Legal Department

December 27, 2010

Chairman Alan Schriber
Ohio Power Siting Board
Public Utilities Commission of Ohio
180 East Broad Street
Columbus, OH 43215-3793

**Matthew J. Satterwhite**
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| | | |
|---|---|---|
| Re: **In the Matter of City of Marietta and Columbus Southern Power Company for Approval of a Special Arrangement Agreement with a Mercantile Customer** | ) ) ) ) ) | **Case No. 10-1836-EL-EEC** |

Dear Chairman Schriber,

Attached please find the Joint Application of Columbus Southern Power (CSP) and mercantile customer **City of Marietta** for approval of a Special Arrangement of the commitment of energy efficiency/peak demand reduction (EE/PDR) resources toward compliance with the statutory benchmarks.

Amended Substitute Senate Bill 221 sets forth in R.C. 4928.66 EE/PDR benchmarks that electric distribution utilities shall be required to meet or exceed. The statute allows utilities to include EE/PDR resources committed by mercantile customers for integration into the utilities programs to be counted toward compliance with a utility's EE/PDR benchmarks. The statute also enables the Commission to approve special arrangements for mercantile customers that commit EE/PDR resources to be counted toward compliance with EE/PDR benchmarks.

The Commission's Order in Case No. 10-834-EL-EEC, established a streamlined process to expedite review of these special arrangements by developing a sample application process for parties to follow for consideration of such programs implemented during the prior three calendar years. Attached is CSP's version of that application and accompanying affidavit. Any confidential information referenced in the Joint Application has been filed in Commission Docket 10-1799-EL-EEC, under a request for protective treatment. CSP respectfully requests that the Commission treat the two cases as associated dockets.

Cordially,

/s/ Matthew J. Satterwhite
Matthew J. Satterwhite, Senior Counsel

Attachments

Ohio | Public Utilities Commission

**Application to Commit Energy Efficiency/Peak Demand Reduction Programs (Mercantile Customers Only)**

**Case No.:** 10-1836**-EL-EEC**

Rule 4901:1-39-05(F), Ohio Administrative Code (O.A.C.), permits a mercantile customer to file, either individually or jointly with an electric utility, an application to commit the customer's existing demand reduction, demand response, and energy efficiency programs for integration with the electric utility's programs. The following application form is to be used by mercantile customers, either individually or jointly with their electric utility, to apply for commitment of such programs implemented during the prior three calendar years.

Completed applications requesting the cash rebate reasonable arrangement option (Option 1) in lieu of an exemption from the rider will be automatically approved on the sixty-first calendar day after filing, unless the Commission, or an attorney examiner, suspends or denies the application prior to that time. Completed applications requesting the exemption from the electric utilities' energy efficiency rider option (Option 2) will not qualify for the 60-day automatic approval.

Complete a separate application for each customer program. Projects undertaken by a customer as a single program at a single location or at various locations within the same service territory should be submitted together as a single program filing, when possible. Check all boxes that are applicable to your program. For each box checked, be sure to complete all subparts of the question, and provide all requested additional information. Submittal of incomplete applications may result in a suspension of the automatic approval process or denial of the application.

If you consider some of the items requested in the application to be confidential or trade secret information, please file a copy of the application under seal, along with a motion for protective order pertaining to the material you believe to be confidential. Please also file a copy of the application in the public docket, with the information you believe to be confidential redacted.

## Section 1: Company Information

Name: CITY OF MARIETTA

Principal address: 304 Putnman Street, Marietta, Oh 45750

Address of facility for which this energy efficiency program applies: 304 Putnam St, Marietta, Oh 45750-3022

Name and telephone number for responses to questions:

Jonathan Milosavljevic, City Of Marietta, (740) 483-2351

Electricity use by our company (at least one must apply to your company—check the box or boxes that apply):

☐ We use more than seven hundred thousand kilowatt hours per year at our facility. (Please attach documentation.)

See Confidential and Proprietary Attachment 4 – Calculation of Rider Exemption and UCT which provides the facility consumption for the last three years, benchmark kWh, and the last 12 months usage.

☒ We are part of a national account involving multiple facilities in one or more states. (Please attach documentation.) When checked, see Attachment 6 – Supporting Documentation for a listing of the customer's name and service addresses of other accounts in the AEP Ohio service territory.

## Section 2: Application Information

A) We are filing this application (choose which applies):

☐ Individually, on our own.

☒ Jointly with our electric utility.

B) Our electric utility is: Columbus Southern Power Company

The application to participate in the electric utility energy efficiency program is "Confidential and Proprietary Attachment 3 – Self Direct Program Project Completed Application."

C) We are offering to commit (choose which applies):

☐ Energy savings from our energy efficiency program. (Complete Sections 3, 5, 6, and 7.)

☐ Demand reduction from our demand response/demand reduction program. (Complete Sections 4, 5, 6, and 7.)

☒ Both the energy savings and the demand reduction from our energy efficiency program. (Complete all sections of the Application.)

## Section 3: Energy Efficiency Programs

A) Our energy efficiency program involves (choose whichever applies):

☒ Early replacement of fully functioning equipment with new equipment. (Provide the date on which you replaced your fully functioning equipment, 3/30/2009 and the date on which you would have replaced your equipment if you had not replaced it early. Please include a brief explanation for how you determined this future replacement date (or, if not known, please explain why this is not known)).

The remaining life of the equipment varies and is not known with certainty. The future replacement date is unknown and has historically been at the end of equipment life. Replacement was completed early to achieve energy savings and to reduce future maintenance costs.

☐ Installation of new equipment to replace equipment that needed to be replaced. We installed our new equipment on the following date(s):

☐ Installation of new equipment for new construction or facility expansion. We installed our new equipment on the following date(s):

B) Energy savings achieved/to be achieved by your energy efficiency program:

a) If you checked the box indicating that your project involves the early replacement of fully functioning equipment replaced with new equipment, then calculate the annual savings [(kWh used by the original equipment) – (kWh used by new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Unit Quantity (watts) = Existing (watts x units) – Installed (watts x units)

kWh Reduction (Annual Savings) = Unit Quantity x (Deemed kWh/Unit)

Annual savings: 546,064 kWh

See Confidential and Proprietary Attachment 5 – Self Direct Program Project Calculation for annual energy savings calculations and Attachment 8 – Prescriptive Protocols for the work papers that provide all methodologies, protocols, and practices used in this application for prescriptive measures, as needed.

b) If you checked the box indicating that you installed new equipment to replace equipment that needed to be replaced, then calculate the annual savings [(kWh used by less efficient new equipment) – (kWh used by the higher efficiency new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Annual savings: kWh

Please describe the less efficient new equipment that you rejected in favor of the more efficient new equipment.

c) If you checked the box indicating that your project involves equipment for new construction or facility expansion, then calculate the annual savings [(kWh used by less efficient new equipment) – (kWh used by higher efficiency new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Annual savings: kWh

Please describe the less efficient new equipment that you rejected in favor of the more efficient new equipment.

## Section 4: Demand Reduction/Demand Response Programs

A) Our program involves (choose which applies):

☒ Coincident peak-demand savings from our energy efficiency program.

☐ Actual peak-demand reduction. (Attach a description and documentation of the peak-demand reduction.)

☐ Potential peak-demand reduction (choose which applies):

- Choose one or more of the following that applies:
  - ☐ Our peak-demand reduction program meets the requirements to be counted as a capacity resource under a tariff of a regional transmission organization (RTO) approved by the Federal Energy Regulatory Commission.
  - ☐ Our peak-demand reduction program meets the requirements to be counted as a capacity resource under a program that is equivalent to an RTO program, which has been approved by the Public Utilities Commission of Ohio.

B) What is the date your peak demand reduction program was initiated?

The coincident peak-demand savings are permanent installations that reduce demand through energy efficiency and were installed on the date specified in Section 3 A above.

C) What is the peak demand reduction achieved or capable of being achieved (show calculations through which this was determined):

Unit Quantity (watts) = Existing (watts x units) – Installed (watts x units)

KW Demand Reduction = Unit Quantity (watts) x (Deemed KW/Unit (watts))

104.0 kW

See <u>Confidential and Proprietary Attachment 5 – Self Direct Program Project Calculation</u> for peak demand reduction calculation, and <u>Attachment 8 – Prescriptive Protocols</u> for the work papers that provide all methodologies, protocols, and practices used in this application for prescriptive measures, as needed.

## Section 5: Request for Cash Rebate Reasonable Arrangement (Option 1) or Exemption from Rider (Option 2)

Under this section, check the box that applies and fill in all blanks relating to that choice.

Note: If Option 2 is selected, the application will not qualify for the 60-day automatic approval. All applications, however, will be considered on a timely basis by the Commission.

A) We are applying for:

☒ Option 1: A cash rebate reasonable arrangement.

OR

☐ Option 2: An exemption from the cost recovery mechanism implemented by the electric utility.

B) The value of the option that we are seeking is:

Option 1: A cash rebate reasonable arrangement, which is the lesser of (show both amounts):

☐ A cash rebate, based on avoided generation cost, of $______________. (Attach documentation showing the methodology used to determine the cash rebate value and calculations showing how this payment amount was determined.)

OR

☒ A cash rebate valued at no more than 50% of the total project cost, which is equal to $ 22,976.25. (Attach documentation and calculations showing how this payment amount was determined.)

See Confidential and Proprietary Attachment 5 – Self Direct Program Project Calculation for incentive calculations for this mercantile program.

Option 2: An exemption from payment of the electric utility's energy efficiency/peak demand reduction rider.

☐ An exemption from payment of the electric utility's energy efficiency/peak demand reduction rider for ____ months (not to exceed 24 months). (Attach calculations showing how this time period was determined.)

OR

☐ Ongoing exemption from payment of the electric utility's energy efficiency/peak demand reduction rider for an initial period of 24 months because this program is part of an ongoing efficiency program that is practiced by our organization. (Attach documentation that establishes your organization's ongoing efficiency program. In order to continue the exemption beyond the initial 24 month period your organization will need to provide a future application establishing additional energy savings and the continuance of the organization's energy efficiency program.)

## Section 6: Cost Effectiveness

The program is cost effective because it has a benefit/cost ratio greater than 1 using the (choose which applies):

☐ Total Resource Cost (TRC) Test. The calculated TRC value is: ______ (Continue to Subsection 1, then skip Subsection 2)

☒ Utility Cost Test (UCT) . The calculated UCT value is: 9.2 (Skip to Subsection 2.)

Subsection 1: TRC Test Used (please fill in all blanks).

The TRC value of the program is calculated by dividing the value of our avoided supply costs (capacity and energy) by the sum of our program costs and our electric utility's administrative costs to implement the program.

Our avoided supply costs were _______.

Our program costs were _______.

The utility's administrative costs were _______.

Subsection 2: UCT Used (please fill in all blanks).

We calculated the UCT value of our program by dividing the value of our avoided supply costs (capacity and energy) by the costs to our electric utility (including administrative costs and incentives paid or rider exemption costs) to obtain our commitment.

Our avoided supply costs were $ 241,428.49

The utility's administrative costs were $ 3,276.38

The utility's incentive costs/rebate costs were $ 22,976.25.

## Section 7: Additional Information

Please attach the following supporting documentation to this application:

- Narrative description of your program including, but not limited to, make, model, and year of any installed and replaced equipment.

  See Attachment 1 - Self Direct Project Overview and Commitment for a description of the project. See Attachment 6 – Supporting Documentation, for the specifications of the replacement equipment Attachment 8 – Prescriptive Protocols for the work papers that provide all methodologies, protocols, and practices used in this application for prescriptive measures, as needed. Due to the length of time since the equipment replacement, the make, model and year of the replaced equipment is not available.

- A copy of the formal declaration or agreement that commits your program to the electric utility, including:

  1) any confidentiality requirements associated with the agreement;

     See Attachment 2 – Self Direct Program Project Blank Application including Rules and Requirements. All confidentially requirements are pursuant to the Retrospective Projects/Rules and Requirements that are part of the signed application which is provided as Confidential and Proprietary Attachment 3 – Self Direct Program Project Completed Application.)

  2) a description of any consequences of noncompliance with the terms of the commitment;

     See Attachment 2 – Self Direct Program Project Blank Application including Rules and Requirements. All consequences of noncompliance are pursuant to the Retrospective Projects/Rules and Requirements that are part of the signed application which is provided as Confidential and Proprietary Attachment 3 – Self Direct Program Project Completed Application.

  3) a description of coordination requirements between you and the electric utility with regard to peak demand reduction;

     None required because the resources committed are permanent installations that reduce demand through increased efficiency during the Company's peak summer demand period generally defined as May through September and do not require specific coordination and communication to provide demand reduction capabilities to the Company.

4) permission by you to the electric utility and Commission staff and consultants to measure and verify energy savings and/or peak-demand reductions resulting from your program; and,

   See Attachment 2 – Self Direct Program Blank Application including Rules and Requirements granting such permission pursuant to the Retrospective Projects/Rules and Requirements that are part of the signed application which is provided as Confidential and Proprietary Attachment 3 – Self Direct Program Project Completed Application.

5) a commitment by you to provide an annual report on your energy savings and electric utility peak-demand reductions achieved.

   See Attachment 1 - Self Direct Project Overview and Commitment for the commitment to comply with any information and compliance reporting requirements imposed by rule or as part of the approval of this arrangement by the Public Utilities Commission of Ohio.

- A description of all methodologies, protocols, and practices used or proposed to be used in measuring and verifying program results. Additionally, identify and explain all deviations from any program measurement and verification guidelines that may be published by the Commission.

  The Company applies the same methodologies, protocols, and practices to Self Direct Program retrospective projects that are screened and submitted for approval as it does to prospective projects submitted through its Prescriptive and Custom Programs. The Commission has not published a technical reference manual for use by the Company so deviations can not be identified. The project submitted is a prescriptive project and energy savings are determined as described in Confidential and Proprietary Attachment 5 - Self Direct Program Project Calculation, and Attachment 8 – Prescriptive Protocols for the work papers that provide all methodologies, protocols, and practices used in this application for prescriptive measures, as needed.

Ohio | Public Utilities Commission

**Application to Commit Energy Efficiency/Peak Demand Reduction Programs (Mercantile Customers Only)**

**Case No.: 10-1836-EL-EEC**

State of OHIO :

RYAN D CALKINS, Affiant, being duly sworn according to law, deposes and says that:

1. I am the duly authorized representative of:

   KEMA Services, Inc agent of Columbus Southern Power

2. I have personally examined all the information contained in the foregoing application, including any exhibits and attachments. Based upon my examination and inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete.

3. I am aware of fines and penalties which may be imposed under Ohio Revised Code Sections 2921.11, 2921.31, 4903.02, 4903.03, and 4903.99 for submitting false information.

Ryan Calkins ENERGY EFFICIENCY ENGINEER
Signature of Affiant & Title

Sworn and subscribed before me this 15TH day of DECEMBER, 2010 Month/Year

Angie Doan
Signature of official administering oath

Angie Doan, Outreach Manager
Print Name and Title

My commission expires on 01-03-11

NOTARIAL SEAL STATE OF OHIO

ANGIE DOAN
Notary Public, State of Ohio
My Commission Expires 01-03-11

AEP OHIO
A unit of American Electric Power



# Self Direct Project Overview & Commitment

The Public Utility Commission of Ohio (PUCO) will soon review your application for participation in AEP Ohio's Energy Efficiency/Peak Demand Response program. Based on your submitted project, please select by initialing one of the two options below, sign and fax to 877-607-0740.

| | | |
|---|---|---|
| **Customer Name** | **CITY OF MARIETTA** | |
| **Project Number** | **AEP-10-02010** | |
| **Customer Premise Address** | **304 PUTNAM ST, MARIETTA, OH 45750-3022** | |
| **Customer Mailing Address** | **304 Putnman Street, Marietta, Oh 45750** | |
| **Date Received** | **8/9/2010** | |
| **Project Installation Date** | **3/30/2009** | |
| **Annual kWh Reduction** | **546,064** | |
| **Total Project Cost** | **$61,753.36** | |
| **Unadjusted Energy Efficiency Credit (EEC) Calculation** | **$30,635.00** | |
| **Simple Payback (yrs)** | **1.09** | |
| **Utility Cost Test (UCT)** | **9.2** | |
| | | **Please Choose One Option Below and Initial** |
| **Option 1 - Self Direct EEC: 75%** | **$22,976.25** | ☐ **Initial:** ________ |
| | | |
| **Option 2 - EE/PDR Rider Exemption** | **NA Months (After PUCO Approval)** | NA **Initial:** ________ |

**Note:** *This is a one time selection. By selecting Option 1, the customer will receive payment in the amount stated above. Selection of Option 2: EE/PDR rider exemption, will result in the customer not being eligible to participate in any other energy efficiency programs offered by AEP Ohio during the period of exemption. In addition, the term of Option 2: EE/PDR rider exemption is subject to ongoing review for compliance and could be changed by the PUCO.*

**If Option 1 has been selected, will the Energy Efficiency Funds selected help you move forward with other energy efficiency projects?**

____YES ____ NO

**Project Overview:**

The Self Direct (Prescriptive) project that the above has completed and applied is as follows.
Installed (282) 12" Red LED Traffic Signals
Installed (276) 12" Green LED Traffic Signals
Installed (206) 12" Pedestrian LED Signals
The LED signals were installed in a total of 36 intersections affecting 104 accounts

The documentation that was included with the application proved that the energy measures applied for were purchased and installed.

*By signing this document, the Mercantile customer affirms its intention to commit and integrate the above listed energy efficiency resources into the utility's peak demand reduction, demand response, and energy efficiency programs. By signing, the Mercantile customer also agrees to serve as a joint applicant in any filings necessary to secure approval of this arrangement by the Public Utilities Commission of Ohio, and comply with any information and compliance reporting requirements imposed by rule or as part of that approval.*

| **Columbus Southern Power Company** | **CITY OF MARIETTA** |
|---|---|
| By:________________________ | By: ________________________ |
| Title: ________________________ | Title: ________________________ |
| Date: ________________________ | Date: ________________________ |

AEP OHIO
A unit of American Electric Power



## Self Direct Project Overview & Commitment

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| Project Number | AEP-10-02010 | |
| Customer Premise Address | 304 PUTNAM ST, MARIETTA, OH 45750-3022 | |
| Customer Mailing Address | 304 Putnman Street, Marietta, Oh 45750 | |
| Date Received | 8/9/2010 | |
| Project Installation Date | 3/30/2009 | |
| Annual kWh Reduction | 546,064 | |
| Total Project Cost | $61,753.36 | |
| Unadjusted Energy Efficiency Credit (EEC) Calculation | $30,635.00 | |
| Simple Payback (yrs) | 1.09 | |
| Utility Cost Test (UCT) | 9.2 | |
| | | Please Choose One Option Below and Initial |
| Option 1 - Self Direct EEC: 75% | $22,976.25 | X Initial: WMD |
| Option 2 - EE/PDR Rider Exemption | NA Months (After PUCO Approval) | NA Initial: |

Note: *This is a one time selection. By selecting Option 1, the customer will receive payment in the amount stated above. Selection of Option 2: EE/PDR rider exemption, will result in the customer not being eligible to participate in any other energy efficiency programs offered by AEP Ohio during the period of exemption. In addition, the term of Option 2: EE/PDR rider exemption is subject to ongoing review for compliance and could be changed by the PUCO.*

If Option 1 has been selected, will the Energy Efficiency Funds selected help you move forward with other energy efficiency projects? X YES ___ NO

**Project Overview:**

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*By signing this document, the Mercantile customer affirms its intention to commit and integrate the above listed energy efficiency resources into the utility's peak demand reduction, demand response, and energy efficiency programs. By signing, the Mercantile customer also agrees to serve as a joint applicant in any filings necessary to secure approval of this arrangement by the Public Utilities Commission of Ohio, and comply with any information and compliance reporting requirements imposed by rule or as part of that approval.*

| Columbus Southern Power Company | CITY OF MARIETTA |
|---|---|
| By: (signature) | By: (signature) |
| Title: Manager | Title: Asst Safety & Service Director |
| Date: 11/10/10 | Date: 11/9/10 |

gridSMART From AEP OHIO

# Self-Direct Program Project Application

## Jan 2010 - Dec 2010

**Step 1: Check Project and Equipment Eligibility**

- ✓ Project must be a facility improvement that results in a *permanent* reduction in electrical energy usage (kWh).
- ✓ *All installed equipment must meet or exceed the specifications given in the application* and be installed in facilities served by AEP Ohio: Customer must have a valid AEP Ohio account number on an eligible AEP Ohio non-residential rate (see terms and conditions for list of eligible rates).

**Step 2: Submit Application**

- ✓ Fill out the Customer Information form and the Worksheet for the measures that you are installing. You may submit the application via mail, fax or e-mail.

**Submit your application to:**

**AEP Ohio gridSMART Program**
**6031 East Main St. Suite 190**
**Columbus, OH 43213**
**Call: (877)-607-0739**
**Fax: (877)-607-0740**
**Email: gridsmartohio@kema.com**
**Visit our web site at gridsmartohio.com**

- ✓ Submit an application prior to December 15, 2010. Complete the checklist page and attach the documentation listed: a signed Agreement and Signature page, a scope of work (type, quantity and wattage of old and new equipment), dated, itemized invoices for the purchase and installation of all equipment installed and specification sheets for all equipment installed showing that it meets the program specifications.

**Step 3: Project Review**

- ✓ The program team will review your Application. For some projects, an inspection will be part of the review, and you will be contacted to schedule it.
- ✓ After approval by AEP Ohio self-direct projects are submitted to the Public Utilities Commission of Ohio (PUCO) for consideration. The PUCO will assign a case number and review the project details that were prepared by AEP Ohio. After the commission reviews the project the case will be put on the docket for a formal meeting, where action is taken to approve or reject the project for energy efficiency credits.

**Step 4: Receive Energy Efficiency Credits**

- ✓ The program team will issue the energy efficiency credits, within four to six weeks after PUCO project approval.
- ✓ In lieu of a one-time energy efficiency credit, you may elect to seek an exemption from the Energy Efficiency / Peak Demand Reduction (EE/ PDR) Rider for the associated electric accounts(s) for a defined period of time as stated on this Application. For this exemption the Energy Efficiency Credit amount (Option 1) is compared to the estimated value of the estimated EE/PDR Rider obligation (Option 2), as calculated by AEP Ohio. The value of Option 2 will be approximately equal to the value of Option 1. If exemption is elected, you are not eligible for other programs offered by AEP Ohio during the exemption period. Unless additional resources are committed, you will, after the specified number of months exempted, be subject to the EE/ PDR Rider.
- ✓ If the energy efficiency credit is elected, you remain in the EE/ PDR rider for the period of time that an exemption would have been in effect and may also participate in the AEP Ohio programs.
- ✓ You are allowed and encouraged to consider using all or a portion of the energy credits, as received from AEP Ohio under this program, to help fund other energy efficiency and demand reduction projects you choose to initiate in the future. Future projects can also qualify for credits under the Prescriptive or Custom programs.

If you are viewing this document in Microsoft Excel, please note that each section of the application is accessible through the tabs at the bottom of the Excel window.

gridSMART From AEP OHIO

**Self-Direct Program**
**Project Application**

# APPLICATION CHECKLIST

## APPLICATION

**Required Attachments**

- ☐ Customer/Contractor Information
- ☐ Completed Energy Efficiency Credits Requested Section of Agreement and Signature Page
- ☐ Completed Payment Release Section of Agreement and Signature Page (if applicable)

- ☐ Itemized Invoices
- ☐ Equipment Specifications
- ☐ Updated scope if project changed

**Worksheets**

- ☐ Lighting
- ☐ HVAC
- ☐ Refrigeration
- ☐ Motors and VFD
- ☐ Custom

**Application Date:** ______________________

**Completion Date:** ______________________

**Incomplete applications will delay processing and energy efficiency credits.*
***Please complete forms for above checked boxes*

***Please fill out if this is a revised submittal***

**SUBMITTAL DATE:** ______________

**APPLICATION NUMBER (IF KNOWN):** ______________

**AEP Ohio gridSMART Program**
**6031 East Main St. Suite 190**
**Columbus, OH 43213**

Phone: (877)-607-0739
Fax: (877)-607-0740
gridsmartohio@kema.com
www.gridsmartohio.com

gridSMART from AEP OHIO

**Self-Direct Program Project Application**

# TERMS AND CONDITIONS

Columbus Southern Power and Ohio Power Company are collectively known as AEP Ohio (AEP Ohio). AEP Ohio is offering Prescriptive and Custom energy efficiency credits under the AEP Ohio gridSMART[SM] program to facilitate the implementation of past cost-effective energy-efficiency improvements for non-residential (commercial and industrial) customers. AEP Ohio provides energy efficiency credits (EEC) for the purchase and installation of qualifying cost effective equipment in the customer's facility (the Customer's "Commitment of Resources") under the Rules and Requirements provided in this application and subject to regulatory approvals. Energy efficiency credits will only be provided in the form of a check or an Energy Efficiency/Peak Demand Reduction (EE/PDR) Rider exemption under this program.

All applications are subject to review and approval by AEP Ohio, its contractor(s)/agent(s), and the Public Utility Commission of Ohio (PUCO) prior to any ECC payments or exemptions from the EE/PDR rider in this program. Funds are limited and subject to availability.

**Program Effective Dates**

gridSMART energy efficiency credits are offered until approved funds are exhausted or Dec 31 of each program year, whichever comes first. The effective dates of Year 2 of the gridSMART program and application submittal requirements are as follows:

- Self-direct projects are retrospective projects completed since 1/1/2007. Self-direct projects are eligible to apply for energy efficiency credits with this application. Future projects that are not yet completed should apply on the Prescriptive/Custom application.
- All 2010 gridSMART program Applications must be received no later than Dec 15, 2010.
- Subsequent program year plans will be made available toward the end of the existing program year. At the current time, AEP Ohio has a commitment to provide this program through the 2010 program year.

**Program and Project Eligibility**

The Self-Direct Program applies to customers served at AEP Ohio's retail electric rates who meet the minimum energy usage requirements of 700,000 kWh per year or who are part of a national account involving multiple facilities in one or more states.

The gridSMART program offers both Prescriptive energy efficiency credits for some of the more common energy efficiency measures and Custom energy efficiency credits for those eligible improvements not included on the list of Prescriptive measures. Program credits are available under the gridSMART program to non-residential customers served at AEP Ohio's regulated retail rates, where qualifying projects are installed in a facility in AEP Ohio's electric service territory. These credits are available to all non residential customers who pay into the Energy Efficiency and Peak Demand Response (EE/PDR) rider and receive their electricity over AEP Ohio wires, regardless of which retail electric supplier the customer has chosen to purchase power from.

Custom projects must involve measures that result in a reduction in electric energy usage due to an improvement in system efficiency. Projects that result in reduced energy consumption without an improvement in system efficiency are not eligible for a Custom credit. However, projects that involve an automated control technology such as energy management system programming may be eligible for a credit. All projects must meet AEP Ohio's cost-effectiveness requirements. The project simple payback prior to the credit must be greater than one year and pass utility cost effectiveness test(s) determined by AEP Ohio, to qualify for credit. The peak demand hours are defined as weekdays, 7:00 AM to 9:00 PM, May through September.

Projects involving measures covered by the Prescriptive energy efficiency credit portion of the program are not eligible for a Custom energy efficiency credit. However, the applicant has the option to apply for a Custom energy efficiency credit for whole building integrated projects or systems even if they include Prescriptive measures.

The energy efficiency credits are calculated in the following Prescriptive or Custom worksheets.

gridSMART from AEP OHIO

**Self-Direct Program Project Application**

# TERMS AND CONDITIONS

Project requirements under the AEP Ohio gridSMART program include the following:

- Projects must involve a facility improvement that results in a permanent reduction in electrical energy usage (kWh)
- Projects that are NOT eligible for a credit include the following:
  - Fuel switching (e.g. electric to gas or gas to electric)
  - Changes in operational and/or maintenance practices or simple control modifications not involving capital costs
  - Removal or termination of existing processes, facilities, and/or operations
  - On-site electricity generation
  - Projects involving gas-driven equipment in place of or to replace electric equipment (such as a chiller)
  - Projects focused primarily on power factor improvement;
  - Projects that involve peak-shifting (and not kWh savings)
  - Renewables
  - Are required by state or federal law, building or other codes, or are standard industry practice
  - Are easily reverted/removed or are installed entirely for reasons other than improving energy efficiency
  - Include other conditions to be determined by AEP Ohio.
- Any measures installed at a facility must produce **verifiable** and **persistent** energy reduction. Measures must be sustainable and provide 100% of the energy benefits as stated in the Application for a period of at least five (5) years or for the life of the product, whichever is less. If the Customer ceases to be a delivery service customer of AEP Ohio or removes the equipment or systems at any time during the 5-year period or the life of the product, the Customer may be required to return a prorated amount of credit funds to AEP Ohio.
- Customer can not apply for incentives for future projects and elect after the fact to apply for credits under this program.
- All documentation and verification is subject to strict confidentiality.
- All equipment must be new; used or rebuilt equipment is NOT eligible for energy efficiency credits
- All installed equipment must meet state, federal, or local codes and requirements
- Costs associated with internal labor are not eligible.
- Projects must be installed on the AEP Ohio electric account listed on the application
- Equipment must be purchased, installed, and operating (or capable of operating in the case of seasonal uses) prior to submitting an application for energy efficiency credits
- The energy efficiency credits are paid as a one-time, one-program offer and cannot be combined with incentive payments from other AEP Ohio programs. The customer may be eligible to participate in other programs offered by AEP Ohio, as long as no project receives more than one incentive/credit.

| PROGRAM INCENTIVES | |
|---|---|
| Energy efficiency credit levels for one-year energy savings | $0.08/kWh x 75% |
| Minimum / Maximum simple payback before energy efficiency credit applied | 1 year Min / 7 year Max<br>Or pass cost effectiveness test(s)<br>(determined by AEP Ohio) |
| Maximum payout | 50% of total project cost<br>(additional caps may also apply) |
| Energy efficiency credit levels for retrospective projects completed since 1/1/2007 | Calculated amount on the Prescriptive or Custom worksheets attached and subject to funding limits |

gridSMART from AEP OHIO

Self-Direct Program
Project Application

# TERMS AND CONDITIONS

**Energy Efficiency Credit Limits**
For both the Prescriptive and Custom measures in this application, the total energy efficiency credits shall be 75% of the lesser of: 1) The calculated credit as approved by AEP Ohio, or 2) 50% of the project cost with larger projects subject to the following limits and credit reductions. In calculating the savings and energy efficiency credits for Custom measures please contact the gridSMART office to determine appropriate baseline for savings.

**Funding is limited**

- The limit for each self-direct project is $225,000.
- The limit for each business entity (corporation, LLC, partnership, etc) in the Self-Direct Program is based on their tariff, as indicated below:

| TARIFF | LIMIT PER BUSINESS ENTITY |
|---|---|
| General Service Tariffs 1, 2, & 3 | $450,000 per year |
| Any Other Tariff | $450,000 overall for years 2009-2011 |

- A sliding scale credit reduction will be incorporated when the calculated energy efficiency credits exceed $160,000 per project.

**Application**
Applications must be submitted by December 15, 2010. Project documentation, such as copies of dated invoices for the purchase and installation of the measures and/or product specification sheets, is required. AEP Ohio reserves the right to request additional backup information, supporting detail, calculations, manufacturer specification sheets or any other information prior to any credit payment.

The location or business name on the invoice must be consistent with the application information. Applications and all required supporting documentation should be received by Dec 15, 2010, to be applicable for the 2010 program year.

A signed application with documentation verifying installation of the project including, but not limited to, equipment, invoices, approvals, and other related information must be submitted to AEP Ohio prior to application approval.

The project invoice should provide sufficient detail to separate the project cost from the cost of other services such as repairs and building code compliance. AEP Ohio reserves the right to request additional supporting documentation as deemed necessary to ensure measure eligibility and verify that the expected energy savings will occur. All customer information will be held in confidence. Requested information could include: equipment purchase dates, installation dates, proof that the equipment is operational, manufacturer specifications, warranty information, and proof of customer co-payment.

The customer understands and agrees that all other terms and conditions, as specified in the application, including all attachments and exhibits attached to this application, which will serve as a contract for the customer's commitment of energy resources to AEP Ohio, shall apply.

**Application Review Process**
AEP Ohio will review Applications for eligibility and completeness. Completed applications will be reviewed in the order received. Funds are reserved for the project when AEP Ohio receives a complete application and determines that the project meets the program eligibility requirements. Applicants who submit incomplete applications will be notified of deficiencies upon review of the application, and could lose their place in line in the review process until all requested information is received. Applicants are encouraged to call the program hotline if they have any questions about documentation requirements.

gridSMART from AEP OHIO

Self-Direct Program
Project Application

# TERMS AND CONDITIONS

**Inspections**
AEP Ohio reserves the right to inspect all projects to verify compliance with the program rules and verify the accuracy of project documentation. This may include installation inspections, detailed lighting layout descriptions, metering, data collection, interviews, and utility bill data analysis. The customer must allow access to project documents and the facility where the measures were installed for a period of five years after receipt of energy efficiency credits by AEP Ohio. Customer understands and agrees that Program installations may also be subject to inspections by the PUCO or their designee, and photographs of installation may be required. All documentation and verification is subject to strict confidentiality.

**Requirements for <u>Custom</u> Project Electricity Savings Calculation**
The annual electricity savings must be calculated for Custom projects using industry accepted engineering algorithms or simulation models. The applicant must estimate the annual electricity usage of both the equipment removed (and baseline) and equipment installed based on the current operation of the facility. If the previous equipment was at the end of its useful life, the applicant must use as the baseline, the equipment that would meet the applicable federal and local energy codes when calculating the annual energy savings.

The applicant must be able to clearly describe the method used to calculate the savings. The applicant must provide all assumptions used in the calculations and document the source for these assumptions.

