Legal Department

December 28, 2010

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

Matthew J. Satterwhite
Senior Counsel –
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RE:

In the Matter of Canton South High School and Ohio Power Company for Approval of A Special Arrangement Agreement with a Mercantile Customer	**)**	**Case No. 10-1680-EL-EEC**

Dear Chairman Schriber,

Attached please find the Joint Application of Ohio Power Company (OPCo) and mercantile customer **Canton South High School** 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 OPCo's version of that application and accompanying affidavit. Any confidential information referenced in the Joint Application has been filed in Commission Docket 10-1599-EL-EEC, under a request for protective treatment. OPCo 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.: 10-1680-**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: CANTON SOUTH HIGH SCHOOL

Principal address: 4526 Ridge Ave Se, Canton, Oh 44707

Address of facility for which this energy efficiency program applies: 600 Faircrest St, Canton, Oh 44707-1344

Name and telephone number for responses to questions:

Tim Ewing, Canton South High School, (330) 484-8019 Ext. 706_

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

- [x] 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: Ohio 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, 10/7/2008 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: 11,073 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))

2.7 kW

See Confidential and Proprietary Attachment 5 – Self Direct Program Project Calculation for peak demand reduction 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.

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 $ 1,348.20. (Attach documentation and calculations showing how this payment amount was determined.)

See <u>Confidential and Proprietary Attachment 5 – Self Direct Program Project Calculation</u> 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: 3.7 (Skip to Subsection 2.)

<u>Subsection 1: TRC Test Used (please fill in all blanks).</u>

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 _______.

<u>Subsection 2: UCT Used (please fill in all blanks).</u>

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 $ 5,238.48

The utility's administrative costs were $ 66.44

The utility's incentive costs/rebate costs were $ 1,348.20.

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.: 10-1680-EL-EEC

State of Ohio :

Ryan J 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 Ohio 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 21st 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 01-03-2011

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	**CANTON SOUTH HIGH SCHOOL**	
Project Number	**AEP-10-01640**	
Customer Premise Address	**600 FAIRCREST ST SE, CANTON, OH 44707-1344**	
Customer Mailing Address	**4526 Ridge Ave SE, Canton, OH 44707**	
Date Received	**5/6/2010**	
Project Installation Date	**10/7/2008**	
Annual kWh Reduction	**11,073**	
Total Project Cost	**$12,500.00**	
Unadjusted Energy Efficiency Credit (EEC) Calculation	**$1,797.60**	
Simple Payback (yrs)	**13.8**	
Utility Cost Test (UCT)	**3.7**	
		Please Choose One Option Below and Initial
Option 1 - Self Direct EEC: 75%	**$1,348.20**	✓ **Initial:** AN
Option 2 - EE/PDR Rider Exemption	**4 Months (After PUCO Approval)**	**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.

Replaced [(24) 400W MH and (4) 1000 W MH] with (48) new 6 lamp T8 fixtures

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.

Ohio Power Company	**CANTON SOUTH HIGH SCHOOL**
By: [signature]	By: [signature]
Title: Manage	Title: TREASURER
Date: 12/13/1	Date: 12/8/10

gridSMART From AEP OHIO

Self-Direct Program Project Application

Application Instructions

- Read the Rules and Requirements for Retrospective Projects before completing an application.
- Complete a separate application form for each installation account number.
- Complete the appropriate Self-Direct Program Excel spreadsheet for each application:
  - The Self-Direct Prescriptive Spreadsheet for specific lighting conversions and installations covered in the Prescriptive Program.
  - The Self-Direct Custom Spreadsheet for lighting improvements not covered in the Prescriptive Program and for any other energy efficiency installation.
- Information necessary for complete applications includes:
  - The Self-Direct Program project description.
  - Full descriptions of each measure replaced and installed along with project costs, existing and new equipment inventories/operation descriptions, baseline and new usage measurements or detailed calculations, total energy and peak demand savings, and other specified information.
  - Detailed customer-approved invoices, proof of purchase, receipts.
  - Technical specifications, studies/proposals, up to five digital photos of the new equipment and, if available, the removed equipment.
  - All other documentation and verification to justify the project for energy efficiency credits (EEC).
  - NOTE: Sending inadequate invoice documentation, incomplete/incorrect forms or incomplete backup information, including detailed energy and peak demand calculations, will delay review of the application. Contact AEP Ohio if you require additional assistance in completing the application.
- Submit all information to AEP Ohio. All completed submissions become the property of AEP Ohio. Make a copy of all documents for your records.

FORM SUBMITTAL: Please note all Rules and Requirements.
Emailed submissions with attachments are preferred.
Return the signed, completed form and all required detailed documentation to:

Email: gridSMARTohio@kema.com

Mail: AEP Ohio
6031 East Main Street, Suite 190
Columbus, OH 43213

Fax: 877-607-0740

Questions: 877-607-0739

Visit **gridSMARTohio.com** for more information on the Self-Direct Program and other incentive programs offered by AEP Ohio.

gridSMART From AEP OHIO

Self-Direct Program Project Application

THIS APPLICATION FORM IS VALID THROUGH DECEMBER 31, 2010.

Will be assigned by AEP Ohio

PROJECT ID: ________________

Account Qualification (Check one or both if applicable)

☐ **700,000 kWh per year** ☐ **National Account or Multiple Facilities** (under the same name in Ohio)

SECTION 1: CUSTOMER INFORMATION

Company Name	Date (mm/dd/yyyy)	
Mailing Address	Contact E-mail*	
City	State	Zip Code
Contact Name (print)	Phone ( ) -	Fax ( ) -
Taxpayer ID #/SSN/FEIN (99-9999999)	Tax Status: (may receive 1099) ☐ Corporation (Incl. INC, PC, etc.) ☐ LLC ☐ Tax Exempt ☐ Individual ☐ Other	

SECTION 2: PAYMENT RELEASE AUTHORIZATION (who will receive payment)

Payable to (if different from Customer)	Mailing Address	
City	State	Zip
Taxpayer ID # of Recipient (if different from Customer) (99-9999999)	Tax Status: (may receive 1099) ☐ Corporation (Incl. INC, PC, etc.) ☐ LLC ☐ Tax Exempt ☐ Individual ☐ Other	

SECTION 3: JOB SITE INFORMATION (where equipment was installed)

Job Site: Customer Name (as it appears on the electric service account)			Project Contact Name
Job Site Address (physical location)			Project Contact Telephone ( ) -
City	State	Zip Code	Project Contact Email
Job Site Account Number			Primary Account Number (if different than Job Site)

Construction Type: ☐ New Construction ☐ Existing Building ☐ Major Renovation

Building Type: ☐ Office ☐ School (K-12) ☐ College ☐ Retail/Service ☐ Restaurant ☐ Hotel/Motel ☐ Medical ☐ Grocery ☐ Warehouse ☐Light industry ☐ Heavy Industry ☐ Government/Municipal ☐ Other_______________

Project In-Service Date	Total Project Cost $	Incremental Cost** $
Total Annual kWh Claimed (applicable only to Custom measures)	Peak kW Demand Reduction Claimed (applicable only to Custom measures)	

SECTION 4: CONTRACTOR INFORMATION (equipment or service provider/ installer other than Customer). Attach additional sheets if needed. Note: internal labor costs are not eligible project costs.

Contractor Name			
Contractor Street Address	City	State	Zip Code
Contractor Contact Name	Contact Telephone ( ) -	Contact Email	

SECTION 5: CUSTOMER ELECTION (your election in this section does not affect your qualification for EEC payment or EE/PDR rider exemption)

If I choose the energy efficiency credit payment:

☐ Yes, I plan to use it for future energy efficiency projects. *Please briefly describe your project here. A pre-approval application will be required to reserve your funds.* ______________________________

☐ No, I have completed all cost-effective energy efficiency projects and intend to use my energy efficiency credit payment for other operational needs.

