Unitary or Split Air Conditioning Systems and Air Source Heat Pumps

Table 157: Unitary or Split Air Conditioning Systems and Air Source Heat Pumps	
Measure Description	New unitary air conditioning units or air source heat pumps that meet or exceed the qualifying cooling efficiency are eligible for an incentive. They can be either split systems or single package units. Water-cooled systems, evaporative coolers, and water source heat pumps do not qualify under this program but may qualify under the Custom Incentive Program.
Units	Ton
Base Case Description	Federal Minimum or ASHRAE 90.1-2007 Minimum Standard for Unitary or Split AC
Measure Savings	Source: KEMA
Incremental Measure Cost	Source: Updated DEER
Effective Useful Life	Source: DEER 15 years

New unitary air conditioning units or air source heat pumps that meet or exceed the qualifying cooling efficiency shown in the table below are eligible for an incentive. They can be either split systems or single package units. Efficiencies of split systems are based on ARI reference numbers. Water-cooled systems, evaporative coolers, and water source heat pumps do not qualify under this program but may qualify under the Custom Incentive Program. All unitary and split-system cooling equipment must meet Air Conditioning and Refrigeration Institute (ARI) standards (210/240, 320 or 340/360), be UL listed, and utilize a minimum ozone-depleting refrigerant (e.g., HCFC or HFC). All required efficiencies are based on the Consortium for Energy Efficiency (CEE) high-efficiency commercial air conditioning and heat pump specifications (www.cee1.org)[36]. A manufacturer's specification sheet indicating the system efficiency must accompany the application. Disposal of the existing unit must comply with local codes and ordinances.

[36] This website also has a list of eligible systems

Table 158: Program Qualifying Efficiencies

	Unit Size	Minimum Efficiency	
Less than or equal 5 tons	< 65,000 Btuh	Tier 1	14 SEER
		Tier 2	15 SEER
More than 5 tons	≥ 65,000 Btuh and <240,000 Btuh	12 EER	
	≥240,000 Btuh and <760,000 Btuh	10.8 EER	
	≥ 760,000 Btuh	10.2 EER	

Measure Savings

The coincident kW and the annual kWh savings per ton of installed cooling system are provided below.

Table 159: Measure Savings for Unitary or Split Air Conditioning Systems (per ton)

Unit Size	CEE Tier	Peak Demand Reduction	Annual Energy Savings
5 or less	1	0.068	56.4
5 or less	2	0.134	105.2
5 to 10	2	0.089	74.6
10 to 20	2	0.113	82.3
20 to 60	2	0.105	76.8
≥ 60	2	0.080	58.7

Measure Savings Analysis

Savings values are determined for efficiency levels listed for the CEE commercial AC systems. HVAC EER values used in the analysis are provided in the table below. It is important to note that the baseline efficiency listed here is significantly higher than the baselines used in the previous version, with the exception of unit 5 tons or less These numbers are in accordance with ASHRAE 90.1-2007 (as of 1/1/10) standards instead of ASHRAE 2004. As a result, we will no longer include CEE tier 1 units unless the unit is 5 tons or less (14 SEER).

Table 1: Demand Savings and Efficiency Assumptions

Size (Tons)	Base (S)EER	Tier 2 (S)EER	SEER or EER
5 or less	13	15[37]	SEER
5 to 10	11	12	EER
10 to 20	10.8	12	EER
20 to 60	9.8	10.8	EER
≥ 60	9.5	10.2	EER

Savings calculations were performed by utilizing DOE-2 models generated with eQUEST software. The models are the same used to generate California's DEER with modifications pertinent to Chicago, regarding climate zone and building construction, as outlined below. Our current assumption is that Chicago weather data is very similar that of Ohio. Since the AEP SmartGrid program does not vary savings by building type, the savings presented below are averages of savings calculated for these building types.

1) Representative models for all building types were obtained from the group that developed DEER.

2) The climate zone was changed to Chicago, which is a feature added to the latest version of eQUEST (version 3.63). Previous versions of eQUEST only included California and Seattle climate zones.

3) Building shell characteristics and lighting power density were changed per ComEd's 2008-2010 Energy Efficiency and Demand Response Plan, Appendix B. The primary building shell characteristics that affect weather sensitive measures include insulation levels and window SHGC and U-value.

4) For each building type, a baseline model included the baseline EER or SEER for the HVAC units.

5) Retrofit cases were determined using the Tier 1 or 2 EER or SEER for the HVAC units.

6) Savings was determined by subtracting the retrofit HVAC energy usage from the baseline usage. Similarly peak demand reductions were determined in the same fashion.

[37] Tier 1 is 14 SEER

7) All units with capacities greater than or equal to 10 tons were assumed to be equipped with economizers for both the baseline and retrofit cases. Units smaller than 10 tons were assumed to not have economizers.

The savings values presented are not direct outputs from eQuest. The models still use ASHRAE 2004 baselines. To calculate new savings values, we applied the ratio of efficiency improvements in both cases to the old savings values as described in the following equation.

$$Savings_{NEWBaseline} = \frac{\Delta Efficiency_{NEWBaseline}}{\Delta Efficiency_{OLDBaseline}} Savings_{OLDBaseline}$$

Measure Life and Incremental Measure Cost
The measure life for packaged units is 15 years according to DEER 2005.

The next table provides incremental measure cost (IMC) documented for this measure. Incremental cost is cost difference between the energy-efficient equipment and the less efficient option.

Table 161: Package Units Incremental Measure Cost[38]

Measure	Cost
65,000 Btuh or less - Tier 1	$113
65,000 Btuh or less - Tier 2	$172
65,000 to 240,000 tons - Tier 2	$97
240,000 to 760,000 Btuh - Tier 2	$247
760,000 Btuh or more - Tier 2	$203

[38] 2008 DEER, www.deeresources.com

Water-Cooled Chillers and Air-Cooled Chillers

Table 162 Water-Cooled Chillers and Air-Cooled Chillers	
Measure Description	Chillers are eligible for an incentive if they have a rated kW/ton for the Integrated Part Load Value (IPLV) that is either 80 or 90 percent of the applicable standard. The chiller efficiency rating must be based on ARI Standard 550/590-2003 for IPLV conditions and not based on full-load conditions. The chillers must meet ARI standards 550/590-2003, be NRTL listed, and use a minimum ozone-depleting refrigerant (e.g., HCFC or HFC). The ARI net capacity value should be used to determine the chiller tons.
Units	Per Ton
Base Case Description	Chillers at IECC 2006 IPLV standards
Measure Savings	Source: KEMA
Measure Incremental Cost	Source: 2008 DEER
Effective Useful Life	Source: DEER 20 years

Chillers are eligible for an incentive if they have a rated kW/ton for the integrated part-load value (IPLV) that is either 80 or 90 percent of the applicable standard. The chiller efficiency rating must be based on ARI Standard 550/590-2003 for IPLV conditions and not based on full-load conditions. The chillers must meet ARI standards 550/590-2003, be NRTL listed, and use a minimum ozone-depleting refrigerant (e.g., HCFC or HFC). The ARI net capacity value should be used to determine the chiller tons. A manufacturer's specification sheet with the rated kW/Ton-IPLV or COP-IPLV must accompany the application. Qualifying efficiencies for chillers are summarized below:

Table 163: Efficiency Levels for Chillers

Chiller Type	Size	IECC 2006 kW/ton- IPLV	Level 1 kW/ton IPLV	Level 2 kW/ton IPLV
Scroll or Helical-Rotary	< 150	0.68	0.61	0.54
	150 to 300	0.63	0.57	0.50
	≥ 300	0.57	0.51	0.46
Centrifugal	< 150	0.67	0.60	0.54
	150 to 300	0.60	0.54	0.48
	≥ 300	0.55	0.49	0.44
Reciprocating	All	0.70	0.63	0.56
Air Cooled Chiller	All	1.15	1.04	0.92

Measure Savings
Qualifying air cooled chillers must have a kW/ton IPLV of 1.04 that is 10 percent below the IECC 2006 standards.

The coincident kW and the annual kWh savings per ton of installed chiller are provided below.

Table 164: Measure Savings for Chillers

Measure Description	Unit Size	Tier Level	Peak Electric Demand Reduction (kW/ton)	Electric Savings (kWh/ton)
Air Cooled	< 150	1	0.101	87.1
Air Cooled	≥ 300	1	0.102	88.7
Air Cooled	150-300	1	0.102	88.3
Centrifugal	< 150	1	0.068	71.1
Centrifugal	< 150	2	0.127	132.0
Centrifugal	≥ 300	1	0.059	63.0
Centrifugal	≥ 300	2	0.109	115.5
Centrifugal	150-300	1	0.065	62.4
Centrifugal	150-300	2	0.123	124.7
Reciprocating	< 150	1	0.067	55.3
Reciprocating	< 150	2	0.141	109.2
Reciprocating	≥ 300	1	0.065	53.9
Reciprocating	≥ 300	2	0.134	108.0
Reciprocating	150-300	1	0.065	53.8
Reciprocating	150-300	2	0.134	107.7
Scroll or Helical Rotary	< 150	1	0.068	54.5
Scroll or Helical Rotary	< 150	2	0.137	109.1
Scroll or Helical Rotary	≥ 300	1	0.058	48.3
Scroll or Helical Rotary	≥ 300	2	0.112	87.7
Scroll or Helical Rotary	150-300	1	0.059	47.2
Scroll or Helical Rotary	150-300	2	0.132	102.4

Measure Savings Analysis

Savings values are calculated for both Level 1 and Level 2 efficiency levels with IECC 2006 efficiency standards as the baseline. The same calculation methodology used for "Unitary or Split Air Conditioning Systems and Air Source Heat Pumps" was used with the following additional assumptions:

1) Air handler units were assumed to be Variable Air Volume (VAV) systems with hot water reheat.

2) VAV units include economizers and supply temperature reset controls based on outside air.

3) Condenser water temperature was set to 75° F.

4) All chillers for pre and post cases were assumed to be constant speed.

5) All measure cases assumed the same type of chiller (screw, centrifugal, etc.) pre and post.

Measure Life and Incremental Measure Cost
The measure life for packaged units is 20 years according to DEER[39].

The following table provides IMC documented for this measure. Incremental cost is cost difference between the energy efficient equipment and the less efficient option.

Table 165: Chiller Incremental Measure Cost[40]

Measure Name	Level 1	Level 2
Water Cooled Chiller - Scroll or Helical Rotary <150 tons	$ 138.53	$ 211.04
Water Cooled Chiller - Scroll or Helical Rotary 151-300 tons	$ 80.89	$ 176.15
Water Cooled Chiller - Scroll or Helical Rotary >300 tons	$ 21.80	$ 49.87
Water Cooled Chiller - Centrifugal <150 tons	$ 138.53	$ 211.04
Water Cooled Chiller - Centrifugal 151-300	$ 80.89	$ 176.15
Water Cooled Chiller - Centrifugal >300 tons	$ 21.80	$ 49.87
Water Cooled Chiller – Reciprocating	$ 80.40	$ 145.69
Air Cooled Chiller kW/ton-IPLV of 1.04 or lower	$ 126.70	

[39] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report
[40] 2008 DEER, www.deeresources.com

Room Air Conditioners

Table 166: Room Air Conditioners	
Measure Description	Room air conditioning units are through-the-wall (or built-in) self-contained units that are 2 tons or less. A unit must qualify under Super Efficient Home Appliance (SEHA) Tier 1 standards. These units are with and without louvered sides, without reverse cycle (i.e., heating), and casement.
Units	Per Ton
Base Case Description	Variable. See table
Measure Savings	Source: ENERGY STAR, CEE
Measure Incremental Cost	Source: 2009 PG&E Workpaper – PGECOHVC109.1 – ENERGY STAR Room Air Conditioner Non-Residential
Effective Useful Life	Source: ENERGY STAR 9 years

Room air conditioning units are through-the-wall (or built-in), self-contained units that are 2 tons or less. This measure consists of the installation of a Room Air Conditioner that falls under Super Efficient Home Appliance (SEHA) Tier 1 standards The minimum requirements and eligible equipment are listed CEE high-efficiency room air conditioning specifications (www.cee1.org)[41]. These units are with and without louvered sides, without reverse cycle (i.e., heating), and casements. The qualifying efficiencies for both levels are provided below. Disposal of existing unit must comply with local codes and ordinances.

