**Work Paper PGE3PLTG171**

**Walk-In LED**

**Revision # 2**

**Pacific Gas & Electric Company**

**PECI EnergySmart Grocer**

**LED Lighting in Walk-in Coolers and Freezers**

**Measure Code LC109, LL51-59**

**PECI**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Applicable Measure Codes:** | LC109, LL51, LL52, LL53, LL54, LL55, LL56, LL57, LL58, LL59 |
| **Measure Description:** | Retrofit LED Lighting in Walk-in Coolers and Freezers. |
| **Energy Impact Common Units:** | Per luminaire. |
| **Base Case Description:** | Source: PECI Calculation.  Incandescent or Linear Fluorescent Luminaires |
| **Base Case Energy Consumption:** | Source: PECI Calculation.  Varies: See Measure List |
| **Measure Energy Consumption:** | Source: PECI Calculation.  Varies: See Measure List. |
| **Energy Savings (Base Case – Measure)** | Source: PECI Calculation.  Varies: See Measure List |
| **Costs Common Units:** | $ per luminaire |
| **Base Case Equipment Cost ($/unit):** | Varies: See Measure List  Source: Pricing from Vendor Quotes. |
| **Measure Equipment Cost ($/unit):** | Varies: See Measure List  Source: Pricing from Vendor Quotes. |
| **Gross Measure Cost ($/unit)** | Varies: See Measure List  Source: Pricing from Vendor Quotes. |
| **Measure Incremental Cost ($/unit):** | Varies: See Measure List  Source: PECI Calculation. |
| **Effective Useful Life (years):** | Source: DEER 2016  GrocDisp-FixtLtg-LED, 16 years. |
| **Measure Application Type:** | Replace on Burnout (ROB) |
| **Net-to-Gross Ratios:** | Source: DEER 2016  Com-Default>2yrs, 0.6 |
| **Important Comments:** |  |

# 

# Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision #** | **Date** | **Section by Section Description of Revisions** | **Author (Company)** |
| **Revision 0** | 5/31/2012 | Original work paper | W. Ben Wright, PECI |
| **Revision 1** | 5/29/2014 | Update 2014 weather files. Format update per PG&E guidelines | Ioana Anghel, PECI  Ben Wright, PE, PECI  Ky Gruenfeldt-Roy, PECI  Tai Voong (PG&E) |
| **Revision 2** | 1/1/2016 | Update for DEER2016  Updated annual hours, coincidence factor, EUL, and load shape. | Henry Liu (PG&E) |

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# Section 1. General Measure & Baseline Data

## 1.1 Product Measure Description & Background

***Catalog Description – LED Lighting in Walk-In Coolers and Freezers***

Rebates are for replacing a variety of fluorescent and incandescent lighting systems in refrigerated areas of a grocery store with Light Emitting Diode (LED) luminaires.

***Program Restrictions and Guidelines***

***Terms and Conditions:***

To qualify for a rebate, the following requirements must be met:

* The existing luminaire must have a rated wattage greater than or equal to that used in the measure name.
* The LED luminaire that is installed must demonstrate wattage draw no greater than the level used in the measure name.
* LED lighting system must be a permanently installed luminaire.
* LED luminaires must work with existing controls or controls with equivalent or better functionality must be installed.
* Replaced fixtures must be rendered inoperable after removal.
* Fluorescent magnetic ballasts cannot be used to power the LED system.
* Manufacturer’s warranty must be a minimum of five years and must include fixtures, mounting hardware, power supply and light source (i.e. LED).
* LEDs must be rated to maintain no less than 70% of initial lumen output (*L70*) at 50,000 hours of operation.
* Lumen efficacy of LED luminaire must be greater than or equal to 40 lumens/watt.
* Color Rendering Index (CRI) of LED luminaire must be greater than or equal to 70.
* Total Harmonic Distortion of LED luminaire must be less than or equal to 20%.
* Power Factor of LED luminaire must be greater than or equal to 0.80.
* LED luminaire must comply with UL 8750 – 2009 *Light Emitting Diode (LED) Equipment for Use in Lighting Products.*

**Performance Characteristics Test Procedure**

In order to demonstrate compliance with performance requirements listed above, results from IESNA LM-79-08 and LM-80-08 tests performed by a laboratory that is DOE CALiPER Recognized or NVLAP Accredited for LM-79-08 must be submitted for all applicable models.

