Attachment F

Technical Reference Manual

Hawaii Energy Efficiency Program

Program Year 4
July 2012 through June 2013

Technical Reference Manual (TRM)

No. 2012

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 peak impacts from measures and projects that receive cash incentives from the Hawaii Energy Efficiency Program.

The reference manual is organized by program, end use and measure. Each section provides mathematical equations for determining savings (algorithms), 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 and engineering judgment
- 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:

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

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

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. The 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%

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			
	Energy	Demand	Net System Level Energy Savings 2008	Gross System Level Energy Savings 2008
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

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.

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:

Table 7.3

PY12			
Residential (R) Business (B)	Measure Type	Description	DEER Effectve Useful Life (EUL)
R	Water Heating	Solar Water Heating	20
R		Heat Pumps	10
R	Lighting	CFL	6
R		LED	15
R	Air Conditioning	VRF Split	15
R		Ceiling Fans	5
R		Solar Attic Fans	20
R		Whole House Fans	20
R	Appliances	Refrigerator (<$600)	14
R		Refrigerator w/Recycling	14
R		Garage Refrigerator/Freezer Bounty	14
R		Clothes Washer (Tier II/III)	11
R		Pool VFD Controller Pumps	10
R	Control Systems	Room Occupancy Sensors & Timers	8
R		Peer Group Comparison	1
R		Whole House Energy Metering	4
R	Custom	Custom Packaged Proposals	5
R	Direct Install	TBD	7
R	Design and Audits	Efficiency Inside	15
		Hawaii Energy Hero Audits	1
R	Tune Ups	Central AC Tune Up	1
		Solar Water Heater Tune Up	5
R	Hard to Reach Grants	Solar Inspections	5
R		Solar Water Heater	20
R		Hawaii Energy Hero Gift Packs	5
R		CFL Exchange	6
R	Landlord Tennant	Hawaii Energy Hero Landlord Program	15
		Custom SWH Proposals	20
B	Lighting	CFL	3
		CFL - Military Homes	3
B		T12 to T8 Standard (2/3/8)	14
B		T12 to T8 Low Wattage	14
B		T8 to T8 Low Wattage	14
B		Delamp	14
B		Delamp w/Reflector	14
B		LED Refrigerator Case Lighting	15
B		ENERGY STAR LED Non-Dimmable	15
B		ENERGY STAR LED Dimmable w/Controls	15
B		ENERGY STAR LED Non-Dimmable A19	15
B		ENERGY STAR LED Dimmable A19	15
B		LED Exit Signs	16
B		HID Pulse Start	14
B		Sensors	8
B		Stairwell Bi-Level Dimming Fluorescent	14
B		Daylighting	20

Residential (R) Business (B)	Measure Type	Description	DEER Effectve Useful Life (EUL)
B	HVAC	Chillers	20
B		VFD - Chilled Water/Condenser Water	15
B		VFD - AHU	15
B		Garage Active Ventilation Control	8
B		Package Units	15
B		VFR Split System - Existing	15
B		VFR Split System - New Construction	15
B	Water Heating	Solar Water Heating - Electric Resistance	15
B		Solar Water Heating - Heat Pump	15
B		Heat Pump - conversion - Electric Resistance	10
B		Heat Pump Upgrade	10
B	Water Pumping	VFD Dom Water Booster Packages	15
B		VFD Pool Pump	15
B	Motors	CEE Tier 1 + Premium Efficiency Motors	15
B		ECM w/Controller - evap fan motors	15
B		ECM - Fan Coil Fans	15
B	Industrial Process	Waste Water Processes	15
		Compressed Air	10
		Kitchen Exhaust Hood Demand Ventilation	15
B		ENERGY STAR Commercial Kitchen Equipment	10
B	Building Envelope	Window Tinting	10
B		Cool Roof	10
B	Business Equipment	ENERGY STAR Refrigerator w/Recycling	14
B	Control Systems	Condominium submetering	8
B		Small Business submetering	8
B	Customized	Custom <= 5 years	5
B		Custom > 5 years	12
B		Custom Carryover	12
B	Direct Install	SBDIL - Lighting	14
B	Design and Audits	Central Plant Performance Competition	5
B		Cooling Tower Optimization	1
B		Decision Maker - Real time submeters	1
B		Energy Study Implementation - 100%	N/A
B		Energy Study Assistance - 50%	N/A
B		Design Assistance - 50%	N/A
B		Energy Project Catalyst	7
B	Grants	Water cooler timer	5
B	Restaurant	SBDI - Kitchen Exhaust Hood Demand Ventilation	15
B		SBDI - Restaurant Lighting	14
B	Landlord Tennant	Energy Hero Landlord	7

8 (REEM) Residential Energy Efficiency Measures

8.1 High Efficiency Water Heating

8.1.1 Solar Water Heater

Version Date & Revision History
Draft date: February 24, 2010
Effective date: July 1, 2012
End date: June 30, 2013

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.

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

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
Persistance 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**	

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
20 years (Table 7.3)

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 (Hot Water Cool Rates)

Version Date & Revision History
Draft date: May 22, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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

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

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
Persistance 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

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
20 years (Table 7.3)

Measure Costs and Incentive Levels
Incentive = $1000 to lender to buydown interest on SWH loan.

8.1.3 Solar Water Heater Energy Hero Gift Packs

Version Date & Revision History
Draft date: October 4, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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.

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

Energy Savings

Measure	Energy Savings (kWh/year)	Demand Savings (kW)
3 CFL	108.8	0.0156
Power Strip	78.0	0.0089
LED	16.6	0.0026
Low Flow Shower Head - Solar	42.5	0.0220
TOTAL	**246**	**0.049**

Measure life

Measure	Measure Life *(Years)*
Compact Fluorescent Lamp	5
Akamai Power Strip	5
LED	5
Low Flow Shower Head	10

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*
Plugs per Unit	5 plugs		7 plugs	Advanced Power Strips
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

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 Syste	Program Design
		10%	Water Heated by Remaining Backup Element	
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
Demand Savings		40%		
Residential Low Flow Shower Head Demand Savings		**0.044**	**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, 2012
End date: June 30, 2013

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 $200. 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

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	HE
Average Occupants	x	3.77	Persons	KEMA 2008
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	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	
Coincedence Factor	x	0.08	cf	4.80 Minutes per hour
		0.36	kW On Peak	
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	
Heat Pump Water Heater Demand	-	0.36	kW On Peak	KEMA 2008
		0.21	kW On Peak	
Residential Heat Pump Demand Savings		**0.21**	**kW Savings**	

Operating Hours
See Table above.

Loadshape
TBD

Freeridership/Spillover Factors
TBD

Persistence

Lifetime
10 years (DEER)

Measure Costs and Incentive Levels

Incentive = $200

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)

Version Date & Revision History
Draft date: February 24, 2010
Effective date: July 1, 2012
End date: June 30, 2013

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

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

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		
Persistance 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.
Persistance 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**

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
6 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)

Version Date & Revision History
Draft date: February 24, 2010
Effective date: July 1, 2012
End date: June 30, 2013

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:

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

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	
Persistance 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.
Persistance Factor	x	0.800	pf	20.0% Lamps not installed or replaced back
		0.003	kW	
LED Demand Savings		**0.003**	**kW Savings**	

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
15 years

Measure Costs and Incentive Levels

Table 1 – Residential LED Measure Costs and Incentive Levels

Description	Unit Incentive	Incremental Cost
LED - Res	$ 7.00	$ 35.00

Component Costs and Lifetimes Used in Computing O&M Savings
TBD

Reference Tables
None

8.3 High Efficiency Air Conditioning

8.3.1 VRF Split System AC

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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

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	
VRFSplit 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 FamilyVRF 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 FamilyVRF 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		
Persistance 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	
Persistance 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**	

Measure Incentive/Incremental Cost

Incentive = $200/unit

8.3.2 Ceiling Fans

Version Date & Revision History
Draft date: March 2, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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 instillation 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

$$\Delta kWh = ((\%_{low} * (LowKW_{base} - LowKW_{ee}) + \%_{med} * (MedKW_{base} - MedKW_{ee}) + \%_{high} * (HighKW_{base} - HighKW_{ee})) * HOURS_{fan}) + ((IncKW – CFLKW) * HOURS_{light} * WHFe)$$

Where:

$\%_{low}$	= Percent of time on Low Speed	= 40%
$\%_{med}$	= Percent of time on Medium Speed	= 40%
$\%_{high}$	= Percent of time on High Speed	= 20%
$LowWatt_{base}$	= Low speed baseline ceiling fan wattage	= 0.0152 kW
$LowWatt_{ee}$	= Low speed ENERGY STAR ceiling fan wattage	= 0.0117 kW
$MedWatt_{base}$	= Medium speed baseline ceiling fan wattage	= 0.0348 kW
$MedWatt_{ee}$	= Medium speed ENERGY STAR ceiling fan wattage	= 0.0314 kW
$HighWatt_{base}$	= High speed baseline ceiling fan wattage	= 0.0725 kW
$HighWatt_{ee}$	= High speed ENERGY STAR ceiling fan wattage	= 0.0715 kW
$HOURS_{fan}$	= 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
$HOURS_{light}$	= 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

ΔkWh = ((0.4 * (0.0152 – 0.0117) + 0.4 * (0.0348 – 0.0314) + 0.2 * (0.0725 – 0.0715)) * 1022) + ((0.18 – 0.06) * 1277.5 * 1.07)

= **167 kWh**

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:

ΔkWh = ((0.4 * (0.0152 – 0.0117) + 0.4 * (0.0348 – 0.0314) + 0.2 * (0.0725 – 0.0715)) * 1022) + ((0.129 – 0.06) * 1277.5 * 1.07)

= **97 kWh**

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

ΔkW = (%low * (LowKWbase - LowKWee) + %med * (MedKWbase - MedKWee) + %high * (HighKWbase - HighKWee)) + ((IncKW – CFLKW) * WHFd) * CF

Where:

WHFd = Waste Heat Factor for Demand to account for cooling savings from efficient lighting
= 1.21

CF = Peak Coincidence Factor for measure
= 0.11

ΔkW = ((0.4 * (0.0152 – 0.0117) + 0.4 * (0.0348 – 0.0314) + 0.2 * (0.0725 – 0.0715)) + ((0.18 – 0.06) * 1.21) * 0.11

ΔkW = **0.019kW**

After 2014, this will be reduced to:

ΔkW = ((0.4 * (0.0152 – 0.0117) + 0.4 * (0.0348 – 0.0314) + 0.2 * (0.0725 – 0.0715)) + ((0.129 – 0.06) * 1.21) * 0.11

ΔkW = **0.012kW**

Operating Hours

See Table above.

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

8.3.3 Solar Attic Fans

Version Date & Revision History
Draft date: March 2, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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

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	Hours per Year
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	kWh / Year Savings
Solar Attic Fan Annual Energy Savings		502	kWh / Year Savings
Solar Attic Fan Annual Energy Savings		502	kWh / Year Savings
Persistance 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	kW
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

Incentive = $50/unit

8.3.4 Whole House Fans

Version Date & Revision History
Draft date: March 2, 2011
Effective date: July 1, 2012
End date: June 30, 2013

Referenced Documents:

- KEMA for the Sate 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

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
Persistance 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	
Coincedence 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

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, 2012
End date: June 30, 2013

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.

- **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

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

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. • 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. • 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. • 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. • 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.

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.

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

Version Date & Revision History
Draft date: February 24, 2010
Effective date: July 1, 2012
End date: June 30, 2013

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.

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

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

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 Horesepower	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/unit

8.5 Energy Awareness, Measurement and Control Systems

8.5.1 Room Occupancy Sensors

Version Date & Revision History
Draft date: March 2, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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

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		63.0	kWh per Year	
Run Time Reduced (RTR)		0.76	Hours per Day	33%
		63.0	kWh per Year	
	x	0.330		33% Run Time Reduced
		20.8	kWh per Year	
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.
Persistance Factor	x	1.000	pf	100.0%
		0.0046	kW	
Demand Savings		**0.0046**	**kW Savings**	

Operating Hours
2.3 hours per day

Loadshape
TBD

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

Incentive = $5

Component Costs and Lifetimes Used in Computing O&M Savings
TBD

Reference Tables
None

8.5.2 Peer Group Comparison

Version Date & Revision History
Draft date: September 18, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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.

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

ΔkWh = (Total Monthly Base Energy Usage)(# of Participating Months)(%Savings)
ΔkW = Annual ΔkWh per Unit/ 3000 hours

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

Version Date & Revision History
Draft date: March 2, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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

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

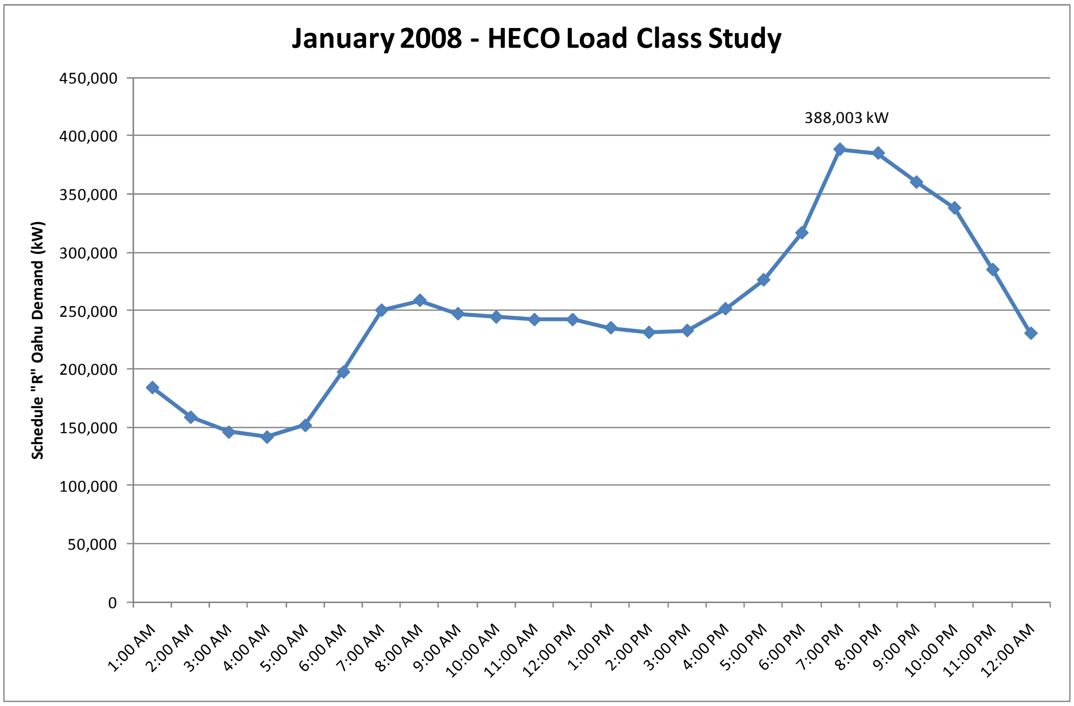
Building Types	Net Customer Savings (kW)	Net Customer Savings (kWh/year)
Net Customer Savings	0.01	410

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
	x	12		
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	
	x	1,000	Watts per kW	
	÷	8,760	Hours per Year	
Average 24/7 Demand Reduction		52	Watts	
Gross Customer Level Energy Savings		456	kwh per Year	
Persistance Factor	x	0.9		
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	
Persistance Factor	x	0.90		
Coincidence Factor	x	0.30		
		0.007	kW	
Whole House Metering Demand Savings		0.007	kW Savings	

Operating Hours
8,760 hours per year

Loadshape
TBD



Freeridership/Spillover Factors
0.73

Persistence Factor
PF = 0.9

Coincedence Factor
CF= 0.3

Lifetime
4 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

Version Date & Revision History
Draft date: October 4, 2011
Effective date: July 1, 2012
End date: June 30, 2013

Referenced Documents:
- n/a

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:
- n/a

Measure Description:
This program will target the contractor/home auditors/energy vendors and encourage them to develop cost-effective projects that focus on high energy consumption homes. The program will be a call for projects that meet a total dollar per kWh savings target and allow the market to be creative in the actions and measures that achieve the targeted cost per kWh energy savings.