Table 167: Qualifying Efficiencies

Size (Btuh)	October 2000 Federal Standard (EER) Baseline	SEHA Tier 1 Retrofit (EER)
< 8,000	9.7	11.2
8000 to 13,999	9.8	11.3
14,000 to 19,999	9.7	11.2
>= 20,000	8.5	9.8

Measure Savings
Below are the coincident kW and the annual kWh savings per ton of installed cooling system.

Table 168: Room A/C Savings (per ton)

[41] This website also has a list of eligible units.

Size (Btuh)	Demand Difference, kW	Annual Electric Savings, kWh	Demand Reduction, kW
< 8,000	0.166	116	0.149
8000 to 13,999	0.163	114	0.146
14,000 to 19,999	0.166	116	0.149
>= 20,000	0.187	131	0.169

Measure Savings Analysis
Savings values are calculated with the baseline efficiencies shown above, since efficiency levels depend on the size of the unit. The assumed operating hours is 700, which is an average of ENERGY STAR Full-Load Cooling Hours for Chicago and Rockford. The Diversity/Duty Cycle factor is 0.90[42]. The following is the calculation for daily energy consumption per the PG&E workpapers.

ΔWatts/unit

The demand difference (watts per unit) is the difference between the electric demand of the base unit and the electric demand of the energy efficient unit.

ΔWatts/ton= Base Watts/ AC Unit - Energy Efficient Unit Watts/ AC Unit
= (12/Baseline EER – 12/Replacement EER)

Annual Electric Savings

Energy Savings [kWh/ton] = (ΔkW/ton) x (Op Hrs)

Demand Reduction

Demand Reduction [kW/ton] = (ΔkW/ton) x (Diversity/Duty Cycle)

Measure Life and Incremental Measure Cost
The following table provides the measure life and IMC documented for this measure as well as the source of the data. Incremental cost is the cost difference between the energy-efficient equipment and the less efficient option.

The measure costs for this measure are assumed to be the same as those for packaged terminal air conditioning units of the same capacity. The figures from DEER 2008 were multiplied by the average capacity of available ENERGY STAR® room air conditioners in tons to arrive at the figures below.[43]

[42] 2009 PG&E Workpaper – PGECOHVC109.1
[43] 2009 PG&E Workpaper – PGECOHVC109 1

The IMC documented for this measure is the cost difference between the energy efficient equipment and the less efficient option at $157.12 per unit.

Table 169: Measure Life and Incremental Measure Cost

	Value	Source
Measure Life	9	ENERGY STAR
Incremental Measure Cost	$157.12	PG&E, DEER 2008

Package Terminal Air Conditioners/Heat Pumps

Table 170: Package Terminal Air Conditioners/Heat Pumps	
Measure Description	Package terminal air conditioners and heat pumps are through-the-wall self contained units that are 2 tons (24,000 Btuh) or less. Only units that have an EER greater than or equal to 13.08 – (0 2556 * Capacity / 1000), where capacity is in Btuh, qualify for the incentive. All EER values must be rated at 95 °F outdoor dry-bulb temperature.
Units	Per Ton
Base Case Description	IECC 2006 EER Efficiencies
Measure Savings	Source: KEMA
Measure Incremental Cost	Source: 2008 DEER $84/ton
Effective Useful Life	Source: DEER 15 years

Package terminal air conditioners and heat pumps are through-the-wall self contained units that are 2 tons (24,000 Btuh) or less. Only units that have an EER greater than or equal to 13.08 – (0.2556 X Capacity / 1000), where capacity is in Btuh, qualify for the incentive. All EER values must be rated at 95 °F outdoor dry-bulb temperature.

Measure Savings
Below are the coincident kW and the annual kWh savings per ton of installed cooling system. The savings are based on efficiencies 20 percent higher than the IECC 2006 minimum efficiency.

Table 171: Measure Savings for PTAC/HP (per ton)

Peak Electric Demand Reduction (kW/ton)	Electric Savings (kWh/ton)
0.22	219

Measure Savings Analysis
Savings values are calculated for qualifying PTAC/HPs with IECC 2006 efficiency standards as the baseline. Both qualifying efficiency levels and baseline efficiencies are based on the capacity of the unit but, for purposes of calculating savings, we have assumed a baseline of 8.3 EER and a replacement efficiency of 10 EER on average, the efficiencies for a 12,000 Btuh (1-ton) unit. The following table provides the efficiencies for a range of PTAC/HP sizes.

Table 172: PTAC/HP Efficiencies

PTAC size	Federal standard	IECC 2006	Qualifying EER

6000	9.0	9.6	11.5
7000	8.9	9.4	11.3
8000	8.7	9.2	11.0
9000	8.6	9.0	10.8
10000	8.4	8.8	10.5
11000	8.2	8.6	10.3
12000	8.1	8.3	10.0
13000	7.9	8.1	9.8
14000	7.8	7.9	9.5
15000	7.6	7.7	9.2
16000	7.4	7.5	9.0
17000	7.3	7.3	8.7
18000	7.1	7.1	8.5

The same calculation methodology used for "Unitary or Split Air Conditioning Systems and Air Source Heat Pumps" was used with one exception. The coincident kW savings have been calculated using the following equation. The coincident factor assumed for this measure is 0.90.

kW Savings per ton = (12/Baseline EER – 12/Replacement EER)

Coincident kW Savings = kW Savings x Coincidence Factor

Measure Life and Incremental Measure Cost
The measure life for packaged units is 15 years according to DEER[44]. The IMC documented for this measure is $84 per ton[45], which is the cost difference between the energy-efficient equipment and the less efficient option.

[44] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report
[45] 2008 DEER, www.deeresources.com

Lodging – Guest Room Energy Management System (GREM)

Table 173: Lodging – Guest Room Energy Management System (GREM)	
Measure Description	GREM is a multi-purpose Direct Digital Control (DDC) device designed to control HVAC unit in hotel guestrooms.
Units	Per room HVAC controller
Base Case Description	Manual Heating/Cooling Temperature Setpoint and Fan On/Off/Auto Thermostat
Measure Savings	Source: KEMA
Measure Incremental Cost	Source: PY1 and PY2 custom projects[46] $260/Unit
Effective Useful Life	Source: DEER 2008 15 years

[46] Custom GREM projects from Smart Ideas for Your Business Incentive Program Year 1 & 2

Variable-Speed Drives for HVAC Applications

Table 174 Variable-Speed Drives for HVAC Applications	
Measure Description	Variable-speed drives (VSDs) which are installed on existing chillers, HVAC fans, or HVAC pumps are eligible for this incentive. New chillers with integrated VSDs are eligible under the chiller incentive. The installation of a VSD must accompany the permanent removal or disabling of any throttling devices such as inlet vanes, bypass dampers, and throttling valves. VSDs for non-HVAC applications may be eligible for a custom incentive.
Units	Per HP.
Base Case Description	No VSD installed.
Measure Savings	Source: KEMA
Measure Incremental Cost	Source: DEER and KEMA
Effective Useful Life	Source: DEER 15 years

Variable-speed drives (VSDs) which are installed on existing chillers, HVAC fans, or HVAC pumps are eligible for this incentive. New chillers with integrated VSDs are eligible under the chiller incentive. The installation of a VSD must accompany the permanent removal or disabling of any throttling devices such as inlet vanes, bypass dampers, and throttling valves. VSDs for non-HVAC applications may be eligible for a custom incentive.

Measure Savings

Provided below are the coincident kW savings and the annual kWh savings per hp of installed motor. The coincident kW savings are the same across all building and application types. The annual kWh savings are dependent on building type and application type.

Table 175: VSD for HVAC Demand Savings (per HP)

Cooling Measure Name	kW Savings	Coin kW Savings
VSD for HVAC chillers, fans, and pumps	0.123	0.025

Table 176: VSD for HVAC Motors (Per HP)

Building Type	Pumps and Fans Annual kWh Savings	Chillers Annual kWh Savings
Average = Miscellaneous	503	421

Measure Savings Analysis

Savings values are calculated with an estimate of a 19 percent savings[47]. The motors are assumed to have a load factor of 80 percent and an efficiency of 92.5 percent for calculating the equipment kW.

kW reduction = 0.19 x (kW of existing equipment)

Where kW of equipment is calculated using:

$$\frac{(\text{Motor HP})\times(0.746\ \text{kW/HP})\times(\text{Load Factor})}{\text{Motor Efficiency}}$$

The coincident kW savings are calculated using the following equation. The coincidence factor is assumed to be 0.20.

Coincident kW reduction = kW reduction x coincidence factor

Annual energy savings values were calculated based on run hours for each building type as modeled in our chillers section. Here run hours were obtained from building simulation runs for 150-300 ton centrifugal chillers at baseline efficiencies. Simulations results yield run times for fans, chilled water pumps, hot water pumps, and chillers. Average of fan and pump hours are listed in the table below as well as the chiller run hours. The savings presented here have been averaged over the various building types.

Annual kWh Savings = kW Savings x Run Hours

Table 177: Chiller Annual Operating Hours

Chillers
3431

Table 178: Pump and Fan Annual Operating Hours

Pumps and Fans
4103

Measure Life and Incremental Measure Cost

The measure life for packaged units is 15 years according to DEER[48].

The IMC documented for this measure is $90 per horsepower and $150 per horsepower for chiller and pump/fan applications respectively[49].

47 This percentage is a conservative estimate. DEER on average calculated over 30% savings for installing a VSD.

48 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report

Commercial Kitchen Demand Ventilation Controls

Table 179: Commercial Kitchen Demand Ventilation Controls	
Measure Description	Installation of commercial kitchen demand ventilation controls that vary the ventilation based on cooking load and/or time of day.
Units	Per exhaust fan horsepower
Base Case Description	Exhaust and makeup fans that operate at 100% speed
Measure Savings	Source: PG&E 2006 Workpapers
Measure Incremental Cost	Source: PG&E 2006 Workpapers
Effective Useful Life	Source: California Energy Efficiency Policy Manual (EEPM) Table 4.1 15 years

The measure consists of installing a control system that varies the exhaust rate of kitchen ventilation (exhaust and/or makeup air fans) based on the energy and effluent output from the cooking appliances (i.e., the more heat and smoke/vapors generated, the more ventilation needed). This involves installing a temperature sensor in the hood exhaust collar and/or an optic sensor on the end of the hood that sense cooking conditions which allows the system to automatically vary the rate of exhaust to what is needed by adjusting the fan speed accordingly.

Measure Savings
The following table provides the savings for this measure.

Table 180: Demand and Energy Savings for Demand Ventilation Control (per exhaust horsepower)

Measure Name	Coincident Peak Demand Reduction (kW)	Annual Energy Savings Per Unit (kWh)
DVC Control Retrofit	0.76	4,486
DVC Control New	0.76	4,486

Measure Savings Analysis
Annual energy use was based on monitoring results from five different types of sites, as summarized in PG&E Food Service Equipment workpaper.

[49] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report from assessment of several measures that include a VSD retrofit

Measure Life and Incremental Measure Cost

The following table provides the measure life and IMC documented for this measure as well as the source of the data. The measure life is assumed to be the same as that of variable speed drives. Incremental cost is cost difference between the energy-efficient equipment and the less efficient option. In the retrofit case, the IMC is equal to the full measure cost since cost of the less efficient option is $0. The cost for the new system is the incremental (difference in) cost of installing ventilation with and without controls.