***Market Applicability:***

These measures are primarily applicable to the grocery store sector, provided that the customer meets the terms and conditions above. In some cases, these measures may also be applicable to the small business, retail, hospitality, and hospital sectors that have lighted refrigerated cases.

## 1.2 Product Technical Description

The measures addressed in this work paper are replacing a variety of fluorescent and incandescent lighting systems in refrigerated areas of a grocery store with Light Emitting Diode (LED) luminaires. The work paper documents energy and demand savings resulting from this retrofit. The base case is defined by the wattage of the existing system, which could be an E-26 Base with an incandescent lamp, a T8 or T12 linear fluorescent luminaire or an HID luminaire. The post-installation case is an LED luminaire, which is further defined by its rated wattage. Qualifying LED products must meet EnergySmart Grocer program requirements in affect at time of submission.

Replacing the existing lighting system with an LED luminaire reduces direct power demand while leaving the hours of operation unchanged. The reduced power demand provides peak demand savings and direct electrical savings. There are additional interactive effects with the building’s refrigeration system, which result in indirect electrical savings.

## 1.3 Measure Application Type

The DEER Measure Cost Data Users Guide found on [www.deeresources.com](http://www.deeresources.com) under DEER2011 Database Format hyperlink, DEER2011 for 13-14, spreadsheet SPTdata\_format-V0.97.xls, defines the terms as follows:

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

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

|  |  |  |
| --- | --- | --- |
| **Code** | **Description** | **Comment** |
| ROB | Replace on Burnout | *Single baseline (above code), incremental or full costs* |

This measure demonstrates energy savings by replacing the existing walk-in lighting fixtures at the end of their useful life. There are no existing building or appliance energy codes that mandate lighting efficiency requirements for existing walk-in boxes. All code addresses new walk-in coolers and freezers manufactured after January 1, 2009. Because the burnt out fixtures are readily replaced with a fixture of the same type, the existing fixture is considered the baseline.

## 1.4 Product Base Case and Measure Case Data

### DEER Base Case and Measure Case Information

|  |  |  |  |
| --- | --- | --- | --- |
| DEER USE and TECHNOLOGY TABLE | | | |
| Use Category Description | Use Category | Use Sub Category Description | Use Sub Category |
| Lighting | Lighting | Indoor General Lighting | InGen |
| Technology Group Description | Technology Group | Technology Type Description | Technology Type |
| Lighting - Lamps + Ballasts | Ltg\_Lmp+Blst | Linear Fluorescent Lamp with Ballast | LF\_LmpBlst |

These specific measures are not included in the Database for Energy Efficient Resources (DEER). However, relevant values from DEER 2016 updates were used for this measure. The Summary of 2016 DEER Revisions report lists the Equivalent Full Load Hours (EFLH) used in its calculations for lighting measures in various building types. The EFLH for non-CFL lighting in the refrigerated areas of a Grocery Building is listed as 4,710.[[2]](#endnote-2) The report also lists a peak demand factor of 0.746 for the same spaces.[[3]](#endnote-3)

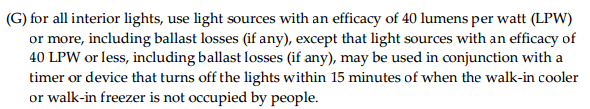
The measures described in this paper are delivered as part of the EnergySmart Grocer program. The program provides no-cost audits and downstream prescriptive rebates to encourage energy efficiency measures in the grocery sector. The measures are not directly addressed in the 2016 DEER NTG Values and Summary Documentation workbook, so the value for ‘All other EEM with no evaluated NTGR’ on the worksheet is applied.[[4]](#endnote-4) The net to gross ratio is 0.6.