SECTION 6: CUSTOMER SIGNATURE

By signing here, I acknowledge the information on this application is accurate and complete. I confirm I have read, agree with and understand the Rules and Requirements of this application and I have the authority to execute on behalf of my company / corporation.

Customer Signature ______________________________ **Date** ______________

* By providing your e-mail address, you are granting AEP Ohio permission to send further e-mails regarding our programs and services.

** Cost of higher efficiency equipment option compared to standard efficiency equipment option.

Self-Direct Program

Rules and Requirements for Retrospective Projects

Columbus Southern Power Company and Ohio Power Company are collectively known as AEP Ohio ("AEP Ohio"). 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.

Customer Qualifications

The Self-Direct Program (the "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.

Terms and Conditions

- THIS APPLICATION FORM IS VALID FOR SUBMITTAL BY CUSTOMERS UNDER THE SELF DIRECT PROGRAM UNTIL DECEMBER 31, 2010. AEP Ohio programs may be changed or cancelled at any time without notice. The Customer and its contractor are solely responsible for contacting AEP Ohio to ask whether or not the program is still in effect and to verify program parameters.
- This application defines the Date of Acceptance.
- For applications submitted in 2010, projects must have a completion date and begun operation between January 1, 2007 and the Date of Acceptance into the Self-Direct Program. Energy efficiency credit levels, as shown in the table below, are based on the calendar year of installation / operation. Customer shall provide proof of equipment installation / operation start-up.
- Customer agrees to commit all energy and demand resources identified in this application to AEP Ohio's energy and demand targets / benchmarks as identified in Senate Bill 221.
- All documentation and verification is subject to strict confidentiality.
- The peak demand hours are defined as weekdays, 7:00 AM to 9:00 PM, May through September.
- All applications are subject to AEP Ohio, its contractor(s) / agent(s), and the Public Utility Commission of Ohio (PUCO) review and approval prior to any EEC payments or exemptions from the Energy Efficiency / Peak Demand Reduction (EE/PDR) Rider under this program.
- Energy efficient equipment must be installed on the AEP Ohio electric account listed on the application.
- EEC payments are limited and subject to availability while program funding lasts.
- While funding is available, the payment will be:
  - 75% of the calculated incentive under the Prescriptive Program, or
  - $0.06 per annual kWh saved under the Custom Program,
    whichever is applicable to this project.
  - To ensure maximum program participation, AEP Ohio reserves the right to limit funding per project, per program and per business entity. A sliding scale incentive reduction will be incorporated when the calculated incentive exceeds $120,000 per project.
- EEC payments will be capped at 37.5% of the project cost.
- In lieu of a one-time EEC payment, the Customer may elect to seek an exemption from the EE/PDR rider for the associated electric account. The exemption is defined in the table below.
- If an exemption is elected, the Customer is not eligible for other Prescriptive and Custom energy efficiency/peak demand reduction programs offered by AEP Ohio during the period of exemption. Unless additional approved resources are committed, the Customer will, after the specified number of months on this Application, be subject to the EE/PDR rider.
- If a one-time EEC payment is elected, the Customer will remain in the EE/PDR rider and may also participate in other AEP Ohio energy efficiency and/or demand reduction programs.
- Eligible measures must produce <u>**verifiable**</u> and <u>**persistent**</u> energy and/or demand reduction, for a period of no less than five (5) years from the date of installation, through an increase in efficiency or through the use of load-shifting technologies and/or demand reduction. Measurement and verification may be required.
- Ineligible measures:
  1. Rely solely on changes in customer behavior and require no capital investment, or merely terminate existing processes, facilities and/or operations.
  2. Are required by state or federal law, building or other codes, or are standard industry practices.
  3. Involve fuel switching, plug loads, or generate electricity.
  4. Are easily reverted / removed or are installed entirely for reasons other than improving energy efficiency.
  5. Include other conditions to be determined by AEP Ohio.
- All equipment must be new; used or rebuilt equipment is <u>**not**</u> eligible.
- Costs associated with internal labor are not eligible.
- Customer is allowed and encouraged to consider using all or a portion of the EEC payment, as received from AEP Ohio under this program, to help fund other customer-initiated energy efficiency and peak demand reduction projects in the future. Future projects can also qualify for participation in the Prescriptive or Custom Program.
- A signed application with documentation verifying installation of the project including, but not limited to, equipment, equipment specifications, invoices, purchase orders, approvals, photographs and other related information must be submitted to AEP Ohio.
- Customer projects that warrant special treatment (i.e., non-typical projects) will be considered on a case-by-case basis by AEP Ohio.
- AEP Ohio reserves the right to randomly inspect Customer facility(ies) for installation of materials listed on this application and will need access to survey the installed project. Customer understands and agrees that their installations submitted under this Program may also be subject to inspections by the PUCO or their designee, and photographs of installation may be required.
- If the inspection finds that Customer did not comply with program rules and requirements, any payment received under this Program must be returned to AEP Ohio including interest. Any rider exemptions will also be voided. In addition, AEP Ohio reserves the right to withhold payment or exemption for projects that do not meet reasonable industry standards as determined by AEP Ohio.
- 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 EEC or rider exemptions promised to Customer as a result of program misrepresentation.
- 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.
- AEP Ohio reserves the right to request additional backup information, supporting details, calculations, manufacturer specification sheets, photographs or any other information prior to any payment or exemption.
- Equipment could have been installed in retrofit, replacement, or new construction applications and must meet reasonable industry standards. All equipment / measures must meet minimum cost effectiveness requirements as defined or determined by AEP Ohio. Customer must also provide evidence of measure life.
- AEP Ohio will issue approved EEC payments in the form of checks.
- Customer can not apply for EEC for future projects and elect after the fact to apply for exemption under this program.
- Customer shall be responsible to comply with any applicable codes or ordinances.
- Customer shall be responsible for the proper disposal of all waste and equipment.
- All submissions become the property of AEP Ohio. Keep a copy for your records.

Disclaimers

AEP Ohio:

- Does not endorse any particular manufacturer, product or system design by offering these EEC.
- Will not be responsible for any tax liability imposed on the Customer as a result of any payment for EEC. AEP Ohio will report EEC payments greater than $600 as income on IRS form 1099. Such payments shall be taxable unless Customer meets acceptable tax exemption criteria. Customers are encouraged to consult with their tax advisors about the tax liability of any payments.
- Does not expressly or implicitly warrant the performance of installed equipment (contact your contractor or supplier for detailed equipment warranties).
- Is not responsible for the proper disposal/recycling of any waste generated as a result of this project.
- Is not liable for any damage caused by the operation or malfunction of the installed equipment.
- Does not guarantee that a specific level of energy or cost savings will result from the implementation of energy conservation measures or the use of products funded under this program.

OPTION #1 - ONE-TIME PAYMENT	
Energy Efficiency Credit Levels	75% of the calculated Prescriptive incentive payment or $0.06/annual kWh saved under the Custom Program. Further funding limits may apply.
Min / Max Payback before Energy Efficiency Credit Applied	1 year Min / 7 Year Max Or pass cost effectiveness test(s) (determined by AEP Ohio)

OPTION #2 - EXEMPTION FROM EE / PDR RIDER
Exemption from the EE/PDR rider is determined by comparing the value of the one-time EEC payment with the estimated net present value (NPV) of the EE/PDR rider as calculated by AEP Ohio for the Customer's associated electric account. This NPV is defined as the Customer's financial contribution to AEP Ohio's efforts to reach EE/PDR targets.