Table 181: Measure Life and Incremental Measure Cost

Measure Category		Value	Source
DVC Control Retrofit & New	Measure Life	15	EEPM
DVC Control Retrofit	Incremental Measure Cost	$1,988	PG&E Work paper
DVC Control New	Incremental Measure Cost	$1,000	PG&E Work paper

Premium Motors

NEMA® Premium-Efficiency Motors

Table 182: NEMA® Premium-Efficiency Motors	
Measure Description	Motors eligible for an incentive are three-phase AC induction motors, 1-200 hp, of open drip-proof (open) and totally enclosed fan-cooled (closed) classifications. Rewound motors do not qualify. Incentives are based on the motor's nominal full-load efficiencies that meet or exceed the NEMA premium-efficiency standards. The application must include the manufacturer's performance data sheet that at least shows equipment type, equipment size, model number, and efficiency rating.
Units	Per motor
Base Case Description	Minimum efficiency under EPACT-92
Measure Savings	Source: KEMA
Measure Incremental Cost	Source: SCE workpapers
Effective Useful Life	Source: DEER 15 years

Motors eligible for an incentive are three-phase AC induction motors, 1-200 hp, of open drip-proof (open) and totally enclosed fan-cooled (closed) classifications. Rewound motors do not qualify. Incentives are based on the motor's nominal full-load efficiencies, tested in accordance with IEEE (Institute of Electrical and Electronics Engineers) Standard 112, method B, that meet or exceed the NEMA premium-efficiency standards on the Motors Incentive Worksheet. The application must include the manufacturer's performance data sheet that at least shows equipment type, equipment size, model number, and efficiency rating. Customers should consider matching water or air flows (GPM, CFM) of the existing pump or fan when installing energy-efficient motors that inherently have higher speeds (less slip), which may increase energy savings.

Measure Savings
The following table provides the measure savings for NEMA premium motors.

Table 183: Measure Coincident kW Savings

MOTOR HORSEPOWER	1200 RPM ODP MOTOR Coincident Demand Reduction (kW)	1200 RPM TEFC MOTOR Coincident Demand Reduction (kW)	1800 RPM ODP MOTOR Coincident Demand Reduction (kW)	1800 RPM TEFC MOTOR Coincident Demand Reduction (kW)	3600 RPM ODP MOTOR Coincident Demand Reduction (kW)	3600 RPM TEFC MOTOR Coincident Demand Reduction (kW)
1	0.016	0.016	0.018	0.018		0.011
1.5	0.021	0.017	0.021	0.021	0.013	0.013
2	0.022	0.022	0.028	0.028	0.017	0.017
3	0.032	0.032	0.048	0.032	0.026	0.017
5	0.053	0.053	0.053	0.053	0.028	0.027
7.5	0.066	0.057	0.096	0.083	0.040	0.039
10	0.075	0.076	0.111	0.111	0.052	0.036
15	0.113	0.113	0.147	0.103	0.054	0.061
20	0.138	0.150	0.196	0.196	0.081	0.081
25	0.158	0.158	0.229	0.144	0.087	0.087
30	0.172	0.189	0.243	0.172	0.104	0.104
40	0.208	0.208	0.208	0.208	0.137	0.137
50	0.260	0.260	0.353	0.353	0.145	0.145
60	0.253	0.253	0.391	0.391	0.171	0.171
75	0.316	0.316	0.313	0.450	0.214	0.214
100	0.417	0.417	0.600	0.413	0.285	0.235
125	0.521	0.521	0.517	0.517	0.294	0.288
150	0.620	0.546	0.546	0.546	0.353	0.346
200	0.827	0.728	0.728	1.087	0.461	0.365

Table 184: Measure kWh Savings

MOTOR HORSEPOWER	1200 RPM		1800 RPM		3600 RPM	
	ODP MOTOR Annual Savings (kWh)	TEFC MOTOR Annual Savings (kWh)	ODP MOTOR Annual Savings (kWh)	TEFC MOTOR Annual Savings (kWh)	ODP MOTOR Annual Savings (kWh)	TEFC MOTOR Annual Savings (kWh)
1	58	58	65	65		40
1.5	79	62	79	79	50	50
2	82	80	106	106	64	64
3	120	118	179	118	96	62
5	196	196	196	196	104	99
7.5	303	262	442	381	184	180
10	344	349	509	509	240	165
15	516	516	673	474	247	277
20	632	688	897	897	370	370
25	867	867	1,259	789	477	477
30	947	1,041	1,335	947	573	573
40	1,144	1,144	1,144	1,144	752	752
50	1,430	1,430	1,942	1,942	794	794
60	1,820	1,820	2,817	2,817	1,233	1,233
75	2,275	2,275	2,251	3,238	1,541	1,541
100	3,002	3,002	4,318	2,977	2,055	1,693
125	3,661	3,661	3,631	3,631	2,065	2,025
150	4,357	3,836	3,836	3,836	2,477	2,431
200	5,809	5,115	5,115	7,640	3,241	2,568

Measure Savings Analysis

The two types of capacity savings estimates discussed here are connected-load reduction achieved by the measure (non-coincident) and demand reduction coincident with the utility's system peak. The non-coincident demand reduction achieved by the measure is estimated from engineering analyses using the following formula:

Non-coincident kW reduction = kW of existing equipment - kW of replacement equipment

Where kW is calculated using $\frac{(\text{Motor HP}) \times (0.746\ \text{kW/HP}) \times (\text{Load Factor})}{\text{Motor Efficiency}}$

Generally motors are oversized and so the load factor is assumed to be 75 percent.[50]

Energy savings are based on the difference between baseline and efficient equipment connected wattage and annual operating hours, according to the following formula:

kWh Reduction = (kW of existing equipment - kW of replacement equipment) * (Annual operating hours)

To determine coincident demand reduction, engineering estimates of savings are multiplied by a coincident diversity factor. Coincident diversity factors have been estimated to be 0.74[51]

Coincident kW Reduction = Coincident Diversity Factor * Non-coincident reduction with Demand Interactive Effects

DEER uses the most recent data is from a study for the Department of Energy completed in 1998[52]. The data for Overall Manufacturing, SIC 20 through 39, is used as for the operating hours to represent the industrial market sector. These hours are assumed reasonable for use with all market sectors.

Table 185: Annual Operating Hours[53]

	Operating Hours.
1 to 5 hp	2,745
6 to 20 hp	3,391
21 to 50 hp	4,067
51 to 100 hp	5,329
101 to 200 hp	5,200

[50] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures
[51] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures
[52] Xenergy, United States Industrial Electric Motor Systems Market Opportunities Assessment. Burlington, MA, 1998. Hours are from Page B-2 for Overall Manufacturing (SIC 20-39).
[53] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures referencing the Xenergy study.

Baseline and retrofit equipment assumptions are presented in the next table. Motor replacement is considered to be a replace on burn-out measure The baseline represents the nonenergy-efficient equipment that would be purchased, which is set at the full-load nominal efficiency as set by the Energy Policy Act of 1992 (EPACT92). This table shows the standard efficiencies used for the savings calculations.

Table 186: Baseline Efficiencies Standard Motors

MOTOR HORSEPOWER	1200 RPM		1800 RPM		3600 RPM	
	Standard Efficiency ODP	Standard Efficiency TEFC	Standard Efficiency ODP	Standard Efficiency TEFC	Standard Efficiency ODP	Standard Efficiency TEFC
1	0.800	0.800	0.825	0.825	Not Avail.	0.755
1.5	0.840	0.855	0.840	0.840	0.825	0.825
2	0.855	0.865	0.840	0.840	0.840	0.840
3	0.865	0.875	0.865	0.875	0.840	0.855
5	0.875	0.875	0.875	0.875	0.855	0.875
7.5	0.885	0.895	0.885	0.895	0.875	0.885
10	0.902	0.895	0.895	0.895	0.885	0.895
15	0.902	0.902	0.910	0.910	0.895	0.902
20	0.910	0.902	0.910	0.910	0.902	0.902
25	0.917	0.917	0.917	0.924	0.910	0.910
30	0.924	0.917	0.924	0.924	0.910	0.910
40	0.930	0.930	0.930	0.930	0.917	0.917
50	0.930	0.930	0.930	0.930	0.924	0.924
60	0.936	0.936	0.936	0.936	0.930	0.930
75	0.936	0.936	0.941	0.941	0.930	0.930
100	0.941	0.941	0.941	0.945	0.930	0.936
125	0.941	0.941	0.945	0.945	0.936	0.945
150	0.945	0.950	0.950	0.950	0.936	0.945
200	0.945	0.950	0.950	0.950	0.945	0.950

Table 187: NEMA Premium Efficiencies

MOTOR HORSEPOWER	1200 RPM		1800 RPM		3600 RPM	
	NEMA Premium Efficiency ODP	NEMA Premium Efficiency TEFC	NEMA Premium Efficiency ODP	NEMA Premium Efficiency TEFC	NEMA Premium Efficiency ODP	NEMA Premium Efficiency TEFC
1	0.825	0.825	0.855	0.855	0.770	0.770
1.5	0.865	0.875	0.865	0.865	0.840	0.840
2	0.875	0.885	0.865	0.865	0.855	0.855
3	0.885	0.895	0.895	0.895	0.855	0.865
5	0.895	0.895	0.895	0.895	0.865	0.885
7.5	0.902	0.910	0.91	0.917	0.885	0.895
10	0.917	0.910	0.917	0.917	0.895	0.902
15	0.917	0.917	0.93	0.924	0.902	0.910
20	0.924	0.917	0.93	0.93	0.910	0.910
25	0.930	0.930	0.936	0.936	0.917	0.917
30	0.936	0.930	0.941	0.936	0.917	0.917
40	0.941	0.941	0.941	0.941	0.924	0.924
50	0.941	0.941	0.945	0.945	0.930	0.930
60	0.945	0.945	0.950	0.950	0.936	0.936
75	0.945	0.945	0.950	0.954	0.936	0.936
100	0.950	0.950	0.954	0.954	0.936	0.941
125	0.950	0.950	0.954	0.954	0.941	0.950
150	0.954	0.958	0.958	0.958	0.941	0.950
200	0.954	0.958	0.958	0.962	0.950	0.954

Measure Life and Incremental Measure Cost
The measure life is assumed to be 15 years.[54]

The following table provides the incremental measure cost. Incremental cost is cost difference between the energy-efficient equipment and the less efficient or standard option. The incremental values are from those presented in the SCE workpaper. Only costs for 1,800-rpm motors are provided since these are the ones most prevalent in the market place. It is assumed the costs for 1200 and 3600 rpm do not differ too much from the 1800 rpm motor.

[54] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

Table 188 Motor Incremental Measure Cost[55]

Measure Category	ODP 1800 RPM	TEFC 1800 RPM
1 HP	$51	$50
1.5 HP	$11	$73
2 HP	$46	$65
3 HP	$38	$73
5 HP	$25	$99
7.5 HP	$71	$71
10 HP	$43	$90
15 HP	$21	$168
20 HP	$100	$165
25 HP	$116	$329
30 HP	$46	$331
40 HP	$226	$398
50 HP	$246	$384
60 HP	$285	$332
75 HP	$100	$366
100 HP	$129	$555
125 HP	$262	$961
150 HP	$342	$609
200 HP	$614	$964

[55] Southern California Edison Premium Motors Workpaper WPSCNPR0008 2007

Refrigeration

Strip Curtains

Table 189 Strip Curtains	
Measure Description	New strip curtains or clear plastic swinging doors must be installed on doorways of walk-in boxes and refrigerated warehouses. This incentive is not available for display cases or replacing existing strip curtains that have useful life left. A pre-inspection may be performed. Incentive is based on square footage of doorway.
Units	Per Square Foot
Base Case Description	Walk-in storage without infiltration barriers.
Measure Savings	Source: SCE, KEMA
Measure Incremental Cost	Source: SCE $7.77
Effective Useful Life	Source: SCE 4 years

Strip curtains can be installed to reduce infiltration in refrigeration storage areas. New strip curtains or clear plastic swinging doors must be installed on doorways of walk-in boxes and refrigerated warehouses to qualify for rebates. This incentive is not available for display cases or replacing existing strip curtains that have useful life left. A pre-inspection may be performed. The incentive is based on square footage of doorway.

Measure Savings [56]
Savings values are obtained from the Southern California Edison (SCE) workpaper for infiltration barriers, which covers all 16 Californian climate zones. SCE savings values were determined using a set of assumed conditions for restaurants, small grocery storage, and large grocery storage. We have used only PG&E climate zones in calculating our averages and have taken out the drier, warmer climates of southern California. Details on cooling load calculations including refrigeration conditions, can be found in the SCE workpaper.