The projects will use utility metered data and submetered if required to insure savings performance.

Incentive = $0.30/kWh
Target Goal = 35,000 kWh

10 (RESM) Residential Direct Installation

10.1 Residential Direct Installation

10.1.1 Real Time Metering

Version Date & Revision History
Draft date:
Effective date: July 1, 2012
End date: June 30, 2013

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 Code: Efficiency Inside

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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.

- *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 Hawaii Energy Hero Audits

Measure Code: Efficiency Inside

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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.

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	625
Percent Savings	4%
Hours per Year	8760

Savings	Energy Savings (kWh)	Demand Savings (kW)
Monthly Savings	25	0.0029
Yearly Savings	300	0.0342

Measure Costs and Incentive Levels

Incentive = $100

Savings Algorithm

Refer to TRM Compact Fluorescent Lighting (CFL) Section

Akamai Power Strips				
Savings per Unit	56.5 kWh		102.8 kWh	*NYSERDA Measure Characterization for*
Plugs per Unit	5 plugs		7 plugs	Advanced Power Strips
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 Central AC Tune Up

Measure ID: See Table 7.3

Version Date & Revision History
Draft date: February 21, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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	4,852

High Efficiency:

With AC Annual Tune Up

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

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	

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		
	÷	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)	x	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	÷	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	
Persistance Factor	x	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	
Persistance Factor	x	1.00		
Pre Tune Up Coincidence Factor	x	0.33		Updated number based on EMV 23 Feb 12. 0.25 changed to 0.33.
Pre Tune Up On Peak Demand		0.925	kW	

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	x	92%	
Post Tune Up Coincidence Factor		0.31	
Average AC Unit Demand		2.77	
Persistance Factor	x	1.00	
Post Tune Up Coincidence Factor	x	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

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

Version Date & Revision History
Draft date: February 21, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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

Operating Hours
10 hours

Loadshape
TBD

Freeridership/Spillover Factors
TBD

Demand Coincidence Factor

Persistence

Lifetime
5 years

Measure Costs and Incentive Levels

Incentive = $100/unit

Component Costs and Lifetimes Used in Computing O&M Savings
TBD

Reference Tables
None

11 (RHTR) Residential Hard to Reach

11.1 Energy Efficiency Equipment Grants

11.1.1 Solar Inspections (Weatherization Assistance Program)

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

Referenced Documents:
- n/a

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:
- n/a

Description:

Energy and Demand Savings:

Based on the percentage (%) the Solar Inspection cost compared to incentives. For example, Solar Inspection Cost = $95 and the Solar Water Heater Incentive = $750. The energy savings = 10%

Energy Savings = 10% x 2066 kWh/year
= 206.6 kWh/year

Demand Savings = 10% x 0.46 kW
= 0.046 kW

Example

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**

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	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	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	Program Design
		10%	Water Heated by Remaining Backup Element	
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	
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	HE
Persistance Factor	x	0.93	pf	KEMA 2008
		2,066	kWh / Year	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	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**	
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

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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

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.

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)
Compact Fluorescent Lamp	119.7	0.0170
Akamai Power Strip	78.0	0.0089
LED	16.6	0.0030
Low Flow Shower Head - Solar	42.0	0.0440
Low Flow Shower Head - Electric Water Heater	306.0	0.2300
Faucet Aerator - Solar	31.0	0.0350
Faucet Aerator - Electric Water Heater	226.0	0.1800

Measure life

Measure	Measure Lfe *(Years)*
Compact Fluorescent Lamp	119.7
Akamai Power Strip	78.0
LED	16.6
Low Flow Shower Head - Solar	42.0
Low Flow Shower Head - Electric Water Heater	306.0
Faucet Aerator - Solar	31.0
Faucet Aerator - Electric Water Heater	226.0

Savings Algorithms

CFL - Single and Multi Family Residential Home				
Quantity three (3) Pack		3		
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		151.1	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		151.1	kWh per Year	
15W Compact Fluorescent Lamp Energy Usage	-	12.6	kWh per Year	
CFL Savings Before Adjustments		138.5	kWh per Year	
		138.5	kWh per Year	
Persistance Factor	x	0.800	pf	20.0% Lamps not installed or replaced back
		110.8	kWh per Year	
Adjustment for Mix of CFL sizes found in CA study		110.8	kWh per Year	
	x	1.08		
		119.7	kWh per Year	
CFL Energy Savings		**119.7**	**kWh / Year Savings**	
Three (3) 60W Incandescent Lamp Demand		0.180	kW	
15W Compact Fluorescent Lamp Demand	-	0.015	kW	
CFL Demand Reduction Before Adjustments		0.165	kW	
CFL Demand Reduction Before Adjustments		0.165	kW	
Coincidence Factor		0.120	cf	12.0% Lamps on between 5 and 9 p.m.
Persistance Factor	x	0.800	pf	20.0% Lamps not installed or replaced back
		0.016	kW	
Adjustment for Mix of CFL sizes found in CA study		0.016	kw	
	x	1.08	factor	
		0.017	kWh per Year	
CFL Demand Savings		**0.017**	**kWh per Year**	

Akamai Power Strips			
Savings per Unit	56.5 kWh	102.8 kWh	*NYSERDA Measure Characterization for*
Plugs per Unit	5 plugs	7 plugs	Advanced Power Strips
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

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	
Persistance 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.
Persistance Factor	x	0.800	pf	20.0% Lamps not installed or replaced back
		0.003	kW	
LED Demand Savings		**0.003**	**kW Savings**	

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 Syste	Program Design
		10%	Water Heated by Remaining Backup Element	
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
Demand Savings		40%		
Residential Low Flow Shower Head Demand Savings		**0.044**	**kW Savings**	

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	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
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	x	0.143	cf	
SERWH On Peak Demand		0.57	kW On Peak	
				8.6 Minutes per hour
Demand Savings		40%		KEMA 2008
Residential Low Flow Shower Head Demand Savings		**0.23**	**kW Savings**	

Faucet Aerator 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 Syste	Program Design
		10%	Water Heated by Remaining Backup Element	
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		26%		Hot water used for showers (AMMA)
Hot Water Usage from Faucets		99		
Base Case Aerator		2.2	GPM	
High Efficiency Case Aerator		1.5	GPM	
Savings = (1 - High Efficiency/Base)		32%		
Energy Savings		**31**	**kWh / Year**	
Solar System Metered on Peak Demand		0.11	kW On Peak	KEMA 2008
Demand Savings		32%		
Residential Aerator Demand Savings		**0.035**	**kW Savings**	

Faucet Aerator 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	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
Utilization Factor		26%		Hot water used for showers (AMMA)
Base SERWH Energy Usage per Year at the Meter		711	kWh / Year	Energy Usage for showers
Base Case Aerator		2.2	GPM	
High Efficiency Case Aerator		1.5	GPM	
Savings = (1 - High Efficiency/Base)		32%		
Energy Savings		**226**	**kWh / Year**	
SERWH Element Power Consumption		4.0	kW	
Coincidence Factor	x	0.143	cf	
SERWH On Peak Demand		0.57	kW On Peak	
				8.6 Minutes per hour
Demand Savings		32%		KEMA 2008
Residential Aerator Demand Savings		**0.18**	**kW Savings**	

11.1.3 CFL Exchange

Version Date & Revision History
Draft date: February 24, 2010
Effective date: July 1, 2012
End date: June 30, 2013

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

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

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	
		37.8	kWh per Year	
Persistance Factor	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.
Persistance 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**

Adjustments based on Evergreen Economics Recommendations (2/23/12)

11.1.4 Hawaii Energy Hero Audits

Version Date & Revision History
Draft date: February 21, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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

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	625
Percent Savings	4%
Hours per Year	8760

Savings	Energy Savings (kWh)	Demand Savings (kW)
Monthly Savings	25	0.0029
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, AOAO Measures

11.2.1 Hawaii Energy Hero Landlord Program

Version Date & Revision History
Draft date:
Effective date: July 1, 2012
End date: June 30, 2013

Referenced Documents:
- n/a

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:
- n/a

Measure Description:

Energy Hero Landlord Program – this program will be targeted at landlords who own affordable rental units. The program will offer such landlords comprehensive audit, RFP and other support to help with projects that will drive the energy cost of their renters down. The program will work with local lenders to provide project financing support in conjunction with the program.

Custom SWH Proposals – with a lack of projects generated from solicitation through a tiered or split incentive, the plan to offer more flexibility within a custom proposal framework was favored for PY12. This offer is budgeted for the equivalent of 484 SWH systems.

Baseline Efficiencies:
TBD

High Efficiency:
TBD

Energy Savings:
TBD

Incentives:

	Incentive	Target Goal (kWh/year)
• Hawaii Energy Hero Landlord	$0.25/kWh	5,212 kWh
• Custom SWH Proposals	$0.65/kWh	1,000,000 kWh

12 (BEEM) Business Energy Efficiency Measures

12.1 High Efficiency Lighting

12.1.1 Compact Fluorescent Lighting (CFL)

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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.

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

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

	CFL Energy Reduction		
Building Type	**< 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

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

	CFL Demand Reduction		
Building Type	**< 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

CFL Operational Hours and Peak Coincidence Factors:

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)

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	
		259.5	kWh per Year	
Persistance 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.
Persistance Factor	x	0.950	pf	5.0% Lamps not installed or replaced back
		0.029	kW	
CFL Demand Savings		**0.029**	**kW Savings**	

Measure
3 years (DEER)

Unit Incentive/Incremental Cost

Incentive = $2/unit

CFL – Military Homes

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		
		56.7	kWh per Year		
Persistance Factor	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.
Persistance 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 standard T8 (Magnetic Ballast)

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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 T12 lamp to standard T8 (magnetic ballast), 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 T12 lamp with magnetic ballast.

High Efficiency

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

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

	Demand Savings (kW)			
Building Type	**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):

	Energy Savings (kWh/year)			
Building Type	**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 T12/T8 to T8 Low Wattage

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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.

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	¢ /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

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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

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)

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

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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.

Energy and Demand Savings:
The wattage per lamp varies greatly depending on the size of the lamp. See Table 3 for Interactive Effect.

	Demand Savings (kW)			
Building Type	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

	Energy Savings (kWh/year)			
Building Type	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

Version Date & Revision History
Draft date: October 3, 2011
Effective date: July 1, 2012
End date: June 30, 2013

Referenced Documents:
- n/a

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:
- n/a

Measure Description:
TBD

Baseline Efficiencies:
40W F40 T8 Linear Fluorescent Lamp

High Efficiency:
23W LED Linear Lamp

Energy Savings:
223.6 kWh and .036 kW
EM&V recommends demand savings at 0.023 kW (note: program cannot mathematically come up with this figure – see algorithm next page).

Savings Algorithms

LED Refrigerated Case Lighting

			40.0 W	
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		248.2 kWh per Year	
Enhanced	23W LED Linear Lamp		0.023 kW	
			17 Hours per Day	
		x	365 Days	6205 Hours per Year
	LED Fixture kWh/Year		142.7 kWh per Year	
	40W F40 T8 kWh/Year		248.2 kWh per Year	
	LED Fixture kWh/Year	-	142.7 kWh per Year	
	LED Savings Before Adjustments		105.5 kWh per Year	
	Demand Compressor Load w/ Existing F40 T8		0.0448 kW	
			17 Hours per Day	
		x	365 Days	6205 Hours per Year
			278.0 kWh per Year	
	Demand Compressor Load w/ LED		0.0258 kW	
			17 Hours per Day	
		x	365 Days	6205 Hours per Year
			159.8 kWh per Year	
	kWh Reduction		105.5 kWh per Year	
	% of Lighting Savings reduced from Compressor Load	x	100%	
	Cooling Energy Reduced from System		105 kWh per Year	
	Lighting Contribution to Cooling Energy Reduced from System		105 kWh per Year	
	Refrigerator Compressor Efficiency	x	1.12 COP	
	Compressor Energy Reduced		118.1 kWh per Year	
	LED Savings Before Adjustments		105.5 kWh per Year	
	Compressor Energy Reduced	+	118.1 kWh per Year	
	Fixture Savings Per Year		223.6 kWh per Year	

	LED Peak Demand Savings per Lamp		**0.036 kW Savings per Lamp**	
Base	**F40 T8 Linear Fluorescent Fixture Demand kW**		**0.085 kW**	
Enhanced	**LED Demand kW**	-	**0.049 kW**	
			0.036 kW Savings	

	Total Annual Energy Savings (including compressor savings) per Lamp		**223.6 Annual Savings (kWh) per Lamp**	
Base	**F40 T8 Annual Energy Use**		**526.184 kWh per Lamp**	
Enhanced	**LED Case Lighting Fixtures Annual Energy Use**	-	**302.556 kWh per Lamp**	
	LED Energy Reduction		**223.6 kWh per Lamp**	

12.1.7 LED

Version Date & Revision History
Draft date: November 30, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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.
- Matched energy/demand savings for LED ENERGY STAR approved recessed-can retrofit kit to PAR30 short/long neck dimmable/non-dimmable.

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 or ENERGY STAR approved recessed-can retrofit kit	0.0750	80%	0.0200	20%	0.0640	0.0163	0.0477	0.0358
PAR30 Long Neck or ENERGY STAR approved recessed-can retrofit kit	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

			Dimmable Commercial Lighting													
			MR16		PAR20 8 deg.		PAR20 25 deg.		PAR30 Short Neck or ENERGY STAR approved recessed-can retrofit kit		PAR30 Long Neck or ENERGY STAR approved recessed-can retrofit kit		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)

Non-Dimmable

			Non-Dimmable Commercial Lighting													
			MR16		PAR20 8 deg.		PAR20 25 deg.		PAR30 Short Neck or ENERGY STAR approved recessed-can retrofit kit		PAR30 Long Neck or ENERGY STAR approved recessed-can retrofit kit		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	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	5,278	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

Version Date & Revision History
Draft date: January, 2010
Effective date: July 1, 2012
End date: June 30, 2013

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_techsheet.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

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	
		306.6	kWh per Year	
Persistance Factor	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.
Persistance 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

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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

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

Operating hours assumed 4,943 hr/year.

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

	Pulse Start Energy Reduction		
Building Type	**<=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):

	Pulse Start Demand Reduction		
Building Type	**<=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

12.1.11 Sensors

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

Reference Documents:

- BC Hydro report: Smart Strip electrical savings and usability, October 2008 (unit can only take one surge, then needs to be replaced)
- Plug Load Characterization Study for Southern California Edison. Prepared by Research Into Action (2010)
- Based on assumption that office equipment will be running during the peak period
- Assumes 2 weeks of vacation and 2 weeks of holidays for a total of 48 work weeks annually
- See Table 'Standby Power Consumption of Devices Using Smart Strip Plug Outlets'
- Standby loads sourced from Lawrence Berkeley National Laboratory http://standby.lbl.gov/summary-table.html. Hours of operation based on engineering estimations.