The method and assumptions used by the applicant to calculate the annual savings will be reviewed by AEP Ohio. AEP Ohio is solely responsible for the final determination of the annual energy savings to be used in calculating the energy efficiency credit amount. AEP Ohio also reserves the right to require specific measurement and verification activities including monitoring the retrofit and to determine the credit. Verification of the preexisting consumption may also be required.

AEP Ohio may need to conduct inspections both before and after the retrofit projects to verify equipment and operation conditions. For Custom projects, the applicant is required to provide information in order to allow AEP Ohio to verify the baseline usage of the pre-existing equipment.

Customers are encouraged to submit projects that warrant special treatment (i.e., non-typical projects) to be considered on a case-by-case basis by AEP Ohio.

**Tax Liability**
Credits are taxable and, if more than $600, will be reported to the IRS unless the customer is exempt. AEP Ohio is not responsible for any taxes that may be imposed on your business as a result of your receipt of the energy efficiency credits.

**Disclaimer**
AEP Ohio does not guarantee the energy savings and does not make any warranties associated with the measures eligible for energy efficiency credits under this program. AEP Ohio has no obligations regarding and does not endorse or guarantee any claims, promises, work, or equipment made, performed, or furnished by any contractors or equipment vendors or manufacturers that sell or install any energy efficiency measures. AEP Ohio is not responsible for the proper disposal/recycling of any waste generated as a result of this project. AEP Ohio is not liable for any damage caused by the operation or malfunction of the installed equipment.

gridSMART From AEP OHIO

# Self-Direct Program Project Application

**Important:** Please read the terms and conditions before signing and submitting this application.
You must complete all information and provide required additional documentation to avoid processing delays.

## CUSTOMER INFORMATION

**Primary Business Type** *(select one)*

- OFFICE ☐
- SCHOOL ☐
- RETAIL/SERVICE ☐
- RESTAURANT ☐
- HOTEL/MOTEL ☐
- MEDICAL ☐
- GROCERY ☐
- WAREHOUSE ☐
- LIGHT INDUSTRY ☐
- HEAVY INDUSTRY ☐
- MISCELLANEOUS ☐
- OTHER ☐
- COLLEGE/UNIVERSITY ☐
- GOVERNMENT/MUNICIPAL ☐

**Tax Status** *(as entered on W9)*

- Corporation (Inc., PC, Etc.) ☐
- Tax Exempt ☐
- Individual ☐
- Other (may receive 1099) ☐ ____________ (describe other)

**Please indicate which category best describes the current operating hours affected of the facility affected by this project.**

- Three shifts (24h / day) ☐
- Two shifts (16h / day) ☐
- One shift (8h / day) ☐

**Project Type**

- Retrofit ☐
- New Construction ☐

SQUARE FOOTAGE OF BUILDING(S) AFFECTED BY THIS PROJECT ____________

| | | | | |
|---|---|---|---|---|
| NAME OF APPLICANT'S BUSINESS | | PROJECT NAME (IF APPLICABLE) | | |
| NAME AS IT APPEARS ON UTILITY BILL | ACCT #* | APPLICANT TAXPAYER ID # (SSN/FEIN) | | |
| MAILING ADDRESS | | CITY | STATE | ZIP |
| INSTALLATION ADDRESS | | CITY | STATE | ZIP |

As an eligible customer, I verify the information is correct and request consideration for participation under this program.

| | |
|---|---|
| CUSTOMER SIGNATURE (AEP CUSTOMER) | PRINT NAME |
| ☐ TOTAL ENERGY EFFICIENCY CREDITS REQUESTED** | DATE |
| COMPLETION DATE | PROJECT COST (internal labor costs are not eligible) |

## CUSTOMER CONTACTS

*Please provide all contacts we may need to process for this project. The business contact should be the project decision maker.*

| | | | |
|---|---|---|---|
| NAME OF CONTACT PERSON - *Preferred Contact for Documentation* | | | TYPE OF CONTACT (BUSINESS, TECHNICAL, ADMINISTRATIVE) |
| CONTACT PHONE # | EXTENSION | CONTACT FAX # | CONTACT EMAIL ADDRESS |
| NAME OF CONTACT PERSON | | | TYPE OF CONTACT (BUSINESS, TECHNICAL, ADMINISTRATIVE) |
| CONTACT PHONE # | EXTENSION | CONTACT FAX # | CONTACT EMAIL ADDRESS |
| NAME OF CONTACT PERSON | | | TYPE OF CONTACT (BUSINESS, TECHNICAL, ADMINISTRATIVE) |
| CONTACT PHONE # | EXTENSION | CONTACT FAX # | CONTACT EMAIL ADDRESS |
| NAME OF CONTACT PERSON | | | TYPE OF CONTACT (BUSINESS, TECHNICAL, ADMINISTRATIVE) |
| CONTACT PHONE # | EXTENSION | CONTACT FAX # | CONTACT EMAIL ADDRESS |

## CONTRACTOR INFORMATION

| | | | | |
|---|---|---|---|---|
| NAME OF CONTRACTING COMPANY | | | | |
| NAME OF CONTACT PERSON | | | TITLE OF CONTACT PERSON | |
| CONTACT PHONE # | EXTENSION | CONTACT FAX # | CONTACT EMAIL ADDRESS | |
| MAILING ADDRESS | | | CITY | STATE / ZIP |

* AEP Ohio Account Number where measure is installed
** Energy efficiency credits cannot exceed 50 percent of the total project

gridSMART From AEP OHIO

**Self-Direct Program Project Application**

# SELF-DIRECT APPLICATION AGREEMENT

As an eligible AEP Ohio customer, I certify that the installation of the indicated energy efficiency measures, which will be demonstrated with supporting documentation required by AEP Ohio, and that work was completed on this project on or after Jan 1, 2007. The energy efficiency measures are for use on-site and not for resale. Project documentation, including copies of dated invoices for the purchase and installation of the measures and product specification sheets, is required. Further documentation requirements can be found at the program website www.gridsmartohio.com or by calling the program hotline.

I understand that the location or business name on the invoice must be consistent with the application information. Final Applications and all required supporting documentation should be received by Dec 15, 2010.

I agree to verification by the utility or their representatives of both sales transactions and equipment installation.

I understand that these energy efficiency credits are available to all eligible customers who pay the Energy Efficiency and Demand Response (EE/PDR) rider and receive their electricity over AEP Ohio wires regardless of which retail electric supplier the customer has chosen to purchase power from.

I certify that the information on this application is true and correct, and that the Taxpayer ID Number and tax status is the applicant's. I understand that incentives over $600 will be reported to the IRS unless the applicant is exempt. I understand that energy efficiency credits assume related energy benefits over a period of 5 years or for the life of the product, whichever is less.

I agree that if: I remove the related product(s) identified in my application before a period of 5 years or the end of the product life, whichever is less, then I shall refund a prorated amount of energy efficiency credits to AEP Ohio based on the actual period of time in which the related product(s) were installed and operating. This is necessary to assure that the project's related energy benefits will be achieved.

I understand that the program may be modified or terminated without prior notice.

AEP Ohio reserves the right to refuse payment and participation if the customer or contractor violates Program rules and requirements. AEP Ohio is not liable for energy efficiency credits promised to customers as a result of misrepresentation of the Program.

Customer and customer's contractor shall be responsible to comply with any applicable codes or ordinances.

All submissions become the property of AEP Ohio. Keep a copy for your records.

I understand that the Application and all required documentation must be received by the AEP Ohio gridSMART℠ program prior to December 15, 2010. All equipment must be fully operational.

I understand that this project must involve a facility improvement that results in improved energy efficiency. I also understand that all materials removed, including lamps and PCB ballasts, must be permanently taken out of service and disposed of in accordance with local codes and ordinances. I understand it is my responsibility to be aware of any applicable codes or ordinances. Information about hazardous waste disposal can be found at: http://www.epa.gov/osw/hazwaste.htm.

AEP Ohio will pay 75% of the lesser of: 1) The calculated credit as approved by AEP Ohio subject to funding limits or 2) 50% of the total project cost (subject to application caps). I understand that AEP Ohio or their representatives have the right to ask for additional information at any time. AEP Ohio's gridSMART program will make the final determination of energy efficiency credit levels for this project.

The program has a limited budget. Applications will be processed within the budget limits. Applications and all supporting documentation required should be received by Dec 15, 2010 to be eligible for funding under the current program period.

Customer understands and agrees that all other terms and conditions, as specified in the application, including all attachments and exhibits attached to this application which will serve as a contract for the Customer's commitment of energy and demand resources to AEP Ohio shall apply.

gridSMART From AEP OHIO

**Self-Direct Program Project Application**

# SELF-DIRECT APPLICATION AGREEMENT

I understand that AEP Ohio does not guarantee the energy savings and does not make any warranties associated with the measures eligible for energy efficiency credits under this program, and, further, that AEP Ohio has no obligations regarding and does not endorse or guarantee any claims, promises, work, or equipment made, performed, or furnished by any contractors or equipment vendors that sell or install any energy efficiency measures.
Energy efficiency credits will be based upon the final application and program terms and conditions, as well as the availability of funds.

Any and all energy savings or environmental credits generated by the project described in this application will be retained by AEP Ohio.

## ENERGY EFFICIENCY CREDITS REQUESTED

| TOTAL PROJECT COST | TOTAL ENERGY EFFICIENCY CREDITS REQUESTED |
|---|---|
| | |

| CUSTOMER SIGNATURE (AEP CUSTOMER) |
|---|
| ☐ |

| PRINT NAME | DATE | ACTUAL COMPLETION DATE |
|---|---|---|
| | | |

**I have read and understand the program requirements and Measure Specifications and Terms and Conditions set forth in this application and agree to abide by those requirements. Furthermore, I concur that I must meet all eligibility criteria in order to be paid under this program.**
**ALL EQUIPMENT MUST BE INSTALLED AND OPERATIONAL. A CUSTOMER SIGNATURE IS REQUIRED. SIGNED APPLICATIONS RECEIVED BY FAX OR EMAIL WILL BE TREATED THE SAME AS ORIGINAL APPLICATIONS RECEIVED BY MAIL. All submissions become the property of AEP Ohio. Keep a copy for your records.**

## PAYMENT RELEASE AUTHORIZATION (OPTIONAL)

*Complete this section ONLY if energy efficiency credits will be provided to an entity other than the AEP Ohio customer listed on the Applicant Information page.*

I am authorizing the third party named below to receive my energy efficiency credits and I understand that I will not be receiving the energy efficiency credits from AEP Ohio. I also understand that my release of the payment to a third party does not exempt me from the program requirements outlined in the measure specifications and Terms & Conditions.

**Authorized by:**

| CUSTOMER SIGNATURE (AEP Ohio CUSTOMER) | PRINT NAME | DATE |
|---|---|---|
| ☐ | | |

**Check should be made payable to:**

| PAYEE: COMPANY/INDIVIDUAL NAME | | |
|---|---|---|
| MAILING ADDRESS | | |
| CITY | STATE | ZIP |
| CONTACT PHONE NUMBER | | |

| TAXPAYER ID # (SSN/FEIN OF PAYEE) | TAX STATUS Corporation (Inc., PC, Etc.), Tax Exempt, Individual, Other (May receive 1099) |
|---|---|
| | |

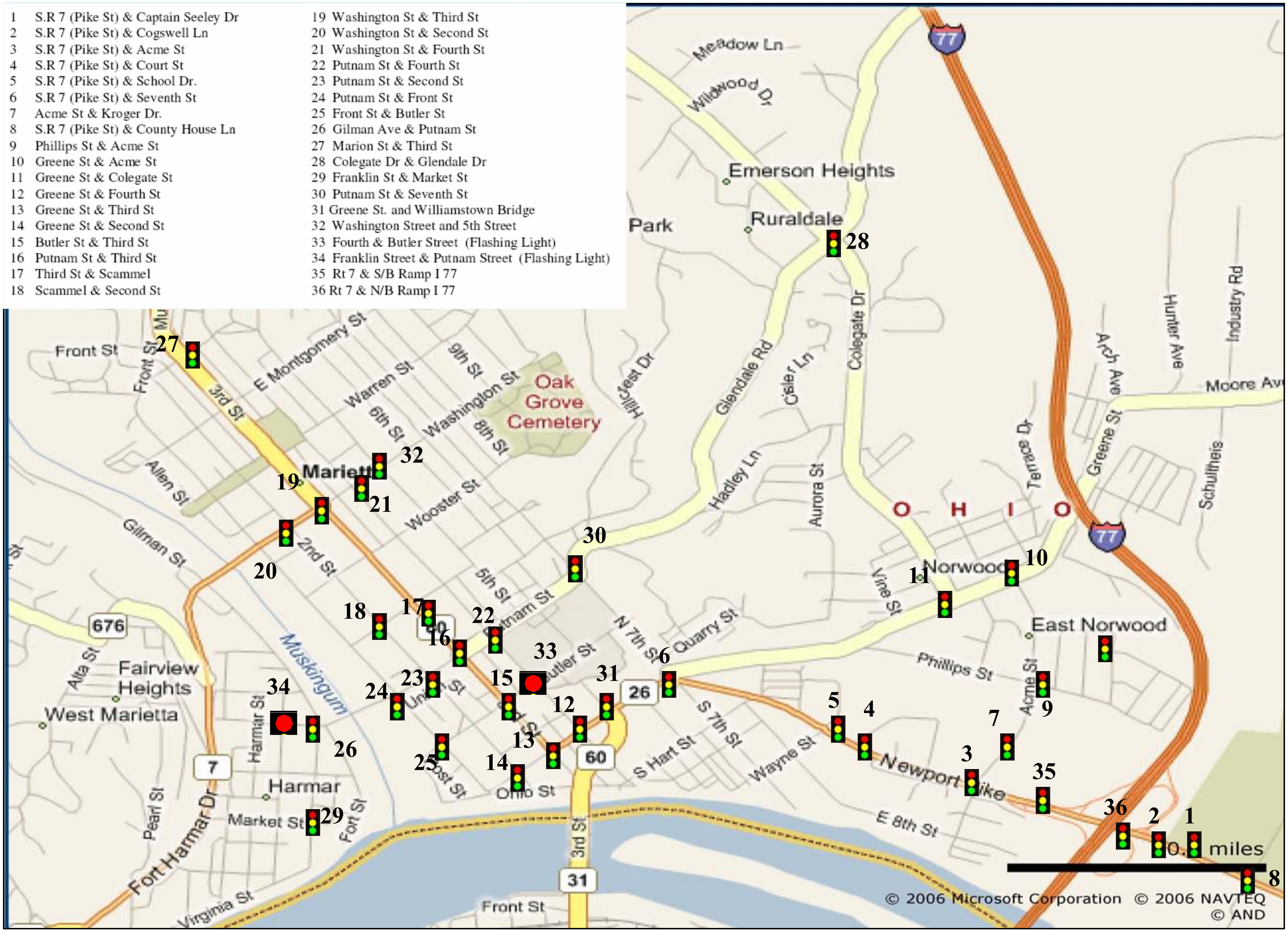
| Account Name | Service Address | City | State |
|---|---|---|---|
| City Of Marietta | Ingleside Ave | Marietta | OH |
| City Of Marietta | Linwood Ave | Marietta | OH |
| City Of Marietta | E 8th St | Marietta | OH |
| City Of Marietta | Gilman Ave | Marietta | OH |
| City Of Marietta | Fay Ave | Marietta | OH |
| City Of Marietta | 763 Greene St | Marietta | OH |
| City Of Marietta | Franklin St | Marietta | OH |
| City Of Marietta | 807 Glendale Rd | Marietta | OH |
| City Of Marietta | Coventry Rd | Marietta | OH |
| City Of Marietta | 311 Fort Harmar Dr | Marietta | OH |
| City Of Marietta | Gilman Ave | Marietta | OH |
| City Of Marietta | Franklin St | Marietta | OH |
| City Of Marietta | 1000 Greene St | Marietta | OH |
| City Of Marietta | 200 4th St | Marietta | OH |
| City Of Marietta | 1702 Greene St | Marietta | OH |
| City Of Marietta | Putnam Pl | Marietta | OH |
| City Of Marietta | 200 Butler St | Marietta | OH |
| City Of Marietta | 2nd St | Marietta | OH |
| City Of Marietta | Pearl St | Marietta | OH |
| City Of Marietta | Pike St | Marietta | OH |
| City Of Marietta | 333 Front St | Marietta | OH |
| City Of Marietta | 402 Fort Harmar Dr | Marietta | OH |
| City Of Marietta | 300 Putnam Ave | Marietta | OH |
| City Of Marietta | 4th St | Marietta | OH |
| City Of Marietta | Wayne St | Marietta | OH |
| City Of Marietta | Acme St | Marietta | OH |
| City Of Marietta | 241 Front St | Marietta | OH |
| City Of Marietta | N 7th St | Marietta | OH |
| City Of Marietta | 200 N 7th St | Marietta | OH |
| City Of Marietta | 105 Oakview Dr | Marietta | OH |
| City Of Marietta | Ohio St | Marietta | OH |
| City Of Marietta | 104 Greene St | Marietta | OH |
| City Of Marietta | Pike St | Marietta | OH |
| City Of Marietta | State Route 7 | Marietta | OH |
| City Of Marietta | 800 Marion St | Marietta | OH |
| City Of Marietta | Scammel St | Marietta | OH |
| City Of Marietta | Colegate Dr | Marietta | OH |
| City Of Marietta | 414 Greene St | Marietta | OH |
| City Of Marietta | Lancaster St | Marietta | OH |
| City Of Marietta | Wayne St | Marietta | OH |
| City Of Marietta | Manchester Dr | Marietta | OH |
| City Of Marietta | 308 Putnam St | Marietta | OH |
| City Of Marietta | State Route 7 | Marietta | OH |

| | | | |
|---|---|---|---|
| City Of Marietta | Fairgrounds Park | Marietta | OH |
| City Of Marietta | 533 Front St | Marietta | OH |
| City Of Marietta | N 8th St | Marietta | OH |
| City Of Marietta | 1114 Glendale Rd | Marietta | OH |
| City Of Marietta | 2nd St | Marietta | OH |
| City Of Marietta | 5th St | Marietta | OH |
| City Of Marietta | 4th St | Marietta | OH |
| City Of Marietta | Butler St | Marietta | OH |
| City Of Marietta | 102 Cullen Rd | Marietta | OH |
| City Of Marietta | 300 Washington St | Marietta | OH |
| City Of Marietta | N 7th St | Marietta | OH |
| City Of Marietta | Linwood Ave | Marietta | OH |
| City Of Marietta | 200 2nd St | Marietta | OH |
| City Of Marietta | 3rd St | Marietta | OH |
| City Of Marietta | 200 Washington St | Marietta | OH |
| City Of Marietta | Linwood Ave | Marietta | OH |
| City Of Marietta | Franklin St | Marietta | OH |
| City Of Marietta | Mountain Laurel Dr | Marietta | OH |
| City Of Marietta | 414 Greene St | Marietta | OH |
| City Of Marietta | Jefferson St | Marietta | OH |
| City Of Marietta | State Route 676 | Marietta | OH |
| City Of Marietta | 5th St | Marietta | OH |
| City Of Marietta | 145 Sunset Dr | Marietta | OH |
| City Of Marietta | Acme St | Marietta | OH |
| City Of Marietta | 100 Front St | Marietta | OH |
| City Of Marietta | 707 Lancaster St | Marietta | OH |
| City Of Marietta | Glendale Rd | Marietta | OH |
| City Of Marietta | Pike St | Marietta | OH |
| City Of Marietta | Phillips St | Marietta | OH |
| City Of Marietta | 200 3rd St | Marietta | OH |
| City Of Marietta | 1225 Glendale Rd | Marietta | OH |
| City Of Marietta | 835 Front St | Marietta | OH |
| City Of Marietta | Linwood Ave | Marietta | OH |
| City Of Marietta | Linwood Ave | Marietta | OH |
| City Of Marietta | 301 Putnam St | Marietta | OH |
| City Of Marietta | 100 Ohio Blvd | Marietta | OH |
| City Of Marietta | 4th St | Marietta | OH |
| City Of Marietta | Groves Ave | Marietta | OH |
| City Of Marietta | Pennsylvania Ave | Marietta | OH |
| City Of Marietta | Linwood Ave | Marietta | OH |
| City Of Marietta | 208 Alderman St | Marietta | OH |
| City Of Marietta | 233 Pennsylvania Ave | Marietta | OH |
| City Of Marietta | 440 E 8th St | Marietta | OH |
| City Of Marietta | 1201 Cisler Dr | Marietta | OH |

| | | | |
|---|---|---|---|
| City Of Marietta | 304 Putnam St | Marietta | OH |
| City Of Marietta | E 8th St | Marietta | OH |
| City Of Marietta | Mill Creek Rd | Marietta | OH |
| City Of Marietta | Fort Sq | Marietta | OH |
| City Of Marietta | 801 Lancaster St | Marietta | OH |
| City Of Marietta | 707 Lancaster St | Marietta | OH |
| City Of Marietta | 233 Pennsylvania Ave Unit 9 | Marietta | OH |
| City Of Marietta | 601 Allen St | Marietta | OH |
| City Of Marietta | Gilman Ave | Marietta | OH |
| City Of Marietta | Grant Edwards Dr | Marietta | OH |
| City Of Marietta | Greene St | Marietta | OH |
| City Of Marietta | 1 City St | Marietta | OH |
| City Of Marietta | 119 Greene St | Marietta | OH |
| City Of Marietta | 217 3rd St | Marietta | OH |
| City Of Marietta | 1 Harmar St | Marietta | OH |
| City Of Marietta | 108 Ohio Blvd | Marietta | OH |
| City Of Marietta | 112 Ohio Blvd | Marietta | OH |
| City Of Marietta | Washington St | Marietta | OH |
| City Of Marietta | 108 2nd St | Marietta | OH |
| City Of Marietta | 101 Front St | Marietta | OH |
| City Of Marietta | 119 Greene St | Marietta | OH |
| City Of Marietta | Ohio St | Marietta | OH |
| City Of Marietta | 102 Ohio Blvd | Marietta | OH |
| City Of Marietta | 101 Greene St | Marietta | OH |
| City Of Marietta | 101 Greene St | Marietta | OH |
| City Of Marietta | 2nd St | Marietta | OH |
| City Of Marietta | 220 Greene St | Marietta | OH |
| City Of Marietta | 108 2nd St | Marietta | OH |
| City Of Marietta | 123 Greene St Unit 2 | Marietta | OH |
| City Of Marietta | 108 2nd St | Marietta | OH |
| City Of Marietta | 123 Greene St Unit 1 | Marietta | OH |
| City Of Marietta | 208 Bellevue St | Marietta | OH |

# City of Marietta LED Replacement Locations

1 S.R 7 (Pike St) & Captain Seeley Dr
2 S.R 7 (Pike St) & Cogswell Ln
3 S.R 7 (Pike St) & Acme St
4 S.R 7 (Pike St) & Court St
5 S.R 7 (Pike St) & School Dr.
6 S.R 7 (Pike St) & Seventh St
7 Acme St & Kroger Dr.
8 S.R 7 (Pike St) & County House Ln
9 Phillips St & Acme St
10 Greene St & Acme St
11 Greene St & Colegate St
12 Greene St & Fourth St
13 Greene St & Third St
14 Greene St & Second St
15 Butler St & Third St
16 Putnam St & Third St
17 Third St & Scammel
18 Scammel & Second St
19 Washington St & Third St
20 Washington St & Second St
21 Washington St & Fourth St
22 Putnam St & Fourth St
23 Putnam St & Second St
24 Putnam St & Front St
25 Front St & Butler St
26 Gilman Ave & Putnam St
27 Marion St & Third St
28 Colegate Dr & Glendale Dr
29 Franklin St & Market St
30 Putnam St & Seventh St
31 Greene St. and Williamstown Bridge
32 Washington Street and 5th Street
33 Fourth & Butler Street (Flashing Light)
34 Franklin Street & Putnam Street (Flashing Light)
35 Rt 7 & S/B Ramp I 77
36 Rt 7 & N/B Ramp I 77



CITY OF MARIETTA
B/R # 90400
QTY. 88

Dialight

# UNIFORM APPEARANCE HAND and PERSON PEDESTRIAN SIGNALS

## Lighting Uniformity. ITE Conformity.

### FEATURES / BENEFITS

- ▲ Uniform non-pixelated appearance
- ▲ Exceeds ITE PTCSI Part 2 requirements for LED pedestrian signals
- ▲ Fuse and transient suppressor incorporated for superior line and load protection
- ▲ ENERGY STAR® qualified
- ▲ 90% reduction in power vs. incandescent
- ▲ Long life; Up to 10 times longer than incandescent
- ▲ Sealed moisture resistant enclosure
- ▲ Lens has a textured surface to reduce glare
- ▲ Easy to install into existing signal enclosure

### SPECIFICATIONS

- ▲ Operating Voltage Range: 80VAC to 135VAC (120VAC nominal)
- ▲ Operating Temperature Range: -40°C to +74°C
- ▲ Turn-on / Turn-off Time < 75 msec
- ▲ Power Factor > 0.9
- ▲ Total Harmonic Distortion < 20%
- ▲ Meets FCC Title 47, Subpart B, Section 15 regulations for electrical noise
- ▲ Failed State Impedance > 250K ohm within 300ms
- ▲ Conforms to MIL-STD-810F for blowing rain
- ▲ Conforms to MIL-STD-883, Test Method 2007, for mechanical vibration
- ▲ Conforms to MIL-STD-883, Test Method 1010, temperature cycling requirements
- ▲ Provided with quick connect terminals and spade adapters
- ▲ Written manufacturer's warranty available on request
- ▲ All products traceable by serial number
- ▲ Luminance uniformity and color uniformity exceed ITE PTCSI-2 LED Pedestrian Signal Specification requirements
- ▲ Symbol Colors:
  Upraised Hand - Portland Orange
  Walking Person - Lunar White
- ▲ Transient suppression exceeds ITE PTCSI-2 LED Pedestrian Signal Specification requirements and meets the following standards:
  - NEMA TS-2 Sec. 2.1.6 and Sec. 2.1.8
  - IEC 1000-4-5, 3KV, 2 ohm source impedance
  - ANSI/IEEE C62, 41-2002; IEC 61000-4-12, 6KV, 200A, 100KHz ring wave
- ▲ Power supply is conformally coated for robust operation

The City of Marietta Engineering Dept.

Dialight Corporation
1501 Route 34 South • Farmingdale, NJ 07727 USA
Tel: (1) 732-919-3119 • Fax: (1) 732-751-5778 • www.dialight.com

MDTSHWPEXCAL001_A

Dialight

**Lighting Uniformity. ITE Conformity.**

# UNIFORM APPEARANCE HAND and PERSON PEDESTRIAN SIGNALS

| Part Number | Housing Size (inches) | Description | Typical Wattage @ 25°C | | Min. Luminance (cd/m²) | | ENERGY STAR® Qualified |
|---|---|---|---|---|---|---|---|
| | | | Hand | Person | Hand | Person | |
| 430-6450-001X | 16 x 18 | Side-by-side Hand and Person | 8 | 7 | 1,400 | 2,200 | ✓ |
| 430-6472-001X | 16 x 18 | Overlay Hand and Person | 8 | 6 | 1,400 | 2,200 | ✓ |
| 430-5770-001X | 12 x 12 | Hand only | 8 | N/A | 1,400 | N/A | ✓ |
| 430-7771-001X | 12 x 12 | Person only | N/A | 7 | N/A | 2,200 | ✓ |
| 430-6772-001X | 12 x 12 | Overlay Hand and Person | 8 | 6 | 1,400 | 2,200 | ✓ |

Dialight reserves the right to make changes at any time in order to supply the best product possible.

Dialight Corporation
1501 Route 34 South • Farmingdale, NJ 07727 USA
Tel: (1) 732-919-3119 • Fax: (1) 732-751-5778 • www.dialight.com

ENERGY STAR PARTNER

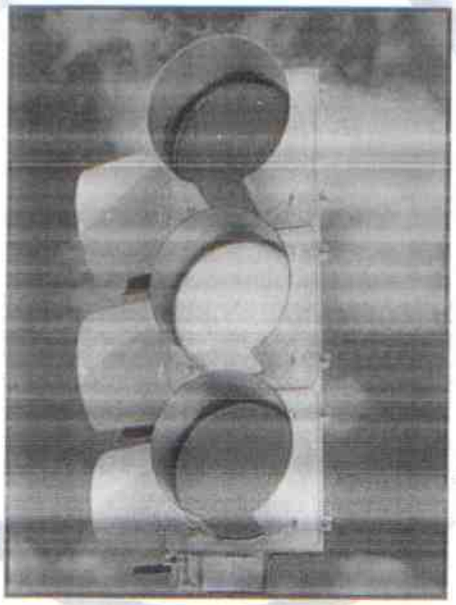
UL REGISTERED FIRM
Dialight Corporation

MDTSHWPEXCAL001_A

Dialight

CITY OF MARIETTA
B/R # 05081
QTY. 1

# HI-FLUX LED MODULES
## "X" & "XL" Series
## TRAFFIC SIGNALS



**Lighting Uniformity.**

Red Ball LED Qty. 1
Yellow Ball LED Qty. 1
Green Ball LED Qty. 1

## FEATURES / BENEFITS

- ▲ Modules including yellow 433-3130-001X and 433-3230-001XL meet the ITE VTCSH-LED Circular Signal Supplement over the full temperature range of -40°C to +74°C
- ▲ Robust Hi-Flux LED Technology
- ▲ Uniform non-pixilated illumination
- ▲ Expanded view radiation pattern suitable for span wire and steep grade applications
- ▲ Fuse and transient suppressor incorporated for superior line and load protection
- ▲ 90% reduction in power vs. incandescent
- ▲ Long life; Up to 10 times longer than incandescent
- ▲ Convex tinted lens reduces glare and sun reflection
- ▲ Hard coated lenses for abrasion resistance
- ▲ Easy to install into existing signal enclosure

## SPECIFICATIONS

- ▲ Operating Voltage Range: 80VAC to 135VAC (120VAC nominal)
- ▲ Operating Temperature Range: -40°C to +74°C
- ▲ Turn-on / Turn-off Time < 75 msec
- ▲ Power Factor > 0.9
- ▲ Total Harmonic Distortion < 20%
- ▲ Meets FCC Title 47, Subpart B, Section 15 regulations for electrical noise
- ▲ Failed State Impedance > 250K ohm within 300ms
- ▲ Conforms to MIL-STD-810F for blowing rain
- ▲ Conforms to MIL-STD-883, Test Method 2007, for mechanical vibration
- ▲ Conforms to MIL-STD-883, Test Method 1010, temperature cycling requirements
- ▲ Provided with quick connect terminals and spade adapters
- ▲ Written manufacturer's warranty available on request
- ▲ All products traceable by serial number
- ▲ Luminance uniformity and color uniformity exceed ITE VTCSH-LED Circular Signal Supplement requirements
- ▲ Transient suppression exceeds ITE VTCSH-LED Circular Supplement requirements and meets the following standards:
  - NEMA TS-2 Sec. 2.1.6 and Sec. 2.1.8
  - IEC 1000-4-5, 3KV, 2 ohm source impedance
  - ANSI/IEEE C62, 41-2002; IEC 61000-4-12, 6KV, 200A, 100KHz ring wave
- ▲ Power supply is conformally coated for robust operation

**LOWEST WATTAGE RED, YELLOW, GREEN PACKAGE ON THE MARKET**

**WE MEET THE NEW ITE REQUIREMENTS EVEN YELLOW AT 74°C**

**Dialight reserves the right to make changes at any time in order to supply the best product possible.**

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Dialight Corporation

433XL_IndyBid

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Lighting Uniformity. ITE Conformity.

# HI-FLUX LED MODULES

## "X" & "XL" Series
## TRAFFIC SIGNALS

### 8" (200MM) 120VAC SIGNAL MODULES

| Part Number | Color | Lens Type | Dominant Wavelength (nm) | Typical Wattage at 25oC | Peak Minimum Maintained Luminous Intensity (cd) | Meets ITE VTCSH LED Circular Signal Supplement |
|---|---|---|---|---|---|---|
| 433-1110-003X | Red | Tinted | 625 | 6 | 165 | ✓ |
| 433-3130-001X | Yellow | Tinted | 590 | 13 | 410 | ✓ |
| 433-2120-001X | Green | Tinted | 500 | 6 | 215 | ✓ |
| 433-2170-001X | Green | Clear | 500 | 6 | 215 | ✓ |

### 12" (300MM) 120VAC SIGNAL MODULES

| Part Number | Color | Lens Type | Dominant Wavelength (nm) | Typical Wattage at 25oC | Peak Minimum Maintained Luminous Intensity (cd) | Meets ITE VTCSH LED Circular Signal Supplement |
|---|---|---|---|---|---|---|
| → 433-1210-003XL | Red | Tinted | 625 | 6 | 365 | ✓ |
| → 433-3230-001XL | Yellow | Tinted | 590 | 19 | 910 | ✓ |
| 433-2220-001XL | Green | Tinted | 500 | 9 | 475 | ✓ |
| → 433-2270-001XL | Green | Clear | 500 | 9 | 475 | ✓ |
| 433-3231-001XL | Yellow | Tinted | 590 | 20 | 910 | ✓ * |

* Luminous intensity measured @ $T_A$=25°C for yellow.