A baseline is used to calculate savings and incremental cost. In this case, the baseline for this measure assumes that there are no strip curtains installed at the facility.

The following tables are values calculated within the SCE workpaper.

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[56] "Infiltration Barriers- Strip Curtains," Workpaper WPSCNRRN0002. Southern California Edison Company. 2007.

Table 190: SCE Restaurant Savings

Restaurant				
SCE Workpaper Values	Cooler Strip Curtains		Freezer Strip Curtains	
Northern California Climate Zones	Annual Savings (kWh/sqft)	Peak Demand Reduction (kW/sqft)	Annual Savings (kWh/sqft)	Peak Demand Reduction (kW/sqft)
1	76	0.005	207	0.015
2	118	0.009	336	0.027
3	106	0.008	302	0.023
4	107	0.008	304	0.023
5	97	0.007	273	0.020
11	136	0.011	386	0.032
12	128	0.010	366	0.030
13	134	0.011	381	0.030
16	99	0.008	282	0.023
Average	111	0.009	315	0.025

Table 191: SCE Small Grocery Savings

Small Grocery				
SCE Workpaper Values	Cooler w/ Glass Doors Strip Curtains		Freezer Strip Curtains	
Northern California Climate Zones	Annual Savings (kWh/sqft)	Peak Demand Reduction (kW/sqft)	Annual Savings (kWh/sqft)	Peak Demand Reduction (kW/sqft)
1	58	0.003	179	0.010
2	91	0.005	296	0.021
3	82	0.004	265	0.017
4	83	0.004	266	0.017
5	74	0.004	238	0.015
11	106	0.007	343	0.025
12	100	0.006	324	0.023
13	104	0.006	337	0.023
16	77	0.004	247	0.017
Average	86	0.005	277	0.019

Table 192: SCE Medium and Large Grocery Savings

Medium & Large Grocery						
SCE Workpaper Values	Cooler Strip Curtains		Cooler w/ Glass Doors Strip Curtains		Freezer Strip Curtains	
Northern California Climate Zones	Annual Savings (kWh/sqft)	Peak Demand Reduction (kW/sqft)	Annual Savings (kWh/sqft)	Peak Demand Reduction (kW/sqft)	Annual Savings (kWh/sqft)	Peak Demand Reduction (kW/sqft)
1	58	0.003	57	0.002	182	0.009
2	91	0.005	90	0.005	307	0.019
3	82	0.004	81	0.004	273	0.015
4	82	0.004	82	0.004	274	0.015
5	74	0.004	74	0.003	244	0.013
11	106	0.006	105	0.006	358	0.023
12	100	0.005	99	0.005	337	0.021
13	104	0.006	103	0.005	351	0.021
16	76	0.004	76	0.004	255	0.015
Average	86	0.004	85	0.004	287	0.017

Savings values in the table below are a weighted average of walk-in cooler (80 percent) and freezer (20 percent) applications. The workpapers for the 2006-2008 program years include this distribution of coolers and freezers in their refrigeration measure savings analyses. It is not anticipated that the application of strip curtains outside of the restaurant/grocery sector; however, the average savings value can apply to all other applications. The following table provides the calculated program savings.

Table 193: Strip Curtain Savings Summary

Building Type	Annual Savings (kWh/sqft)	Peak Demand Reduction (kW/sqft)
Restaurant	152	0.012
Grocery	125	0.007
Average	139	0.010

Measure Life and Incremental Measure Cost

The following table provides the measure life and IMC documented for this measure as well as the source of the data.

Incremental cost is cost difference between the energy-efficient equipment and the less efficient option. In this case, the strip curtain measure, the IMC is equal to the full measure cost since the cost of the less efficient option, i.e., not conducting the retrofit, is $0.

Table 194: Measure Life and Incremental Measure Cost

	Value	Source
Measure Life	4	SCE
Incremental Measure Cost	$7.77	SCE

Anti-Sweat Heater Controls

Table 195: Anti-Sweat Heater Controls	
Measure Description	For this measure, a device is installed that senses the relative humidity in the air outside of the display case and reduces or turns off the glass door (if applicable) and frame anti-sweat heaters at low-humidity conditions. Technologies that can turn off anti-sweat heaters based on sensing condensation (on the inner glass pane) also qualify. Rebate is based on the total linear footage of the case.
Units	Per Linear Foot (width)
Base Case Description	No Anti-Sweat Heater controls installed.
Measure Savings	Source: PG&E, SCE
Measure Incremental Cost	Source: PG&E, SCE $34
Effective Useful Life	Source: PG&E, SCE 12 years

An anti-sweat heater is a device that senses the relative humidity in the air outside of the display case and reduces or turns off the glass door (if applicable) and frame anti-sweat heaters at low-humidity conditions. Technologies that can turn off anti-sweat heaters based on sensing condensation (on the inner glass pane) also qualify. The rebate is based on the total linear footage of the case.

Measure Savings [57]
Savings values are obtained from the draft Pacific Gas and Electric (PG&E) workpaper for anti-sweat heater controls. However, both PG&E and Southern California (SCE) savings values were determined using a set of assumed conditions for grocery stores. In the workpapers, some of the key assumptions are:

- ASH demand is assumed to be 0.0423 kW/linear foot
- On average, the control system reduces the run time of the ASH by 86.8 percent.

Details on assumptions and calculations can be found in the workpapers.

The following table is the average values (across PG&E climate zones) calculated within the PG&E workpaper.

Table 196: ASH Control Savings

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57 "Anti-Sweat Heater Controls," Workpaper WPSCNRRN0009. Southern California Edison Company 2007. PG&E uses the same method as SCE, but the workpaper is not yet published, ASH Controls PGECOREF108.

	kWh Savings/ft	Coincident kW Savings/ft
Anti-Sweat Heater Controller	402	0.007

Both energy and peak kW savings take into account additional savings due to interactive effects.

Measure Life and Incremental Measure Cost

The following table provides the measure life and IMC documented for this measure as well as the source of the data.

Incremental cost is cost difference between the energy-efficient equipment and the less efficient option. In this case the anti-sweat heater controls, the IMC is equal to the full measure cost since the cost of the less efficient option, i.e., not conducting the retrofit, is $0.

Table 197: Measure Life and Incremental Measure Cost

	Value	Source
Measure Life	12	SCE
Incremental Measure Cost	$34	SCE

Electronically Commutated Motors (ECM)

Table 198 Electronically Commutated Motors (ECM)	
Measure Description	This measure is applicable to the replacement of an existing standard-efficiency shaded-pole evaporator fan motor in refrigerated display cases or fan coil in walk-ins. The replacement unit must be an ECM. This measure cannot be used in conjunction with the evaporator fan controller measure.
Units	Per Motor
Base Case Description	Shaded Pole Motors
Measure Savings	Source: SCE, KEMA
Measure Incremental Cost	Source: SCE, Fisher-Nickel
Effective Useful Life	Source: DEER 15 years

This measure applies to the replacement of an existing standard-efficiency shaded-pole evaporator fan motor in refrigerated display cases or fan coil in walk-ins The replacement unit must be an electronically commutated motor (ECM). This measure cannot be used in conjunction with the evaporator fan controller measure.

Measure Savings [58]

Savings values are obtained from the SCE workpaper for efficient evaporator fan motors, which covers all 16 California climate zones. SCE savings values were determined using a set of assumed conditions for restaurants and grocery stores. We have used only PG&E climate zones in calculating our averages and have taken out the drier, warmer climates of southern California.

SCE's savings approach calculates refrigeration demand, by taking into consideration temperature, compressor efficiency, and various loads involved for both walk-in and reach-in refrigerators. Details on cooling load calculations, including refrigeration conditions, can be found in the SCE workpaper. The baseline for this measure assumes that the refrigeration unit has a shaded-pole motor. The following tables are values calculated within the SCE workpaper.

Table 199 SCE Restaurant Savings Walk-In

[58] "Efficient Evaporator Fan Motors (Shaded Pole to ECM)," Workpaper WPSCNRRN0011. Southern California Edison Company. 2007

SCE Workpaper Values	Restaurant			
	Cooler		Freezer	
Northern California Climate Zones	kWh Savings Per Motor	Peak kW Savings Per Motor	kWh Savings Per Motor	Peak kW Savings Per Motor
1	318	0.0286	507	0.030
2	253	0.0330	263	0.037
3	364	0.0315	649	0.034
4	365	0.0313	652	0.034
5	350	0.0305	605	0.033
11	410	0.0351	780	0.040
12	399	0.0340	748	0.039
13	407	0.0342	771	0.039
16	354	0.0315	620	0.034
Average	358	0.0322	622	0.036

Table 200: SCE Grocery Savings Walk-In

SCE Workpaper Values	Grocery			
	Cooler		Freezer	
Northern California Climate Zones	kWh Savings Per Motor	Peak kW Savings Per Motor	kWh Savings Per Motor	Peak kW Savings Per Motor
1	318	0.0284	438	0.030
2	252	0.0534	263	0.064
3	364	0.0486	552	0.056
4	365	0.0480	553	0.055
5	349	0.0452	516	0.051
11	410	0.0601	656	0.074
12	398	0.0566	631	0.069
13	406	0.0574	649	0.070
16	354	0.0486	528	0.056
Average	357	0.0496	532	0.058

Table 201: SCE Grocery Savings Reach-In

SCE Workpaper Values	Grocery			
	Cooler		Freezer	
Northern California Climate Zones	kWh Savings Per Motor	Peak kW Savings Per Motor	kWh Savings Per Motor	Peak kW Savings Per Motor

1	306	0.031	362	0.031
2	269	0.033	273	0.035
3	331	0.032	421	0.034
4	332	0.032	422	0.034
5	323	0.032	402	0.033
11	357	0.034	476	0.037
12	350	0.034	462	0.036
13	355	0.034	472	0.037
16	325	0.032	409	0.034
Average	328	0.033	411	0.035

Savings values in the following table are an average of walk-in cooler (80 percent) and freezer (20 percent) applications. The workpapers for the 2006-2008 program years include this distribution of coolers and freezers in their refrigeration measure savings analyses. Strip curtains are unlikely to occur outside the restaurant/grocery sector, but if they do the average savings can apply. The following table provides the calculated program savings.

Table 202: ECM Walk-In Savings Values Summary

	kWh Savings/ft	Peak kW Savings/ft
Restaurant	411	0.033
Grocery	392	0.054
Average	401	0.044

Table 203: ECM Reach-In Savings Values Summary

kWh Savings/ft	Peak kW Savings/ft
345	0.033

Measure Life and Incremental Measure Cost

The following table provides the measure life and IMC documented for this measure as well as the source of the data.

Incremental cost is cost difference between the energy-efficient equipment and the less efficient option. We will consider ECM an early replacement measure where the IMC is equal to the full measure cost since the cost of the less efficient option, i.e., not conducting the retrofit, is $0.

Table 204: Measure Life and Incremental Measure Cost

	Measure Category	Value	Source
Measure Life	All	15	DEER[59]

[59] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report

Incremental Measure Cost	Walk-In	$250	Fisher Nickel[60]
Incremental Measure Cost	Reach-In	$184.71	SCE

[60] "GE ECM Evaporator Fan Motor Energy Monitoring" Food Service Technology Center, Fisher-Nickel Inc. 2006. Prepared for PG&E.

Refrigeration Economizer

Table 205: Refrigeration Economizer	
Measure Description	Installation of an outside air refrigeration economizer
Units	Per compressor horsepower
Base Case Description	Refrigeration system without an economizer.
Measure Savings	Source: Efficiency Vermont
Measure Incremental Cost	Source: Efficiency Vermont
Effective Useful Life	Source: Efficiency Vermont 15 years

This measure is for the installation of outside air economizers for walk-in coolers. The economizers allow the use of outside airs rather than operating the compressor. Sufficient controls must be installed with the economizer.

Measure Savings
The coincident peak demand savings is 0 kW (i.e., no summer time savings). The coincident demand savings is 0 385 kW and annual energy savings is 1,135 kWh per economizer.