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description
Plug load occupancy sensors are devices that control low wattage office equipment using an occupancy sensor. They typically use an infrared sensor to monitor movement, and use a smart strip to turn off connected devices, or put them in standby mode, when no one is present.

Definition of Efficient Equipment
In order for this characterization to apply, the installed equipment must be a 'smart' power strip with both control and peripheral outlets, and an occupancy sensor.

Definition of Baseline Equipment
The baseline assumes a mix of typical document station office equipment (printers, scanners, fax machines, etc.) each with uncontrolled standby load.

Deemed Savings for this Measure

Annual kWh Savings = 169 kWh/yr
Demand kW Savings = 0

Deemed O&M Cost Adjustments
n/a

Coincidence Factor
0

Energy Savings

$\Delta kWh = (WORKDAYS \times \Delta Wsleep)/1000$

Where:

WORKDAYS = Average number of workdays, or business days, in a year
= 240 (4)

ΔWsleep = The energy savings of devices plugged into the strip when in 'sleep' mode (Wh)
= 704 (5)

Coincident Peak Demand Savings

ΔkW = 0

Deemed O&M Cost Adjustment Calculation
n/a

Reference Tables
Standby Power Consumption for Devices Using Smart Strip Plug Outlets (6) (All values in Watts)

Computer Peripherals	Connected Load when 'On'	Connected Load in 'Sleep'	Hours in Sleep Mode	Daily Savings
Laser Printer	131	2	4	516
Multi-function device, laser (scanner, fax)	50	3	4	188
			Total	704

Lifetime of Efficient Equipment
The estimated useful life for a smart strip plug outlet is 8 years (1)

Measure Cost
The incremental cost for this measure is assumed to be $70 (2)

12.1.12 Stairwell Bi-Level Dimming Fluorescent

Version Date & Revision History
Draft date:
Effective date: July 1, 2012
End date: June 30, 2013

Referenced Documents:
- n/a

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:
- n/a

Measure Description:
This measure is evaluated and incentivized base on a customized approach comparing base case to enhanced case scenarios along with studies from Seattle City Lights based on reduced run time and height and type of building.

12.1.13 Daylighting

Version Date & Revision History
Draft date:
Effective date: July 1, 2012
End date: June 30, 2013

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 base on custom program with pre and post data logging.

12.2 High Efficiency HVAC

12.2.1 Chiller

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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

Energy Savings:

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

Building Type	Recipricating	Rotary Screw or Scroll			Centrifugal		
	All	<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	Rotary Screw or Scroll			Centrifugal		
	All	<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

$0.25/kWh

12.2.2 VFD – Chilled Water/Condenser Water

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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)
- 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

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*0.746*% 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

Measure Life = 15 years (DEER)

12.2.3 VFD – AHU

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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.

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*0.746*% 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

Version Date & Revision History
Draft date: October 3, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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.
- 85% cap of incentive was removed May 2013

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.

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.

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

Incentives

- $0.14/kWh
- Incentives is limited to 85% of incremental costs.
- Installations are subject to inspection for up to 5 years. Removal will be cause for incentive forfeiture.

Measure Life
8 years

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				7.5	(0.2)	103.2%
	GSF-3	2-B	PSF-4	10.0	7.5				65,700	657	100.0%		Data logger installed	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%		Data logger installed	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				5.6	1.1	80.4%
	GSF-5	4-A	PSF-3	7.5	5.8				50,808	508	100.0%		Data logger installed	5.6	(0.2)	103.7%
6	GEF-11	5-A	PEF-1	7.5	4.9				42,924	429				5.6	0.7	87.6%
	GSF-6	5-A	PSF-3	7.5	5.8				50,808	508	100.0%		Data logger installed	5.6	(0.2)	103.7%
7	GEF-13	6-A	PEF-2	10.0	7.5				65,700	657				7.5	(0.0)	100.5%
	GSF-7	6-A	PSF-3	7.5	5.0				43,800	438	100.0%		Data logger installed	5.6	0.6	89.4%
8	GEF-2	1-B	PEF-1	7.5	3.6				31,536	315				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%		Data logger installed	5.6	0.7	87.6%
	GEF-14	6-A	PEF-4	3.0	2.4				21,024	210				2.2	(0.2)	107.2%
TOTALS				**156.0**	**109.1**	kW		Pre-Project	955,716	9,557				116.4	7.3	
				Coincidence Factor	1.0			Post-Project	(9,557)							
				On Peak Demand Savings	109.1	kW		Energy Savings per Year	946,159	kWh						
					109.1	kW			946,159	kWh/yr.						
				Demand Cost per Unit	$ 12.60	/kW month		Energy Cost per Unit	$ 0.21	/kWh						
				Demand Cost Savings	$ 1,375	/month		Energy Cost Savings	$ 200,586	/yr.						
					12	months						Incentive	$ 0.18			
					$ 16,496	/Year										
								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

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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 (kW/ton)	SEER/EER	Hawaii Energy Premium Efficiency (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

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

Measure Life = 15 years
Incentive = $200/ton

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

Version Date & Revision History
Draft date: February 24, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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 should have been 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

Savings for retrofit and new construction

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

Incentive = $250/ton (new construction)
= $300/ton (retrofit)

12.3 High Efficiency Water Heating

12.3.1 Commercial Solar Water Heating

Version Date & Revision History
Draft date: May 30, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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

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	Program Design
		10%	Water Heated by Remaining Backup Element	
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
Persistance 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**	

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	÷	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	
Heat Pump Efficiency	÷	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	
	x	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	x	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
Persistance Factor	x	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	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**	

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

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

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	KEMA 2008
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		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	
Coincedence 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	8.6 Minutes per hour
Base SERWH On Peak Demand		0.05	kW On Peak	KEMA 2008
Base SERWH On Peak Demand	-	0.05	kW On Peak	
Heat Pump Water Heater Demand	-	0.02	kW On Peak	KEMA 2008
		0.03	kW On Peak	

Commercial Solar Water Heater Demand Savings 0.03 kW Savings per Ton

Incentive

$65/ton

12.4 High Efficiency Water Pumping

12.4.1 VFD Domestic Water Booster Packages

Version Date & Revision History
Draft date: May 23, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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:

- <u>Effective 7/1/10 through 3/6/11</u>
  Previous Incentive = $1,600 + [(Existing System hp – New System hp) x $65]
- <u>Effective 3/7/11 through 6/30/11</u>
  New Incentive = $3,000 + [(Existing System hp – New System hp) x $80]

Description: 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.
- 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 Constructions.

Energy and Demand Savings:

Demand Savings = 2.62 + (HP Reduction) x 0.115

Energy Savings = 25,500 + (HP Reduction) x 989

	No HP Reduction	W/HP Reduction	HP Reduction Multiplier
Demand Savings (kW/HP)	2.620	2.735	0.115
Energy Savings (kWh/HP-year)	25,500	26,489	989

Savings Algorithm:

	No HP Reduction	W/HP Reduction	HP Reduction Multiplier
Demand Savings (kW/HP)	2.620	2.735	0.115
Energy Savings (kWh/HP-year)	25,500	26,489	989

Based on HECO's evaluation from past projects and monitoring

Previous Incentive	$ 1,600	$ 1,600
Cost/kWh	$ 0.06	$ 0.06
Base HP Reduction		$ 65.00
New Incentive	$ 3,000	$ 3,000
Cost/kWh	$ 0.12	$ 0.11
Proposed HP Reduction		$ 80.00

Demand Savings = 2.62 + (HP Reduction) x 0.115

Energy Savings = 25,500 + (HP Reduction) x 989

Example

	Existing System	New System
Small Building	7.5 HP	3 HP
12 Floors (83 Units)	7.5 HP	3 HP
	15 HP	6 HP
Cost	$ 31,000	

Savings Summary

HP Reduction	kW	kWh
9	3.77	34,401

Previous Rebate	HP Reduction	Total	$/kWh
$ 1,600	$ 585	$ 2,185	$ 0.064
	7% Incremental Cost		

New Rebate	HP Reduction	Total	$/kWh
$ 3,000	$ 720	$ 3,720	$ 0.108
	12% Incremental Cost		

Incentives:

Incentive = [(Existing System hp – New System hp) x $80] + $3000

12.4.2 VFD Pool Pump Packages

Version Date & Revision History
Draft date: February 24, 2010
Effective date: July 1, 2012
End date: June 30, 2013

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.

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

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.

Savings Algorithm

Commercial Pool Pump

Average Pool Pump Horesepower	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

Based Demand	0.93	kW
Base Energy Usage per day	5.60	kWh/day
Base Energy Usage per year	2042	kWh/year

Demand Reduction	10%	
High Efficiency Demand	0.84	kW
Energy Savings	55%	
High Efficiency Energy Usage	919	kWh/year

Energy Savings per year	1123	kWh/year
Demand Savings	0.093	kW

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

$225/HP

12.5 High Efficiency Motors

12.5.1 CEE Listed Premium Efficiency Motors

Version Date & Revision History
Draft date: March 2, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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

Energy Savings

Based on per HP

Demand Savings	0.0283 kW
Energy Savings	46.4 kWh/year

Savings Algorithm

$$\Delta kWh = HP \times 0.746 \times ((1/\eta BASE)-(1/\eta EE)) \times LF \times HOURS$$

Where:

HP	= Motor Horse Power
	= Actual installed
ηBASE	= Efficiency of baseline motor. Based on EPACT 92 for installed HP
ηEE	= 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

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)

12.5.2 ECM Evaporator Fan Motors for Walk-in Coolers and Freezers

Version Date & Revision History
Draft date:
Effective date: July 1, 2013
End date: June 30, 2014

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.

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 Condenser Fan – Freezer Compressor Fan – Freezer Evaporator Fan – Refrigerator Condenser Fan – Refrigerator Compressor Fan - Freezer	115 141 985 294 141 690	0.013 0.016 0.112 0.034 0.016 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

Table 1

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:

kW savings = Rated Wattage x (kW/Wpre - kW/Wpost)

kWh savings = Rated Wattage x (kWh/Wpre – kWh/Wpost)

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

12.5.3 EC Motors – Fan Coil Units

Measure ID:

Version Date & Revision History
Draft date:
Effective date: July 1, 2013
End date: June 30, 2014

Referenced Documents:
- n/a

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:
- n/a

Measure Description:

Electronically commutated motors provide clear advantages over AC or conventional DC motors in terms of service life, controllability, flexibility, and cost-effectiveness.

For the past 30 years, forward-bladed centrifugal fans in fan coil-units have been driven by AC motors, which are typically around 45% efficient. However, the latest electronically commutated (EC) motors are 80% efficient, leading to significant operational benefits. The term EC is applied to a DC motor having electronic commutation achieved with a microprocessor.

Commutation means applying a current to the motor phases to produce the best torque at the motor's shaft. In brush-type motors, commutation is done electromechanically using graphite brushes and a commutator. In brushless motors, however, it is achieved by switching electronics using rotor-position information obtained by sensors. Thus, the EC motor is essentially a DC motor that can be connected direct to an AC mains supply.

Baseline Efficiencies:

BASE CASE		
Base demand 4 pole (1800 rpm)	107	watts

High Efficiency:

ENHANCED CASE		
High efficiency DC/EC demand	54	watts

The major advantage of EC motors over their AC counterparts is far higher efficiency, which enables a fan-coil unit to achieve a specific fan power (SFP) of 0.3 compared with 0.8 for an AC motor (the limit in the latest Building Regulations is 0.8 W/l/s).

This higher efficiency can be maintained at low speeds, so less motor heat is absorbed by the cold air discharged from the FCU, which in turn leads to more cooling applied in the space. Lower temperatures increase motor life, and in-built soft starting gives longer bearing life.

Speed control is simple, and results in impressive energy saving performance. The maximum cooling load on an FCU may only apply for 500 hour out of a total annual running time of 3,000 hour. With a typical fan coil unit, the fans deliver more air than necessary for 2500 hour/year — a shocking waste of energy.

By using the temperature controller on an FCU to reduce the speed of the EC motor during periods of reduced cooling demand, we can cut energy wastage dramatically. For example, an annual fan energy consumption of 620 kWh can be reduced to 140 kWh using speed control.

The reduction of air volume is, however, limited by considerations of the room air distribution. That is why we recommend that tests are undertaken in a suitable test facility to determine the optimum range of air volume.

Energy Savings:

ENERGY SAVINGS		
Energy savings 4 pole	232	kWh/year

PEAK DEMAND SAVINGS (5PM-9PM)		
Coincidence factor	0.5	
Peak demand savings (4 pole)	0.0265	kW

Electronically commutated motors offer six major benefits when used in fan-coil units.

• High efficiency of 85%, leading to lower input power.
• Lower rise in air temperature on the air stream.
• Efficient speed control.
• Longer motor life resulting from lower running temperatures.
• Longer bearing life because of the soft-start feature.
• Suitable for a 230 V supply.

By considering a typical 2 fan, fan coil unit providing 190l/s of air against an external resistance of 30Pa, from the testing undertaken by Caice the following figures were derived:
• 4 pole AC Motor Fan Unit powered by 2 off fans energy consumed = 107 watts, sfp 0.55 = w/l/s
• DC/EC Motor Fan Unit powered by 2 off fans energy consumed = 54 watts, sfp = 0.28 w/l/s.

Savings Algorithms

BASE CASE		
Base demand 4 pole (1800 rpm)	107	watts
ENHANCED CASE		
High efficiency DC/EC demand	54	watts
DEMAND SAVINGS		
Demand savings 4 pole	53	watts
hours of operation	12	hours/day
hours of operation	4380	hours/year
ENERGY SAVINGS		
Energy savings 4 pole	232	kWh/year
PEAK DEMAND SAVINGS (5PM-9PM)		
Coincidence factor	0.5	
Peak demand savings (4 pole)	0.0265	kW

Operating Hours
4,380 hours/year (12 hours/day)

Demand Coincidence Factor
0.5

Lifetime
15 years

Measure Costs and Incentive Levels
$55/unit

12.6 Commercial Industrial Processes

12.6.1 Waste Water Process Improvements

Version Date & Revision History
Draft date:
Effective date: July 1, 2012
End date: June 30, 2013

Referenced Documents:
- n/a

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:
- n/a

Measure Description:
Wastewater facilities are 24/7 facilities that have specific technical requirements, high capital costs and long procurement process. This targeted program will target the two highest energy consumers in the plants, air systems & UV lighting through process improvements. A list of private waste water facilities will be leveraged in targeting opportunities.

Baseline Efficiencies:
TBD

High Efficiency:
TBD

Energy Savings:
The methodology for energy savings will be based on a customized approach.

Incentives
This measure will be in the $0.50/kWh range.

12.6.2 Air Compressor Technologies and Operations

Version Date & Revision History
Draft date:
Effective date: July 1, 2012
End date: June 30, 2013

Referenced Documents:
- n/a

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:
- n/a

Measure Description:
This program is to encourage the newer VFD rotary and screw air compressor systems that provide 25% to 30% savings. The program will be vendor driven to provide them direct incentives and the support of Hawaii Energy technology papers and sales call assistance.

Baseline Efficiencies:
No action

High Efficiency:
Corrective measure

Energy Savings:
The methodology would be based on a customized approach with industry studies with energy savings associated to leakage correction.

Incentives
This measure will be in the $0.25/kWh range.