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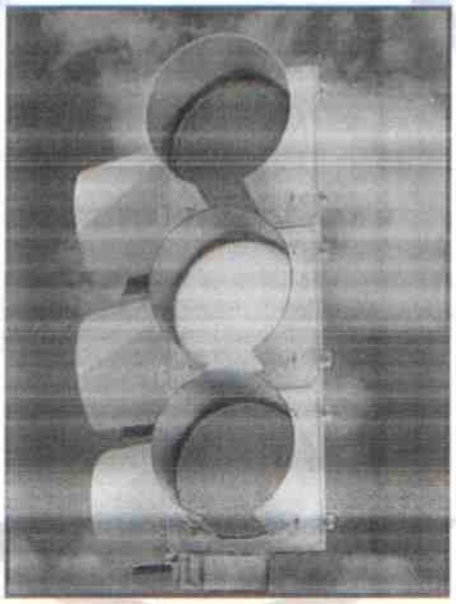
CITY OF MARIETTA
B/R # 05001
QTY. 2

Dialight

# HI-FLUX LED MODULES
## "X" & "XL" Series
## TRAFFIC SIGNALS



**Lighting Uniformity.**

**Red Ball LED Qty. 2**
**Yellow Ball LED Qty. 2**
**Green Ball LED Qty. 2**

## FEATURES / BENEFITS

- ▲ Modules including yellow 433-3130-001X and 433-3230-001XL meet the ITE VTCSH-LED Circular Signal Supplement over the full temperature range of -40°C to +74°C
- ▲ Robust Hi-Flux LED Technology
- ▲ Uniform non-pixilated illumination
- ▲ Expanded view radiation pattern suitable for span wire and steep grade applications
- ▲ Fuse and transient suppressor incorporated for superior line and load protection
- ▲ 90% reduction in power vs. incandescent
- ▲ Long life; Up to 10 times longer than incandescent
- ▲ Convex tinted lens reduces glare and sun reflection
- ▲ Hard coated lenses for abrasion resistance
- ▲ Easy to install into existing signal enclosure

## SPECIFICATIONS

- ▲ Operating Voltage Range:
  80VAC to 135VAC (120VAC nominal)
- ▲ Operating Temperature Range: -40°C to +74°C
- ▲ Turn-on / Turn-off Time < 75 msec
- ▲ Power Factor > 0.9
- ▲ Total Harmonic Distortion < 20%
- ▲ Meets FCC Title 47, Subpart B, Section 15 regulations for electrical noise
- ▲ Failed State Impedance > 250K ohm within 300ms
- ▲ Conforms to MIL-STD-810F for blowing rain
- ▲ Conforms to MIL-STD-883, Test Method 2007, for mechanical vibration
- ▲ Conforms to MIL-STD-883, Test Method 1010, temperature cycling requirements
- ▲ Provided with quick connect terminals and spade adapters
- ▲ Written manufacturer's warranty available on request
- ▲ All products traceable by serial number
- ▲ Luminance uniformity and color uniformity exceed ITE VTCSH-LED Circular Signal Supplement requirements
- ▲ Transient suppression exceeds ITE VTCSH-LED Circular Supplement requirements and meets the following standards:
  - NEMA TS-2 Sec. 2.1.6 and Sec. 2.1.8
  - IEC 1000-4-5, 3KV, 2 ohm source impedance
  - ANSI/IEEE C62, 41-2002; IEC 61000-4-12, 6KV, 200A, 100KHz ring wave
- ▲ Power supply is conformally coated for robust operation

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**Lighting Uniformity. ITE Conformity.**

# HI-FLUX LED MODULES
## "X" & "XL" Series
## TRAFFIC SIGNALS

### 8" (200MM) 120VAC SIGNAL MODULES

| Part Number | Color | Lens Type | Dominant Wavelength (nm) | Typical Wattage at 25oC | Peak Minimum Maintained Luminous Intensity (cd) | Meets ITE VTCSH LED Circular Signal Supplement |
|---|---|---|---|---|---|---|
| 433-1110-003X | Red | Tinted | 625 | 6 | 165 | ✓ |
| 433-3130-001X | Yellow | Tinted | 590 | 13 | 410 | ✓ |
| 433-2120-001X | Green | Tinted | 500 | 6 | 215 | ✓ |
| 433-2170-001X | Green | Clear | 500 | 6 | 215 | ✓ |

### 12" (300MM) 120VAC SIGNAL MODULES

| Part Number | Color | Lens Type | Dominant Wavelength (nm) | Typical Wattage at 25oC | Peak Minimum Maintained Luminous Intensity (cd) | Meets ITE VTCSH LED Circular Signal Supplement |
|---|---|---|---|---|---|---|
| → 433-1210-003XL | Red | Tinted | 625 | 6 | 365 | ✓ |
| → 433-3230-001XL | Yellow | Tinted | 590 | 19 | 910 | ✓ |
| 433-2220-001XL | Green | Tinted | 500 | 9 | 475 | ✓ |
| → 433-2270-001XL | Green | Clear | 500 | 9 | 475 | ✓ |
| 433-3231-001XL | Yellow | Tinted | 590 | 20 | 910 | ✓ * |

* Luminous intensity measured @ $T_A$=25ºC for yellow.

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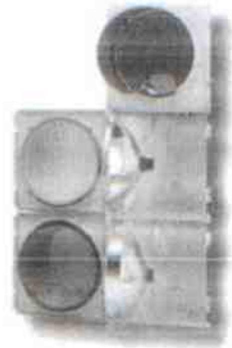
CITY OF MARIETTA
B/R # 05081
QTY. 1

# 12-Inch Aluminum Signal

The signal head is interchangeable with incandescent reflector assemblies or LED modules and offers the option of custom hardware color.



## General

Each traffic signal consists of a number of identical signal sections rigidly fastened together to present a continuous, pleasing appearance. Each section has a separate and complete housing. The traffic signal meets or exceeds the latest version of the Equipment Standard from the Institute of Transportation Engineers (ITE).

## Housing

The housing of each section is a one-piece corrosion-resistant aluminum alloy die-casting. Two integrally-cast hinge lugs and latch screws are cast on each side of the housing. Built upon a symmetrical concept, each housing is capable of providing either right or left-hand door openings. While the left hinge is standard, the right hinge must be specified. The top and bottom of the housing have openings to accommodate standard 1½-inch pipe brackets. Each signal section is rigidly attached, one above the other, by means of corrosion-resistant bolts and washer attachment that allows sections to be rotated about a vertical axis as well as the ability to be oriented with respect to an adjacent section.

The top and bottom openings of the signal housing have an integrally-cast Shurlock boss. The radial angular grooves of the Shurlock boss, when used with Shurlock fittings, provide positive five-degree increment positioning of the signal head to eliminate rotation or misalignment of the signal. Each housing has cast bosses for two-, five-, or six-position terminal blocks. Each position is identified with both number and function cast on housing. Each housing has provisions for easily adding a back-plate. Hinge pins, door latching hardware, visor back-plate, and lens clip screws are high-quality stainless steel.

## Features

- Tested to ITE required wind loading on single-point attachment
- Straight sides - no protruding hinges or latches
- Stainless steel hardware
- Reversible door - left side standard, right side optional
- Aluminum or plastic reflector ring with spun ALZAK reflector
- Optional hydroformed reflector
- Provisions for two-, five-, or six-position terminal blocks in each housing
- Ethylene Propylene Diene Monomer (EPDM) or optional red silicone lens gasketing

*Yellow Housing

*Yellow Visor Cap

## Housing Door

The housing door of each section is a one-piece, corrosion-resistant, aluminum alloy die-casting. Two hinge lugs are cast on one side of the door, and two latch points are cast on the other side. The door is attached to the housing by means of two straight pins. Two "eye" bolts and wing nuts on one side of the door allow for opening and closing of the signal door without the use of tools. A gasket groove on the inside of the door accommodates a weatherproof and mildew proof resilient gasket which, when the door is closed, seals against a raised bead on the housing, creating a positive seal. The outer face of the door has four holes, equally spaced about the circumference of the lens opening, with four screws to accommodate the signal head visor. The door has at least two index points to enable positive orientation of the lens. The door and visor overlap to prevent light escaping between the visor and door.

*For Use W/ LED's

## Optical System

Lens - The prismed traffic signal lens is standard red, yellow, or green and conforms to the latest revision of the ITE standard specification. The lens fits into a specially designed, slotted, extruded, and bonded full-circle EPDM lens gasket designed to fit the housing door so as to exclude moisture, dust, and road film. The lens and gasket are secured to the door with four aluminum lens clips and stainless steel screws. The lenses are ~~polycarbonate, glass,~~ or LED modules, as specified.

~~Reflector - The reflector assembly consists of a glass-filled polycarbonate or aluminum reflector ring (or optional unitized hydroformed ALZAK aluminum reflector). The assembly is pivoted in the signal housing on two stainless steel pins so that it can be easily opened to service the unit. The entire assembly can be easily removed for maintenance or service without the use of tools.~~

~~Lamp Receptacle - The pre-focused, molded phenolic lamp receptacle is equipped with a lamp grip to prevent the lamp from coming loose due to vibration. The receptacle is able to be rotated to allow proper orientation of lamp filament.~~

~~Bail - The bail is a corrosion-resistant plated wire assembly that secures and orients the socket to the reflector.~~

## Wiring

Each receptacle provides two leads with "Fast-on" type terminals. Wires are color coded per customer specifications.

Lamp receptacle conductors are No. 18 AWG (or larger) 600V appliance wiring material, which conforms to Military Specification MIL-W-16878 D, Type B with a vinyl nylon jacket rated 115°C.

## Terminal Block

Each signal face is provided with a terminal block. The terminal block for a standard three-section head is a five- or six-position, ten or twelve-terminal, barrier-type strip. Attached to one side of each "Fast-on" terminal strip are section leads, leaving the opposite screw-clamp terminal for field wires.

## Visors

Visors are tunnel, full-circle, or cap, and are a minimum of 9½ inches long. Visors are formed of corrosion-resistant aluminum alloy sheet. They have attaching tabs to facilitate installation.

## Painting

All interior and exterior parts of the housing, door, back-plate, and visor are pre-treated for painting in the following stages: Degrease, rinse, etch with an iron phosphate solution, rinse, final dionized water rinse, and then dry for 10 minutes at 400°F. The parts are then painted with a single coat of environmentally safe, ultraviolet-resistant, polyester powder coating which is applied electrostatically at 90 kV and baked for 20 minutes at 400°F per ASTM D-3359, ASTM D-3363, and ASTM D-522. The signal head color is specified by the customer, except for the inside of the visor and the front side of the back-plate which are painted dull black.

Standard Colors Are:

- Dark Olive Green (matches Federal Standard 595b-14056)
- Yellow (matches Federal Standard 595b-13538
- Black (matches Federal Standard 595b-17038)
- Dull Black (matches Federal Standard 595b-37038)

## Technical Data

- Dimensions (less visor) 14¼ in. H x 12⅝ in. W x 7 in. D
- Weight, typical:
  - ~~Poly lens – 8.85 lb (less visor)~~
  - ~~Glass lens – 10.50 lb (less visor)~~



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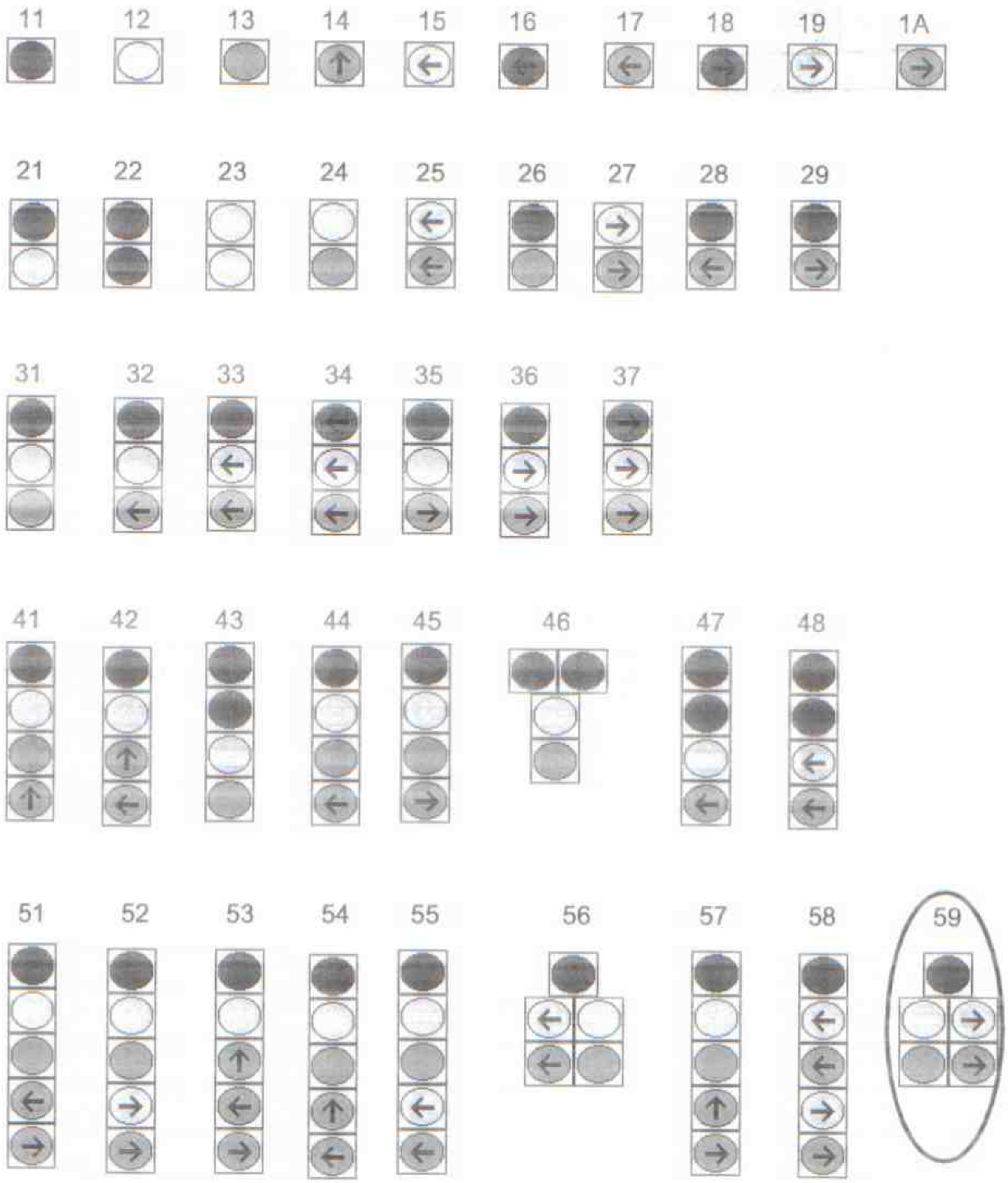
B/R # 05081
QTY. 1

**Signal Arrangements Qty. 1**

# FACE ARRANGEMENTS

## VERTICAL



CITY OF MARIETTA
B/R # 05001
QTY. 2

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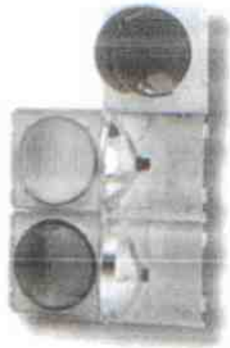
# 12-Inch Aluminum Signal

The signal head is interchangeable with incandescent reflector assemblies or LED modules and offers the option of custom hardware color.



## General

Each traffic signal consists of a number of identical signal sections rigidly fastened together to present a continuous, pleasing appearance. Each section has a separate and complete housing. The traffic signal meets or exceeds the latest version of the Equipment Standard from the Institute of Transportation Engineers (ITE).

## Housing

The housing of each section is a one-piece corrosion-resistant aluminum alloy die-casting. Two integrally-cast hinge lugs and latch screws are cast on each side of the housing. Built upon a symmetrical concept, each housing is capable of providing either right or left-hand door openings. While the left hinge is standard, the right hinge must be specified. The top and bottom of the housing have openings to accommodate standard 1½-inch pipe brackets. Each signal section is rigidly attached, one above the other, by means of corrosion-resistant bolts and washer attachment that allows sections to be rotated about a vertical axis as well as the ability to be oriented with respect to an adjacent section.

The top and bottom openings of the signal housing have an integrally-cast Shurlock boss. The radial angular grooves of the Shurlock boss, when used with Shurlock fittings, provide positive five-degree increment positioning of the signal head to eliminate rotation or misalignment of the signal. Each housing has cast bosses for two-, five-, or six-position terminal blocks. Each position is identified with both number and function cast on housing. Each housing has provisions for easily adding a back-plate. Hinge pins, door latching hardware, visor back-plate, and lens clip screws are high-quality stainless steel.

## Features

- Tested to ITE required wind loading on single-point attachment
- Straight sides - no protruding hinges or latches
- Stainless steel hardware
- Reversible door - left side standard, right side optional
- Aluminum or plastic reflector ring with spun ALZAK reflector
- Optional hydroformed reflector
- Provisions for two-, five-, or six-position terminal blocks in each housing
- Ethylene Propylene Diene Monomer (EPDM) or optional red silicone lens gasketing

*Yellow Housing

*Yellow Visor Cap

## Housing Door

The housing door of each section is a one-piece, corrosion-resistant, aluminum alloy die-casting. Two hinge lugs are cast on one side of the door, and two latch points are cast on the other side. The door is attached to the housing by means of two straight pins. Two "eye" bolts and wing nuts on one side of the door allow for opening and closing of the signal door without the use of tools. A gasket groove on the inside of the door accommodates a weatherproof and mildew-proof resilient gasket which, when the door is closed, seals against a raised bead on the housing, creating a positive seal. The outer face of the door has four holes, equally spaced about the circumference of the lens opening, with four screws to accommodate the signal head visor. The door has at least two index points to enable positive orientation of the lens. The door and visor overlap to prevent light escaping between the visor and door.

## Optical System

*For Use W/ LED's

Lens - The prismed traffic signal lens is standard red, yellow, or green and conforms to the latest revision of the ITE standard specification. The lens fits into a specially designed, slotted, extruded, and bonded full-circle EPDM lens gasket designed to fit the housing door so as to exclude moisture, dust, and road film. The lens and gasket are secured to the door with four aluminum lens clips and stainless steel screws. The lenses are ~~polycarbonate, glass,~~ or LED modules, as specified.

~~Reflector - The reflector assembly consists of a glass-filled polycarbonate or aluminum reflector ring (or optional unitized hydroformed ALZAK aluminum reflector). The assembly is pivoted in the signal housing on two stainless steel pins so that it can be easily opened to service the unit. The entire assembly can be easily removed for maintenance or service without the use of tools.~~

~~Lamp Receptacle - The pre-focused, molded phenolic lamp receptacle is equipped with a lamp grip to prevent the lamp from coming loose due to vibration. The receptacle is able to be rotated to allow proper orientation of lamp filament.~~

~~Bail - The bail is a corrosion-resistant piano wire assembly that secures and orients the socket to the reflector.~~

## Wiring

Each receptacle provides two leads with "Fast-on" type terminals. Wires are color coded per customer specifications.

Lamp receptacle conductors are No. 18 AWG (or larger) 600V appliance wiring material, which conforms to Military Specification MIL-W-16878 D, Type B with a vinyl nylon jacket rated 115°C.

## Terminal Block

Each signal face is provided with a terminal block. The terminal block for a standard three-section head is a five- or six-position, ten or twelve-terminal, barrier-type strip. Attached to one side of each "Fast-on" terminal strip are section leads, leaving the opposite screw-clamp terminal for field wires.

## Visors

Visors are tunnel, full-circle, or cap, and are a minimum of 9½ inches long. Visors are formed of corrosion-resistant aluminum alloy sheet. They have attaching tabs to facilitate installation.

## Painting

All interior and exterior parts of the housing, door, back-plate, and visor are pre-treated for painting in the following stages: Degrease, rinse, etch with an iron phosphate solution, rinse, final dionized water rinse, and then dry for 10 minutes at 400°F. The parts are then painted with a single coat of environmentally-safe, ultraviolet-resistant, polyester powder coating which is applied electrostatically at 90 kV and baked for 20 minutes at 400°F per ASTM D 3359, ASTM D 3363, and ASTM D 522.

The signal head color is specified by the customer, except for the inside of the visor and the front side of the back-plate which are painted dull black.

Standard Colors Are:

- Dark Olive Green (matches Federal Standard 595b-14056)
- Yellow (matches Federal Standard 595b-13538)
- Black (matches Federal Standard 595b-17038)
- Dull Black (matches Federal Standard 595b-37038)

## Technical Data

- Dimensions (less visor) 14½ in. H x 12⅝ in. W x 7 in. D
- Weight, typical:
  - ~~Poly lens = 8.85 lb (less visor)~~
  - ~~Glass lens = 10.50 lb (less visor)~~



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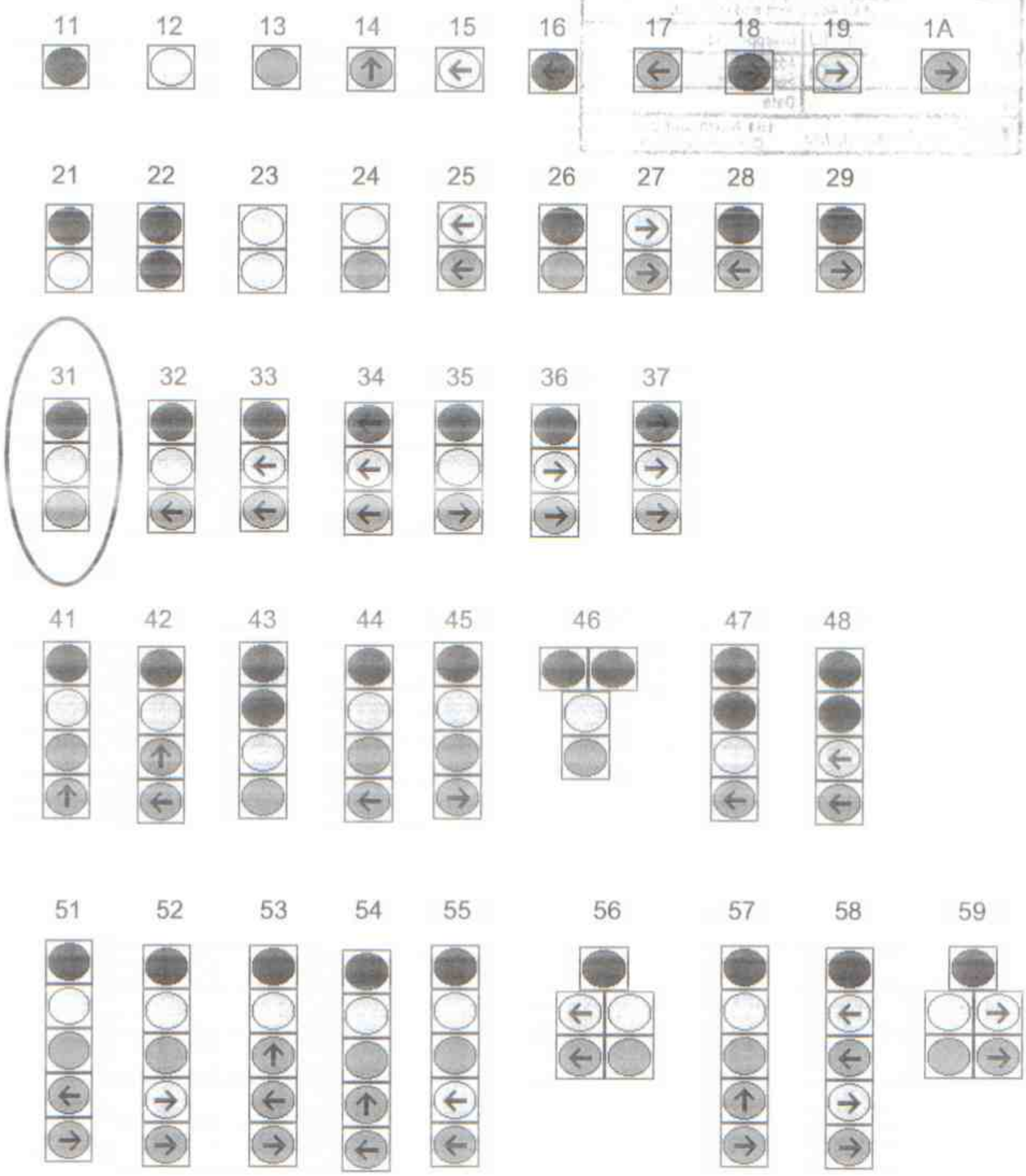
B/R # 05001
QTY. 2

# FACE ARRANGEMENTS

## VERTICAL

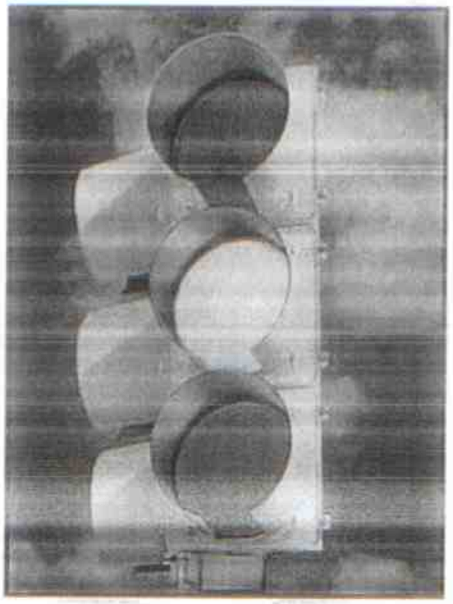
**Signal Arrangements Qty. 2**



CITY OF MARIETTA
B/R # 10011
QTY. 252

Dialight

# HI-FLUX LED MODULES
## "X" & "XL" Series
## TRAFFIC SIGNALS



Yellow Ball LED Qty. 252

## Lighting Uniformity. ITE Conformity.

### FEATURES / BENEFITS

- ▲ Modules including yellow 433-3130-001X and 433-3230-001XL meet the ITE VTCSH-LED Circular Signal Supplement over the full temperature range of -40°C to +74°C
- ▲ Robust Hi-Flux LED Technology
- ▲ Uniform non-pixilated illumination
- ▲ Expanded view radiation pattern suitable for span wire and steep grade applications
- ▲ Fuse and transient suppressor incorporated for superior line and load protection
- ▲ 90% reduction in power vs. incandescent
- ▲ Long life; Up to 10 times longer than incandescent
- ▲ Convex tinted lens reduces glare and sun reflection
- ▲ Hard coated lenses for abrasion resistance
- ▲ Easy to install into existing signal enclosure

### SPECIFICATIONS

- ▲ Operating Voltage Range: 80VAC to 135VAC (120VAC nominal)
- ▲ Operating Temperature Range: -40°C to +74°C
- ▲ Turn-on / Turn-off Time < 75 msec
- ▲ Power Factor > 0.9
- ▲ Total Harmonic Distortion < 20%
- ▲ Meets FCC Title 47, Subpart B, Section 15 regulations for electrical noise
- ▲ Failed State Impedance > 250K ohm within 300ms
- ▲ Conforms to MIL-STD-810F for blowing rain
- ▲ Conforms to MIL-STD-883, Test Method 2007, for mechanical vibration
- ▲ Conforms to MIL-STD-883, Test Method 1010, temperature cycling requirements
- ▲ Provided with quick connect terminals and spade adapters
- ▲ Written manufacturer's warranty available on request
- ▲ All products traceable by serial number
- ▲ Luminance uniformity and color uniformity exceed ITE VTCSH-LED Circular Signal Supplement requirements
- ▲ Transient suppression exceeds ITE VTCSH-LED Circular Supplement requirements and meets the following standards:
  - NEMA TS-2 Sec. 2.1.6 and Sec. 2.1.8
  - IEC 1000-4-5, 3KV, 2 ohm source impedance
  - ANSI/IEEE C62, 41-2002; IEC 61000-4-12, 6KV, 200A, 100KHz ring wave
- ▲ Power supply is conformally coated for robust operation

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**Lighting Uniformity. ITE Conformity.**

# HI-FLUX LED MODULES
## "X" & "XL" Series
## TRAFFIC SIGNALS

### 8" (200MM) 120VAC SIGNAL MODULES

| Part Number | Color | Lens Type | Dominant Wavelength (nm) | Typical Wattage at 25oC | Peak Minimum Maintained Luminous Intensity (cd) | Meets ITE VTCSH LED Circular Signal Supplement |
|---|---|---|---|---|---|---|
| 433-1110-003X | Red | Tinted | 625 | 6 | 165 | ✓ |
| 433-3130-001X | Yellow | Tinted | 590 | 13 | 410 | ✓ |
| 433-2120-001X | Green | Tinted | 500 | 6 | 215 | ✓ |
| 433-2170-001X | Green | Clear | 500 | 6 | 215 | ✓ |

### 12" (300MM) 120VAC SIGNAL MODULES

| Part Number | Color | Lens Type | Dominant Wavelength (nm) | Typical Wattage at 25oC | Peak Minimum Maintained Luminous Intensity (cd) | Meets ITE VTCSH LED Circular Signal Supplement |
|---|---|---|---|---|---|---|
| 433-1210-003XL | Red | Tinted | 625 | 6 | 365 | ✓ |
| → 433-3230-001XL | Yellow | Tinted | 590 | 19 | 910 | ✓ |
| 433-2220-001XL | Green | Tinted | 500 | 9 | 475 | ✓ |
| 433-2270-001XL | Green | Clear | 500 | 9 | 475 | ✓ |
| 433-3231-001XL | Yellow | Tinted | 590 | 20 | 910 | ✓* |

* Luminous intensity measured @ $T_A$=25°C for yellow.