Measure Savings Analysis
Annual energy savings were calculated based on the methodology presented in Efficiency Vermont Technical User Reference Manual (No. 2004-29). The following are the equations used (see the reference for references of assumed values):

Demand Savings = kWh savings / Hours

$$\text{Energy Savings} = [HP \times kWh_{Cond}] + [((kW_{Evap} \times n_{fans}) - kW_{Circ}) \times Hours \times FC \times DC_{Comp} \times BF] - [kW_{Econ} \times DC_{Econ} \times Hours]$$

Where:

HP = Horsepower of compressor (assumes 5 HP)

kWh_{Cond} = Condensor unit savings, assumed on average 1,138 kWh/HP

kW_{Evap} = Evaporator fan connected load (0.123 kW)

n_{fans} = Number of evaporator fans (assume two)

kW_{Circ} = Circulating fan connected load (0.035 kW)

Hours = Number of annual hours that economizer operates, 2944 hours based on 39°F cooler set point, Chicago weather data

FC = Fan control factor, assumed to be 1 for fan controls

DC_{Comp} = Duty cycle for compressor (50%)

BF = Interactive effects for reduced cooling load from reduced hours of evaporator fan operation (1.3)

kW_{Econ} = Economizer fan connected load (0 227 kW)

DC_{Econ} = Duty cycle for economizer fan (63%)

Measure Life and Incremental Measure Cost
The following table provides the measure life and incremental measure cost (IMC) documented for this measure as well as the source of the data.

Incremental cost is cost difference between the energy efficient equipment and the less efficient option.

Table 206: Measure Life and Incremental Measure Cost

	Value	Source
Measure Life	15	Efficiency Vermont
Incremental Measure Cost	$511.60	Efficiency Vermont

Evaporator Fan Control

Table 207: Evaporator Fan Control	
Measure Description	This measure is for the installation of controls in medium-temperature walk-in coolers. The controller reduces airflow of the evaporator fans when there is no refrigerant flow. The measure must control a minimum of 1/20 HP where fans operate continuously at full speed. The measure also must reduce fan motor power by at least 75% during the off cycle. This measure is not applicable if any of the following conditions apply: 1) The compressor runs all the time with high duty cycle 2) The evaporator fan does not run at full speed all the time 3) The evaporator fan motor runs on poly-phase power 4) The evaporator fan motor is not shaded-pole or permanent split capacitor 5) Evaporator does not use off-cycle or time-off defrost.
Units	Per Motor
Base Case Description	Cooler with continuously running evaporator fan.
Measure Savings	Source: DEER
Measure Incremental Cost	Source: DEER $291
Effective Useful Life	Source: DEER 16 years

This measure is for the installation of controls in medium temperature walk-in coolers. The controller reduces airflow of the evaporator fans when there is no refrigerant flow. The measure must control a minimum of 1/20 HP where fans operate continuously at full speed. The measure also must reduce fan motor power by at least 75 percent during the off cycle.

This measure is not applicable if any of the following conditions apply:

1) The compressor runs all the time with high duty cycle
2) The evaporator fan does not run at full speed all the time
3) The evaporator fan motor runs on poly-phase power
4) The evaporator fan motor is not shaded-pole or permanent split capacitor
5) Evaporator does not use off-cycle or time-off defrost

Measure Savings [61]

[61] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report

Savings for this measure were obtained from the DEER database and are summarized in the following table. The baseline is assumed to be evaporator fans that run continuously with either a permanent split capacitor or shaded-pole motors. In the energy-efficient case the fan is still assumed to operate even with the evaporator inactive.

Table 208: Evaporative Fan Control Savings

Northern California Climate Zones	kWh Savings Per Motor	Peak kW Savings Per Motor
1	480	0.057
2	476	0.064
3	479	0.062
4	475	0.061
5	477	0.056
11	476	0.058
12	476	0.065
13	476	0.061
16	483	0.061
Average	478	0.060

DEER provides savings numbers for building vintages and grocery only. The numbers above are averages of these vintages. We are assuming that this measure will be applicable for all building types.

Measure Life and Incremental Measure Cost

The following table provides the measure life and IMC documented for this measure as well as the source of the data.

Incremental cost is cost difference between the energy efficient equipment and the less efficient option. We will consider evaporator fan controllers a new technology measure where the IMC is equal to the full measure cost since the cost of the less efficient option, i.e., not conducting the retrofit, is $0.

Table 209: Measure Life and Incremental Measure Cost

	Value	Source
Measure Life	16	DEER
Incremental Measure Cost	$291.50	DEER

Automatic Door Closer for Walk-In Coolers

Table 210: Automatic Door Closer for Walk-In Coolers	
Measure Description	This measure is for installing an auto-closer to the main insulated opaque door(s) of a walk-in cooler. The auto-closer must firmly close the door when it is within 1 inch of full closure.
Units	Per closer
Base Case Description	No auto door closer or non-operational door closer
Measure Savings	Source: PGECOREF110.1 – Auto-Closers for Main Cooler or Freezer Doors
Measure Incremental Cost	Source: DEER 2008 $156.82
Effective Useful Life	Source: DEER 2008 8 years

This measure consists of the installation of an automatic, hydraulic-type door closer on main walk-in cooler doors. These closers save energy by reducing the infiltration of warm outside air into the refrigeration itself.

Measure Savings

Savings calculations are based on values from through PG&E's Workpaper PGECOREF110.1 – Auto-Closers for Main Cooler or Freezer Doors. Savings are averaged across all California climate zones and vintages. Annual savings are 943 kWh and 0.137 kW.

Measure Life and Incremental Measure Cost

The following table provides the measure life and IMC documented for this measure as well as the source of the data. Incremental cost is cost difference between the energy-efficient equipment and the less efficient option. In this case the IMC is equal to the full measure cost since the cost of the less efficient option, i.e., not conducting the retrofit, is $0.

Table 211: Measure Life and Incremental Measure Cost

	Value	Source
Measure Life	8	DEER 2008
Incremental Measure Cost	$156.82	DEER 2008

Automatic Door Closer for Walk-in Freezers

Table 212: Automatic Door Closer for Walk-in Freezers

Measure Description	This measure is for installing an auto-closer to the main insulated opaque door(s) of a walk-in freezer. The auto-closer must firmly close the door when it is within 1 inch of full closure.
Units	Per closer
Base Case Description	No auto door closer or non-operational door closer
Measure Savings	Source: PGECOREF110.1 – Auto-Closers for Main Cooler or Freezer Doors
Measure Incremental Cost	Source: DEER 2008 $156.82
Effective Useful Life	Source: DEER 2008 8 years

This measure is for installing an auto-closer to the main insulated opaque door(s) of a walk-in freezer. The auto-closer must firmly close the door when it is within 1 inch of full closure.

Measure Savings

Savings calculations are based on values from through PG&E's Workpaper PGECOREF110.1 – Auto-Closers for Main Cooler or Freezer Doors. Savings are averaged across all California climate zones and vintages. Annual savings are 2307 kWh and 0.309 kW.

Measure Life and Incremental Measure Cost

The following table provides the measure life and IMC documented for this measure as well as the source of the data.

Incremental cost is cost difference between the energy-efficient equipment and the less efficient option. We will consider the incremental cost of door closers as full cost.

Table 213: Measure Life and Incremental Measure Cost

	Value	Source
Measure Life	8	DEER 2008
Incremental Measure Cost	$156.82	DEER 2008

Door Gaskets

Table 214: Door Gaskets	
Measure Description	This measure consists of the replacement of weak, worn out refrigeration door gaskets with new, better fitting gaskets.
Units	Per linear feet of gasket
Base Case Description	Non-sealing leaking gasket
Measure Savings	Source: NCPA 2009 – Refrigerated Door Gasket Replacement Energy Savings – Keep Your Cool Program, SCE WPSCNRRN0001.1, SCE WPSCNRRN0004.1
Measure Incremental Cost	Source: DEER 2008 $9 61
Effective Useful Life	Source: DEER 2008 4 years

This measure consists of the replacement of weak, worn out refrigeration door gaskets with new, better fitting gaskets. Tight-fitting gaskets inhibit the infiltration of warm and moist air from the surrounding environment.

These gaskets must be installed on a glass or solid walk-in or reach-in cooler or freezer door which opens to an unrefrigerated space. The replacement gaskets must meet the case/door manufacturer's installation specifications in regards to dimensions, materials, attachment method, gasket profile, compression, and magnet placement.

Measure Savings

Savings calculations are based on SCE's work papers *WPSCNRRN0001.1 – Door Gasket for Main Doors of Walk-In Coolers & Freezers* and *WPSCNRRN0004.1 – Door Gaskets for Glass Doors of Walk-In Coolers*. Adjustments were made to accommodate field observations made during NCPA's Keep Your Cool Program, which found a ratio of 2 inches of damaged gasket per foot of gasket (0.17) replaced, instead of one foot of every 45 feet of gasket replaced (0.02). every 45 feet of gasket replaced (0.02). Other assumptions include:

1. Hinge repair was provided with gasket repair but is not captured in the savings estimate calculation.
2. Of gasket replacements, 90% were found in medium temperature applications (cooler) and 10% were low temperature applications (freezer).
3. SCE work papers based results on missing gaskets only versus damaged or worn gaskets. This analysis assumes 67% heat loss for damaged or worn gaskets, compared to missing gaskets.

Savings are averaged across all CA climate zones. Annual savings are 48 kWh and 0.011 kW.

Measure Life and Incremental Measure Cost

The following table provides the measure life and IMC documented for this measure as well as the source of the data. Incremental cost is cost difference between the energy-efficient equipment and the less efficient option. In this case the IMC is equal to the full measure cost since the cost of the less efficient option, i.e., not conducting the retrofit, is $0.

Table 215: Measure Life and Incremental Measure Cost

	Value	Source
Measure Life	4	DEER 2008
Incremental Measure Cost	$9.61	DEER 2008

LED Refrigerated Case Lighting

Table 216: LED Refrigerated Case Lighting	
Measure Description	Replace fluorescent refrigerated case lighting with light emitting diode (LED) source illumination. Fluorescent lamps, ballasts, and associated hardware are typically replaced with pre-fabricated LED light bars and driver units.
Units	Per door
Base Case Description	Fluorescent refrigerated case lighting
Measure Savings	Source: PG&E LED Refrigerated Case Lighting Workpaper
Measure Incremental Cost	Source: PG&E LED Refrigerated Case Lighting Workpaper
Effective Useful Life	Source: PG&E LED Refrigerated Case Lighting Workpaper 16 years

Replace fluorescent refrigerated case lighting with light emitting diode (LED) source illumination. Fluorescent lamps, ballasts, and associated hardware are typically replaced with pre-fabricated LED light bars and LED driver units. The two LED lamp products, 5' light bars and 6' light bars are eligible.

Measure Savings Analysis
The coincident demand savings is 0.061KW per door and annual energy savings is 375 kWh per door.

Measure Savings Analysis
The energy and demand savings are derived from an Emerging Technologies (ET) study of the refrigerated case lighting done by PG&E.

The electricity use (kWh) savings and gross summer peak demand (kW) reduction comprises two factors: reduced lighting load and reduced refrigeration requirements due to reduced heat gain. Reductions in lighting load occur continuously over the expected annual operating period, which includes the summer peak period. Savings due to reduced heat gain are computed assuming those reduced effects occur during the period in which the lighting systems operate, in consideration of the refrigeration compressor COP and the reduced cooling load, under normal operation (i.e., doors closed). Baseline and retrofit equipment assumptions are presented in the next table.

Table 217: Baseline and Retrofit Wattages LED refrigeration Lighting (per door)

	Estimated Energy Savings kWh/yr/door	Estimated Demand Savings kW/door	Weight Percentages
5' LED Light Bar			
Premium Tier	341	0.055	25%
Standard Tier	292	0.047	25%
6' LED Light Bar			
Premium Tier	465	0.075	25%
Standard Tier	403	0.065	25%
Weighted Average	375	0.061	

Measure Life and Incremental Measure Cost
The table below provides the measure life and IMC documented for this measure as well as the source of the data. Incremental cost is cost difference between the energy-efficient equipment and the less efficient option. In this case the lighting measures, the IMC is equal to the full measure cost since cost of the less efficient option is $0.