12.6.3 Demand Control Kitchen Ventilation (DCKV)

Version Date & Revision History
Draft date:
Effective date: July 1, 2013
End date: June 30, 2014

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:

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

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

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
5824	

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)

12.6.4 Low Flow Spray Nozzles for Food Service (Retrofit)

Measure ID:

Version Date & Revision History
Draft date:
Effective date: July 1, 2013
End date: June 30, 2014

Referenced Documents:

- n/a

TRM Review Actions:

- 10/5/11 – Currently Under Review.

Major Changes:

- n/a

Measure Description:
All pre-rinse valves use a spray of water to remove food waste from dishes prior to cleaning in a dishwasher. They reduce water consumption, water heating cost, and waste water (sewer) charges. Pre-rinse spray valves include a nozzle, squeeze lever, and dish guard bumper. The spray valves usually have a clip to lock the handle in the "on" position. Pre-rinse valves are inexpensive and easily interchangeable with different manufacturers' assemblies.

Baseline Efficiencies:
The baseline equipment is assumed to be a spray valve with a flow rate of 3 gallons per minute.

High Efficiency:
The efficient equipment is assumed to be a pre-rinse spray valve with a flow rate of 1.6 gallons per minute, and with a cleanability performance of 26 seconds per plate or less.

Energy Savings:

$$\Delta kWh = \Delta Water \times HOT_{\%} \times 8.33 \times (\Delta T) \times (1/EFF) \times 10^{-6}$$

ΔWater = Water savings (gallons)
$HOT_{\%}$ = The percentage of water used by the pre-rinse spray valve that is heated = 69%
8.33 = The energy content of heated water (Btu/gallon/°F)
ΔT = Temperature rise through water heater (°F) = 70°F
EFF = Water heater thermal efficiency = 0.97
10^{-6} = Factor to convert Btu to MMBtu

$$\Delta Water = (FLO_{base} - FLO_{eff}) \times 60 \times HRS_{day} \times 365$$

FLO_{base} = The flow rate of the baseline spray nozzle = 3 gallons per minute
FLO_{eff} = The flow rate of the efficient equipment = 1.6 gallons per minute
60 = minutes per hour
365 = days per year
HRS = Hours used per day – depends on facility type as below

Savings Algorithms

Base Case Flow		3	Gallons per Minute	
Enhanced Case Flow		1.6	Gallons per Minute	
Average useage time per day		120	Minutes per Day	*Average hour estimate based on PG&E savings estimates, algorithms, sources (2005).*
Reduce Shower		1.4	Gallon per Minute	
Water Usage Reduction		168.0	Gallons per Day	
Mass of Water Conversion		8.34	lbs/gal	
Finish Temperature of Water		140	deg. F Finish Temp	
Initial Temperature of Water	-	70	deg. F Initial Temp	
Temperature Rise		70	deg. F Temperature Rise	
Energy to Raise Water Temp		1.0	BTU / deg. F / lbs.	
Energy per Day (BTU) Needed in Tank		98,078	BTU/Day	
Energy per Day (BTU) Needed in Tank		98,078	BTU/Day	
BTU to kWh Energy Conversion	÷	3,412	kWh / BTU	
Energy per Day (kWh)		28.7	kWh / Day	
Days per Month	x	30.4	Days per Month	
Energy (kWh) per Month		874	kWh / Month	
Days per Year	x	365	Days per Year	
Energy (kWh) Needed in Tank to Heat Water per Year		10,486	kWh / Year	
Elec. Res. Water Heater Efficiency	÷	0.97	COP	
		10,811	kWh / Year	
Percentage of water used by nozzle that is heated		69%		
Annual Energy Savings		7,459	kWh / Year	
Coincident Peak Demand Savings		0	kW	

Operating Hours

Facility Type	Hours of Pre-Rinse Spray Valve Use per Day (HOURS)
Full Service Restaurant	4
Other	2
Limited Service (Fast Food) Restaurant	1

Demand Coincidence Factor
TBD

Persistence
TBD

Lifetime
5 years

Measure Costs and Incentive Levels
The actual measure installation cost should be used (including material and labor).

12.6.5 ENERGY STAR Commercial Kitchen Equipment - Ice Makers

Version Date & Revision History
Draft date:
Effective date: July 1, 2013
End date: June 30, 2014

Referenced Documents:

- PG&E Work Paper PGECOFST108 Commercial Ice Machines Revision 3 – May 30, 2012

TRM Review Actions:

- Currently Under Review.

Major Changes:

- New measure

Measure Description:
This measure applies to Energy Efficient air-cooled commercial ice makers in retrofit and new construction applications installed in conditioned spaces. Commercial ice makers are classified into three equipment types; ice-making heads (IMHs), remote condensing units (RCUs) and self-contained units (SCUs). The measure described here applies to ice makers that use a batch process to make cubed ice.

The industry standard for energy use and performance of commercial ice machines is AHRI Standard 810. Key parameters reported for ice makers include the Equipment Type, Harvest Rate (lbs of ice/24hrs) and Energy Consumption Rate. The AHRI Directory of Certified Equipment150 lists these values by equipment manufacturer and model number.

Baseline and Efficiency Standard:
The Energy Efficient criteria for ice makers define efficiency requirements for both energy and potable water use.

Market Applicability
Hospitals account for 39.4 percent of all commercial icemaker purchases, followed by hotels (22.3 percent), restaurants (13.8 percent), retail outlets (8.5 percent), schools (8.5 percent), offices (4.3 percent), and grocery stores (3.2 percent).

Measure Savings Calculations:
Annual electric savings can be calculated by determining the energy consumed for baseline ice makers compared against ENERGY STAR performance requirements using the harvest rate of the more efficient unit. Peak demand savings can then be derived from the electric savings.

$$\Delta kWh = (kWh_{\boldsymbol{base,per100lb}} - kWh_{\boldsymbol{ee,per100lb}})/100 \times DC \times H \times 365$$

$$\Delta kW = \Delta kWh / HRS$$

Where:

- 100 = conversion factor to convert kWh***base,per100lb*** and kWh***ee,per100lb*** into maximum kWh consumption per pound of ice.
- DC = Duty Cycle of the ice maker representing the percentage of time the ice machine is making ice
- H = Harvest Rate (lbs of ice made per day)
- 365 = days per year
- kWh = Annual energy savings
- HRS = Annual operating hours
- CF = 1.0

The baseline and energy efficient energy usage per 100lbs of ice produced is dependent on the category of ice maker, as well as the capacity of the energy efficient ice maker. The equations used to determine the energy per 100lbs of ice produced can be seen below.

This incentive applies towards the purchase of new or replacement energy efficient Air-cooled ice machines. Used or rebuilt equipment is not eligible. Customers must provide proof that the appliance meets the energy efficiency specifications listed in Table below.

This specification covers machines generating 60 grams (2 oz.) or lighter ice cubes, as well as flaked, crushed, or fragmented ice machines that meet the Energy Efficiency thresholds by Ice harvest (IHR) rate listed below. Only air cooled machines (icemaker heads, self-contained unites, and remote condensing units) are eligible for incentives. Performance data is based on ARI Standard 810.

Energy Efficiency Requirements

Equipment Type	Ice Harvest Rate Range (lbs of ice/24 hrs)	Energy Effficient Ice Makers		Federal Minimum Standard Energy Consumption Rate (kWh/100 lbs ice) (H = Harvest Rate)
		Energy Consumption Rate (kWh/100 lbs ice) (H = Harvest Rate)	Potable Water Use Limit (gal/100 lbs ice)	
Ice Making Heads	<450	$\leq$ 8.72 - 0.0073H	$\leq$ 20	10.26 - 0.0086H
	$\geq$ 450	$\leq$ 5.86 - 0.0009H	$\leq$ 20	6.89 - 0.0011H
Remote Condensing Units	< 1,000	$\leq$ 7.52 - 0.0032H	$\leq$ 20	8.85 - 0.0038H
	$\geq$ 1,000	$\leq$ 4.34	$\leq$ 20	5.10
Remote Condensing Units	< 934	$\leq$ 7.52 - 0.0032H	$\leq$ 20	8.85 - 0.0038H
	$\geq$ 934	$\leq$ 4.51	$\leq$ 20	5.30
Self-Contained Units	< 175	$\leq$ 15.3 - 0.0399H	$\leq$ 30	18.0 - 0.069H
	$\geq$ 175	$\leq$ 8.33	$\leq$ 30	9.80

Example Savings Calculations

Savings calculation for varying Harvest Rates (H) can be seen below:

Performance	IHR	IHR	IHR	IHR	IHR
Ice Harvest Rate (IHR) (lbs per 24 hrs.)	101-300	301-500	501-1,000	1,001-1,500	> 1,500
Average IHR Used in Energy Calculations (lbs/day)	200	400	750	1,250	1,750
Baseline Model Energy Usage (kWh/100 lbs)	9.8	6.82	6.07	5.1	5.1
Energy Efficient Model Energy Usage (kWh/100 lbs)	8.33	5.8	5.19	4.34	4.34
Baseline Model Daily Energy Consumption (kWh)	14.7	20.5	34.1	47.8	66.9
Energy Efficient Model Daily Energy Consumption (kWh)	12.5	17.4	29.2	40.7	57
Baseline Model Average Demand (kW)	0.613	0.853	1.421	1.992	2.789
Energy Efficient Model Average Demand (kW)	0.521	0.725	1.215	1.695	2.373
Estimated Demand Reduction (kW)	0.092	0.128	0.206	0.297	0.416
Baseline Model Annual Energy Consumption (kWh/yr)	5,366	7,468	12,452	17,452	24,432
Energy Efficient Model Annual Energy Consumption (kWh/yr)	4,561	6,351	10,645	14,851	20,791
Estimated Annual Energy Savings (kWh/yr)	805	1,117	1,807	2,601	3,641
Electric Cost ($/kWh)	$0.25	$0.25	$0.25	$0.25	$0.25
Baseline Model Annual Energy Cost ($/yr)	$1,342	$1,867	$3,113	$4,363	$6,108
Energy Efficient Model Annual Energy Cost ($/yr)	$1,140	$1,588	$2,661	$3,713	$5,198
Estimated Annual Energy Cost Savings ($/yr)	$201	$279	$452	$650	$910
Estimated Incremental Cost	$306	$266	$249	$589	$939
Estimated Useful Life (EUL)	12	12	12	12	12

Demand Coincidence Factor
CF = 1.0

Lifetime
12 years

Incentive Levels

12.6.6 ENERGY STAR Commercial Kitchen Equipment - Electric Steam Cooker

Version Date & Revision History
Draft date:
Effective date: July 1, 2013
End date: June 30, 2014

Referenced Documents:

- ENERGY STAR Commercial Kitchen Equipment Savings Calculator: Steam Cooker Calcs.
- PG&E Work Paper PGECOFST104 Commercial Steam Cooker Revision #4 (5/22/12)

TRM Review Actions:

- Currently Under Review.

Major Changes:

- New measure

Measure Description:
The installation of a qualified ENERGY STAR commercial steam cooker. ENERGY STAR steam cookers save energy during cooling and idle times due to improved cooking efficiency and idle energy rates.

Baseline Efficiencies:
The Baseline Efficiency case is a conventional electric steam cooker with a cooking energy efficiency of 30%, pan production of 23.3 pounds per hour, and an idle energy rate of 1.2 kW.

High Efficiency:
The High Efficiency case is an ENERGY STAR electric steam cooker with a cooking energy efficiency of 50%, pan production capacity of 16.7 pounds per hour, and an idle energy rate of 0.4 kW.

Energy Savings:
Unit savings are deemed based on study results:

ΔkWh/year = 3,258 kWh/pan
ΔkW = 2.23 kW

Savings Algorithms

Steam Cooker Calculations for the ENERGY STAR Commercial Kitchen Equipment Calculato

Inputs

	USER ENTRY	
	Electric	
Average daily operation	12	hours
Annual days of operation	365	days
Food cooked per day	100	pounds
Number of pans per unit	3	
Incremental cost	$2,000	

Assumptions

	Electric		
	Conventional	ENERGY STAR	
Type	steam generator	boilerless	
Water Use	40	3	gallons/hour
Time in constant steam mode	40%	40%	
Cooking energy efficiency	30%	50%	
Production capacity per pan	23.3	16.7	pounds/hour
Number of preheats per day	1	1	
Preheat length	15	15	minutes
Preheat energy rate	6,000	6,000	W
Idle energy rate	1,200	400	W
ASTM energy to food	30.8		Wh/pound
Equipment lifetime	12		years

Calculations

	Electric		
	Conventional	ENERGY STAR	
Annual operation	4,380		hours
Daily preheat energy	1,500	1,500	Wh
Daily cooking energy	10,267	6,160	Wh
Daily idle time	10.32	9.75	hour
Daily idle energy	37,052	14,382	Wh
Total daily energy	48,819	22,042	Wh

Annual energy consumption per steam cooker

	Conventional	ENERGY STAR	Savings (3 Pan)	Savings per Pan
Electric Usage (kWh/year)	17,819	8,045	9,774	3258

Operating Hours
The average steam cooker is assumed to operate 4,380 hours per year.

Demand Coincidence Factor
CF = 1.0

Persistence
100% persistence factor

Lifetime
12 years

Measure Costs and Incentive Levels
Incremental cost = $2,000, Incentive Level = $750/steamer

12.6.7 ENERGY STAR Commercial Kitchen Equipment - Griddle

Version Date & Revision History
Draft date:
Effective date: July 1, 2013
End date: June 30, 2014

Referenced Documents:

- The industry standard for energy use and cooking performance of griddles are ASTM F1275-03: Standard Test
- Method for the Performance of Griddles and ASTM F1605-01: Standard Test Method for the Performance of Double-Sided Griddles
- ENERGY STAR Commercial Griddles Program Requirements Version 1.1, effective May 2009 for gas griddles and effective January 1, 2011 for electric.
- Database for Energy Efficient Resources, 2008, http://www.deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls
- Assumptions based on PG&E Commercial Griddles Work Paper developed by FSTC, May 22, 2012.

TRM Review Actions:

- Currently Under Review.

Major Changes:

- New measure

Measure Description:
This measure applies to ENERGY STAR or equivalent electric commercial griddles in retrofit and new construction applications. This appliance is designed for cooking food in oil or its own juices by direct contact with either a flat, smooth, hot surface or a hot channeled cooking surface where plate temperature is thermostatically controlled.

Energy-efficient commercial electric griddles reduce energy consumption primarily through the application of advanced controls and improved temperature uniformity.

Baseline and Efficiency Standard
Key parameters for defining griddle efficiency are Heavy Load Cooking Energy Efficiency and Idle Energy Rate. There are currently no federal minimum standards for Commercial Griddles, however, the American Society of Testing and Materials (ASTM) publishes Test Methods155 that allow uniform procedures to be applied to each commercial cooking appliance for a fair comparison of performance results.

ENERGY STAR efficiency requirements apply to single and double sided griddles. The ENERGY STAR criteria should be reviewed on an annual basis to reflect the latest requirements.

ENERGY STAR Criteria for Electric Single and Double Sided Griddles

Performance Parameters	Electric Griddles
Heavy-Load Cooking Energy Efficiency	>= 70%
Idle Energy Rate	<= 320 watts per ft^2

Energy Savings:
Annual savings can be calculated by determining the energy consumed by a standard efficiency griddle as compared with an ENERGY STAR rated griddle.

