**Work Paper PGE3PREF124**

**Display Case ECM Motor Retrofit Revision #2**

**PECI**

**EnergySmart Grocer**

**Display Case ECM Motor Retrofit**

**Measure Codes: R76**

**PECI EnergySmart Grocer**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Applicable Measure Codes:** | **R76** |
| **Measure Description:** | Shaded Pole to ECM in Refrigerated Display Cases |
| **Energy Impact Common Units:** | Per motor |
| **Base Case Description:** | The existing base case is shaded-pole evaporator fan motor in fan coil systems in display cases. |
| **Base Case Energy Consumption:** | Varies across climates and vintage  Source: eQUEST-R calculations |
| **Measure Energy Consumption:** | Varies across climates and vintage  Source: eQUEST-R calculations |
| **Energy Savings (Base Case – Measure)** | Varies across climates and Source: eQUEST-R calculations |
| **Costs Common Units:** | Per motor |
| **Base Case Equipment Cost ($/unit):** | $0  Retrofit, no cost for base case |
| **Measure Equipment Cost ($/unit):** | $95.10  Source: DEER |
| **Full Measure Cost ($/unit):** | $168.75  Source: DEER |
| **Measure Incremental Cost ($/unit):** | $168.75  Source: DEER |
| **Effective Useful Life (years):** | 15 years  Source: DEER |
| **Measure Application Type:** | Early Retirement (ER) |
| **Net-to-Gross Ratios:** | 0.60  Source: DEER2011 NTRG Update |
| **Important Comments:** |  |

# Work Paper Approvals

The following Manager(s) approved this workpaper through the PG&E Electronic Data Routing System under Routing Requisition # \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| --- |
|  |
| **Grant Brohard**  Manager, Technical Product Support |
| **Carolyn Weiner**  Principal, CES Products and Programs |

# Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| Revision # | Revision Date | Section by Section Description of Revisions | Author (Company) |
| **Revision 0** | 10/01/2009 | Original work paper | PECI |
| **Revision 1** | 6/14/2012 | Updated to 2013-2014 PG&E work paper format | Dustin Bailey, PECI |
| **Revision 2** | 4/28/2014 | Updated to 2014 weather files. Formatting updated per PG&E guidelines | Ky Gruenfeldt-Roy, PECI  Ben Wright, PE, PECI |

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# Section 1. General Measure & Baseline Data

## 1.1 Product Measure Description & Background

***Catalog Description***

This measure is the replacement of an existing standard efficiency shaded-pole evaporator fan motor with an Electronically Commutated Motor (ECM) of equivalent size in fan coil systems in refrigerated display cases.

***Program Restrictions and Guidelines***

***Terms and Conditions***

**Requirements**

* The existing motor must be a shaded-pole motor in fan coil systems in refrigerated display cases.
* Shaded-pole motors must be replaced by Electronically Commutated Motors (ECM).
* This measure only applies to motors under 1 horsepower.
* Only shaded pole motors manufactured before March 9, 2015 are eligible.
* The motor must be in working order with no signs of imminent failure

***Market Applicability***

This measure is applicable to retail grocery stores, of all sizes, in a downstream rebate program.

## 1.2 Product Technical Description

This measure is the replacement of an existing standard efficiency shaded-pole evaporator fan motor with an Electronically Commutated Motor (ECM) of equivalent size in fan coil systems in refrigerated display cases. ECM evaporator fan motors are found within the display case itself and because they are more efficient than shaded pole motors, they reduce equipment operating load as well as producing lower waste heat, which reduces the internal load generated within the case.

Savings vary by climate zone and vintage. Savings for case temperature and motor size were weighted and combined in order to produce one kWh savings number per climate zone and vintage for efficient program implementation.