Self-Direct Program

Retrospective Project Description: Project ______ of ______

Project Descriptive Name	Project In-service Date
Affected Electric Account Number	

Claimed Project Baseline (AEP Ohio will make the final determination of applicable baseline):

____ Retrofit (the project was an elective retrofit and the equipment was still operable)

____ Replacement (the project was a replacement of equipment at or near the end of its useful life)

____ New (the project was an addition of new equipment in an existing facility or new construction)

Describe the project including detail of energy savings equipment. Attach additional sheets if needed.

Describe the removed equipment and operating strategy. Please provide up to five digital photos of the equipment, if available. Attach additional sheets if needed.

Describe the installed equipment and operating strategy. Please provide up to five digital photos of the equipment. Attach additional sheets if needed.

Describe your calculation method for energy efficiency and attach all documentation of energy savings. Use additional sheets if needed.

Identify other benefits of proposed project in addition to electrical energy and/or demand reduction:

___Conserves other utilities (gas, water, etc.)

___Improves process flow

___Improves product quality

___Increases production capacity

___Meets environmental regulations

___Reduces labor

___Saves energy

___Uses fewer raw materials

___Other ____

Project Technical Specifications

(This sheet provides an example of the required data for input to the Self-Direct spreadsheet. The Self-Direct spreadsheet provides additional guidance and streamlines the process for collecting, documenting and reporting this information to AEP Ohio, and it follows the format of this sheet. Please provide as much detail as possible on the Self-Direct spreadsheet to expedite review and processing of the application).

Please complete the Self-Direct spreadsheet for each measure installed and provide supporting documentation including engineering or equipment supplier studies, customer-approved invoices, purchase orders, detailed calculations of baseline and energy and peak demand savings. A detailed proposal and complete package will expedite review of application. This information is required by AEP Ohio and/or its consultants for project analysis.

	EQUIPMENT REMOVED OR LOWER EFFICIENCY OPTION	INSTALLED EQUIPMENT OR HIGHER EFFICIENCY OPTION
Equipment type		
Manufacturer of equipment (attach manufacturer specification sheets)		
Model number(s)		
Date of removal / In-service date		
Age of equipment at removal		
Estimated remaining useful life at time of removal or installation		
Efficiency rating		
Nameplate data: kW, tons, HP, watts, etc.		
Quantity		
Annual operating hours		
Annual energy savings (kWh)		
Peak reduction (kW)*		
Annual electric bill savings ($)		
COST BREAKOUT		
Equipment		
Engineering		
Installation		
Other (explain)		
TOTAL PROJECT COST		
Incremental Cost = Cost of higher efficiency equipment option compared to standard efficiency equipment option.		

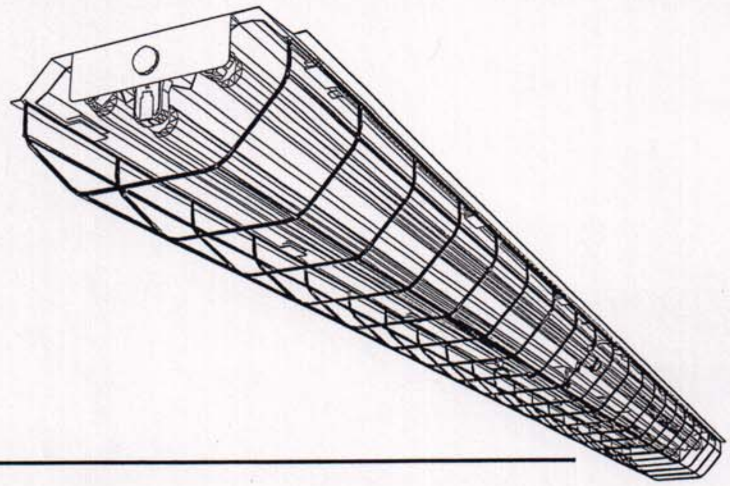
* **Determination of peak demand reduction (kW) from non-HVAC equipment:** For non-HVAC measures, calculate the average kW reduction over the period from 7 a.m. to 9 p.m., weekdays, from May 1 through September 30. The preferred calculation method will estimate hourly kW demands over the peak demand period, and average the results. However, if measures do not vary significantly during those hours, a less rigorous estimation process may be applied if approved in advance by the program.

* **Determination of peak demand reduction (kW) within HVAC systems:** Calculate the maximum HVAC peak demand reduction that occurs between 7 a.m. to 9 p.m. on a weekday from May 1 through September 30.

6 Lamp Heavy Duty Industrial Fixture

HD Series

Features



Combines the durability of a full steel body with the performance of a specular insert

Superior Light Quality, 92.5% Photometric Efficiency

Rigid, Four-Bend Press-Brake Formed Body

Optional wire guard kit

224 Watts (with high-lumen ballasts)

Technical Data

Housing: 20ga. (0.036") pre-painted steel die formed with sufficient knockouts for mounting and electrical supply.

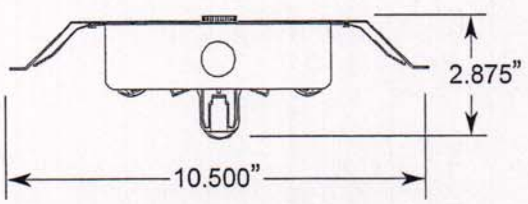
Finish: All cold rolled steel parts are painted with a smooth, glossy, highly reflective white paint.

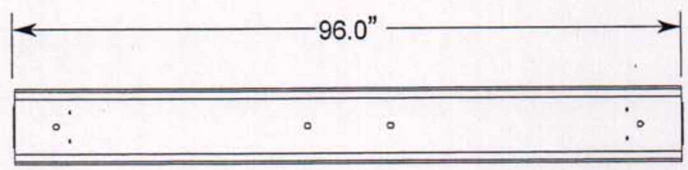
Reflector: Can be ordered with a 95% specular, a 85% specular, or a 92% diffuse white enamel. (For maximum performance, 95% specular is recommended.) Substrate is 0.020" high quality aluminum. The reflector profile is optimized using computer analysis and manufactured using state of the art CNC equipment. A protective premask is applied to all reflective surfaces prior to manufacture.

Construction: The solid four-bend body provides added rigidity. The socket bars and endplates securely snap into place. The reflectors are attached to the fixture body with a tab lock system. No tools or additional fasteners are required for reflector installation and removal.

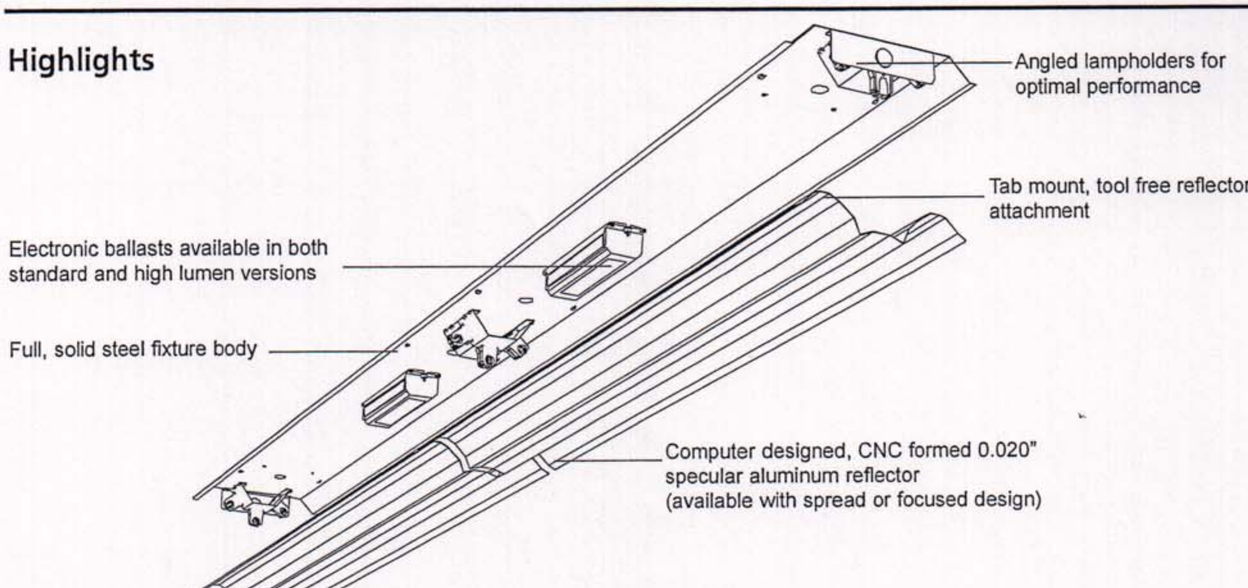
Mounting: Fixture can be surface, pendant, or chain suspended.