The EUL for an LED exit sign or retrofit kit is estimated to be 16 years (over 140,000 hours), according to DEER. The core technology, LED sources and driver, are similar for both the established application (exit sign lighting) and the emerging technology (refrigeration case lighting). LED Power (LED equipment manufacturer) provided an expected life of 50,000 hours for the LED low-temperature case lighting, which is much less than the DEER estimate of 16 years for LED exit sign technology. It is well documented that LED life is extended in a low-temperature environment; therefore the expected useful life of 50,000 hours assumed for this application is probably conservative. Based on the fixture run-time of 6,205 hours annually for the facility in the study, the expected life calculates to 8 years.

Table 218: Measure Life and Incremental Measure Cost

	Measure Category	Value	Source
Measure Life	Fixture life	16	PG&E Work paper
Incremental Measure Cost	LED Refrigerated Case Lighting	$266	PG&E Work paper

Beverage Machine Controls

Table 219: Beverage Machine Controls	
Measure Description	The beverage machine is assumed to be a refrigerated vending machine that contains only nonperishable bottled and canned beverages The controller must include a passive infrared occupancy sensor to turn off fluorescent lights and other vending machine systems when the surrounding area is unoccupied for 15 minutes or longer. For the beverage machine, the control logic should power up the machine at 2-hour intervals to maintain product temperature and provide compressor protection.
Units	Per machine
Base Case Description	No controls
Measure Savings	Source: DEER 2005
Measure Incremental Cost	Source: DEER 2005 $180
Effective Useful Life	Source: DEER 2005 10 years

The beverage machine is assumed to be a refrigerated vending machine that contains only nonperishable bottled and canned beverages. The controller must include a passive infrared occupancy sensor to turn off fluorescent lights and other vending machine systems when the surrounding area is unoccupied for 15 minutes or longer. For the beverage machine, the control logic should power up the machine at 2-hour intervals to maintain product temperature and provide compressor protection.

Measure Savings

Beverage machine controls savings are taken from the DEER database. It is assumed that controls are only effective during off-peak hours and so have no peak-kW savings. The annual energy savings are 1,612 kWh per year.[62]

Measure Life and Incremental Measure Cost

The measure life is 10 years.[63] The IMC documented for this measure is $180 per unit.[64] For this measure, the beverage machine controls, the IMC is equal to the full measure cost since the cost of the less efficient option, i.e., not conducting the retrofit, is $0.

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[62] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

[63] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

[64] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

Snack Machine Controls

Table 220: Snack Machine Controls	
Measure Description	The controller must include a passive infrared occupancy sensor to turn off fluorescent lights and other vending machine systems when the surrounding area is unoccupied for 15 minutes or longer.
Units	Per machine
Base Case Description	No controls
Measure Savings	Source: DEER 2005
Measure Incremental Cost	Source: DEER 2005 $80
Effective Useful Life	Source: DEER 2005 10 years

The snack machine controller must include a passive infrared occupancy sensor to turn off fluorescent lights and other vending machine systems when the surrounding area is unoccupied for 15 minutes or longer.

Measure Savings
Snack machine controls savings are taken from the DEER database. It is assumed that controls are only effective during off-peak hours and so have no peak-kW savings. The annual energy savings are 387 kWh per year.[65]

A baseline is used to calculate savings and incremental cost. In this case, the baseline for this measure assumes that there are controls installed for the machine.

Measure Life and Incremental Measure Cost[66]
The measure life is 10 years. The IMC documented for this measure is $80 per unit. For this measure, the beverage machine controls, the IMC is equal to the full measure cost since the cost of the less efficient option, i.e., not conducting the retrofit, is $0.

[65] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures
[66] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

ENERGY STAR Refrigerated Beverage Vending Machine

Table 221: ENERGY STAR Refrigerated Beverage Vending Machine	
Measure Description	ENERGY STAR beverage vending machines qualify for an incentive. Qualifying machines can be found at http://www.energystar.gov/ia/products/prod_lists/vending_machines_prod_list.pdf.
Units	Per Machine
Base Case Description	Standard Unit
Measure Savings	Source: ENERGY STAR
Effective Useful Life	Source: ENERGY STAR 14 years

Qualifying beverage vending machines must be ENERGY STAR rated. Qualifying machines can be found at http://www.energystar.gov/ia/products/prod_lists/vending_machines_prod_list.pdf.

Measure Savings [67]

Beverage machine savings are taken from the ENERGY STAR savings calculator and summarized in the following table. ENERGY STAR provides savings numbers for machines with and without control software. The average savings are calculated here. It is assumed that controls are only effective during off-peak hours and so have no peak-kW savings.

Table 222: ENERGY STAR Vending Machine Savings

Vending Machine Capacity (cans)	kWh Conventional Machine	kWh ENERGY STAR Machine w/o software	kWh ENERGY STAR Machine w/ software	kWh Savings Per Machine w/o software	kWh Savings Per Machine w/ software
<500	3,113	2,014	1,454	1,099	1,659
500	3,916	2,162	1,685	1,754	2,231
699	3,551	2,309	1,800	1,242	1,751
799	4,198	2,457	1,915	1,741	2,283
800+	3,318	2,605	2,030	713	1,288
Average	3,619	2,309	1,777	1,310	1,842
Total Average			1,576		

Measure Life and Incremental Measure Cost

The measure life is 14 years according to ENERGY STAR.

[67] ENERGY STAR Savings Calculator
http://www energystar gov/index cfm?c=vending_machines pr_vending_machines

High-Efficiency Icemakers

Table 223: High-Efficiency Icemakers	
Measure Description	The rebate covers ice machines that generate 60 grams (2 oz.) or lighter ice cubes, flaked, crushed, or fragmented ice. Only air-cooled machines qualify (self contained, ice making heads, or remote condensing). The machine must have a minimum capacity of 101 lb of ice per 24-hour period (per day). The minimum efficiency required is per ENERGY STAR or CEE Tier 2.[68] A manufacturer's specification sheet must accompany the application that shows rating in accordance to ARI standard 810.
Units	Per icemaker
Base Case Description	0.10% less efficient than CEE Tier 1 qualifying icemaker
Measure Savings	Source: KEMA calculation
Measure Incremental Cost	Source: PG&E workpapers
Effective Useful Life	Source: DEER 2005 12 years

The rebate covers ice machines that generate 60 grams (2 oz.) or lighter ice cubes, flaked, crushed, or fragmented ice. Only air-cooled machines qualify (self-contained, ice-making heads, or remote condensing). The machine must have a minimum capacity of 101 lb of ice per 24-hour period (per day). The minimum efficiency required is per ENERGY STAR or CEE Tier 2[69]. A manufacturer's specification sheet must accompany the application that shows rating in accordance to ARI standard 810.

Measure Savings [70]

Savings values are obtained from the PG&E workpaper for the food service sector. Annual operating hours are assumed to be 8,760.

Table 224: Ice Maker Savings (per unit)

Size (lb / 24 hrs)	Peak kW Savings	Annual kWh Savings
101-200	0.118	1029
201-300	0.177	1551
301-400	0.210	1840
401-500	0.229	2004
501-1,000	0.363	3176
1,001-1,500	0.573	5019

[68] The websites have a list of qualifying model numbers, www.energystar.gov or www.cee1.org.
[69] The websites have a list of qualifying model numbers, www.energystar.gov or www.cee1.org
[70] "Food Service Equipment Workpapers; Ice Machine –Commercial Air Cooled," Pacific Gas and Electric. 2005.

> 1,500	0.638	5585

Measure Savings Analysis
The savings methodology for this measure is based on the method presented in PG&E's 2006-2008 Food Service Equipment workpapers. The savings are based on the difference of the ice harvest rate (IHR) which is expressed as kWh per 100 lb. Icemaker sizes are expressed by the rate of their production in lb per 24-hour period. The following are the equations used to calculate the savings.

Annual kWh Savings = (Baseline IHR – Retrofit IHR) x Size x 365 days per year/ 100 lb

The baseline IHR assumed for this workpaper are units that have an IHR 110 percent of the CEE Tier 1 qualifying equipment (also the FEMP recommended efficiency). The following table provides the Tier 1 and the program's baseline IHR.

Table 225: Baseline Ice Harvest Rate

Size (lbs / 24 hrs)	CEE Tier 1 IHR	Program Baseline IHR
101-200	9.4	10.34
201-300	8.5	9.35
301-400	7.2	7.92
401-500	6.1	6.71
501-1,000	5.8	6.38
1,001-1,500	5.5	6.05
> 1,500	5.1	5.61

The qualifying efficiencies (CEE Tier 2) are provided in the table below.

Table 226: Qualifying Icemakers

Size (lb / 24 hrs)	Qualifying kWh per 100 lb
101-200	8.5
201-300	7.7
301-400	6.5
401-500	5.5
501-1000	5.2
1001-1500	5.0
>1500	4.6

Measure Life and Incremental Measure Cost
The measure life for icemakers is 12 years based on the DEER study assumption for food service equipment.

The following table provides the IMC documented for this measure. For some measures the IMC is equal to the full measure cost. These are replace-on-burnout measures or measures that are a new technology. Retrofit measures generally dictate IMC, which is the cost difference between the retrofit and baseline technology. Installing high-efficiency icemakers is typically a retrofit that occurs as a replace on burnout; hence, the incremental measure cost is the difference between the retrofit and baseline equipment.

The PG&E workpapers have different assumptions of qualifying equipment. They qualify equipment that meets FEMP-recommended kWh per 100 lb ice-making rate (CEE Tier 1). Their baseline is based on the lower 25 percentile of available equipment as listed in the ARI directory. It is assumed the incremental cost of the icemaker that qualifies in the Smart Ideas Program as compared to the baseline calculated here is comparable to the difference in cost (IMC) to the units discussed in the PG&E workpapers.

Table 227: Ice Maker Incremental Measure Cost

Size (lbs / 24 hrs)	$ per unit
101-200	$296
201-300	$312
301-400	$559
401-500	$981
501-1,000	$1,485
1,001-1,500	$1,821
> 1,500	$2,194

Food Service

ENERGY STAR® Steam Cooker

Table 228: ENERGY STAR® Steam Cooker

Measure Description	This measure consists of the replacement of a conventional Steam Cooker unit with an ENERGY STAR rated unit.
Units	Per cooker
Base Case Description	Conventional, non ENERGY STAR unit
Measure Savings	Source: ENERGY STAR
Measure Incremental Cost	Source: 2009 PG&E Workpaper – PGECOFST104.1 – Commercial Steam Cooker – Electric and Gas $2,490
Effective Useful Life	Source: ENERGY STAR 12 years

This measure consists of the replacement of a conventional Steam Cooker unit with an ENERGY STAR rated unit. Steamer performance is determined by applying the ASTM *Standard Test Method for the Performance of Steam Cookers* (F1484),[71] considered to be the industry standard for quantifying the efficiency and performance of steamers. The following table is the ENERGY STAR standards for electric steam cookers. The standard is version 1.1, current as of August 2003.

Table 229. ENERGY STAR Steam Cooker Standards

Pan Capacity	Cooking Energy Efficiency	Idle Rate (watts)
3-pan	50%	400
4-pan	50%	530
5-pan	50%	670

[71] American Society for Testing and Materials. 2005. *Standard Test Method for the Performance of Steam Cookers.* ASTM Designation F1484-05, in *Annual Book of ASTM Standards,* West Conshohocken, PA.

6-pan and larger	50%	800

*Cooking Energy Efficiency is based on heavy load (potato) cooking capacity

Measure Savings
The savings for this measure is calculated using ENERGY STAR methodology, with updates based upon research done at the Food Service Technology Center. Measure data for savings calculations are based on average equipment characteristics. Annual energy use is calculated based on preheat, idle, and potato cooking energy efficiency and production capacity test results from applying ASTM F1484.