## 1.3 Measure Application Type

The program type for the measure is Early Retirement (ER) since this measure provides incentive to replace a working technology prior to failure. The DEER Measure Cost Data Users Guide, found on www.deeresources.com under DEER2011 Database Format hyperlink, DEER2011 for 13-14, spreadsheet SPTdata\_format-V0.97.xls, defines the terms as follows:

Table  Measure Application Type[[1]](#endnote-1)

*Identifies the measure application type in the Measure Implementation table in DEER2011.*

|  |  |  |
| --- | --- | --- |
| **Code** | **Description** | **Comment** |
| ER | Early retirement | *measure applied while existing equipment still viable, or retrofit of existing equipment* |

## 1.4 Product Base Case and Measure Case Data

### 1.4.1 DEER Base Case and Measure Case Information

This measure is not in DEER 2014. This version of the measure has been updated with more relevant motor size and power data base on invoice and audit data from the Energy Smart Grocer program. This real market data provides a more accurate assessment of ECM savings in display case applications. Savings in this work paper resemble real market conditions regarding installed motor horsepower ratios and the frequency that these motors are installed in both low and medium temperature display cases. In section 2 this updated data is presented.

The cost information is downloaded from DEER 2005 2.01 directly and matches the measure D03-203

Net-to-Gross Assumption: 2011 DEER Update Report – Section 15 Table 15-3

Table 1 below summarizes all applicable DEER based Net-to-Gross ratios for programs that may be used by this measure.

Table DEER Net-to-Gross Ratios

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **DEER Spreadsheet** | |
| Program Approach | NTG | File name | Cell Number |
| EnergySmart Grocer | 0.6 | DEER2011\_NTGR\_2012-05-16 | T66 |

### 1.4.2 Codes & Standards Requirements Base Case and Measure Information

The measure in this work paper is not governed by either state or federal codes and standards.

***Title 20:*** This measure does not fall under Title 20 of the California Energy Regulations.

***Title 24:*** This measure does not fall under Title 24 of the California Energy Regulations.

***Federal Standards:*** This measure does not fall under Federal DOE or EPA Energy Regulations. There are currently no Federal codes that mandate minimum efficiency of fractional appliance motors. Section 431.445 of the Code of Federal indicates effectively that no shaded pole motors will be manufactured for general use after March 9, 2015. However, at the current time there are no codes that apply for this early retirement measure.

### 1.4.3 EM&V, Market Potential, and Other Studies

Application of a similar measure was evaluated by a third party for the Bonneville Power Administration as part of a program evaluation[[2]](#footnote-1). The motor savings data, of several different case motors sizes, was collected at five sites in the Pacific Northwest and estimated to be 469kWh/motor. The average savings is very dependent on the mix of these motors. For this work paper, we relied on data from actual motor replacements to indicate the mix of motor sizes. Invoices from hundreds of installations were used to define the motor size mix.

### 1.4.4 Assumptions and Calculations from other sources—Base and Measure Cases

There are no assumptions and calculations from other sources used in support of this measure in the work paper. Full details of the calculation procedure can be found in Section 2.

### 1.4.5 Time-of-Use Adjustment Factor

We are required by CPUC decision 06-06-063 dated June 29, 2006 to apply time-of-use (TOU) adjustment factors on residential A/C and commercial A/C (packaged and split-system direct-expansion cooling) measures only. Since this is not an A/C measure, the TOU adjustment factor is 0.

## 1.5 Summary of Inputs for Savings Calculations

The following table provides references to sections that document the inputs for calculation:

Table -Summary of Inputs for Savings Calculations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Input Variable** | **Variations** | **Base Case 1 Average Value** | **Base Case 2 Average Value** | **Measure Case Average Value** | **Reference Section** |
| **Electric Savings** | CZ, BV | 708 kWh | N/A | 708 kWh |  |
| **Gas Savings** | N/A | N/A | N/A | N/A |  |
| **Hours of operation** | N/A | N/A | N/A | N/A |  |
| **Full Cost** | ER | $168.75 | $100.81 | N/A | Section 4.2 |
| **Incremental Cost** | ER | $168.75 | $67.94 | N/A | Section 4.2 |
| **EUL /RUL** | ER | 15 | 15 | 15 | Section 1.4.4 |
| **NTG** | One | 0.7 | N/A | 0.7 | Section 1.4.1 |
| **ISR** | Applies -- Yes | 1 | N/A | 1 |  |
| **TOU Factor** | *A/C projects only* | N/A | N/A | N/A | Section 1.4.5 |

