Tools and Tips for Estimating Energy Efficiency – Workshop

Customer Energy Savings Calculations Reference Guide

Presented by:
San Diego Gas & Electric

Location:
Energy Innovation Center
4760 Clairemont Mesa Blvd.
San Diego, CA 92117

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Customer Programs Reference Guide
Sempra Energy Utilities

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Program Overview

Purpose

…of this reference guide is to provide guidelines and understanding and aid in maneuvering through the customized incentive process.

This is the new *Tools and Tips for Estimating Energy Efficiency* reference guide. The guide will assist in the process and explanation of Rebates & Incentives for your business. We are excited about the new design and hope that you will find new areas that provide savings for your business.

> This reference guide will work hand-in-hand with information provided by the Customer Programs Energy Efficiency Engineer staff and resources found on www.sdge.com

The course will cover the following topics:

- Understanding the program
- Describing Tools & Calculators
- Verify Energy Calculations
- Review California Public Utility Commission (CPUC) Requirements
- Program Compliance
- Consolidate Documentation
- Approve Cash Incentives

In addition, the course will help to understand how a business can reduce demand, save energy, and conserve resources.

Preferred Calculation Tools

Customers submitting customized projects are asked to use the list of preferred tools when applicable. The tools listed have been reviewed by San Diego Gas & Electric's engineering groups for satisfactory use in calculating customized project savings.

While the tools listed have been reviewed, none of them are endorsed by any of the IOUs or its engineering groups. Uses of these tools are NOT mandatory. However, they are recommended to help improve accuracy and shorten review time. Project savings calculated by these tools are not pre-approved. Projects will need to be reviewed and approved by San Diego Gas & Electric to ensure inputs are appropriate and consistent with the project scope, and that all documentation is available.

The table below includes a list of preferred calculation tools.

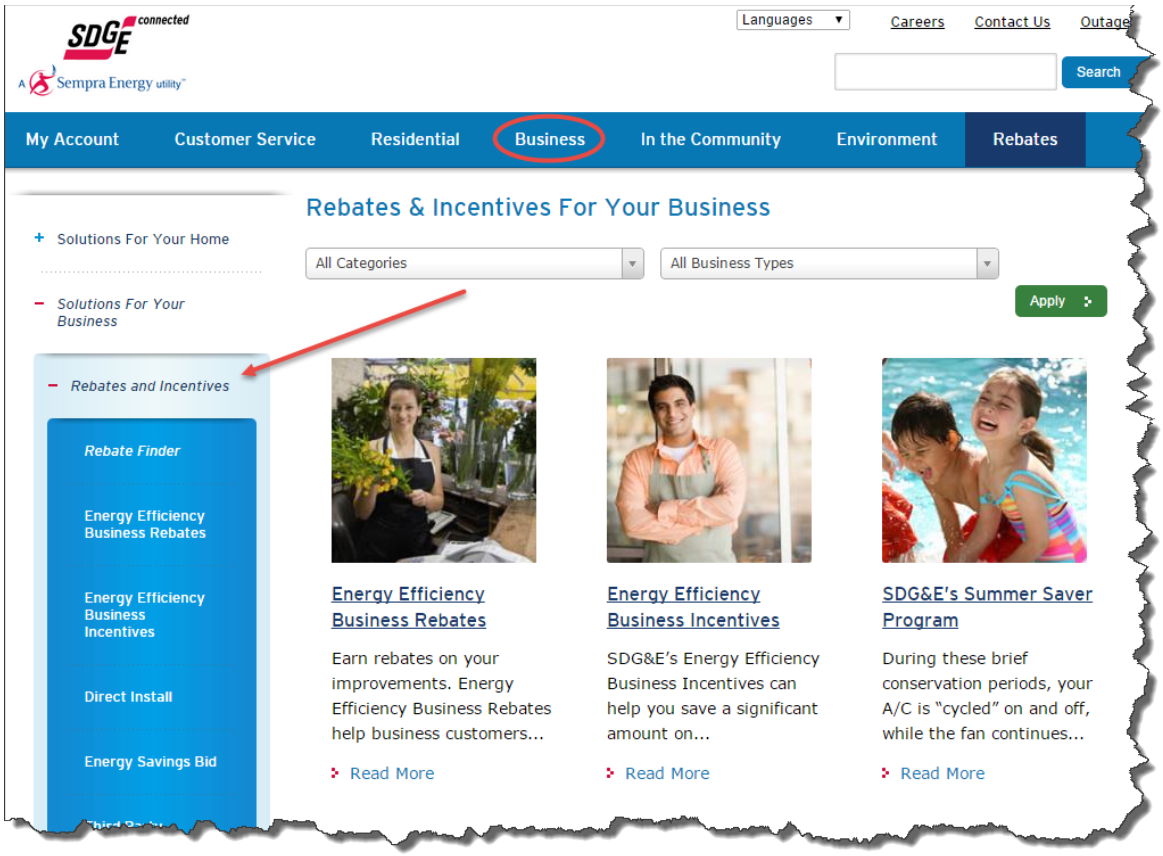
Preferred Tool List

Calculation Tool	Category	Notes/Applications
AirMaster	Preferred	Air Compressor Systems
DOE2.2R	Preferred	Refrigeration measures
EnergyPro	Preferred	Residential & Non-Residential Retrofits/New Construction
eQuest	Preferred	Residential & Non-Residential Retrofits/New Construction
IDSM Online Application Tool	Preferred	Non-Residential Retrofits & Industrial Processes
LPD Calculator	Preferred	Non-Residential Lighting Retrofits (Title 24 Covered Buildings)
Motor Master	Preferred	Motors Replacements
Sim Calc2	Preferred	Non-Residential New Construction – System Approach
TRACE 700	Preferred	Non-Residential Retrofits

Note: This list will routinely be updated for new versions, software phase out (i.e. SDG&E moving to Online Application), and stakeholder recommendations on new methodologies.

Note 2: Newest Version should be used at all times, Inter-version (e.g. 1.2.1 vs. 1.2.3) are okay, only if changes do not impact calculation method in a significant way (i.e. savings significantly different from previous version).

To begin please locate the applicable industry using the list of businesses types the utility provides rebates and incentives. It is helpful to become familiar with the guidelines necessary for the type of improvements being performed. Locate your rebate and/or incentive at http://www.sdge.com/rebates-finder/business



Energy Efficiency Business Rebates

Earn rebates on your improvements. Energy Efficiency Business Rebates help business customers...

Read More

SDG&E's Energy Efficiency Business Incentives can help you save a significant amount on your energy bill. Earn cash incentives based on the amount of energy you save when you retrofit existing equipment or install new high-efficiency equipment.

The more you save, the more you earn

Benefit from cash incentives for retrofitting existing or installing new high-efficiency equipment to save energy. Your incentive amount is driven by the amount of energy the project saves. The more you save, the more you earn — up to 50 percent of your project cost, or 100 percent of the allowable incentive amount. In addition to the incentive, eligible participants can now receive a comprehensiveness bonus.

Energy Efficiency Business Incentives

Learn more about Energy Efficiency Business Incentives here.

Read More

Process

The Statewide Customized Retrofit Offering ("Offering") provides financial incentives for non-residential customers to install new, high-efficiency equipment or systems, otherwise referred to as measures.

Measures must exceed applicable code and/or industry minimum efficiency standards to qualify and must operate and produce verifiable energy savings for at least five years. Applicable projects may consist of the retrofit of existing equipment/systems or the installation of equipment associated with new or added load.

Incentives are paid based on kWh, peak kW, and/or therms saved by the installation of the new equipment or system per calculations or Measurement & Verification (M&V) compared to baseline energy performance. Baselines are determined by *measure classification*, which may vary from the actual energy use of the existing equipment. Incentives for peak demand reduction (peak kW) are paid on the peak demand permanently reduced as a result of the project which may vary from total demand savings.

Typical Process Steps

Customer / Project Sponsor		Utility Administrator		Project Sponsor	Utility Administrator	
1. Review Offerings	2. Application Submission	3. Application Review	4. Application Approval	5. Project Installation	6. Installation Review	7. Incentive Payment

Project Sponsor/Authorized Agent is required to follow a multi-step application process using forms specific to the Customized Retrofit Offering. The forms are submitted to the Utility Administrator for review and approval prior to beginning project work, which includes demolishing, purchasing or installing equipment. Pre and post-inspections in the review phases will be required. The Utility Administrator will work closely with the Project Sponsor/Authorized Agent to facilitate the review and payment process.

Participation in the Offering is entirely voluntary. Applicants incur all costs associated with preparing an application, installing equipment, conducting measurement and verification activities, and otherwise reviewing or executing the Offering agreement. In return, Customers (or otherwise indicated payee) receive cash payments and acquire high-efficiency equipment that will help lower energy costs and reduce energy consumption.

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Lighting

Custom Lighting Calculations

To begin, the custom energy savings calculations for lighting, each participant should become familiar with the necessary websites and have an understanding of the lighting programs. The Energy Efficiency Business Incentive (EEBI) is the program.

Lighting tables are located on the company website www.sdge.com/eebi
Approved lighting fixture and LEDs must be on Appendix E and Appendix F
Located at the bottom of the site under additional resources

http://www.sdge.com/rebates-finder/save-energy-earn-incentives

Approved fluorescent lamps and ballast must be on the Consortium for Energy Efficiency (CEE) website:

http://www.cee1.org

Title 24, 2013 and Lighting

The California Public Utility Commission has mandated utilities to calculate current Title 24 code as existing base-case.

Title 24 indoor lighting is the allowed lighting power the 2013 building energy efficiency standard also known as the allowed lighting power which is in Watts

The 2013 Title 24 update is the *new* mandatory code lighting control

- Automatic daylighting control is in primary day light zones
- Hotel/Motel guestrooms captive card, occupancy sensing lighting controls, and occupancy sensing receptacles
- Automatic lighting controls for multi-family and hotel/motel corridors
- Occupancy sensors in warehouses, libraries, offices, classrooms, conference rooms, and multipurpose rooms
- Occupancy sensor lighting in parking garage spaces and outdoor luminaires < 24 feet must have motion sensors to reduce light levels

Lighting Power Density (LPD) and Dual Baseline

Lighting Power Density (LPD) is the lighting power requirement defined by the American National Standards Institute (ANSI), American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), and the Illuminating Engineering Society of North America (IESNA) lighting subcommittee.

Lighting Power Density technically represents the load of any lighting equipment in any defined area, or the watts per square foot of the lighting equipment. However, in the lighting industry it is often associated with the lighting power allowance (LPA) permitted by the building energy code.

The lighting table will calculate LPD and dual baseline.

First baseline is calculated by the lighting audit. It calculates the actual lighting power.

Second baseline and LPD is automatically calculated. Title 24 maximum allowed lighting power LPD using the formula below

$$LPD = \frac{Watts}{Sq.FT}$$

Calculating LPD – Data Collection

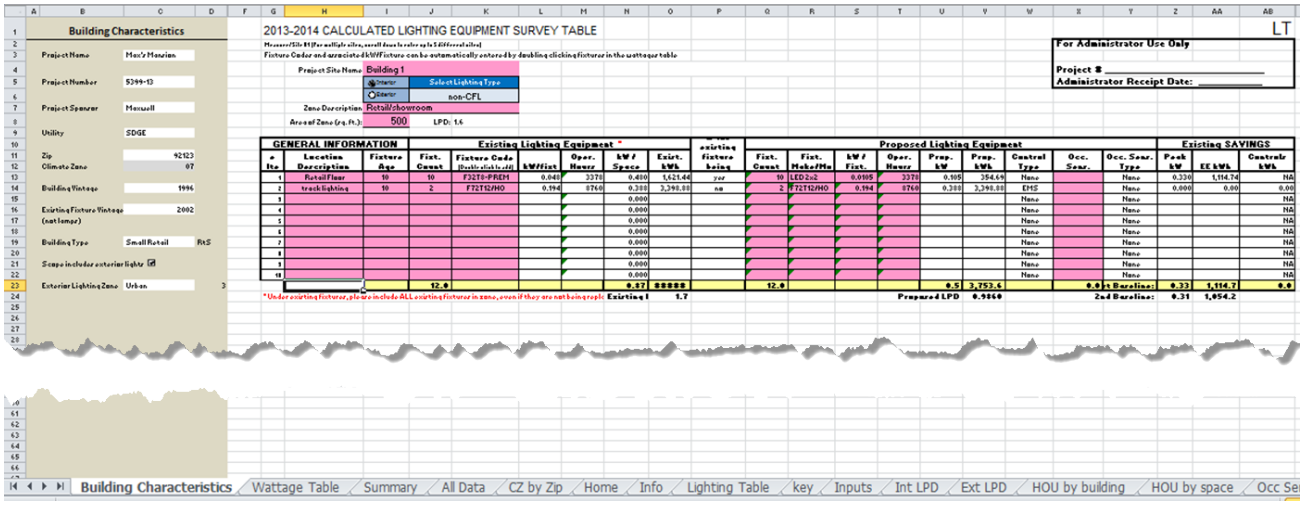
Step 1:
Collecting wattage and an item count for all permanent ceiling, wall lighting, and floor mounted lighting in each zone.

Note: *Decorative, task and egress lighting is not included.*

Step 2:
Collect square footage for space or building.

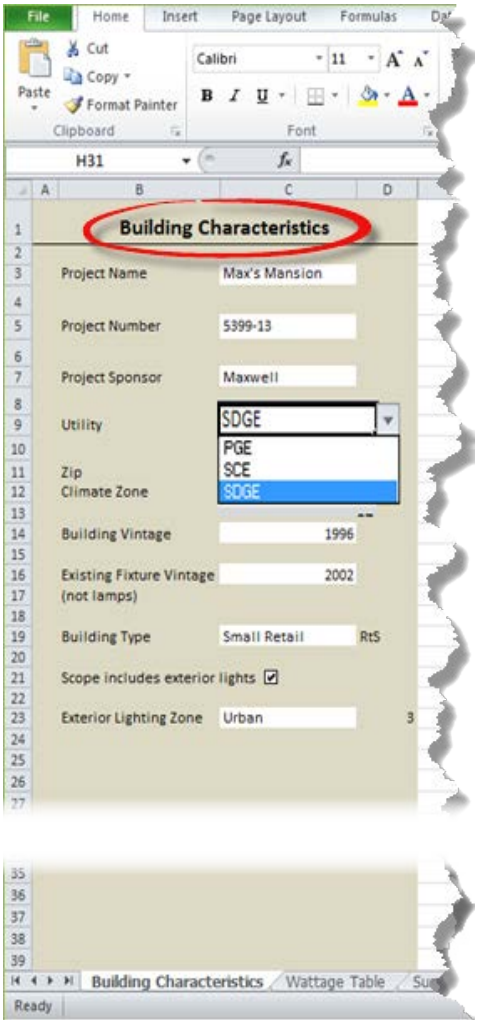
Note: *If existing LPD is lower than current code LPD then the first baseline and second baseline are the same.*

Lighting Table



Picture 1

The new Customer Energy Savings Calculation spreadsheet has been designed to simplify the process when capturing the necessary details for a project.



Building Characteristics

The input section on the left-hand side of the spreadsheet captures the building's characteristics. See Picture 2

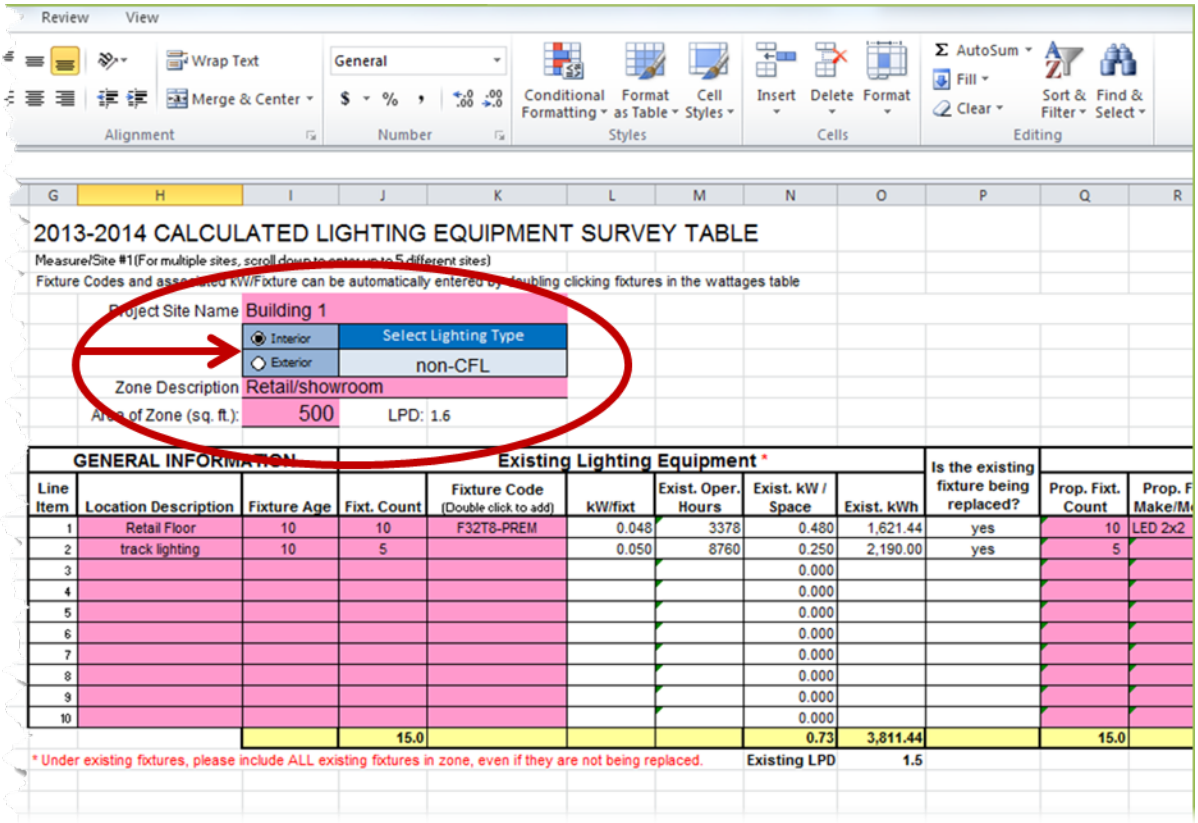
First Step: requires identifying the features of the project.

Enter characteristics for the building

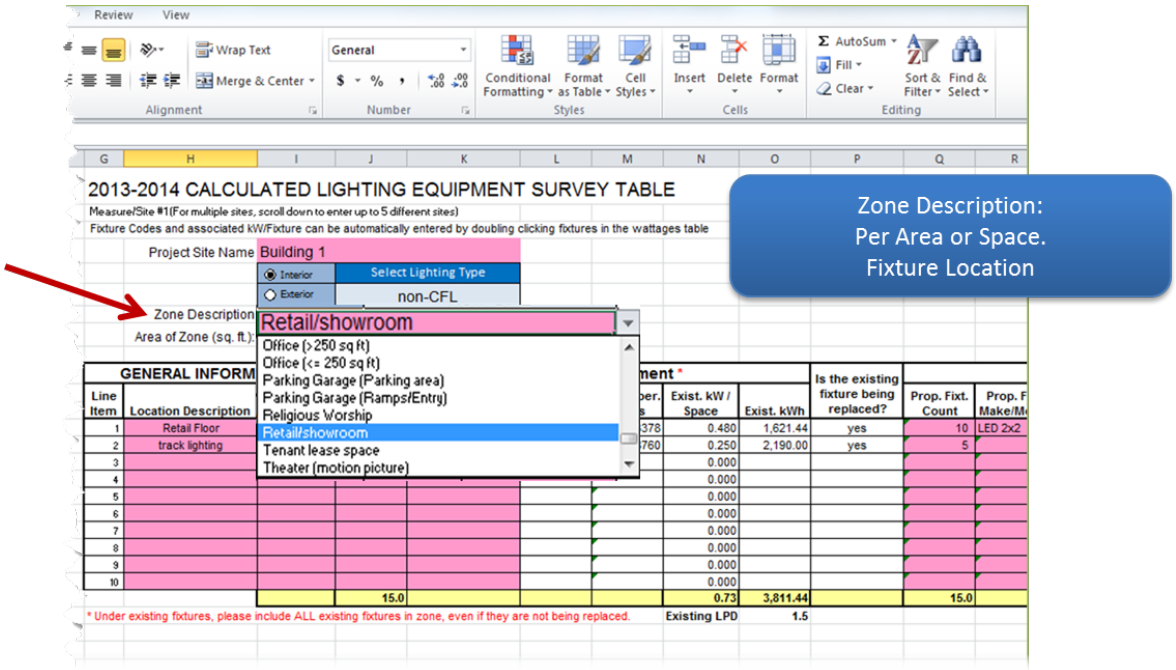
- Project name
- Project number assigned (leave blank if unknown)
- Project Sponsor
- Utility
- Zip code
- Climate Zone
- Building Vintage
- Existing fixture vintage
- Building type.
- Exterior Lighting Zone

Additionally, if the scope of work includes exterior lights, the box must be checked. Picture 2