Installation





Highlights



6 Lamp Heavy Duty Industrial Fixture

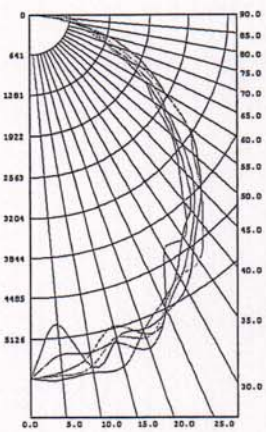
HD **Series**

Photometrics

Energy Solutions
Premium Lighting without the Premium Price

Energy Solutions International, Inc.
1385 Mendota Heights Road
Saint Paul, MN 55120

.ENERGY SOLUTIONS 1 X 8 FLUORESCENT LUMINAIRE
WITH WHITE INTERIOR, SPECULAR REFLECTORS AND NO LENS
SIX LINEAR FLUORESCENT 32 WATT LAMPS, LUMEN RATING 2950 LMS.
TWO GE B332I277RHSC BALLAST OPERATING AT 120 VAC AND 218 WATTS

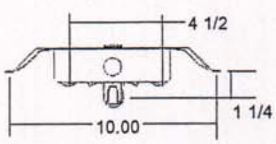


CANDLEPOWER SUMMARY

	0.00	22.50	45.00	67.50	90.00
0.00	5729	5729	5729	5729	5729
5.00	4909	5704	5384	5767	5651
10.00	5640	5617	5414	5718	5431
15.00	5294	5277	5364	5734	5092
20.00	5289	5433	5594	5298	5369
25.00	5188	5106	5170	5013	5135
30.00	5002	4783	4824	4715	4299
35.00	4565	4747	4466	4257	4319
40.00	4199	4319	4095	4011	3848
45.00	3902	3900	3709	3558	3387
50.00	3527	3421	3197	3043	2970
55.00	3113	3116	2697	2604	2410
60.00	2520	2483	2298	2121	2120
65.00	2121	1972	1782	1679	1586
70.00	1717	1453	1284	1309	1293
75.00	1287	1080	895	1085	1174
80.00	702	621	745	849	822
85.00	244	320	452	662	660
90.00	34.5	179	370	396	432

ZONAL LUMENS AND PERCENTAGES

Zone	Lumens	%Lamp	%Fixt
0- 30	4419	25.4	27.4
0- 40	7207	41.4	44.8
0- 60	12535	72.0	77.9
0- 90	16017	92.1	99.5
90-120	81	0.5	0.5
90-130	81	0.5	0.5
90-150	81	0.5	0.5
90-180	81	0.5	0.5
0-180	16098	92.5	100.0



** EFFICIENCY = 92.5% **

LUMINANCE SUMMARY - CD./SQ.M.

	0	45	90
0	5439	5439	5439
45	5152	4840	4731
55	4906	4511	4188
65	4637	3993	3671
75	4197	3189	2716
85	3542	1729	1257

PAINT REFLECTANCE = 0.78 S/MH = 1.49
SC (ALONG) = 1.27 SC (ACROSS) = 1.14

PREPARED IN PHOTOPIA FOR
ENERGY SOLUTIONS
ST. PAUL, MN

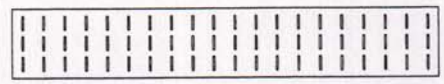
Case Study

250' x 40' x 25' Warehouse Space

Reflectances:

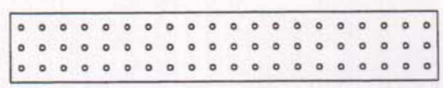
Ceiling 60
Walls 40
Floor 10

Power Strip Layout: 60 Fixtures



ESI HD Strip 1' x 8'
(6) 32W FO32 T8 Lamps
High Power Ballast (1.18)
LDD: 1.12
UPS: 1.37 watts/sq.foot
Illuminance: **73.4fc***

HID Layout: 60 Fixtures



HID High Bay Fixture
(1) 400W Metal Halide
LDD: 0.66
UPS: 2.79 watts/sq.foot
Illuminance: **80fc***

* Calculations made at 10,000hrs

Ordering Information

Part Number = Fixture Size + Reflector Material + # Lamps + Lamp Wattage + Voltage + Ballast Type + Options

(Example 18HDEA632277H = 1'x8' Heavy Duty Strip with an enhanced aluminum reflector, 6-32W lamps, 277 volts, and a high power ballast)

Size	Reflector	# Lamps	Lamp Watts	Voltage	Ballast
14HD - 1' x 4'	EA - Enhanced Alum	3	32	120	N - Normal
18HD - 1' x 8'	AA - Anodized Alum	6		277	H - High Ballast Factor
	WR - White Enamel				L - Low Ballast Factor

Ordering Guide and System Wattage

Starting	Ballast Factor	# Lamps	Prod Code	Description	Input Voltage		F32T8 Input Watts: Input Watts	F32T8 In Fixture: Open	F32T8 In Fixture: Enclosed	F32T8/WM Input Watts: Input Watts	F32T8/WM In Fixture: Open	F32T8/WM In Fixture: Enclosed	F28T8 UMX Input Watts	Units per Case
IS	L	1	49706	GE-132-MAX-L/Ultra	Multi-Volt	120	25	24	24	24	23	23	22	10
						277	25	24	24	24	23	23	22	
IS	L	2	49707	GE-232-MAX-L/Ultra	Multi-Volt	120	48	48	47	46	46	45	44	10
						277	48	48	47	46	46	45	44	
IS	L	3	49708	GE-332-MAX-L/Ultra	Multi-Volt	120	73	72	71	69	68	67	65	10
						277	72	71	70	68	67	66	65	
IS	L	4	49709	GE-432-MAX-L/Ultra	Multi-Volt	120	97	95	93	92	90	88	87	10
						277	96	93	92	91	89	87	86	
IS	N	1	49771	GE-132-MAX-N/Ultra	Multi-Volt	120	28	28	27	27	26	26	25	10
						277	28	28	27	27	26	26	25	
IS	N	2	49772	GE-232-MAX-N/Ultra	Multi-Volt	120	54	54	53	53	52	51	49	10
						277	53	53	52	52	51	50	48	
IS	N	3	49773	GE-332-MAX-N/Ultra	Multi-Volt	120	82	80	78	78	77	74	72	10
						277	80	78	77	77	75	73	71	
IS	N	4	49774	GE-432-MAX-N/Ultra	Multi-Volt	120	109	105	103	105	101	98	98	10
						277	107	103	101	103	99	97	96	
IS	N+	2	71421	GE-232MAX-N+	Multi-Volt	120	63			60			58	10
						277	62			59			57	10
IS	N+	3	71422	GE-332MAX-N+	Multi-Volt	120	91			87			83	10
						277	90			86			82	10
IS	N+	4	71423	GE-432MAX-N+	Multi-Volt	120	124			119			114	10
						277	121			117			112	10
IS	H	2	49775	GE-232-MAX-H/Ultra	Multi-Volt	120	74	71	69	71	[illegible]	[illegible]	[illegible]	[illegible]
						277	73	70	68	70	[illegible]	[illegible]	[illegible]	
IS	H	3	49776	GE-332-MAX-H/Ultra	Multi-Volt	120	111	105	102	106	[illegible]	[illegible]	[illegible]	[illegible]
						277	109	103	100	104	[illegible]	[illegible]	[illegible]	
IS	H	4	49777	GE-432-MAX-H/Ultra	Multi-Volt	120	151	TBD	TBD	145	[illegible]	[illegible]	[illegible]	[illegible]
						277	147	TBD	TBD	141	[illegible]	[illegible]	[illegible]	
							F96T8 Input Watts			F96T8/WM Input Watts			F96T8/WM+	
IS	N	1	49766	GE-159-MAX-N/Ultra	Multi-Volt	120	54	N/A	N/A	51	N/A	N/A	53	10
						277	53	N/A	N/A	51	N/A	N/A	52	
IS	N	2	49767	GE-259-MAX-N/Ultra	Multi-Volt	120	107	N/A	N/A	102	N/A	N/A	106	10
						277	105	N/A	N/A	100	N/A	N/A	104	