**Dialight reserves the right to make changes at any time in order to supply the best product possible.**

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Dialight Corporation

**Dialight Corporation**
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433XL_IndyBid

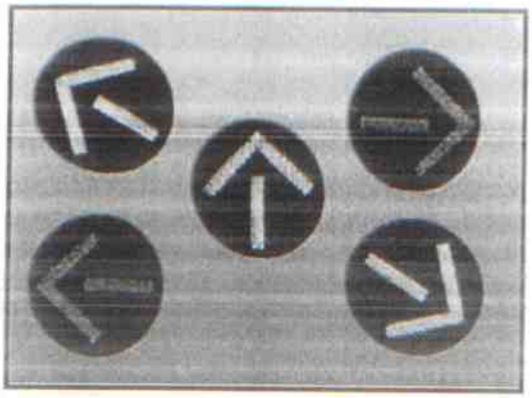
CITY OF MARIETTA
B/R # 10031
QTY. 23

Dialight

**Lighting Uniformity, ITE Conformity**

Yellow Arrow LED Qty. 23

# OMNI-DIRECTIONAL, UNIFORM APPEARANCE LED ARROWS



## FEATURES / BENEFITS

- ▲ All modules (including yellow) meet the ITE VTCSH LED Vehicle Arrow Traffic Signal Supplement version April 3, 2006 over the full temperature range of -40°C to +74°C
- ▲ Uniform, non-pixelated appearance
- ▲ Omni-Directional, expanded view radiation pattern meets ITE VTCSH LED Vehicle Arrow Traffic Signal Supplement version April 3, 2006
- ▲ 90% reduction in power vs. incandescent
- ▲ Long life: Up to 10 times longer than incandescent
- ▲ Fuse and transient suppressor incorporated for superior line and load protection
- ▲ Convex tinted lens reduces glare and sun reflection
- ▲ Hard coated lenses for abrasion resistance
- ▲ Easy to install into existing signal enclosure

## SPECIFICATIONS

- ▲ Omni-directional radiation pattern compliant with ITE omni-directional arrow specifications
- ▲ Operating Voltage Range: 80VAC to 135VAC (120VAC nominal)
- ▲ Operating Temperature Range: -40°C to +74°C
- ▲ Turn-on / Turn-off Time < 75 msec
- ▲ Power Factor > 0.9
- ▲ Total Harmonic Distortion < 20%
- ▲ Meets FCC Title 47, Subpart B, Section 15 regulations for electrical noise
- ▲ Failed State Impedance > 250K ohm within 300ms
- ▲ Conforms to MIL-STD-810F for blowing rain
- ▲ Conforms to MIL-STD-883, Test Method 2007, for mechanical vibration
- ▲ Conforms to MIL-STD-883, Test Method 1010, temperature cycling requirements
- ▲ Provided with quick connect terminals and spade adapters
- ▲ Written manufacturer's warranty available on request
- ▲ All products traceable by serial number
- ▲ Luminance Uniformity and Color Uniformity exceed ITE VTCSH LED Vehicle Arrow Traffic Signal Supplement version April 3, 2006
- ▲ Transient suppression exceeds ITE VTCSH-3 LED Arrow Specification requirements and meets the following standards:
  - NEMA TS-2 Sec. 2.1.6 and Sec. 2.1.8
  - IEC 1000-4-5, 3KV, 2 ohm source impedance
  - ANSI/IEEE C62, 41-2002; IEC 61000-4-12, 6KV, 200A, 100KHz ring wave
- ▲ Power supply is conformally coated for robust operation

**WE MEET THE NEW ITE REQUIREMENTS, EVEN YELLOW AT 74°C**

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Dialight

**Lighting Uniformity, ITE Conformity**

# OMNI-DIRECTIONAL, UNIFORM APPEARANCE LED ARROWS

## 12" (300mm) - 120 VOLT OMNI-DIRECTIONAL ARROWS

| Part Number | Color | Lens Type | Typical Wattage at 25°C | Dominant Wavelength (nm) | Peak Minimum Maintained Luminous Intensity (cd) |
|---|---|---|---|---|---|
| 432-1314-001XOD | Red | Tinted | 6 | 628 | 56.8 |
| 431-3334-001XOD | Yellow | Tinted | 9 | 590 | 141.6 |
| 432-2324-001XOD | Green | Tinted | 6 | 500 | 73.9 |
| 432-2374-001XOD | Green | Clear | 6 | 500 | 73.9 |

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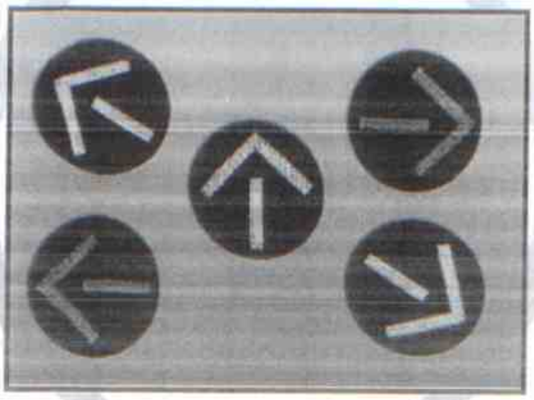
B/R # 05081
QTY. 1

Dialight

# OMNI-DIRECTIONAL, UNIFORM APPEARANCE LED ARROWS



## Lighting Uniformity, ITE Conformity

## FEATURES / I

Yellow Arrow LED Qty. 1
Green Arrow LED Qty. 1

- ▲ All modules (including yellow) meet the ITE VTCSH LED Vehicle Arrow Traffic Signal Supplement version April 3, 2006 over the full temperature range of -40°C to +74°C
- ▲ Uniform, non-pixelated appearance
- ▲ Omni-Directional, expanded view radiation pattern meets ITE VTCSH LED Vehicle Arrow Traffic Signal Supplement version April 3, 2006
- ▲ 90% reduction in power vs. incandescent
- ▲ Long life; Up to 10 times longer than incandescent
- ▲ Fuse and transient suppressor incorporated for superior line and load protection
- ▲ Convex tinted lens reduces glare and sun reflection
- ▲ Hard coated lenses for abrasion resistance
- ▲ Easy to install into existing signal enclosure

## SPECIFICATIONS

- ▲ Omni-directional radiation pattern compliant with ITE omni-directional arrow specifications
- ▲ Operating Voltage Range: 80VAC to 135VAC (120VAC nominal)
- ▲ Operating Temperature Range: -40°C to +74°C
- ▲ Turn-on / Turn-off Time < 75 msec
- ▲ Power Factor > 0.9
- ▲ Total Harmonic Distortion < 20%
- ▲ Meets FCC Title 47, Subpart B, Section 15 regulations for electrical noise
- ▲ Failed State Impedance > 250K ohm within 300ms
- ▲ Conforms to MIL-STD-810F for blowing rain
- ▲ Conforms to MIL-STD-883, Test Method 2007, for mechanical vibration
- ▲ Conforms to MIL-STD-883, Test Method 1010, temperature cycling requirements
- ▲ Provided with quick connect terminals and spade adapters
- ▲ Written manufacturer's warranty available on request
- ▲ All products traceable by serial number
- ▲ Luminance Uniformity and Color Uniformity exceed ITE VTCSH LED Vehicle Arrow Traffic Signal Supplement version April 3, 2006
- ▲ Transient suppression exceeds ITE VTCSH-3 LED Arrow Specification requirements and meets the following standards:
  - NEMA TS-2 Sec. 2.1.6 and Sec. 2.1.8
  - IEC 1000-4-5, 3KV, 2 ohm source impedance
  - ANSI/IEEE C62, 41-2002; IEC 61000-4-12, 6KV, 200A, 100KHz ring wave
- ▲ Power supply is conformally coated for robust operation

**WE MEET THE NEW ITE REQUIREMENTS, EVEN YELLOW AT 74°C**

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Engineering Dept

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# AEP GridSMART

## KEMA Operations Manual

## Supplement – Summary of Deemed Savings with Multipliers for Incentives Year 2010

# Summary of Common Deemed Savings Measures

The below table contains prescriptive measures in a convenient format for viewing the default deemed savings. These values are multiplied by business type using the chart found in the next section.

| Measure | Unit | Incentive Per Unit | kW Per Unit | Total kWh Per Unit | Years Life | Savings Category |
|---|---|---|---|---|---|---|
| Interior T8/T5 New Fluorescent Fixture w/ Electronic Ballast | Watts Reduced | 0.35 | 0.000916 | 4.9141 | 11 | Interior Non CFL Lighting |
| Exterior T8/T5 New Fluorescent Fixture w/ Electronic Ballast | Watts Reduced | 0.30 | 0 | 4.1 | 11 | Exterior Lighting |
| Garage T8/T5 New Fluorescent Fixture w/ Electronic Ballast | Watts Reduced | 0.35 | 0.001 | 8.76 | 11 | Garage Lighting |
| CFL - Screw-in (15W or Less) | Lamp | 2.00 | 0.029 | 157 | 2.5 | Interior CFL Lighting |
| CFL - Screw-in (16W to 26W) | Lamp | 2.00 | 0.054 | 292 | 2.5 | Interior CFL Lighting |
| CFL - Screw-in (27W or Greater) | Lamp | 3.00 | 0.069 | 371 | 2.5 | Interior CFL Lighting |
| HW CFL - 29W or Less | Fixture | 30.00 | 0.052 | 280 | 12 | Interior CFL Lighting |
| HW CFL - 30W or Greater | Fixture | 60.00 | 0.103 | 551 | 12 | Interior CFL Lighting |
| Permanent Lamp Removal - 2-ft Lamp | Lamp Removed | 5.00 | 0.019 | 104.6 | 11 | Interior Non CFL Lighting |
| Permanent Lamp Removal - 3-ft Lamp | Lamp Removed | 5.00 | 0.028 | 152.3 | 11 | Interior Non CFL Lighting |
| Permanent Lamp Removal - 4-ft Lamp | Lamp Removed | 7.00 | 0.032 | 172.3 | 11 | Interior Non CFL Lighting |
| Permanent Lamp Removal - 8-ft Lamp | Lamp Removed | 12.00 | 0.062 | 333.7 | 11 | Interior Non CFL Lighting |
| HP or RW T8 - 4-ft Lamp and Ballast | Lamp | 7.00 | 0.012 | 62 | 11 | Interior Non CFL Lighting |
| HP or RW T8 - 4-ft Reduced Watt Lamp only | Lamp | 1.00 | 0.005 | 28.8 | 3 | Interior Non CFL Lighting |
| CFL - Downlight, Dimmable or 3-way | Lamp | 10.00 | 0.05 | 266 | 2.5 | Interior CFL Lighting |
| RW T8 - 8-ft Lamp and Ballast | Lamp | 7.00 | 0.015 | 78.7 | 11 | Interior Non CFL Lighting |
| RW T8 - 8-ft Lamp only | Lamp | 1.00 | 0.005 | 24.6 | 3 | Interior Non CFL Lighting |
| 2-ft T12 to T8 | Lamp | 6.00 | 0.01 | 51.6 | 11 | Interior Non CFL Lighting |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3-ft T12 to T8 | Lamp | 6.00 | 0.013 | 69.5 | 11 | Interior Non CFL Lighting |
| 4-ft T12 to T8 - Includes U Lamps | Lamp | 7.00 | 0.009 | 46.7 | 11 | Interior Non CFL Lighting |
| T12 to T5 | Lamp | 7.00 | 0.012 | 65.1 | 11 | Interior Non CFL Lighting |
| LED Lamp/Fixture | Lamp | 15.00 | 0.03 | 160.9 | 16 | Interior CFL Lighting |
| LED, T-1, or Electroluminescent Exit Signs | Signs | 25.00 | 0.042 | 343.4 | 16 | None |
| LED Open Sign | Signs | 40.00 | 0.145 | 776.7 | 16 | Interior Non CFL Lighting |
| LED Channel Sign <= 2 feet Interior | Letter | 15.00 | 0.034 | 147 | 16 | Interior Non CFL Lighting |
| LED Channel Sign > 2 feet Interior | Letter | 45.00 | 0.086 | 378 | 16 | Interior Non CFL Lighting |
| Integrated Ballast Ceramic Metal Halide Lamps | Fixture | 10.00 | 0.044 | 231.1 | 8 | Interior Non CFL Lighting |
| Pulse Start or Ceramic, 100W or Less | Fixture | 20.00 | 0.048 | 211 | 16 | Interior Non CFL Lighting |
| Pulse Start or Ceramic, 101W - 200W | Fixture | 35.00 | 0.065 | 285 | 16 | Interior Non CFL Lighting |
| Pulse Start or Ceramic, 201W - 350W | Fixture | 40.00 | 0.126 | 553 | 16 | Interior Non CFL Lighting |
| Interior Induction Fixture | Fixture | 35.00 | 0.063 | 337.7 | 16 | Interior Non CFL Lighting |
| Cold Cathode | Lamp | 5.00 | 0.02 | 108 | 5 | Interior CFL Lighting |
| Occupancy Sensor | Watts Controlled | 0.10 | 0.0003 | 1.385 | 8 | Interior Non CFL Lighting |
| Daylight Sensor Controls | Watts Controlled | 0.12 | 0.0003 | 1.475 | 8 | Interior Non CFL Lighting |
| Bi-level Stairwell/Hall/Garage Fixture w/ integrated sensors | Fixture | 30.00 | 0 | 340 | 11 | Interior Non CFL Lighting |
| Lighting Density | W Reduction | 0.40 | 0.000916 | 4.914 | 11 | Interior Non CFL Lighting |
| Exterior High Wattage Screw-in CFLs | Lamp | 10.00 | 0 | 1382.5 | 2.5 | Exterior Lighting |
| LED Channel Sign <= 2 feet Outdoor | Letter | 6.00 | 0 | 93 | 16 | Exterior Lighting |
| LED Channel Sign > 2 feet Outdoor | Letter | 20.00 | 0 | 237 | 16 | Exterior Lighting |
| LED traffic lights - Green 8" | Lamp | 25.00 | 0.06 | 226 | 10 | Exterior Lighting |
| LED traffic lights - Green 12" | Lamp | 35.00 | 0.14 | 520 | 10 | Exterior Lighting |

| | | | | | | |
|---|---|---|---|---|---|---|
| LED traffic lights - Red 8" | Lamp | 25.00 | 0.06 | 299 | 10 | Exterior Lighting |
| LED traffic lights - Red 12" | Lamp | 35.00 | 0.14 | 694 | 10 | Exterior Lighting |
| LED traffic lights - Walk/Don't Walk - 9" | Lamp | 40.00 | 0.06 | 491 | 10 | Exterior Lighting |
| LED traffic lights - Walk/Don't Walk - 12" | Lamp | 50.00 | 0.11 | 946 | 10 | Exterior Lighting |
| Pulse Start or Ceramic, 350W - 400W | Fixture | 40.00 | 0 | 1623 | 16 | Exterior Lighting |
| Exterior LED or Induction replacing 175W or Less HID | Fixture | 35.00 | 0 | 275 | 16 | Exterior Lighting |
| Exterior LED or Induction replacing 176W - 250W HID | Fixture | 45.00 | 0 | 484 | 16 | Exterior Lighting |
| Exterior LED or Induction replacing 251W - 400W HID | Fixture | 65.00 | 0 | 589 | 16 | Exterior Lighting |
| Bi-Level Parking Lot Fixture | Fixture | 100.00 | 0 | 482 | 8 | Exterior Lighting |
| Bi-Level Wall Pack Fixture | Fixture | 135.00 | 0 | 1194 | 8 | Exterior Lighting |
| Exterior Lighting Bi-Level Control w/ Override 150W-1000W HID | Fixture | 60.00 | 0 | 743 | 10 | Exterior Lighting |
| Photocells | Watts Controlled | 0.05 | 0 | 0.28 | 8 | Exterior Lighting |
| Time Clocks | Watts Controlled | 0.05 | 0 | 1.248 | 8 | Exterior Lighting |
| Interior Garage LED or Induction replacing 175W or Less HID | Fixture | 65.00 | 0.042 | 369 | 16 | Garage Lighting |
| Interior Garage LED or Induction replacing 176W - 250W HID | Fixture | 80.00 | 0.067 | 587 | 16 | Garage Lighting |
| Interior Garage LED or Induction replacing 251W - 400W HID | Fixture | 125.00 | 0.131 | 1146 | 16 | Garage Lighting |
| Interior Garage High Wattage Screw-in CFLs | Fixture | 20.00 | 0.158 | 1382.5 | 2.5 | Garage Lighting |
| Interior Garage Metal Halides (Pulse start or Ceramic) 350W- 400W | Fixture | 70.00 | 0.396 | 3467 | 16 | Garage Lighting |
| Exterior Garage High Wattage Screw-in CFLs | Lamp | 20.00 | 0 | 574.5 | 2.5 | Garage Lighting |

| | | | | | | |
|---|---|---|---|---|---|---|
| VFD for HVAC Fans | HP | 60.00 | 0.025 | 503 | 15 | VFD for HVAC Fans |
| VFD for HVAC Pumps | HP | 60.00 | 0.025 | 503 | 15 | VFD for HVAC Pumps |
| VFD for Kitchen Exhaust Fan - New Hood | HP | 300.00 | 0.76 | 4486 | 15 | None |
| VFD for Kitchen Exhaust Fan - Retrofit Hood | HP | 400.00 | 0.76 | 4486 | 15 | None |
| VFD for HVAC Chillers | HP | 30.00 | 0.025 | 421 | 15 | VFD for HVAC Chillers |
| Ice Maker 101-200 lbs / 24 hrs | Per Ice Maker | 150.00 | 0.118 | 1029 | 12 | None |
| Ice Maker 201-300 lbs / 24 hrs | Per Ice Maker | 150.00 | 0.177 | 1551 | 12 | None |
| Ice Maker 301-400 lbs / 24 hrs | Per Ice Maker | 150.00 | 0.21 | 1840 | 12 | None |
| Ice Maker 401-500 lbs / 24 hrs | Per Ice Maker | 225.00 | 0.229 | 2004 | 12 | None |
| Ice Maker 501-1000 lbs / 24 hrs | Per Ice Maker | 225.00 | 0.363 | 3176 | 12 | None |
| Ice Maker 1001-1500 lbs / 24 hrs | Per Ice Maker | 350.00 | 0.573 | 5019 | 12 | None |
| Ice Maker >1500 lbs / 24 hrs | Per Ice Maker | 350.00 | 0.638 | 5585 | 12 | None |
| Refrigeration Strip Curtains on Walk-in | Square Foot | 4.00 | 0.01 | 139 | 4 | None |
| Refrigeration Anti-Sweat Heater Controls | Linear Foot | 30.00 | 0.007 | 402 | 12 | None |
| Refrigeration EC Motor for Walk-in | Motor | 50.00 | 0.044 | 401 | 15 | None |
| Refrigeration EC Motor for Reach-in Refrigerator cases | Motor | 35.00 | 0.033 | 345 | 15 | None |
| Refrigeration Evaporator Fan Controls | Motor | 60.00 | 0.06 | 478 | 16 | None |
| Refrigeration Door Gaskets | Linear Foot | 4.00 | 0.011 | 13 | 4 | None |
| Refrigeration Automatic Door Closers for Walk-in Coolers | Door | 70.00 | 0.137 | 943 | 8 | None |
| Refrigeration Automatic Door Closers for Walk-in Freezers | Door | 100.00 | 0.309 | 2307 | 8 | None |

| | | | | | | |
|---|---|---|---|---|---|---|
| Refrigeration LED Refrigeration Case Lighting | Door | 45.00 | 0.061 | 375 | 16 | None |
| Refrigeration ENERGY STAR Solid Door Freezer | Unit | 150.00 | 0.193 | 1695 | 12 | None |
| Refrigeration ENERGY STAR Glass Door Freezer | Unit | 400.00 | 0.676 | 5923 | 12 | None |
| Food Service Steam Cookers | Unit | 450.00 | 1 | 4419 | 12 | None |
| Food Service Combination Oven | Unit | 1,500.00 | 0.96 | 4208 | 12 | None |
| Food Service Hot Holding Cabinet | Unit | 300.00 | 0.6 | 2628 | 12 | None |
| Food Service Beverage Machine Controls | Unit | 100.00 | 0 | 1612 | 10 | None |
| Food Service Snack Machine Controls | Unit | 30.00 | 0 | 387 | 10 | None |
| Food Service ENERGY STAR Refrigerated Vending Machine | Unit | 150.00 | 0 | 1576 | 14 | None |
| Networked Power Management Software | PC Controlled | 10.00 | 0 | 200 | 10 | None |
| Plug Load Occ Sensors | Sensor | 20.00 | 0.091 | 258 | 8 | None |

# HVAC Savings

| Measure SubCategory | Measure | Building Type | Unit | Coincident kW Savings | kWh Savings |
|---|---|---|---|---|---|
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 14 SEER | College/University | Tons | 0.07 | 49.1 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 14 SEER | Grocery | Tons | 0.07 | 87.8 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 14 SEER | Heavy Industry | Tons | 0.07 | 40.4 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 14 SEER | Hotel/Motel | Tons | 0.07 | 87.3 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 14 SEER | Light Industry | Tons | 0.07 | 41.5 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 14 SEER | Medical | Tons | 0.07 | 96.7 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 14 SEER | Office | Tons | 0.07 | 41.2 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 14 SEER | Restaurant | Tons | 0.07 | 54.4 |

| | | | | | |
|---|---|---|---|---|---|
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 14 SEER | Retail/Service | Tons | 0.07 | 65 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 14 SEER | School | Tons | 0.07 | 20.7 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 14 SEER | Warehouse | Tons | 0.07 | 36 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 14 SEER | Miscellaneous | Tons | 0.07 | 56.4 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 15 SEER | College/University | Tons | 0.13 | 91.6 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 15 SEER | Grocery | Tons | 0.13 | 164 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 15 SEER | Heavy Industry | Tons | 0.12 | 75.5 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 15 SEER | Hotel/Motel | Tons | 0.2 | 163 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 15 SEER | Light Industry | Tons | 0.13 | 77.4 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 15 SEER | Medical | Tons | 0.13 | 181 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 15 SEER | Office | Tons | 0.13 | 76.8 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 15 SEER | Restaurant | Tons | 0.13 | 102 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 15 SEER | Retail/Service | Tons | 0.13 | 121 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 15 SEER | School | Tons | 0.12 | 38.6 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 15 SEER | Warehouse | Tons | 0.13 | 67.1 |
| Unitary&Split AC and ASHP | < 65,000 Btu/h (5.4 tons) - 15 SEER | Miscellaneous | Tons | 0.13 | 105 |
| Unitary&Split AC and ASHP | >= 65,000 Btu/h and < 120,000 Btu/h (5.5-10 tons) | College/University | Tons | 0.09 | 64 |
| Unitary&Split AC and ASHP | >= 65,000 Btu/h and < 120,000 Btu/h (5.5-10 tons) | Grocery | Tons | 0.09 | 114 |
| Unitary&Split AC and ASHP | >= 65,000 Btu/h and < 120,000 Btu/h (5.5-10 tons) | Heavy Industry | Tons | 0.09 | 52.6 |
| Unitary&Split AC and ASHP | >= 65,000 Btu/h and < 120,000 Btu/h (5.5-10 tons) | Hotel/Motel | Tons | 0.09 | 114 |
| Unitary&Split AC and ASHP | >= 65,000 Btu/h and < 120,000 Btu/h (5.5-10 tons) | Light Industry | Tons | 0.09 | 54.1 |
| Unitary&Split AC and ASHP | >= 65,000 Btu/h and < 120,000 Btu/h (5.5-10 tons) | Medical | Tons | 0.1 | 139 |
| Unitary&Split AC and | >= 65,000 Btu/h and < | Office | Tons | 0.09 | 53.6 |

| | | | | | |
|---|---|---|---|---|---|
| ASHP | 120,000 Btu/h (5.5-10 tons) | | | | |
| Unitary&Split AC and ASHP | >= 65,000 Btu/h and < 120,000 Btu/h (5.5-10 tons) | Restaurant | Tons | 0.09 | 70.8 |
| Unitary&Split AC and ASHP | >= 65,000 Btu/h and < 120,000 Btu/h (5.5-10 tons) | Retail/Service | Tons | 0.09 | 84.7 |
| Unitary&Split AC and ASHP | >= 65,000 Btu/h and < 120,000 Btu/h (5.5-10 tons) | School | Tons | 0.09 | 27 |
| Unitary&Split AC and ASHP | >= 65,000 Btu/h and < 120,000 Btu/h (5.5-10 tons) | Warehouse | Tons | 0.09 | 46.8 |
| Unitary&Split AC and ASHP | >= 65,000 Btu/h and < 120,000 Btu/h (5.5-10 tons) | Miscellaneous | Tons | 0.09 | 74.6 |
| Unitary&Split AC and ASHP | >=120,000 Btu/h and < 240,000 Btu/h (10-20 tons) | College/University | Tons | 0.11 | 71.3 |
| Unitary&Split AC and ASHP | >=120,000 Btu/h and < 240,000 Btu/h (10-20 tons) | Grocery | Tons | 0.11 | 127 |
| Unitary&Split AC and ASHP | >=120,000 Btu/h and < 240,000 Btu/h (10-20 tons) | Heavy Industry | Tons | 0.11 | 65.4 |
| Unitary&Split AC and ASHP | >=120,000 Btu/h and < 240,000 Btu/h (10-20 tons) | Hotel/Motel | Tons | 0.12 | 123 |
| Unitary&Split AC and ASHP | >=120,000 Btu/h and < 240,000 Btu/h (10-20 tons) | Light Industry | Tons | 0.11 | 68.9 |
| Unitary&Split AC and ASHP | >=120,000 Btu/h and < 240,000 Btu/h (10-20 tons) | Medical | Tons | 0.11 | 126 |
| Unitary&Split AC and ASHP | >=120,000 Btu/h and < 240,000 Btu/h (10-20 tons) | Office | Tons | 0.12 | 60.7 |
| Unitary&Split AC and ASHP | >=120,000 Btu/h and < 240,000 Btu/h (10-20 tons) | Restaurant | Tons | 0.11 | 82.9 |
| Unitary&Split AC and ASHP | >=120,000 Btu/h and < 240,000 Btu/h (10-20 tons) | Retail/Service | Tons | 0.11 | 92.3 |
| Unitary&Split AC and ASHP | >=120,000 Btu/h and < 240,000 Btu/h (10-20 tons) | School | Tons | 0.11 | 31.3 |
| Unitary&Split AC and ASHP | >=120,000 Btu/h and < 240,000 Btu/h (10-20 tons) | Warehouse | Tons | 0.12 | 58 |
| Unitary&Split AC and ASHP | >=120,000 Btu/h and < 240,000 Btu/h (10-20 tons) | Miscellaneous | Tons | 0.11 | 82.3 |
| Unitary&Split AC and ASHP | >= 240,000 Btu/h and < 760,000 Btu/h (21-63 tons) | College/University | Tons | 0.1 | 66.1 |
| Unitary&Split AC and ASHP | >= 240,000 Btu/h and < 760,000 Btu/h (21-63 tons) | Grocery | Tons | 0.11 | 117 |
| Unitary&Split AC and ASHP | >= 240,000 Btu/h and < 760,000 Btu/h (21-63 tons) | Heavy Industry | Tons | 0.1 | 61.9 |
| Unitary&Split AC and ASHP | >= 240,000 Btu/h and < 760,000 Btu/h (21-63 tons) | Hotel/Motel | Tons | 0.11 | 114 |
| Unitary&Split AC and ASHP | >= 240,000 Btu/h and < 760,000 Btu/h (21-63 tons) | Light Industry | Tons | 0.11 | 63.9 |

| | | | | | |
|---|---|---|---|---|---|
| Unitary&Split AC and ASHP | >= 240,000 Btu/h and < 760,000 Btu/h (21-63 tons) | Medical | Tons | 0.1 | 116 |
| Unitary&Split AC and ASHP | >= 240,000 Btu/h and < 760,000 Btu/h (21-63 tons) | Office | Tons | 0.11 | 56.2 |
| Unitary&Split AC and ASHP | >= 240,000 Btu/h and < 760,000 Btu/h (21-63 tons) | Restaurant | Tons | 0.1 | 76.7 |
| Unitary&Split AC and ASHP | >= 240,000 Btu/h and < 760,000 Btu/h (21-63 tons) | Retail/Service | Tons | 0.11 | 90.5 |
| Unitary&Split AC and ASHP | >= 240,000 Btu/h and < 760,000 Btu/h (21-63 tons) | School | Tons | 0.1 | 28.9 |
| Unitary&Split AC and ASHP | >= 240,000 Btu/h and < 760,000 Btu/h (21-63 tons) | Warehouse | Tons | 0.11 | 53.8 |
| Unitary&Split AC and ASHP | >= 240,000 Btu/h and < 760,000 Btu/h (21-63 tons) | Miscellaneous | Tons | 0.11 | 76.8 |
| Unitary&Split AC and ASHP | >= 760,000 Btu/h (> 63 tons) | College/University | Tons | 0.08 | 50.5 |
| Unitary&Split AC and ASHP | >= 760,000 Btu/h (> 63 tons) | Grocery | Tons | 0.08 | 89.7 |
| Unitary&Split AC and ASHP | >= 760,000 Btu/h (> 63 tons) | Heavy Industry | Tons | 0.08 | 47.3 |
| Unitary&Split AC and ASHP | >= 760,000 Btu/h (> 63 tons) | Hotel/Motel | Tons | 0.08 | 86.9 |
| Unitary&Split AC and ASHP | >= 760,000 Btu/h (> 63 tons) | Light Industry | Tons | 0.08 | 48.9 |
| Unitary&Split AC and ASHP | >= 760,000 Btu/h (> 63 tons) | Medical | Tons | 0.08 | 88.9 |
| Unitary&Split AC and ASHP | >= 760,000 Btu/h (> 63 tons) | Office | Tons | 0.08 | 42.4 |
| Unitary&Split AC and ASHP | >= 760,000 Btu/h (> 63 tons) | Restaurant | Tons | 0.08 | 58.7 |
| Unitary&Split AC and ASHP | >= 760,000 Btu/h (> 63 tons) | Retail/Service | Tons | 0.08 | 69.3 |
| Unitary&Split AC and ASHP | >= 760,000 Btu/h (> 63 tons) | School | Tons | 0.08 | 22.1 |
| Unitary&Split AC and ASHP | >= 760,000 Btu/h (> 63 tons) | Warehouse | Tons | 0.08 | 41.1 |
| Unitary&Split AC and ASHP | >= 760,000 Btu/h (> 63 tons) | Miscellaneous | Tons | 0.08 | 58.7 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 1 | College/University | Tons | 0.06 | 72.4 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 1 | Grocery | Tons | 0.07 | 115 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 1 | Heavy Industry | Tons | 0.07 | 69.4 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 1 | Hotel/Motel | Tons | 0.08 | 104 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 1 | Light Industry | Tons | 0.07 | 43.1 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 1 | Medical | Tons | 0.07 | 91.2 |
| Water Cooled Chillers, | <= 150 tons - Level 1 | Office | Tons | 0.07 | 45.6 |

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|---|---|---|---|---|---|
| Centrifugal | | | | | |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 1 | Restaurant | Tons | 0.07 | 89.4 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 1 | Retail/Service | Tons | 0.06 | 67.3 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 1 | School | Tons | 0.06 | 38.7 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 1 | Warehouse | Tons | 0.07 | 46.1 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 1 | Miscellaneous | Tons | 0.07 | 71.1 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 2 | College/University | Tons | 0.12 | 134 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 2 | Grocery | Tons | 0.13 | 213 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 2 | Heavy Industry | Tons | 0.13 | 129 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 2 | Hotel/Motel | Tons | 0.15 | 194 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 2 | Light Industry | Tons | 0.13 | 80.1 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 2 | Medical | Tons | 0.13 | 169 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 2 | Office | Tons | 0.13 | 84.8 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 2 | Restaurant | Tons | 0.13 | 166 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 2 | Retail/Service | Tons | 0.12 | 125 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 2 | School | Tons | 0.12 | 71.8 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 2 | Warehouse | Tons | 0.13 | 85.6 |
| Water Cooled Chillers, Centrifugal | <= 150 tons - Level 2 | Miscellaneous | Tons | 0.13 | 132 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 1 | College/University | Tons | 0.05 | 62 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 1 | Grocery | Tons | 0.06 | 98.2 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 1 | Heavy Industry | Tons | 0.06 | 59.4 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 1 | Hotel/Motel | Tons | 0.07 | 89.4 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 1 | Light Industry | Tons | 0.06 | 50.1 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 1 | Medical | Tons | 0.06 | 78.1 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 1 | Office | Tons | 0.06 | 39.1 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 1 | Restaurant | Tons | 0.06 | 76.5 |

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|---|---|---|---|---|---|
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 1 | Retail/Service | Tons | 0.06 | 58.7 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 1 | School | Tons | 0.06 | 33.1 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 1 | Warehouse | Tons | 0.12 | 41.5 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 1 | Miscellaneous | Tons | 0.07 | 62.4 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 2 | College/University | Tons | 0.11 | 124 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 2 | Grocery | Tons | 0.13 | 196 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 2 | Heavy Industry | Tons | 0.12 | 119 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 2 | Hotel/Motel | Tons | 0.14 | 179 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 2 | Light Industry | Tons | 0.12 | 100 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 2 | Medical | Tons | 0.12 | 156 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 2 | Office | Tons | 0.12 | 78.1 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 2 | Restaurant | Tons | 0.12 | 153 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 2 | Retail/Service | Tons | 0.11 | 117 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 2 | School | Tons | 0.11 | 66.1 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 2 | Warehouse | Tons | 0.18 | 82.9 |
| Water Cooled Chillers, Centrifugal | 151 to 300 tons - Level 2 | Miscellaneous | Tons | 0.12 | 125 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 1 | College/University | Tons | 0.05 | 62 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 1 | Grocery | Tons | 0.06 | 98.1 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 1 | Heavy Industry | Tons | 0.06 | 59.4 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 1 | Hotel/Motel | Tons | 0.07 | 89.3 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 1 | Light Industry | Tons | 0.06 | 50.1 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 1 | Medical | Tons | 0.06 | 78 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 1 | Office | Tons | 0.06 | 39 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 1 | Restaurant | Tons | 0.06 | 76.5 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 1 | Retail/Service | Tons | 0.06 | 63 |
| Water Cooled Chillers, | > 300 tons - Level 1 | School | Tons | 0.06 | 33 |

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|---|---|---|---|---|---|
| Centrifugal | | | | | |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 1 | Warehouse | Tons | 0.06 | 44.5 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 1 | Miscellaneous | Tons | 0.06 | 63 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 2 | College/University | Tons | 0.1 | 114 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 2 | Grocery | Tons | 0.11 | 180 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 2 | Heavy Industry | Tons | 0.11 | 109 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 2 | Hotel/Motel | Tons | 0.13 | 164 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 2 | Light Industry | Tons | 0.11 | 91.8 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 2 | Medical | Tons | 0.11 | 143 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 2 | Office | Tons | 0.11 | 71.6 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 2 | Restaurant | Tons | 0.11 | 140 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 2 | Retail/Service | Tons | 0.11 | 116 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 2 | School | Tons | 0.1 | 60.6 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 2 | Warehouse | Tons | 0.11 | 81.6 |
| Water Cooled Chillers, Centrifugal | > 300 tons - Level 2 | Miscellaneous | Tons | 0.11 | 116 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 1 | College/University | Tons | 0.06 | 55.5 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 1 | Grocery | Tons | 0.07 | 82.6 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 1 | Heavy Industry | Tons | 0.06 | 47.6 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 1 | Hotel/Motel | Tons | 0.07 | 79.9 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 1 | Light Industry | Tons | 0.07 | 35.6 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 1 | Medical | Tons | 0.07 | 75 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 1 | Office | Tons | 0.07 | 40.5 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 1 | Restaurant | Tons | 0.08 | 58.5 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 1 | Retail/Service | Tons | 0.07 | 54.6 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 1 | School | Tons | 0.06 | 29.3 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 1 | Warehouse | Tons | 0.07 | 39.8 |

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|---|---|---|---|---|---|
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 1 | Miscellaneous | Tons | 0.07 | 54.5 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 2 | College/University | Tons | 0.12 | 111 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 2 | Grocery | Tons | 0.14 | 166 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 2 | Heavy Industry | Tons | 0.12 | 95.3 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 2 | Hotel/Motel | Tons | 0.14 | 160 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 2 | Light Industry | Tons | 0.14 | 71.2 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 2 | Medical | Tons | 0.14 | 150 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 2 | Office | Tons | 0.14 | 81.2 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 2 | Restaurant | Tons | 0.15 | 117 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 2 | Retail/Service | Tons | 0.16 | 110 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 2 | School | Tons | 0.12 | 58.7 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 2 | Warehouse | Tons | 0.14 | 79.7 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | <= 150 tons - Level 2 | Miscellaneous | Tons | 0.14 | 109 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 1 | College/University | Tons | 0.05 | 47.7 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 1 | Grocery | Tons | 0.06 | 71 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 1 | Heavy Industry | Tons | 0.05 | 40.9 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 1 | Hotel/Motel | Tons | 0.06 | 68.7 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 1 | Light Industry | Tons | 0.06 | 33.8 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 1 | Medical | Tons | 0.06 | 64.4 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 1 | Office | Tons | 0.06 | 34.8 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 1 | Restaurant | Tons | 0.06 | 50.2 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 1 | Retail/Service | Tons | 0.08 | 47.4 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 1 | School | Tons | 0.05 | 25.2 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 1 | Warehouse | Tons | 0.06 | 35 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 1 | Miscellaneous | Tons | 0.06 | 47.2 |
| Water Cooled Chillers, | 151 to 300 tons - Level 2 | College/University | Tons | 0.11 | 104 |

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|---|---|---|---|---|---|
| Rotary, Scroll, or Screw | | | | | |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 2 | Grocery | Tons | 0.13 | 154 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 2 | Heavy Industry | Tons | 0.12 | 88.7 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 2 | Hotel/Motel | Tons | 0.13 | 149 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 2 | Light Industry | Tons | 0.13 | 73.3 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 2 | Medical | Tons | 0.13 | 140 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 2 | Office | Tons | 0.13 | 75.6 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 2 | Restaurant | Tons | 0.13 | 109 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 2 | Retail/Service | Tons | 0.15 | 103 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 2 | School | Tons | 0.11 | 54.7 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 2 | Warehouse | Tons | 0.19 | 76 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | 151 to 300 tons - Level 2 | Miscellaneous | Tons | 0.13 | 102 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 1 | College/University | Tons | 0.05 | 47.8 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 1 | Grocery | Tons | 0.06 | 71.2 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 1 | Heavy Industry | Tons | 0.05 | 41 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 1 | Hotel/Motel | Tons | 0.06 | 68.8 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 1 | Light Industry | Tons | 0.06 | 33.9 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 1 | Medical | Tons | 0.06 | 64.6 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 1 | Office | Tons | 0.06 | 35 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 1 | Restaurant | Tons | 0.06 | 50.4 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 1 | Retail/Service | Tons | 0.06 | 56.9 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 1 | School | Tons | 0.05 | 25.3 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 1 | Warehouse | Tons | 0.06 | 36 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 1 | Miscellaneous | Tons | 0.06 | 48.3 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 2 | College/University | Tons | 0.1 | 87.8 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 2 | Grocery | Tons | 0.11 | 131 |