Table 2 - DEER Net-to-Gross Ratios

|  |  |
| --- | --- |
| NTG ID | NTG |
| Com-Default>2yrs | 0.6 |

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

***Title 20:*** These measures do not fall under Title 20 of the California Energy Regulations. Title 20 has rules applying to walk-in coolers and freezers, but they are applicable only to new walk-ins built on or after January 1, 2009.[[5]](#endnote-5)



***Title 24:*** These measures do not fall under Title 24 of the California Energy Regulations. Per Section 146(a)3E walk-in lighting is excluded from lighting requirements described elsewhere in Section 146.[[6]](#endnote-6)

***Federal Standards:*** This measure does not fall under Federal DOE or EPA Energy Regulations.

### 1.4.3 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information

LED Refrigerated Case lighting technology has been closely tracked in California Emerging Technology studies. PG&E has conducted a series of three ET studies, and SCE and SMUD have conducted studies: Application Assessment Reports #0723[[7]](#endnote-7), #0722[[8]](#endnote-8), #0608 (Ref #3)and #0606 (Ref # 5). These studies have all studied reach-in cases (i.e. with glass doors), and all but one have focused on low-temperature rather than medium-temperature cases (i.e. freezers instead of refrigerators). Even with these limitations, the ET studies provide reliable information on lighting performance, the contribution of refrigeration savings and occupancy sensing savings, and customer satisfaction.

PG&E’s Emerging Technologies group has established that nearly half of supermarket electric costs are spent on refrigeration, and that lighting accounts for about 15% of the total energy consumed by commercial refrigerators. The ET group’s demonstration projects show that LED refrigerated case lighting can lower lighting energy usage, and produce refrigeration savings as well. Another gauge of the market potential in LED refrigerated case lighting is the continuing success of the PG&E’s ERCO midstream program, and the vendor and customer feedback in day-to-day Program operations. To date, the PG&E offerings for refrigerated case LED lighting have focused entirely on vertical cases. Vendors and customers have relayed that while vertical cases are a good application, additional potential can be found in horizontal case lighting, where multiple lamp profiles are common, particularly for canopy lighting. Current ERCO participants indicate support for the expanded measures in this workpaper.

LED lighting is a rapidly advancing technology. It is anticipated that on-going improvements to LED technology, power supplies, and installation methods will lead to continuing price reductions and increases in energy savings.

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

The measure effective useful life (EUL) is 16 years based on 4,710 hour a year lighting operation[[9]](#endnote-9) and a minimum rated equipment life of 50,000 hours.[[10]](#footnote-1)

### 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. Additionally, if a measure is assigned a DEER16 load shape, i.e. the load shape starts with “DEER:” the TOU assigned to that measure should also be zero.

## 1.5 Summary of Inputs for Savings Calculations

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

Table 3 - Variable Assumptions

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Input Variable** | **Variations** | **Base Case 1 Average Value** | **Base Case 2 Average Value** | **Measure Case Average Value** | **Reference Section** |
| **Luminaire Power (32W to 24W)** | N/A | 32 | 32 | 24 | Section 1.1 Measure Description & Background |
| **Luminaire Power (60W to 38W)** | N/A | 60 | 60 | 38 | Section 1.1 Measure Description & Background |
| **Luminaire Power (75W to 38W)** | N/A | 75 | 75 | 38 | Section 1.1 Measure Description & Background |
| **Luminaire Power (100W to 38W)** | N/A | 100 | 100 | 38 | Section 1.1 Measure Description & Background |
| **Luminaire Power (220W to 80W)** | N/A | 220 | 220 | 80 | Section 1.1 Measure Description & Background |
| **Annual Hours of Operation** | N/A | 4,810 | 4,810 | 4,710 | 2016 DEER Grocery Building: Refrigerated Areas |
| **Annual Average EER- Medium Temp Refrigeration System (Btu/hr / W)** | N/A | 10.9 | 10.9 | 10.9 | DOE2.2R Models representing a range of Refrigeration System Operational Parameters and Climate Zones |
| **EER at Utility Peak- Medium Temp Refrigeration System (Btu/hr / W)** | N/A | 9.4 | 9.4 | 9.4 | DOE2.2R Models representing a range of Refrigeration System Operational Parameters and Climate Zones |
| **Annual Average EER- Low Temp  Refrigeration System (Btu/hr / W)** | N/A | 5.0 | 5.0 | 5.0 | DOE2.2R Models representing a range of Refrigeration System Operational Parameters and Climate Zones |
| **EER at Utility Peak- Low Temp Refrigeration System (Btu/hr / W)** | N/A | 4.7 | 4.7 | 4.7 | DOE2.2R Models representing a range of Refrigeration System Operational Parameters and Climate Zones |
| **Peak Coincidence Factor** | N/A | 0.762 | 0.762 | 0.746 | 2016 DEER Grocery Building: Refrigerated Areas |

Table 3 displays all of the assumed values for the variables that affect energy and demand savings calculations.