(2) 3 Lamp T8 Ballas
106x2
=212V

ULTRAMAX L *High-Efficiency Electronic Ballast*

The Low watt option for maximum energy savings. With a ballast factor of .77, the L line is the most energy efficient choice. It provides adequate illumination for most applications. For 1, 2, 3, and 4 T8 lamps in 2', 3', and 4' lengths.

ULTRAMAX N *High-Efficiency Electronic Ballast*

The Normal light option balances efficiency and illumination. The most-used type of ballast, the N line saves energy without sacrificing lumens. A ballast factor of .87 meets most application needs. For 1, 2, 3, and 4 T8 lamps in 2', 3', 4', and 8' lengths.

ULTRAMAX N+ *High-Efficiency Electronic Ballast*

The Normal-High light option at a 1.0 ballast factor is a perfect balance between efficiency and high light output. The N+ line is designed for high efficient high bay fixtures that use high reflectance materials to get more utilized light resulting in less watts needed. N+ also works perfectly when delamping standard F32T8 4 or 3 lamp N fixtures to 3 or 2 lamp High Lumen F32T8 N+ fixtures.

ULTRAMAX H *High-Efficiency Electronic Ballast*

The choice for High light output. With a ballast factor of 1.15, UltraMax® H delivers the most lumens for maximum light or when you want more savings using fewer lamps. This is the first high-efficiency high-light output line for 2, 3, and 4' T8 lamps.

Safety
- No PCBs
- UL Listed
  - -Class R Type 1
  - -Type CC
  - -Type HL (Hazardous Location)

Application Information
- Minimum Starting
  - -Temperature: 0°F, -18°C
- Maximum Ambient
  - -Temperature: 148° F, 70°C
- Sound Rated A
- Remote Mounting:
  - -18' maximum lead length,
  - -18 AWG
- High Frequency Lamp Operation: Above 60 kHz

Physical Parameters
(Except for the 4H model)
Length: 9.50 in.
Width: 1.70 in.
Height: 1.2 in.
Weight: 1.4 lbs.

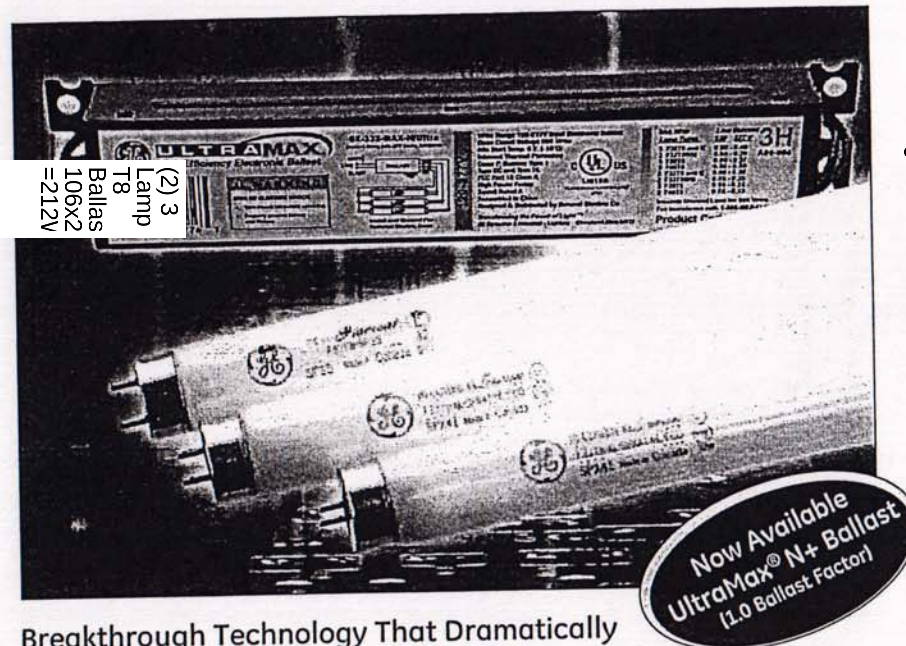
4H Model Parameters
Length: 9.50 in.
Width: 2.30 in.
Height: 1.60 in.
Weight: 2.16 lbs.

16233 06/2007 · Printed in USA

ULTRAMAX *High-Efficiency Electronic Ballast*

GE Consumer & Industrial
Lighting

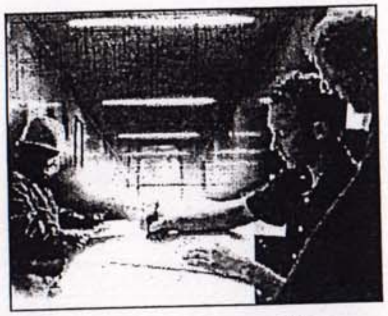
Instant Start Ballasts



Breakthrough Technology That Dramatically Improves Efficiency, Simplifies Installation and Delivers Optimal Lamp Performance

imagination at work

ULTRAMAX®
High-Efficiency Electronic Ballast



GE revolutionizes lighting again with new, breakthrough technology.

In the GE labs, our engineers have developed a breed of ballasts to make lighting systems that save more energy, are more adaptable, and deliver optimal lamp performance.

There's more to Ultra
M — Multi-Voltage Control
A — Arc-Guard Protection
X — Xtreme Efficiency

The innovative, patented technology in our UltraMax® electronic ballasts exceeds expectations.

120 → 277volts
MVC
Multi-Voltage Control

Multi-Voltage technology means single UltraMax® model handles voltage from 120 through 277.

UltraMax® Ballasts can virtually "read" the incoming voltage and adapt automatically to any voltage from 108V to 305V. The benefits of Multi-Voltage Control (MVC) are obvious:

- Fewer models handle more jobs. Eliminating inventory hassles
- MVC simplifies installation and eliminates guesswork at the job site.
- MVC compensates for incoming voltage fluctuations or variations from unreliable power.

GE's UltraMax® line is the only full line of T8 ballasts with a UL Type CC Anti-Arc Rating

UL Type CC Rating is a stringent designation of protection against arcing in electrical devices. GE's Arc-Guard design eliminates the damaging effects arcing can have on lamps, ballasts and sockets.

High efficiency delivers over 40% energy savings.