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| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 2 | Heavy Industry | Tons | 0.1 | 75.2 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 2 | Hotel/Motel | Tons | 0.11 | 126 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 2 | Light Industry | Tons | 0.11 | 62.2 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 2 | Medical | Tons | 0.11 | 119 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 2 | Office | Tons | 0.11 | 64.2 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 2 | Restaurant | Tons | 0.11 | 92.5 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 2 | Retail/Service | Tons | 0.11 | 94.5 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 2 | School | Tons | 0.1 | 46.4 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 2 | Warehouse | Tons | 0.18 | 66.1 |
| Water Cooled Chillers, Rotary, Scroll, or Screw | > 300 tons - Level 2 | Miscellaneous | Tons | 0.11 | 87.7 |
| Water Cooled Chillers, Reciprocal | Level 1 | College/University | Tons | 0.06 | 56.4 |
| Water Cooled Chillers, Reciprocal | Level 1 | Grocery | Tons | 0.07 | 74.5 |
| Water Cooled Chillers, Reciprocal | Level 1 | Heavy Industry | Tons | 0.06 | 46.3 |
| Water Cooled Chillers, Reciprocal | Level 1 | Hotel/Motel | Tons | 0.06 | 81.2 |
| Water Cooled Chillers, Reciprocal | Level 1 | Light Industry | Tons | 0.07 | 37.9 |
| Water Cooled Chillers, Reciprocal | Level 1 | Medical | Tons | 0.06 | 75.5 |
| Water Cooled Chillers, Reciprocal | Level 1 | Office | Tons | 0.08 | 39.9 |
| Water Cooled Chillers, Reciprocal | Level 1 | Restaurant | Tons | 0.07 | 56.9 |
| Water Cooled Chillers, Reciprocal | Level 1 | Retail/Service | Tons | 0.07 | 53.8 |
| Water Cooled Chillers, Reciprocal | Level 1 | School | Tons | 0.06 | 28.8 |
| Water Cooled Chillers, Reciprocal | Level 1 | Warehouse | Tons | 0.07 | 40.5 |
| Water Cooled Chillers, Reciprocal | Level 1 | Miscellaneous | Tons | 0.07 | 53.8 |
| Water Cooled Chillers, Reciprocal | Level 2 | College/University | Tons | 0.12 | 113 |
| Water Cooled Chillers, Reciprocal | Level 2 | Grocery | Tons | 0.14 | 149 |
| Water Cooled Chillers, Reciprocal | Level 2 | Heavy Industry | Tons | 0.13 | 92.7 |
| Water Cooled Chillers, | Level 2 | Hotel/Motel | Tons | 0.13 | 163 |

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|---|---|---|---|---|---|
| Reciprocal | | | | | |
| Water Cooled Chillers, Reciprocal | Level 2 | Light Industry | Tons | 0.13 | 75.9 |
| Water Cooled Chillers, Reciprocal | Level 2 | Medical | Tons | 0.13 | 151 |
| Water Cooled Chillers, Reciprocal | Level 2 | Office | Tons | 0.14 | 79.9 |
| Water Cooled Chillers, Reciprocal | Level 2 | Restaurant | Tons | 0.15 | 114 |
| Water Cooled Chillers, Reciprocal | Level 2 | Retail/Service | Tons | 0.16 | 108 |
| Water Cooled Chillers, Reciprocal | Level 2 | School | Tons | 0.12 | 57.6 |
| Water Cooled Chillers, Reciprocal | Level 2 | Warehouse | Tons | 0.14 | 81.1 |
| Water Cooled Chillers, Reciprocal | Level 2 | Miscellaneous | Tons | 0.13 | 108 |
| Air-Cooled Chillers | Air-Cooled Chillers | College/University | Tons | 0.15 | 144 |
| Air-Cooled Chillers | Air-Cooled Chillers | Grocery | Tons | 0.16 | 176 |
| Air-Cooled Chillers | Air-Cooled Chillers | Heavy Industry | Tons | 0.15 | 119 |
| Air-Cooled Chillers | Air-Cooled Chillers | Hotel/Motel | Tons | 0.16 | 201 |
| Air-Cooled Chillers | Air-Cooled Chillers | Light Industry | Tons | 0.16 | 88.2 |
| Air-Cooled Chillers | Air-Cooled Chillers | Medical | Tons | 0.16 | 194 |
| Air-Cooled Chillers | Air-Cooled Chillers | Office | Tons | 0.17 | 102 |
| Air-Cooled Chillers | Air-Cooled Chillers | Restaurant | Tons | 0.16 | 147 |
| Air-Cooled Chillers | Air-Cooled Chillers | Retail/Service | Tons | 0.15 | 136 |
| Air-Cooled Chillers | Air-Cooled Chillers | School | Tons | 0.14 | 73 |
| Air-Cooled Chillers | Air-Cooled Chillers | Warehouse | Tons | 0.15 | 100 |
| Air-Cooled Chillers | Air-Cooled Chillers | Miscellaneous | Tons | 0.1 | 87.1 |
| Air-Cooled Chillers | Air-Cooled Chillers | College/University | Tons | 0.15 | 144 |
| Air-Cooled Chillers | Air-Cooled Chillers | Grocery | Tons | 0.16 | 176 |
| Air-Cooled Chillers | Air-Cooled Chillers | Heavy Industry | Tons | 0.15 | 119 |
| Air-Cooled Chillers | Air-Cooled Chillers | Hotel/Motel | Tons | 0.16 | 201 |
| Air-Cooled Chillers | Air-Cooled Chillers | Light Industry | Tons | 0.17 | 106 |
| Air-Cooled Chillers | Air-Cooled Chillers | Medical | Tons | 0.16 | 194 |
| Air-Cooled Chillers | Air-Cooled Chillers | Office | Tons | 0.17 | 102 |
| Air-Cooled Chillers | Air-Cooled Chillers | Restaurant | Tons | 0.16 | 147 |
| Air-Cooled Chillers | Air-Cooled Chillers | Retail/Service | Tons | 0.15 | 141 |
| Air-Cooled Chillers | Air-Cooled Chillers | School | Tons | 0.14 | 73 |
| Air-Cooled Chillers | Air-Cooled Chillers | Warehouse | Tons | 0.15 | 105 |
| Air-Cooled Chillers | Air-Cooled Chillers | Miscellaneous | Tons | 0.1 | 88.7 |
| Air-Cooled Chillers | Air-Cooled Chillers | College/University | Tons | 0.15 | 144 |
| Air-Cooled Chillers | Air-Cooled Chillers | Grocery | Tons | 0.16 | 176 |
| Air-Cooled Chillers | Air-Cooled Chillers | Heavy Industry | Tons | 0.15 | 119 |
| Air-Cooled Chillers | Air-Cooled Chillers | Hotel/Motel | Tons | 0.16 | 201 |
| Air-Cooled Chillers | Air-Cooled Chillers | Light Industry | Tons | 0.17 | 106 |
| Air-Cooled Chillers | Air-Cooled Chillers | Medical | Tons | 0.16 | 194 |
| Air-Cooled Chillers | Air-Cooled Chillers | Office | Tons | 0.17 | 102 |

| | | | | | |
|---|---|---|---|---|---|
| Air-Cooled Chillers | Air-Cooled Chillers | Restaurant | Tons | 0.16 | 147 |
| Air-Cooled Chillers | Air-Cooled Chillers | Retail/Service | Tons | 0.15 | 137 |
| Air-Cooled Chillers | Air-Cooled Chillers | School | Tons | 0.14 | 73 |
| Air-Cooled Chillers | Air-Cooled Chillers | Warehouse | Tons | 0.15 | 102 |
| Air-Cooled Chillers | Air-Cooled Chillers | Miscellaneous | Tons | 0.1 | 88.3 |
| Room Air Conditioners | Room AC < 8,000 Btu/h (0.67 tons) | College/University | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC < 8,000 Btu/h (0.67 tons) | Grocery | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC < 8,000 Btu/h (0.67 tons) | Heavy Industry | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC < 8,000 Btu/h (0.67 tons) | Hotel/Motel | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC < 8,000 Btu/h (0.67 tons) | Light Industry | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC < 8,000 Btu/h (0.67 tons) | Medical | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC < 8,000 Btu/h (0.67 tons) | Office | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC < 8,000 Btu/h (0.67 tons) | Restaurant | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC < 8,000 Btu/h (0.67 tons) | Retail/Service | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC < 8,000 Btu/h (0.67 tons) | School | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC < 8,000 Btu/h (0.67 tons) | Warehouse | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC < 8,000 Btu/h (0.67 tons) | Miscellaneous | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC >= 8,000 Btu/h and < 14,000 Btu/h (0.67 - 1.2 tons) | College/University | Tons | 114 | 0.15 |
| Room Air Conditioners | Room AC >= 8,000 Btu/h and < 14,000 Btu/h (0.67 - 1.2 tons) | Grocery | Tons | 114 | 0.15 |
| Room Air Conditioners | Room AC >= 8,000 Btu/h and < 14,000 Btu/h (0.67 - 1.2 tons) | Heavy Industry | Tons | 114 | 0.15 |
| Room Air Conditioners | Room AC >= 8,000 Btu/h and < 14,000 Btu/h (0.67 - 1.2 tons) | Hotel/Motel | Tons | 114 | 0.15 |
| Room Air Conditioners | Room AC >= 8,000 Btu/h and < 14,000 Btu/h (0.67 - 1.2 tons) | Light Industry | Tons | 114 | 0.15 |
| Room Air Conditioners | Room AC >= 8,000 Btu/h and < 14,000 Btu/h (0.67 - 1.2 tons) | Medical | Tons | 114 | 0.15 |
| Room Air Conditioners | Room AC >= 8,000 Btu/h and < 14,000 Btu/h (0.67 - 1.2 tons) | Office | Tons | 114 | 0.15 |
| Room Air Conditioners | Room AC >= 8,000 Btu/h | Restaurant | Tons | 114 | 0.15 |

| | | | | | |
|---|---|---|---|---|---|
| | and < 14,000 Btu/h (0.67 - 1.2 tons) | | | | |
| Room Air Conditioners | Room AC >= 8,000 Btu/h and < 14,000 Btu/h (0.67 - 1.2 tons) | Retail/Service | Tons | 114 | 0.15 |
| Room Air Conditioners | Room AC >= 8,000 Btu/h and < 14,000 Btu/h (0.67 - 1.2 tons) | School | Tons | 114 | 0.15 |
| Room Air Conditioners | Room AC >= 8,000 Btu/h and < 14,000 Btu/h (0.67 - 1.2 tons) | Warehouse | Tons | 114 | 0.15 |
| Room Air Conditioners | Room AC >= 8,000 Btu/h and < 14,000 Btu/h (0.67 - 1.2 tons) | Miscellaneous | Tons | 114 | 0.15 |
| Room Air Conditioners | Room AC >= 14,000 Btu/h and < 20,000 Btu/h (1.3 - 1.7 tons) | College/University | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC >= 14,000 Btu/h and < 20,000 Btu/h (1.3 - 1.7 tons) | Grocery | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC >= 14,000 Btu/h and < 20,000 Btu/h (1.3 - 1.7 tons) | Heavy Industry | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC >= 14,000 Btu/h and < 20,000 Btu/h (1.3 - 1.7 tons) | Hotel/Motel | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC >= 14,000 Btu/h and < 20,000 Btu/h (1.3 - 1.7 tons) | Light Industry | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC >= 14,000 Btu/h and < 20,000 Btu/h (1.3 - 1.7 tons) | Medical | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC >= 14,000 Btu/h and < 20,000 Btu/h (1.3 - 1.7 tons) | Office | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC >= 14,000 Btu/h and < 20,000 Btu/h (1.3 - 1.7 tons) | Restaurant | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC >= 14,000 Btu/h and < 20,000 Btu/h (1.3 - 1.7 tons) | Retail/Service | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC >= 14,000 Btu/h and < 20,000 Btu/h (1.3 - 1.7 tons) | School | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC >= 14,000 Btu/h and < 20,000 Btu/h (1.3 - 1.7 tons) | Warehouse | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC >= 14,000 Btu/h and < 20,000 Btu/h (1.3 - 1.7 tons) | Miscellaneous | Tons | 0.15 | 116 |
| Room Air Conditioners | Room AC >= 20,000 Btu/h | College/University | Tons | 0.17 | 131 |

| | | | | | |
|---|---|---|---|---|---|
| | (> 1.7 tons) | | | | |
| Room Air Conditioners | Room AC >= 20,000 Btu/h (> 1.7 tons) | Grocery | Tons | 0.17 | 131 |
| Room Air Conditioners | Room AC >= 20,000 Btu/h (> 1.7 tons) | Heavy Industry | Tons | 0.17 | 131 |
| Room Air Conditioners | Room AC >= 20,000 Btu/h (> 1.7 tons) | Hotel/Motel | Tons | 0.17 | 131 |
| Room Air Conditioners | Room AC >= 20,000 Btu/h (> 1.7 tons) | Light Industry | Tons | 0.17 | 131 |
| Room Air Conditioners | Room AC >= 20,000 Btu/h (> 1.7 tons) | Medical | Tons | 0.17 | 131 |
| Room Air Conditioners | Room AC >= 20,000 Btu/h (> 1.7 tons) | Office | Tons | 0.17 | 131 |
| Room Air Conditioners | Room AC >= 20,000 Btu/h (> 1.7 tons) | Restaurant | Tons | 0.17 | 131 |
| Room Air Conditioners | Room AC >= 20,000 Btu/h (> 1.7 tons) | Retail/Service | Tons | 0.17 | 131 |
| Room Air Conditioners | Room AC >= 20,000 Btu/h (> 1.7 tons) | School | Tons | 0.17 | 131 |
| Room Air Conditioners | Room AC >= 20,000 Btu/h (> 1.7 tons) | Warehouse | Tons | 0.17 | 131 |
| Room Air Conditioners | Room AC >= 20,000 Btu/h (> 1.7 tons) | Miscellaneous | Tons | 0.17 | 131 |
| PTAC/PTHP | PTAC/PTHP | College/University | Tons | 0.22 | 211 |
| PTAC/PTHP | PTAC/PTHP | Grocery | Tons | 0.22 | 301 |
| PTAC/PTHP | PTAC/PTHP | Heavy Industry | Tons | 0.22 | 147 |
| PTAC/PTHP | PTAC/PTHP | Hotel/Motel | Tons | 0.22 | 328 |
| PTAC/PTHP | PTAC/PTHP | Light Industry | Tons | 0.22 | 147 |
| PTAC/PTHP | PTAC/PTHP | Medical | Tons | 0.22 | 315 |
| PTAC/PTHP | PTAC/PTHP | Office | Tons | 0.22 | 136 |
| PTAC/PTHP | PTAC/PTHP | Restaurant | Tons | 0.22 | 288 |
| PTAC/PTHP | PTAC/PTHP | Retail/Service | Tons | 0.22 | 216 |
| PTAC/PTHP | PTAC/PTHP | School | Tons | 0.22 | 105 |
| PTAC/PTHP | PTAC/PTHP | Warehouse | Tons | 0.22 | 148 |
| PTAC/PTHP | PTAC/PTHP | Miscellaneous | Tons | 0.22 | 219 |

# Motor Coincident kW Savings

| | 1200 RPM | | 1800 RPM | | 3600 RPM | |
|---|---|---|---|---|---|---|
| MOTOR HORSEPOWER | ODP MOTOR Coincident Demand Reduction (kW) | TEFC MOTOR Coincident Demand Reduction (kW) | ODP MOTOR Coincident Demand Reduction (kW) | TEFC MOTOR Coincident Demand Reduction (kW) | ODP MOTOR Coincident Demand Reduction (kW) | TEFC MOTOR Coincident Demand Reduction (kW) |
| 1 | 0.016 | 0.016 | 0.018 | 0.018 | 0.011 | 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 |

# Motor kWh Savings

| | 1200 RPM | | 1800 RPM | | 3600 RPM | |
|---|---|---|---|---|---|---|
| MOTOR HORSEPOWER | 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 |

# 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.

### Measure and Building Type Multipliers

| Business Type | 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 | | | | | | | | | | | | | |
| | | kW Savings | 1.00 | 1.00 | 1.00 | | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industry | | Multiplier | | | | | | | | | | | |
| | | 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 | | | |

# AEP GridSMART

## KEMA Operations Manual

## Appendix A – AEP Ohio Prescriptive Lighting Protocols

# Table of Contents

# Lighting

Most lighting measures presented in these work papers use the same methodology. The following provides the assumptions and methods used for calculating energy savings.

Baseline and retrofit equipment assumptions, i.e. wattages, are specific to the measure. Most lighting retrofits assume an early replacement of existing technologies where the baseline represents the equipment removed.

Savings are calculated by appyling operating hours and other parameters that define the energy savings. These workpapers base the energy savings methodology on the California 2005 DEER Study[1] assumptions. The DEER database is a tool that was jointly developed by the California Public Utilities Commission (CPUC) and the California Energy Commission with support and input from the Investor-Owned Utilities and other interested stakeholders. DEER provides operating hours, interative effects and coincidence factors by building type; however, savings for AEP Ohio Program will not be dependent on building type. Savings presented here are calculated using averages of DEER building type values.

Lighting factors used in savings calculations are listed in the table below. This document explains how these values and the resulting savings were derived.

**Table 1: Average Lighting Factors**

| CFL Annual Operating Hours | Other Lighting Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects |
|---|---|---|---|---|
| 4,321 | 4,389 | 1.19 | 0.77 | 1.12 |

Annual energy savings and the peak coincident demand savings were calculated using the equations below:

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

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

[1] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

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

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

Interactive factors account for savings that the measures achieve through avoided air conditioning load because of reduced internal heat gains from energy-efficient lighting. The interactive effects do not apply to exterior lighting.

The annual operating hours, the coincidence factors, and the interactive effect factors are all derived from DEER figures.

The following table lists building types set by DEER. A straight average across DEER building types would heavily weight sectors that happen to have multiple DEER categories. For instance, DEER has four sectors in education and only two in medical. A straight average of operating hours would have weighted the education sector twice as heavily as the medical sector where in reality the two are similar in electric demand.[2] Instead, our average values are that of sector groupings as stated in the table below.

[2] AEP Ohio 2009 to 2028 Energy Efficiency, Peak Demand Reduction Potential Study, Volume 2. Page 48. Summit Blue Consulting, Inc. August 13, 2009.

**Table 2: DEER Building Types**

| DEER | Average Grouping |
|---|---|
| Education – Primary School | K-12 School |
| Education – Secondary School | |
| Education – Community College | College/University |
| Education – University | |
| Grocery | Grocery |
| Health/Medical – Hospital | Medical |
| Health/Medical – Nursing Home | |
| Lodging – Hotel | Hotel/Motel |
| Lodging – Motel | |
| Lodging – Guest Room | |
| Manufacturing – Light Industrial | Light Industry |
| Office – Large | Office |
| Office – Small | |
| Restaurant – Sit-Down | Restaurant |
| Restaurant – Fast-Food | |
| Retail – 3-Story Large | Retail/Service |
| Retail – Single-Story Large | |
| Retail – Small | |
| Storage – Conditioned | Warehouse |
| Storage – Unconditioned | |
| Warehouse – Refrigerated | |

The following tables list DEER values. Compact fluorescent lamps (CFLs), LED lighting (unless otherwise noted), and integrated ballast ceramic metal halides have CFL lighting operating hours. Other lighting categories have different operating hours as shown below.

**Table 3: Interactive Effects by Building Type from DEER**

| DEER Market Sector | Demand Interactive Effects | Energy Interactive Effects |
|---|---|---|
| Education – Primary School | 1.23 | 1.15 |
| Education – Secondary School | 1.23 | 1.15 |
| Education – Community College | 1.22 | 1.15 |
| Education – University | 1.22 | 1.15 |
| Grocery | 1.25 | 1.13 |
| Medical – Hospital | 1.26 | 1.18 |
| Medical – Clinic | 1.26 | 1.18 |
| Lodging Hotel | 1.14 | 1.14 |
| Lodging Motel | 1.14 | 1.14 |
| Lodging – Guest Rooms | 1.14 | 1.14 |
| Manufacturing – Light Industrial | 1.08 | 1.04 |
| Office – Large | 1.25 | 1.17 |
| Office – Small | 1.25 | 1.17 |
| Restaurant – Sit-Down | 1.26 | 1.15 |
| Restaurant – Fast-Food | 1.26 | 1.15 |
| Retail – 3-Story Large | 1.19 | 1.11 |
| Retail – Single-Story Large | 1.19 | 1.11 |
| Retail – Small | 1.19 | 1.11 |
| Storage Conditioned | 1.09 | 1.06 |
| Storage Unconditioned | 1.09 | 1.06 |
| Warehouse | 1.09 | 1.06 |

**Table 4: Coincident Diversity Factors from DEER**

| DEER Market Sector | Coincident Diversity Factors |
|---|---|
| Education – Primary School | 0.42 |
| Education – Secondary School | 0.42 |
| Education – Community College | 0.68 |
| Education – University | 0.68 |
| Grocery | 0.81 |
| Medical – Hospital | 0.74 |
| Medical – Clinic | 0.74 |
| Lodging Hotel | 0.67 |
| Lodging Motel | 0.67 |
| Lodging – Guest Rooms | 0.67 |
| Manufacturing – Light Industrial | 0.99 |
| Office – Large | 0.81 |
| Office – Small | 0.81 |
| Restaurant – Sit-Down | 0.68 |
| Restaurant – Fast-Food | 0.68 |
| Retail – 3-Story Large | 0.88 |
| Retail – Single-Story Large | 0.88 |
| Retail – Small | 0.88 |
| Storage Conditioned | 0.84 |
| Storage Unconditioned | 0.84 |
| Warehouse | 0.84 |

**Table 5: Annual Operating Hours from DEER**

| DEER Market Sector | CFL Annual Operating Hours | Other Lighting Annual Operating Hours |
|---|---|---|
| Education – Primary School | 1,440 | 1,440 |
| Education – Secondary School | 2,305 | 2,305 |
| Education – Community College | 3,792 | 3,792 |
| Education – University | 3,073 | 3,073 |
| Grocery | 5,824 | 5,824 |
| Medical – Hospital | 8,736 | 8,736 |
| Medical – Clinic* | 4,212 | 4,212 |
| Lodging Hotel | 8,736 | 8,736 |
| Lodging Motel | 8,736 | 8,736 |
| Lodging – Guest Rooms | 1,145 | NA |
| Manufacturing – Light Industrial* | 4,290 | 4,290 |
| Office – Large | 2,739 | 2,808 |
| Office – Small | 2,492 | 2,808 |
| Restaurant – Sit-Down | 3,444 | 4,368 |
| Restaurant – Fast-Food | 6,188 | 6,188 |
| Retail – 3-Story Large | 4,259 | 4,259 |
| Retail – Single-Story Large | 4,368 | 4,368 |
| Retail – Small | 3,724 | 4,004 |
| Storage Conditioned* | 2,860 | 4,859 |
| Storage Unconditioned* | 2,860 | 4,859 |
| Warehouse* | 2,600 | 4,859 |

* Not from DEER

Industrial-operating hours are assumed based on the following sources:

- DEER estimates hours to be 2,860.
- Efficiency Vermont Technical Reference User Manual's (No. 2004-29) estimates 5,913 hours.
- The 2004-2005 PG&E work papers assumed 6,650 hours for process industrial and 4,400 for assembly industrial.

DEER's estimated hours are far lower than figures other sources have provided and so we have increased the DEER values by 50% or to 4,290 hours. This value is reasonable and on the conservative side of the averages. We will use this conservative value until more data is available for AEP Ohio or other MidWestern utility territory.

Similarly, we believe that the DEER storage and warehouse operating hours are low as well. Using data from other programs in the region, KEMA has seen average operating hours that are significantly higher and is using a higher value of 4,859 as a better estimate of deemed operating hours for this region.

DEER has set Medical-Hospital operating hours at 8,736. We have lowered this value for the purposes of calculating our average by using operating hours that are 50% above that of offices or 4,212 hours (Medical-Clinic operating hours). This reduction accounts for areas in medical facilities that behave more like offices and do not operate around the clock. The value used in our calculations is the average of the DEER Hospital and the revised clinic operating hours.

Hotel/Motel operating hours are the average of guest room hours and either hotel or motel operating hours since a facility can only be one or the other.

Incremental costs are taken from a number of sources. The AEP Ohio 2009-2028 Energy Efficiency/Peak Demand Reduction Potential Study conducted in August of 2009 provides costs for some measures. Since this study was prepared specifically for AEP, the utility's costs are used whenever applicable. Because some measures listed in the study do not match with that of the program, costs are derived from other sources as well including DEER, KEMA, and the Commonwealth Edison Company's 2008-10 Energy Efficiency and Demand Response Plan prepared by ICF International. The ICF document is referenced as the ICF Portfolio Plan.

## Compact Fluorescent Lamps, Screw-In

**Table 6 Compact Fluorescent Lamps, Screw-In**

| | |
|---|---|
| **Measure Description** | ENERGY STAR-rated CFLs with lamp/ballast efficacy of ≥ 40 lumens per Watt. Measure applies only if incandescent or HID lamps are being replaced. |
| **Units** | Per lamp |
| **Base Case Description** | Incandescent or HID lamps. |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: AEP Ohio Potential Study |
| **Effective Useful Life** | Source: DEER<br>2.5 years |

This incentive applies to screw-in lamps and applies only if an incandescent or high-intensity discharge (HID) lamp is being replaced. All screw-in CFLs must be ENERGY STAR® rated. The lamp/ballast combination must have an efficacy ≥40 lumens per Watt (LPW). For screw-in CFLs, electronic ballasts are required for lamps ≥18 Watts.

### Measure Savings

Baseline and retrofit equipment assumptions are presented in the next table. Most lighting retrofits assume an early replacement of existing technologies where the baseline represents the equipment removed. The table shows the wattages used for the savings calculations.

**Table 7: Baseline and Retrofit Wattages**

| Measure | Base Wattage (Watts) | Retrofit Wattage (Watts) | kW Reductions (kW) |
|---|---|---|---|
| 15 W or less | 75 | 15 | 0.060 |
| 15 W or less | 60 | 15 | 0.045 |
| 15 W or less | 60 | 14 | 0.046 |
| 15 W or less | 50 | 14 | 0.036 |
| 15 W or less | 65 | 13 | 0.052 |
| 15 W or less | 60 | 13 | 0.047 |
| 15 W or less | 40 | 13 | 0.027 |
| 15 W or less | 40 | 11 | 0.029 |
| 15 W or less | 40 | 10 | 0.030 |
| 15 W or less | 35 | 7 | 0.028 |
| 15 W or less | 30 | 7 | 0.023 |
| 15 W or less | 25 | 7 | 0.018 |
| 15 W or less | 30 | 9 | 0.021 |
| 15 W or less | 25 | 9 | 0.016 |
| 15 W or less | 25 | 5 | 0.020 |
| 15 W or less | 20 | 5 | 0.015 |
| 16W-25W | 100 | 25 | 0.075 |
| 16W-25W | 75 | 25 | 0.05 |
| 16W-25W | 100 | 23 | 0.077 |
| 16W-25W | 100 | 20 | 0.08 |
| 16W-25W | 75 | 20 | 0.055 |
| 16W-25W | 75 | 19 | 0.056 |
| 16W-25W | 75 | 18 | 0.057 |
| 16W-25W | 60 | 18 | 0.042 |
| 16W-25W | 60 | 16 | 0.044 |
| 26W and Greater | 150 | 40 | 0.11 |
| 26W and Greater | 150 | 36 | 0.114 |
| 26W and Greater | 100 | 30 | 0.07 |
| 26W and Greater | 100 | 28 | 0.072 |
| 26W and Greater | 100 | 26 | 0.074 |
| 26W and Greater | 75 | 26 | 0.049 |

**Table 8 Wattage Reduction**

| Wattage Category | Average Wattage Reduction |
|---|---|
| ≤15 | 32 |
| 16 to 26 | 60 |
| >26 | 76 |

The following tables provide the measure savings using the above wattage reduction assumptions.

**Table 9 Measure Savings for 15 W or less**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak kW Savings | kWh Savings |
|---|---|---|---|---|---|
| 4,321 | 1.19 | 0.77 | 1.12 | 0.029 | 155 |

**Table 10 Measure Savings for 16 – 26 W**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak kW Savings | kWh Savings |
|---|---|---|---|---|---|
| 4,321 | 1.19 | 0.77 | 1.12 | 0.054 | 290 |

**Table 11 Measure Savings for > 26 W**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak kW Savings | kWh Savings |
|---|---|---|---|---|---|
| 4,321 | 1.19 | 0.77 | 1.12 | 0.069 | 368 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below.

Noncoincident kW reduction = kW of existing equipment - kW of replacement equipment

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)*( Energy Interactive Effects)

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = noncoincident kW savings * Coincidence Factor * Demand interactive effect

Interactive factors account for savings that the measures achieve through avoided air conditioning load because of reduced internal heat gains from energy-efficient lighting.

The annual operating hours, the coincidence factors, and the interactive effect factors are all derived from DEER figures.[3]

**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 the cost difference between the energy-efficient equipment and the less efficient option. For lighting measures, 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 12 Measure Life and Incremental Measure Cost**

| Wattage Category | | Value | Source |
|---|---|---|---|
| All | Measure Life | 2.5 | DEER 2005 |
| ≤15W | Incremental Measure Cost | $4.13 | AEP Ohio Potential Study |
| 16W-26W | Incremental Measure Cost | $4.13 | AEP Ohio Potential Study |
| > 26W | Incremental Measure Cost | $4.13 | AEP Ohio Potential Study |

[3] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

## T5 Lamp and Ballast

| T5 Lamp and Ballast | |
|---|---|
| **Measure Description** | This measure consists of replacing 4 foot T12 lamps and magnetic ballasts with T5 lamps and electronic ballast. The T5 lamps must have a color rendering index (CRI) ≥ 80. The electronic ballast must be high frequency (≥20 kHz), UL listed, and warranted against defects for 5 years. Ballasts must have a power factor (PF) ≥ 0.90 and a total harmonic distortion (THD) ≤20 percent at full light output. |
| **Units** | Per Lamp |
| **Base Case Description** | T12 lamps with magnetic ballasts. |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: KEMA |
| **Effective Useful Life** | Source: DEER<br>11 years |

This measure consists of replacing 4 foot T12 lamps and magnetic ballasts with T5 lamps and electronic ballast. The T5 lamps must have a color rendering index (CRI) ≥ 80. The electronic ballast must be high frequency (≥20 kHz), UL listed, and warranted against defects for 5 years. Ballasts must have a power factor (PF) ≥ 0.90 and a total harmonic distortion (THD) ≤20 percent at full light output.

**Measure Savings**
The savings are presented in the following table. The annual operation hours, the coincidence factors, and the interactive effect factors are obtained from the DEER database.[4] 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.

**Table 13 T12 to T5 Fluorescent Fixtures per Watt Reduced**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak Watt Savings | kWh Savings |
|---|---|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 | 0.012 | 65.1 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below.

[4] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = Non-Coincident kW Savings * Annual Operating Hours * Energy Interactive Effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = Non-Coincident kW Savings * Coincidence Factor * Demand Interactive Effect

Baseline and retrofit equipment assumptions are listed in the table below.

**Table 14 Baseline and Retrofit Wattages for T12 to T5 Fixture Retrofits**

| Baseline Configuration | Base Fixture Wattage | Retrofit Configuration | Retrofit Fixture Wattage | Demand Savings per lamp (kW) | Weight Percentages |
|---|---|---|---|---|---|
| 4ft 4-lamp T12 | 270 | 4ft T5 4lamp HO | 234 | 0.009 | 13% |
| 4ft 4-lamp T12 | 164 | 4ft T5 4lamp | 128 | 0.009 | 13% |
| 4ft 3-lamp T12 | 230 | 4ft T5 3 Lamp HO | 179 | 0.017 | 13% |
| 4ft 3-lamp T12 | 133 | 4ft T5 3 Lamp | 97 | 0.012 | 13% |
| 4ft 2-lamp T12 | 145 | 4ft T5 2 Lamp HO | 117 | 0.014 | 13% |
| 4ft 2-lamp T12 | 82 | 4ft T5 2 Lamp | 64 | 0.009 | 13% |
| 4ft 1-lamp T12 | 80 | 4ft T5 1 Lamp HO | 62 | 0.018 | 13% |
| 4ft 1-lamp T12 | 51 | 4ft T5 1 Lamp | 33 | 0.018 | 13% |
| Weighted Average | | | | 0.013 | |

**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.

**Table15 Measure Life and Incremental Measure Cost**

| | Value | Source |
|---|---|---|
| Measure Life | 11 | DEER |
| Incremental Measure Cost | $18.54 | KEMA |

## High Performance and Reduced Wattage 4-foot T8 Lamps and Ballast

| High Performance and Reduced Wattage 4-foot T8 Lamps and Ballast | |
|---|---|
| **Measure Description** | This measure consists of replacing existing T12 4' lamps and magnetic ballasts with high performance 32W T8 lamps or reduced wattage 28W or 25W lamps and electronic ballasts. Both the lamp and ballast must meet the Consortium for Energy Efficiency (CEE) high performance or reduced wattage T8 specification (www.cee1.org) summarized below. |
| **Units** | Per lamp |
| **Base Case Description** | T12 lamp and magnetic ballasts |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: AEP Ohio Potential Study |
| **Effective Useful Life** | Source: DEER<br>11 years |

This measure consists of replacing existing T12 lamps and magnetic ballasts with high-performance T8 lamps or reduced wattage (28 or 25W) T8 lamps and electronic ballasts. This measure is based on the Consortium for Energy Efficiency (CEE) high-performance T8 or reduced wattage specification (www.cee1.org) and is summarized below. A list of qualified lamps and ballasts can be found at: http://www.cee1.org. Both the lamp and ballast must meet the specification to qualify for an incentive. The incentive is calculated based on the number of lamps installed. A manufacturer's specification sheet must accompany the application.