Second Step: identify the fixtures as interior or exterior

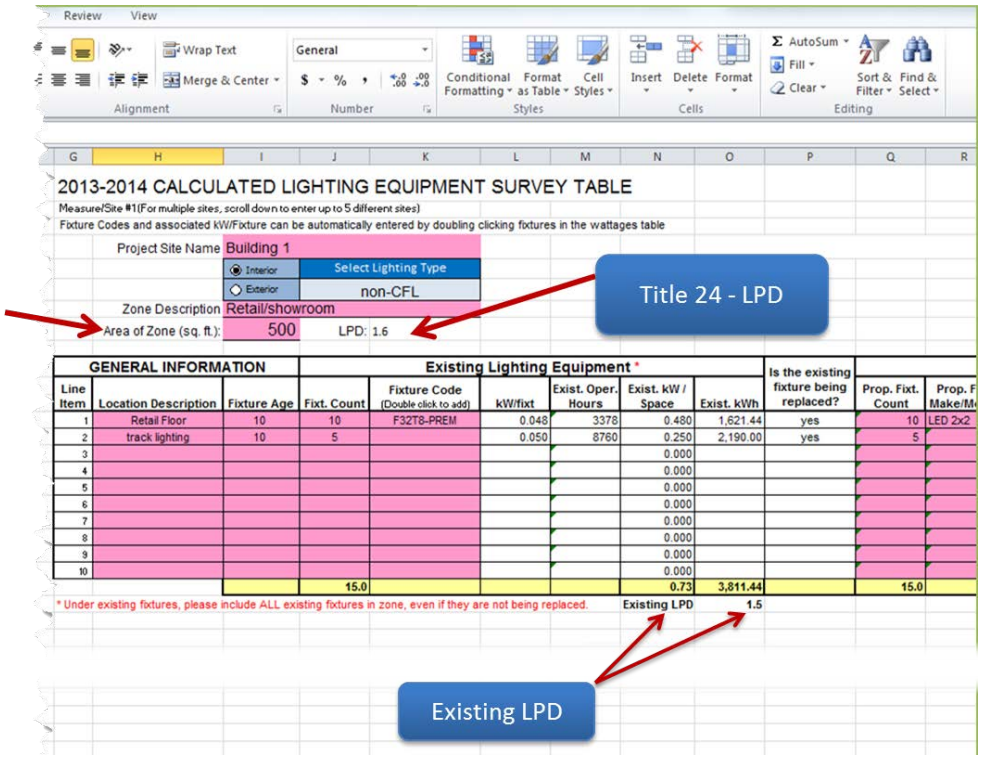


Third Step: Select Zone Description from dropdown menu



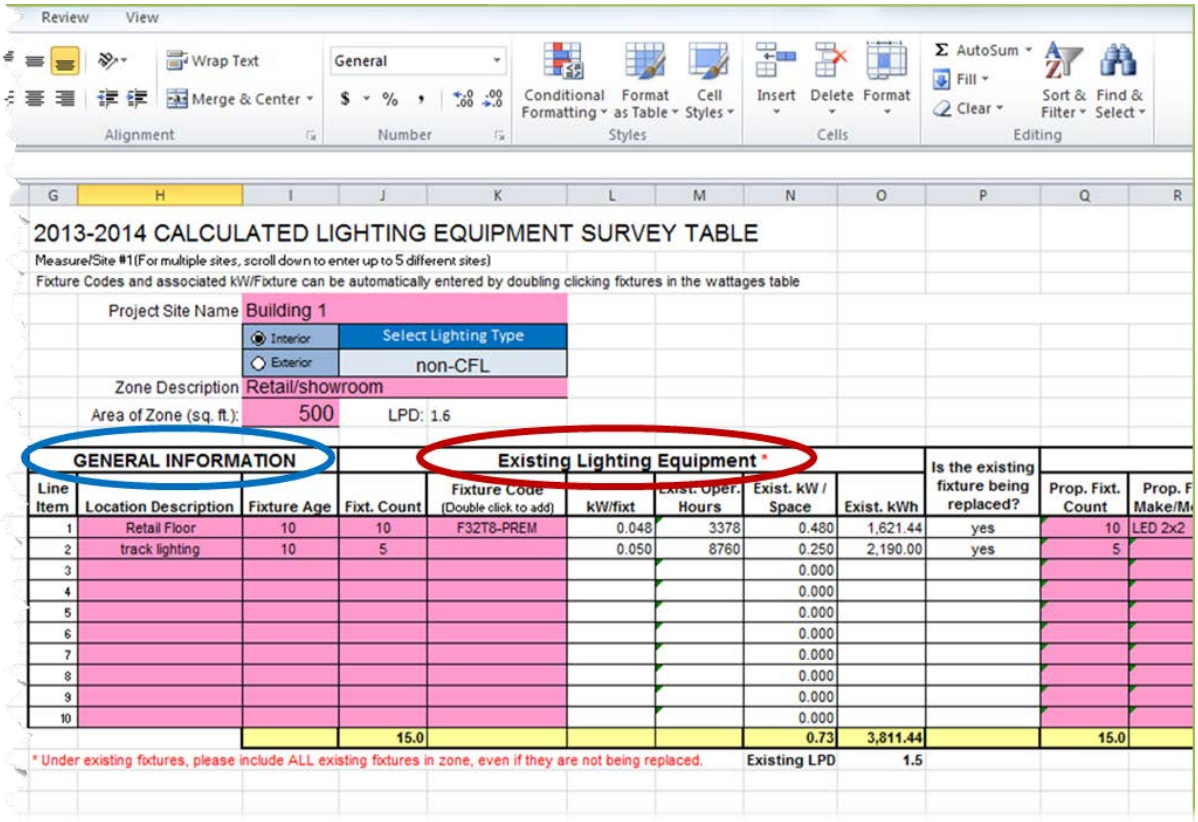
Fourth Step: enter square feet in Area of Zone

Note: *sq. ft. need to be accurate to calculate LPD.*



This information will calculate the Title 24 LPD and compare it to the existing LPD.

To correlate the existing LPD, the details can be viewed on the table.



2013-2014 CALCULATED LIGHTING EQUIPMENT SURVEY TABLE

Measure/Site #1 (For multiple sites, scroll down to enter up to 5 different sites)

Fixture Codes and associated kW/Fixture can be automatically entered by doubling clicking fixtures in the wattages table

Project Site Name: Building 1

Interior / Exterior: Interior — Select Lighting Type: non-CFL

Zone Description: Retail/showroom

Area of Zone (sq. ft.): 500 LPD: 1.6

GENERAL INFORMATION			Existing Lighting Equipment *						Is the existing fixture being replaced?		
Line Item	Location Description	Fixture Age	Fixt. Count	Fixture Code (Double click to add)	kW/fixt	Exist. Oper. Hours	Exist. kW / Space	Exist. kWh		Prop. Fixt. Count	Prop. F Make/M
1	Retail Floor	10	10	F32T8-PREM	0.048	3378	0.480	1,621.44	yes	10	LED 2x2
2	track lighting	10	5		0.050	8760	0.250	2,190.00	yes	5	
3							0.000				
4							0.000				
5							0.000				
6							0.000				
7							0.000				
8							0.000				
9							0.000				
10							0.000				
			15.0				0.73	3,811.44		15.0	

* Under existing fixtures, please include ALL existing fixtures in zone, even if they are not being replaced. Existing LPD 1.5

General information – will detail:

- Location description
- Fixture age

Existing lighting equipment – will detail:

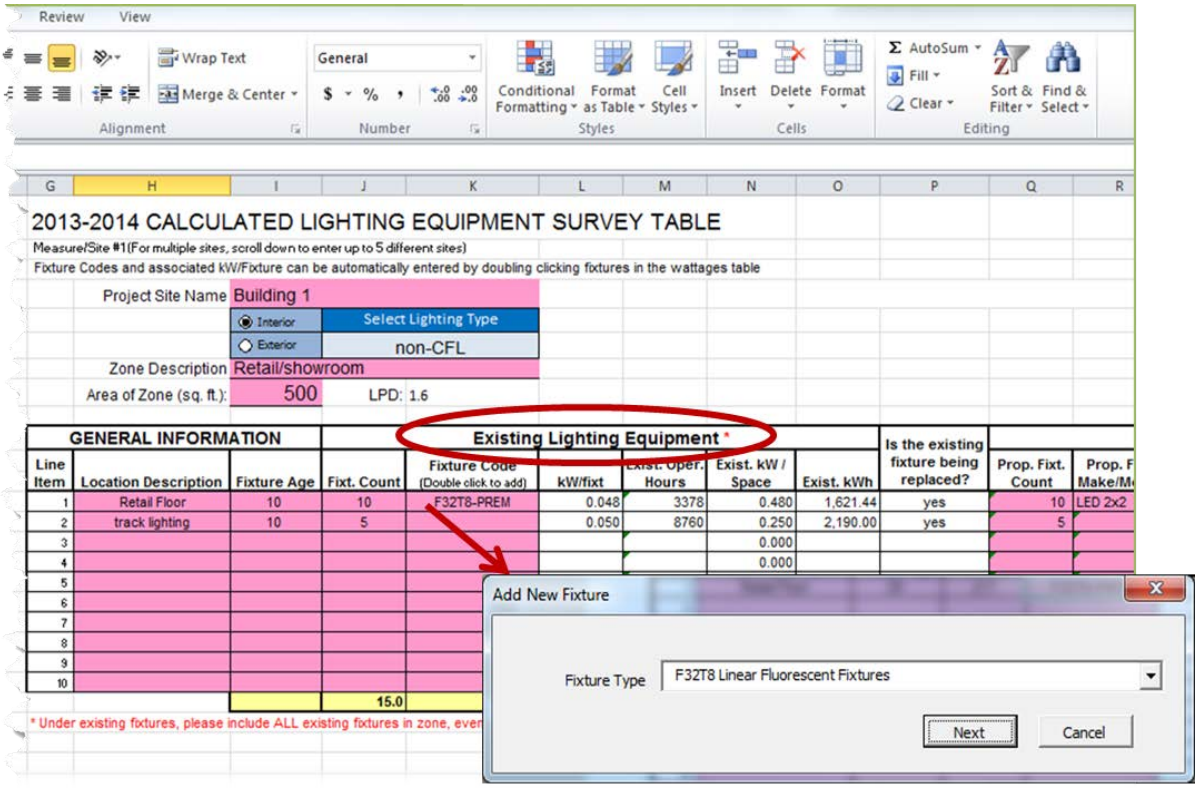
- Fixture count
- Fixture code

Existing Lighting Equipment

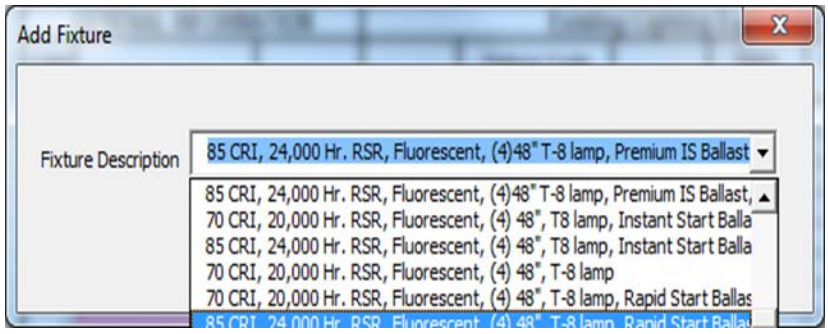
Step Five: Enter existing lighting equipment into table.

A window will appear with a drop-down where you can identify what type of existing fixture.

***Note:** Under existing lighting equipment please include all existing fixtures in zone even if they are not being replaced.*



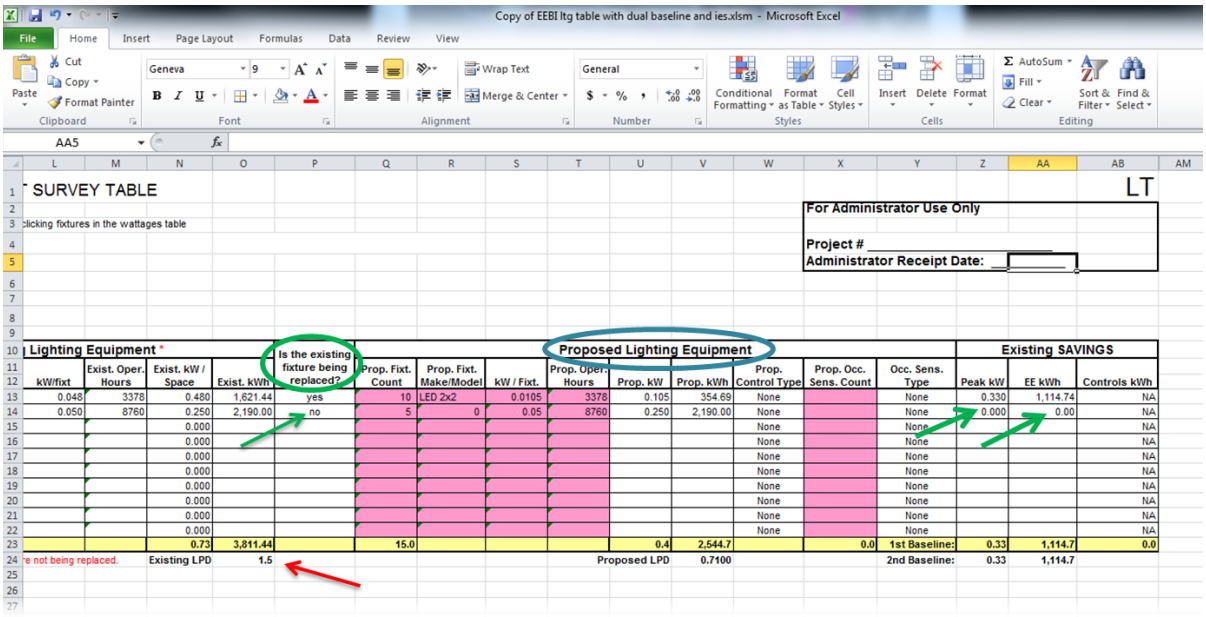
Highlight fixture to be added from drop-down then click Next.



Proposed Lighting Equipment – will detail:

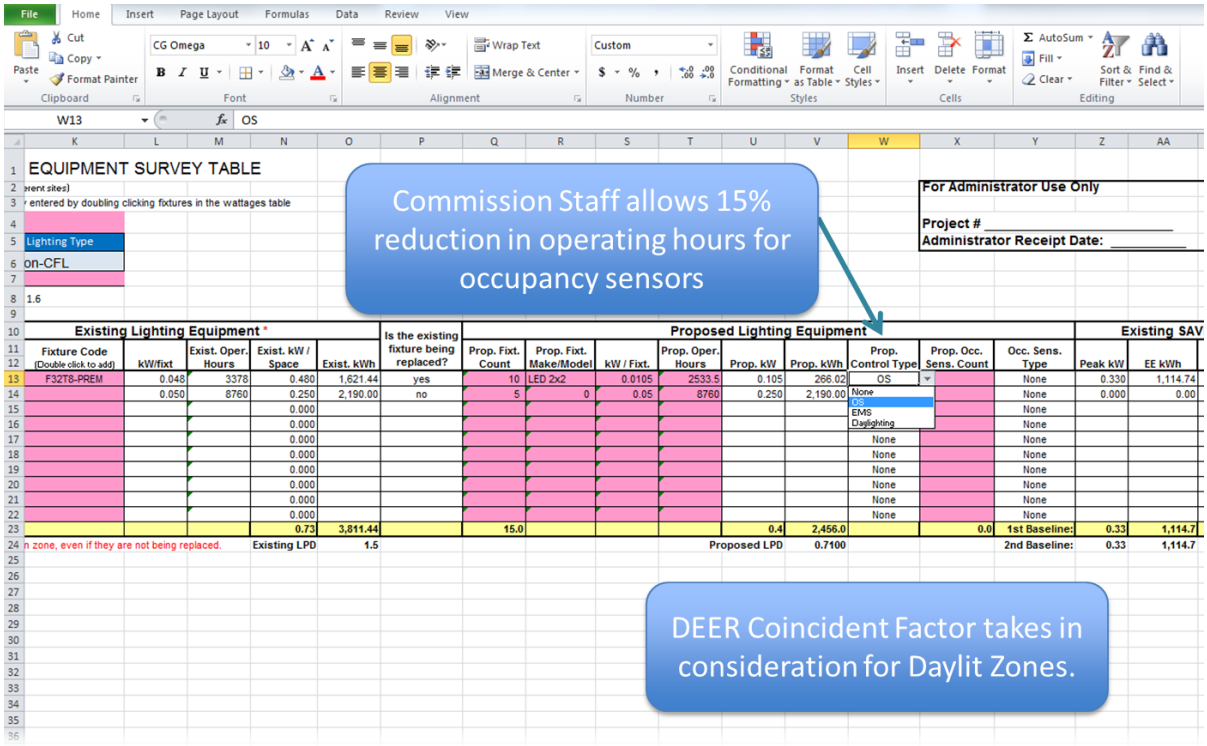
- Existing fixture replacement (yes/no)
- Proposed Fixture Count
- Proposed Fixture Make/Model
- Proposed Control Type
- Proposed Occupancy Sensor Count

Step Six: enter proposed equipment into table



Indicate whether an existing fixture is being replaced. ***Note:*** *If no is entered, the savings will be zero. This will calculate the existing LPD.*

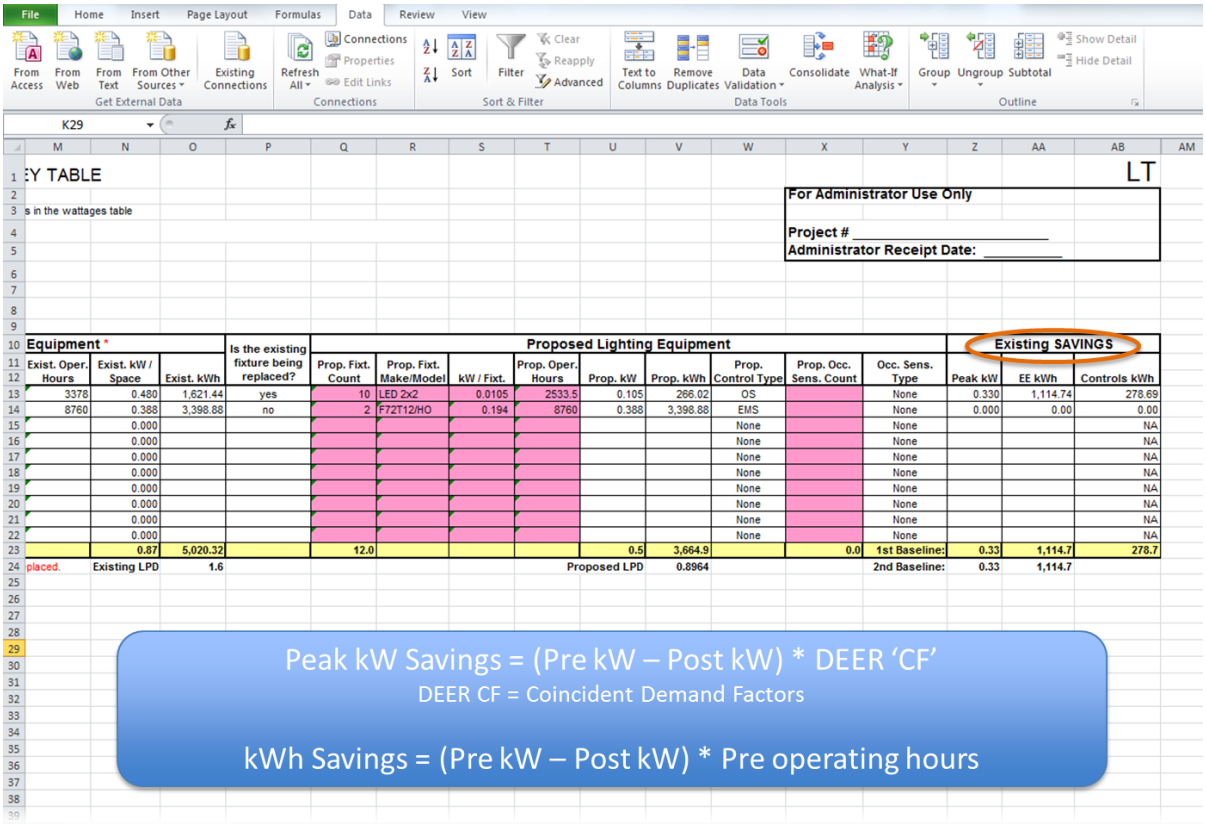
Step 7: enter proposed control type



Proposed lighting equipment: Commission staff allows 15% reduction in operating hours for all occupancy sensors.

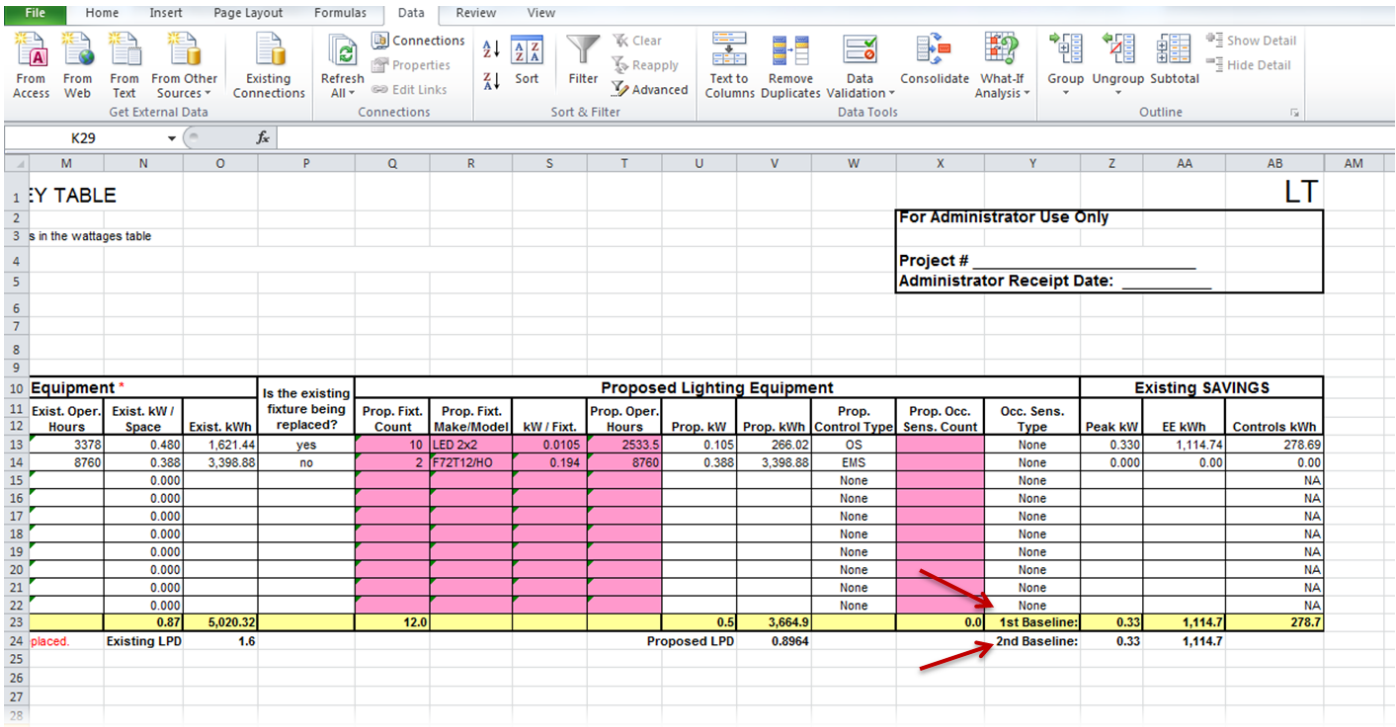
This includes energy management systems and daylight harvesting.

Existing Savings



The energy savings is calculated by the Peak KW savings, which is the Pre-KW minus the Post KW, multiplied by the DEER Coincidence Factor (CF). The DEER Coincidence Factor is the factor that the lights will be off during peak hours. The kWh savings is the Pre-KW minus the Post-KW multiplied by the Pre-operating hours.