# Section 2. Calculation Methods

Table Baseline by Measure Application Type

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Measure Life Basis** | **First Baseline Period: Energy Savings Baseline** | **Second Baseline Period: Energy Savings Baseline** |
| ***ER* (early retirement)** | **EUL** | Customer Average Baseline | Code Baseline |

## 2.1 Energy Savings Estimation Methodologies

The following outlines the approach used to estimate demand and energy savings for ECMs in display cases. Exact calculations can be found in the attachment “Display Case ECM Motor Retrofit Calculations.”

1. Direct/auxiliary energy savings:

Determine the direct energy savings of replacing a shaded pole motor with an ECM of equivalent size in a display case.

* 1. Take rated output power of <12 Watt, 16-23 Watt, 1/20 HP (37 Watt) and determine the input power for each aforementioned size based on 66% efficiency and 26% efficiency for ECM and shaded pole motor types respectively.
  2. Based on these input powers, direct energy savings were calculated for each motor size for both low temp and medium temp display case applications.

1. Total system energy savings:

Determine the savings that the refrigeration system will see due to the reduction on internal heat load from the more efficient ECM motors and add that to the direct/auxiliary savings for total system savings.

* 1. Determine specific system Full Load Hours and EER for each California climate zone and vintage.
  2. Determine the condenser degradation factor that considers age and condenser condition based on a 5 year old condenser.

1. Motor size weighting:

Determine the frequency in which various motor sizes are installed in evaporator fans in display cases.

* 1. Review program invoices to determine motor sizes.
  2. Weight energy savings based on the frequency each motor size is installed.

1. Display Case temperature weighting:

Determine the frequency that ECMs are installed in low temperature and medium temperature applications.

* 1. Review data from California store audits where shaded pole motors were replaced with ECMs to determine temperature mix in display cases.

5. Calculate one kWh savings number for each California climate zone and vintage.

### 2.1.1 Direct Energy Savings

Energy savings were calculated by taking output power of <12 Watt, 16-23 Watt, 1/20 HP (37 Watt) motors and using the following efficiencies to get input power for both baseline (shaded pole) and efficient (ECM) motors. An average of 9 Watts was used for the <12 Watt motor size because contractor invoice data only indicated a range of powers (between 7 W and 12 W) for specific motors. An average of 19.5 Watts was used for the 16-23 Watt motor size because contractor invoice data only indicated a range of powers (between 16 W and 23 W) for specific motors.

Table -Motor Input and Output Efficiencies

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Motor Output for Display Case** | **Data Source** | **SP Input W** | **ECM Input W** | **ECM Efficiency[[3]](#footnote-2)** | **SP Efficiency[[4]](#footnote-3)** |
| <12 W (9.0 W average) | ESG Invoice Data | 35 W | 14 W | 66% | 26% |
| 16-23 W (19.5 W average) | ESG Invoice Data | 75 W | 30 W | 66% | 26% |
| 1/20HP (37 W) | ESG Invoice Data | 142 W | 56 W | 66% | 26% |

Input Watts were then used to calculate direct energy savings (direct fan savings between baseline and efficient motors: Equation 1 - Direct Fan Energy Savings) and refrigeration system savings (the effects of these savings on the refrigeration system: Equation 2 - Total System Savings). See Table 3 - Fan (direct) kWh Savings per Motor HP and Case Temp for sample calculations.