For reduced wattage 4-foot T8 lamps, the nominal wattage must be 28 W (≥2,585 Lumens) or 25 W (≥2,400 Lumens) to qualify. The mean system efficacy must be ≥ 90 MLPW, CRI ≥80, and lumen maintenance at 94 percent.  Other requirements can be found on the CEE website using the links above.

The table below provides the specification for high performance systems.

## High-Performance T8 Specifications

**Table 16 High-Performance T8 Specifications**

<table>
<tr><th colspan="5">Performance Characteristics for Systems</th></tr>
<tr><td rowspan="2">Mean system efficacy</td><td colspan="4">≥ 90 Mean Lumens per Watt (MLPW) for Instant Start Ballasts</td></tr>
<tr><td colspan="4">≥ 88 MLPW for Programmed Rapid Start Ballasts</td></tr>
<tr><th colspan="5">Performance Characteristics for Lamps</th></tr>
<tr><td>Color Rendering Index (CRI)</td><td colspan="4">≥ 80</td></tr>
<tr><td>Minimum initial lamp lumens</td><td colspan="4">≥ 3100 Lumens[5]</td></tr>
<tr><td>Lamp life</td><td colspan="4">≥ 24,000 hours</td></tr>
<tr><td>Lumen maintenance or minimum mean lumens</td><td colspan="4">≥ 90% or<br>≥ 2,900 Mean Lumens</td></tr>
<tr><th colspan="5">Performance Characteristics for Ballasts</th></tr>
<tr><td rowspan="12">Ballast Efficacy Factor (BEF)<br><br>BEF = (BF x 100) / Ballast Input Watts</td><th colspan="4">Instant-Start Ballast (BEF)</th></tr>
<tr><td>Lamps</td><td>Low BF ≤ 0.85</td><td>Norm 0.85 < BF ≤ 1.0</td><td>High BF ≥ 1.01</td></tr>
<tr><td>1</td><td>> 3.08</td><td>> 3.11</td><td>NA</td></tr>
<tr><td>2</td><td>> 1.60</td><td>> 1.58</td><td>>1.55</td></tr>
<tr><td>3</td><td>≥ 1.04</td><td>≥ 1.05</td><td>≥ 1.04</td></tr>
<tr><td>4</td><td>≥ 0.79</td><td>≥ 0.80</td><td>≥ 0.77</td></tr>
<tr><th colspan="4">Programmed Rapid Start Ballast (BEF)</th></tr>
<tr><td>1</td><td>≥ 2.84</td><td>≥ 2.84</td><td>NA</td></tr>
<tr><td>2</td><td>≥ 1.48</td><td>≥ 1.47</td><td>≥ 1.51</td></tr>
<tr><td>3</td><td>≥ 0.97</td><td>≥ 1.00</td><td>≥ 1.00</td></tr>
<tr><td>4</td><td>≥ 0.76</td><td>≥ 0.75</td><td>≥ 0.75</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Ballast Frequency</td><td colspan="4">20 to 33 kHz or ≥ 40 kHz</td></tr>
<tr><td>Power Factor</td><td colspan="4">≥ 0.90</td></tr>
<tr><td>Total Harmonic Distortion</td><td colspan="4">≤ 20%</td></tr>
</table>

**Measure Savings**
Savings are summarized by the following table:

**Table 17 Measure Savings for High-Performance or Reduced Wattage 4-foot Lamp and Ballast (per lamp)**

| Coincident Demand Savings (kW) | Energy Savings (kWh) |
|---|---|
| 0.012 | 62.0 |

[5] For lamps with temperature ≥4500K, 2,950 minimum initial lamp lumens are specified.

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below. The annual operating hours, the coincidence factors, and the interactive effect factors were all derived from the DEER database and shown in the following table. However, DEER values by building type were averaged for the AEP Ohio Program.

**Table 18 Factors used for Calculating Lighting Savings**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects |
|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 |

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

Baseline and retrofit equipment assumptions are presented in the table below.

**Table 19 Baseline and Retrofit Wattages for High-Performance or Reduced Wattage Fixture Retrofits**

| | T8, 4-foot Configuration | Base Fixture Wattage | Retrofit Lamp Wattage | Retrofit Fixture Wattage | Demand Savings per fixture (kW) | Demand Savings per lamp (kW) | Weight Percentages |
|---|---|---|---|---|---|---|---|
| High | 4-lamp | 144 | 32 | 108 | 0.036 | 0.009 | 9% |
| | 3-lamp | 103 | 32 | 83 | 0.02 | 0.007 | 4% |
| | 2-lamp | 72 | 32 | 54 | 0.018 | 0.009 | 8% |
| | 1-lamp | 43 | 32 | 28 | 0.015 | 0.015 | 4% |
| Med | 4-lamp | 144 | 28 | 96 | 0.048 | 0.012 | 15% |
| | 3-lamp | 103 | 28 | 72 | 0.031 | 0.010 | 10% |
| | 2-lamp | 72 | 28 | 48 | 0.024 | 0.012 | 15% |
| | 1-lamp | 43 | 28 | 25 | 0.018 | 0.018 | 10% |
| Low | 4-lamp | 144 | 25 | 85 | 0.059 | 0.015 | 9% |
| | 3-lamp | 103 | 25 | 66 | 0.037 | 0.012 | 4% |
| | 2-lamp | 72 | 25 | 44 | 0.028 | 0.014 | 8% |
| | 1-lamp | 43 | 25 | 22 | 0.021 | 0.021 | 4% |
| | Weighted Average | | | | | 0.0126 | |

**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 the 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 cost of the less efficient option is 0.

**Table 20 Measure Life and Incremental Measure Cost**

| | Measure Category | Value | Source |
|---|---|---|---|
| Measure Life | Lamp and Ballast | 11 | DEER |
| Incremental Measure Cost | 4 Foot Lamp and Ballast | $13.14 | AEP Ohio Potential Study |

## Reduced Wattage 4-foot Lamp Only

| Reduced Wattage 4-foot Lamp Only | |
|---|---|
| **Measure Description** | This measure consists of replacing existing standard T8 4' lamps and electronic ballasts with reduced wattage T8 lamps. The lamp must meet the Consortium for Energy Efficiency (CEE) reduced wattage T8 specification (www.cee1.org). The nominal wattage for 4 foot lamps must be 28W (≥2585 Lumens) or 25W (≥2400 Lumens) to qualify. The mean system efficacy must be ≥ 90 MLPW, CRI ≥ 80, and lumen maintenance at 94%. A manufacturer's specification sheet must accompany the application. |
| **Units** | Per lamp |
| **Base Case Description** | Standard T8 fixtures. |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: ICF Portfolio Plan |
| **Effective Useful Life** | Source: KEMA<br>3 years |

Incentives are available when replacing standard 32-Watt T8 lamps with reduced-wattage T8 lamps when an electronic ballast is already present. The lamps must be reduced wattage in accordance with the Consortium for Energy Efficiency (CEE) specification (www.cee1.org). Qualified products can be found at http://www.cee1.org. The nominal wattage must be 28 W (≥2,585 Lumens) or 25 W (≥2,400 Lumens) to qualify. The mean system efficacy must be ≥ 90 MLPW, CRI ≥80, and lumen maintenance at 94 percent. A manufacturer's specification sheet must accompany the application.

**Measure Savings**
Savings are summarized by the following table:

**Table 21 Measure Savings for Reduced-Wattage 4-foot Lamp Only**

| Coincident Demand Savings (kW) | Energy Savings (kWh) |
|---|---|
| 0.005 | 28.8 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below. The annual operating hours, the coincidence factors, and the interactive effect factors were all derived from the DEER database and shown in the next table. However, DEER values by building type were averaged for the AEP Ohio Program.

**Table 22 Factors used for Calculating Lighting Savings**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects |
|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 |

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

Baseline and retrofit equipment assumptions are presented in the next table.

**Table 23 Baseline and Retrofit Wattages for 4-foot T8 Lamp Only**

| T8 Configuration | Base Lamp Wattage | Base Fixture Wattage | Retrofit Lamp Wattage | Retrofit Fixture Wattage | Demand Savings per fixture (kW) | Demand Savings per lamp (kW) | Weight Percentages |
|---|---|---|---|---|---|---|---|
| 4 ft, 4-lamp | 32 | 112 | 28 | 96 | 0.016 | 0.004 | 18% |
| 4 ft, 3-lamp | 32 | 85 | 28 | 72 | 0.013 | 0.004 | 13% |
| 4 ft, 2-lamp | 32 | 58 | 28 | 48 | 0.01 | 0.005 | 15% |
| 4 ft ,1-lamp | 32 | 32 | 28 | 25 | 0.007 | 0.007 | 5% |
| 4 ft, 4-lamp | 32 | 112 | 25 | 85 | 0.027 | 0.007 | 18% |
| 4 ft, 3-lamp | 32 | 85 | 25 | 66 | 0.019 | 0.006 | 13% |
| 4 ft, 2-lamp | 32 | 58 | 25 | 44 | 0.014 | 0.007 | 15% |
| 4 ft ,1-lamp | 32 | 32 | 25 | 22 | 0.01 | 0.010 | 5% |
| Weighted Average | | | | | | 0.006 | |

**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. In this case, the IMC is equal to the full measure cost for lamp and ballast retrofit and incremental for lamp only. The lamp and ballast retrofit is a change in technology.

**Table 24 Measure Life and Incremental Measure Cost**

| | Measure Category | Value | Source |
|---|---|---|---|
| Measure Life | Lamp Only | 3 | KEMA |
| Incremental Measure Cost | 4 Foot Lamp Only | $2.10 | ICF Portfolio Plan |

## Reduced Wattage 8-foot

**Table 25 Reduced Wattage 8-foot**

| | |
|---|---|
| **Measure Description** | This measure consists of replacing existing T12 8' lamps and magnetic ballasts with reduced wattage T8 lamps and electronic ballasts. Both the lamp and ballast must meet the Consortium for Energy Efficiency (CEE) high performance or reduced wattage T8 specification (www.cee1.org). Eight foot lamps must have a minimum MLPW of 90 and must have a nominal wattage of less than 57W. A manufacturer's specification sheet must accompany the application.<br><br>High wattage T8 (59W) can be replaced with reduced wattage lamps without replacing the ballast. The lamps must also meet CEE standards for reduced wattage. |
| **Units** | Per lamp |
| **Base Case Description** | T12 lamp and magnetic ballasts or high watt T8 fixtures (for reduced wattage lamp only replacements). |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: DEER and ICF Portfolio Plan |
| **Effective Useful Life** | Source: KEMA and DEER |

This measure consists of replacing existing T12 lamps and magnetic ballasts with reduced wattage lamp and electronic ballast systems. The lamps and ballasts must meet the Consortium for Energy Efficiency (CEE) specification (www.cee1.org). Qualified lamps and ballast products can be found at http://www.cee1.org. Incentives are also available when replacing 59-Watt T8 lamps with reduced-wattage T8 lamps when an electronic ballast is already present. Eight-foot lamps must have a minimum MLPW of 90 and must have a nominal wattage of less than 57 W. A manufacturer's specification sheet must accompany the application.

**Measure Savings**
Savings are summarized by the following table:

**Table 26 Measure Savings for Reduced-Wattage 8-foot Lamp and Ballast**

| Coincident Demand Savings (kW) | Energy Savings (kWh) |
|---|---|
| 0.016 | 78.7 |

**Table 27 Measure Savings for Reduced-Wattage 8-foot Lamp Only**

| Coincident Demand Savings (kW) | Energy Savings (kWh) |
|---|---|
| 0.005 | 24.6 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below. The annual operating hours, the coincidence factors, and the interactive effect factors were all derived from the DEER database and shown in the table below. DEER values by building type were averaged for the AEP Ohio Program.

**Table 28 Factors used for Calculating Lighting Savings**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects |
|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 |

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

Baseline and retrofit equipment assumptions are presented in the next table.

**Table 29 Baseline and Retrofit Wattages for 8-foot**

| | Configuration | Base Lamp Wattage | Base Fixture Wattage | Retrofit Lamp Wattage | Retrofit Fixture Wattage | Demand Savings per fixture (kW) | Demand Savings per lamp (kW) | Weight Percentages |
|---|---|---|---|---|---|---|---|---|
| Lamp and Ballast | 8ft, 2 lamp | 60 | 132 | 57 | 102 | 0.030 | 0.015 | 50% |
| | 8ft, 1-lamp | 60 | 77 | 57 | 60 | 0.017 | 0.017 | 50% |
| | Weighted Average | | | | | | 0.016 | |
| Lamp Only | 8ft, 2 lamp | 59 | 106 | 57 | 102 | 0.004 | 0.002 | 50% |
| | 8ft, 1-lamp | 59 | 68 | 57 | 60 | 0.008 | 0.008 | 50% |
| | Weighted Average | | | | | | 0.005 | |

**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. In this case, the IMC is equal to the full measure cost for lamp and ballast retrofit and incremental for lamp only. The lamp and ballast retrofit is a change in technology.

**Table 30 Measure Life and Incremental Measure Cost**

| | Measure Category | Value | Source |
|---|---|---|---|
| Measure Life | Lamp and Ballast | 11 | DEER |
| Measure Life | Lamp Only | 3 | KEMA |
| Incremental Measure Cost | 8 Foot Lamp and Ballast | $36.91 | DEER |
| Incremental Measure Cost | 8 Foot Lamp Only | $5.50 | ICF Portfolio Plan |

## U-Tube T8 Lamps and Ballast

**Table 31 U-Tube T8 Lamps and Ballast**

| | |
|---|---|
| **Measure Description** | This measure consists of replacing existing T12 U-tube lamps and magnetic ballasts with T8 U-tube lamps and electronic ballasts. |
| **Units** | Per lamp |
| **Base Case Description** | U-tube T12 lamps and magnetic ballast |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: AEP Ohio Potential Study |
| **Effective Useful Life** | Source: DEER<br>11 years |

This measure consists of replacing existing U-tube T12 lamps and magnetic ballasts with U-tube T8 lamps and electronic ballasts. The lamp must have a color rendering index (CRI) ≥ 80 and the ballast must have a total harmonic distortion (THD) ≤ 20% at full light output and power factor (PF) ≥ 90. Ballasts must also be warranted against defect for 5 years. The incentive is calculated based on the number of lamps installed. A manufacturer's specification sheet must accompany the application.

**Measure Savings**
The coincident kW and kWh savings are in the following table.

**Table 32 Measure Savings for U-tube Lamp and Ballast (per lamp)**

| Coincident Demand Savings (kW) | Energy Savings (kWh) |
|---|---|
| 0.009 | 46.7 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below. The annual operating hours, the coincidence factors, and the interactive effect factors were all derived from the DEER database and shown in the following table.[6]

[6] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

**Table 33 Factors used for Calculating Lighting Savings**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects |
|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 |

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

Baseline and retrofit equipment assumptions are presented in the following table. The wattages were collected from PG&E's Non-residential retrofit standard wattages table.

**Table 34 Baseline and Retrofit Wattages for U-tube lamps**

| T8 Configuration | Base Lamp Wattage | Base Fixture Wattage | Retrofit Lamp Wattage | Retrofit Fixture Wattage | Demand Savings per fixture (kW) | Demand Savings per lamp (kW) | Weight Percentages |
|---|---|---|---|---|---|---|---|
| U-tube, 2 lamp | 35 | 72 | 32 | 59 | 0.013 | 0.007 | 50% |
| U-tube, 1 lamp | 35 | 43 | 32 | 31 | 0.012 | 0.012 | 50% |
| Weighted Average | | | | | | 0.010 | |

**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 IMC is equal to the full measure cost since cost of the less efficient option is $0. For U-tubes, it is assumed that the cost is the same as a high performance 4-foot T8 lamp (DEER measure ID D03-852).

**Table35 Measure Life and Incremental Measure Cost**

| | Measure Category | Value | Source |
|---|---|---|---|
| Measure Life | Lamp and Ballast | 11 | DEER |
| Measure Life | Lamp Only | 3 | KEMA |
| Incremental Measure Cost | U-Tube Lamp and Ballast | $13.14 | AEP Potential Study |

## 2-foot & 3-foot T8 Lamps and Ballast

**Table 36 2-foot & 3-foot T8 Lamps and Ballast**

| | |
|---|---|
| **Measure Description** | This measure consists of replacing existing T12 2-foot and 3-foot lamps and magnetic ballasts with 17W, 2-foot, and 25W, 3-foot, T8 lamps and electronic ballasts. |
| **Units** | Per lamp |
| **Base Case Description** | T12 lamps and magnetic ballast |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: PG&E 2006 Work papers |
| **Effective Useful Life** | Source: DEER<br>11 years |

This measure consists of replacing existing T12 lamps and magnetic ballasts with T8 lamps and electronic ballasts. The lamp must have a color rendering index (CRI) ≥ 80 and the ballast must have a total harmonic distortion (THD) ≤ 32% at full light output and power factor (PF) ≥ 0.90. Ballasts must also be warranted against defects for 5 years. The incentive is calculated based on the number of lamps installed. A manufacturer's specification sheet must accompany the application.

**Measure Savings**
The coincident kW and kWh savings are provided in the following table:

**Table 37 Measure Savings for 2-foot and 3-foot Lamp and Ballast (per lamp)**

| 2-foot Lamp fixtures | | 3-foot Lamp fixtures | |
|---|---|---|---|
| **Coincident Demand Savings (kW)** | **Energy Savings (kWh)** | **Coincident Demand Savings (kW)** | **Energy Savings (kWh)** |
| 0.010 | 51.6 | 0.013 | 69.5 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below. The annual operating hours, the coincidence factors, and the interactive effect factors were all derived from the DEER database and shown in the following table.

**Table 38 Factors used for Calculating Lighting Savings**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects |
|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 |

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

Baseline and retrofit equipment assumptions are presented in the tables below. The fixture wattages were collected from PG&E's Non-residential Retrofit Program standard fixture wattage table.

**Table 39 Baseline and Retrofit Wattages for 2-foot lamps**

| T8 Configuration | Base Lamp Wattage | Base Fixture Wattage | Retrofit Lamp Wattage | Retrofit Fixture Wattage | Demand Savings per fixture (kW) | Demand Savings per lamp (kW) | Weight Percentages |
|---|---|---|---|---|---|---|---|
| 2 ft, 4-lamp | 20 | 112 | 17 | 61 | 0.051 | 0.013 | 2.5% |
| 2 ft, 3-lamp | 20 | 84 | 17 | 47 | 0.037 | 0.012 | 2.5% |
| 2 ft, 2-lamp | 20 | 56 | 17 | 33 | 0.023 | 0.012 | 65% |
| 2 ft ,1-lamp | 20 | 28 | 17 | 20 | 0.008 | 0.008 | 30% |
| Weighted Average | | | | | | 0.011 | |

**Table 40 Baseline and Retrofit Wattages for 3-foot lamps**

| T8 Configuration | Base Lamp Wattage | Base Fixture Wattage | Retrofit Lamp Wattage | Retrofit Fixture Wattage | Demand Savings per fixture (kW) | Demand Savings per lamp (kW) | Weight Percentages |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 ft, 4-lamp | 30 | 152 | 25 | 87 | 0.065 | 0.0163 | 2.5% |
| 3 ft, 3-lamp | 30 | 114 | 25 | 67 | 0.047 | 0.0157 | 2.5% |
| 3 ft, 2-lamp | 30 | 76 | 25 | 46 | 0.030 | 0.0150 | 65% |
| 3 ft ,1-lamp | 30 | 38 | 25 | 26 | 0.012 | 0.0120 | 30% |
| Weighted Average | | | | | | 0.014 | |

**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 IMC is equal to the full measure cost since cost of the less efficient option is $0.

**Table 41 Measure Life and Incremental Measure Cost**

| | Measure Category | Value | Source |
|---|---|---|---|
| Measure Life | Lamp and Ballast | 11 | DEER |
| Measure Life | Lamp Only | 3 | KEMA |
| Incremental Measure Cost | 2 Foot Lamp and Ballast | $10.50 | PG&E 2006 Work Paper |
| Incremental Measure Cost | 3 Foot Lamp and Ballast | $21 | PG&E 2006 Work Paper |

## Ceramic Metal Halides or Pulse Start Metal Halides

**Table 42 Ceramic Metal Halides or Pulse Start Metal Halides**

| | |
|---|---|
| **Measure Description** | This measure applies to retrofits of high intensity discharge fixtures with either pulse start metal halide or ceramic metal halide fixtures. The new fixture must replace a higher wattage existing fixture. |
| **Units** | Per Fixture |
| **Base Case Description** | High wattage HID fixtures |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: KEMA |
| **Effective Useful Life** | Source: DEER<br>16 years |

This incentive applies to retrofits of high-intensity discharge fixtures with either pulse-start metal halide or ceramic metal halide fixtures. Total replacement wattage must be lower than existing wattage to ensure energy savings. This measure is subject to possible pre-inspection. Retrofit kits may be used on existing mercury vapor, standard metal halide or high-pressure sodium fixtures only.

**Measure Savings**
The table below provides the non-coincident savings.

**Table 43 Wattage Reduction**

| Wattage Category | Average Wattage Reduction |
|---|---|
| 100W or Less | 48 |
| 101W-200W | 65 |
| 201-350W | 126 |

The savings are presented in the following table. The annual operation hours, the coincidence factors, and the interactive effect factors are obtained from the DEER database.[7] 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.

[7] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

**Table 44: Measure Savings for ≤100W MH**

| Annual Operating Hours | Peak kW Savings | kWh Savings |
|---|---|---|
| 4,389 | 0.048 | 211 |

**Table 45 : Measure Savings for 101W-200W MH**

| Annual Operating Hours | Peak kW Savings | kWh Savings |
|---|---|---|
| 4,389 | 0.065 | 285 |

**Table 46: Measure Savings for >200W-350W MH**

| Annual Operating Hours | Peak kW Savings | kWh Savings |
|---|---|---|
| 4,389 | 0.126 | 553 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below. The annual operation hours, the coincidence factors, and the interactive effect factors were all obtained from the DEER database. The savings presented here are averages of those savings by building type.

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

For this measure, it is assumed that the lighting is placed in non-conditioned areas so the energy and demand interactive effects are 1.0.

Baseline and retrofit equipment assumptions are presented in the following table. Most lighting retrofits assume an early replacement of existing technologies where the baseline represents the equipment removed. The table shows the wattages used for the savings calculations.

**Table 47: Baseline and Retrofit Wattages**[8]

| Measures | Base Wattage | Retrofit Wattage | Wattage Reduction |
|---|---|---|---|
| **100W or Less** | | | |
| Base case => Ceramic MH (20W lamp) | 57 | 22 | 35 |
| Base case => Ceramic MH (39W lamp) | 83 | 46 | 37 |
| Base case (100W) => Ceramic MH (25W lamp) | 100 | 27 | 73 |
| Average | | | 48 |
| **101W-200W** | | | |
| Base case (250W lamp) => Metal Halide (175W lamp) | 295 | 208 | 87 |
| Base case (175W lamp) => Metal Halide (150W lamp) | 208 | 185 | 23 |
| Metal Halide (250W) => Pulse Start Metal Halide (175W) | | | 85 |
| Average | | | 65 |
| **201-350W** | | | |
| Base case (400W lamp) => Metal Halide (320W lamp) | 458 | 365 | 93 |
| Mercury Vapor (400W) => Pulse Start Metal Halide (250W) | | | 159 |
| Average | | | 126 |

**Measure Life and Incremental Measure Cost**

The next 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, lighting measures, 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.

[8] 2006 PG&E Interior Pulse Start Metal Halide Workpaper, PG&E Directional Lighting CMH Workpaper, SCE Ceramic Metal Halide Workpaper (WPSCNRLG0054.1), 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures.

Table 48: Measure Life and Incremental Measure Cost

| Wattage Category | | Value | Source |
|---|---|---|---|
| All | Measure Life | 16 | DEER |
| 100W or Less | Incremental Measure Cost | $95 | SCE WP[9] |
| 101W-200W | Incremental Measure Cost | $170 | PG&E WP[10] |
| 201-350W | Incremental Measure Cost | $266 | SCE WP[11] |

[9] WPSCNRLG0054.1 Ceramic Metal Halide Fixtures, Southern California Edison Workpaper, 2008.
[10] 2006 PG&E Interior Pulse Start Metal Halide Workpaper
[11] WPSCNRLG0046.1 Interior Pulse Start Metal Halide Fixtures 251 -400W, Southern California Edison Workpaper, 2008.

## New T5/T8 Fluorescent Fixtures

**Table 49 New T5/T8 Fluorescent Fixtures**

| | |
|---|---|
| **Measure Description** | This measure consists of replacing one or more existing fixtures with new fixtures containing T8 or T5 lamps and electronic ballasts. The T8 or T5 lamps must have a color rendering index (CRI) ≥ 80. The electronic ballast must be high frequency (≥20 kHz), UL listed, and warranted against defects for 5 years. Ballasts must have a power factor (PF) ≥ 0.90. Ballasts for 4-foot lamps must have total harmonic distortion (THD) ≤20 percent at full light output. For 2- and 3-foot lamps, ballasts must have THD ≤32% at full light output. |
| **Units** | Per Watt reduced |
| **Base Case Description** | Typically high wattage HID fixtures |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: KEMA |
| **Effective Useful Life** | Source: DEER<br>11 years |

This measure consists of replacing one or more existing fixtures with new fixtures containing T8 or T5 lamps and electronic ballasts. The T8 or T5 lamps must have a color rendering index (CRI) ≥ 80. The electronic ballast must be high frequency (≥20 kHz), UL listed, and warranted against defects for 5 years. Ballasts must have a power factor (PF) ≥ 0.90. Ballasts for 4-foot lamps must have total harmonic distortion (THD) ≤20 percent at full light output. For 2- and 3-foot lamps, ballasts must have THD ≤32 percent at full light output.

**Measure Savings**
The annual operating hours, the coincidence factors, and the interactive effect factors were all derived from the DEER database.[12]

**Table 50: Measure Savings for New T8/T5 Fluorescent Fixtures per Watt Reduced**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak kW Savings | kWh Savings |
|---|---|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 | 0.000916 | 4.9141 |

[12] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below.

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

Baseline and retrofit equipment assumptions are variable. Because we define this measure with the number of watts reduced, the non-coincident demand savings will be one watt by definition.

**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. For lighting measures, 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 51: Measure Life and Incremental Measure Cost**

| | Value | Source |
|---|---|---|
| Measure Life | 11 | DEER |
| Incremental Measure Cost[13] | $0.75 | KEMA |

## Exit Signs

**Table 52 Exit Signs**

| | |
|---|---|
| **Measure Description** | High-efficiency exit signs must replace or retrofit an existing incandescent exit sign. Electroluminescent, photoluminescent, T1 and light-emitting diode (LED) exit signs are eligible under this category. Non-electrified and remote exit signs are not eligible. All new exit signs or retrofit exit signs must be UL or ETL listed, have a minimum lifetime of 10 years, and have an input wattage ≤5 Watts or be ENERGY STAR qualified. |
| **Units** | Per Sign |
| **Base Case Description** | Incandescent Exit Signs |
| **Measure Savings** | Source: ENERGY STAR |
| **Measure Incremental Cost** | Source: AEP Ohio Potential Study |
| **Effective Useful Life** | Source: DEER<br>16 years |

High-efficiency exit signs must replace or retrofit an existing incandescent exit sign. Electroluminescent, photoluminescent, T1 and light-emitting diode (LED) exit signs are eligible under this category. Non-electrified and remote exit signs are not eligible. All new exit signs or retrofit exit signs must be UL or ETL listed, have a minimum lifetime of 10 years, and have an input wattage ≤5 Watts or be ENERGY STAR qualified.

**Measure Savings**
Baseline and retrofit equipment assumptions are presented in the next table. Most lighting retrofits assume an early replacement of existing technologies where the baseline represents the equipment removed. The table shows the wattages used for the savings calculations.

**Table 53: Baseline and Retrofit Wattages**

| Measure | Base Wattage | Retrofit Wattage | Wattage Reduction |
|---|---|---|---|
| Two Incandescent Bulbs (20W each) -> LED EXIT Sign (5W) | 40 | 5 | 35 |

The measure savings use the above non-coincident savings.

**Table 54: Exit Sign Savings**

| Peak kW Savings | kWh Savings |
|---|---|
| 0.042 | 343.4 |

### Measure Savings Analysis

Annual energy savings and the peak coincident demand savings were calculated using the equations below. The coincident diversity factor is 1.0 since the sign is on all the time. The operating hours are 8,760 hours per year.[14]

**Table 55: Factors used for Calculating Savings**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects |
|---|---|---|---|
| 8,760 | 1.19 | 1.00 | 1.12 |

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect.

### 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.

14 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

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 56: Measure Life and Incremental Measure Cost**

| | Value | Source |
|---|---|---|
| Measure Life | 16 | DEER |
| Incremental Measure Cost | $82.54 | AEP Ohio Potential Study |

## LED Lamps

**Table 57 LED Lamps**

| | |
|---|---|
| **Measure Description** | LED recessed down lamps or screw-in base lamps qualify. The LED recessed downlight must be ≤ 18 Watts and have a minimum efficacy of 35 lumens per Watt. The product must meet Energy Star Criteria. For screw-in base LED lamps, the wattage must be < 8 Watts. |
| **Units** | Per lamp |
| **Base Case Description** | 100 Watt or less incandescent |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: PG& E 2006 Work papers |
| **Effective Useful Life** | Source: PG& E 2006 Work papers<br>16 years |

LED recessed down lamps or screw-in base lamps qualify. The LED recessed downlight must be ≤ 18 Watts and have a minimum efficacy of 35 lumens per Watt. The product must meet Energy Star Criteria. For screw-in base LED lamps, the wattage must be < 8 Watts.

### Measure Savings

The coincident kW and kWh savings are provided in the following table.

**Table 58: Measure Savings for LED (per lamp)**

| Coincident Demand Savings (kW) | Annual Energy Savings (kWh) |
|---|---|
| 0.030 | 160.9 |

### Measure Savings Analysis

Annual energy savings and the peak coincident demand savings were calculated using the equations below. The annual operation hours, the coincidence factors, and the interactive effect factors are obtained from the DEER database.[15] 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.

[15] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

**Table 59: Factors used for Calculating Lighting Savings**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects |
|---|---|---|---|
| 4,321 | 1.19 | 0.77 | 1.12 |

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

Baseline and retrofit equipment assumptions are presented in the table below. The fixture wattages were collected from PG&E's Non-residential Retrofit Program standard fixture wattage table.

**Table 60: Baseline and Retrofit Wattages for LED Lamps**

| Base Case lamps | Base Lamp Wattage | Retrofit Lamp Wattage | Demand Savings per lamp (kW) | Weight Percentages |
|---|---|---|---|---|
| 100 W incandescent | 100 | 8 | 0.092 | 5% |
| 75 W incandescent | 75 | 8 | 0.067 | 15% |
| 60 W incandescent | 60 | 8 | 0.052 | 15% |
| 40 W incandescent | 40 | 8 | 0.032 | 15% |
| 25 W incandescent | 25 | 8 | 0.017 | 25% |
| 15 W incandescent | 15 | 8 | 0.007 | 25% |
| Weighted Average | | | 0.033 | |

**Measure Life and Incremental Measure Cost**

The next 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 lighting measures, the IMC is equal to the full measure cost since cost of the less efficient option is $0. For LED lighting, the IMC was calculated as the average price of 8 LED bulbs ranging from 0.85 to 4.7 W.

The measure life for the LED bulbs is taken from the PG&E work paper on LED open signs and is 16 years.

**Table 61: Measure Life and Incremental Measure Cost**

| Measure Category | Lamp | Value | Source |
|---|---|---|---|
| Measure Life | LED | 16 years | PG&E LED Open sign Work paper |
| Incremental Measure Cost | LED | $30 | Average of 8 LED bulbs sold at CCrane.com |

## LED Refrigerated Case Lighting

**Table 62: 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<br>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 63: 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 64: 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 |

## LED Open Signs

**Table 65: LED Open Signs**

| | |
|---|---|
| **Measure Description** | Light-emitting diodes (LED) open signs are eligible under this category. |
| **Units** | Per Sign |
| **Base Case Description** | Neon open sign |
| **Measure Savings** | Source: PG&E work paper |
| **Measure Incremental Cost** | Source: PG&E work paper |
| **Effective Useful Life** | Source: PG&E work paper<br>16 years |

LED open signs must replace an existing neon open sign. LED drivers can be either electronic switching or linear magnetic, with the electronic switching supplies being the most efficient. The on-off power switch may be found on either the power line or load side of the driver, with the line side location providing significantly lower standby losses when the sign is turned off and is not operating.

**Measure Savings**
The coincident kW and kWh savings are provided in the following table. Open signs are assumed to be on during the typical operating hours of these buildings.

**Table 66: Measure Savings for LED Open Signs (per sign)**

| Coincident Demand Savings (kW) | Energy Savings (kWh) |
|---|---|
| 0.145 | 776.7 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below. The annual operation hours, the coincidence factors, and the interactive effect factors are obtained from the DEER database.[16] 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.

[16] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

**Table 67: Factors used for Calculating Lighting Savings**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects |
|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 |

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

The following table provides the sample retrofit options and demand reduction assumptions used.

**Table 68: Demand Reduction for Open Signs**

| | Demand Savings per Sign | Weight Percentages |
|---|---|---|
| Replacement of Neon-Large Neon-Like Appearance | 0.169 | 33% |
| Replacement of Neon-Small Dot Pattern | 0.125 | 33% |
| Replacement of Neon-Large Oblong Dot Pattern | 0.180 | 33% |
| Weighted Average | 0.158 | |

**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. The measure life is assumed to be the same as that of an LED exit sign.