The following is the calculation for daily energy consumption per the PG&E workpapers.

$$EDay = LBFood * \frac{EFood}{Efficiency} + IdleRate * (OpHrs - \frac{LBFood}{PC} - \frac{TpreHT}{60}) + EpreHT$$

$$Average\ Demand = \frac{EDay}{OpHrs}$$

Table 230: Steam Cooker Variable Assumptions[72]

Variable	Variable Description (Units)	Value Assumed (Baseline)	Value Assumed (ENERGY STAR)
EDay	Daily Energy Consumption (kWh/day)	23.7	11.6
LBFood	Pounds of Food Cooked per Day (lb/day)	100	100
Efood	ASTM Energy to Food (kWh/lb) = kWh/pound of energy absorbed by food product during cooking	0.0308	0.0308
Efficiency	Heavy Load Cooking Energy Efficiency %	26%	50%
IdleRate	Idle Energy Rate (kW)	1.0	0.4
OpHrs	Operating Hours/Day (hr/day)	12	12
PC	Production Capacity (lbs/hr)	70	50

[72] ENERGY STAR Commercial Steam Cooker Calculator

TPreHt	Preheat Time (min/day)	15	15
EPreHt	Preheat Energy (kWh/day)	1.5	1.5

Savings assume a 3-pan steam cooker, operating 12 hours a day, 365 days per, with one preheat daily. The annual savings calculated for an ENERGY STAR steam cooker is 4,419 kWh. Average demand savings is 1 kW.

Measure Life and Incremental Measure Cost

The following table provides the measure life and IMC documented for this measure as well as the source of the data. Incremental cost is the cost difference between the energy-efficient equipment and the less efficient option.

Table 231: Measure Life and Incremental Measure Cost

	Value	Source
Measure Life	12	ENERGY STAR
Incremental Measure Cost	$2,490	PG&E

ENERGY STAR® Combination Oven

Table 232 ENERGY STAR® Combination Oven	
Measure Description	This measure consists of the replacement of a conventional Combination Oven unit with an ENERGY STAR rated unit.
Units	Per oven
Base Case Description	Conventional, non ENERGY STAR unit
Measure Savings	Source: ENERGY STAR
Measure Incremental Cost	Source: 2009 PG&E Workpaper – PGECOFST100.1 – Commercial Combination Oven – Electric and Gas $3,824
Effective Useful Life	Source: DEER 2008 12 years

This measure consists of the replacement of a conventional Combination Oven unit with an ENERGY STAR rated unit. Oven performance is determined by the ASTM Standard Test Method for the Performance of Combination Ovens defined in standard F1639-05,[73] considered to be the industry standard for quantifying combination oven efficiency and performance.[74] Savings calculations for combination ovens assume they meet or exceed heavy-load cooking energy efficiencies of > 60%, utilizing the ASTM standard F1639.

Measure Savings

The savings for this measure is calculated using ENERGY STAR methodology, with updates based upon research done at the Food Service Technology Center. Measure data for savings calculations are based on average equipment characteristics, as established by ENERGY STAR. Annual energy use was calculated based on preheat, idle, and cooking energy efficiency and production capacity test results from applying ASTM F1639.

[73] American Society for Testing and Materials. "Standard Test Method for the Performance of Convection Ovens." ASTM Designation F1639-05. in *Annual Book of ASTM Standards*, West Conshohocken, PA.
[74] PG&E Food Service

The following is the calculation for daily energy consumption per the PG&E workpapers.

$$EDay = LBFood * \frac{EFood}{Efficiency} + IdleRate * (OpHrs - \frac{LBFood}{PC} - \frac{TpreHT}{60}) + EpreHT$$

$$Average\ Demand = \frac{EDay}{OpHrs}$$

Table 233: Combination Oven Variable Assumptions[75]

Variable	Variable Description (Units)	Value Assumed (Baseline)	Value Assumed (Energy Efficient)
EDay	Daily Energy Consumption (kWh/day)	106	55
LBFood	Pounds of Food Cooked per Day (lb/day)	200	200
Efood	ASTM Energy to Food (kWh/lb) = kWh/pound of energy absorbed by food product during cooking	0.0732	0.0732
Efficiency	Heavy Load Cooking Energy Efficiency %	44%	60%
IdleRate	Idle Energy Rate (kW)	7.5	3.0
OpHrs	Operating Hours/Day (hr/day)	12	12
PC	Production Capacity (lbs/hr)	80	100
TPreHt	Preheat Time (min/day)	15	15
EPreHt	Preheat Energy (kWh/day)	3.0	1.5

Savings assume a 10-pan steam cooker, operating 12 hours a day, 365 days per, with one preheat daily. The annual savings calculated for an ENERGY STAR steam cooker is 4,208 kWh. Average demand savings is 0.96 kW.

Measure Life and Incremental Measure Cost

The following table provides the measure life and IMC documented for this measure as well as the source of the data. Incremental cost is cost difference between the energy-efficient equipment and the less efficient option.

Table 234: Measure Life and Incremental Measure Cost

	Value	Source
Measure Life	12	DEER2008
Incremental Measure Cost	$3,824	PG&E

[75] PG&E Food Service Equipment Workpapers (October 2005)

ENERGY STAR® Hot Food Holding Cabinet

Table 235 ENERGY STAR® Hot Food Holding Cabinet

Measure Description	This measure consists of the replacement of a conventional Hot Food Holding Cabinet unit with an ENERGY STAR rated unit.
Units	Per cabinet
Base Case Description	Conventional, non ENERGY STAR unit
Measure Savings	Source: ENERGY STAR
Measure Incremental Cost	Source: PG&E Full Size: $1,891 Three-Quarter Size: $1,497 Half Size: $707
Effective Useful Life	Source: DEER 2008 12 years

This measure consists of the replacement of a conventional Hot Food Holding Cabinet unit with an ENERGY STAR rated unit. Hot-food holding cabinets that meet current ENERGY STAR specifications are 60% more energy-efficient than standard models and must meet a maximum idle energy rate of 40 watts/ft^3. All operating energy rates' savings assumptions are used in accordance with American Society for Testing and Materials' (ASTM) Standard F2140. Energy-usage calculations are based on 15 hours-a-day, 365 days-per-year operation (5,475 hours) at a typical temperature setting of 150°F (based on ENERGY STAR assumptions).

To estimate energy savings, hot food holding cabinets are categorized into three size categories, as in the following table.

Table 236. Cabinet Size Assumptions[76]

Size	Internal volume	Average volume for calculations

[76] ENERGY STAR Commercial Hot Food Holding Cabinet Calculator based on PG&E FSTC research

Full-size	> 15 ft³	20 ft³
Three-quarter size	10 – 15 ft³	12 ft³
Half size	< 10 ft³	8 ft³

The following is the calculation for daily energy consumption per the ENERGY STAR Hot Food Holding Cabinet calculator.

$$EDay = \frac{InternalVolume * (IdleRate) * (OpHrs)}{1000}$$

$$Average\ Demand = \frac{EDay}{OpHrs}$$

Measure Savings
The savings based on ENERGY STAR savings methodology are summarized in the table below.

Table 237: Hot Holding Cabinet Savings by Size

	Full-size	Three-quarter size	Half size
Energy (kWh/year)	9,308	3,942	2,628
Demand (kW)	2.125	0.900	0.600

Measure Life and Incremental Measure Cost
The estimate useful life of this measure is 12 years (DEER 2008). The following table provides the IMC documented for this measure. Cost data is taken from PG&E workpapers. Incremental cost is cost difference between the energy-efficient equipment and the less efficient option.

Table 238: Incremental Measure Cost

	Full-size	Three-quarter size	Half size
Full Measure Cost	4160	3743	2295
Incremental Measure Cost	1891	1497	707

ENERGY STAR® Solid Door Reach-In Freezer

Table 239 ENERGY STAR® Solid Door Reach-In Freezer	
Measure Description	This measure consists of the replacement of a conventional Solid Reach-In Freezer unit with an ENERGY STAR rated unit.
Units	Per freezer
Base Case Description	Conventional, non ENERGY STAR unit
Measure Savings	Source: ENERGY STAR
Measure Incremental Cost	Source: PG&E Workpaper PGECOFST107.1 – Commercial Glass Door Refrigerators $804.75
Effective Useful Life	Source: DEER 2008 12 years

This measure consists of the replacement of a conventional Solid Reach-In Freezer unit with an ENERGY STAR rated unit. Only units with built-in refrigeration systems are qualified. Units with remote refrigeration systems or units do not qualify. Customers must provide proof that the appliance meets the CEE Tier II efficiency specifications using ASHRAE Standard 117-1992 (38°F ± 2°F).

Table 240: ENERGY STAR Qualified Commercial Solid Door Freezers (kWh per day)[77]

Product Volume, cubic feet	Freezer
$0 < V < 15$	$\le 0.250V + 1.250$
$15 \le V < 30$	$\le 0.400V - 1.000$
$30 \le V < 50$	$\le 0.163V + 6.125$
$50 \le V$	$\le 0.158V + 6.333$

77 www.energystar.gov, Note: V = Internal volume in ft^3

Measure Savings

The savings for this measure is calculated using ENERGY STAR methodology. Savings are calculated using an average volume for all qualified Solid Door Reach-In Freezer units, which is 39.61 cubic feet. The estimated annual savings is 1695 kWh and 0.193 kW. Actual savings will vary based on equipment type and volume.

Measure Life and Incremental Measure Cost

The following table provides the measure life and IMC documented for this measure as well as the source of the data. Incremental cost is cost difference between the energy-efficient equipment and the less efficient option.

Costs are averaged across unit volumes. The units modeled in PG&E's work papers have slightly different efficiency requirements, but incremental costs are assumed to be similar.

Table 241: Measure Life and Incremental Measure Cost

	Value	Source
Measure Life	12	DEER2008
Full Measure Cost	$5624.00	PG&E Workpaper PGECOFST107.1
Incremental Measure Cost	$804.75	PG&E Workpaper PGECOFST107.1

ENERGY STAR® Solid Door Reach-In Freezer

Table 242 ENERGY STAR® Solid Door Reach-In Freezer

Measure Description	This measure consists of the replacement of a conventional Glass Reach-In Freezer unit with an ENERGY STAR rated unit.
Units	Per freezer
Base Case Description	Conventional, non ENERGY STAR unit
Measure Savings	Source: ENERGY STAR
Measure Incremental Cost	Source: PG&E Workpaper PGECOFST106.1 – Commercial Glass Door Refrigerators $804.75
Effective Useful Life	Source: DEER 2008 12 years

This measure consists of the replacement of a conventional Glass Reach-In Freezer unit with an ENERGY STAR rated unit. Only units with built-in refrigeration systems are qualified. Units with remote refrigeration systems or units do not qualify. Customers must provide proof that the appliance meets the CEE Tier II efficiency specifications using ASHRAE Standard 117-1992 (38°F ± 2°F).

Table 243. Efficiency Standards for ENERGY STAR Qualified Commercial Glass Door Freezers (kWh per day)[78]

Product Volume, cubic feet	Freezer
$0 < V < 15$	$\leq 0.607V + 0.893$
$15 \leq V < 30$	$\leq 0.733V - 1.000$
$30 \leq V < 50$	$\leq 0.250V + 13.500$

[78] www.energystar.gov, Note: V = Internal volume in ft^3

$50 \leq V$	$\leq 0.450V + 3.500$

Measure Savings

The savings for this measure is calculated using ENERGY STAR methodology. Savings are calculated using an average volume for all qualified Glass Door Reach-In Freezer units, which is 52.09 cubic feet. The estimated annual savings is 5923 kWh and 0.676 kW. Actual savings will vary based on equipment type and volume.

Measure Life and Incremental Measure Cost

The following table provides the measure life and IMC documented for this measure as well as the source of the data. Incremental cost is cost difference between the energy-efficient equipment and the less efficient option.

Costs are averaged across unit volumes. Costs are assumed to be comparable to Glass Door Reach-In Refrigerators.