Baselines



Equipment *				Proposed Lighting Equipment									Existing SAVINGS		
Exist. Oper. Hours	Exist. kW / Space	Exist. kWh	Is the existing fixture being replaced?	Prop. Fixt. Count	Prop. Fixt. Make/Model	kW / Fixt.	Prop. Oper. Hours	Prop. kW	Prop. kWh	Prop. Control Type	Prop. Occ. Sens. Count	Occ. Sens. Type	Peak kW	EE kWh	Controls kWh
3378	0.480	1,621.44	yes	10	LED 2x2	0.0105	2533.5	0.105	266.02	OS		None	0.330	1,114.74	278.69
8760	0.388	3,398.88	no	2	F72T12/HO	0.194	8760	0.388	3,398.88	EMS		None	0.000	0.00	0.00
	0.000									None		None			NA
	0.000									None		None			NA
	0.000									None		None			NA
	0.000									None		None			NA
	0.000									None		None			NA
	0.000									None		None			NA
	0.000									None		None			NA
	0.000									None		None			NA
	0.87	**5,020.32**		**12.0**				**0.5**	**3,664.9**		**0.0**	**1st Baseline:**	**0.33**	**1,114.7**	**278.7**
placed.	**Existing LPD**	**1.6**						**Proposed LPD**	**0.8964**			**2nd Baseline:**	**0.33**	**1,114.7**	

The lighting table will correlate the first baseline and the second baseline

Measurement & Verification

M&V is performed on projects that are proposed >20% higher than Deemed and/or DEER savings.

M&V projects must be minimum 50,000 kWh savings or requested by utility engineers or the CPUC.

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Hotel / Motel Guestroom Controls

Guest Controls

Significantly reduce energy consumption in a hotel guest room when a guest is away. Controls range from lighting controls to HVAC equipment controls.

HVAC Equipment Controls

A thermostat combines the operations of a state-of the-art programmable digital thermostat with a sensing device. The built-in occupancy sensor detects the presence or absence of room occupants.

Other versions of guest controls may require a card key control system from the door. When the guest accesses the room using their guest card, the HVAC system is then triggered within the room.

The HVAC and card key control units work seamlessly when the door sensor signals the thermostat that the door has been opened. When the guest enters the room, the sensor detects their presence and automatically sends a signal to the room's HVAC, signaling that the room is occupied. The heating/cooling system begins operations in accordance with the pre-programmed room occupied settings. This may be to heat the room to a predetermined temperature, or to cool the room. When the room is unoccupied, the system will work in reverse and begin to shut down the system.

Lighting Controls

Wall switches and wall outlets may also be conveniently activated by the master key card switch. When these controls are installed, all lighting devices are activated at the time the key card is inserted into the master switch. Once activated, operates as expected. The controlling technology for all electrical outlets and switches are generally wireless; eliminating the need to run wires during the installation process.

M&V Criteria for Controls

Large hotel projects require M&V to prove savings

Certain criteria is necessary on how to perform the measure and the tools when estimating savings The utility standards originate from the International Performance Measurement and Verification Protocol (IPMVP) Standards for sampling.

This requirement is generally triggered when savings is >50,000 kWh of claimed savings per project. Included documentation required in this measure is capturing measurements and performance of each selected room. (I.e. number of sample sizes and sample rooms). This requirement is dictated based on the number of guestrooms within the hotel/motel.

For the sampling, the utility need to include different orientations of the building, rooms located on the North, South, East, and West of the building. As well as include booking rates. The rates are required to classify the trends and fluctuations within the hotel/motel. This documentation allows viewing the low, mid, mid-to-high, and high seasonal points in the industry occupancy. The data enables the engineering team see and understand the dynamics of the hotel/motel's occupancy per building. M&V needs to see the different changes or booking rates within a 12 month period. Collecting these trends and billing data, the M&V team develops specific conditions specific to the site.

The criterion is calibrated using an E-Quest model to generate savings potentials. Engineering will need the following documentation:

- Guest room thermostats – verification of the install guestrooms thermostat settings
- Heating and cooling modes for occupied and unoccupied times
- Points when housekeeping or the customer instructs the housekeeper to reset the thermostat
- Time housekeeping is cleaning the room.

Title 24, 2013 for Controls

New Construction Applications:

On July 1, 2014 the utility adopted the new 2013 Title 24 Standards, which require hotel/motel guest room controls (Key card or motion sensor type).

Retrofit Applications:

Hotel/Motel guest room controls can only be considered for incentive if the existing thermostats have remaining useful life (RUL).

As an example, if the guest room existing thermostats are programmable, with useful life of 11 years and the programmable thermostats were installed eight years ago there is three years remaining useful life. With three years RUL, the retrofit would be eligible for an incentive.

Set-points:

Set at least +5°F above in cooling mode

Set at least -5°F below in heating mode

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Chillers

This section reviews only constant speed chillers, how and what types of tools the utility uses to conduct an estimate savings for chiller replacements. In order for the utility to estimate savings for chillers, the utility engineers use four specific types of tools.

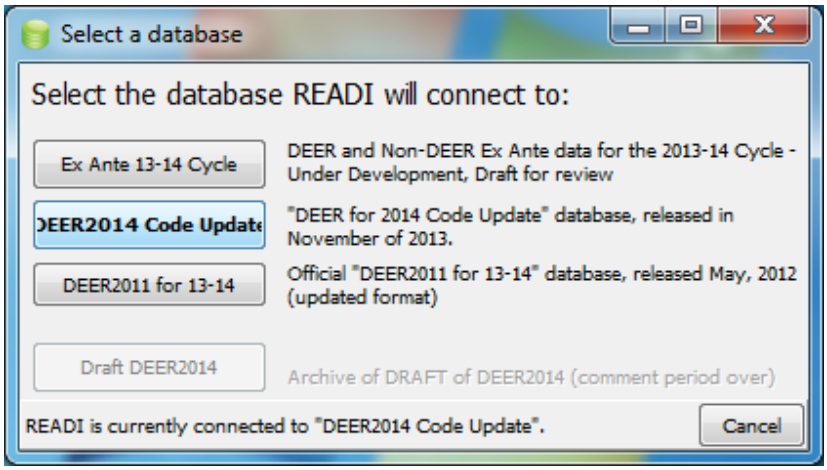
- READI tool
- Customized Calculation Tool (CCT)
- E Quest
- Spreadsheet Calculations for complex chiller projects, using raw data.

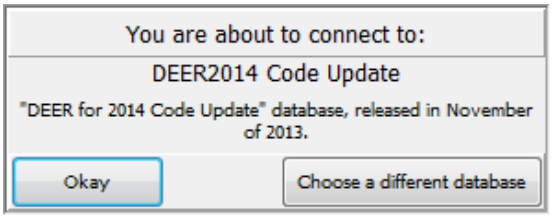
Title 24, Part Six

It is important to understand the changes under Title 24, Part Six. Under this section, a comparison of current standard vs. old or outdated Title 24 standards. ***Note:*** *The efficiencies have been raised under new Title 24, 2013 Standards.* There will be a breakdown between the different size chillers.

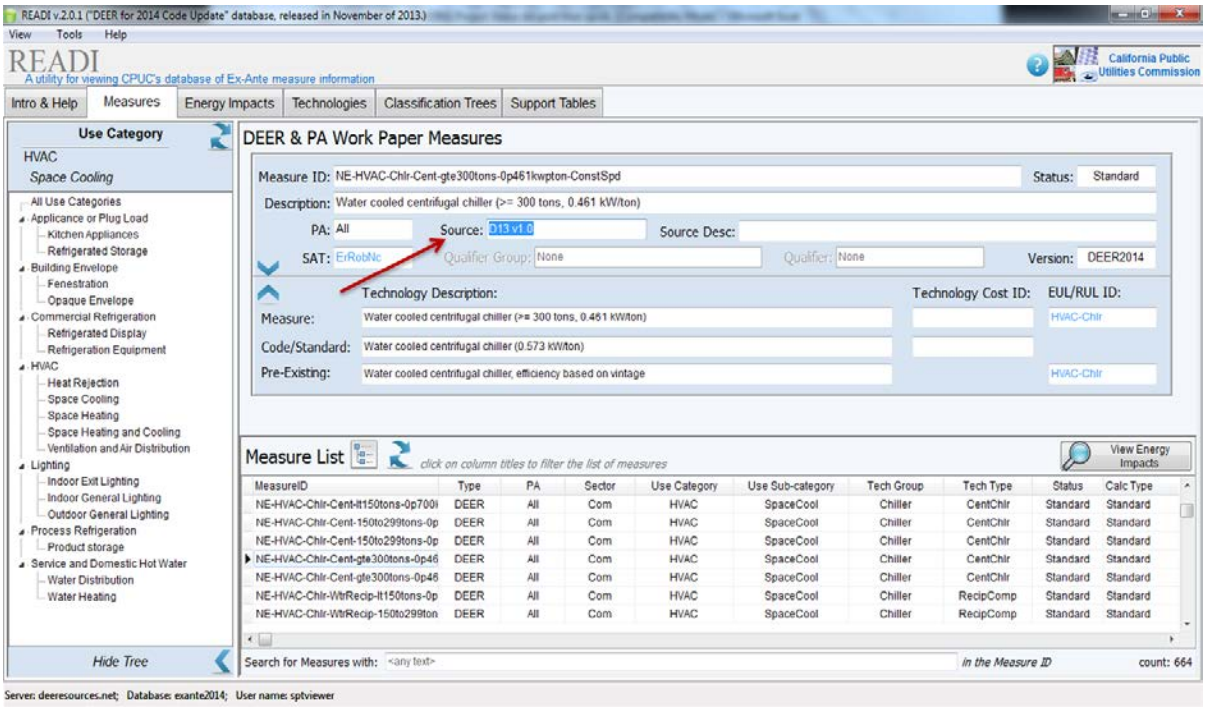
Familiarization with the Database for Energy Efficiency Resources (DEER) provides the latest information about the efficiencies used in the READI tool.

http://www.deeresources.com/index.php/deer2013-update-for-2014-codes





When permits are complying with 2013 Title 24, Part 6, use DEER 2014 Code Update option



Note: The *Source* has changed from DEER 2011 to **DEER 2013**, as well as the baseline code/standard efficiencies all relating to the updated code.

Next, understanding the Energy Efficiency Business Incentive (EEBI) programs and how incentives are claimed for chiller projects.

http://www.sdge.com/save-energy-earn-incentives

Lastly, understanding Climate Zones and identifying the different climate zones for multiple buildings when conducting an audit for a chiller project is important and valuable to establish an energy efficiency building.

http://www.energy.ca.gov/maps/renewable/building_climate_zones.html

Using the Correct Tool with Data Collection

A data collection sheet should be taken to the site and completed. Information defined on the data sheet will define the scope of the project. See data sheets in handout appendices.

- One for one replacement?
- Upgrade back-up chiller to lead chiller?
- Multiple Chillers at site?
- Multiple Capacities / Increased Capacity
- Modifications

In addition, nameplate data for existing chillers should be collected. Spot reading – (chilled water temperatures, condensing water temperatures flow rates, chiller load (amps) should be recorded, when available). Consult the plant operator about chiller operating schedules and chiller loading. Refer to refrigeration workbook.

- Building Type, Vintage, and Conditioned Area (Sq. Ft.)
- Hours of Operation
- Climate Zone / Zip code
- Operating Conditions – water temps, GMP flow, etc.
- New Chiller Type, Tons, Efficiency (kW/ton), VSD
- Chiller Operation- Lead-Lag? Shared Load? Age?
- Additional Plant Chillers- type, capacity, operation

Centrifugal Chiller Example – READI Tool:

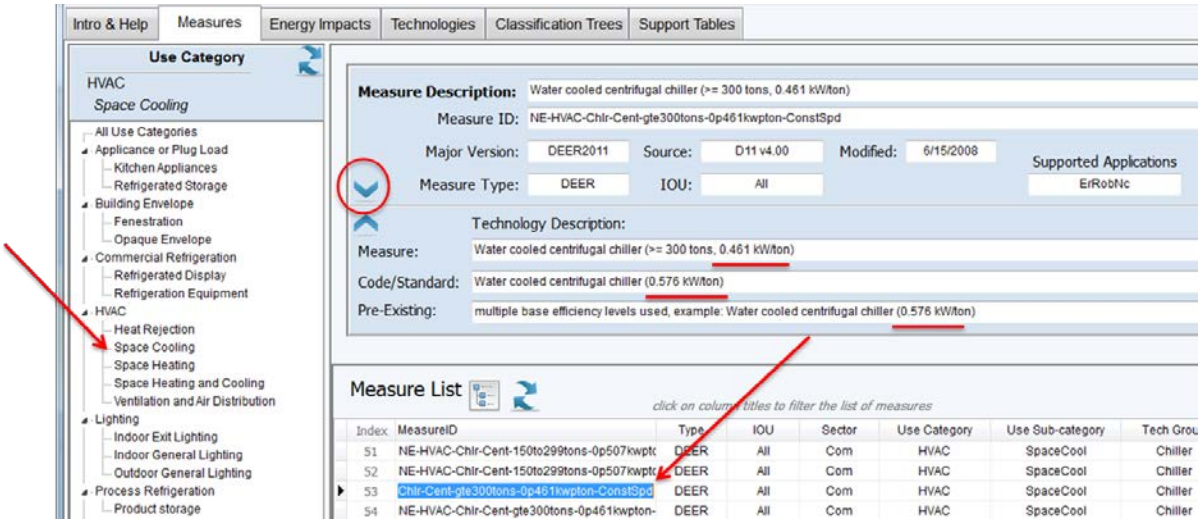
This is a READI example, for replacing an existing chiller, with one chiller on-site. Dual Baseline review is covered by this example.

Building and Equipment Characteristics::

- Large Office located in 92128
- Vintage of building is 1997
- Existing Chiller: 350 tons, water-cooled, centrifugal
- Proposed Chiller: 350 tons, water-cooled, centrifugal, efficiency = 0.461 kW/ton
- DEER EUL = 20 years; Title 24 = 0.576 kW/ton

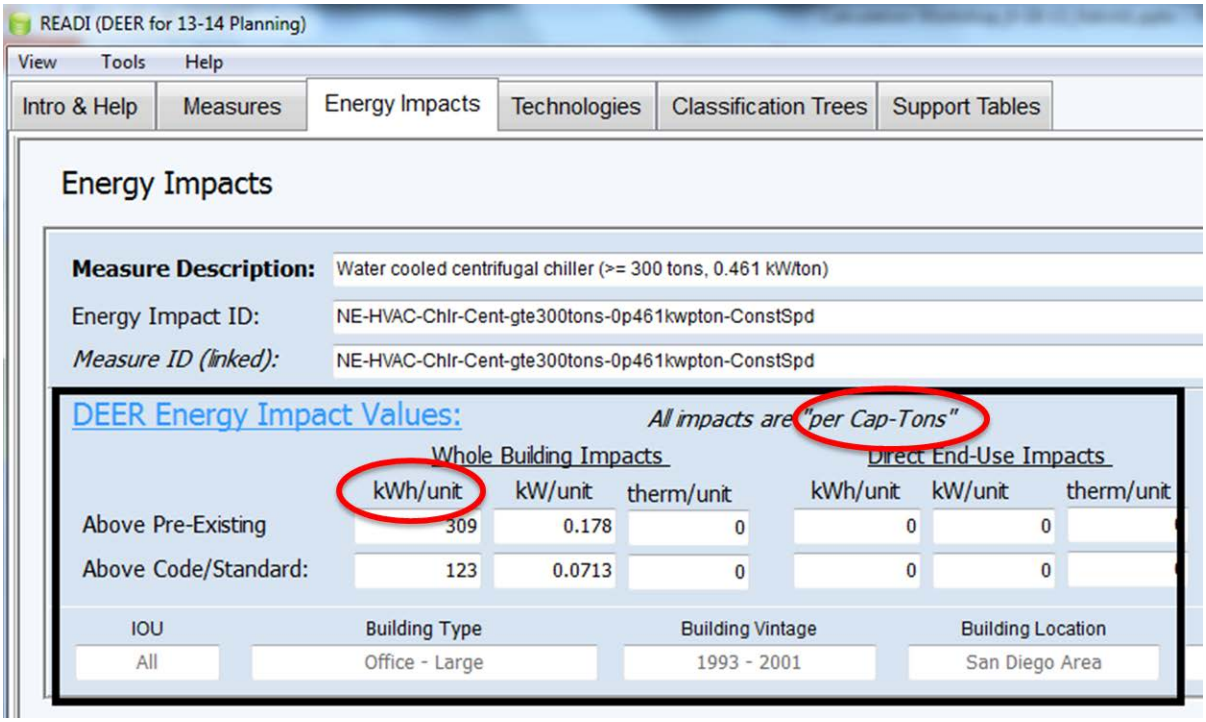
READI specifies replacement chiller performance (kW/ton).

READI input screen



Note the directory on the left for selecting the type of measure. The more definitive measure is on the right. Click on the Measure List to further define the measure by building, vintage, and climate zone.

Energy Impacts – Output Information



The new Chiller Efficiency Evaluated will equal the READI chiller efficiency.

Above Pre-Existing is savings above *a survey of typical chillers* in service. It will be used to evaluate the first baseline – existing to new.

Above Code / Standard is savings above current Title 24 Code. It is used to evaluate second baseline – code to new.

The building type, vintage, and location (climate zone) are defined.

The savings impacts are defined as a function of chiller capacity.

	Whole Building Impacts		
	kWh/unit	kW/unit	therm/unit
Above Pre-Existing	309	0.178	0
Above Code/Standard:	123	0.0713	0

Calcs	kWh Savings	kW Savings	Measure
RUL>1	(350 x 309) = 108,150	(350 x 0.178) = 62.3	ER
RUL<1	(350 x 123) = 43,050	(350 x 0.0713) = 25.0	ROB

See the appendix for DEER measure life values. Water cooled chillers have a 20 year life. Since this chiller was installed in 1997 it has a remaining useful life of four years.

Vintage = 1997, **RUL** = 4 years (20 years – 16 years), which qualifies for Early Retirement (ER).

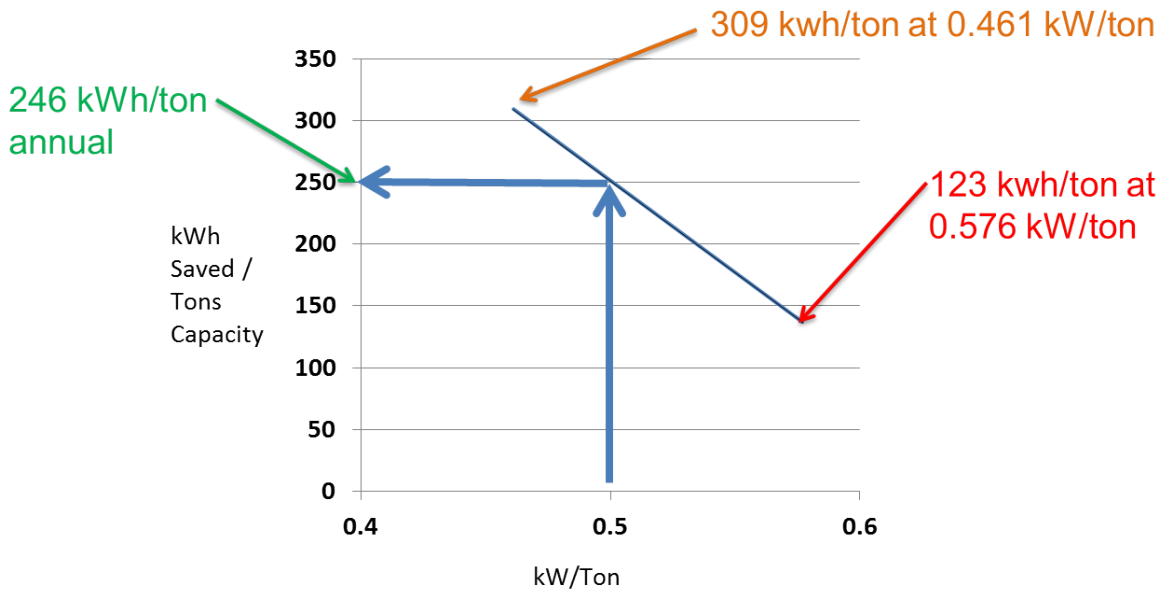
If RUL < 1 years; Replace on Burnout (ROB)

Note: First baseline and second baseline energy and demand savings are calculated. Incentives are calculated based on First Baseline Savings.

- First Baseline Savings = **108,150 kWh** savings & **62.3 kW** savings
- Second Baseline Savings = **43,050 kWh** savings & **25.0 kW** savings

Chiller evaluated using unmodified READI are not reviewed by Energy Division.

Centrifugal Chiller Example – Modified READI

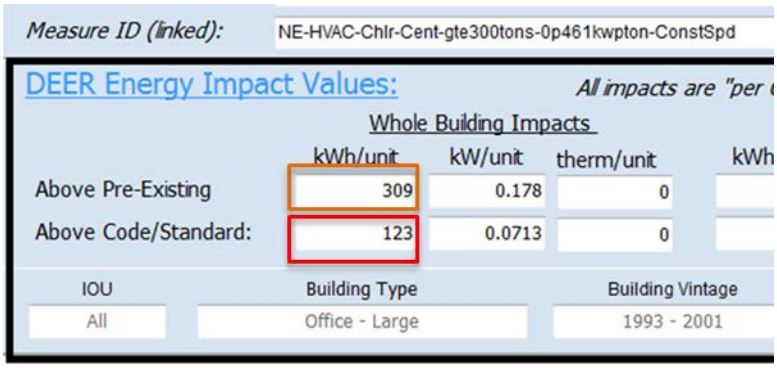


The above example evaluates savings for a new 350 ton chiller with full load efficiency of .5 kW/ton

Since READI does not list a .5 kW/ton chiller, savings must be interpolated from READI.

Calculating:

1. Plot kWh-saved vs. chiller-efficiency. The READI run provides two values- above pre-existing and above code. Current code is .576 kW/ton.
2. By drawing the graph and locating the .5 kW/ton kWh savings above the pre-existing (First Baseline Savings) can be determined



Since READI is used with changes, the calculations are reported to Energy Division for review.

Linear Interpolation Equation

$$y = y_0 + (y_1 - y_0)\frac{x - x_0}{x_1 - x_0}$$

Where y = Modified-READI Savings; x = 0.500 kW/ton

y_0 = 309 kWh/ton; x_0 = 0.461 kW/ton

y_1 = 123 kWh/ton; x_1 = 0.576 kW/ton

y **= 246**; same as plot method

Vintage = 1997, **RUL** = 4 years (20 years – 16 years), which qualifies for Early Retirement (ER).

If RUL < 1 years; Replace on Burnout (ROB)

Note: First baseline and second baseline energy and demand savings are calculated. Incentives are calculated based on First Baseline Savings.

- First Baseline Savings = **86,100 kWh** savings & **49.7 kW** savings
- Second Baseline Savings = **43,050 kWh** savings & **25.0 kW** savings

Calcs	kWh Savings	kW Savings	Measure
RUL>1	(350 x 246) = 86,100	(350 x 0.142) = 49.7	ER
RUL<1	(350 x 123) = 43,050	(350 x 0.0713) = 25.0	ROB

First and second baseline savings are calculated like the previous example.