Ten iterations of the measure were developed to account for the range of existing lighting technologies used in the grocery sector and for the impact of case temperature on refrigeration system efficiency.

Table 4 illustrates a number of retrofit scenarios that were used to develop the power levels for each measure. The system power for the linear fluorescent scenarios assumes a ballast factor of 1.00. While ballasts are available in a wide range of ballast factors, a ballast factor of 1.00 or more is often used in refrigerated spaces to avoid striation and other issues associated with fluorescent technology in sub-room temperature environments. The lumen output levels of the fluorescent baselines are also reduced from rated values to account for fixture losses and the impact of the cold environment. The light output for the retrofit scenario is not adjusted in the same way because the LM-79 testing already includes the fixture efficiency.[[11]](#endnote-10) Additionally the LED luminaires should actually perform better in the refrigerated spaces than at the temperatures at which they were tested.[[12]](#endnote-11) Based on a review of available products two LED luminaires will be required to reach the typical light output of an 8 ft Double Lamp HO T12 Fixture. This assumption carries throughout this document.

Table 4 - Example Retrofit Scenarios

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Name** | **Typical Baseline Product** | **Typical Baseline Lumen Output** | **Sample Retrofit Lumen Output** |
| LED Walk-in Fixture- 32W to 24W | 4 ft Single Lamp T8 Fixture | 1,460 | 1,423 |
| LED Walk-in Fixture- 60W to 38W | 60W Incandescent *or*  4 ft Double Lamp T8 Fixture | 850-2,920 | 2,250 |
| LED Walk-in Fixture- 75W to 38W | 75W Incandescent *or*  4 ft Double Lamp T12 Fixture | 1,200-2,350 | 2,250 |
| LED Walk-in Fixture- 100W to 38W | 100W Incandescent | 1,700 | 2,250 |
| LED Walk-in Fixture- 220W to 80W | 8 ft Double Lamp HO T12 Fixture | 4,100 | 4,500 |

# Section 2. Calculation Methods

Table 5 - Baseline by Measure Application Type

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Measure Life Basis** | **First Baseline Period: Energy Savings Baseline** | **Second Baseline Period: Energy Savings Baseline** |
| ***ROB* (replace-on-burnout)** | **EUL** | Code Baseline | N/A |

## 2.1 Electric Energy Savings Estimation Methodologies

No state or federal codes guide the energy efficiency standards for lighting in existing walk-in freezers and coolers. Therefore there is a single baseline that spans the effective useful life of the measure. The savings from these are represented in the calculations below. Each equation is accompanied by a sample calculation using the inputs used for LED Luminaire in Walk-In Cooler: 32W to 24W, one of the 10 iterations of the LED Lighting in Walk-in Coolers and Freezers measure. Appendix A contains the spreadsheet used to calculate all values presented in the At a Glance Measure List. Equation 1- Equation 7 display all of the assumed values for the variables that affect energy and demand savings calculations:

Equation 1



Example Calculation: 

Where:

∆Watts/unit = The difference between the electric demand of the base unit and the electric demand of the energy efficient unit.

Base Case Watts = The rated electric power demand of the base unit. This value will include the impact of ballasts on the system wattage when they are present.

Post Case Watts = The electric power demand of the energy efficient unit as defined by the LM-79 testing protocol.

**Annual Electric Savings:**

Annual direct electric savings is calculated by multiplying the wattage difference calculated in Equation 1 with the annual operating hours. A standard conversion factor is applied to arrive at the desired units.

Equation 2



Example Calculation: 

Where:

Direct Energy Savings = The annual energy savings achieved per unit of implemented measure.