Ballasts are the new frontier of energy efficiency. Systems combining UltraMax® electronic ballasts and T8/WM lamps can deliver over 40% energy savings over standard electromagnetically ballasted T12 systems. Since energy costs are typically 80% of the overall cost of light, a more efficient system can pay for itself in a very short time and provide an excellent return on investment.

UltraMax® is ultra lamp friendly.

With an industry low lamp current crest factor (LCCF) of 1.4, UltraMax® ensures optimal lamp operation and maximum lamp life, which can save on lamp and maintenance costs and ensures GE's Ultra System limited warranty.

Active Current Regulation (ACR) technology is a patented advantage.

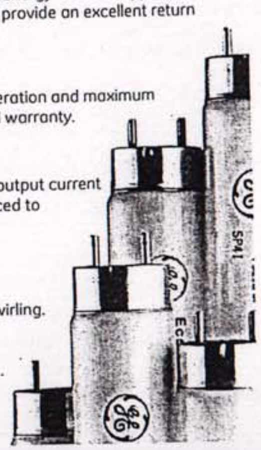
GE's UltraMax®'s patented ACR modular design means individual inverter modules regulate the output current to each lamp. So, unlike conventional ballasts, if one lamp fails, the remaining lamps are not forced to operate at a higher current. This ensures optimal lamp performance.

Anti-Striation Control for better light quality, with no striations.

UltraMax® is the only line of T8 ballasts with Anti-Striation Control. This advanced technology eliminates the maintenance issues caused by striating lamps, often referred to as spiraling or swirling. This provides a flicker- and worry-free environment.

Fully parallel independent lamp operation makes system easier to maintain

If one lamp fails, all the others in the system stay lit. That means system maintenance is easier to manage.



UltraMax® ballasts are *Ultra Cool.*

UltraMax®'s high efficiency design results in ultra-cool operation that can provide additional AC energy savings, especially during peak demand periods. Combine GE's Ultra ballasts with cool running fixtures to achieve maximum system performance in hot temperatures.
GE provides the Ultra Cool™ system certification with high grade fixture systems which means a 5 year 55C max ambient warranty.

A big idea in a small package.

The UltraMax® housing has a small, low profile and is lightweight. That can be a big help in retrofits. It also means future fixture designs can be more compact and streamlined.

Every unit is tested and proven before it's shipped.

GE does 100% burn-in on every UltraMax® ballast; using our extreme open/short test, which simulates undesirable and harsh-use situations, so you are assured of a system you can rely on right out of the box.

GE Six Sigma quality backed by a full 5-year ballast limited warranty.

UltraMax® ballasts are designed by GE's expert engineers and custom-manufactured to our exacting. Six Sigma specifications, all backed by a 5-year limited warranty. And, when used with GE T8 lamps you get our Ultra System limited warranty. (See gelighting.com system warranty page for details).

System Performance Comparisons

2-Lamp System Performance 4' Fluorescent (4-lamp performance approx 2x 2-lamp system)

		Electromagnetic E.S.	Standard - N	UltraMax - L	UltraMax - N	UltraMax N+	UltraMax - H
Watt-Miser T12CW	Watts:	74					
	BF:	0.9					
	Light:	100%					
	RLPW:	100%					
	LPW:	55					
F32T8 & F32T8/HL SPX	Watts:	69	58	48	53	62	73
	BF:	0.88	0.88	0.77	0.87	1.0	1.15
	Light:	120%	120%	105%	119%	136%	157%
	RLPW:	129%	153%	162%	166%	163%	159%
	LPW:	71	85	90	92	90	88
F32T8/WM SP	Watts:	Not Recommended	54	46	52	60	70
	BF:		0.88	0.77	0.87	1.0	1.15
	Light:		115%	100%	113%	130%	150%
	RLPW:		157%	161%	161%	161%	158%
	LPW:		87	90	90	89	88
F28T8/UMX UltraMax System SP	Watts:	Not Recommended	Not Recommended	44	48	56	65
	BF:			0.77	0.87	1.0	1.15
	Light:			97%	110%	126%	145%
	RLPW:			163%	169%	166%	165%
	LPW:			90	94	92	91

3-Lamp System Performance 4' Fluorescent

		Electromagnetic E.S.	Standard - N	UltraMax - L	UltraMax - N	UltraMax N+	UltraMax - H
Watt-Miser T12CW	Watts:	117					
	BF:	0.91					
	Light:	100%					
	RLPW:	100%					
	LPW:	53					
F32T8 & F32T8/HL SPX	Watts:	105	87	72	80	94	109
	BF:	0.88	0.88	0.77	0.87	1.0	1.15
	Light:	180%	119%	104%	117%	135%	155%
	RLPW:	127%	160%	169%	172%	168%	167%
	LPW:	70	85	90	91	89	89
F32T8/WM SP	Watts:	Not Recommended	81	68	77	90	104
	BF:		0.88	0.77	0.87	1.0	1.15
	Light:		113%	99%	112%	129%	148%
	RLPW:		164%	171%	170%	168%	167%
	LPW:		87	91	91	89	89
F28T8/UMX UltraMax System SP	Watts:	Not Recommended	Recommended	65	71	83	96
	BF:			0.77	0.87	1.0	1.15
	Light:			96%	108%	125%	143%
	RLPW:			173%	179%	176%	175%
	LPW			92	95	93	93

26668 – F32T8/SP41/ECO

GE Ecolux® Starcoat® T8

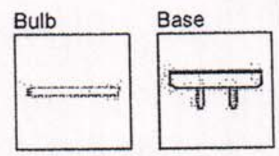
- Passes TCLP, which can lower disposal costs.

High Color Rendering
Meets Federal Minimum Efficiency Standards

PR

GENERAL CHARACTERISTICS

Lamp type	Linear Fluorescent - Straight Linear
Bulb	T8
Base	Medium Bi-Pin (G13)
Wattage	32
Voltage	137
Rated Life	20000 hrs
Rated Life (instant start) @ Time	20000 h @ 3 h 24000 h @ 12 h
Rated Life (rapid start) @ Time	24000 h @ 12 h
Bulb Material	Soda lime
Starting Temperature (MIN)	10
LEED-EB MR Credit	74 picograms Hg per mean lumen hour
Additional Info	TCLP compliant



View Larger

ADDITIONAL RESOURCES

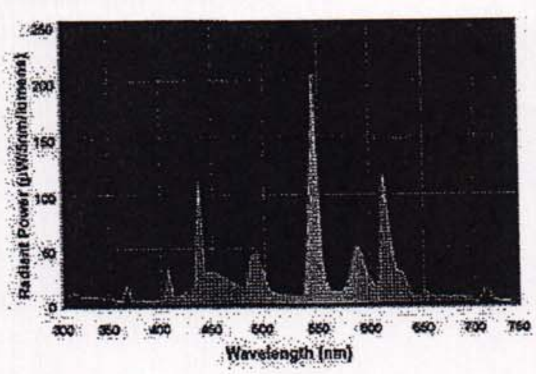
Catalogs
Testimonials
MSDS (Material Safety Data Sheets)
Disposal Policies & Recycling Information

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2800
Mean Lumens	2660
Nominal Initial Lumens per Watt	87
Color Temperature	4100 K
Color Rendering Index (CRI)	78
S/P Ratio (Scotopic/Photopic Ratio)	1.6