Table 244: Measure Life and Incremental Measure Cost

	Value	Source
Measure Life	12	DEER2008
Full Measure Cost	$4241.00	PG&E Workpaper PGECOFST106.1
Incremental Measure Cost	$163.25	PG&E Workpaper PGECOFST106.1

Miscellaneous

Engineered Nozzle

Table 245 Engineered Nozzle

Measure Description	This measure consists of the installation of engineered nozzles onto a standard efficiency compressed air system.
Units	Per nozzle
Base Case Description	Standard efficiency compressed air system
Measure Savings	Source: Michigan CI Technologies Workpaper FES-I1
Measure Incremental Cost	Source: Michigan CI Technologies Workpaper FES-I1 $99
Effective Useful Life	Source: Michigan CI Technologies Workpaper FES-I1 15 years

Engineered nozzles reduce the amount of air required to blow off parts or for drying. These nozzles utilize the coanda effect to pull in free air to accomplish tasks for up to 70% less compressed air. Engineered nozzles often replace simple copper tubes. Engineered nozzles have the added benefits of noise reduction and improved safety in systems with greater than 30 psig.

Measure Savings

The baseline for these savings estimates is a standard efficiency compressed air system operating at an efficiency of 0.16 kW/scfm for a minimum of 2,000 hours per year. Nozzle flow rates are averages based on existing nozzle models. The estimated annual savings is 7343 kWh with demand savings of 3.68 kW.

Measure Life and Incremental Measure Cost

The following table provides the measure life and IMC documented for this measure as well as the source of the data. Incremental cost is cost difference between the energy efficient equipment and the less efficient option. In this case the IMC is equal to the full measure cost since the cost of the less efficient option, i.e., not conducting the retrofit, is $0.

Table 246: Measure Life and Incremental Measure Cost

	Value	Source
Measure Life	15	Michigan CI Technologies Workpaper FES-I1

Incremental Measure Cost	$99	Michigan CI Technologies Workpaper FES-I1

Variable-Speed Drives for Compressed Air

Table 247 Variable-Speed Drives for Compressed Air

Measure Description	Only new oil-flooded rotary screw and rotary vane compressors are eligible. Only single compressor systems are eligible. Only compressors operating at 145 psi or below are eligible. Primary storage required on all system projects. Compressors must operate a minimum of 1,500 hours annually to be eligible for an incentive.
Units	Per HP
Base Case Description	No VSD installed.
Measure Savings	Source: KEMA
Measure Incremental Cost	Source: DEER and KEMA
Effective Useful Life	Source: DEER 15 years

Only new oil-flooded rotary screw and rotary vane compressors are eligible. Only single compressor systems are eligible. Only compressors operating at 145 psi or below are eligible. Primary storage required on all system projects. Compressors must operate a minimum of 1,500 hours annually to be eligible for an incentive.

Measure Savings

Provided below are the coincident kW savings and the annual kWh savings per hp of installed motor. The coincident kW savings are the same across all compressed air application types.

Table 248: VSD for Air Compressor Motor Savings (per HP)

kW	kWh per year
0.129	393

=0.746/.92* hp * 2000 hours * 0.3 (30% savings and 0.92 is motor eff)

Measure Savings Analysis

Savings values are calculated with an estimate of a 17.3 percent savings (savings fraction)[79]. The motors are assumed to have a load factor of 80 percent and an efficiency of 92 percent for calculating the equipment kW. Run hours are assumed to be 3,500 hours.

$$\text{Peak kW reduction} = 0.129 \times \text{HP}$$

Where kW of equipment is calculated using:

$$\frac{(\text{Motor HP}) \times (0.746\ \text{kW/HP}) \times (\text{Load Factor})}{\text{Motor Efficiency}} \times \text{Savings Fraction}$$

$$\text{Annual kWh Savings} = \text{kW Savings} \times \text{Run Hours}$$

Measure Life and Incremental Measure Cost
The measure life for packaged units is 15 years according to DEER[80].

The IMC documented for this measure is $150 per horsepower for pump/fan applications (assumed to be the same as installing a drive on a HVAC motor)[81].

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[79] Savings percentage is from Pennsylvania Technical Reference Manual, May 2009.
[80] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report
[81] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report from assessment of several measures that include a VSD retrofit.

Network PC Management Software

Table 249 Network PC Management Software

Measure Description	Network PC management software allows network administrators to control the power settings on all network computers. Power settings include "on", "standby", "sleep" and "off" modes. Energy savings can be achieved, as network administrators can put computers on low power settings during off hours.
Units	Per Workstation
Base Case Description	Computers without network power management software.
Measure Savings	200 kWh per year
Measure Incremental Cost	$23/workstation
Effective Useful Life	10 years

Network PC management software allows network administrators to control the power settings on all network computers. Most computers come with power settings that include "on", "standby", "sleep" and "off" modes, each of which can be set to activate during periods of inactivity. These modes however may not be set properly. This measure can achieve savings by allowing network administrators to put all network computers on low power settings during appropriate hours.

Measure Savings

Table 250: Network PC Management Savings

Peak kW Savings	Annual kWh Savings
0	200

Measure Savings Analysis

Various studies have been conducted on the savings achieved by central computer power management systems. Savings depend on both the baseline conditions as well as the usage type of the computers. The analysis in this paper is based on papers done by Beacon Consultants Network Inc[82] and Northwest Energy Efficiency Alliance prepared by Quantec[83].

The Quantec paper summarizes a number of verification studies at various sites, including both schools and office building, using the following table of demand assumptions.

Table 251: Assumed Power Demand (Watts) [84]

Mode	Flat Panel Monitors	CRT Monitors	Desktop Computers	Laptop Computers
On	31.7	65	50.8	12.0
Suspend/Sleep	0.6	5	1.8	1.9
Off	0.6	1	1.2	1.2

The paper concludes that average annual savings are 129 kWh/workstation for office computers and 317 kWh/workstation for those in computer labs. The higher savings in the latter case result from higher idle times.

On a per site basis, the annual savings vary from 350 kWh/workstation to as low as 34 kWh/workstation. The large range reflects both the differences in baseline behavioral conditions and differences in the demands of laptops and desktops, as well as CRT monitors and flat panel monitors (as shown in the above table). The phase out of CRT monitors should also be noted. For the reasons of uncertainty stated above, there is good reason to be conservative with our savings figure. The stated conservative case is an annual savings of 200 kWh/workstation.[85]

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[82] J. Michael Walker, Beacon Consultants Network Inc. "Power Management for Network Computers: A Review of Utility Incentive Programs." Updated July 14, 2009

[83] "Surveyor Network Energy Manager, Market Progress Evaluation Report, No 2," Prepared by Quantec for Northwest Energy Efficiency Alliance. January 19, 2005.

[84] "Surveyor Network Energy Manager, Market Progress Evaluation Report, No 2," Prepared by Quantec for Northwest Energy Efficiency Alliance. Section V. Verification of Surveyor Functionality and Energy Savings. January 19, 2005.

[85] J. Michael Walker, Beacon Consultants Network Inc. "Power Management for Network Computers: A Review of Utility Incentive Programs." Updated July 14, 2009

There is no peak demand saving for this measure, since at peak times it is assumed that the computers are on.

Measure Life and Incremental Measure Cost

Measure life indicates the license life and so goes beyond the useful life of the computer itself (usually 3-5 years).

Table 252: Measure Life and Incremental Measure Cost

	Value	Source
Measure Life	10	Northwest Energy Efficiency Alliance
Incremental Measure Cost	$23	Northwest Energy Efficiency Alliance

Addendum: Savings Multipliers for Business Types

Savings claimed in the 2010 AEP GridSMART Program varies by business type. Savings presented in this document are averages across different business types. To calculate savings for a particular building type the appropriate multiplier need to be applied to the average savings value. The following table presents these KEMA calculated multipliers. The multipliers can vary across business and measure types. They also can differ for kW and kWh savings given a single measure type and business type.

For Light Industrial, Heavy Industrial and Warehouse business types, further breakdowns are used. Since these sectors present a wide range of operating hours, multipliers have been determined for 24/7, 16/5 and 8/5 facility schedules.

Table 253: Measure and Building Type Multipliers

BusinessTypeID	Shift	Data	Exterior Lighting	Food Service	Garage Lighting	Interior CFL Lighting	Interior Non CFL Lighting	Miscellaneous	Motors	None	VFD for HVAC Chillers	VFD for HVAC Fans	VFD for HVAC Pumps
College/University		kW Savings Multiplier	1.00	1.00	1.00	0.92	0.83	1.00	1.00	1.00	1.00	1.00	1.00
		kWh Savings Multiplier	1.00	1.00	1.00	0.82	0.80	1.00	1.00	1.00	1.02	1.03	1.03
Grocery		kW Savings Multiplier	1.00	1.00	1.00	1.12	1.08	1.00	1.00	1.00	1.00	1.00	1.00
		kWh Savings Multiplier	1.00	1.00	1.00	1.36	1.34	1.00	1.00	1.00	1.70	1.42	1.42
Heavy Industry		kW Savings Multiplier	1.00	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00
		kWh Savings Multiplier	1.00	1.00	1.00			1.00	1.00	1.00	1.28	0.87	0.87
	16/5	kW Savings Multiplier				1.17	1.17						
		kWh Savings Multiplier				1.06	1.06						
	24/7	kW Savings Multiplier				1.17	1.17						
		kWh Savings Multiplier				1.85	1.85						
	8/5	kW Savings Multiplier				1.17	1.17						

		kWh Savings Multiplier				0.44	0.44						
Hotel/Motel		kW Savings Multiplier	1.00	1.00	1.00	0.84	0.83	1.00	1.00	1.00	1.00	1.00	1.00
		kWh Savings Multiplier	1.00	1.00	1.00	1.16	1.15	1.00	1.00	1.00	0.98	1.67	1.67
Light Industry		kW Savings Multiplier	1.00	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00
		kWh Savings Multiplier	1.00	1.00	1.00			1.00	1.00	1.00	0.88	0.60	0.60
	16/5	kW Savings Multiplier				1.17	1.17						
		kWh Savings Multiplier				1.06	1.06						
	24/7	kW Savings Multiplier				1.17	1.17						
		kWh Savings Multiplier				1.85	1.85						
	8/5	kW Savings Multiplier				1.17	1.17						
		kWh Savings Multiplier				0.44	0.44						
Medical		kW Savings Multiplier	1.00	1.00	1.00	1.02	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		kWh Savings Multiplier	1.00	1.00	1.00	1.58	1.55	1.00	1.00	1.00	0.77	1.67	1.67
Miscellaneous		kW Savings Multiplier	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		kWh Savings Multiplier	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Office		kW Savings Multiplier	1.00	1.00	1.00	1.12	1.08	1.00	1.00	1.00	1.00	1.00	1.00
		kWh Savings Multiplier	1.00	1.00	1.00	0.63	0.67	1.00	1.00	1.00	0.36	0.43	0.43
Restaurant		kW Savings Multiplier	1.00	1.00	1.00	0.94	0.92	1.00	1.00	1.00	1.00	1.00	1.00
		kWh Savings Multiplier	1.00	1.00	1.00	1.14	1.23	1.00	1.00	1.00	1.54	1.14	1.14
Retail/Service		kW Savings Multiplier	1.00	1.00	1.00	1.14	1.08	1.00	1.00	1.00	1.00	1.00	1.00
		kWh Savings Multiplier	1.00	1.00	1.00	0.94	0.95	1.00	1.00	1.00	0.98	0.84	0.84
School		kW Savings Multiplier	1.00	1.00	1.00	0.56	0.58	1.00	1.00	1.00	1.00	1.00	1.00
		kWh Savings Multiplier	1.00	1.00	1.00	0.44	0.44	1.00	1.00	1.00	0.55	0.54	0.54

Warehouse		kW Savings Multiplier	1.00	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00
		kWh Savings Multiplier	1.00	1.00	1.00			1.00	1.00	1.00	0.94	0.79	0.79
	16/5	kW Savings Multiplier				1.00	1.00						
		kWh Savings Multiplier				1.08	1.08						
	24/7	kW Savings Multiplier				1.00	1.00						
		kWh Savings Multiplier				1.89	1.89						
	8/5	kW Savings Multiplier				1.00	1.00						
		kWh Savings Multiplier				0.45	0.45						
Other		kW Savings Multiplier								1.00			
		kWh Savings Multiplier								1.00			