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, i.e., of not conducting the retrofit is $0.

The actual incremental cost of LED technology over new neon technology with electronic ballasts is about $50 to 100 per sign, or $75, on average.

**Table 69: Measure Life and Incremental Measure Cost**

| | Value | Source |
|---|---|---|
| Measure Life | 16 | PG&E work paper |
| Incremental Measure Cost | $75 | PG&E work paper |

## LED Channel Signs, Indoor

**Table 70 LED Channel Signs, Indoor**

| | |
|---|---|
| **Measure Description** | Retrofit and replacement of inefficient neon and argon-mercury channel letter signs with efficient LED channel letter signs. |
| **Units** | Per letter |
| **Base Case Description** | Existing signage– Neon (red) channel letter signs and argon-mercury (white) channel letter signs. |
| **Measure Savings** | Source: PG&E workpaper |
| **Measure Incremental Cost** | Source: PG&E workpaper |
| **Effective Useful Life** | 16 years<br>Source: PG&E workpaper |

LED channel sign incentive is available for retrofitting or replacing incandescent, HID, argon-mercury or neon-lighted channel letter signs. Replacement signs cannot use more than 20% of the actual input power of the sign that is replaced.

**Measure Savings[17]**
The following table summarizes the savings for LED channel signs.

**Table 71: Savings for LED Channel Signs**

| Location | Hours of Operation | Sign Height | Annual Energy Savings kWh/letter | Demand Savings kW/letter | Peak Demand Savings kW/letter |
|---|---|---|---|---|---|
| Indoor | 4375 | ≤ 2 ft | 147 | 0.034 | 0.034 |
| | | >2 ft | 378 | 0.086 | 0.086 |

**Measure Savings Analysis**
The calculation methodology used by PG&E in the LED Channel Sign workpaper is outlined below. All the supporting documentation and spreadsheets are shown in the PG&E workpaper.

(1) Collected letter schematics showing linear feet of tubing and number of LED modules for each letter of the alphabet, both uppercase and lowercase, for 24 inch high letters and 36 inch high letters.
(2) The base case wattage (W/ft) and the energy efficient case wattage (W/module) input values were collected for each specific letter.

[17] PGE LED Channel Sign work paper

(3) A probability table, showing the frequency each letter appears in the English language, was integrated into the spreadsheet. By multiplying the wattage for each specific letter by the probability, a weighted average wattage per letter was obtained. This single value represents all 26 letters of that height and will be accurate over a range of signs with a weighted average watts/letter for red and white for uppercase and lowercase letters.

(4) This spreadsheet was then modified to account for the average height of signs in each category. (According to sign industry sources, the average height of a sign in the 2 feet or less category is 21 inches. The average height of a sign in the greater than 2 feet high category is 27 inches).

(5) The watts/letter values were then weighted assuming 70% of letters are uppercase and 30% of letters are lowercase, as well as 50% are red signs and 50% are white signs.

**Measure Life and Incremental Measure Cost**

Measure life is assumed to be 16 years for the signs. LEDs have a lifetime of 25,000 hours for LEDs. However, to be consistent, DEER uses 16 years for LED exit signs, hence all LEDs are assumed to have a 16 year life.

Incremental cost is cost difference between the energy efficient equipment and the less efficient option. The incremental cost for the retrofit case is the full cost of the LED-lighted sign because the retrofit case assumes the existing lighting is working properly and does not need to be replaced. The incremental cost for the replacement case is the difference between the base case and the energy-efficient alternative. The incremental costs were weighted assuming that 30% of the channel signs will be retrofit and 70% of the channel signs will be new or replacement. Therefore, the incremental cost for signs less than or equal to 2 ft. high is $35/letter and the incremental cost for signs greater than 2 ft. high is $154/letter.

## Interior Induction Fixtures

**Table 72: Interior Induction Fixtures**

| | |
|---|---|
| **Measure Description** | This measure consists of replacing Mercury Vapor, T12/High Output Fluorescent, T12/Very High Output Fluorescent, Standard Metal Halide, or High Pressure Sodium fixtures with induction fixtures. |
| **Units** | Per fixture |
| **Base Case Description** | Mercury Vapor, T12/High Output Fluorescent, T12/Very High Output Fluorescent, Standard Metal Halide, or High Pressure Sodium fixtures |
| **Measure Savings** | Source: PG&E 2006 Workpapers |
| **Measure Incremental Cost** | Source: PG&E 2006 Workpapers |
| **Effective Useful Life** | Source: PG&E 2006 Workpapers<br>16 years |

Only new, hard-wired induction fixtures qualify. New fixtures must replace, one for one, existing Incandescent, Mercury Vapor, T12/High Output Fluorescent, T12/Very High Output Fluorescent, Standard Metal Halide, or High Pressure Sodium fixtures in interior installations. The new fixtures must not exceed the maximum Wattage listed in the table below for each range of lamp Wattage being replaced.

**Table 73: Wattage Criteria for Induction Lighting Replacement**

| Basecase Wattage | Replacement Fixture Wattage (Maximum) |
|---|---|
| ≥ 400 Watt | 360W |
| 176-399 Watt | 180W |
| 101-175 Watt | 160W |
| ≤100 Watt | 95W |

### Measure Savings
The coincident kW and kWh savings are provided in the following table.

**Table 74: Measure Savings for Induction Fixtures**

| Coincident Demand Savings (kW) | Energy Savings (kWh) |
|---|---|
| 0.063 | 337.7 |

### Measure Savings Analysis
Annual energy savings and the peak coincident demand savings were calculated using the equations below. The annual operation hours, the coincidence factors, and the interactive effect

factors are obtained from the DEER database.[18] 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.

**Table 75: Factors used for Calculating Lighting Savings**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects |
|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 |

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

Baseline and retrofit equipment assumptions are presented in the table below.

[18] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

**Table 76: Baseline and Retrofit Wattages for Induction Lighting**

| | Base Lamp Wattage | Base Fixture Wattage | Retrofit Lamp Wattage | Retrofit Fixture Wattage | Demand Savings per fixture | Weight Percentages |
|---|---|---|---|---|---|---|
| 400 Watt lamp basecase, up to 360 Watt replacement fixture | 400 | 458 | 330 | 354 | 0.104 | 40% |
| 176-399 Watt lamp basecase, up to 180 Watt replacement fixture | 250 | 295 | 165 | 177 | 0.118 | 10% |
| 101-175 Watt lamp basecase, up to 160 Watt replacement fixture | 150 | 190 | 150 | 160 | 0.030 | 40% |
| 100 Watt lamp basecase, up to 95 Watt replacement fixture | 100 | 128 | 85 | 95 | 0.033 | 10% |
| Weighted Average | | | | | 0.069 | |

**Measure Life and Incremental Measure Cost**

The next 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 for HID lighting. 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.

**Table 77: Measure Life and Incremental Measure Cost**

| | Measure Category | Value | Source |
|---|---|---|---|
| Measure Life | All | 16 | PG&E Work paper |
| Incremental Measure Cost | All | $290 | PG&E Work paper |

## Compact Fluorescent Fixtures, Hardwired

**Table 78: Compact Fluorescent Fixtures, Hardwired**

| | |
|---|---|
| **Measure Description** | New fixtures or modular retrofits with hardwired electronic ballasts qualify. The CFL ballast must be programmed start or programmed rapid start with a PF ≥90 and THD ≤20%. |
| **Units** | Per fixture |
| **Base Case Description** | Incandescent or HID lamps. |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: KEMA |
| **Effective Useful Life** | Source: DEER<br>12 years |

Hardwired CFL incentives apply only to complete new fixtures or modular (pin-based) retrofits with hardwired electronic ballasts. The CFL ballast must be programmed 'start' or programmed 'rapid start' with a PF ≥90 and THD ≤20 percent.

**Measure Savings**
Baseline and retrofit equipment assumptions are presented in the table below. Most lighting retrofits assume early replacement of existing technologies where the baseline represents the equipment removed. The following table shows the wattages used for the savings calculations.

**Table 79 Baseline and Retrofit Wattages**

| Measure | Base Wattage | Retrofit Wattage | kW Reduction |
|---|---|---|---|
| 29W or Less | 100 | 28 | 0.072 |
| 29W or Less | 125 | 27 | 0.098 |
| 29W or Less | 110 | 27 | 0.083 |
| 29W or Less | 100 | 26 | 0.074 |
| 29W or Less | 75 | 26 | 0.049 |
| 29W or Less | 100 | 25 | 0.075 |
| 29W or Less | 75 | 25 | 0.05 |
| 29W or Less | 100 | 23 | 0.077 |
| 29W or Less | 75 | 20 | 0.055 |
| 29W or Less | 75 | 19 | 0.056 |
| 29W or Less | 75 | 18 | 0.057 |
| 29W or Less | 60 | 18 | 0.042 |
| 29W or Less | 60 | 16 | 0.044 |
| 29W or Less | 60 | 15 | 0.045 |
| 29W or Less | 60 | 14 | 0.046 |
| 29W or Less | 60 | 13 | 0.047 |
| 29W or Less | 40 | 13 | 0.027 |
| 29W or Less | 40 | 9 | 0.031 |
| 30W or Greater | 120 | 30 | 0.09 |
| 30W or Greater | 120 | 40 | 0.08 |
| 30W or Greater | 200 | 55 | 0.145 |
| 30W or Greater | 200 | 65 | 0.135 |

**Table 80: Wattage Reduction**

| Wattage Category | Average Wattage Reduction |
|---|---|
| ≤29 | 57 |
| ≥30W | 113 |

The following tables provide the measure savings using the above wattage reduction assumptions.

**Table 81 Measure Savings for 29W or less**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak kW Savings | kWh Savings |
|---|---|---|---|---|---|
| 4,321 | 1.19 | 0.77 | 1.12 | 0.052 | 276 |

**Table 82: Measure Savings for ≥30W**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak kW Savings | kWh Savings |
|---|---|---|---|---|---|
| 4,321 | 1.19 | 0.77 | 1.12 | 0.103 | 544 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below. The annual operation hours, the coincidence factors, and the interactive effect factors were all derived from the DEER database.[19] DEER values by building type were averaged for the AEP Ohio Program.

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

**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 the cost difference between the energy-efficient equipment and the less efficient option. For lighting measures, 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.

[19] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

**Table 83: Measure Life and Incremental Measure Cost**

| Wattage Category | | Value | Source |
|---|---|---|---|
| All | Measure Life | 12 | DEER |
| ≤29 | Incremental Measure Cost | $95 | KEMA |
| ≥30W | Incremental Measure Cost | $132 | KEMA |

## Cold Cathode

**Table 84: Cold Cathode**

| | |
|---|---|
| **Measure Description** | All cold cathode fluorescent lamps (CCFLs) must replace incandescent lamps of at least 10 W and not greater than 40 W. Cold cathode lamps may be medium (Edison) or candelabra base. Product must be rated for at least 18,000 average life hours. |
| **Units** | Per lamp |
| **Base Case Description** | Incandescent |
| **Measure Savings** | Source: KEMA, SCE |
| **Measure Incremental Cost** | Source: PG&E |
| **Effective Useful Life** | Source: SCE<br>5 years |

All cold cathode fluorescent lamps (CCFLs) must replace incandescent lamps of at least 10 W and not greater than 40 W. Cold cathode lamps may be medium (Edison) or candelabra base. The product must be rated for at least 18,000 average life hours.

**Measure Savings**
Baseline and retrofit equipment assumptions are presented in table below. Most lighting retrofits assume an early replacement of existing technologies where the baseline represents the equipment removed. The table shows the wattages used for the savings calculations from SCE and KEMA research of cold cathode manufacturers.

**Table 85: Baseline and Retrofit Wattages**

| Measures[20] | Base Wattage (Watts) | Retrofit Wattage (Watts) | Wattage Reduction (Watt) |
|---|---|---|---|
| Incandescent (15W) -> Cold Cathode FL (5W) | 15 | 5 | 10 |
| Incandescent (30W) -> Cold Cathode FL (5W) | 30 | 5 | 25 |
| Incandescent (40W) -> Cold Cathode FL (8W) | 40 | 8 | 32 |
| Average | | | 22 |

The following table provides the measure savings using the above non-coincident savings.

[20] Southern California Edison Company, Cold Cathode Fluorescent Lamp Workpaper WPSCNRLG0063. 2007.

**Table 86: Measure Savings**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak kW Savings | kWh Savings |
|---|---|---|---|---|---|
| 4,321 | 1.19 | 0.77 | 1.12 | 0.020 | 108 |

**Measure Savings Analysis**

Annual energy savings and the peak coincident demand savings were calculated using the equations below. The annual operating hours, the coincidence factors, and the interactive effect factors were all derived from the DEER database.

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

**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 cost of the less efficient option is $0..

**Table 87: Measure Life and Incremental Measure Cost[21]**

| | Value | Source |
|---|---|---|
| Measure Life | 5 | SCE WP |
| Incremental Measure Cost | $9.68 | PG&E WP |

[21] Southern California Edison Company, Cold Cathode Fluorescent Lamp Workpaper WPSCNRLG0063. 2007, Pacific Gas & Electric, Lighting WP.doc, 2006.

## Specialty Screw-In CFL

**Table 88: Specialty Screw-In CFL**

| | |
|---|---|
| **Measure Description** | This measure consists of the replacement of a conventional incandescent lamp with a specialty CFL. |
| **Units** | Per lamp |
| **Base Case Description** | Conventional, incandescent bulb |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: KEMA<br>$47 |
| **Effective Useful Life** | Source: DEER 2008<br>2.5 years |

This measure consists of the replacement of an existing incandescent, metal halide, or induction lamp with a specialty compact fluorescent lamp (CFL). These specialty applications typically include 3-way and dimmable lamps. These lamps must meet ENERGY STAR® criteria, if available for the type of lamp.

### Measure Savings

**Table 89: Baseline and Retrofit Wattages**

| Measures | Base Wattage | Retrofit Wattage | Wattage Reduction, kW | Weights |
|---|---|---|---|---|
| Incandescent (60W) -> CFL (14.5W) | 60 | 14.5 | 0.046 | 50% |
| Incandescent (75W) -> CFL (20W) | 75 | 20 | 0.055 | 25% |
| Incandescent (100W) -> CFL (26.5W) | 100 | 26.5 | 0.074 | 25% |
| Weighted average | | | **0.055** | |

The savings are presented in the following table. The annual operation hours, the coincidence factors, and the interactive effect factors are obtained from the DEER database.[22] 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.

**Table 90: Measure Savings, per lamp**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak kW Savings | kWh Savings |
|---|---|---|---|---|---|

[22] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

| | | | | | |
|---|---|---|---|---|---|
| 4,321 | 1.19 | 0.77 | 1.12 | 0.050 | 266 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below. The annual operation hours, the coincidence factors, and the interactive effect factors were all obtained from the DEER database.

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

**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 91: Measure Life and Incremental Measure Cost**

| | Value | Source |
|---|---|---|
| Measure Life | 2.5 | DEER 2008 |
| Incremental Measure Cost | $47 | KEMA |

## Permanent Lamp Removal

**Table 92: Permanent Lamp Removal**

| | |
|---|---|
| **Measure Description** | Incentives are paid for the permanent removal of existing 8', 4', 3' and 2' fluorescent lamps. Unused lamps, lamp holders, and ballasts must be permanently removed from the fixture. This measure is applicable when retrofitting from T12 lamps to T8 lamps or simply removing lamps from a T8 fixture. Removing lamps from a T12 fixture that is not being retrofitted with T8 lamps are not eligible for this incentive. |
| **Units** | Per lamp |
| **Base Case Description** | Various configurations of fluorescent fixtures before removal of lamps. |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: ICF Portfolio Plan |
| **Effective Useful Life** | Source: DEER<br>11 years |

Incentives are paid for the permanent removal of existing fluorescent lamps resulting in a net reduction of the number of foot-lamps. Customers are responsible for determining whether or not to use reflectors in combination with lamp removal in order to maintain adequate lighting levels. Unused lamps, lamp holders, and ballasts must be permanently removed from the fixture. This measure is applicable when retrofitting from T12 lamps to T8 lamps or simply removing lamps from a T8 fixture. Removing lamps from a T12 fixture that is not being retrofitted with T8 lamps is not eligible for this incentive. A Pre-approval Application is required for lamp removal projects in order for KEMA to have the option of conducting a pre-retrofit inspection.

**Measure Savings**
Non-coincident demand savings are summarized by the following table:

**Table 93: Wattage Reduction**

| Wattage Category | Average Wattage Reduction |
|---|---|
| 8 Foot Lamp Removal | 68 |
| 4 Foot Lamp Removal | 35 |
| 2 Foot or 3 Foot Lamp Removal | 24 |

**Table 94: Measure Savings for 8-Foot Lamp Removal**

| Annual | Demand | Coinciden | Energy | 8-foot | 8-foot |
|---|---|---|---|---|---|

| Operating Hours | Interactive Effects | t Diversity Factors | Interactive Effects | Lamp Peak Savings (kW) | Savings (kWh) |
|---|---|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 | 0.062 | 333.7 |

**Table 95: Measure Savings for 4-Foot Lamp Removal**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | 4-foot Lamp Peak Savings (kW) | 4-foot Savings (kWh) |
|---|---|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 | 0.032 | 172.3 |

**Table 96: Measure Savings for 2-Foot or 3-Foot Lamp Removal**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | 2-foot or 3-foot Lamp Peak Savings (kW) | 2-foot or 3-foot Savings (kWh) |
|---|---|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 | 0.022 | 119.3 |

**Measure Savings Analysis**

Annual energy savings and the peak coincident demand savings were calculated using the equations below. The annual operating hours, the coincidence factors, and the interactive effect factors were all derived from the DEER database.[23] However, DEER values by building type were averaged for the AEP Ohio Program.

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

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[23] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

Baseline assumptions are presented in the next table. Most lighting retrofits assume an early replacement of existing technologies where the baseline represents the equipment removed. The table shows the wattages used for the savings calculations. Weighted average savings values are used when determining deemed savings for each 8 foot or 4 foot lamp permanently removed.

**Table 97: Wattages for Eight-foot Lamps**

| Baseline | Base Wattage | Lamp Removed Wattage | Weight Percentages |
|---|---|---|---|
| Two 8' T12 (60W/75W) | 140 | 70 | 85% |
| Two 8' T8 (59W) | 111 | 56 | 15% |
| Total Weighted Average | | 68 | |

**Table 98: Wattages for Four-foot Lamps**

| Baseline | Base Wattage | Lamp Removed Wattage | Weight Percentages |
|---|---|---|---|
| Two 4' T8 (32W) | 65 | 36 | 3% |
| Two 4' T12 (34W/40W) | 72 | 36 | 8% |
| Three 4' T8 (32W) | 92 | 31 | 7% |
| Three 4' T12 (34W/40W) | 115 | 38 | 22% |
| Four 4' T8 (32W) | 118 | 30 | 15% |
| Four 4' T12 (34W/40W) | 144 | 36 | 45% |
| Total Weighted Average | | **35** | |

**Table 99: Wattages for Two and Three-foot Lamps**

| Baseline | Base Wattage | Lamp Removed Wattage | Weight Percentages |
|---|---|---|---|
| Two 3' T12 (30W) | 76 | 38 | 15% |
| Two 3' T8 (34W/40W) | 48 | 24 | 15% |
| Two 2' T8 (17W) | 31 | 15 | 30% |
| Two 2' T12 (20W) | 56 | 28 | 30% |
| Three 2' T8 (17W) | 46 | 16 | 2.5% |

| | | | |
|---|---|---|---|
| Three 2' T12 (20W) | 62 | 21 | 2.5% |
| Four 2' T8 (17W) | 60 | 15 | 2.5% |
| Four 2' T12 (20W) | 112 | 28 | 2.5% |
| Total Weighted Average | | 24 | |

**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. For lighting measures, 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 100: Measure Life and Incremental Measure Cost**

| Measure Category | | Value | Source |
|---|---|---|---|
| All | Measure Life | 11 | DEER |
| 8-Foot Lamp Removal | Incremental Measure Cost | $25.91 | ICF Portfolio Plan |
| 4-Foot Lamp Removal | Incremental Measure Cost | $25.70 | ICF Portfolio Plan |
| 2-Foot or 3-Foot Removal | Incremental Measure Cost | $25.70 | KEMA |

## Occupancy Sensors

**Table 101: Occupancy Sensors**

| | |
|---|---|
| **Measure Description** | Passive infrared, ultrasonic detectors and fixture-integrated sensors or sensors with a combination thereof are eligible. All sensors must be hard-wired and control interior lighting fixtures. The incentive is per Watt controlled. |
| **Units** | Per Connected Watt |
| **Base Case Description** | No Sensor |
| **Measure Savings** | Source: DEER |
| **Measure Incremental Cost** | Source: DEER |
| **Effective Useful Life** | Source: DEER<br>8 years |

Passive infrared, ultrasonic detectors and fixture-integrated sensors or sensors with a combination thereof are eligible. All sensors must be hard-wired and control interior lighting fixtures. The incentive is per Watt controlled.

**Measure Savings**
The annual operation hours, the coincidence factors, and the interactive effect factors were all derived from the DEER database.

**Table 102: Measure Savings for Occupancy Sensor per Connected Watt**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak Watt Savings | kWh Savings |
|---|---|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 | 0.0003 | 1.385 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below.

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = Connected wattage/1000 * Annual operating hours * Energy interactive effect*Occupancy Off Rate

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = Connected wattage/1000 * Occupancy Off Rate * Coincidence Factor * Demand interactive effect

The baseline for this measure is fixtures that do not include any automatic controls, i.e., manual switches. Since the unit is defined as per connected Watt, the baseline demand is one watt. Demand savings depend on whether areas are high or low occupancy. DEER states that occupancy time off rates are at 20 percent for high-occupancy building types and 50 percent for low-occupancy building types.[24]. The table below shows the assumed range of occupancy off rates. Calculations here are performed with the 28% average sensor off rate.

**Table 103: Occupancy Off Rate**

| Average Grouping | Occupancy Sensor Off Rate |
|---|---|
| Office | 20% |
| School (K-12) | 20% |
| College/University | 20% |
| Retail/Service | 20% |
| Restaurant | 20% |
| Hotel/Motel | 20% |
| Medical | 20% |
| Grocery | 20% |
| Warehouse | 50% |
| Light Industry | 50% |
| Heavy Industry | 50% |
| Average | 28% |

**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. For lighting measures, 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.

[24] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

**Table 104: Measure Life and Incremental Measure Cost**

| | Value | Source |
|---|---|---|
| Measure Life | 8 | DEER |
| Incremental Measure Cost | $0.32 | DEER |

## Plug Load Occupancy Sensors

**Table 105 Plug Load Occupancy Sensors**

| | |
|---|---|
| **Measure Description** | Installation of an occupancy sensor on a plug load. |
| **Units** | Per sensor |
| **Base Case Description** | 50W of task lighting and a computer monitor with no controls |
| **Measure Savings** | Source: DEER |
| **Measure Incremental Cost** | Source: DEER |
| **Effective Useful Life** | Source: DEER<br>8 years |

This rebate applies to passive infrared and/or ultrasonic detectors only. Plug-load sensors must control electricity using equipment in offices or cubicles, including shared copiers and/or printers.

**Measure Savings**
The coincident demand savings is 0.091 kW and annual energy savings is 258 kWh per application. The savings are provided for the Office building type (interactive effects are Included in the savings).

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below. The annual operation hours, the coincidence factors, and the interactive effect factor are obtained from the DEER database and shown in the following table. The occupancy sensor is assumed to turn off equipment for 2,450 hours/year. The factors used are for office building.

**Table 106: Office Building Factors**

| Hours | Energy Interactive Effect | Demand Interactive Effects | Coincidence Factor |
|---|---|---|---|
| 2,450 | 1.17 | 1.25 | 0.81 |

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula. The non-coincident demand reduction is 90W in this calculation.

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

**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. The full measure cost is the cost applicable for this measure.

**Table 107: Measure Life and Incremental Measure Cost**

| | Value | Source |
|---|---|---|
| Measure Life | 8 | DEER |
| Incremental Measure Cost | $20 | DEER |

# Daylighting Controls

**Table 108: Daylighting Controls**

| | |
|---|---|
| **Measure Description** | This measure consists of the installation of daylighting controls. |
| **Units** | Per square foot |
| **Base Case Description** | No lighting controls |
| **Measure Savings** | Source: KEMA, Michigan CI Technologies Workpaper FES-L12 |
| **Measure Incremental Cost** | Source: Michigan CI Technologies Workpaper FES-L12 |
| **Effective Useful Life** | Source: DEER 2008<br>8 years |

This measure consists of the installation of daylighting controls. These systems use photoelectric controls to take advantage of available daylight in interior building spaces. These controls can be used to turn lights off/on, A-B switching, or continuous dimming.

**Measure Savings**
Installation of daylighting controls is assumed to result in 30% savings for most perimeter and open space applications. Assumed average lighting density is 1.3 watts per square foot.

$$Annual\ kWh\ Savings = (\frac{1.3\ watts\ per\ square\ foot}{1000\ watts\ per\ kW}) \times (30\%\ savings) \times (annual\ operating\ hours) \times (energy\ \mathrm{int}\ era$$

$$Peak\ Savings = (1.3\ watts\ per\ square\ foot) \times (1\ square\ foot) \times (coincidence\ factor) \times (diversity\ factor)$$

The savings are presented in the following table. The annual operation hours, the coincidence factors, and the interactive effect factors are obtained from the DEER database.[25] 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.

[25] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

**Table 109: Measure Savings for Daylighting Controls, per sq ft**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak kW Savings, W per sq ft | Peak kW Savings, kW per 10,000 sq ft | kWh Savings, sq ft |
|---|---|---|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 | 0.001 | 11.91 | 1.92 |

**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.

The cost assumes a space of 3000 sq ft. Material cost is $3,000, and installation cost is estimated at $1,000.

**Table 110: Measure Life and Incremental Measure Cost, per sq ft**

| | Value | Source |
|---|---|---|
| Measure Life | 8 | DEER 2008 |
| Incremental Measure Cost | $1.33 | Michigan CI Technologies Workpaper FES-L12 |

## Bi-level Stairwell/Hall/Garage Light Fixtures

**Table 111: Bi-level Stairwell/Hall/Garage Light Fixtures**

| | |
|---|---|
| **Measure Description** | This measure consists of replacing 2-lamp T12 fixture (full level output only) with a 2-lamp T8 bi-level fixture. |
| **Units** | Fixture |
| **Base Case Description** | 2-lamp T12 fixture (full level output only) |
| **Measure Savings** | Source: PG&E 2006 Work papers |
| **Measure Incremental Cost** | Source: PG&E 2006 Work papers and KEMA |
| **Effective Useful Life** | Source: DEER<br>11 years |

Existing fixtures must be a two-lamp T12 fixture. Eligible fixtures are hardwired (including linear) two-lamp T8 fluorescent fixtures with electronic ballasts and manufacturer integrated occupancy sensors used in areas where code requires lighting.24 hours a day (such as stairwells, halls, and garages). Fixtures with manual on override are not eligible. During occupied periods, the fixture should operate at full light output. During unoccupied periods, the fixture should operate at lower light output and wattage. This measure is not also eligible for the occupancy sensor or T12 to T8 incentive.

**Measure Savings**
Average annual energy savings is 340 kWh and 0.039 kW savings. Peak demand savings are assumed to be zero. Fixtures are assumed to be in unconditioned spaces so interactive energy and demand effects are not claimed.

**Measure Savings Analysis**
This measure assumes that an existing 2-lamp T12 fixture (full level output only) will be replaced with a 2-lamp T8 bi-level fixture. At full level output, the existing is at 72 W/fixture and bi-level fixtures consume 58 W. Based on a survey of market-available bi-level fixtures, at low level output, the bi-level fixture would, on average, consume 22 W.

Based on the Final Report of Bi-level Stairwell Fixtures from a California Energy Commission Lighting Research Project, the percentage of time in the low output mode ranged from 62% to 82% on weekdays and 85% to 97% on weekends. Therefore, a conservative calculation of the percentage of time in the low output mode = [(5)(62%)+(2)(85%)]/7 = 69%.

Average demand of the bi-level fixture is (58 W)(0.31) + (22 W)(0.69) = 33 W, or 0.033 kW. Average demand savings = 0.072 kW – 0.033 kW = 0.039 kW per fixture.

Annual energy savings = (0.039 kW per fixture )(8,760 hours per year) = 340 kWh per fixture.

**Measure Life and Incremental Measure Cost**
The next 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 lighting measures, the IMC is equal to the full measure cost since cost of the less efficient option.

**Table 112: Measure Life and Incremental Measure Cost**

| | Measure Category | Value | Source |
|---|---|---|---|
| Measure Life | Lamp and Ballast | 11 | DEER |
| Incremental Measure Cost | 2 Lamp System | $150 | PG&E workpaper/ KEMA |

## Sensor-controlled LED Parking Lot Bi-Level Fixture

**Table 113: Sensor-controlled LED Parking Lot Bi-Level Fixture**

| | |
|---|---|
| **Measure Description** | This measure consists of the replacement of a 150W Metal Halide fixture with a 60-lamp sensor-controlled LED Bi-Level Fixture |
| **Units** | Per fixture |
| **Base Case Description** | 150W Metal Halide, (system wattage=190W) |
| **Measure Savings** | Source: CLTC, PG&E Workpaper – PGECOLTG101.1 – Bi-Level Light Fixture |
| **Measure Incremental Cost** | Source: California Lighting Technology Center (CLTC) http://cltc.ucdavis.edu/content/view/354/287/. "UC / CSU case study: Bi-level Smart Parking Garage Fixture"<br>$975 |
| **Effective Useful Life** | Source: DEER 2008 (same as occupancy sensors)<br>8 years |

Fixture is integrated with occupancy sensor that allows the light to switch between high and low levels based on the presence of vehicle or pedestrian traffic. Switching between high and low light levels based on occupancy maintains sufficient light for security and way-finding while maximizing energy savings. New fixture must be pulse start metal halide, induction, or LED and have lower nominal wattage than existing fixture.

**Measure Savings and Analysis**

This measure assumes that an existing 150W Metal Halide fixture (190W connected) will be replaced by a 60-lamp Bi-Level SMART LED Fixture. At full output, the bi-level fixture is assumed to consume 110W, while at low light level the fixture consumes 35W. The bi-level fixtures are assumed to be in low output mode 50% of the time.

The demand savings are calculated as follows:

$\Delta$Watts/unit = Pre-Retrofit Wattage - Bi-Level Fixture Wattage

Bi-Level Fixture Wattage is calculated by a time-weighted average as follows:

$$(0.5*35W) + (0.5*110W) = 72.5W$$

Demand Savings= 190W – 72.5W

**= 117.5 W**

**Energy Savings [kWh/Unit]** = $\frac{(\Delta \text{Watts/unit}) \times (\text{hours/day}) \times (\text{days/year})}{1{,}000 \text{ Watts / kW}}$

=(117.5 W)x(4,100/yr)/(1,000W/kW)

= **482 kWh**

**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 114: Measure Life and Incremental Measure Cost**

| | Value | Source |
|---|---|---|
| Measure Life | 8 (same as occupancy sensors) | DEER 2008 |
| Full Measure Cost | $975 | CLTC |
| Incremental Measure Cost | $975 | CLTC |

## Sensor-controlled Wallpack Fixtures

**Table 115: Sensor-controlled Wallpack Fixtures**

| | |
|---|---|
| **Measure Description** | This measure consists of the replacement of a 150W Metal Halide fixture with a 60-lamp sensor-controlled LED Bi-Level Fixture |
| **Units** | Per fixture |
| **Base Case Description** | 150W Metal Halide, (system wattage=190W) |
| **Measure Savings** | Source: CLTC, PG&E Workpaper – PGECOLTG101.1 – Bi-Level Light Fixture |
| **Measure Incremental Cost** | Source: California Lighting Technology Center (CLTC) http://cltc.ucdavis.edu/content/view/354/287/. "UC / CSU case study: Bi-level Smart Parking Garage Fixture" $975 |
| **Effective Useful Life** | Source: DEER 2008 (same as occupancy sensors) 8 years |

Bi-level fixtures are typically found in hallways, stairwells, and garages. These fixtures are intended for use in levels where high lighting levels are required when occupied, but are actually unoccupied for the majority of the time. These fixtures employ a motion sensor-type lighting switch to provide lower levels of light while unoccupied, and full illumination while occupied.

These particular fixtures also feature LED lighting sources, which typically require less energy demand than typical HID sources. These fixtures can also incorporate a fully integrated LED night light for illumination during low-output mode.

**Measure Savings and Analysis**

This measure assumes that an existing 150W Metal Halide fixture (190W connected) will be replaced by a 60-lamp Bi-Level SMART LED Fixture. At full output, the bi-level fixture is assumed to consume 110W, while at low light level the fixture consumes 35W. The bi-level fixtures are assumed to be in low output mode 75% of the time.

The demand savings are calculated as follows:

$\Delta$Watts/unit = Pre-Retrofit Wattage - Bi-Level Fixture Wattage

Bi-Level Fixture Wattage is calculated by a time-weighted average as follows:

(0.75*35W) + (0.25*110W) = 53.75W

Demand Savings= 190W – 53.75W

**= 136.25 W**

**Energy Savings [kWh/Unit]** = $\frac{(\Delta \text{Watts/unit}) \times (\text{hours/day}) \times (\text{days/year})}{1{,}000 \text{ Watts / kW}}$

=(136.25 W)x(8760/yr)/(1,000W/kW)

= **1194 kWh**

**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 116: Measure Life and Incremental Measure Cost**

| | Value | Source |
|---|---|---|
| Measure Life | 8 (same as occupancy sensors) | DEER 2008 |
| Incremental Measure Cost | $975 | CLTC |

## Exterior LED and Induction Lighting

**Table 117 Exterior LED and Induction Lighting**

| | |
|---|---|
| **Measure Description** | Light emitting diodes and induction lighting can be use for street lighting, and parking lots with significant energy savings compared to HID fixtures. These technologies also have longer useful lives and lower maintenance costs when compared to HIDs. |
| **Units** | Per Fixture |
| **Base Case Description** | High wattage HID fixtures |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: KEMA |
| **Effective Useful Life** | Source: DEER 2005<br>16 years |

This measure applies to the retrofit of high wattage HID or incandescent outdoor light fixtures to LED or Inductions lamps. Both LED and induction lamps offer significant energy savings over their HID options and have longer life spans. The downside of this technology is cost. Prices for LED and induction are still high. Operating hours for exterior lighting may not as high as interior operating hours. There is also no benefit in heat reduction since there is no conditioned space to speak of. The payback period on this measure, as a result is also relatively high.