GRAPHS & CHARTS

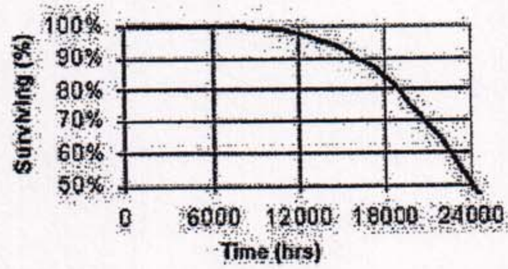
Spectral Power Distribution



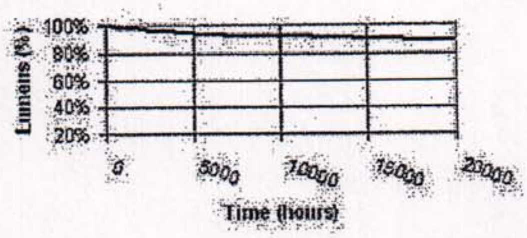
Lamp Mortality

ELECTRICAL CHARACTERISTICS

Open Circuit Voltage (rapid start) Min @ Temperature	315 V @ 10 °C
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
·athode Resistance Ratio - ·h/Rc (MAX)	6.5
·rrent Crest Factor (MAX)	1.7



Lumen Maintenance



DIMENSIONS

Maximum Overall Length (MOL)	47.7800
Minimum Overall Length	47.6700
Nominal Length	48
Bulb Diameter (DIA)	1
Bulb Diameter (DIA) (MIN)	0.940
Bulb Diameter (DIA) (MAX)	1.100
Max Base Face to Base Face (A)	47.220
Face to End of Opposing Pin (B) (MIN)	47.400
Face to End of Opposing Pin (B) (MAX)	47 1/2
End of Base Pin to End of Opposite Pin End (C)	47.670

PRODUCT INFORMATION

Product Code	26668
Description	F32T8/SP41/ECO
ANSI Code	1005-2
Standard Package	Case
Standard Package GTIN	10043168266687
Standard Package Quantity	36
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	36
UPC	043168266680

COMPATIBLE GE BALLASTS

Product Code	Description	# of Bulbs	Power Factor	Ballast Factor
80353	B132R120V5	1	90.0	0.88
80355	B232SR120V5	2	90.0	0.88
80362	B232SR277S50	2	90.0	0.88
80356	B232SR277V5	2		0.88
80357	B332SR120V5	3	90.0	0.88
80358	B332SR277V5	3	90.0	0.88
23680	GE-132-120-N	1	99.0	0.87
24161	GE-132-120-N-84T	1	99.0	0.87
23681	GE-132-277-N	1	99.0	0.87
24162	GE-132-277-N-84T	1	99.0	0.87
72258	GE132MAX-L/ULTRA	1	99.0	0.77
72259	GE132MAX-N/ULTRA	1	99.0	0.87
72269	GE-132-MV-N	1	99.0	0.87
72270	GE-132-MV-N-42T	1	99.0	0.87

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

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

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

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

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

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

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

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											
Industry		kWh Savings Multiplier	1.00	1.00	1.00			1.00	1.00	1.00	0.88	0.60	0.60
Industry	16/5	kW Savings Multiplier				1.17	1.17						
Industry	16/5	kWh Savings Multiplier				1.06	1.06						
Industry	24/7	kW Savings Multiplier				1.17	1.17						
Industry	24/7	kWh Savings Multiplier				1.85	1.85						
Industry	8/5	kW Savings Multiplier				1.17	1.17						
Industry	8/5	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
Medical		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
Miscellaneous		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
Office		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
Restaurant		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
Retail / Service		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
School		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
Warehouse		kWh Savings Multiplier	1.00	1.00	1.00			1.00	1.00	1.00	0.94	0.79	0.79
Warehouse	16/5	kW Savings Multiplier				1.00	1.00						
Warehouse	16/5	kWh Savings Multiplier				1.08	1.08						
Warehouse	24/7	kW Savings Multiplier				1.00	1.00						
Warehouse	24/7	kWh Savings Multiplier				1.89	1.89						
Warehouse	8/5	kW Savings Multiplier				1.00	1.00						
Warehouse	8/5	kWh Savings Multiplier				0.45	0.45						
Other		kW Savings Multiplier								1.00			
Other		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 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 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 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
≥ 2,900 Mean Lumens</td></tr>
<tr><th colspan="5">Performance Characteristics for Ballasts</th></tr>
<tr><td rowspan="11">Ballast Efficacy Factor (BEF)

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>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 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. 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 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 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 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 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 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.

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[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 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 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 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 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 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 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 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 $47
Effective Useful Life	Source: DEER 2008 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 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 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 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 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.

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

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

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 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" $975
Effective Useful Life	Source: DEER 2008 (same as occupancy sensors) 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:

ΔWatts/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] = (∆Watts/unit) x (hours/day)x(days/year) / 1,000 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:

$\underline{\Delta \text{Watts/unit}}$ = 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 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 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 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 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.

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 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 Traffic Signal: 6 Years 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 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 15 years

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

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

Table 158: Program Qualifying Efficiencies

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

Measure Savings

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

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

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

Measure Savings Analysis

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

Table 1: Demand Savings and Efficiency Assumptions

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

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

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

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

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

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

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

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

[37] Tier 1 is 14 SEER

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

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

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

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

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

Table 161: Package Units Incremental Measure Cost[38]

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

[38] 2008 DEER, www.deeresources.com

Water-Cooled Chillers and Air-Cooled Chillers

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

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

Table 163: Efficiency Levels for Chillers

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

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

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

Table 164: Measure Savings for Chillers

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

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

1) Air handler units were assumed to be Variable Air Volume (VAV) systems with hot water reheat.
2) VAV units include economizers and supply temperature reset controls based on outside air.
3) Condenser water temperature was set to 75° F.
4) All chillers for pre and post cases were assumed to be constant speed.
5) All measure cases assumed the same type of chiller (screw, centrifugal, etc.) pre and post.

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

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

Table 165: Chiller Incremental Measure Cost[40]

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

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

Room Air Conditioners

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

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

Table 167: Qualifying Efficiencies

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

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

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

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

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

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

∆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 $84/ton
Effective Useful Life	Source: DEER 15 years

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

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

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

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

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

Table 172: PTAC/HP Efficiencies

PTAC size	Federal standard	IECC 2006	Qualifying EER

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

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

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

Coincident kW Savings = kW Savings x Coincidence Factor

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

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

Lodging – Guest Room Energy Management System (GREM)

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

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

Variable-Speed Drives for HVAC Applications

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

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

Measure Savings

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

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

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

Table 176: VSD for HVAC Motors (Per HP)

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

Measure Savings Analysis

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

kW reduction = 0.19 x (kW of existing equipment)

Where kW of equipment is calculated using:

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

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

Coincident kW reduction = kW reduction x coincidence factor

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

Annual kWh Savings = kW Savings x Run Hours

Table 177: Chiller Annual Operating Hours

Chillers
3431

Table 178: Pump and Fan Annual Operating Hours

Pumps and Fans
4103

Measure Life and Incremental Measure Cost
The measure life for packaged units is 15 years according to DEER[48].

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

[47] This percentage is a conservative estimate. DEER on average calculated over 30% savings for installing a VSD.
[48] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report

Commercial Kitchen Demand Ventilation Controls

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

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

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

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

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

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

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

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

Table 181: Measure Life and Incremental Measure Cost

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

Premium Motors

NEMA® Premium-Efficiency Motors

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

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

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

Table 183: Measure Coincident kW Savings

	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 $7.77
Effective Useful Life	Source: SCE 4 years

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

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

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

The following tables are values calculated within the SCE workpaper.