Equation - Direct Fan Energy Savings



**“Wattsbaseline”** is the input watts of shaded pole motor

**“Wattsefficient”** is the input watts of ECM motor

**“1000”** is the conversion from watts to kilowatts (kW)

**“hrs”** is the number of hours per year. It is assumed that evaporator fan motors operate continuously throughout the year (approximately 8750 hours) in medium temp applications. For low temp applications, 8395 hours per year was used to reflect the 1 hour a day that the motors were off during defrost[[5]](#footnote-4).

Table - Fan (direct) kWh Savings per Motor HP and Case Temp

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case Temp and Motor Output** | **Baseline Input Fan Power (Shaded Pole)** | **Efficient Input Fan Power** | **Hours** | **Direct Demand kW Savings** | **Fan (direct) kWh Savings** |
| Med Temp Shaded Pole to ECM in Display Case - <12 Watt Output | 35 W | 14 W | 8750 | 0.021 | 183.6 |
| Med Temp Shaded Pole to ECM in Display Case - 16-23 (19.5 Avg.) Output | 75 W | 30 W | 8750 | 0.045 | 397.7 |
| Med Temp Shaded Pole to ECM in Display Case - 37 Watt Output | 142 W | 56 W | 8750 | 0.086 | 754.7 |
| Low Temp Shaded Pole to ECM in Display Case - <12 Watt Output | 35 W | 14 W | 8395 | 0.021 | 176.1 |
| Low Temp Shaded Pole to ECM in Display Case - 16-23 (19.5 Avg.) Output | 75 W | 30 W | 8395 | 0.045 | 381.6 |
| Low Temp Shaded Pole to ECM in Display Case - 37 Watt Output | 142 W | 56 W | 8395 | 0.086 | 724.0 |

Direct “” savings were then added to the refrigeration system savings calculation to calculate total kWh savings.

### 2.1.2 Total System Savings

Equation - Total System Savings



“**3.413**” is the conversion of Watts to Btu per hour

**“FLH”** are annual equivalent refrigeration system Full Load Hours. FLH values were derived by PECI and are based on a custom analysis of thousands of parametric DOE-2.2R runs. See Derivation of FLH and EER values section for specific details on how FLH were used for this measure’s savings.

**“EER”** is the annual average refrigeration system equivalent Energy Efficiency Ratio, (W-hr/Btu). EER values were derived by PECI and are based on custom analysis of thousands of parametric DOE2.2R runs. See Derivation of FLH and EER values section for specific details on how EER was used for this measure’s savings.

### 2.1.3 Derivation of FLH and EER Values

A matrix of values was generated from DOE-2.2R simulations of prototypical grocery stores. Refrigeration full-load hours (FLH) and annual average compressor efficiency (EER) were derived from the results of parametric runs (parameters below in Table 5 - Parametric Variations) in the DOE-2.2R models. This table shows the DOE-2.2R values, as well as the specific values used to drive FLH and EER values for this measure’s savings.

Table -Parametric Variations

|  |  |  |
| --- | --- | --- |
| Parameter | DOE-2.2R Values | Values Used for Savings |
| Climate zones | 24 unique zones | CZ 1-16 |
| Case temperature | low, medium | low, medium |
| Compressor system type | self-contained, single, multiplex | multiplex |
| Compressor efficiency | standard (reed valve), high (discus) | standard (reed valve) |
| Condenser type | air, evaporative | air |
| Condenser efficiency | standard, high efficiency | standard |
| Head pressure control | fixed, floating | fixed |
| Condenser fan control | cycle fan (1-speed), 2-speed fan, variable-speed | cycle fan (1-speed) |
| Suction pressure control | fixed, ambient (floating), dry bulb staged | fixed |
| Fixed condensing temperature set point | 70, 80, 90, 100 | 85 (average of 80 and 90), 90 |