***Note:** If there are multiple site chillers with different efficiencies, the READI tool or modified READI cannot be used.*

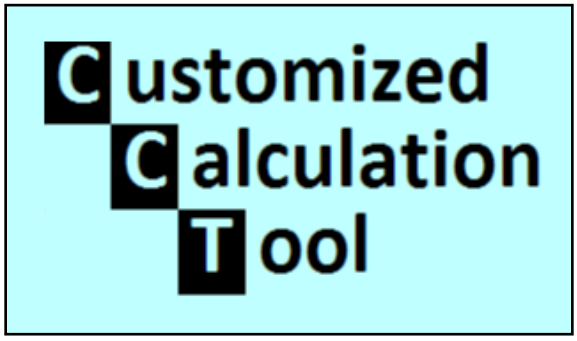
Centrifugal Chiller Example – Customized Calculation Tool, 2013:

The Customized Calculation Tool is provided with the *Statewide Customized Offering Procedures Manual for Business*

Use the data sheet provided in the appendix to collect site data. The tool limitations are similar to READI. Generally the tool will not work at sites with multiple chillers and multiple efficiencies.

If there are two site chillers that are identical, and the two chillers equally share the load or run alternately, then this method can be used.

Used for most common building types and sizes:



- Education
- Health/Medical
- Lodging – Hotel
- Large & Small Offices
- Retail

Look at the same chiller used with the READI example, the building size is estimated for this example at 400 Sq. Ft. / ton

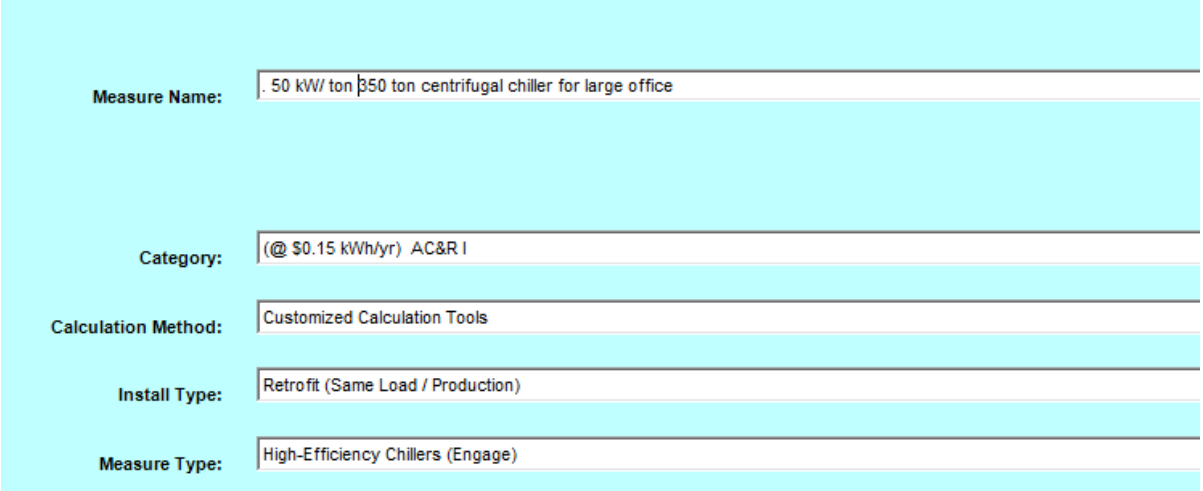
Building and Equipment Characteristics:

- Large Office located in 92128
- Vintage of building is 1997
- Existing Chiller: 350 tons, water-cooled, centrifugal
- Proposed Chiller: 350 tons, water-cooled, centrifugal, efficiency = 0.5 kW/ton
- DEER EUL = 20 years

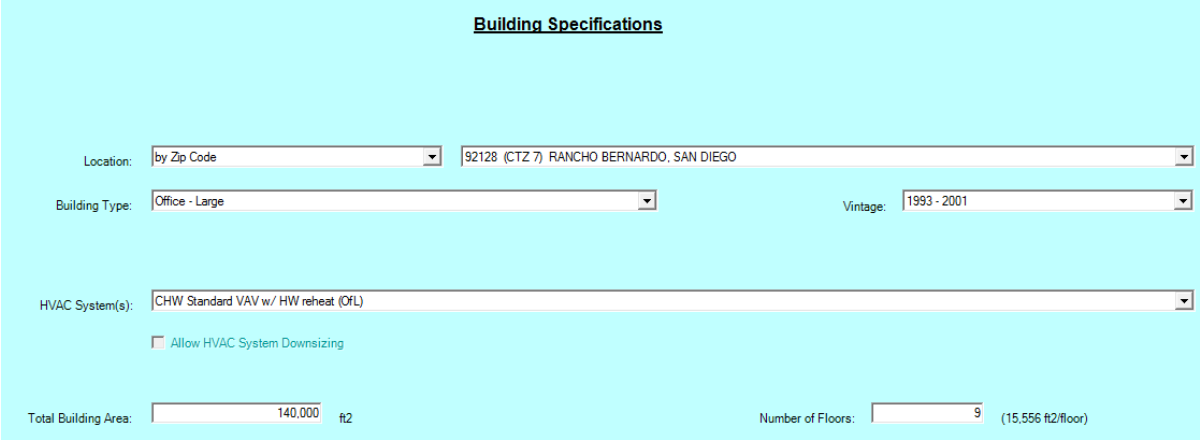
Input Sheets – Customized Calculation Tool-2013

First Input Sheet- Measure Description

Select the incentive category and Measure Type

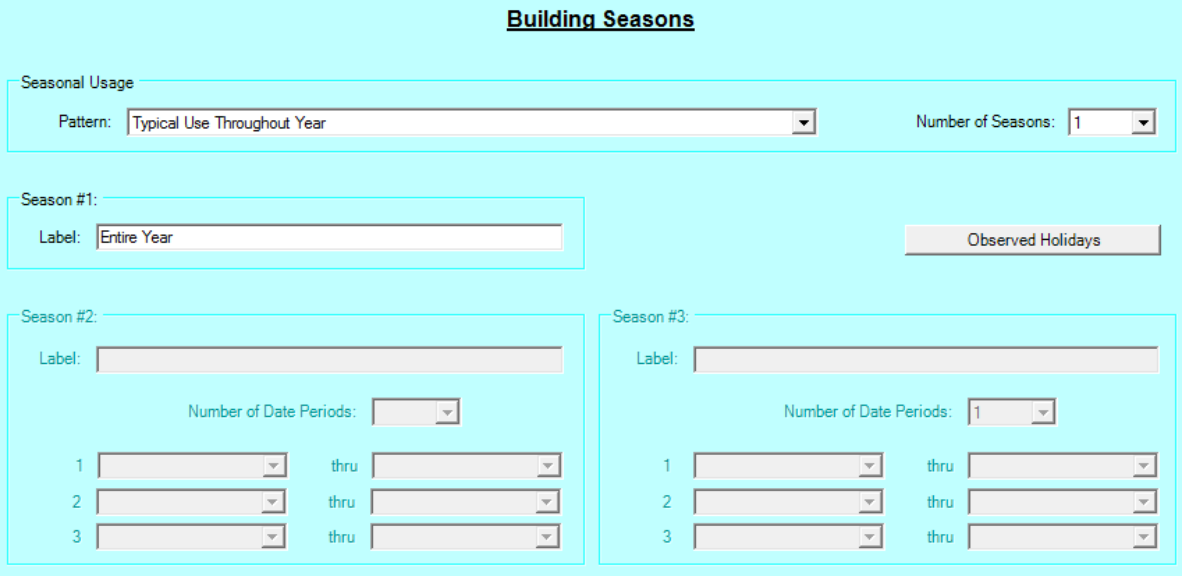


Second Input Sheet - Climate zone, Building Description



Use the Site Data Sheet, which was previously completed to add any additional data.

Third Input Sheet – Define seasons

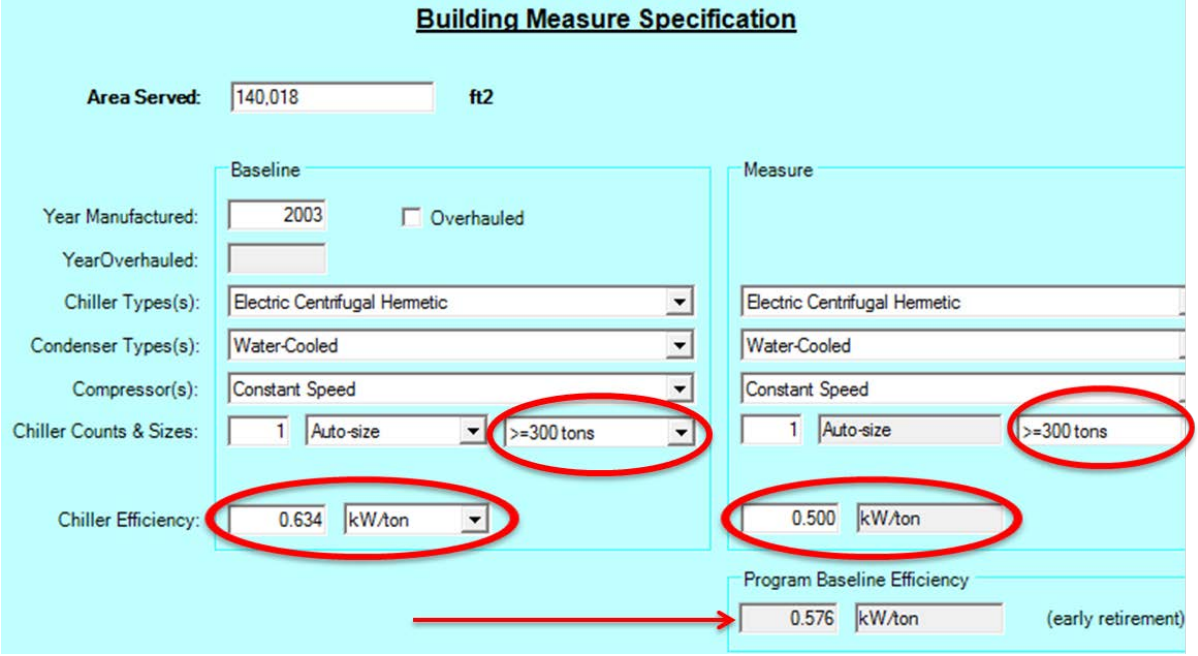


Add any specific seasons, if necessary.

Fourth Input sheet – Building Schedules (from operator)

Obtain building operating hours from the site operator and complete the operating schedules. This screenshot shows a single operating schedule. Multiple schedule inputs are available for the software.

Fifth Input Sheet –Chiller Information

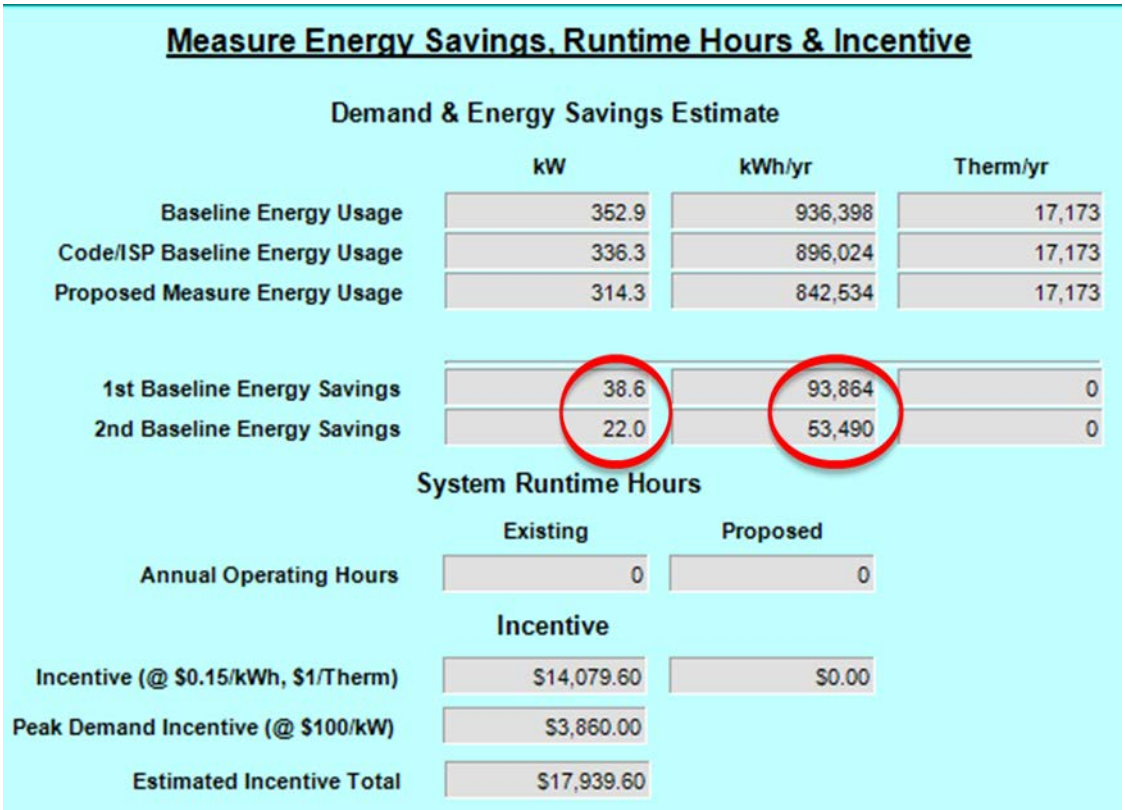


Enter capacity and efficiency for the new and existing chiller. If existing chiller efficiency is unknown, use the default efficiency corresponding to vintage Title 24 for the existing chiller.

This efficiency, compared to the new chiller efficiency will develop the First Baseline Savings.

Note: the Program Baseline Efficiency is used for the Second Baseline Savings.

Output



Measure Energy Savings, Runtime Hours & Incentive

Demand & Energy Savings Estimate

	kW	kWh/yr	Therm/yr
Baseline Energy Usage	352.9	936,398	17,173
Code/ISP Baseline Energy Usage	336.3	896,024	17,173
Proposed Measure Energy Usage	314.3	842,534	17,173
1st Baseline Energy Savings	38.6	93,864	0
2nd Baseline Energy Savings	22.0	53,490	0

System Runtime Hours

	Existing	Proposed
Annual Operating Hours	0	0

Incentive

Incentive (@ $0.15/kWh, $1/Therm)	$14,079.60
Peak Demand Incentive (@ $100/kW)	$3,860.00
Estimated Incentive Total	$17,939.60

Compare these savings to the Modified READI Example: kWh and kW

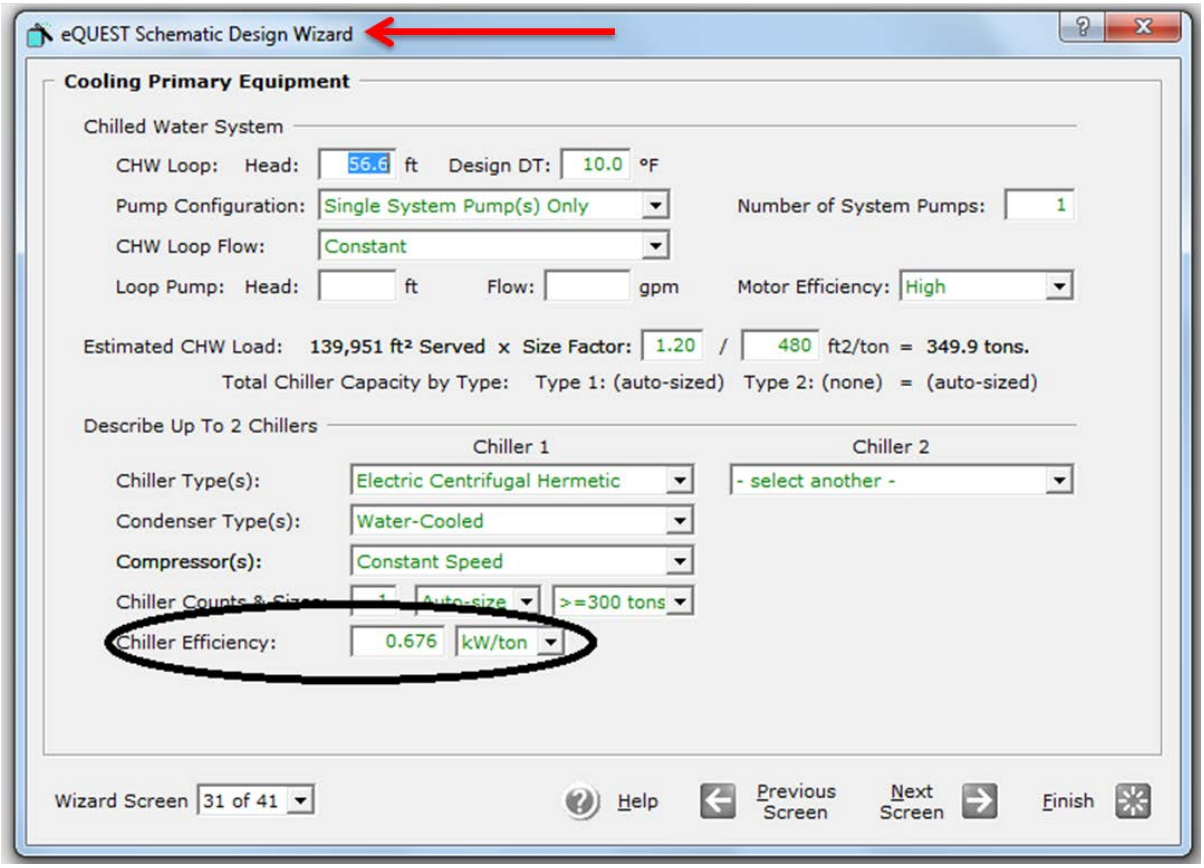
Centrifugal Chiller Example – eQUEST

Below is an example using the eQUEST schematic design wizard, for replacing an existing chiller, with one chiller on-site. Dual Baseline review is covered by this example.

Building and Equipment Characteristics::

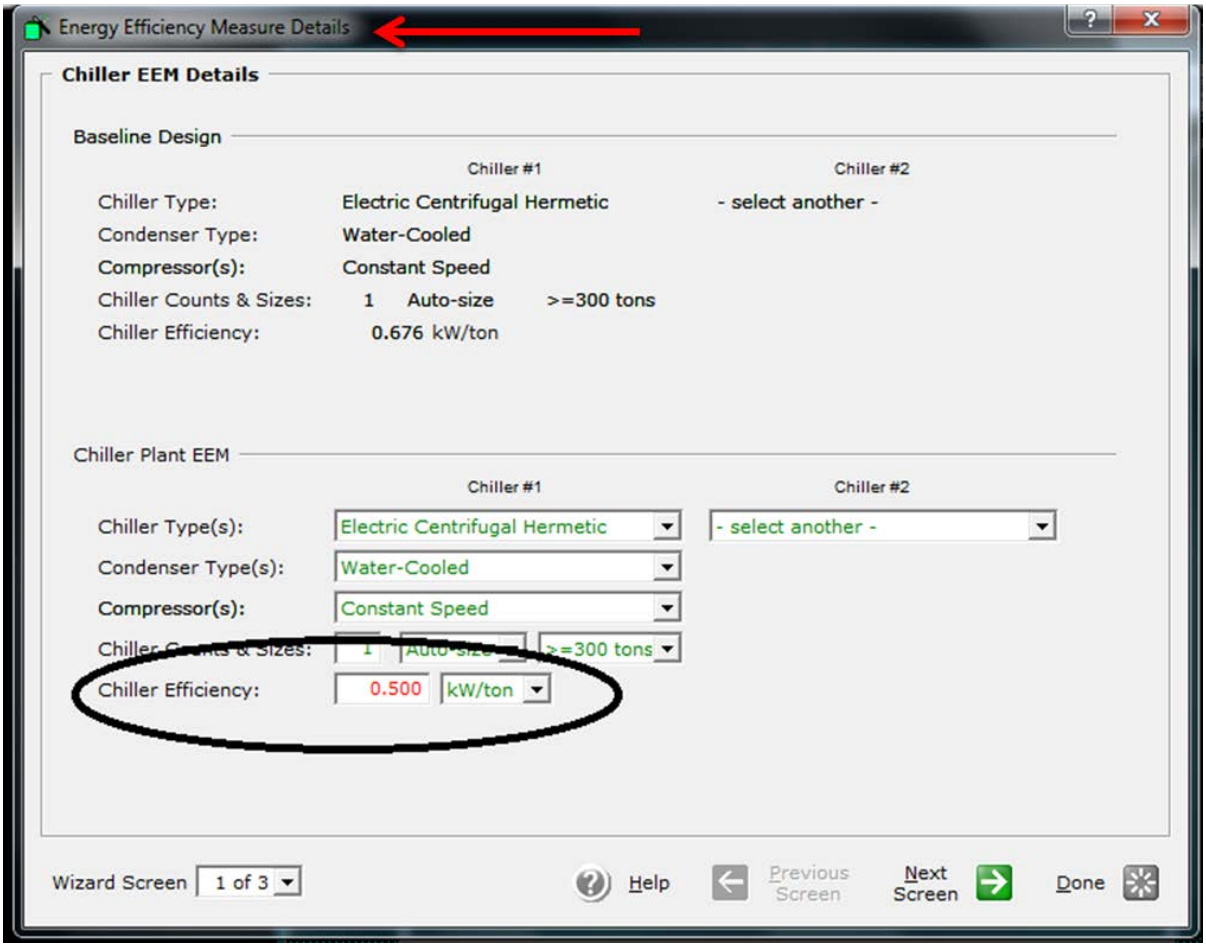
- Large Office located in 92128
- Vintage of building is 1997
- Existing Chiller: 350 tons, water-cooled, centrifugal
- Proposed Chiller: 350 tons, water-cooled, centrifugal, efficiency = 0.5 kW/ton
- DEER EUL = 20 years

eQUEST Schematic Design Wizard



Details of the building will be entered into the different screens within the program.

eQUEST Energy Efficiency Measure Details



eQUEST Output Reports – Energy Savings

Annual Energy and Demand (pg 1 of 2)