ΔkWh = kWh(base) – kWh(eff)

ΔkWh(base or eff) = kWh(cooking) + kWh(idle) + kWh(preheat)

kWh(cooking) = [LB(food) x E(food)/Cook(eff)] x Days

kWh(idle) = IdleEnergy x [DailyHrs – LB(food)/Capacity – PreheatTime/60] x Days

kWh(preheat) = PreheatEnergy x Days

Parameter	Description	Value	Source
Daily Hrs	Daily Operating Hours	12 hours	FSTC
Preheat Time	Time to Preheat (min)	15 min	FSTC
E(food)	ASTM defined Energy to Food	0.139 kWh/lb	FSTC
Days	Number of days of operation	365 days	FSTC
CookEff	Cooking energy efficiency (%)	See Table below	FSTC, ENERGY STAR
IdleEnergy	Idle energy rate (kW)		
Capacity	Production capacity (lbs/hr)		FSTC
Preheat Energy	kWh/day		FSTC
LB(food)	Food cooked per day (lb/day)		FSTC

General assumptions used for deriving deemed electric savings are values taken from the Food Service Technology Center (FSTC) work papers. These deemed values assume that the griddles are 3 x 2 feet in size. Parameters in the table are per linear foot, with an assumed depth of 2 feet.

Baseline and Efficient Assumptions for Electric Griddles

Parameter	Baseline Electric Griddles	Efficient Electric Griddles
Preheat Energy (kWh/ft)	1.33	0.67
Idle Energy Rate (kW/ft)	0.80	0.64
Cooking Energy Efficiency (%)	65%	70%
Production Capacity (lbs/h/ft)	11.7	16.33
Lbs of food cooked/day/ft	33.33	33.33

Base (kWh/year) per linear foot	
Cooking	2602
Idle	2599
Preheat	485
Total Base Energy Usage (kWh)	**5686**
Demand (kW)	**1.30**

Efficient (kWh/year) per linear foot	
Cooking	2416
Idle	2268
Preheat	245
Total Efficient Energy Usage (kWh)	**4928**
Demand (kW)	**1.13**

Energy Savings (kWh/year) per linear foot	**758**
Demand Savings (kW)	**0.17**

Operating Hours
The average steam cooker is assumed to operate 4,380 hours per year.

Demand Coincidence Factor
Coincidence factor is 1.0 because the cooking equipment is assumed to operate throughout the on-peak demand periods (5PM – 9PM).

Persistence
100% persistence factor

Lifetime
12 years – DEER (2008)

Measure Costs and Incentive Levels
Incremental cost = $774
(Assumptions based on PG&E Commercial Griddles Work Paper developed by FSTC, May 22, 2012).

12.6.8 ENERGY STAR Commercial Kitchen Equipment - Fryer

Version Date & Revision History
Draft date:
Effective date: July 1, 2013
End date: June 30, 2014

Referenced Documents:

- The industry standards for energy use and cooking performance of fryers are ASTM Standard Test Method for the Performance of Open Deep Fat Fryers (F1361) and ASTM Standard Test Method for the Performance of Large Vat Fryers (FF2144).
- ENERGY STAR Version 2.0, effective April 22, 2011
- Assumptions based on PG&E Commercial Fryers Work Paper developed by FSTC, June 13, 2012

TRM Review Actions:

- Currently Under Review.

Major Changes:

- New measure

Measure Description:
This measure applies to ENERGY STAR or its equivalent electric commercial open-deep fat fryers in retrofit and new construction applications. Commercial fryers consist of a reservoir of cooking oil that allows food to be fully submerged without touching the bottom of the vessel. Electric fryers use a heating element immersed in the cooking oil. High efficiency standard and large vat fryers offer shorter cook times and higher production rates through the use of heat exchanger design. Standby losses are reduced in more efficient models through the use of fry pot insulation.

Baseline and Efficiency Standard
Key parameters for defining fryer efficiency are Heavy Load Cooking Energy Efficiency and Idle Energy Rate. ENERGY STAR requirements apply to a standard fryer and a large vat fryer. A standard fryer measures 14 to 18 inches wide with a vat capacity from 25 to 60 pounds. A large vat fryer measures 18 inches to 24 inches wide with a vat capacity greater than 50 pounds. The ENERGY STAR criteria should be reviewed on an annual basis to reflect the latest requirements.

There are currently no federal minimum standards for Commercial Fryers, however, the American Society of Testing and Materials (ASTM) publishes Test Methods183 that allow uniform procedures to be applied to each commercial cooking appliance for a fair comparison of performance results.

ENERGY STAR Criteria and FSTC Baseline for Open Deep-Fat Electric Fryers

Performance Parameters	ENERGY STAR Electric Fryer Criteria	
	Standard Fryers	Large Vat Fryers
Heavy-Load Cooking Energy Efficiency	>= 80%	>= 80%
Idle Energy Rate	<+ 1.0 kW	<= 1.1 kW

Energy Savings:

Annual savings can be calculated by determining the energy consumed by a standard efficiency fryer as compared with an ENERGY STAR rated fryer.

ΔkWh = kWh(base) – kWh(eff)

ΔkWh(base or eff) = kWh(cooking) + kWh(idle) + kWh(preheat)

kWh(cooking) = [LB(food) x E(food)/Cook(eff)] x Days

kWh(idle) = IdleEnergy x [DailyHrs – LB(food)/Capacity – PreheatTime/60] x Days

kWh(preheat) = PreheatEnergy x Days

Parameter	Description	Value	Source
Daily Hrs	Daily Operating Hours	12 hours	FSTC
Preheat Time	Time to Preheat (min)	15 min	FSTC
E(food)	ASTM defined Energy to Food	0.167 kWh/lb	FSTC
Days	Number of days of operation	365 days	FSTC
CookEff	Cooking energy efficiency (%)	See Table below	FSTC, ENERGY STAR
IdleEnergy	Idle energy rate (kW)		
Capacity	Production capacity (lbs/hr)		FSTC
Preheat Energy	kWh/day		FSTC
LB(food)	Food cooked per day (lb/day)		FSTC

General assumptions used for deriving deemed electric savings are values taken from the Food Service Technology Center (FSTC) work papers.

Baseline and Efficient Assumptions for Electric Standard and Large Vat Fryers

Parameter	Baseline Electric Fryers		Efficient Electric Fryers	
	Standard	Large Vat	Standard	Large Vat
Preheat Energy (kWh/ft)	2.3	2.5	1.7	2.1
Idle Energy Rate (kW/ft)	1.05	1.35	1.00	1.1
Cooking Energy Efficiency (%)	75%	70%	80%	80%
Production Capacity (lbs/h/ft)	65	100	70	110
Lbs of food cooked/day/ft	150	150	150	150

Baseline Electric Fryers	Standard	Large Vat
Cooking	12191	13062
Idle	3619	5051
Preheat	840	913
Total Energy Usage (kWh/year) per Vat	16649	19025
Demand	3.80	4.34

Efficient Electric Fryers	Standard	Large Vat
Cooking	11429	11429
Idle	3507	4170
Preheat	621	767
Total Energy Usage (kWh/year) per Vat	15556	16366
Demand	3.55	3.74

Savings	Standard	Large Vat
Energy Savings (kWh/year) per Vat	1093	2659
Demand Savings (kW)	0.25	0.61

Operating Hours
The average steam cooker is assumed to operate 4,380 hours per year.

Demand Coincidence Factor
Coincidence factor is 1.0 because the cooking equipment is assumed to operate throughout the on-peak demand periods (5PM – 9PM).

Persistence
100% persistence factor

Lifetime
12 years – DEER (2008)

Measure Costs and Incentive Levels
Incremental cost = $769
(Assumptions based on PG&E Commercial Fryers Work Paper developed by FSTC, May 22, 2012).

12.6.9 ENERGY STAR Commercial Kitchen Equipment - Hot Food Holding Cabinet

Version Date & Revision History
Draft date:
Effective date: July 1, 2013
End date: June 30, 2014

Referenced Documents:

- PG&E Work Paper PGEFST105 (Revision 3) – June 8, 2012

TRM Review Actions:

- Currently Under Review.

Major Changes:

- New measure

Measure Description:
Commercial insulated hot food holding cabinet models that meet program requirements incorporate better insulation, reducing heat loss, and may also offer additional energy saving devices such as magnetic door electric gaskets, auto-door closures, or dutch doors. The insulation of the cabinet also offers better temperature uniformity within the cabinet from top to bottom. This means that qualified hot food holding cabinets are more efficient at maintaining food temperature while using less energy.

- **Full-size holding cabinets** are defined as any holding cabinet with an internal measured volume of greater than or equal to 15 cubic feet (≥15 ft.3). This measure does not include cook-and-hold equipment. All measures must be electric hot food holding cabinets that are fully insulated and have doors. Qualifying cabinets must not exceed the maximum idle energy rate of 20 Watts per cubic foot in accordance with the ASTM Standard test method.

- **Half-size holding cabinets** are defined as any holding cabinet with an internal measured volume of less than 15 cubic feet (<15 ft.3). This measure does not include cook-and-hold or retherm equipment. All measures must be electric hot food holding cabinets that are fully insulated and have doors. Qualifying cabinets must not exceed the maximum idle energy rate of 20 Watts per cubic foot in accordance with the ASTM Standard test method.

Baseline Efficiency:
The baseline equipment is assumed to be a standard hot food holding cabinet with an idle energy rate of 40 watts per cubic foot.

High Efficiency:
The efficient equipment is assumed to be an ENERGY STAR qualified hot food holding cabinet with an idle energy rate of 20 watts per cubic foot.

Energy Savings:
Energy usage calculations are based on 15 hours a day, 365 days per year operation at a typical temperature setting of 150°F. The different sizes for the holding cabinets (half size and full size) have proportional operating energy rates. Operating energy rate for the full size holding cabinets was obtained in accordance with the ASTM Standard.

The energy savings calculations listed in the following tables use Title 20 (California) as the baseline for potential energy savings requiring all hot food holding cabinets sold in California to meet a normalized idle energy rate of 40 Watts/ft³.

Insulated Hot Food Holding Cabinet - Full Size

Performance	Baseline	High Efficiency Qualifying Model
Demand (kW)	1	0.28
Annual Energy Use (kWh/year)	5475	1533
Estimated Demand Reduction (kW)	-	0.72
Annual Energy Savings (kWh/year)	-	3942
Incremental Measure Cost ($)		2336
Estimated Useful Life (years)	12	12

Insulated Hot Food Holding Cabinet - Half Size

Performance	Baseline	High Efficiency Qualifying Model
Demand (kW)	0.38	0.05
Annual Energy Use (kWh/year)	2081	274
Estimated Demand Reduction (kW)	-	0.33
Annual Energy Savings (kWh/year)	-	1807
Incremental Measure Cost ($)		381
Estimated Useful Life (years)	12	12

The demand reduction estimation is based on measured data for standard efficiency insulated holding cabinets and for high-efficiency insulated holding cabinets. The measured data are derived from tests conducted under ASTM Standard Test Method for the Performance of Hot Food Holding Cabinets.

Measure ASTM test results for Hot Food Holding Cabinets

Cabinet Size	Cabinet Volume (ft³)	Normalized Idle Energy Rate (W/ft³)	Total Cabinet Idle Energy Rate (W)
Full-Size	25	11.3	0.28
Half-Size	10	5.7	0.05

Operating Hours
15 hr/day, 365 day/year = 5,475 hours/year

Demand Coincidence Factor
CF = 1.0

Lifetime
12 years

Measure Costs and Incentive Levels
The incremental cost for ENERGY STAR hot food holding cabinet is $2,336 (full size) & $381 (half size)

12.6.10 ENERGY STAR Commercial Kitchen Equipment -Combination Ovens

Version Date & Revision History
Draft date:
Effective date: July 1, 2013
End date: June 30, 2014

Referenced Documents:

- U.S. Department of Energy, Energy Star website: http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COO
- Energy Star Commercial Kitchen Equipment Savings Calculator
- PG&E Work Paper PGEFST105 (Revision 3) – June 8, 2012
- Arkansas TRM Version 2.0 Volume 2
- KEMA report titled "Business Programs: Deemed Savings Parameter Development", November 2009 - Coincidence factor for food service building type listed as 0.84

TRM Review Actions:

- Currently Under Review.

Major Changes:

- New measure

Measure Description:
Commercial combination ovens offer the ability to steam food in the oven cavity. These oven are capable of steaming, proofing and reheating various food products in addition to the normal functions of baking and roasting. Foods can be cooked in a variety of ways: in a convection oven dry heat only mode, a steam only mode, and a combination of dry heat and steam modes. Food to be cooked partially in one mode at a certain temperature and then finished in another mode and at a separate temperature by utilizing the programmability of combination ovens. Combination ovens range in size from 6 pan countertop models up to 40 pan stand-alone models.

Baseline Efficiency:

Parameter	< 15 Pans	15-28 Pans	> 28 Pans
Assumptions			
% Time in Steam Mode	50%	50%	50%
Preheat Energy (kWh/day)	3.0	3.75	5.63
Convection Idle Energy Rate (kW)	1.5	3.75	5.25
Steam Idle Energy Rate (kW)	10.0	12.5	18.0
Convection Cooking Energy Efficiency (%)	65%	65%	65%
Steam Cooking Energy Efficiency (%)	40%	40%	40%
Convection Production Capacity (lbs/hour)	80	100	275
Steam Production Capacity (lbs/hour)	100	150	350
Lbs of Food Cooked/day	200	250	400
Total Energy			
Annual Energy Consumption (kWh)	35,263	48,004	74,448
Demand (kW)	6.8	9.2	14.3

High Efficiency:

Parameter	< 15 Pans	15-28 Pans	> 28 Pans
Assumptions			
% Time in Steam Mode	50%	50%	50%
Preheat Energy (kWh/day)	1.5	2.0	3.0
Convection Idle Energy Rate (kW)	1.0	2.5	4.0
Steam Idle Energy Rate (kW)	5.0	6.0	9.0
Convection Cooking Energy Efficiency (%)	70%	70%	70%
Steam Cooking Energy Efficiency (%)	50%	50%	50%
Convection Production Capacity (lbs/hour)	100	152	325
Steam Production Capacity (lbs/hour)	120	200	400
Lbs of Food Cooked/day	200	250	400
Total Energy			
Annual Energy Consumption (kWh)	23,658	32,001	50,692
Demand (kW)	4.5	6.1	9.7

Energy Savings

Energy usage calculations are based on 12 hours a day, 365 days per year (4,380 hours/year). The different sizes for the combination ovens (< 15 pans, 15-28 pans, and > 28 pans) have proportional operating energy rates.

Performance	< 15 Pans	15-28 Pans	> 28 Pans
Annual Energy Savings (kWh)	11,604	16,003	23,756
Estimated Demand Reduction (kW)	2.6	3.7	5.4

Operating Hours
12 hr/day, 365 day/year = 4,380 hours/year

Demand Coincidence Factor
CF = 0.84

Lifetime
12 years

Measure Costs and Incentive Levels

12.6.11 ENERGY STAR Commercial Kitchen Equipment - Convection Ovens

Version Date & Revision History
Draft date:
Effective date: July 1, 2013
End date: June 30, 2014

Referenced Documents:

- U.S. Department of Energy, Energy Star website: http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COO
- Energy Star Commercial Kitchen Equipment Savings Calculator
- PG&E Work Paper PGEFST105 (Revision 3) – June 8, 2012
- Arkansas TRM Version 2.0 Volume 2
- KEMA report titled "Business Programs: Deemed Savings Parameter Development", November 2009 - Coincidence factor for food service building type listed as 0.84

TRM Review Actions:

- Currently Under Review.