Each combination of refrigeration system parameters was simulated in the 16 different California climate zones. Design temperatures, for each climate zone, were used to calculate the condenser capacity based on the selected approach temperature difference between the saturated condensing temperature and design dry-bulb outside air temperature. The 16 California thermal zones (CTZ) were used within California. The following table lists the design temperatures used for each of the California climate zones:

Table - California Climate Zones



A specific FLH and EER value was calculated from these parametric variations to generate savings for each California climate zone and vintage. These specific FLH and EER values were used in the refrigeration system savings equation (Equation 2 - Total System Savings). Furthermore, savings per vintage were driven by the Fixed Condensing Temperature Setpoints as follows (based on air-cooled condenser only)[[6]](#footnote-5):

* Built before 1978: Fixed set point at 90°F SCT
* 1978-1991: Fixed set point at 90°F SCT
* 1992-2000: Fixed set point at 90°F SCT
* Built after 2000: Fixed set point at 85°F SCT

Table -Example Total kWh Savings for 1/20 HP in Medium Temp Display Case

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Case Temp and Motor Output** | **FLH** | **EER (BTU/watt)** | **Fan (direct) kWh Savings** | **Total System kWh Energy Savings** |
| Med Temp Shaded Pole to ECM in display case 37 Watt Output (1/20 HP) | 5688 | 9.36 | 754.7 | 933 |

In this example, FLH and EER resemble the outputs calculated by using the Parametric Variations Values Used for Savings (Table 4 - Parametric Variations) for Climate Zone 1 and Built Before 1978 vintage.

Each Case Temp (low and medium) and Motor Output (<12 W, 16-23 W, and 1/20 HP) was run for each California Climate Zone and Vintage. These savings per Climate Zone and Vintage were then weighted to resemble real market conditions regarding install motor horsepower ratios and the frequency that these motors are installed in both low and medium temperature display cases.

### 2.1.4 Motor Size Weighting

Motor horsepower ratios were derived from analyzing submitted invoices to the Energy Smart Grocer program to determine the motor horsepower sizes that were going into each display case. It is assumed that for each motor replaced, the same size motor is installed. From these invoices we determined the following motor size ratios:

Table -Motor Size Weighting for <12 W, 16-23 W, 1/20 HP

|  |  |
| --- | --- |
| **Motor Output (Watts)** | **% Installed** |
| < 12 W (9 W average) | 9% |
| 16-23 W (19.5 W average) | 49% |
| 37 W (1/20 HP) | 42% |

### 2.1.5 Display Case Temperature Weighting

Savings were then calculated using these weights for low temp and medium temp display cases using the ratio of 25% low temp and 75% medium temp frequencies. The display case temperature mix frequencies were the result of analyzing Energy Smart Grocer store audit data.

This results in one kWh savings number for all cases and all motor sizes, weighted by frequency of install.

The following example shows the weighting for motor HP and case temp frequency for Climate Zone 1 and Built Before 1978 Vintage.

Table -Weighting for <12 W, 16-23 W, and 1/20 HP

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Weighting – 9 W, 19.5 W, and 37 W Low Temp and Med. Temp - 90 SCT** | | | | | | | | |
| Frequency of motor size occurrence: < 12 W (9 W average) 9%, 16-23 W (19.5 W average) 49%, 1/20 HP (37 W) 42% | | | | | | | | |
| Frequency of case temp mix: 25% low temp and 75% medium temp | | | | | | | | |
| **Low Temp HP** | **Weighting Number**  **(Population)** | **kWh Base** | **Weighted kWh** | **kW Base** | **Weighted kW** | **Avg Low Temp**  **Case Weight 25%** | **Total Weighted**  **Low Temp**  **kWh Savings** | **Total Weighted**  **Low Temp**  **kW Savings** |
| 9 W | 0.09 | 290 | 26 | 0.0373 | 0.0034 |
| 19.5 W | 0.49 | 628 | 308 | 0.0809 | 0.0396 |
| 37 W | 0.42 | 1192 | 501 | 0.1535 | 0.0645 |
|  |  |  | 835 |  | 0.1075 | 0.25 | 209 | 0.0269 |
| **Med Temp HP** | **Weighting Number**  **(Population)** | **kWh Base** | **Weighted kWh** | **kW Base** | **Weighted kW** | **Avg Med Temp**  **Case Weight 75%** | **Total Weighted**  **Med Temp**  **kWh Savings** | **Total Weighted**  **Med Temp**  **kW Savings** |
| 9 watt | 0.09 | 227 | 20 | 0.0286 | 0.0026 |
| 19.5 watt | 0.49 | 492 | 241 | 0.0620 | 0.0304 |
| 37 watt | 0.42 | 933 | 392 | 0.1177 | 0.0494 |
|  |  |  | 653 |  | 0.0824 | 0.75 | 490 | 0.0618 |
| **Average of all cases kWh (9 W, 19.5 W, 37 W)** | | | | | 699 |
| **Average of all cases kW (9 W, 19.5 W, 37 W)** | | | | | 0.0887 |