		Ann. Source Energy		Annual Site Energy		Lighting	HVAC Energy			Peak	
		Total Mbtu	EUI kBtu/sf/yr	Elect kWh	Nat Gas Therms	Electric kWh	Electric kWh	Nat Gas Therms	Total Mbtu	Elect kW	Cooling Tons
Annual Energy USE or DEMAND											
0	Base Design	19,444	138.93	1,871,966	2,768	532,785	759,242	55	2,597	737	354
1	0+Chiller Plant EEM	18,255	130.44	1,755,847	2,768	532,785	643,123	55	2,200	663	354
Incremental SAVINGS	(values are relative to previous measure (% savings are relative to base case use), negative entries indicate increased use)										
1	0+Chiller Plant EEM	1,189	8.50 (6%)	116,119 (6%)	0 (0%)	0 (0%)	116,120 (15%)	0 (0%)	396 (15%)	74 (10%)	0 (0%)

eQUEST Output Reports – Demand Reduction

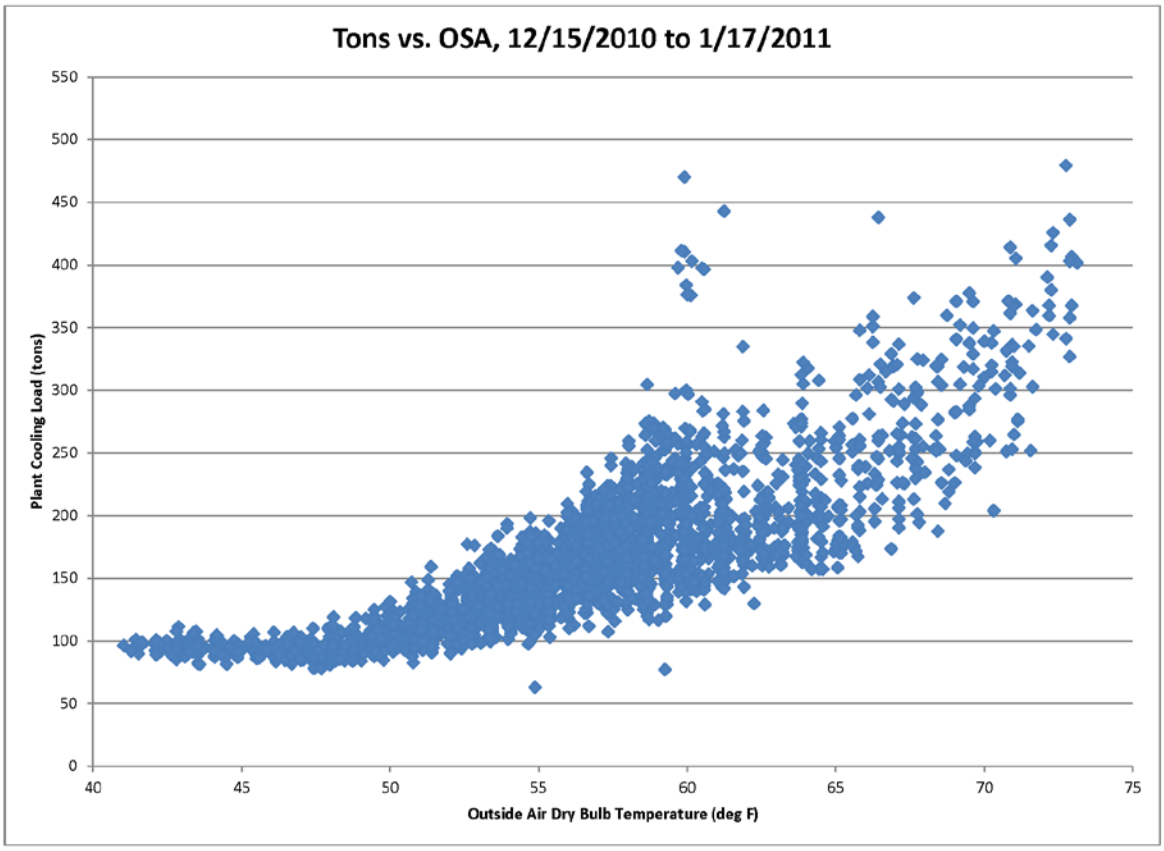
Annual Electric Coincident Peak Demand by Enduse (pg 2 of 4)

		Ambient Lights	Task Lights	Misc Equip	Space Heating	Space Cooling	Heat Reject	Pumps & Aux	Vent Fans	Dom Ht Wtr	Exterior Usage	Total
Annual Energy Coincident Demand (kW)												
0	Base Design	148.2	22.7	152.8	0.0	268.3	49.8	61.4	33.4	0.0	0.0	736.6
1	0+Chiller Plant EEM	148.2	22.7	152.8	0.0	198.3	47.7	60.0	33.4	0.0	0.0	663.0

Incremental SAVINGS (kW) (values are relative to previous measure (% savings are relative to base case demand), negative entries indicate increased demand)

1	0+Chiller Plant EEM	0.00 (0%)	0.00 (0%)	0.00 (0%)	--	69.94 (26%)	2.18 (4%)	1.44 (2%)	0.00 (0%)	--	--	73.56 (10%)

Centrifugal Chiller Example – M&V



Measurement & Verification may be required, using CCT, eQUEST, or spreadsheet calculations. Typical M&V is based on kW/ton vs. OSA (Option B, Key Parameter, IPMVP-III). If scope of work is complex, M&V could use Option C, Whole Building Method.

TABLE 112-D WATER CHILLING PACKAGES – MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Efficiency	Test Procedure
Air Cooled, With Condenser, Electrically Operated	< 150 Tons	2.80 COP 3.05 IPLV	ARI 550/590
	≥ 150 Tons		
Air Cooled, Without Condenser, Electrically Operated	All Capacities	3.10 COP 3.45 IPLV	
Water Cooled, Electrically Operated, Positive Displacement (Reciprocating)	All Capacities	4.20 COP 5.05 IPLV	ARI 550/590
Water Cooled, Electrically Operated, Positive Displacement (Rotary Screw and Scroll)	< 150 Tons	4.45 COP 5.20 IPLV	ARI 550/590
	≥ 150 Tons and < 300 Tons	4.90 COP 5.60 IPLV	
	≥ 300 Tons	5.50 COP 6.15 IPLV	
Water Cooled, Electrically Operated, Centrifugal	< 150 Tons	5.00 COP 5.25 IPLV	ARI 550/590
	≥ 150 Tons and < 300 Tons	5.55 COP 5.90 IPLV	
	≥ 300 Tons	6.10 COP 6.40 IPLV	
Air Cooled Absorption Single Effect	All Capacities	0.60 COP	ARI 560
Water Cooled Absorption Single Effect	All Capacities	0.70 COP	
Absorption Double Effect, Indirect-Fired	All Capacities	1.00 COP 1.05 IPLV	
Absorption Double Effect, Direct-Fired	All Capacities	1.00 COP 1.00 IPLV	
Water Cooled Gas Engine Driven Chiller	All Capacities	1.2 COP 2.0 IPLV	ANSI Z21.40.4

Measurement & Verification Example, 2013 Title 24

Equipment Type	Size Category	Path A Efficiency [a, b]	Path B Efficiency [a,b]	Test Procedure
Air Cooled, with condenser Electrically Operated	< 150 tons	EER ≥ 12.5 IPLV		**AHRI 550/590**
	≥ 150 tons	EER ≥ 12.75 IPLV		
Air Cooled, without condenser Electrically Operated	All Capacities	Air-cooled chillers without condensers must be rated with matching condensers and comply with the air-cooled chiller efficiency requirements.		
Water Cooled, Electrically Operated, Reciprocating	All Capacities	Reciprocating units must comply with the water-cooled positive displacement efficiency requirements.		
Water Cooled, Electrically Operated Positive Displacement	< 75 tons	≤ 0.780 kW/ton ≤ 0.630 IPLV	≤ 0.800 kW/ton ≤ 0.600 IPLV	
	≥ 75 tons and < 150 tons	≤ 0.775 kW/ton ≤ 0.615 IPLV	≤ 0.790 kW/ton ≤ 0.586 IPLV	
	≥ 150 tons and < 300 tons	≤ 0.680 kW/ton ≤ 0.580 IPLV	≤ 0.718 kW/ton ≤ 0.540 IPLV	
	≥ 300 tons	≤ 0.620 kW/ton ≤ 0.540 IPLV	≤ 0.639 kW/ton ≤ 0.490 IPLV	
Water Cooled, Electrically Operated, Centrifugal	< 150 tons	≤ 0.634 kW/ton ≤ 0.596 IPLV	≤ 0.639 kW/ton ≤ 0.450 IPLV	
	≥ 150 tons and < 300 tons	**≤ 0.634 kW/ton ≤ 0.596 IPLV**	**≤ 0.639 kW/ton ≤ 0.450 IPLV**	

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Chillers with Variable Speed Drive (VSD)

This section probes deeper into energy savings from adding a variable speed drive (VSD) to a chiller. There are three methods the utility uses to analyze these projects.

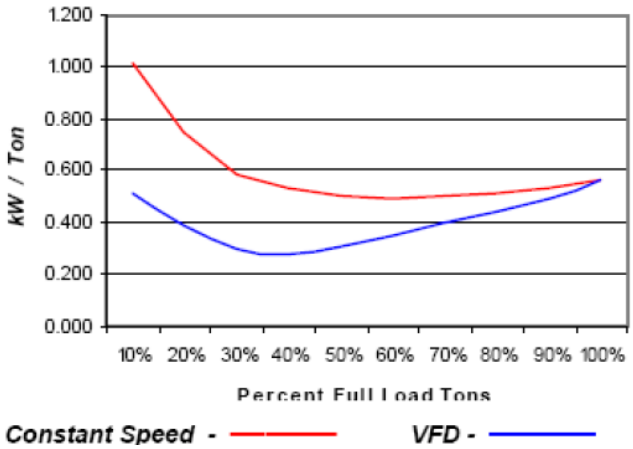
The following tools are used to analyze energy savings for chillers with VSD.

- Modified READI Tool
- Customized Calculation Tool
- eQuest

Preferred analysis tool is READI, followed by CCT and then eQUEST software.

The eQUEST software allows the project to include multiple chillers at a site.

Below is the chiller data used to evaluate the savings for a variable speed drive.



Required Data on the existing chiller:

- Manufacturer/Model number
- Age
- Serial numbers
- Number of Chillers - How the chiller(s) operate
- Capacity in tons
- Type - Screw, Centrifugal
- Full load efficiency

Required Data on building:

- Type – Office building, Hospital, Hotel, etc.
- Vintage – Year Built
- Location – Climate Zone
- Conditioned Area
- Operating hours
- Economizer

The inputs should provide enough information using either the READI Tool, Customized Calculation Tool, or eQUEST.

Chiller VSD Example – Modified READI

This example is demonstrated using the modified READI tool. Chiller VSD savings is determined by comparing constant speed and SVD chiller energy impacts.

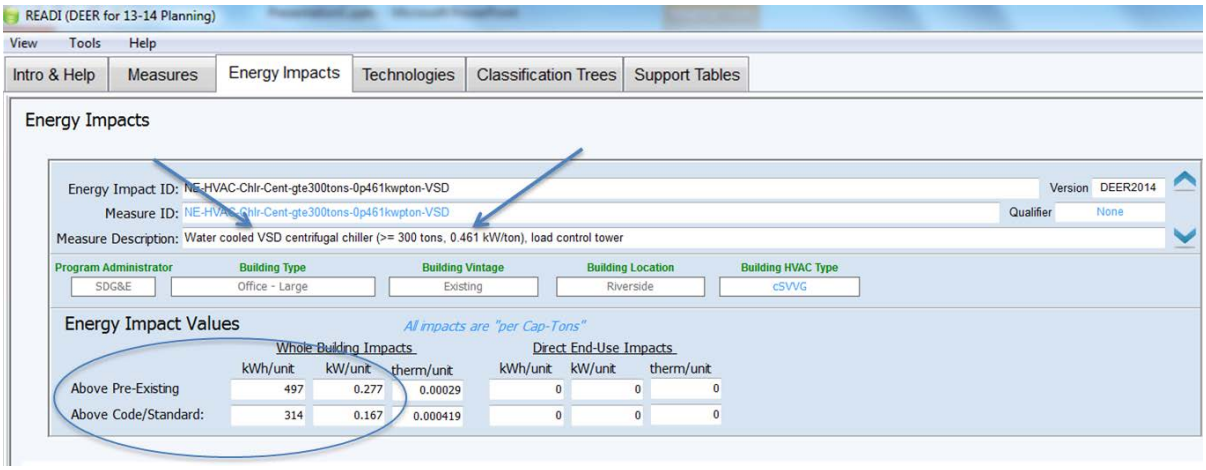
Building and Equipment Characteristics::

- Large Office located in 92128
- Vintage of building is 1997
- Existing Chiller: 350 tons, water-cooled, centrifugal, constant speed
- Proposed Chiller: 350 tons, water-cooled, centrifugal, with added VSD

This example takes place in climate zone 10. The proposed chiller will remain the same; however, a variable speed drive will be added to the unit.

First Step: From the Energy Impacts Tab, Select the appropriate measure from the pull-down options in Measure Description.

Measure Description: *Water cooled VSD centrifugal chiller*



Energy and Demand Savings are circled above.

Above Pre-Existing is savings above *a survey of typical chillers* in service. It will be used to evaluate the first baseline – existing to new. This is a comparison of a typical existing chiller to a new chiller at 0.461 kW/ton.

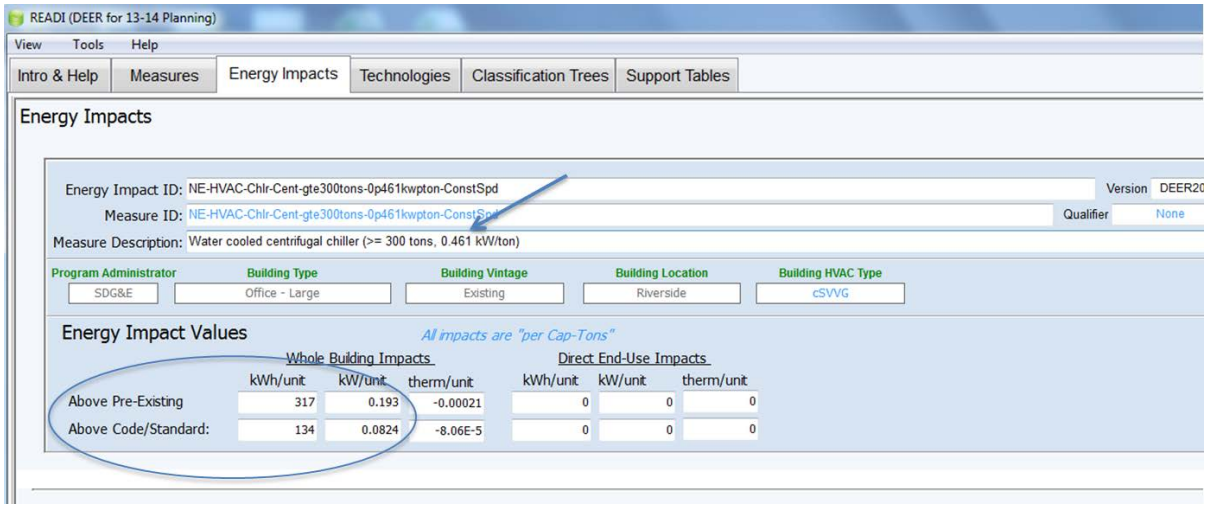
Above Code/Standard is savings above current Title 24 Code. It is used to evaluate second baseline – code to new. This is a comparison of 2013 Title 24 code to a new chiller at 0.461 kW/ton.

Second Step: From the Energy Impacts Tab, Select the chiller with the appropriate capacity range from the pull-down options in Measure Description. Then select the same full load efficiency from the Energy Impact ID drop-down.

Example:

Energy Impact ID: NE-HVAC-Chlr-Cent-gte300tons-Op461kwpton-ConstSpd

Measure Description: *Water cooled centrifugal chiller (>= 300 tons. 0.461 kW/ton)*



Chiller Comparison – READI VSD Chiller vs. READI Chiller

	READI VSD Chiller	READI Chiller	VSD kWh savings
Above Pre-Existing savings, kWh/ton	497	317	180
Above Code savings, kWh/ton	314	134	180
	READI VSD Chiller	READI Chiller	VSD kW savings
Above Pre-Existing savings, kWh/ton	0.277	0.193	0.084
Above Code savings, kWh/ton	0.167	0.082	0.084

- Chiller VSD energy savings = 350tons x 180kWh/ton = 63,000 kWh
- Chiller VSD demand savings = 350tons x 0.084 kW/ton = 29 kW

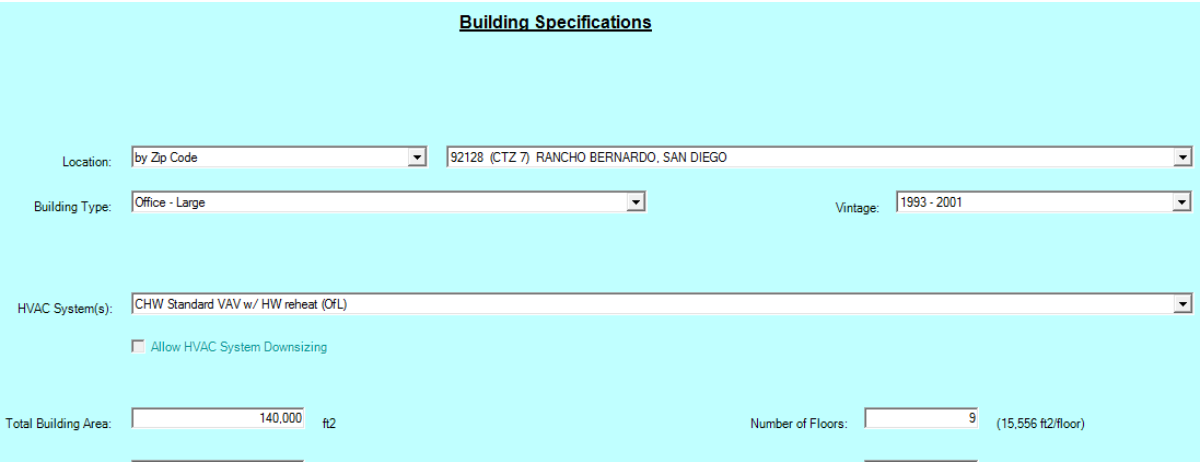
The chart compares constant speed chiller to VSD chiller. The savings is segregated, using just the VSD portion of the savings.

Chiller VSD Example – Customized Calculation Tool, 2013

Open the Customized Calculation Tool and select Energy Savings Calculator. Name the measure then select the category:

a. Non Lighting/Non Gas.
b. Retrofit
c. High Efficiency Chillers

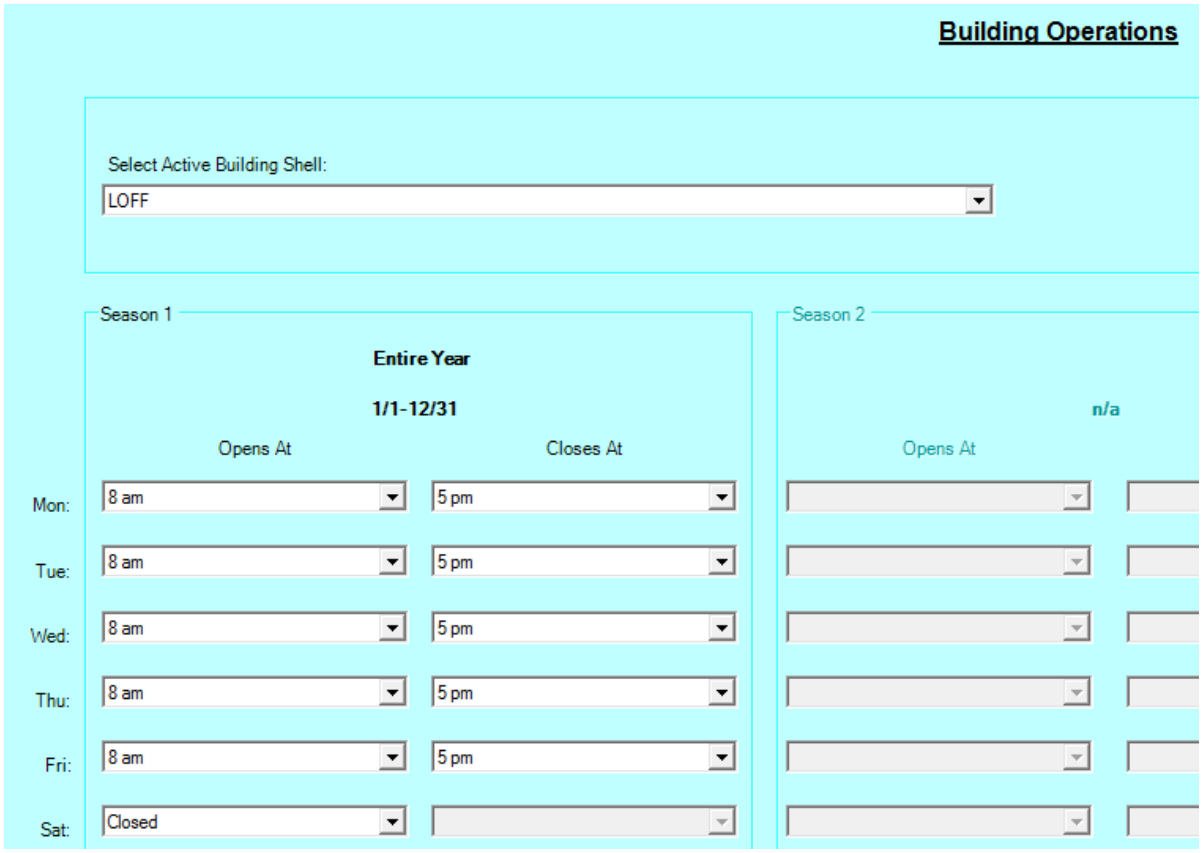
First Input Sheet –Building Specification (Climate zone)



Complete all fields

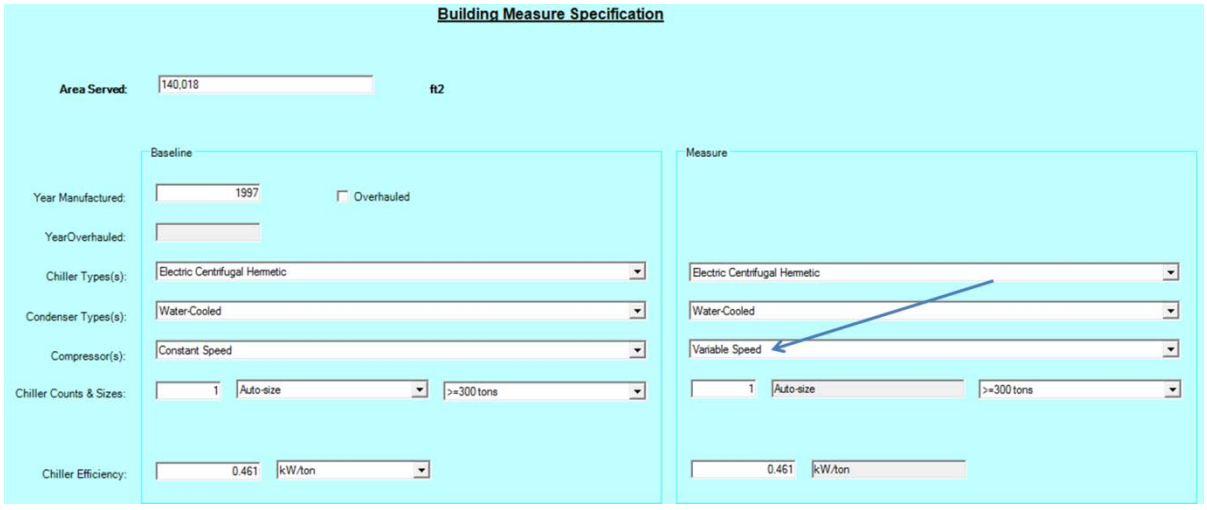
Second Input Sheet – Building Operations (Schedules)

Enter building operating schedules, using drop-downs.