Annual Hours of Use = The number of hours per year that the lighting fixture is expected to operate at full power in both the base and retrofit case. The value for this variable is from DEER 2016 and is specific to refrigerated spaces in grocery buildings.

Annual indirect electric savings occur as a result of a reduced load on the refrigeration system conditioning the walk-in case where the LED lighting is retrofit. The indirect savings value is calculated by converting the direct energy savings calculated in Equation 2 into a refrigeration load (Btu/yr) and dividing by the refrigeration system annual energy efficiency ratio (EER). The implicit assumption is that all energy consumed by the lighting fixture is converted to heat that must be rejected by the refrigeration system.

Equation 3



Example Calculation: 

Where:

EERAverage = The ratio of total heat rejected by the refrigeration system over the

course of a year to the power consumed by the system over the same time period. A separate value is used to represent medium and low temperature refrigeration systems.

Total annual electric savings is calculated as the sum of the direct and indirect electric savings values calculated in Equation 2 and respectively.

Equation 4



Example Calculation: 

## 2.2 Demand Reduction Estimation Methodologies

No state or federal codes guide the energy efficiency standards for lighting in existing walk-in freezers and coolers. Therefore there is a single baseline that spans the effective useful life of the measure. The savings from these are represented in the calculations below.

The coincident peak direct demand reduction (kW) is calculated by multiplying the demand difference calculated in Equation 1 with the peak coincidence factor. A standard conversion factor is applied to arrive at the desired units.

Equation 5



Example Calculation: 

Where:

Direct Demand Savings = The direct demand savings achieved at the electric system’s peak demand as defined by the CPUC per unit of implemented measure.

Peak Coincidence Factor = The ratio of the maximum lighting demand to the sum of the individual lighting demands at the time of system peak. The value for this variable is specific to refrigerated spaces in grocery buildings and was taken from the 2016 DEER Update. See Section 1.5 Summary of Inputs for Savings Calculations for additional information.

Indirect demand savings also occur during the peak coincident period due to reduced load on the refrigeration system conditioning the walk-in case where the LED lighting is retrofit. The coincident peak indirect demand is calculated by converting the coincident peak direct demand savings calculated in Equation 5 into a refrigeration load (Btu/yr) and dividing by the refrigeration system peak energy efficiency ratio (Peak EER).

Equation 6



Example Calculation: 

Where:

Indirect Demand Savings= The indirect demand savings achieved at the electric system’s peak demand as defined by the CPUC per unit of implemented measure.

EERPeak = The ratio of total heat rejected by the refrigeration system during its peak load to the power consumed by the system in order to meet that load. A separate value is used to represent medium and low temperature refrigeration systems.

The total coincident peak demand savings is calculated as the sum of the direct and indirect coincident peak demand savings values calculated in Equation 5 and Equation 6 respectively.

Equation 7



Example Calculation: 

## 2.3 Gas Energy Savings Estimation Methodologies

There are no gas energy savings associated with this measure.

# Section 3. Load Shapes

Load Shapes are an important part of the life-cycle cost analysis of any energy efficiency program portfolio. The net benefits associated with a measure are based on the amount of energy saved and the avoided cost per unit of energy saved. For electricity, the avoided cost varies hourly over an entire year. Thus, the net benefits calculation for a measure requires both the total annual energy savings (kWh) of the measure and the distribution of that savings over the year. The distribution of savings over the year is represented by the measure’s load shape. The measure’s load shape indicates what fraction of annual energy savings occurs in each time period of the year. An hourly load shape indicates what fraction of annual savings occurs for each hour of the year. A Time-of-Use (TOU) load shape indicates what fraction occurs within five or six broad time-of-use periods, typically defined by a specific utility rate tariff. Formally, a load shape is a set of fractions summing to unity, one fraction for each hour or for each TOU period. Multiplying the measure load shape with the hourly avoided cost stream determines the average avoided cost per kWh for use in the life cycle cost analysis that determines a measure’s Total Resource Cost (TRC) benefit.

## 3.1 Base Case Load Shapes

The closest load shape chosen for this measure is the PGE:DEER:Com:Indoor\_Non-CFL\_Ltg load shape.