These aforementioned calculations and weightings were done for each California Climate Zone and each Vintage to come up with the 64 different runs presented in attached measure table. A coincident diversity factor (see Table 10 – Demand Reduction) of 0.81 was applied to the kW to come up with Coincident Demand Reduction (Customer Peak Electric Demand Reduction as cited in the At a Glance Summary.)

### 2.1.6 Linear Feet Calculation for Per-Motor Unit Conversion

DEER savings for ECMs in display cases are reported in a per fixture linear foot unit. For easier program implementation, many utilities convert this per fixture linear foot savings to a per-motor savings. This workpaper calculates savings on a per motor basis, but it is understood that a per fixture linear foot unit is sometimes needed. To align with the DEER per fixture linear foot unit conversion, one can assume 3 feet/fan based on an average of fan-to-fan distances as shown in the following table.

Table -Number of Fans in Display Cases

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of Case** | **Display Length (ft)** | **Number of Fans** | **Feet/Fan** |
| Coffin | 4 | 1 | 4 |
| Coffin | 6 | 2 | 3 |
| Coffin | 8 | 2 | 4 |
| Coffin | 12 | 3 | 4 |
| Multi-deck | 8 | 4 | 2 |
| Multi-deck | 12 | 6 | 2 |

## 2.2 Demand Reduction Estimation Methodologies

The replacement of shaded pole motors with ECMs contributes to peak demand reduction as they save demand and are in operation during the peak demand period (summer weekdays, 2:00 PM to 5:00 PM as set forth in CPUC Decision D06-06-063). The demand calculation methodology is similar to the energy savings methodology but only accounts for changes in the wattage during the peak periods mentioned above.

The Demand reduction is the result of the total kW savings multiplied by a diversity factor of 0.81 to get the coincident demand reduction. The table below shows the coincident demand reduction for Climate Zone 1 and Built Before 1978 Vintage for Work Paper Run ID 1.

Table -Demand Reduction

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Work Paper RunID** | **Building Type** | **Building Vintage** | **Climate Zone** | **Total kW Savings** | **Coincident Diversity Factor** | **Coincident Demand Reduction** |
| 1 | Grocery | Built before 1978 | 1 | 0.0892 | 0.81 | 0.0723 |

# Section 3. Load Shapes

## 3.1 Base Case Load Shapes

The base case load shape, characterized by the PG&E E3 Calculator, is “Commercial Refrigeration.”

## 3.2 Measure Load Shapes

The measure load shape, characterized by the PG&E E3 Calculator, is “Commercial Refrigeration.”