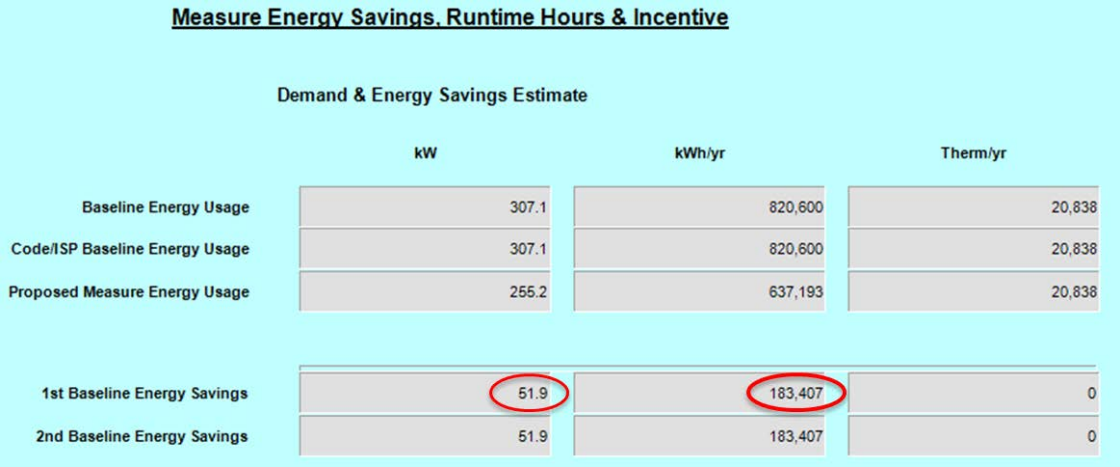
Third Input Sheet – Building Measure Specification

Under *Baseline* enter the existing chiller information. Under *Measure* enter the same chiller information as entered in Baseline. Except specify *Variable Speed*.



Fourth Input Sheet – Measure Energy Savings Runtime Hours & Incentive (Output)

For a single chiller serving the entire building, air conditioning load equipped with VSD, the savings is **183,407 kWh**



Measure Energy Savings, Runtime Hours & Incentive

Demand & Energy Savings Estimate

	kW	kWh/yr	Therm/yr
Baseline Energy Usage	307.1	820,600	20,838
Code/ISP Baseline Energy Usage	307.1	820,600	20,838
Proposed Measure Energy Usage	255.2	637,193	20,838
1st Baseline Energy Savings	51.9	183,407	0
2nd Baseline Energy Savings	51.9	183,407	0

- 183,407 kWh saved, 51.9 kW demand reduced

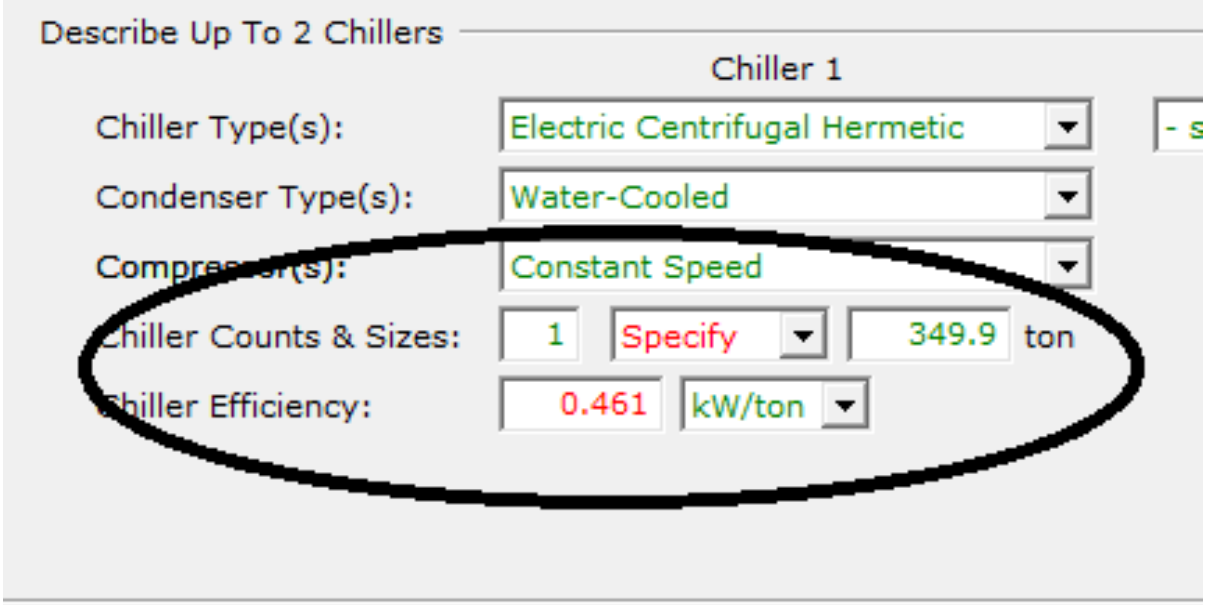
Chiller VSD Example – eQUEST

Below is an example using the eQUEST schematic design wizard, for replacing an existing chiller, with a new chiller (one-for-one replacement); Dual Baseline review is covered.

Building and Equipment Characteristics::

- Large Office located in 92128
- Vintage of building is 1997
- Existing Chiller: 350 tons, water-cooled, centrifugal
- Proposed Chiller: 350 tons, water-cooled, centrifugal, efficiency = 0.461 kW/ton
- DEER EUL = 20 years

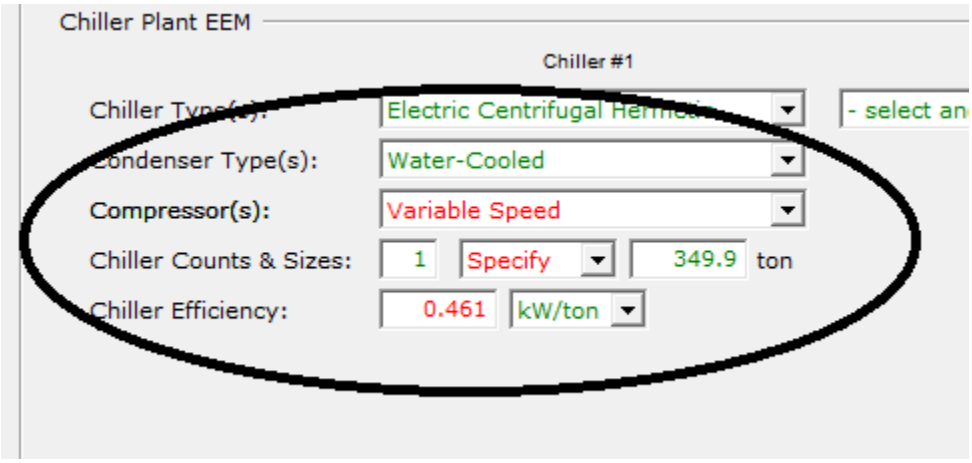
Building Creation Wizard - Baseline



Create an office building model. From the Chiller Input screen, select Constant Speed in the ***Compressor(s)*** field and enter 0.461 in ***Chiller Efficiency*** field.

Energy Efficiency Measure Wizard - Proposed

Next, add a comparison model by selecting Variable Speed in the ***Compressor(s)*** field and enter 0.461 in ***Chiller Efficiency*** field.



eQUEST Output Reports – Energy Savings

Below is an output of the eQUEST models comparing the two energy consumptions of both types of chillers constant speed and variable speed drive. Note: the savings is circled at the bottom of the page.

Annual Electric Energy by Enduse (pg 1 of 4)

	Ambient Lights	Task Lights	Misc Equip	Space Heating	Space Cooling	Heat Reject	Pumps & Aux	Vent Fans	Dom Ht Wtr	Exterior Usage	Total
Annual Energy USE (kWh)											
0 Base Design	395,842	51,216	521,099	0	231,097	31,940	128,598	96,004	0	0	1,455,805
1 0+Chiller Plant EEM	395,842	51,216	521,099	0	196,634	31,484	128,598	96,004	0	0	1,420,887
Incremental SAVINGS (MWh) (values are relative to previous measure (% savings are relative to base case use), negative entries indicate increased use)											
1 0+Chiller Plant EEM	0.00 (0%)	0.00 (0%)	0.00 (0%)	--	34.46 (15%)	0.46 (1%)	0.00 (0%)	0.00 (0%)	--	--	34.92 (2%)

- Energy Saved = 34,460 kWh

eQUEST Output Reports – Demand Savings

You will notice for this example the demand savings is negative. This indicates that the model is looking at the full load operation of the chiller On-Peak and there is an energy penalty for the energy used to operate the drive.

Annual Electric Coincident Peak Demand by Enduse (pg 2 of 4)

	Ambient Lights	Task Lights	Misc Equip	Space Heating	Space Cooling	Heat Reject	Pumps & Aux	Vent Fans	Dom Ht Wtr	Exterior Usage	Total
Annual Energy Coincident Demand (kW)											
0 Base Design	148.2	22.7	152.8	0.0	165.7	31.1	46.6	43.5	0.0	0.0	610.6
1 0+Chiller Plant EEM	148.2	22.7	152.8	0.0	173.5	31.9	46.6	37.3	0.0	0.0	613.0
Incremental SAVINGS (kW) (values are relative to previous measure (% savings are relative to base case demand), negative entries indicate increased demand)											
1 0+Chiller Plant EEM	0.00 (0%)	0.00 (0%)	0.00 (0%)	--	-7.79 (-5%)	-0.76 (-2%)	0.00 (0%)	6.16 (14%)	--	--	-2.39 (-0%)

- Demand Saved? = **-2.4 kW (increased)**

Chiller VSD Example – Tool Savings Comparison

Varied results are provided by the three modeling techniques. Modified READI is the most simple and preferred. If the results of the modified READI Tool do not accurately represent the building performance, a model calibrated to site operating conditions and annual energy consumption can be used. All eQUEST files should be submitted with an eQUEST model.

Which Value should be used?

	kWh saved	kW saved
Modified READI	63,000	29
CCT	183,407	51.9
eQUEST	34,460	-2.4

Note: *M&V is required for larger savings claims*

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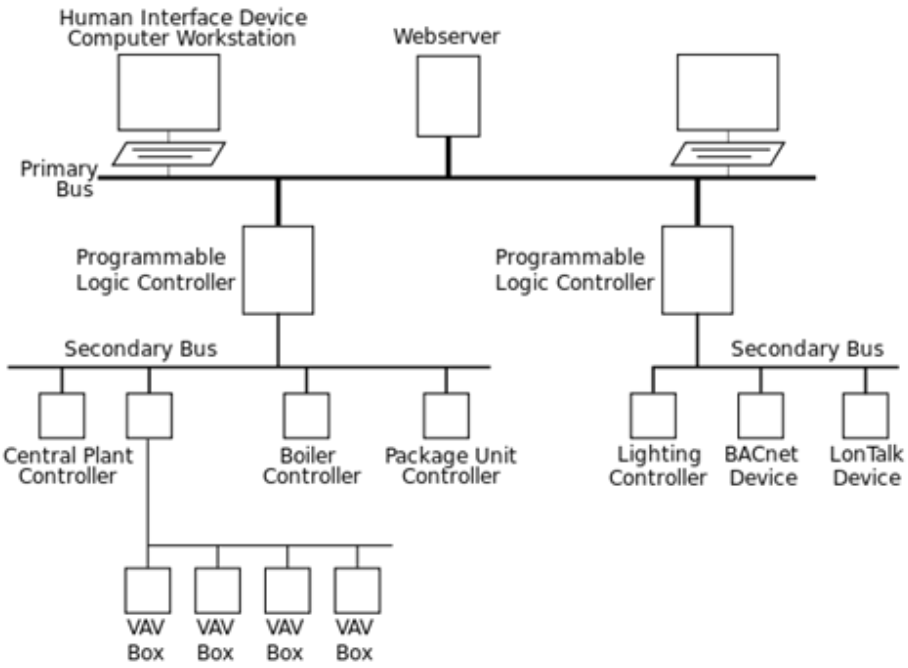
Controls



First check the ***DEER to Deemed Rebate Table*** (See website and/or Appendix). Many controls incentive measures are now limited by 2013Title 24 Code requirements.

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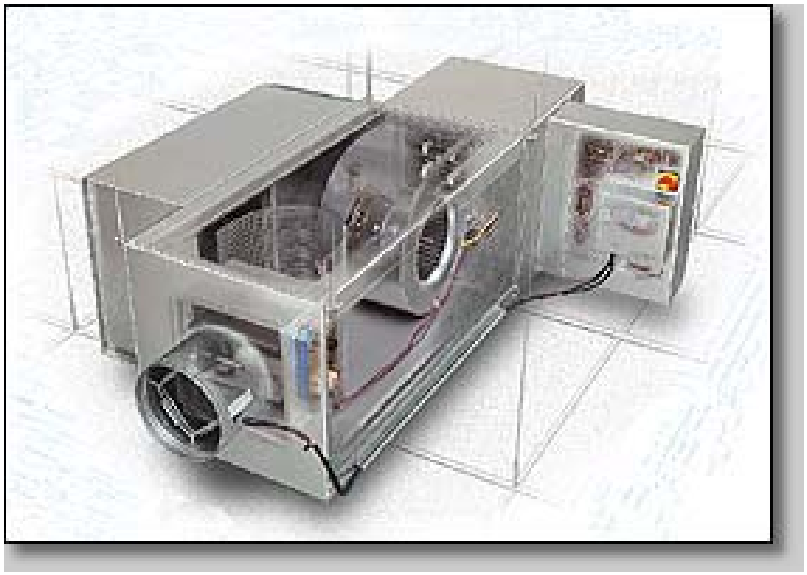
Constant Air Volume (CAV) to Variable Air Volume (VAV)



Savings Calculation Tools

DEER To Deemed Rebate Table

SDGE connected — A Sempra Energy utility

HVAC & Refrigeration Products

Product Code	READI Measure ID	Description	Units	Rebate $/Unit
DM-02	D03-044	Chilled Water Reset	per controller	TBD
DM-03	D03-045	Hot Water Reset	per controller	TBD
DM-04	D03-046	Variable Flow Chilled Water Loop	Rated-HP	TBD
DM-05	D03-047	VSD Chilled Water Loop Pump	Rated-HP	TBD
DM-06	D03-048	Variable Flow Hot Water Loop	Rated-HP	TBD
DM-07	D03-049	VSD Hot Water Loop Pump	Rated-HP	TBD
DM-08	D03-050	Variable Air Volume Box	Area-1kFP	TBD

Convert a constant air volume system to variable air volume (VAV) by installing VAV boxes or convert constant volume Dual Duet system to VAV using new control system and additional zone dampers. Use rebate product code DM-08.

Project Type

Retrofit-Add-On, 15 year life, per DEER database

CAV to VAV – Lab Conversion Spreadsheet Analysis

XYZ Pharmaceuticals
Building energy use reduction-Phase I

AH 1-01 CV to Phoenix VAV Conversion &

Air Handling System Energy Saving

Existing Air Handling System	CFM	TSP in. H2O	Motor HP	Fan kW	Remarks	kWh
AH 1-01	15,500	2.4	50	7.9	24 hours, constant volume	69,222
Total	15,500		50	7.9		69,222
New Air Handling System						
AH 1-01	9,940	2.08	20	4.4	24 Hours, variable volume, VSD was added	25,392
Total	9,940		20	4.4		25,392
AH 1-01 Fan Saving						
AH 1-01 Cooling Saving						
AH 1-01 Heating/Reheat Saving						
CV conversation to VAV Phoenix system						
AH-01 and EF 1-1	CV kWh	VAV kWh				
Fan Saving	145,340	54,760				
Cooling Saving	92,747	51,550				
	CV Therm	VAV Therm				
	16,813	6,639				
Savings				3.5		

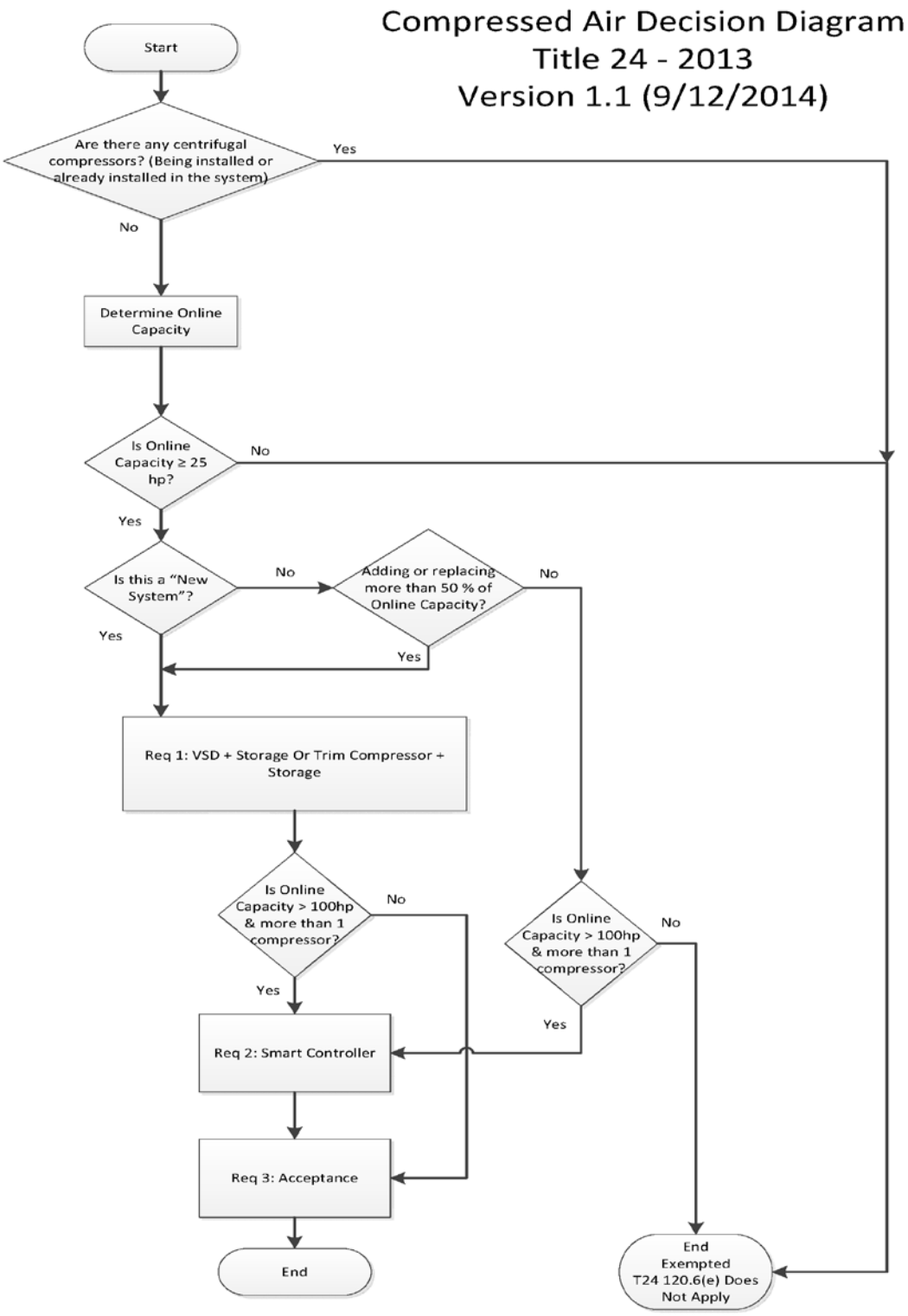
Exhaust Fan System Energy Savings

Existing Exhaust Fan System	CFM	TSP in. H2O	Motor HP	Fan kW	Remarks	kWh
EF 1-01	26,000	2.25	20	12.4	24 hr Const Vol.	108,858
EF 1-02	26,000	2.25	20	12.4	24 hr Const Vol.	108,858
EF 1-03	1,500	1	0.5	0.3	24 hr Const Vol.	2,791
EF 1-04	6,650	1	2	1.4	24 hr Const Vol.	12,374
EF 1-23	2,550	1	1	0.5	24 hr Const Vol.	4,745
EF 1-24	26,000	2.5	20	13.8	24 hr Const Vol.	120,953
Total	88,700		63.5	40.9		358,579
New Exhaust Fan System						kWh at 66%full load
EF 2-1	10,500	1.6	9.45	3.6	24 hr Const Vol. Variable volume with VSD	20,633
EF 2-2	7,030	0.7	2.57	1.0	24 hr Const Vol. Constant volume with VSD	6,044
EF 2-3	11,340	1.111	6.32	2.7	24 hr Const Vol. Constant volume with VSD	15,473
EF 1-23	1,380	0.357	0.46	0.1	24 hr Const Vol.	605
Total	30,250		18.8	7.4		64,779
Savings				33.5		

For laboratory conversions that do not trigger code evaluations, a spreadsheet analysis can be performed. Fan air flows and power are logged before and after modifications. Lab Pro is used to chiller and heating savings from reduced air flow.

Air Compressors

Compressed Air Decision Diagram – Title 24, 2013



Looking at the decision chart on the previous page, will help to determine whether the changes to Title 24 code apply to the project being submitted. Beginning from the diamond, decide whether there are any centrifugal compressors. If Yes, the project is exempt from Title 24 and can be submitted. Everything would be considered baseline current efficiency. If No, the utility needs to determine the online capacity of the compressors. The actual horsepower needs to be determined, not the nameplate capacity but the actual output capacity of the compressors in horsepower.

If the online capacity is less than 25HP, this project is exempt from Title 24. This project will be handled by the rebate program EEBR. A reservation needs to be made with the EEBR group for approval on this type of projects.

If the capacity is greater than 25HP, there is a new decision point to make. Looking at the system, the vintage of the system needs to be determined. Is this a new system? If No, the system is an older system, determine whether the capacity that is going to be added or replaced will be more than 50% of the online capacity. If Yes, the decision is equivalent to a new system, and Title 24 is required. This decision will necessitate variable speed drive, storage, and controls. The new requirements do not allow for the utility to provide an incentive.

If the additional capacity is less than 50% of the online capacity, the next decision is to determine whether the online capacity is less than 100HP and more than one compressor? If No, the project is exempt from Title 24 requirements. If Yes, the additional online capacity is less than 100HP, Smart Controls are required and the utility cannot provide an incentive in this case.

If the online capacity is larger than 100 HP and more than one compressor then one needs to install smart controls. The utility cannot provide an incentive for measures Title 24 requires.

The same applies to new system lodges in 100HP when smart controls are required.