## 3.2 Measure Load Shapes

The measure load shape for this measure is determined based on the applicable commercial market sector and the lighting end-use.

The closest load shape chosen for this measure is the PGE:DEER:Com:Indoor\_Non-CFL\_Ltg load shape. See Table 6 for a list of all Building Types and Load Shapes.

Table 6 - Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **Load Shape** | **E3 Alternate Building Type** |
| DEER Building Type GRO | PGE:DEER:Com:Indoor\_Non-CFL\_Ltg | NON\_RES |

# Section 4. Base Case & Measure Cost

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Measure Life Basis** | **First Baseline Period Full Measure Cost (RUL)** | **Second Baseline Period Full Measure Cost (EUL – RUL)** |
| ***ROB(replace on burnout)*** | EUL | Calculated as Incremental Measure Cost | N/A |

## 4.1 Base Case Costs

The base case cost is the cost of the fluorescent or incandescent lamp. The lamp costs were developed using industrial supply websites for currently available products specific to this application. The following Measure Application Type is appropriate to these measures. The Base Case Costs are:

| ***Measure Code*** | **Measure Application Type** | **Baseline** | **Equipment Cost** |
| --- | --- | --- | --- |
| LED Luminaire in Walk-in Cooler: 32W to 24W | ROB | Existing | $4.79 |
| LED Luminaire in Walk-in Freezer: 32W to 24W | ROB | Existing | $4.79 |
| LED Luminaire in Walk-in Cooler: 60W to 38W | ROB | Existing | $9.58 |
| LED Luminaire in Walk-in Freezer: 60W to 38W | ROB | Existing | $9.58 |
| LED Luminaire in Walk-in Cooler: 75W to 38W | ROB | Existing | $11.52 |
| LED Luminaire in Walk-in Freezer: 75W to 38W | ROB | Existing | $11.52 |
| LED Luminaire in Walk-in Cooler: 100W to 38W | ROB | Existing | $3.50 |
| LED Luminaire in Walk-in Freezer: 100W to 38W | ROB | Existing | $3.50 |
| LED Luminaire in Walk-in Cooler: 220W to 80W | ROB | Existing | $39.00 |
| LED Luminaire in Walk-in Freezer: 220W to 80W | ROB | Existing | $39.00 |

*All costs are noted as $ per luminaire*

## 4.2 Measure Case Costs

The measure cost is the cost of the LED luminaire. The LED lamp costs were developed using vendor quotes for two currently available products specific to this application. The costs for the two 220W to 80W measures assumes that two LED luminaires are required to match the light output of a single 220W baseline fixture. The following Measure Application Type is appropriate to these measures. The Measure Case Costs are:

| ***Measure Code*** | **Measure Application Type** | **Baseline** | **Equipment Cost** |
| --- | --- | --- | --- |
| LED Luminaire in Walk-in Cooler: 32W to 24W | ROB | Existing | $121.50 |
| LED Luminaire in Walk-in Freezer: 32W to 24W | ROB | Existing | $121.50 |
| LED Luminaire in Walk-in Cooler: 60W to 38W | ROB | Existing | $250.00 |
| LED Luminaire in Walk-in Freezer: 60W to 38W | ROB | Existing | $250.00 |
| LED Luminaire in Walk-in Cooler: 75W to 38W | ROB | Existing | $250.00 |
| LED Luminaire in Walk-in Freezer: 75W to 38W | ROB | Existing | $250.00 |
| LED Luminaire in Walk-in Cooler: 100W to 38W | ROB | Existing | $250.00 |
| LED Luminaire in Walk-in Freezer: 100W to 38W | ROB | Existing | $250.00 |
| LED Luminaire in Walk-in Cooler: 220W to 80W | ROB | Existing | $500.00 |
| LED Luminaire in Walk-in Freezer: 220W to 80W | ROB | Existing | $500.00 |

*All costs are noted as $ per luminaire*

## 4.3 Incremental

|  |  |
| --- | --- |
| **Measure Application Type** | **Incremental Measure Cost** |
| ROB | Measure Total Cost  – Base Case Total Cost |

### 4.3.1 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 type is ROB so the Incremental Measure Cost (IMC) is represented by the appropriate equation below:

IMC = (Measure Equipment Cost + Measure Labor Cost) –

(Base Case Equipment Cost + Base Case Labor Cost)

\*Note: The measure case labor and base case labor are assumed to be the same value reducing the equation to the following:

IMC = (Measure Equipment Cost) – (Base Case Equipment Cost)

The Incremental Measure Costs vary by measure, see summary table below.