# Section 4. Base Case & Measure Costs

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Measure Life Basis** | **First Baseline Period Full Measure Cost (RUL)** | **Second Baseline Period Full Measure Cost (EUL – RUL)** |
| ***ER (early retirement)*** | RUL/  EUL-RUL | Calculated as Full Gross Measure Cost | Calculated as Negative Full Gross Base Case Cost |

## 4.1 Base Case(s) Costs

The following Measure Application type is appropriate to this measure. The Base Case Costs are:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Measure Code*** | **Measure Application Type** | **Baseline** | **Equipment Cost** | **Labor / Installation Cost** | **Maintenance / Other Cost** | **Total Base Case Cost** |
| R76 | ER | Existing | $0 | $0 | $0 | $0 |

*All costs are noted as $ per measure unit*

## 4.2 Measure Case Costs

The following Measure Application type is appropriate to this measure. The Measure Case Costs are:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Measure Code*** | **Measure Application Type** | **Baseline** | **Equipment Cost** | **Labor / Installation Cost** | **Maintenance / Other Cost** | **Total Measure Case Cost** |
| R76 | ER | Existing | $95.10 | $73.65 | $0 | $168.75 |

*All costs are noted as $ per measure unit*

## 4.3 Incremental & Full Measure Costs

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Full Measure Cost**  **(RUL Period/First Baseline)** | **Full Measure Cost**  **(EUL-RUL Period/ Second Baseline)** | **Incremental Measure Cost** |
| ER | Measure Equipment Cost  +Measure Labor Cost | (-1)x(Base Equipment Cost  + Base Labor Cost) | Measure Equipment Cost  – Base Case Equipment Cost |

### 4.3.1 Full Measure Cost

Full Measure Cost is the cost to install an energy-efficient measure per the CPUC calculators. This definition implies a different meaning depending on the Measure Application type.

This Measure Application Type is ER for the First baseline period only (RUL) the Full measure Cost (FMC) is represented by the equation below:

FMC = Measure Equipment Cost + Measure Labor Cost

FMC = $95.10+$73.65 = $168.75

For ER in the second baseline period (EUL – RUL) period, FMC is represented by the equation below:

FMC = (-1) x (Base Equipment Cost + Base Labor Cost)

FMC = (-1) ($27.16 + $73.65) = $-100.81

\*Note: Various complicated price fluctuations are not addressed in these equations, such as future costs due to inflation in labor, future costs due to deflation in material cost, and other variables that cannot be accurately described at this time.

### 4.3.2. Incremental Measure Costs

Incremental Measure Cost is the premium cost to install an energy efficient measure over a standard efficiency measure or code baseline measure. While IMC has a straightforward definition depending on the Measure Application type, the equation does vary.

This Measure Application Types is ER. There is no base case to which to compare the measure, so the Incremental Measure Cost (IMC) is represented by the equation below:

IMC = Measure Equipment Cost + Measure Labor Cost

IMC = $95.10 + $73.65 = $ 168.75

**Summary Table for Section 4**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Measure ID** | **Measure Application Type** | **Base Case Total Cost** | **Measure Case Total Cost** | **Full Measure Case Cost** | **Incremental Measure Cost** |
| R76 | ER | 0 | $168.75 | $168.75 | $ 168.75 |

# References:

CFR-2012-title10-vol3-part431-subpartX.pdf

BPA-GrocerEval\_Final-9-28-09.docx

1. [↑](#endnote-ref-1)
2. BPA EnergySmart Grocer Program, Process and Impact Evaluations, Bonneville Power Administration, September 28, 2009, Summit Blue Consulting, LLC, Final Report. [↑](#footnote-ref-1)
3. “2004-2005 Database for Energy Efficiency Resources (DEER) Update Study”, prepared for Southern California Edison, prepared by Itron, Inc., December 2005, Measure IDs D03-202 and D03-203, 7-72 to 7-73. [↑](#footnote-ref-2)
4. Manufacture’s suggested shaded pole efficiency taken as industry standard. [↑](#footnote-ref-3)
5. Hill Phoenix Glass Door Reach-In Frozen Food Case manufacturer data. [↑](#footnote-ref-4)
6. 2004-2005 DEER Update Final Report, Section 7-87 [↑](#footnote-ref-5)