5HP – 25HP Air Compressors: Deemed Measure

		Annual Electric Savings (kWh/HP/year)	Demand Reduction (kW/HP)
	5 up to 15 HP Variable Speed Drive on Air Compressor Control	491.48	0.15264
	15 up to 25 HP Variable Speed Drive on Air Compressor Control	421.65	0.13095

Small compressors will be handled by EEBR. These projects are categorized as deemed value under two groups:

- Compressors from 5 to 15HP
- Compressor 15 to 25HP

By calculating the respective kWh, per horsepower, per year horsepower and multiplying it by respective value, the annual is determined. These projects are rebated through EEBR.

Compressed Air – Title 24 requirement

This section reviews compressed air systems and the New Title 24 requirements for these components. The following topics will be discussed:

New compressed air systems and all editions alteration of compressed air with a total combined compressor powers over 25HP.

The compressed air system shall be equipped with appropriate size trim compressor in primary storage to provide acceptable performance across the range of the system and avoid control gaps. The objective is to have a system that does not consistently start and stop and is not energy efficient.

Lastly, compressed air systems with more than one compressor, having combined horsepower rating large and 100HP must operate with an approved controller that is able to choose the most efficient combination of compressors within the system based on the current air demand as measured by the sensor.

Air Compressor 2013 Code Requirements

Subsection 120.6 (e) of Title 24 code: Compressors larger than 25HP require trim compressor. Trim compressor may be with variable speed ability or operate at reduced load, good turndown ratio, with storage and controls. Most often businesses will install variable speed compressors rather than a small pony compressor.

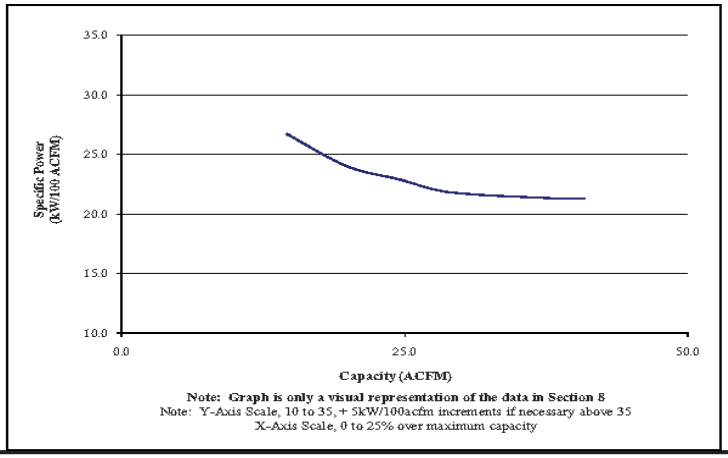
Note: *For new installations, construction inspection and functional testing is required by the local authorities.*

Air compressor project will require the submittal of a Compressed Air Gas Institute sheet (CAGI), showing the compressor demands and output in terms of CFM and KW per 100 CFM and pressure. All compressors, existing and new, will require the submittal of the CAGI sheet with values and specification specific to the compressor. (See CAGI Sheet – Next Page).

Compressed Air Gas Institute (CAGI) Sheet

COMPRESSOR DATA SHEET

Rotary Compressor: Variable Frequency Drive

MODEL DATA - FOR COMPRESSED AIR				
1	Manufacturer:	**Atlas Copco**		
2	Model Number:	**GA7VSD+-175 AP**	Date:	**7/25/2013**
	[X] Air-cooled [ ] Water-cooled		Type:	**Screw**
	[X] Oil-injected [ ] Oil-free		# of Stages:	**1**
3	Rated Operating Pressure		**125**	psig[b]
4	Drive Motor Nominal Rating		**10**	hp
5	Drive Motor Nominal Efficiency		**93.3**	percent
6	Fan Motor Nominal Rating (if applicable)		**0.29**	hp
7	Fan Motor Nominal Efficiency		**73**	percent
8*	Input Power (kW)		Capacity (acfm)[a,d]	Specific Power (kW/100 acfm)[d]
	8.7	Max	**40.9**	**21.3**
	8.2		**38.5**	**21.3**
	6.4		**29.2**	**21.8**
	5.6		**24.5**	**22.9**
	4.8		**19.9**	**24.0**
	3.9	Min	**14.6**	**26.7**
9*	Total Package Input Power at Zero Flow[c, d]		**0**	kW
10				

Note: Graph is only a visual representation of the data in Section 8
Note: Y-Axis Scale, 10 to 35, + 5kW/100acfm increments if necessary above 35
X-Axis Scale, 0 to 25% over maximum capacity

*For models that are tested in the CAGI Performance Verification Program, these items are verified by program administrator

Consult CAGI website for a list of participants in the third party verification program: www.cagi.org

NOTES:
a. Measured at the discharge terminal point of the compressor package in accordance with ISO 1217, Annex E; acfm is actual cubic feet per minute at inlet conditions.
b. The operating pressure at which the Capacity and Electrical Consumption were measured for this data sheet.
c. No Load Power. In accordance with ISO 1217, Annex E, if measurement of no load power equals less than 1%, manufacturer may state "not significant" or "0" on the test report.
d. Tolerance is specified in ISO 1217, Annex E, as shown in table below:
NOTE: The terms "power" and "energy" are synonymous for purposes of this document.

Member

CAGI Compressed Air & Gas Institute

Volume Flow Rate at specified conditions		Volume Flow Rate	Specific Energy Consumption	No Load / Zero Flow Power
m^3 / min	ft3 / min	%	%	
Below 0.5	Below 15	+/- 7	+/- 8	
0.5 to 1.5	15 to 50	+/- 6	+/- 7	+/- 10%
1.5 to 15	50 to 500	+/- 5	+/- 6	
Above 15	Above 500	+/- 4	+/- 5	

ROT 031

10/11 R7 This form was developed by the Compressed Air and Gas Institute for the use of its members. CAGI has not independently verified the reported data.

Custom Energy Savings Calculations

This section discusses the different tools used to evaluate air compressors and determine savings.

- Air Master
- Custom Calculation Tool (CCT)-2013 Software Tool
- Custom Energy Savings Calculations (Spreadsheet – small compressor systems)

Each tool requires measurement of the compressors. Compressors are specific to each facility. Each facility has different demand profiles. Therefore, estimations cannot be used. The utility needs to record the actual load, either CFM or the demand profile of the compressors.

This section will provide an overview of the software and the entry fields that are required for each program.

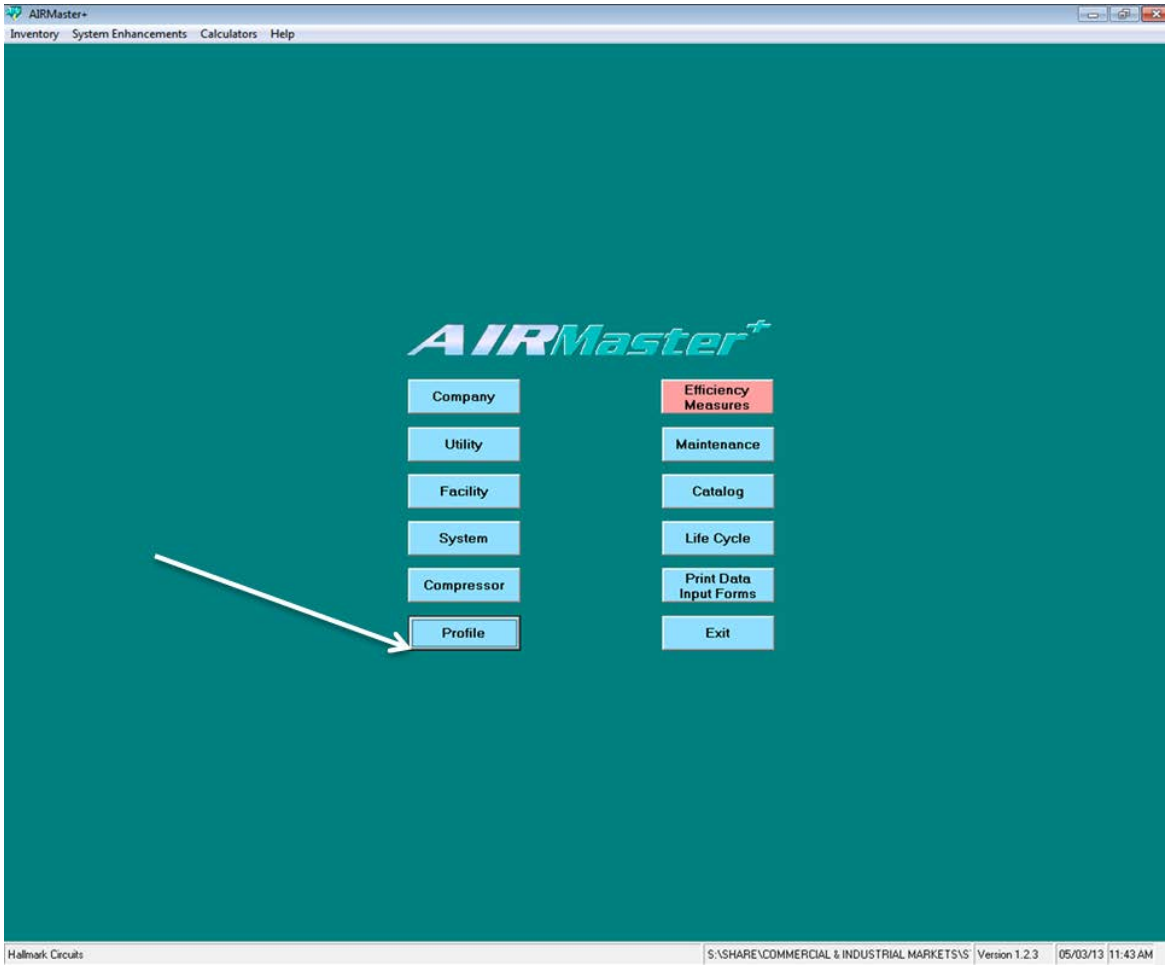
Air Master Software Program

The first program, Air master - Developed by DOE, and Maintained by University of Washington. This software is free and downloadable using the link below:

http://www1.eere.energy.gov/manufacturing/tech_assistance/software_airmaster.html

Home Screen:

Step 1: Click on Profile



Profile:

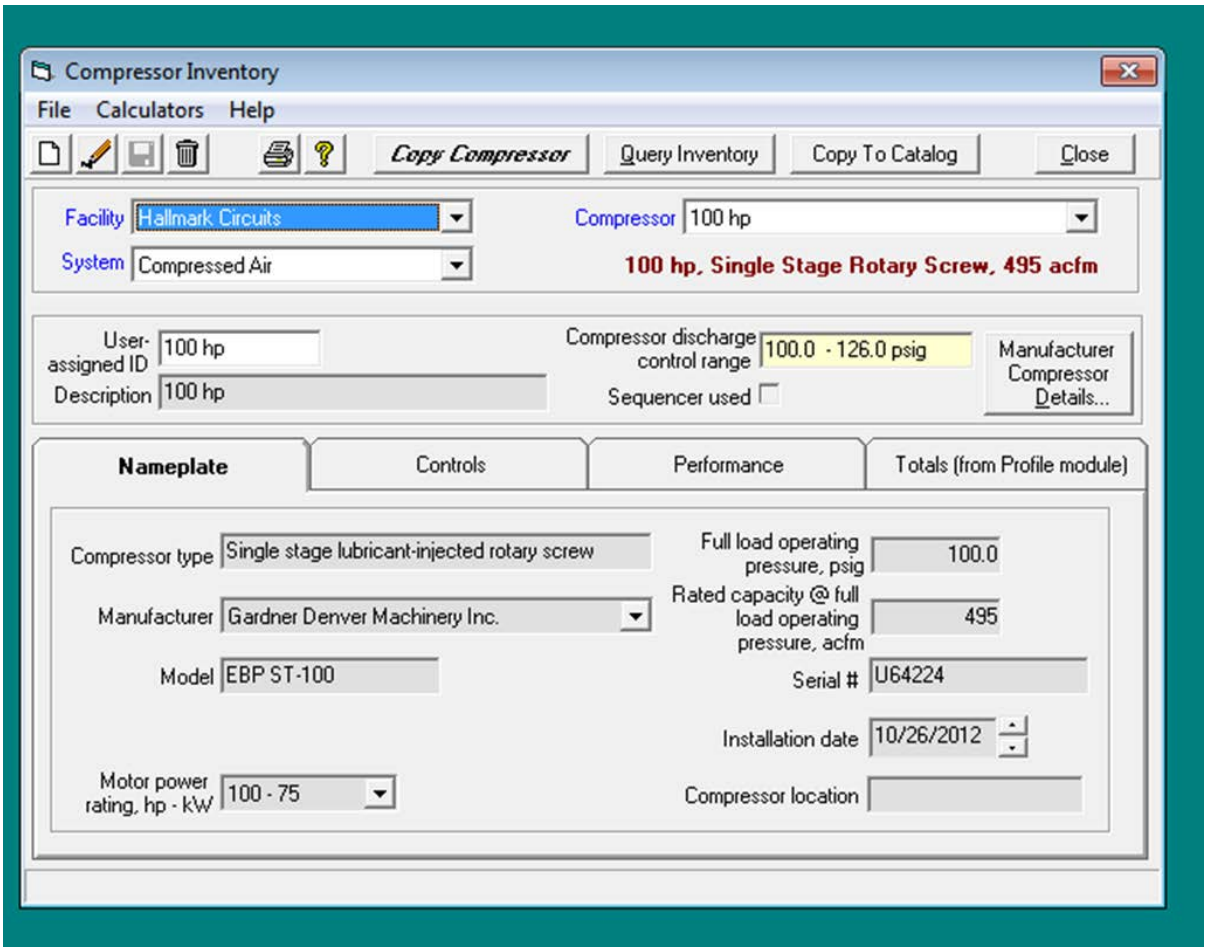
Required entry fields to compile information about the compressor.

- Facility Type
- System (Type of a compressor)
- Compressor (Horsepower)

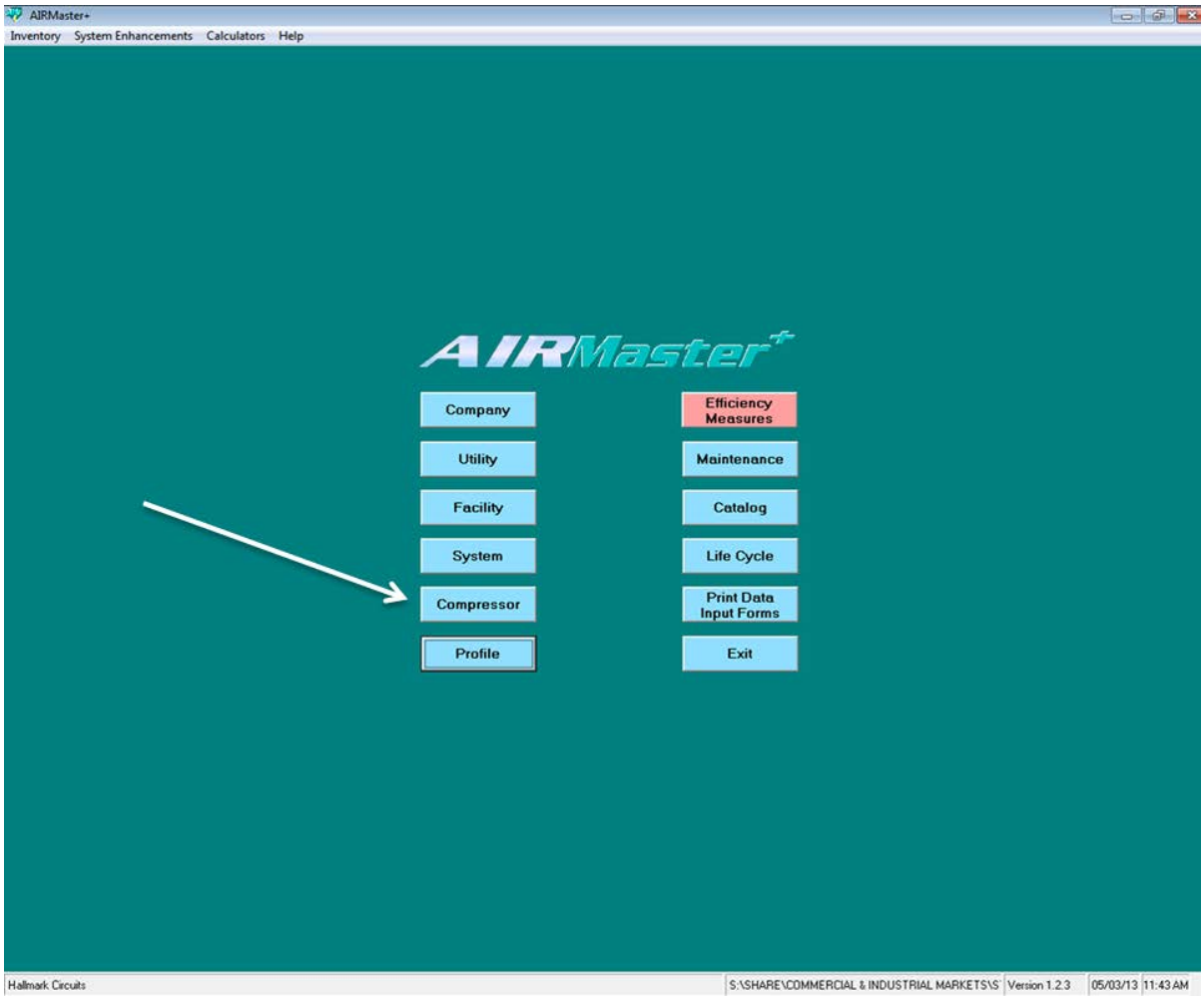
Enter fields for each tab – Nameplate, Controls, and Performance.

Nameplate Tab:

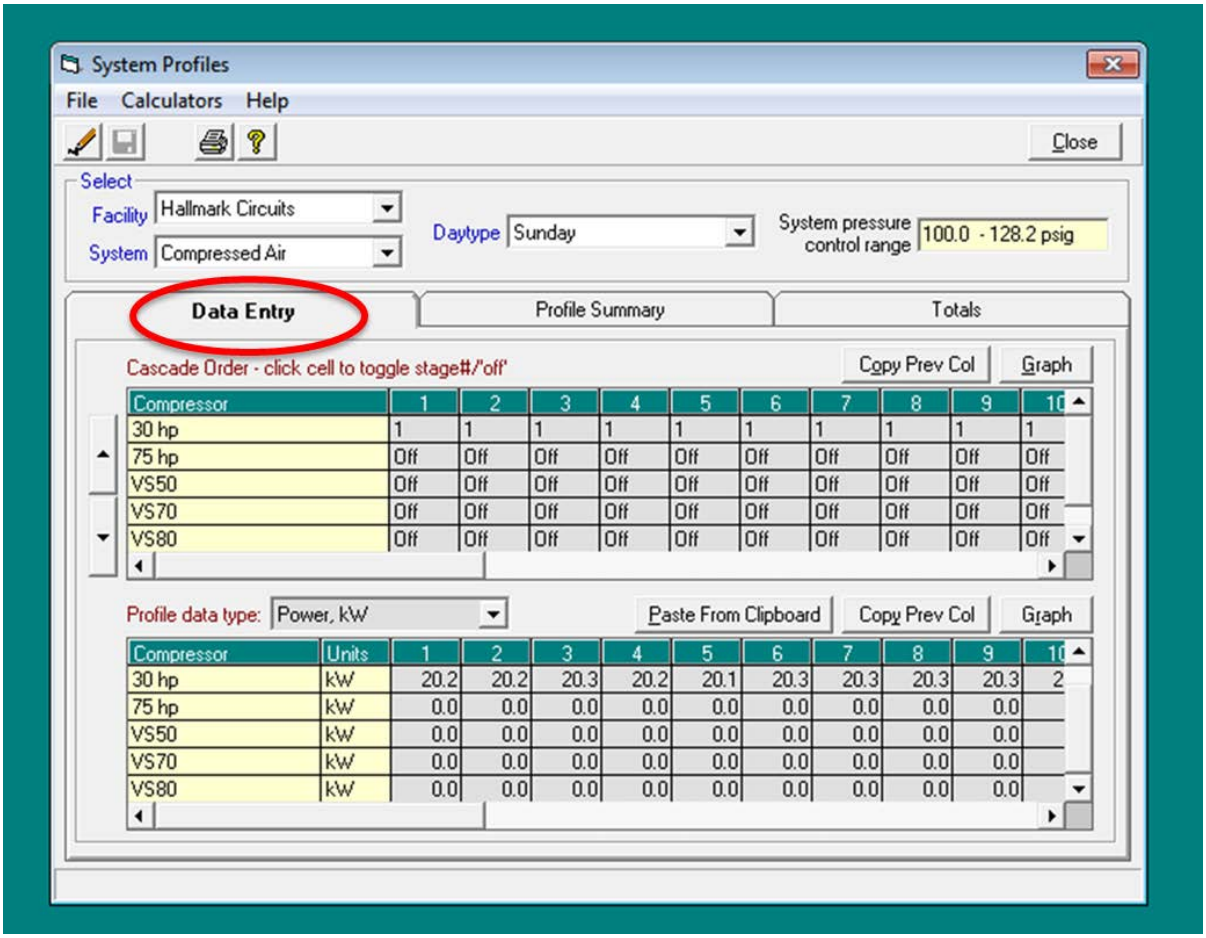
- Compressor type
- Manufacturer (drop-down)
- Model
- Pressure
- CFM flow



Step 2: Click on each box to supply required information

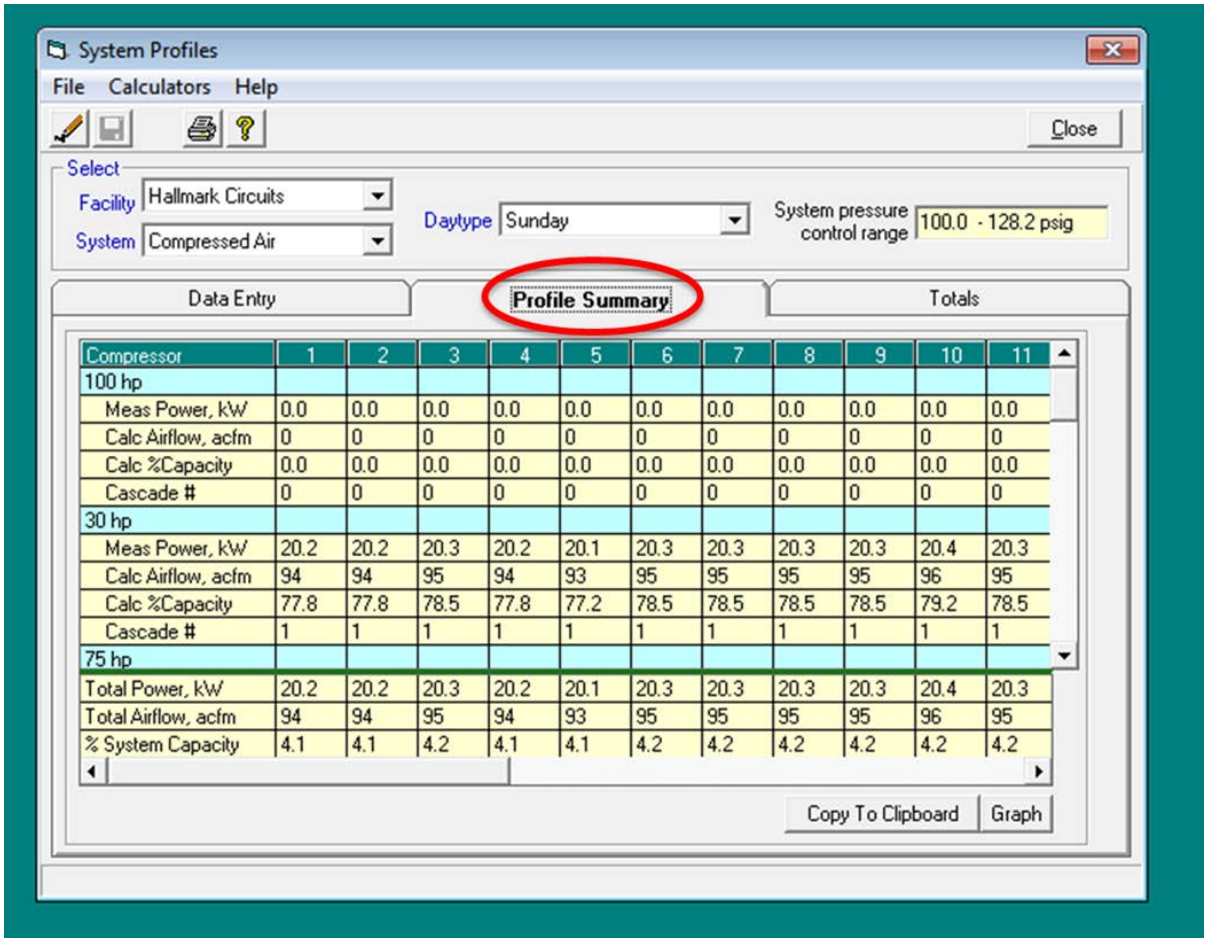


Data Entry:



In this case there are several compressors onsite. In this section, the hours of operation for the compressor are identified detailing when the compressors are on or off. In the table above the kW during various hours of the day are seen. The energy used varies between 20.1 kW and 20.3 kW in the early part of the morning.