Summary Table for Section 4

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure ID** | **Measure Application**  **Type** | **Base Case Total Cost** | **Measure Case Total Cost** | **Incremental Measure Cost** |
| LED Luminaire in Walk-in Cooler: 32W to 24W | ROB | $4.79 | $121.50 | $116.71 |
| LED Luminaire in Walk-in Freezer: 32W to 24W | ROB | $4.79 | $121.50 | $116.71 |
| LED Luminaire in Walk-in Cooler: 60W to 38W | ROB | $9.58 | $250.00 | $240.42 |
| LED Luminaire in Walk-in Freezer: 60W to 38W | ROB | $9.58 | $250.00 | $240.42 |
| LED Luminaire in Walk-in Cooler: 75W to 38W | ROB | $11.52 | $250.00 | $238.48 |
| LED Luminaire in Walk-in Freezer: 75W to 38W | ROB | $11.52 | $250.00 | $238.48 |
| LED Luminaire in Walk-in Cooler: 100W to 38W | ROB | $3.50 | $250.00 | $246.50 |
| LED Luminaire in Walk-in Freezer: 100W to 38W | ROB | $3.50 | $250.00 | $246.50 |
| LED Luminaire in Walk-in Cooler: 220W to 80W | ROB | $39.00 | $500.00 | $461.00 |
| LED Luminaire in Walk-in Freezer: 220W to 80W | ROB | $39.00 | $500.00 | $461.00 |

# References

**See attachments**

1. The DEER Measure Cost Data Users Guide found on [www.deeresources.com](http://www.deeresources.com) under *DEER2011 Database Format* hyperlink, DEER2011 for 13-14, spreadsheet *SPTdata\_format-V0.97.xls.* [↑](#endnote-ref-1)
2. DEER Resources website, 2016 HVAC Interactive Effects Factors, May 2015. http://www.deeresources.com/files/DEER2016/download/DEER2016\_Lighting-HOU-CDF-IE-Update\_25May2015.xlsx [↑](#endnote-ref-2)
3. Ibid. [↑](#endnote-ref-3)
4. California Public Utilities Commission. “Updated DEER NTGR Values – 053008.xls” May 2008.

   <http://www.deeresources.com/index.php?option=com_content&view=article&id=65&Itemid=57> [↑](#endnote-ref-4)
5. California Code of Regulations, Title 20: Division 2, Chapter 4, Article 4, Sections 1601 – 1608: Appliance Efficiency Regulations, p. 1. [↑](#endnote-ref-5)
6. California Code of Regulations, Title 24: Part 6, Section 100(a)2. Edition: May 2012, 15 Day, p. 32. [↑](#endnote-ref-6)
7. Application Assessment Report #0723. *LED Lighting in Reach-In Freezer Cases:Retail Sector*. PG&E Emerging Technologies Program, 2008. <http://www.etcc-ca.com/images/stories/ledfreezercasestudy1.pdf> [↑](#endnote-ref-7)
8. Application Assessment Report #0722. *LED Refrigerated Case Lighting, Costco, Northern California*. PG&E Emerging Technologies Program. <http://www.etcc-ca.com/images/stories/pdf/ETCC_Report_469.pdf> [↑](#endnote-ref-8)
9. DEER 2016. http://www.deeresources.com/files/DEER2016/download/DEER2015-2016-NTG-Update-2015-10-20.xls [↑](#endnote-ref-9)
10. See terms and conditions described in Section1.1 Product Measure Description & Background [↑](#footnote-ref-1)
11. Pacific Northwest National Laboratory. “Caliper Summary Report: Round 2” Prepared for US Department of

    Energy. August 2007, p.3. [↑](#endnote-ref-10)
12. Ibid., p.10. [↑](#endnote-ref-11)