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

Table 190: SCE Restaurant Savings

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

Table 191: SCE Small Grocery Savings

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

Table 192: SCE Medium and Large Grocery Savings

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

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

Table 193: Strip Curtain Savings Summary

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

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

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

Table 194: Measure Life and Incremental Measure Cost

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

Anti-Sweat Heater Controls

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

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

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

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

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

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

Table 196: ASH Control Savings

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

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

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

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

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

Table 197: Measure Life and Incremental Measure Cost

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

Electronically Commutated Motors (ECM)

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

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

Measure Savings [58]
Savings values are obtained from the SCE workpaper for efficient evaporator fan motors, which covers all 16 California climate zones. SCE savings values were determined using a set of assumed conditions for restaurants and grocery stores. We have used only PG&E climate zones in calculating our averages and have taken out the drier, warmer climates of southern California.

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

Table 199 SCE Restaurant Savings Walk-In

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

	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 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. This measure is not applicable if any of the following conditions apply: 1) The compressor runs all the time with high duty cycle 2) The evaporator fan does not run at full speed all the time 3) The evaporator fan motor runs on poly-phase power 4) The evaporator fan motor is not shaded-pole or permanent split capacitor 5) Evaporator does not use off-cycle or time-off defrost.
Units	Per Motor
Base Case Description	Cooler with continuously running evaporator fan.
Measure Savings	Source: DEER
Measure Incremental Cost	Source: DEER $291
Effective Useful Life	Source: DEER 16 years

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

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

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

Measure Savings [61]

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

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

Table 208: Evaporative Fan Control Savings

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

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

Measure Life and Incremental Measure Cost

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

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

Table 209: Measure Life and Incremental Measure Cost

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

Automatic Door Closer for Walk-In Coolers

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

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

Measure Savings

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

Measure Life and Incremental Measure Cost

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

Table 211: Measure Life and Incremental Measure Cost

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

Automatic Door Closer for Walk-in Freezers

Table 212: Automatic Door Closer for Walk-in Freezers	
Measure Description	This measure is for installing an auto-closer to the main insulated opaque door(s) of a walk-in freezer. The auto-closer must firmly close the door when it is within 1 inch of full closure.
Units	Per closer
Base Case Description	No auto door closer or non-operational door closer
Measure Savings	Source: PGECOREF110.1 – Auto-Closers for Main Cooler or Freezer Doors
Measure Incremental Cost	Source: DEER 2008 $156.82
Effective Useful Life	Source: DEER 2008 8 years

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

Measure Savings

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

Measure Life and Incremental Measure Cost

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

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

Table 213: Measure Life and Incremental Measure Cost

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

Door Gaskets

Table 214: Door Gaskets	
Measure Description	This measure consists of the replacement of weak, worn out refrigeration door gaskets with new, better fitting gaskets.
Units	Per linear feet of gasket
Base Case Description	Non-sealing leaking gasket
Measure Savings	Source: NCPA 2009 – Refrigerated Door Gasket Replacement Energy Savings – Keep Your Cool Program, SCE WPSCNRRN0001.1, SCE WPSCNRRN0004.1
Measure Incremental Cost	Source: DEER 2008 $9.61
Effective Useful Life	Source: DEER 2008 4 years

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

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

Measure Savings

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

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

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

Measure Life and Incremental Measure Cost

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

Table 215: Measure Life and Incremental Measure Cost

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

LED Refrigerated Case Lighting

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

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

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

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

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

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

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

Measure Life and Incremental Measure Cost

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

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

Table 218: Measure Life and Incremental Measure Cost

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

Beverage Machine Controls

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

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

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

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

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[62] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures
[63] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures
[64] 2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report - Residential and Commercial Non-Weather Sensitive Measures

Snack Machine Controls

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

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

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

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

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

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

ENERGY STAR Refrigerated Beverage Vending Machine

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

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

Measure Savings [67]
Beverage machine savings are taken from the ENERGY STAR savings calculator and summarized in the following table. ENERGY STAR provides savings numbers for machines with and without control software. The average savings are calculated here. It is assumed that controls are only effective during off-peak hours and so have no peak-kW savings.

Table 222: ENERGY STAR Vending Machine Savings

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

Measure Life and Incremental Measure Cost

The measure life is 14 years according to ENERGY STAR.

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

High-Efficiency Icemakers

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

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

Measure Savings [70]
Savings values are obtained from the PG&E workpaper for the food service sector. Annual operating hours are assumed to be 8,760.

Table 224: Ice Maker Savings (per unit)

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

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

> 1,500	0.638	5585

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

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

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

Table 225: Baseline Ice Harvest Rate

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

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

Table 226: Qualifying Icemakers

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

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

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

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

Table 227: Ice Maker Incremental Measure Cost

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

Food Service

ENERGY STAR® Steam Cooker

Table 228: ENERGY STAR® Steam Cooker	
Measure Description	This measure consists of the replacement of a conventional Steam Cooker unit with an ENERGY STAR rated unit.
Units	Per cooker
Base Case Description	Conventional, non ENERGY STAR unit
Measure Savings	Source: ENERGY STAR
Measure Incremental Cost	Source: 2009 PG&E Workpaper – PGECOFST104.1 – Commercial Steam Cooker – Electric and Gas $2,490
Effective Useful Life	Source: ENERGY STAR 12 years

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

Table 229. ENERGY STAR Steam Cooker Standards

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

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

6-pan and larger	50%	800

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

Measure Savings

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

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

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

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

Table 230: Steam Cooker Variable Assumptions[72]

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

[72] ENERGY STAR Commercial Steam Cooker Calculator

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

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

Measure Life and Incremental Measure Cost

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

Table 231: Measure Life and Incremental Measure Cost

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

ENERGY STAR® Combination Oven

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

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

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

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

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

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

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

Table 233: Combination Oven Variable Assumptions[75]

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

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

Measure Life and Incremental Measure Cost

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

Table 234: Measure Life and Incremental Measure Cost

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

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

ENERGY STAR® Hot Food Holding Cabinet

Table 235 ENERGY STAR® Hot Food Holding Cabinet	
Measure Description	This measure consists of the replacement of a conventional Hot Food Holding Cabinet unit with an ENERGY STAR rated unit.
Units	Per cabinet
Base Case Description	Conventional, non ENERGY STAR unit
Measure Savings	Source: ENERGY STAR
Measure Incremental Cost	Source: PG&E Full Size: $1,891 Three-Quarter Size: $1,497 Half Size: $707
Effective Useful Life	Source: DEER 2008 12 years

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

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

Table 236. Cabinet Size Assumptions[76]

Size	Internal volume	Average volume for calculations

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

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

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

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

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

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

Table 237: Hot Holding Cabinet Savings by Size

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

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

Table 238: Incremental Measure Cost

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

ENERGY STAR® Solid Door Reach-In Freezer

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

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

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

Product Volume, cubic feet	Freezer
0 < V < 15	≤ 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 $804.75
Effective Useful Life	Source: DEER 2008 12 years

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

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

Product Volume, cubic feet	Freezer
0 < V < 15	≤ 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 $99
Effective Useful Life	Source: Michigan CI Technologies Workpaper FES-I1 15 years

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

Measure Savings

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

Measure Life and Incremental Measure Cost

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

Table 246: Measure Life and Incremental Measure Cost

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

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

Variable-Speed Drives for Compressed Air

Table 247 Variable-Speed Drives for Compressed Air	
Measure Description	Only new oil-flooded rotary screw and rotary vane compressors are eligible. Only single compressor systems are eligible. Only compressors operating at 145 psi or below are eligible. Primary storage required on all system projects. Compressors must operate a minimum of 1,500 hours annually to be eligible for an incentive.
Units	Per HP
Base Case Description	No VSD installed.
Measure Savings	Source: KEMA
Measure Incremental Cost	Source: DEER and KEMA
Effective Useful Life	Source: DEER 15 years

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

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

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

kW	kWh per year
0.129	393

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

Measure Savings Analysis

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

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

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].

[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			