Major Changes:

- New measure

Measure Description:

Commercial convection ovens are widely used in the foodservice industry and have a wide variety of uses from baking and roasting to warming and reheating. Convection ovens are also used for nearly all types of food preparation, including foods typically prepared using other types of appliances (e.g., griddles, fryers, etc.). ENERGY STAR commercial ovens are about 20 percent more energy efficient than standard models.

- **<u>Full-size electric convection ovens</u>** are defined by the ability to accept a minimum of five (5) standard full-size sheet pans (18 in. x 26 in. x 1 in.). Qualifying ovens must meet Energy Star requirements by having a tested heavy-load (potato) cooking efficiency in accordance with ASTM F1496. Cooking energy efficiency must be greater than or equal to 70 percent (≥70%) and must not exceed the maximum idle energy rate of 1.6 kW (≤ 1.6kW).

- **<u>Half-size electric convection ovens</u>** are defined by the ability to accept a minimum of five (5) sheet pans measuring (18 in. x 13 in. x 1 in.). Qualifying ovens must meet Energy Star requirements by having a tested heavy-load (potato) cooking efficiency in accordance with ASTM F1496. Cooking energy efficiency must be greater than or equal to 70 percent (≥70%) and must not exceed the maximum idle energy rate of 1.0 kW (≤ 1.0kW).

Baseline Efficiency:

Parameter	Half Size	Full Size
Assumptions		
Preheat Energy (kWh/day)	1.0	1.5
Idle Energy Rate (kW)	1.5	2.0
Cooking Energy Efficiency (%)	65%	65%
Production Capacity (lbs/hour)	45	70
Lbs of food cooked/day	100	100
Energy per pound of food (kWh/lb)	0.0732	0.0732
Total Energy		
Annual Energy Consumption (kWh)	9,692	12,193
Demand (kW)	1.86	2.34

High Efficiency:

Parameter	Half Size	Full Size
Assumptions		
Preheat Energy (kWh/day)	0.9	1.0
Idle Energy Rate (kW)	1.0	1.6
Cooking Energy Efficiency (%)	70%	70%
Production Capacity (lbs/hour)	50	80
Lbs of food cooked/day	100	100
Energy per pound of food (kWh/lb)	0.0732	0.0732
Total Energy		
Annual Energy Consumption (kWh)	7,704	10,314
Demand (kW)	1.48	1.98

Energy Savings
Energy usage calculations are based on 12 hours a day, 365 days per year. The different sizes for the holding cabinets (half size and full size) have proportional operating energy rates.

Performance	Half Size	Full Size
Annual Energy Savings (kWh)	1,988	1,879
Estimated Demand Reduction (kW)	0.38	0.36

Operating Hours
12 hr/day, 365 day/year = 4,380 hours/year

Demand Coincidence Factor
CF = 0.84

Lifetime
12 years

Measure Costs and Incentive Levels

12.6.12 ENERGY STAR Commercial Kitchen Equipment - Solid Door Refrigerators & Freezers

Version Date & Revision History
Draft date:
Effective date: July 1, 2013
End date: June 30, 2014

Referenced Documents:
- Southern California Edison Work Paper SCE13CC001 Commercial Reach-In Refrigerators and Freezers – April 6, 2012

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:
- New measure

Measure Description:
This measure relates to the installation of a new reach-in commercial refrigerator or freezer meeting ENERGY STAR efficiency standards. ENERGY STAR labeled commercial refrigerators and freezers are more energy efficient because they are designed with components such as ECM evaporator and condenser fan motors, hot gas anti-sweat heaters, or high-efficiency compressors, which will significantly reduce energy consumption. This measure could relate to the replacing of an existing unit at the end of its useful life, or the installation of a new system in a new or existing building.

Baseline Efficiencies:
In order for this characterization to apply, the baseline equipment is assumed to be a solid or glass door refrigerator or freezer meeting the minimum federal manufacturing standards.

High Efficiency:
In order for this characterization to apply, the efficient equipment is assumed to be a solid or glass door refrigerator or freezer meeting the minimum ENERGY STAR efficiency level standards.

Energy Savings:

Annual Energy Savings (kWh/year) = (kWhbase – kWhee) * 365

Demand Savings = Annual Energy Savings / HOURS * CF

Baseline Energy Usage

Type	kWhbase
Solid Door Refrigerator	0.10 * V + 2.04
Glass Door Refrigerator	0.12 * V + 3.34
Solid Door Freezer	0.40 * V + 1.38
Glass Door Freezer	0.75 * V + 4.10

Energy Efficient Usage

Equipment Description (cubic feet)	kWhee Daily Energy Usage (kWh/day)
Solid-Door Reach-In Refrigerator	
0 ≤ V < 15	≤ 0.089V + 1.411
15 ≤ V < 30	≤ 0.037V + 2.200
30 ≤ V < 50	≤ 0.056V + 1.635
50 ≤ V	≤ 0.060V + 1.416
Solid-Door Reach-In Freezer	
0 ≤ V < 15	≤ 0.250V + 1.250
15 ≤ V < 30	≤ 0.400V -1.000
30 ≤ V < 50	≤ 0.163V + 6.125
50 ≤ V	≤ 0.158V + 6.333
Glass-Door Reach-In Refrigerator	
0 ≤ V < 15	≤ 0.118V + 1.382
15 ≤ V < 30	≤ 0.140V + 1.050
30 ≤ V < 50	≤ 0.0888V + 2.625
50 ≤ V	≤ 0.110V + 1.500
Glass-Door Reach-In Freezer	
0 ≤ V < 15	≤ 0.607V + 0.893
15 ≤ V < 30	≤ 0.733V - 1.000
30 ≤ V < 50	≤ 0.250V + 13.500
50 ≤ V	≤ 0.450V + 3.500

Operating Hours

8760 hours/year

Demand Coincidence Factor

CF = 1.0

Lifetime

12 years

Measure Costs and Incentive Levels

Incremental Measure Refrigerator and Freezer Costs

Description	Under-Counter	Single-Door	Double-Door	Triple-Door
Nominal Size	1 door	1 door	2 doors	3 doors
Nominal Volume Range (cubic feet)	0 ≤ V < 15	15 ≤ V < 30	30 ≤ V 50	50 ≤ V
Solid-Door Reach-In Refrigerators Incremental Cost	$1,092.00	$ 1,410.73	$ 1,968.70	$2,723.28
Solid-Door Reach-In Freezers Incremental Cost	$ 257.60	$ 1,363.18	$15,556.71	$1,968.03
Glass-Door Reach-In Refrigerators Incremental Cost	$ 103.60	$ 863.80	$ 1,076.11	$1,548.96
Glass-Door Reach-In Freezers Incremental Cost	$ 25.48	$ 124.04	$ 214.20	$ 899.30

12.7 Building Envelope Improvements

12.7.1 Window Tinting

Version Date & Revision History
Draft date: March 2, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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**

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

Version Date & Revision History
Draft date:
Effective date: July 1, 2012
End date: June 30, 2013

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
$\Delta kWh = SF / 1000 * \Delta kWhkSF$

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

Hawaii Building Example:

ΔkWh = 0.25 kWh / square feet

Coincident Peak Demand Savings
ΔkW ΔkW x CF

Where:

CF = The coincident peak factor, or 0.50

Demand Savings per square feet

ΔkW = 0.0001 * 0.50
= 0.00005 kW

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
$0.20/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

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	-	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. • 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. • 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. • 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. • 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.

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.

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, 2012
End date: June 30, 2013

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. Baseline Annual Energy Usage is the actual average usage (kWh/year) based on historical usage for past 24 months (or as appropriate) for entire condominium (master metered) divided by the number of condominium units. Baseline demand (kW) is the Average Historical Demand divided by the number of condominium units.

Building Types	Demand Baseline (kW)	Energy Baseline (kWh/year)
Condominium	1.42	7,200

High Efficiency

The high efficiency case is with submetering. It is expected there will be a 10% reduction in energy usage and 8% reduction in peak demand during (5PM – 9PM).

Building Types	Efficient Case (kW)	Efficient Case (kWh/year)
Condominium	1.30	6,480

Energy and Demand Savings:

Building Types	Gross Customer Savings (kW)	Gross Customer Savings (kWh/year)
Condominium	0.113	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	0.113	720

Example Savings Algorithm:

Submetering (Condominium)				
Average Master Meter Energy Usage (kWh/month)		180,000	kWh per month	
Number of tenant Units	÷	300	Units	
Average Tenant Energy Usage (Example)		600	kWh per home per month	
	x	12	month per year	
Baseline Annual Household Energy Usage		7,200	kWh per Year	
Average Master Meter Demand (kW)		425		
Number of tenant Units	÷	300		
Baseline Demand (kW)		1.42	kW	
Energy Reduction		10.0%		
Actively Informed Household Energy Usage		6,480	kWh per Year	
Baseline Annual 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	
Gross Customer Level Energy Savings		720	kwh per Year	
Persistance Factor	x	1.0		
Net Customer Level Savings		720	kwh per Year	
Submetering Energy Savings		720	kWh / Year Savings	
Baseline Household Demand		1.42	kW	HECO 2008 Load Study
Peak Demand Reduction		8.00%		
Actively Informed Household Demand		1.30	kW	
Baseline Household Demand		1.42	kW	
Actively Informed Household Demand	-	1.30	kW	
Gross Customer Demand Savings		0.113	kW	
Gross Customer Demand Savings		0.113	kW	
Persistance Factor	x	1.0		
Coincidence Factor	x	1.0		
		0.113	kW	
Condominium Sub-Metering Demand Savings		0.113	kW Savings	

Incentives/Incremental Cost

- $150 per unit metered, payable to the AOAO 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 AOAO securing the approval, installing and utilizing the submeters for billing purposes.
- There is no minimum reduction in electrical use to be required by AOAO to retain the incentive.

Description	Incentive	Incremental Cost
Condominium Submeter	$150	$750

Measure Life: 8 years (based on DEER. Similar technology as time-clocks and occupancy sensors)

12.9.2 Small Business Submetering

Version Date & Revision History
Draft date: October 3, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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

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.

Savings Algorithm:

Small Business Submetering			
Average Tenant Energy Usage		900	kWh per business per month (Schedule G)
	x	12	
Baseline Business Energy Usage		10,800	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		1,080	kwh per Year
	x	1,000	Watts per kW
	÷	8,760	Hours per Year
Average 24/7 Demand Reduction		123	Watts
Gross Customer Level Energy Savings		1,080	kwh per Year
Persistance Factor	x	1.0	
Net Customer Level Savings		1,080	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		0.240	kW
Gross Customer Demand Savings		0.240	kW
Persistance Factor	x	1.00	
Coincidence Factor	x	1.00	
		0.240	kW
Small Business Demand Savings		0.24	kW Savings

Incentives/Incremental Cost

- Incentive payment will be made upon billing individual tenants.
- Incentive payment cannot exceed 50% of total project cost.
- Incentive = $150/unit

12.9.3 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:

ΔkWh = (kWrated)(Hours)(SAVE)
ΔkW = ΔkWh/ Hours

Where:

kWrated = 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.

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

13 (CBEEM) Custom Business Energy Efficiency Measures

13.1 Customized Project Measures

13.1.1 Customized Project Measures

Version Date & Revision History
Draft date: March 2, 2011
Effective date: July 1, 2012
End date: June 30, 2013

Referenced Documents:
- n/a

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:

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	$0.10 /kWh	$125 / kW	*$100 / kW		
> 5 years	$0.15 /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.

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

Incentives

- Incentives are limited to 50% of incremental costs.
- Installations are subject to inspection for up to 5 years. Removal will be cause for incentive forfeiture.

14 (BESM) Business Energy Services and Maintenance

14.1 Business Direct Installation

14.1.1 Small Business Direct Lighting Retrofits

Version Date & Revision History
Draft date:
Effective date: July 1, 2012
End date: June 30, 2013

Referenced Documents:
- n/a

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:
- n/a

Measure 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.

- Provide complete process to provide direct installation of lighting retrofits for small business customers.
- Participating Hawaii Energy Participating contractors will offer six month payment plans for the lighting retrofits
- Use of workforce development groups and grass roots volunteer organizations to generate leads and perform initial audits to lower cost of sales for Lighting contractors
- Quick Inventory worksheet to ID potential targeting for future mechanical measures (AC/Water heating/Appliances/Refrigeration)

Small Business Lighting Retrofit providing a “Turnkey” program consisting of audits, 100% incentivized lighting measures, installation by participating Hawaii Energy Participating contractors and 6 month financing of lighting retrofit costs of custom measures beyond the cost per kWh incentive.

A “Turnkey” program consisting of audits, 100% incentivized lighting measures, installation by participating Hawaii Energy Participating contractors.

The following lighting technology changes will be 100% incentivized under this measure:

	Measure Description		Measure Description
28W Retrofits	Two 8 ft. T12HO 110W to Four 4 ft. T8 28W Normal BF / Reflector	25W Retrofits	Two 8 ft. T12HO 110W to Four 4 ft. T8 25W Normal BF / Reflector
	One 8 ft. T12HO 110W to Two 4 ft. T8 28W High BF		One 8 ft. T12HO 110W to Two 4 ft. T8 25W High BF
	Two 8 ft. T12HO 110W to Two 4 ft. T8 28W High BF / Reflector		Two 8 ft. T12HO 110W to Two 4 ft. T8 25W High BF / Reflector
	Two 8 ft. T12 75W to Two 4 ft. T8 28W Normal BF		Two 8 ft. T12 75W to Two 4 ft. T8 25W Normal BF
	One 8 ft. T12 75W to Two 4 ft. T8 28W Normal BF		One 8 ft. T12 75W to Two 4 ft. T8 25W Normal BF
	Four 4 ft. T12 40W to Four 4 ft. T8 28W Normal BF		Four 4 ft. T12 40W to Four 4 ft. T8 25W Normal BF
	Four 4 ft. T12 40W to Two 4 ft. T8 28W Normal BF / Reflector		Four 4 ft. T12 40W to Two 4 ft. T8 25W Normal BF / Reflector
	Three 4 ft. T12 40W to Three 4 ft. T8 28W Normal BF		Three 4 ft. T12 40W to Three 4 ft. T8 25W Normal BF
	Three 4 ft. T12 40W to Two 4 ft. T8 28W Normal BF / Reflector		Three 4 ft. T12 40W to Two 4 ft. T8 25W Normal BF / Reflector
	Two 4 ft. T12 40W to Two 4 ft. T8 28W Normal BF		Two 4 ft. T12 40W to Two 4 ft. T8 25W Normal BF
	One 4 ft. T12 40W to One 4 ft. T8 28W Normal BF		One 4 ft. T12 40W to One 4 ft. T8 25W Normal BF
	Four 4 ft. T12 34W to Four 4 ft. T8 28W Normal BF		Four 4 ft. T12 34W to Four 4 ft. T8 25W Normal BF
	Four 4 ft. T12 34W to Two 4 ft. T8 28W Normal BF / Reflector		Four 4 ft. T12 34W to Two 4 ft. T8 25W Normal BF / Reflector
	Three 4 ft. T12 34W to Three 4 ft. T8 28W Normal BF		Three 4 ft. T12 34W to Three 4 ft. T8 25W Normal BF
	Three 4 ft. T12 34W to Two 4 ft. T8 28W Normal BF / Reflector		Three 4 ft. T12 34W to Two 4 ft. T8 25W Normal BF / Reflector
	Two 4 ft. T12 34W to Two 4 ft. T8 28W Normal BF		Two 4 ft. T12 34W to Two 4 ft. T8 25W Normal BF
	One 4 ft. T12 34W to One 4 ft. T8 28W Normal BF		One 4 ft. T12 34W to One 4 ft. T8 25W Normal BF
	Four 4 ft. T8 32W to Four 4 ft. T8 28W Normal BF		Four 4 ft. T8 32W to Four 4 ft. T8 25W Normal BF
	Four 4 ft. T8 32W to Two 4 ft. T8 28W Normal BF / Reflector		Four 4 ft. T8 32W to Two 4 ft. T8 25W Normal BF / Reflector
	Three 4 ft. T8 32W to Three 4 ft. T8 28W Normal BF		Three 4 ft. T8 32W to Three 4 ft. T8 25W Normal BF
	Three 4 ft. T8 32W to Two 4 ft. T8 28W Normal BF / Reflector		Three 4 ft. T8 32W to Two 4 ft. T8 25W Normal BF / Reflector
	Two 4 ft. T8 32W to Two 4 ft. T8 28W Normal BF		Two 4 ft. T8 32W to Two 4 ft. T8 25W Normal BF
	One 4 ft. T8 32W to One 4 ft. T8 28W Normal BF		One 4 ft. T8 32W to One 4 ft. T8 25W Normal BF
	Two 4ft. FB40 T8 to Three 2 ft. F17	Refrigerated Case Lighting	6 ft. T12HO Refrigerated Case to LED - Center
			6 ft. T12HO Refrigerated Case to LED - Single/Ends
LED Retrofit	PAR20 Halogen 50W to LED		6 ft. T12 Refrigerated Case to LED - Center
	PAR30 Halogen 75W to LED		6 ft. T12 Refrigerated Case to LED - Single/Ends
	PAR38 Halogen 75W to LED		6 ft. T8HO Refrigerated Case to LED - Center
	PAR38 Halogen 90W to LED		6 ft. T8HO Refrigerated Case to LED - Single/Ends
	MR16 Halogen 20W to LED		
	MR16 Halogen 50W to LED		5 ft. T12HO Refrigerated Case to LED - Center
	Par20 CFL to LED		5 ft. T12HO Refrigerated Case to LED - Single/Ends
	Par30 CFL to LED		5 ft. T12 Refrigerated Case to LED - Center
	Par38 CFL to LED		5 ft. T12 Refrigerated Case to LED - Single/Ends
			5 ft. T8HO Refrigerated Case to LED - Center
CFL	A19 Incandescent 100W to CFL 26W		5 ft. T8HO Refrigerated Case to LED - Single/Ends
	A19 Incandescent 60W to CFL 13W		
	A19 Incandescent 75W to CFL 19W		LED Refrigerated Case Light Drivers
Exit	Incandescent Exit Sign Retrofit with LED Kit		
	Incandescent Exit Sign to New LED Fixture		

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.

Example Savings Algorithms

Small Business Direct Install Lighting Retrofit Pilot Program
Summary Sheet

Business Name:	
Contact Name:	
Address:	
Phone:	
Fax:	
Email:	

Contractor Name:	
Auditor Name:	
Address:	
Phone:	
Fax:	
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	
f2	
Oahu	Island of Project Location
$ 0.234 /kWh	2010 "G" Marginal Cost of Electricity

Measure Code	Existing Technology	New Technology	Total Units	M-F Hours per Day	Sat. Hours per Day	Sun. Hours per Day	Annual Hours of Operation	Wkdays Hours on between 5 and 9 p.m.	On-Peak Fraction	Total Watts Saved	Energy Savings	Energy Cost Savings	Hawaii Energy Participating Contractor NTE Pricing	Hawaii Energy Cash Incentive	Net Customer Cost	Simple Payback	6 Month Monthly Payment	Monthly Savings % of Payment
			Step 2	Step 3				Step 4										
			(each)				(hrs/year)	(hrs)	(%)	(Watts)	(kWh/Year)	($/year)	($)	($)	($)	(Months)	($/month)	(%)
			a	b1a	b1b	b2a	b3 = b1*b2*(365/7)	c	c2 = c / 4	d = a x o	e = b x (d/1000)	f = e x f2	g = a x p	h = a x q	i = a x (p-q)	j = (i/f) x 12	k = i /6	l = (f/12)/k
8L1-4L2	8 ft. 1 Lamp F96	4 ft. 2 lamp F25/28 N	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 75	$ 62	$ 13	6	$ 2.24	100%
8L2-4L2	8 ft. 2 Lamp F96	4 ft. 2 lamp F25/28 H	1	8	8	0	2,503	-	0%	57	143	$ 33	$ 84	$ 53	$ 31	11	$ 5.17	54%
8L2HO-4L2R	8 ft. 2 Lamp F96 HO	4 ft. 2 lamp F25/28 N, Reflct.	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 85	$ 27	$ 58	26	$ 9.67	23%
8L2HO-4L4	8 ft. 2 Lamp F96 HO	4 ft. 4 lamp F25/28 N	1	8	8	0	2,503	-	0%	92	230	$ 54	$ 138	$ 53	$ 85	19	$ 14.17	32%
4L4-4L4	4 ft. 4 Lamp F40	4 ft. 4 lamp F25/28 N	1	8	8	0	2,503	-	0%	92	230	$ 54	$ 83	$ 51	$ 32	7	$ 5.33	84%
4L4-4L2R	4 ft. 4 lamp F40	4 ft. 2 lamp F25/28 N, Reflct.	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 65	$ 27	$ 38	17	$ 6.33	35%
4L3-4L3	4 ft. 3 lamp F40	4 ft. 3 lamp F25/28 N, Reflct.	1	8	8	0	2,503	-	0%	69	173	$ 40	$ 74	$ 38	$ 36	11	$ 6.00	56%
4L3-4L2R	4 ft. 3 lamp F40	4 ft. 2 lamp F25/28 N, Reflct.	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 65	$ 27	$ 38	17	$ 6.33	35%
4L2-4L2	4 ft. 2 lamp F40	4 ft. 2 lamp F25/28 N	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 35	$ 27	$ 8	4	$ 1.33	168%
4L1-4L1	4 ft. 1 lamp F40	4 ft. 1 lamp F25/28 N	1	8	8	0	2,503	-	0%	23	58	$ 13	$ 30	$ 14	$ 16	14	$ 2.67	42%
4L4-4L4	4 ft. 4 lamp F32	4 ft. 4 lamp F25/28 N	1	8	8	0	2,503	-	0%	92	230	$ 54	$ 83	$ 34	$ 49	11	$ 8.17	55%
4L4-4L2	4 ft. 4 lamp F32	4 ft. 2 lamp F25/28 N	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 65	$ 53	$ 12	5	$ 2.00	112%
4L3-4L3	4 ft. 3 lamp F32	4 ft. 3 lamp F25/28 N	1	8	8	0	2,503	-	0%	69	173	$ 40	$ 74	$ 26	$ 48	14	$ 8.00	42%
4L3-4L2	4 ft. 3 lamp F32	4 ft. 2 lamp F25/28 N	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 65	$ 25	$ 40	18	$ 6.67	34%
4L2-4L2	4 ft. 2 lamp F32	4 ft. 2 lamp F25/28 N	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 35	$ 27	$ 8	4	$ 1.33	168%
4L1-4L1	4 ft. 1 lamp F32	4 ft. 1 lamp F25/28 N	1	8	8	0	2,503	-	0%	23	58	$ 13	$ 35	$ 9	$ 26	23	$ 4.33	26%
1L400-4L6	HID Pendant 1 lamp 400W	4 foot 6 lamp F25/T8 N	1	8	8	0	2,503	-	0%	138	345	$ 81	$ 360	$ 76	$ 284	42	$ 47.33	14%
1L250-4L4	HID Pendant 1 lamp 250W	4 foot 4 lamp F25/T8 N	1	8	8	0	2,503	-	0%	92	230	$ 54	$ 330	$ 51	$ 279	62	$ 46.50	10%
1L175-4L4	HID Pendant 1 lamp 175W	4 foot 4 lamp F25/T8 N	1	8	8	0	2,503	-	0%	92	230	$ 54	$ 330	$ 51	$ 279	62	$ 46.50	10%
UBL2-2L2	4 ft. U-Bend 2 lamp FB40	2 ft. 2 lamp F17 N	1	8	8	0	2,503	-	0%	32	80	$ 19	$ 40	$ 22	$ 18	12	$ 3.00	52%
UBL2-2L2R	4 ft. U-Bend 2 lamp FB40	2 ft. 2 lamp F17 L, Reflector	1	8	8	0	2,503	-	0%	27	68	$ 16	$ 50	$ 30	$ 20	15	$ 3.33	39%
100-23	100 Watt Incandescent	23 Watt CFL	1	8	8	0	2,503	-	0%	23	58	$ 13	$ 10	$ 4	$ 6	5	$ 1.00	112%
75-19	75 Watt Incandescent	19 Watt CFL	1	8	8	0	2,503	-	0%	19	48	$ 11	$ 8	$ 4	$ 4	4	$ 0.67	139%
60-13	60 Watt Incandescent	13 Watt CFL	1	8	8	0	2,503	-	0%	13	33	$ 8	$ 6	$ 4	$ 2	3	$ 0.33	190%
Exit	40W Incandecent	2 Watt LED	1	24	24	24	8,760	-	0%	2	18	$ 4	$ 75	$ 38	$ 37	109	$ 6.17	6%
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)	($/unit)	($)	($/kWh)
	m	n	o = m-n	p	q	r
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

Central Plant Optimization Competition Process and Project Review Worksheet

Deliverable	Action		Customer Cost	Incentive Rate	Committed Incentive	Set Aside Incentive	
Initial Meeting	Scope review, Program review						
Application							
Preliminary Systems Review	Price Proposal		$ -	50%	$ -		*Payment 1*
	Perform Systems Review						
Metering and Commissioning Plan	Approve Metering Plan						
	Metering Budget		$ -				
	Metering Installation		$ -				
	Design/Oversight/Test Metering/Base Meter Readings-2 Weeks		$ -	100%		$ -	*Payment 2*
			$ -				
System Commissioning Program	Approve Commissioning Plan						
	Investigation		$ -	50%		$ -	
	Analysis /Documentation		$ -	50%		$ -	
	Field Commissioning / Tuning		$ -	50%		$ -	
	Development of Sequence of Operations		$ -	50%		$ -	
	Recommend Operational Improvements		$ -	50%		$ -	
	Recommended System Upgrades		$ -	50%		$ -	
	Maintenance and Operations Plan		$ -	50%		$ -	
	Operational Training		$ -	50%		$ -	
	System Commissioning Budget		$ -			$ -	*Payment 3*
	Final Report & Documentation						
Operational Performance Period	Start Operational Period (after commissioning, training)						
						Incentive $ 0.10	*Multiply Est. Performance Assessments by Incentive to achieve potential savings*
						Potential Savings	
	Estimated Performance Assessment **1**	(1mo after start of Operational Period)	#REF!	50%		**#REF!**	*Payment 4*
	Estimated Performance Assessment **2**	(6mo after start of Operational Period)	#REF!	25%		**#REF!**	*Payment 5*
	Estimated Performance Assessment **3**	(End of Operational Period)	#REF!	25%		**#REF!**	*Payment 6*
	Potential Savings per Year		#REF!	100%		#REF!	
	End Operational Period (1 - year after start of operational period)						
	Review Savings Achievement						

Incentives and Responsibilities:

Incentive	Amount	Responsibilities
Commissioning Contract	50% incentive up to $0.20 per sq. ft.	• 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	• 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	• 50% upon implementation • 25% for performance at sixth month • 25% for performance at one year

*Total incentives not to exceed customer cost.

14.2.3 Cooling Tower Optimization

Version Date & Revision History
Draft date:
Effective date: July 1, 2012
End date: June 30, 2013

Referenced Documents:
- n/a

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:
- n/a

Measure Description:
This program combines the water and energy savings potential of cooling towers. The water treatment processes drive both water consumption and the persistence of energy savings by keeping the heat exchange processes in the chillers and in the tower itself at optimum levels. The program will work with the local water departments, water treatment companies and mechanical service contractors to drive the program.

Baseline Efficiencies:
TBD

High Efficiency:
TBD

Energy Savings:
Energy savings will be based on a customized approach.

Savings Algorithms

Incentive = $0.25/kWh

14.2.4 Decision Maker – Real Time Submetering

Version Date & Revision History
Draft date:
Effective date: July 1, 2012
End date: June 30, 2013

Referenced Documents:
- n/a

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:
- n/a

Measure Description:
There are individuals within business organizations who have influence over a large number of employees whose behavior within the work environment drive unnecessary energy consumption (e.g. leaving on lights, additional electronic equipment, etc.). This offer is the direct installation of a web-based electrical metering device. This metering will be monitored by the decision makers within the organization to identify usage patterns and be the basis of peer group competitions within the organization.

Baseline Efficiencies:
TBD

High Efficiency:
TBD

Energy Savings:
TBD

Savings Algorithms

Incentive = $12,000/group (5 group budget @ $60,000)

14.2.5 Energy Study

Version Date & Revision History
Draft date: September 20, 2011
Effective date: July 1, 2012
End date: June 30, 20123

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.

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

14.2.6 Design Assistance

Measure ID:
Measure Code:

Version Date & Revision History
Draft date: September 20, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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.

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 cased 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

14.2.7 Energy Project Catalyst

Version Date & Revision History
Draft date:
Effective date: July 1, 2012
End date: June 30, 2013

Referenced Documents:
- n/a

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:
- n/a

Measure Description:
The objective of the catalyst program is to accelerate stalled high impact energy efficiency projects from an idea to reality as follows:
• Full Cost Incentives - Provide up to 30% cost incentive to proposals that fulfill program needs
• Commitment to Implement - Recipients must commit to implementing all projects with less than a 1 year payback including incentives.
• Desired Project Profiles
  o High potential for energy savings (>30% reduction in consumption).
  o Commitment and high probability of owner taking action on Site Audit / Commissioning / Energy Study report
  o Typical site that can be repeated, such as chain convenience stores
  o Sites with Energy Usage Density over 2.5 kWh/Sq. ft./month
  o Site with Peak Demand Density over 6.0 kW/ Sq. ft.
  o Control System Recommissioning - Sequence of operation documentation, review, testing.
  o Demonstrate usefulness of the addition of critical system efficiency metering such as total central plant kW/ton.

Baseline Efficiencies:
TBD

High Efficiency:
TBD

Energy Savings:
Energy savings will be based on a customized approach.

<u>Savings Algorithms</u>

Incentive = $0.40/kWh

15 (BHTR) Business Hard to Reach

15.1 Energy Efficiency Equipment Grants

15.1.1 SBDI - Demand Control Kitchen Ventilation (DCKV)

Version Date & Revision History
Draft date:
Effective date: July 1, 2013
End date: June 30, 2014

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:

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

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

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
5824	

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)

15.1.2 Small Business Direct Installation – Restaurant Lighting

Version Date & Revision History
Draft date: March 2, 2011
Effective date: July 1, 2012
End date: June 30, 2013

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.

- Provide complete process to provide direct installation of lighting retrofits for small business customers.
- Participating Hawaii Energy Participating contractors will offer six month payment plans for the lighting retrofits
- Use of workforce development groups and grass roots volunteer organizations to generate leads and perform initial audits to lower cost of sales for Lighting contractors
- Quick Inventory worksheet to ID potential targeting for future mechanical measures (AC/Water heating/Appliances/Refrigeration)

Small Business Lighting Retrofit providing a “Turnkey” program consisting of audits, 100% incentivized lighting measures, installation by participating Hawaii Energy Participating contractors and 6 month financing of lighting retrofit costs of custom measures beyond the cost per kWh incentive.