### Measure Savings

The tables below provides the baseline and replacement wattages for induction and LED lamps.

**Table 118: Exterior Induction Wattage Reduction**

| | Peak kW Reduction | Induction kWh Savings | LED kWh Savings | Average kWh Savings |
|---|---|---|---|---|
| 250-400W HID | 0 | 455 | 617 | 589 |
| 175-250W HID | 0 | 205 | 344 | 484 |
| ≤175W HID | 0 | 135 | 210 | 275 |

**Table 119: Garage Induction Wattage Reduction**

| | Induction Peak kW Reduction | LED Peak kW Reduction | Induction kWh Savings | LED kWh Savings | Average kW Reduction | Average kWh Savings |
|---|---|---|---|---|---|---|
| 250-400W HID | 0.111 | 0.151 | 972 | 1319 | 0.131 | 1258 |
| 175-250W HID | 0.050 | 0.084 | 438 | 736 | 0.067 | 1034 |
| ≤175W HID | 0.033 | 0.051 | 289 | 449 | 0.042 | 587 |

There is no coincident kW savings in this case since lamps are assumed to be off during peak hour in both the base and retrofit conditions. Exterior kWh savings are calculated with annual operating hours of 4,100, equating to a 12 hour daily use during non-summer days and 9 hour use during summer days. Garage kWh savings are calculated with annual operating hours of 8760, assuming these are on all the time. No interactive effects are used.

**Measure Savings Analysis**

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

For this measure, it is assumed that the lighting is placed in non-conditioned areas so the energy and demand interactive effects are 1.0. Operating hours are 4,100 hours for exterior and 8760 hours for interior usage annually.

Exterior coincident kW savings are 0 since both baseline and retrofit lamps are off during peak hours. Interior garage lighting is on all the time and so coincident kW savings are calculated with a coincident factor of 1.

The following table shows the wattage reduction assumed for induction lighting retrofits.

**Table 120: Induction Wattage Reduction**

| | Base Fixture Wattage | Retrofit Fixture Wattage | Non-Coincident kW Reduction |
|---|---|---|---|
| 400W HID to Induction | 458 | 354 | 0.104 |
| 250W HID to Induction | 295 | 177 | 0.118 |
| 150W HID to Induction | 210 | 160 | 0.050 |
| 100W HID to Induction | 128 | 95 | 0.033 |

The following table summarizes exterior LED retrofits from 3 LED manufacturers.

**Table 121 Manufacturer's LED Wattage Reduction[26]**

| | Manufacturer | Base Fixture Wattage | Retrofit Fixture Wattage |
|---|---|---|---|
| 100W HID to LED | Ledtronics | 130 | 25 |
| 100W HID to LED | LuxBright | 130 | 42 |
| 100W HID to LED | MoonCell | 130 | 55 |

These figures suggest energy savings of 60– 80%. Forty percent energy savings is also often cited in various publications.

[26] "Technology Assessment of Light Emitting Diodes (LED) for Street and Parking Lot Lighting Applications" Prepared for San Diego Regional Energy Office, Public Agency Energy Partnership Program. Prepared by Tetra Tech EM Inc. Aug 2003.

We will use the more conservative 40% here but note that savings may actually be greater depending on the application.

**Table 122: LED Energy Reduction**

| | Base Fixture Wattage | kW Reduction |
|---|---|---|
| 400W HID | 458 | 183 |
| 250W HID | 295 | 118 |
| 175W HID | 210 | 84 |
| 100W HID | 128 | 51 |

**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.

**Table 123: Measure Life and Incremental Measure Cost**

| | Measure Category | Value | Source |
|---|---|---|---|
| Induction Measure Life | All | 16 | PG&E Lighting Work paper |
| Induction Incremental Measure Cost | All | $290 | PG&E Lighting Work paper |
| LED Measure Life | Incremental Measure Cost | 16 | DEER 2005 (LED Exit Signs) |
| LED Measure Cost | Incremental Measure Cost | $265- $799 | KEMA |

## New T5/T8 Fluorescent Fixtures (Parking Garage)

**Table 124: New T5/T8 Fluorescent Fixtures (Parking Garage)**

| | |
|---|---|
| **Measure Description** | This measure consists of replacing one or more existing fixtures with new fixtures containing T8 or T5 lamps and electronic ballasts specifically in interior and exterior garages. The T8 or T5 lamps must have a color rendering index (CRI) ≥ 80. The electronic ballast must be high frequency (≥20 kHz), UL listed, and warranted against defects for 5 years. Ballasts must have a power factor (PF) ≥ 0.90. Ballasts for 4-foot lamps must have total harmonic distortion (THD) ≤20 percent at full light output. For 2- and 3-foot lamps, ballasts must have THD ≤32% at full light output. |
| **Units** | Per Watt reduced |
| **Base Case Description** | Typically high wattage HID fixtures at interior and exterior garages. |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: KEMA |
| **Effective Useful Life** | Source: DEER<br>11 years |

This measure consists of replacing one or more existing fixtures with new fixtures containing T8 or T5 lamps and electronic ballasts. The T8 or T5 lamps must have a color rendering index (CRI) ≥ 80. The electronic ballast must be high frequency (≥20 kHz), UL listed, and warranted against defects for 5 years. Ballasts must have a power factor (PF) ≥ 0.90. Ballasts for 4-foot lamps must have total harmonic distortion (THD) ≤20 percent at full light output. For 2- and 3-foot lamps, ballasts must have THD ≤32 percent at full light output.

This section only applies to interior and exterior parking garages and is presented separately from other building types due to the drastic difference in operating hours. We define interior as parking structures that are enclosed where it is reasonable to assume that all lighting fixtures operate 24 hours per day, 7 days a week.[27] This will include underground parking structures and also stand alone parking structures that may be semi-enclosed. Exterior parking structures are outdoor parking lots where light fixtures do not operate during the day. For other building types refer to savings numbers in the New T5/T8 fluorescent fixture section.

**Measure Savings**
The savings are provided for interior and exterior parking garages.

[27] PG&E Lighting WP 2006

**Table 125: Parking Garage Savings for New T8/T5 Fluorescent Fixtures per Watt Reduced**

| Garage Types | Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak Watt Savings | kWh Savings |
|---|---|---|---|---|---|---|
| Interior | 8,760 | 1.00 | 1 | 1.00 | 0.0010 | 8.7600 |
| Exterior | 4,100 | 1.00 | 0 | 1.00 | 0.0000 | 4.1000 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below.

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

Baseline and retrofit equipment assumptions are variable. Because we define this measure with the number of watts reduced, the non-coincident demand savings will be one watt by definition.

Operating hours vary depending on the parking structure type. Interior garages keep lights on at all times while exterior parking lots operate daily at 12 hours per day, except during the summer when lights are on 3 hours less. These operating hours imply that coincident factors are 1 for interior parking (lights are always in operation) and 0 for exterior parking (lights are only in operation at night). Since parking structures are not conditioned space, interactive effects are set to 1.

**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 126: Measure Life and Incremental Measure Cost**

| | Value | Source |
|---|---|---|
| Measure Life | 11 | DEER |

| | | |
|---|---|---|
| Incremental Measure Cost[28] | $0.75 | KEMA |

[28] Based on the assessment of active projects in the 2008-09 ComEd Smart Ideas Program.

## High Wattage Screw-In CFLs for Parking Structures

**Table 127: High Wattage Screw-In CFLs for Parking Structures**

| | |
|---|---|
| **Measure Description** | High Wattage Scew-In CFLs must be greater than 40W and must replace HIDs or incandescent lamps. CFLs must have lamp/ballast efficacy of ≥ 40 lumens per watt. |
| **Units** | Per Lamp |
| **Base Case Description** | Incandescent or HID lamps. |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: KEMA |
| **Effective Useful Life** | Source: DEER<br>2.5 years |

This incentive applies to screw-in lamps and applies only if an incandescent or high-intensity discharge (HID) lamp is being replaced. Lamp/ballast combination must have an efficacy ≥40 lumens per Watt (LPW).

**Measure Savings**

Most lighting retrofits assume an early replacement of existing technologies where the baseline represents the equipment removed. The table shows the wattage reductions used for the savings calculations. Since incandescent lamps produce lower lumens per watt compared to HIDs, they tend to have higher wattage for a given application. Savings are therefore greater in the incandescent case.

**Table 128: High Wattage Screw-in CFLs Wattage Reduction**

| Measure | Wattage Reduction |
|---|---|
| Incandescent Baseline | 214 |
| HID Baseline | 102 |

The coincident kW and kWh savings are provided by parking structure type below. Interior parking garages will have annual operating hours of 8,760 (24/7) and exterior parking lots will have annual operating hours of 3,640 (10/7). This implies that interior coincidence factors are assumed to be 1 since the lights operate at all times. Similarly, exterior coincidence factors are assumed to be 0 since lights do not operate during daylight.

**Table 129: High Wattage Screw-in CFL Savings for Incandescent Baseline**

| Building Types | Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak kW Savings | kWh Savings |
|---|---|---|---|---|---|---|
| Interior Garage | 8,760 | 1.00 | 1.00 | 1.00 | 0.214 | 1875 |
| Exterior Parking | 4,100 | 1.00 | 0.00 | 1.00 | 0.000 | 779 |

**Table 130: High Wattage Screw-in CFL Savings for HID Baseline**

| Building Types | Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak kW Savings | kWh Savings |
|---|---|---|---|---|---|---|
| Interior Garage | 8,760 | 1.00 | 1.00 | 1.00 | 0.102 | 890 |
| Exterior Parking | 4,100 | 1.00 | 0.00 | 1.00 | 0.000 | 370 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below.

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = Non-Coincident kW Savings * Annual Operating Hours * Energy Interactive Effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = Non-Coincident kW Savings * Coincidence Factor * Demand Interactive Effect

For this measure, it is assumed that the lighting is placed in non-conditioned areas so the energy and demand interactive effects are 1.0.

Baseline and retrofit equipment assumptions are presented in the following table. Most lighting retrofits assume an early replacement of existing technologies where the baseline represents the equipment removed. The table shows the wattages used for the savings calculations.

**Table 131: High Wattage Screw-in CFL Baseline and Retrofit Wattages**

| Baseline | Base Wattage (Watts) | Retrofit Wattage (Watts) | kW Reductions (kW) |
|---|---|---|---|
| 75 MH | 85 | 42 | 0.043 |
| 150 MH | 165 | 68 | 0.097 |
| 175 MH | 188 | 68 | 0.120 |
| 175 MH | 203 | 100 | 0.103 |
| 250 MH | 295 | 150 | 0.145 |

| | | | |
|---|---|---|---|
| 200 Inc | 200 | 55 | 0.145 |
| 250 Inc | 250 | 68 | 0.182 |
| 400 Inc | 400 | 85 | 0.315 |
| Average | | | 0.158 |

**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 132: Measure Life and Incremental Measure Cost**

| Measure Category | | Value | Source |
|---|---|---|---|
| All | Measure Life | 2.5 | DEER |
| Incandescent Baseline | Incremental Measure Cost | $28 | KEMA |
| HID Baseline | Incremental Measure Cost | $38 | KEMA |

## Ceramic Metal Halides or Pulse Start Metal Halides (Parking Lots and Garages)

| Table 134 Ceramic Metal Halides or Pulse Start Metal Halides (Parking Lots and Garages) | |
|---|---|
| **Measure Description** | This measure applies to retrofits of high intensity discharge fixtures with either pulse start metal halide or ceramic metal halide fixtures in parking lots or garages. The new fixture must replace a higher wattage existing fixture. |
| **Units** | Per Fixture |
| **Base Case Description** | High wattage HID fixtures |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: KEMA |
| **Effective Useful Life** | Source: DEER<br>16 years |

This incentive applies to retrofits of high-intensity discharge fixtures with either pulse-start metal halide or ceramic metal halide fixtures in parking lots or garages. Total replacement wattage must be lower than existing wattage to ensure energy savings. This measure is subject to possible pre-inspection. Retrofit kits may be used on existing mercury vapor, standard metal halide or high-pressure sodium fixtures only.

**Measure Savings**
The table below provides the non-coincident savings.

**Table 135: Metal Halides Wattage Reduction**

| Wattage Category | Average Wattage Reduction |
|---|---|
| 100W or Less | 48 |
| 101W-200W | 65 |
| 201-350W | 128 |
| 351-400W | 396 |

The coincident kW and kWh savings are provided by parking structure type below. Interior parking garages will have an annual operating hours of 8,760 (24/7) and exterior parking lots will have an annual operating hours of 4,100 (12/7 Non-Summer, 9/7 Summer). This implies that interior coincidence factors are assumed to be 1 since the lights operate at all times. Similarly, exterior coincidence factors are assumed to be 0 since lights do not operate during daylight hours.

**Table 136: Metal Halides Savings for ≤100W MH**

| Building Types | Annual Operating Hours | Peak kW Savings | kWh Savings |
|---|---|---|---|
| Interior Parking Garage | 8,760 | 0.048 | 423 |
| Exterior Parking Garage | 4,100 | 0.000 | 198 |

**Table 137 Metal Halides Savings for 101W-200W MH**

| Building Types | Annual Operating Hours | Peak kW Savings | kWh Savings |
|---|---|---|---|
| Interior Parking Garage | 8,760 | 0.065 | 569 |
| Exterior Parking Garage | 4,100 | 0.000 | 267 |

**Table 138: Metal Halides Savings for 201W-350W MH**

| Building Types | Annual Operating Hours | Peak kW Savings | kWh Savings |
|---|---|---|---|
| Interior Parking Garage | 8,760 | 0.128 | 1121 |
| Exterior Parking Garage | 4,100 | 0.000 | 525 |

**Table 139: Metal Halides Savings for 351W-400W MH**

| Building Types | Annual Operating Hours | Peak kW Savings | kWh Savings |
|---|---|---|---|
| Interior Parking Garage | 8,760 | 0.396 | 3467 |
| Exterior Parking Garage | 4,100 | 0.000 | 1,623 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below.

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

For this measure, it is assumed that the lighting is placed in non-conditioned areas so the energy and demand interactive effects are 1.0.

Baseline and retrofit equipment assumptions are presented in the following table. Most lighting retrofits assume an early replacement of existing technologies where the baseline represents the equipment removed. The table shows the wattages used for the savings calculations.

**Table 140: Metal Halide Baseline and Retrofit Wattages**[29]

| Measures | Base Wattage | Retrofit Wattage | Wattage Reduction |
|---|---|---|---|
| **100W or Less** | | | |
| Base case => Ceramic MH (20W lamp) | 57 | 22 | 35 |
| Base case => Ceramic MH (39W lamp) | 83 | 46 | 37 |
| Base case (100W) => Ceramic MH (25W lamp) | 100 | 27 | 73 |
| **Average** | | | **48** |
| | | | |
| **101W-200W** | | | |
| Base case (250W lamp) => Metal Halide (175W lamp) | 295 | 208 | 87 |
| Base case (175W lamp) => Metal Halide (150W lamp) | 208 | 185 | 23 |
| Metal Halide (250W) => Pulse Start Metal Halide (175W) | | | 85 |
| **Average** | | | **65** |
| | | | |
| **201-350W** | | | |
| Base case (400W lamp) => Metal Halide (320W lamp) | 458 | 365 | 93 |
| Mercury Vapor (400W) => Pulse Start Metal Halide (250W) | 458 | 295 | 163 |
| **Average** | | | **128** |
| | | | |
| **351-400W** | | | |
| Basecase (1000 W) -> Metal Halide (<400W) | 1075 | 458 | 617 |
| Basecase (700 W) -> Metal Halide (<400W) | 780 | 458 | 322 |
| **Average** | | | **396** |

[29] 2006 PG&E Interior Pulse Start Metal Halide Workpaper, PG&E Directional Lighting CMH Workpaper, SCE Ceramic Metal Halide Workpaper (WPSCNRLG0054.1), 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures.

**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 lighting measures, 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 141: Measure Life and Incremental Measure Cost**

| Wattage Category | | Value | Source |
|---|---|---|---|
| All | Measure Life | 16 | DEER |
| 100W or Less | Incremental Measure Cost | $95 | SCE WP[30] |
| 101-200W | Incremental Measure Cost | $170 | PG&E WP[31] |
| 201-350W | Incremental Measure Cost | $266 | SCE WP[32] |
| 351-400W | Incremental Measure Cost | $266 | SCE WP[33] |

[30] WPSCNRLG0054.1 Ceramic Metal Halide Fixtures, Southern California Edison Workpaper, 2008.
[31] 2006 PG&E Interior Pulse Start Metal Halide Workpaper
[32] WPSCNRLG0046.1 Interior Pulse Start Metal Halide Fixtures 251 -400W, Southern California Edison Workpaper, 2008.
[33] WPSCNRLG0046.1 Interior Pulse Start Metal Halide Fixtures 251 -400W, Southern California Edison Workpaper, 2008.

KEMA

## LED Channel Signs, Outdoor

**Table 142: LED Channel Signs, Outdoor**

| | |
|---|---|
| **Measure Description** | Retrofit and replacement of inefficient neon and argon-mercury channel letter signs with efficient LED channel letter signs. |
| **Units** | Per letter |
| **Base Case Description** | Existing signage– Neon (red) channel letter signs and argon-mercury (white) channel letter signs. |
| **Measure Savings** | Source: PG&E workpaper |
| **Measure Incremental Cost** | Source: PG&E workpaper |
| **Effective Useful Life** | 16 years<br>Source: PG&E workpaper |

LED channel sign incentive is available for retrofitting or replacing incandescent, HID, argon-mercury or neon-lighted channel letter signs. Replacement signs can not use more than 20% of the actual input power of the sign that is replaced.

**Measure Savings**[34]
The following table summarizes the savings for LED channel signs.

**Table143 Savings for LED Channel Signs**

| Location | Hours of Operation | Sign Height | Annual Energy Savings kWh/letter | Demand Savings kW/letter | Peak Demand Savings kW/letter |
|---|---|---|---|---|---|
| Outdoor | 2750 | ≤ 2 ft | 93 | 0.034 | 0 |
| | | >2 ft | 237 | 0.086 | 0 |

**Measure Savings Analysis**
The calculation methodology used by PG&E in the LED Channel Sign workpaper is outlined below. All the supporting documentation and spreadsheets are shown in the PG&E workpaper.

[34] PGE LED Channel Sign work paper

1. Collected letter schematics showing linear feet of tubing and number of LED modules for each letter of the alphabet, both uppercase and lowercase, for 24 inch high letters and 36 inch high letters.
2. The base case wattage (W/ft) and the energy efficient case wattage (W/module) input values were collected for each specific letter.
3. A probability table, showing the frequency each letter appears in the English language, was integrated into the spreadsheet. By multiplying the wattage for each specific letter by the probability, a weighted average wattage per letter was obtained. This single value represents all 26 letters of that height and will be accurate over a range of signs with a weighted average watts/letter for red and white for uppercase and lowercase letters.
4. This spreadsheet was then modified to account for the average height of signs in each category. (According to sign industry sources, the average height of a sign in the 2 feet or less category is 21 inches. The average height of a sign in the greater than 2 feet high category is 27 inches).
5. The watts/letter values were then weighted assuming 70% of letters are uppercase and 30% of letters are lowercase, as well as 50% are red signs and 50% are white signs.

**Measure Life and Incremental Measure Cost**

Measure life is assumed to be 16 years for the signs. LEDs have a lifetime of 25,000 hours for LEDs. However, to be consistent, DEER uses 16 years for LED exit signs, hence all LEDs are assumed to have a 16 year life.

Incremental cost is cost difference between the energy efficient equipment and the less efficient option. The incremental cost for the retrofit case is the full cost of the LED-lighted sign because the retrofit case assumes the existing lighting is working properly and does not need to be replaced. The incremental cost for the replacement case is the difference between the base case and the energy-efficient alternative. The incremental costs were weighted assuming that 30% of the channel signs will be retrofit and 70% of the channel signs will be new or replacement. Therefore, the incremental cost for signs less than or equal to 2 ft. high is \$35/letter and the incremental cost for signs greater than 2 ft. high is \$154/letter.

## Photocells

**Table 144 Photocells**

| | |
|---|---|
| **Measure Description** | Photocells can be used to control both outdoor and indoor lamps. When there is enough day lighting, lights are automatically turned off. This workpaper will only apply to outdoor lighting. The primary use is to shut off lights at dawn and on at dusk. |
| **Units** | Per Photocell |
| **Base Case Description** | High pressure sodium exterior lamps with time clock. |
| **Measure Savings** | DEER 2005 |
| **Measure Incremental Cost** | DEER 2005 |
| **Effective Useful Life** | 8 years (DEER 2008), assumed to be the same as a timeclock or daylighting controls. |

Photocells control lighting fixtures by sensing the amount of sunlight in the area and switching lights off when enough sunlight is present. The measure assumes that the existing exterior lights are controlled by a time clock and the measure retrofits those with a new photocell. With a photocell, exterior lights operate approximately 4,100 hours per year. Without the photocell, the lights would operate an additional 280 hours per year (approximately 3 months at 3 hours per day). For this calculation, the photocell controls four 70-watt high-pressure sodium exterior lamps with an effective 95 watts including the ballast.

**Measure Savings**

**Table 145: Photocell Measure Savings**

| Peak kW Savings | Annual kWh Savings |
|---|---|
| 0 | 106.4 |

**Measure Savings Analysis**

We assume in our calculations that lighting systems with time clocks only will be on 12 hours a day or 4,380 hours annually. Due to seasonal shifts, photocells will shut off an additional 3 hours per day for 3 months. This equates to annual savings of 280 hours.

DEER assumes that each photocell will control 4 lamps at 95W each, effectively 380W per photocell.

Since no interactive effects are considered for exterior lighting, annual kWh savings per photocell is calculated to be 106.4kWh. On average, the demand in this period will be 0 in both the retrofit and base case.

**Measure Life and Incremental Measure Cost**

Measure life is assumed to be the same as a timeclock or daylighting controls as listed in DEER.

**Table 146: Measure Life and Incremental Measure Cost**

| | Value | Source |
|---|---|---|
| Measure Life | 8 | DEER 2008 |
| Incremental Measure Cost | $59.81 | DEER 2005 |

## Time Clocks for Lighting

**Table 147: Time Clocks for Lighting**

| | |
|---|---|
| **Measure Description** | Time clocks are an electrical device that control lighting equipment by turning the equipment on and off according to a set schedule. This measure applies to external lighting. The timeclocks must be installed with a 3 hour battery pack and astronomical controls. |
| **Units** | Per Time Clock |
| **Base Case Description** | High pressure sodium exterior lamps with no control system |
| **Measure Savings** | DEER 2005 |
| **Measure Incremental Cost** | DEER 2005 |
| **Effective Useful Life** | 8 years (DEER 2008) |

Time clocks are an electrical device that control lighting equipment by turning the equipment on and off according to a set schedule. This measure applies to external lighting. These clocks can program lights to switch off during weekends, for example. The time clocks must be installed with a 3 hour battery pack so that schedule information do not get whipped out during any power outages. Time clocks should also include astronomical controls, to adjust the schedule to the appropriate season.

**Measure Savings**

**Table 148: Timeclock Measure Savings**

| Peak kW Savings | Annual kWh Savings |
|---|---|
| 0 | 474.24 |

**Measure Savings Analysis**
DEER assumes that each time clock will control 4, 70W high pressure sodium lamps. Including the ballast, each lamp has a demand of 95W or 380W total.

We assume in our calculations that lighting systems without time clocks will be on 12 hours a day during weekends. This measure would eliminate weekend operation which equates to 1,248 hours annually.

Since no interactive effects are considered for exterior lighting, energy saving is calculated by multiplying 1,248 hours and 380W. There is no peak demand savings associated with this measure since peak usage are not impacted by time clocks.

**Measure Life and Incremental Measure Cost**

**Table 149: Measure Life and Incremental Measure Cost**

| | Value | Source |
|---|---|---|
| Measure Life | 8 | DEER 2008 |
| Incremental Measure Cost | $102.78 | DEER 2005 |

## LED Traffic Signals

| Table 150: LED Traffic Signals | |
|---|---|
| **Measure Description** | Replacement of existing incandescent traffic and pedestrian lamps with LED lamps. |
| **Units** | Per Signal |
| **Base Case Description** | Incandescent fixtures |
| **Measure Savings** | Source: Ohio TRM |
| **Measure Incremental Cost** | Source: Michigan Statewide Energy Savings Database |
| **Effective Useful Life** | Source: Michigan Statewide Energy Savings Database<br>Traffic Signal: 6 Years<br>Pedestrian Signal: 8 Years |

LED traffic signals can save 80-90 percent of the energy typically consumed by incandescent traffic signals and LED signals generally last 5-10 times longer. Since traffic signals operate 24 hours a day, 365 days a year, the opportunity for energy savings is significant, particularly in the peak demand. LED Traffic signals perform better than incandescent models and are a better value. They also have lower maintenance costs because they need to be replaced less frequently.

Signals shall have a maximum LED module wattage of 17. Credits are offered for LED traffic lights on a per-signal basis (including arrows) that replace or retrofit an existing incandescent traffic signal. At minimum, red and green lamps must be retrofitted to qualify for the signal credit. Lights must be hard-wired, with the exception of pedestrian hand signals. Credits are not available for spare lights.

**Measure Savings**
The energy savings vary for red, green and yellow signals. Savings also vary for round lamps, arrows and pedestrian signals.

**Table 151: Measure Savings Traffic and Pedestrian Signals, per signal**

| Measure Name | kWh | Coincident Peak kW |
|---|---|---|
| Green 8 inch ROUND | 226.0 | 0.06 |
| Green 12 inch ROUND | 519.8 | 0.14 |
| Red 8 inch ROUND | 298.7 | 0.06 |
| Red 12 inch ROUND | 693.8 | 0.14 |
| Walk/Don't Walk - 9 inch | 946.1 | 0.081 |
| Walk/Don't Walk - 12 inch | 946.1 | 0.11 |

### Measure Savings Analysis

Operating hours, coincident factors, and baseline and retrofit wattages are from values found in the Ohio TRM (pg 187).

### Measure Life and Incremental Measure Cost

The measure life is assumed to be 6 for traffic and 8 years for pedestrian signals. The IMC is $90 and $140 for traffic and pedestrian signal, respectively. Data is from the Michigan Statewide database 2010.

## Lighting Density

**Table 153: Lighting Density**

| | |
|---|---|
| **Measure Description** | Savings for new construction lighting projects will be calculated with lighting density. |
| **Units** | Per kW Reduced |
| **Base Case Description** | ASHRAE 90.1-2004 Lighting density. |
| **Measure Savings** | Source: KEMA |
| **Measure Incremental Cost** | Source: NA |
| **Effective Useful Life** | Source: DEER<br>11 Years |

This measure applies only to new construction lighting projects and savings are calculated using the ASHRAE 90.1-2004 new construction lighting density as a baseline. The wattages are given on a per square foot basis and vary with business type.

The following table shows the ASHRAE criteria.

**Table 154: ASHRAE Building Density Criteria**

| Building Type | Lighting Power Density ($W/ft^2$) | Building Type | Lighting Power Density ($W/ft^2$) |
|---|---|---|---|
| Automotive | 0.9 | Motion Picture Theatre | 1.2 |
| Convention Center | 1.2 | Multi-Family | 0.7 |
| Court House | 1.2 | Museum | 1.1 |
| Dining: Bar Lounge/Leisure | 1.3 | Office | 1.0 |
| Dining: Cafeteria/Fast Food | 1.4 | Parking Garage | 0.3 |
| Dining: Family | 1.6 | Penitentiary | 1.0 |
| Dormitory | 1.0 | Performing Arts Theatre | 1.6 |
| Exercise Center | 1.0 | Police/Fire Station | 1.0 |
| Gymnasium | 1.1 | Retail | 1.5 |
| Health Care | 1.0 | School/University | 1.2 |
| Hospital | 1.2 | Sports Arena | 1.1 |

| | | | |
|---|---|---|---|
| Hotel | 1.0 | Town Hall | 1.1 |
| Library | 1.3 | Transportation | 1.0 |
| Manufacturing Facility | 1.3 | Warehouse | 0.8 |
| Motel | 1.0 | Workshop. | 1.4 |

Applications must calculate the kW reduction using the above numbers, taking into account the business type as well as the actual building square footage. On a per kW reduced basis, the following table shows the energy and coincident savings.

**Table 155: Lighting Density Savings**

| Annual Operating Hours | Demand Interactive Effects | Coincident Diversity Factors | Energy Interactive Effects | Peak Watt Savings | kWh Savings |
|---|---|---|---|---|---|
| 4,389 | 1.19 | 0.77 | 1.12 | 0.916 | 4,914 |

**Measure Savings Analysis**
Annual energy savings and the peak coincident demand savings were calculated using the equations below.

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

Energy savings are calculated by applying the annual operating hours and the energy interactive effect, according to the following formula:

kWh Reduction = non-coincident kW savings * Annual operating hours * Energy interactive effect

Coincident demand savings are calculated by applying the coincidence factor and the demand interactive effect, according to the following formula:

Coincident kW savings = non-coincident kW savings * Coincidence Factor * Demand interactive effect

Baseline and retrofit equipment assumptions are variable. Because we define this measure as in the number of watts reduced, the non-coincident demand savings will be one kW by definition.

**Measure Life**

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

**Table 156: Measure Life**

| | Value | Source |
|---|---|---|
| Measure Life | 11 | DEER |

# Cooling

## 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<br>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<br>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<br>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.

***∆Watts/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.*

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

***Annual Electric Savings***

*Energy Savings [kWh/ton] = (∆kW/ton) x (Op Hrs)*

***Demand Reduction***

*Demand Reduction [kW/ton] = (∆kW/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<br>$84/ton |
| **Effective Useful Life** | Source: DEER<br>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]<br>$260/Unit |
| **Effective Useful Life** | Source: DEER 2008<br>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<br>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<br>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<br>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**

| | 1200 RPM | | 1800 RPM | | 3600 RPM | |
|---|---|---|---|---|---|---|
| MOTOR HORSEPOWER | ODP MOTOR Coincident Demand Reduction (kW) | TEFC MOTOR Coincident Demand Reduction (kW) | ODP MOTOR Coincident Demand Reduction (kW) | TEFC MOTOR Coincident Demand Reduction (kW) | ODP MOTOR Coincident Demand Reduction (kW) | 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**

| | 1200 RPM | | 1800 RPM | | 3600 RPM | |
|---|---|---|---|---|---|---|
| MOTOR HORSEPOWER | 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**

| | 1200 RPM | | 1800 RPM | | 3600 RPM | |
|---|---|---|---|---|---|---|
| MOTOR HORSEPOWER | 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**

| | 1200 RPM | | 1800 RPM | | 3600 RPM | |
|---|---|---|---|---|---|---|
| MOTOR HORSEPOWER | 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<br>$7.77 |
| **Effective Useful Life** | Source: SCE<br>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.

[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<br>$34 |
| **Effective Useful Life** | Source: PG&E, SCE<br>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**

[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<br>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.

| | Restaurant | | | |
|---|---|---|---|---|
| **SCE Workpaper Values** | **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**

| | Grocery | | | |
|---|---|---|---|---|
| **SCE Workpaper Values** | **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**

| | Grocery | | | |
|---|---|---|---|---|
| **SCE Workpaper Values** | **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<br>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$^{o}$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.<br><br>This measure is not applicable if any of the following conditions apply:<br>1) The compressor runs all the time with high duty cycle<br>2) The evaporator fan does not run at full speed all the time<br>3) The evaporator fan motor runs on poly-phase power<br>4) The evaporator fan motor is not shaded-pole or permanent split capacitor<br>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<br>$291 |
| **Effective Useful Life** | Source: DEER<br>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<br>$156.82 |
| **Effective Useful Life** | Source: DEER 2008<br>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<br>$156.82 |
| **Effective Useful Life** | Source: DEER 2008<br>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<br>$9.61 |
| **Effective Useful Life** | Source: DEER 2008<br>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<br>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<br>$180 |
| **Effective Useful Life** | Source: DEER 2005<br>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.

[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<br>$80 |
| **Effective Useful Life** | Source: DEER 2005<br>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<br>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<br>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<br>$2,490 |
| **Effective Useful Life** | Source: ENERGY STAR<br>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<br>$3,824 |
| **Effective Useful Life** | Source: DEER 2008<br>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<br>Full Size: $1,891<br>Three-Quarter Size: $1,497<br>Half Size: $707 |
| **Effective Useful Life** | Source: DEER 2008<br>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<br>$804.75 |
| **Effective Useful Life** | Source: DEER 2008<br>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 | ≤ 0.250V + 1.250 |
| 15 ≤ V < 30 | ≤ 0.400V – 1.000 |
| 30 ≤ V < 50 | ≤ 0.163V + 6.125 |
| 50 ≤ V | ≤ 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<br>$804.75 |
| **Effective Useful Life** | Source: DEER 2008<br>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 | ≤ 0.607V + 0.893 |
| 15 ≤ V < 30 | ≤ 0.733V – 1.000 |
| 30 ≤ V < 50 | ≤ 0.250V + 13.500 |

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

| | |
|---|---|
| 50 ≤ V | ≤ 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<br>$99 |
| **Effective Useful Life** | Source: Michigan CI Technologies Workpaper FES-I1<br>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<br>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.

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

Where kW of equipment is calculated using:

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

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

**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 | | | |