAC applications. The NPCC study gave savings estimates for upgrading a CAV box single speed motor to an ECM. The other four studies gave wide ranging savings and cost data for compressor, condenser, and evaporator fan motors. KW Engineering completed a study for PacifiCorp in October of 2005 regarding the market for ECMs in walk-in refrigerators (kW Engineering, 2005). This study included the market share in each state for refrigeration ECMs as well as cost and energy savings data. These values for energy and demand savings are given in Table 1 below.

Table 1

Measure Information Available	Resource	Application	Annual Energy Savings ¹ (kWh/unit)	Demand Savings ¹ (kW/unit)
Yes	Ecotope 2003	Small Evaporator Fan ECM	200	-
Yes	PG&E 2003	Evaporator Fan	673	0.077
Yes	Stellar Processes 2006	Small Evaporator Fan ECM	200	-
No	Xcel Energy 2006			
No	Quantec 2005			
No	DEER			
No	KEMA 2006			
Yes	CEE	Evaporator Fan – Freezer	115	0.013
		Condenser Fan – Freezer	141	0.016
		Compressor Fan – Freezer	985	0.112
		Evaporator Fan – Refrigerator	294	0.034
		Condenser Fan – Refrigerator	141	0.016
		Compressor Fan - Freezer	690	0.079
No	Energy Star			
No	RTF			
Yes	NPCC 2005	CAV Box	517	0.397
Yes	kW Engineering 2005	Evaporator Fan	734	0.084

¹ Savings values reflect gross savings at the customer meter



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Baseline Efficiencies:

The standard motor type for this application is a shaded pole (SP) motor. Table 2 contains the baseline annual energy consumption and demand for ECM equivalent SP motors.

Table 2 (Baseline Efficiency)

Measure	Annual Energy Consumption	Demand
Shaded Pole (SP) motor	18 kWh/W	0.002 kW/W

Minimum Requirements/High Efficiency

Any ECM up to 1 hp in size will meet the minimum requirements for both retrofit and new construction installations. Table 3 contains the estimated annual energy consumption, demand, and cost for the ECM application.

Table 3 (High Efficiency)

Measure	Annual Energy Consumption	Demand
ECM	8.7 kWh/W	0.001 kW/W

Energy Savings:

Annual Energy Savings	Demand Savings
9.3 kWh/W	0.001 kW/W

Savings Algorithms

Deemed demand and energy savings should be calculated by the following formulas for Refrigeration applications:

$$\text{kW savings} = \text{Rated Wattage} \times (\text{kW/W pre} - \text{kW/W post})$$

$$\text{kWh savings} = \text{Rated Wattage} \times (\text{kWh/W pre} - \text{kWh/W post})$$



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Where:

Rated Wattage = Rated Wattage of the electronically commutated motor

kW /W pre = Demand of the existing electronically commutated motor. If unavailable, demand listed in Table 2 should be used

kW /W post = Demand of the new electronically commutated motor. If unavailable, demand listed in Table 3 should be used

kWh /W pre = Annual energy consumption of the existing electronically commutated motor. If unavailable, annual energy consumption listed in Table 2 should be used

kWh /W post = Annual energy consumption of the new electronically commutated motor. If unavailable, annual energy consumption listed in Table 3 should be used

Lifetime

DEER – 15 years

Measure Costs and Incentive Levels

\$85 per motor and controller set