A “Turnkey” program consisting of audits, 100% incentivized lighting measures, installation by participating Hawaii Energy Participating contractors.

The following lighting technology changes will be 100% incentivized under this measure:

	Measure Description		Measure Description
28W Retrofits	Two 8 ft. T12HO 110W to Four 4 ft. T8 28W Normal BF / Reflector	25W Retrofits	Two 8 ft. T12HO 110W to Four 4 ft. T8 25W Normal BF / Reflector
28W Retrofits	One 8 ft. T12HO 110W to Two 4 ft. T8 28W High BF	25W Retrofits	One 8 ft. T12HO 110W to Two 4 ft. T8 25W High BF
28W Retrofits	Two 8 ft. T12HO 110W to Two 4 ft. T8 28W High BF / Reflector	25W Retrofits	Two 8 ft. T12HO 110W to Two 4 ft. T8 25W High BF / Reflector
28W Retrofits	Two 8 ft. T12 75W to Two 4 ft. T8 28W Normal BF	25W Retrofits	Two 8 ft. T12 75W to Two 4 ft. T8 25W Normal BF
28W Retrofits	One 8 ft. T12 75W to Two 4 ft. T8 28W Normal BF	25W Retrofits	One 8 ft. T12 75W to Two 4 ft. T8 25W Normal BF
28W Retrofits	Four 4 ft. T12 40W to Four 4 ft. T8 28W Normal BF	25W Retrofits	Four 4 ft. T12 40W to Four 4 ft. T8 25W Normal BF
28W Retrofits	Four 4 ft. T12 40W to Two 4 ft. T8 28W Normal BF / Reflector	25W Retrofits	Four 4 ft. T12 40W to Two 4 ft. T8 25W Normal BF / Reflector
28W Retrofits	Three 4 ft. T12 40W to Three 4 ft. T8 28W Normal BF	25W Retrofits	Three 4 ft. T12 40W to Three 4 ft. T8 25W Normal BF
28W Retrofits	Three 4 ft. T12 40W to Two 4 ft. T8 28W Normal BF / Reflector	25W Retrofits	Three 4 ft. T12 40W to Two 4 ft. T8 25W Normal BF / Reflector
28W Retrofits	Two 4 ft. T12 40W to Two 4 ft. T8 28W Normal BF	25W Retrofits	Two 4 ft. T12 40W to Two 4 ft. T8 25W Normal BF
28W Retrofits	One 4 ft. T12 40W to One 4 ft. T8 28W Normal BF	25W Retrofits	One 4 ft. T12 40W to One 4 ft. T8 25W Normal BF
28W Retrofits	Four 4 ft. T12 34W to Four 4 ft. T8 28W Normal BF	25W Retrofits	Four 4 ft. T12 34W to Four 4 ft. T8 25W Normal BF
28W Retrofits	Four 4 ft. T12 34W to Two 4 ft. T8 28W Normal BF / Reflector	25W Retrofits	Four 4 ft. T12 34W to Two 4 ft. T8 25W Normal BF / Reflector
28W Retrofits	Three 4 ft. T12 34W to Three 4 ft. T8 28W Normal BF	25W Retrofits	Three 4 ft. T12 34W to Three 4 ft. T8 25W Normal BF
28W Retrofits	Three 4 ft. T12 34W to Two 4 ft. T8 28W Normal BF / Reflector	25W Retrofits	Three 4 ft. T12 34W to Two 4 ft. T8 25W Normal BF / Reflector
28W Retrofits	Two 4 ft. T12 34W to Two 4 ft. T8 28W Normal BF	25W Retrofits	Two 4 ft. T12 34W to Two 4 ft. T8 25W Normal BF
28W Retrofits	One 4 ft. T12 34W to One 4 ft. T8 28W Normal BF	25W Retrofits	One 4 ft. T12 34W to One 4 ft. T8 25W Normal BF
28W Retrofits	Four 4 ft. T8 32W to Four 4 ft. T8 28W Normal BF	25W Retrofits	Four 4 ft. T8 32W to Four 4 ft. T8 25W Normal BF
28W Retrofits	Four 4 ft. T8 32W to Two 4 ft. T8 28W Normal BF / Reflector	25W Retrofits	Four 4 ft. T8 32W to Two 4 ft. T8 25W Normal BF / Reflector
28W Retrofits	Three 4 ft. T8 32W to Three 4 ft. T8 28W Normal BF	25W Retrofits	Three 4 ft. T8 32W to Three 4 ft. T8 25W Normal BF
28W Retrofits	Three 4 ft. T8 32W to Two 4 ft. T8 28W Normal BF / Reflector	25W Retrofits	Three 4 ft. T8 32W to Two 4 ft. T8 25W Normal BF / Reflector
28W Retrofits	Two 4 ft. T8 32W to Two 4 ft. T8 28W Normal BF	25W Retrofits	Two 4 ft. T8 32W to Two 4 ft. T8 25W Normal BF
28W Retrofits	One 4 ft. T8 32W to One 4 ft. T8 28W Normal BF	25W Retrofits	One 4 ft. T8 32W to One 4 ft. T8 25W Normal BF
	Two 4ft. FB40 T8 to Three 2 ft. F17	Refrigerated Case Lighting	6 ft. T12HO Refrigerated Case to LED - Center
		Refrigerated Case Lighting	6 ft. T12HO Refrigerated Case to LED - Single/Ends
LED Retrofit	PAR20 Halogen 50W to LED	Refrigerated Case Lighting	6 ft. T12 Refrigerated Case to LED - Center
LED Retrofit	PAR30 Halogen 75W to LED	Refrigerated Case Lighting	6 ft. T12 Refrigerated Case to LED - Single/Ends
LED Retrofit	PAR38 Halogen 75W to LED	Refrigerated Case Lighting	6 ft. T8HO Refrigerated Case to LED - Center
LED Retrofit	PAR38 Halogen 90W to LED	Refrigerated Case Lighting	6 ft. T8HO Refrigerated Case to LED - Single/Ends
LED Retrofit	MR16 Halogen 20W to LED	Refrigerated Case Lighting	
LED Retrofit	MR16 Halogen 50W to LED	Refrigerated Case Lighting	5 ft. T12HO Refrigerated Case to LED - Center
LED Retrofit	Par20 CFL to LED	Refrigerated Case Lighting	5 ft. T12HO Refrigerated Case to LED - Single/Ends
LED Retrofit	Par30 CFL to LED	Refrigerated Case Lighting	5 ft. T12 Refrigerated Case to LED - Center
LED Retrofit	Par38 CFL to LED	Refrigerated Case Lighting	5 ft. T12 Refrigerated Case to LED - Single/Ends
		Refrigerated Case Lighting	5 ft. T8HO Refrigerated Case to LED - Center
CFL	A19 Incandescent 100W to CFL 26W	Refrigerated Case Lighting	5 ft. T8HO Refrigerated Case to LED - Single/Ends
CFL	A19 Incandescent 60W to CFL 13W	Refrigerated Case Lighting	
CFL	A19 Incandescent 75W to CFL 19W	Refrigerated Case Lighting	LED Refrigerated Case Light Drivers
Exit	Incandescent Exit Sign Retrofit with LED Kit		
Exit	Incandescent Exit Sign to New LED Fixture		

Example Savings Algorithms

Small Business Direct Install Lighting Retrofit Pilot Program
Summary Sheet

Business Name:	
Contact Name:	
Address:	
Phone:	
Fax:	
Email:	

Contractor Name:	
Auditor Name:	
Address:	
Phone:	
Fax:	
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	
f2	
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 Units	M-F Hours per Day	Sat. Hours per Day	Sun. Hours per Day	Annual Hours of Operation	Wkdays Hours on between 5 and 9 p.m.	On-Peak Fraction	Total Watts Saved	Energy Savings	Energy Cost Savings	Hawaii Energy Participating Contractor NTE Pricing	Hawaii Energy Cash Incentive	Net Customer Cost	Simple Payback	6 Month Monthly Payment	Monthly Savings % of Payment
			(each)				(hrs/year)	(hrs)	(%)	(Watts)	(kWh/Year)	($/year)	($)	($)	($)	(Months)	($/month)	(%)
			a	b1a	b1b	b2a	b3 = b1*b2*(365/7)	c	c2 = c / 4	d = a x o	e = b x (d/1000)	f = e x f2	g = a x p	h = a x q	i = a x (p-q)	j = (i/f) x 12	k = i /6	l = (f/12)/k
8L1-4L2	8 ft. 1 Lamp F96	4 ft. 2 lamp F25/28 N	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 75	$ 62	$ 13	6	$ 2.24	100%
8L2-4L2	8 ft. 2 Lamp F96	4 ft. 2 lamp F25/28 H	1	8	8	0	2,503	-	0%	57	143	$ 33	$ 84	$ 53	$ 31	11	$ 5.17	54%
8L2HO-4L2R	8 ft. 2 Lamp F96 HO	4 ft. 2 lamp F25/28 N, Reflct.	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 85	$ 27	$ 58	26	$ 9.67	23%
8L2HO-4L4	8 ft. 2 Lamp F96 HO	4 ft. 4 lamp F25/28 N	1	8	8	0	2,503	-	0%	92	230	$ 54	$ 138	$ 53	$ 85	19	$ 14.17	32%
4L4-4L4	4 ft. 4 Lamp F40	4 ft. 4 lamp F25/28 N	1	8	8	0	2,503	-	0%	92	230	$ 54	$ 83	$ 51	$ 32	7	$ 5.33	84%
4L4-4L2R	4 ft. 4 lamp F40	4 ft. 2 lamp F25/28 N, Reflct.	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 65	$ 27	$ 38	17	$ 6.33	35%
4L3-4L3	4 ft. 3 lamp F40	4 ft. 3 lamp F25/28 N, Reflct.	1	8	8	0	2,503	-	0%	69	173	$ 40	$ 74	$ 38	$ 36	11	$ 6.00	56%
4L3-4L2R	4 ft. 3 lamp F40	4 ft. 2 lamp F25/28 N, Reflct.	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 65	$ 27	$ 38	17	$ 6.33	35%
4L2-4L2	4 ft. 2 lamp F40	4 ft. 2 lamp F25/28 N	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 35	$ 27	$ 8	4	$ 1.33	168%
4L1-4L1	4 ft. 1 lamp F40	4 ft. 1 lamp F25/28 N	1	8	8	0	2,503	-	0%	23	58	$ 13	$ 30	$ 14	$ 16	14	$ 2.67	42%
4L4-4L4	4 ft. 4 lamp F32	4 ft. 4 lamp F25/28 N	1	8	8	0	2,503	-	0%	92	230	$ 54	$ 83	$ 34	$ 49	11	$ 8.17	55%
4L4-4L2	4 ft. 4 lamp F32	4 ft. 2 lamp F25/28 N	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 65	$ 53	$ 12	5	$ 2.00	112%
4L3-4L3	4 ft. 3 lamp F32	4 ft. 3 lamp F25/28 N	1	8	8	0	2,503	-	0%	69	173	$ 40	$ 74	$ 26	$ 48	14	$ 8.00	42%
4L3-4L2	4 ft. 3 lamp F32	4 ft. 2 lamp F25/28 N	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 65	$ 25	$ 40	18	$ 6.67	34%
4L2-4L2	4 ft. 2 lamp F32	4 ft. 2 lamp F25/28 N	1	8	8	0	2,503	-	0%	46	115	$ 27	$ 35	$ 27	$ 8	4	$ 1.33	168%
4L1-4L1	4 ft. 1 lamp F32	4 ft. 1 lamp F25/28 N	1	8	8	0	2,503	-	0%	23	58	$ 13	$ 35	$ 9	$ 26	23	$ 4.33	26%
1L400-4L6	HID Pendant 1 lamp 400W	4 foot 6 lamp F25/T8 N	1	8	8	0	2,503	-	0%	138	345	$ 81	$ 360	$ 76	$ 284	42	$ 47.33	14%
1L250-4L4	HID Pendant 1 lamp 250W	4 foot 4 lamp F25/T8 N	1	8	8	0	2,503	-	0%	92	230	$ 54	$ 330	$ 51	$ 279	62	$ 46.50	10%
1L175-4L4	HID Pendant 1 lamp 175W	4 foot 4 lamp F25/T8 N	1	8	8	0	2,503	-	0%	92	230	$ 54	$ 330	$ 51	$ 279	62	$ 46.50	10%
UBL2-2L2	4 ft. U-Bend 2 lamp FB40	2 ft. 2 lamp F17 N	1	8	8	0	2,503	-	0%	32	80	$ 19	$ 40	$ 22	$ 18	12	$ 3.00	52%
UBL2-2L2R	4 ft. U-Bend 2 lamp FB40	2 ft. 2 lamp F17 L, Reflector	1	8	8	0	2,503	-	0%	27	68	$ 16	$ 50	$ 30	$ 20	15	$ 3.33	39%
100-23	100 Watt Incandescent	23 Watt CFL	1	8	8	0	2,503	-	0%	23	58	$ 13	$ 10	$ 4	$ 6	5	$ 1.00	112%
75-19	75 Watt Incandescent	19 Watt CFL	1	8	8	0	2,503	-	0%	19	48	$ 11	$ 8	$ 4	$ 4	4	$ 0.67	139%
60-13	60 Watt Incandescent	13 Watt CFL	1	8	8	0	2,503	-	0%	13	33	$ 8	$ 6	$ 4	$ 2	3	$ 0.33	190%
Exit	40W Incandecent	2 Watt LED	1	24	24	24	8,760	-	0%	2	18	$ 4	$ 75	$ 38	$ 37	109	$ 6.17	6%
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)	($/unit)	($)	($/kWh)
	m	n	o = m-n	p	q	r
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

15.2 Landlord, Tenant, AOAO Measures

15.2.1 Energy Hero Landlord

Version Date & Revision History
Draft date:
Effective date: July 1, 2012
End date: June 30, 2013

Referenced Documents:
- n/a

TRM Review Actions:
- 10/5/11 – Currently Under Review.

Major Changes:
- n/a

Measure Description:
The landlord/tenant relationship provides challenges to making energy efficiency capital investments in properties and operations such as air conditioning and lighting upgrades.

The tenant energy usage can be accounted for by:
- 1. Paying a flat rate per square foot based on a lease agreement
- 2. Costs Incorporated in CAM
- 3. Third-Party submetered
- 4. Separate Utility submeter

This program will be targeted to provide landlords of small business schedule “G” customers with comprehensive audit, RFP and other support for energy saving projects that will drive down the energy cost of their tenants.

The program will work with local lenders to provide project financing support in conjunction with the program.

Baseline Efficiencies:
TBD

High Efficiency:
TBD

Energy Savings:
Energy savings project may:
- • not have a direct financial incentive for either party
- • have simple payback beyond lease term

<u>Savings Algorithms</u>

Incentive = $0.30/kWh
Target goal = 50,000 kWh

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, 2012
End date: June 30, 2013

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.

- *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: 2CBEEM111111
Date: 12/16/2010
Techology 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
										Reduction Percentage		-52%	-52%

Notes:

Project Summary

Average Energy Savings Per Year	9510.86 kWh/Year
Demand Savings	1.43 kW

Cost Breakdown

Material Cost	$7,990