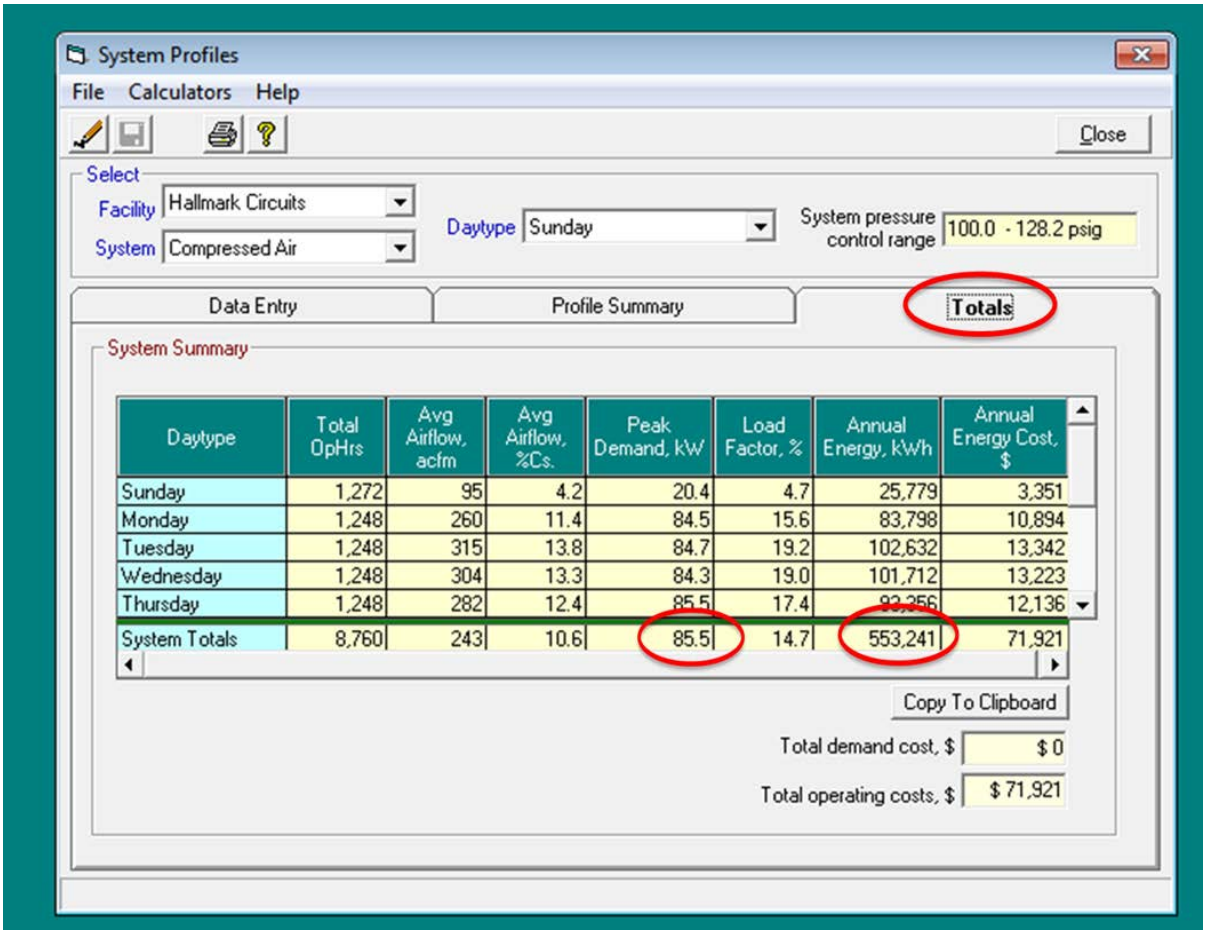
Profile Summary:



Compressor	1	2	3	4	5	6	7	8	9	10	11
100 hp											
Meas Power, kW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calc Airflow, acfm	0	0	0	0	0	0	0	0	0	0	0
Calc %Capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cascade #	0	0	0	0	0	0	0	0	0	0	0
30 hp											
Meas Power, kW	20.2	20.2	20.3	20.2	20.1	20.3	20.3	20.3	20.3	20.4	20.3
Calc Airflow, acfm	94	94	95	94	93	95	95	95	95	96	95
Calc %Capacity	77.8	77.8	78.5	77.8	77.2	78.5	78.5	78.5	78.5	79.2	78.5
Cascade #	1	1	1	1	1	1	1	1	1	1	1
75 hp											
Total Power, kW	20.2	20.2	20.3	20.2	20.1	20.3	20.3	20.3	20.3	20.4	20.3
Total Airflow, acfm	94	94	95	94	93	95	95	95	95	96	95
% System Capacity	4.1	4.1	4.2	4.1	4.1	4.2	4.2	4.2	4.2	4.2	4.2

This tab provides an operating summary of all compressors on site. The review engineers can see the kW inputted based on current logger reading and are able to see the calculated CFM airflow at all hours of the day and the percent of the capacity for each compressor.

Totals



The tab allows for a day type view for the weekday. Saturday and Sunday is a different day type compared to the work week. The datatype is different, providing readings for each day type. The system summarizes the total demand and the existing annual electric consumption; in this case, 553,241 kWh, with a total operating cost of $71,921. The same data input is used for pre-and post-conditions to calculate savings.

CCT-2013 Software Tool

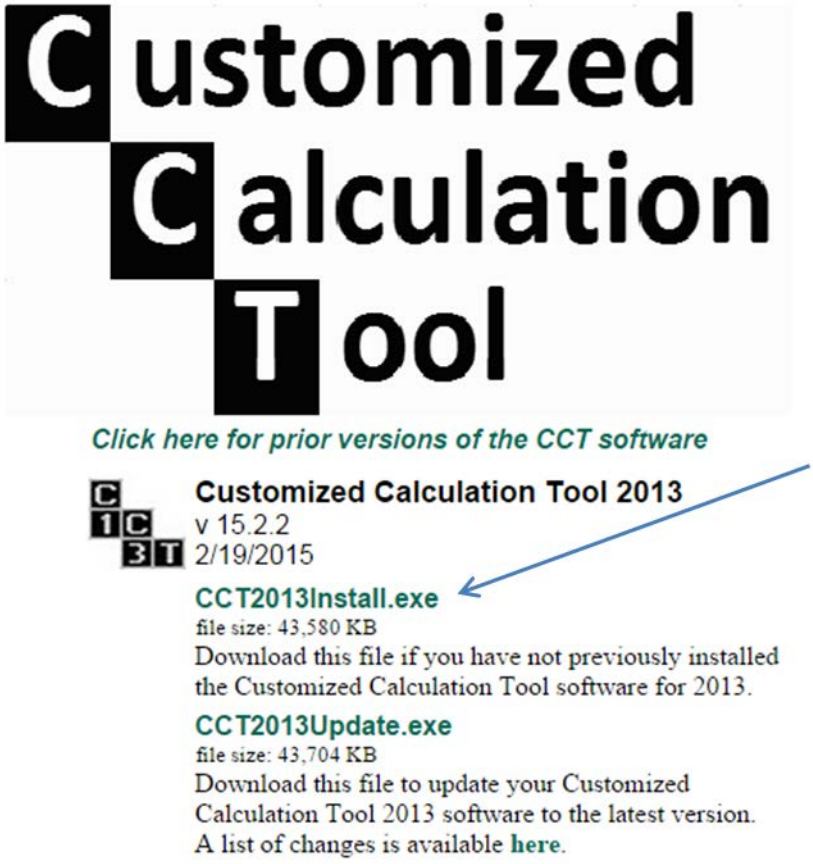
The Customize Calculation Tool (CCT tool) for Energy Efficiency Business Incentives is the second tool available for submitting compressor projects.

This software is free and downloadable using the link below:

http://www.aesc-inc.com/download/spc/

First-Time Users:

Home screen view for first-time users. Download .exe file by clicking on the link identified below:



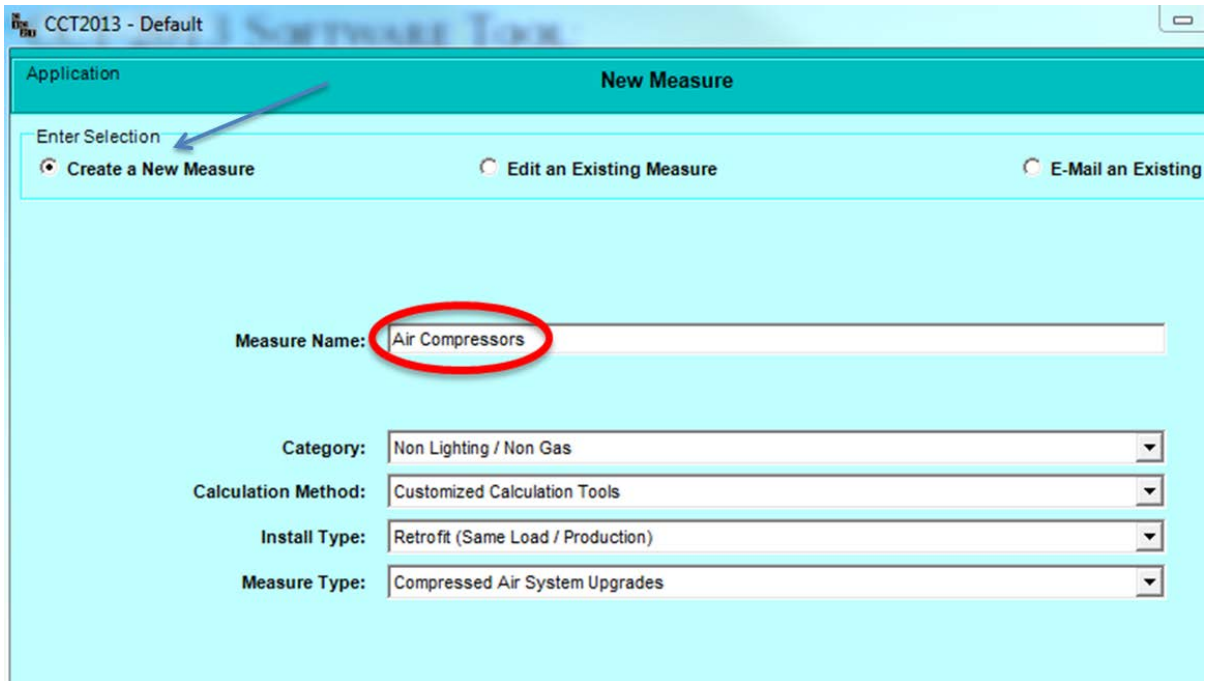
Home Screen – Returning Users:

Very similar to previous tool, details about the compressor operation is entered.

The following pages will outline the software screens within the Customized Calculation Tool.

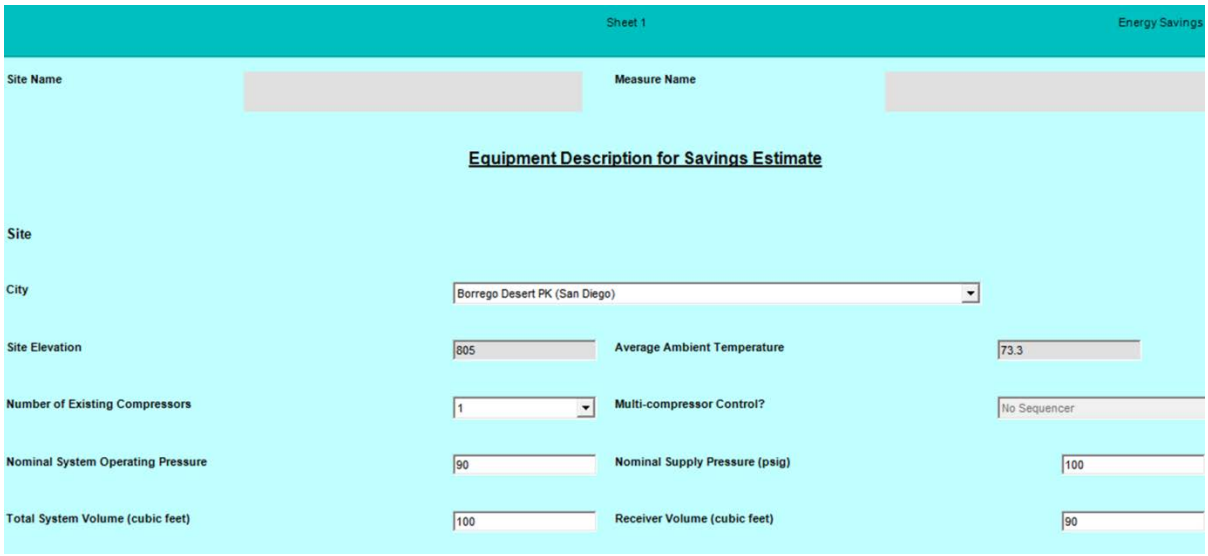
Step 1: Click on Create or Edit Application

Create a new Measure

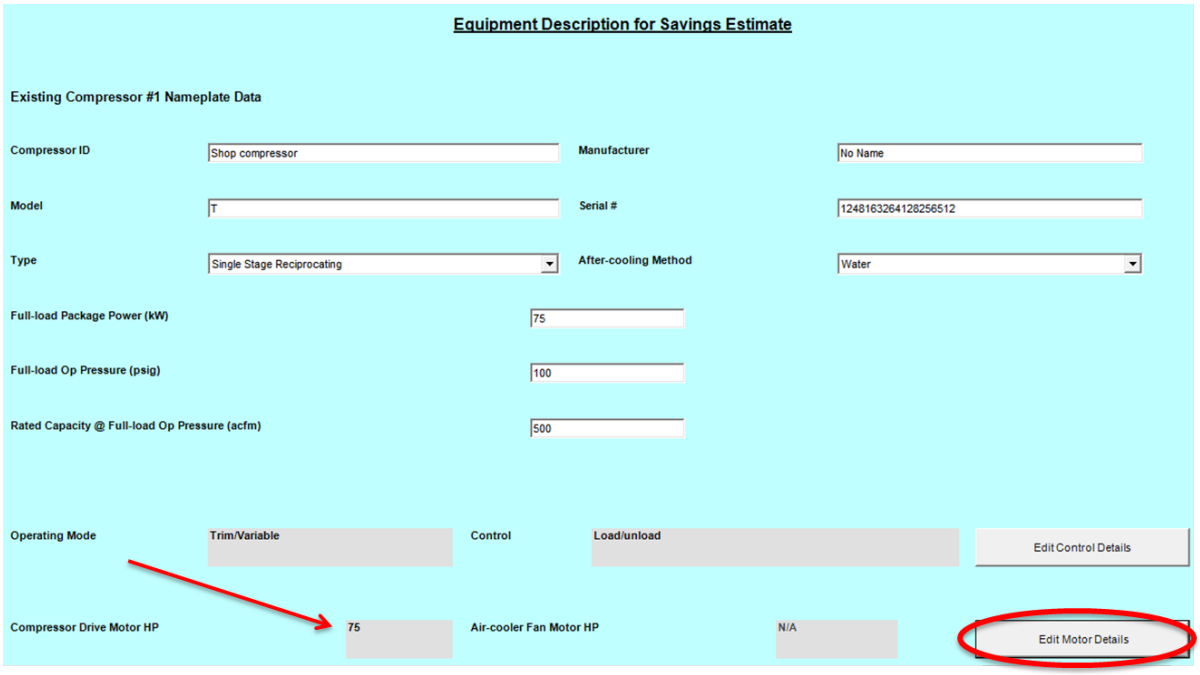


Step 2: Begin entering Equipment Description

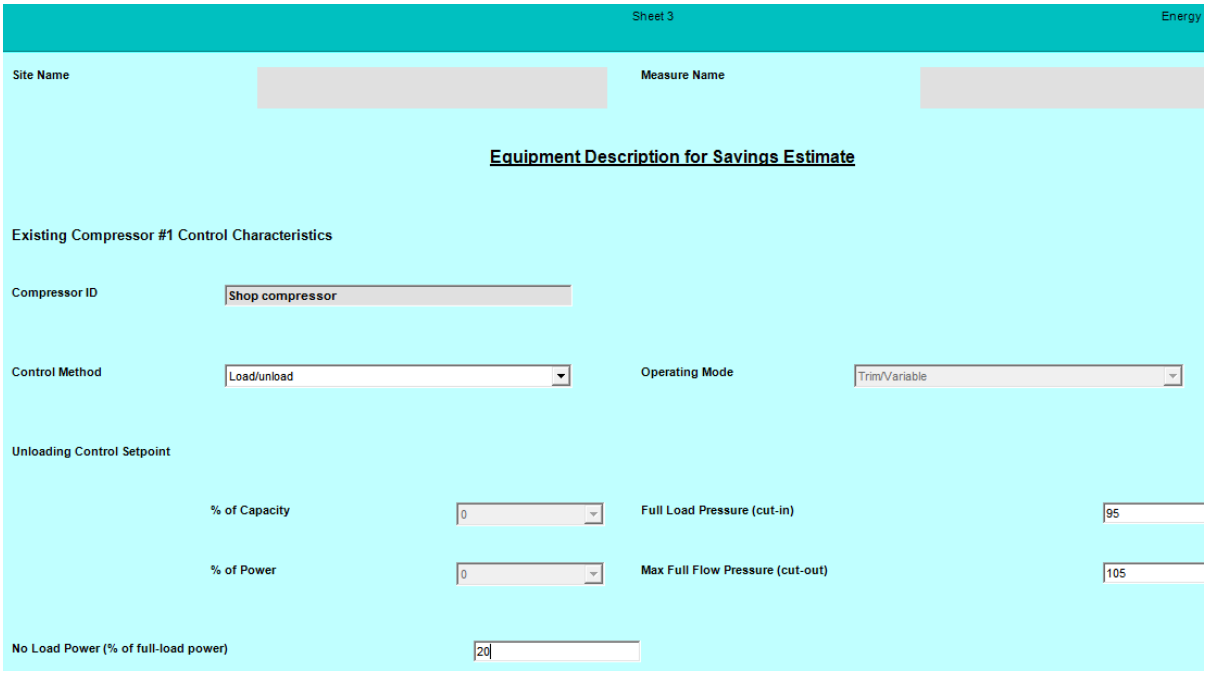
First Input Sheet – Site Information



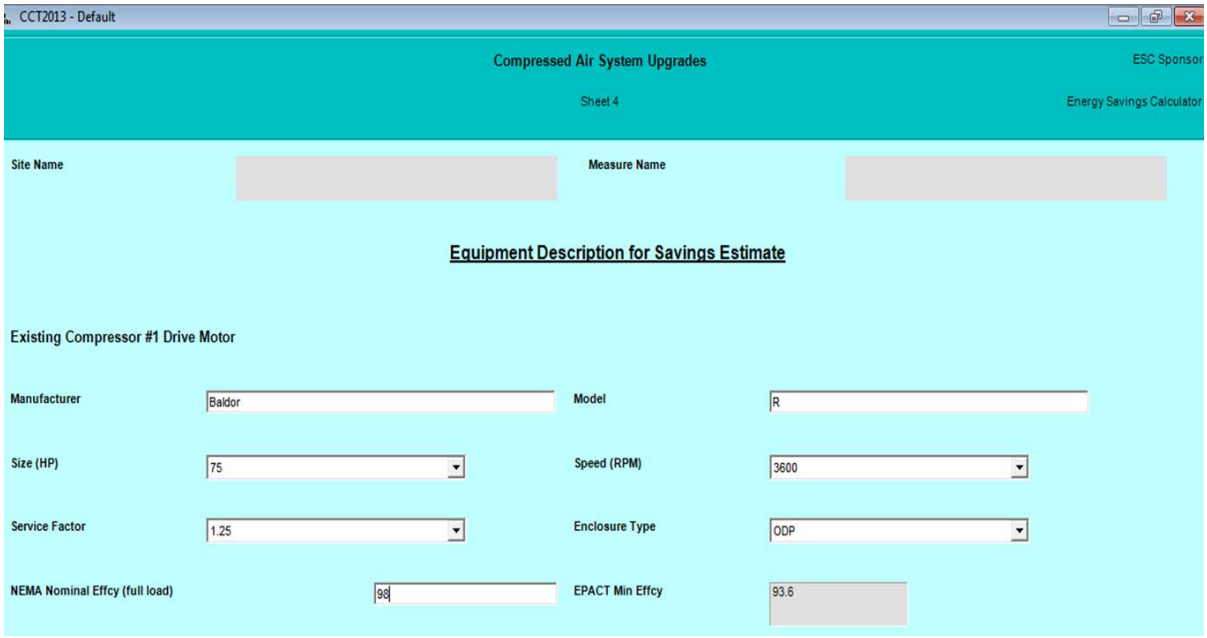
Second Input Sheet – Existing Compressor Nameplate Data



Third Input Sheet



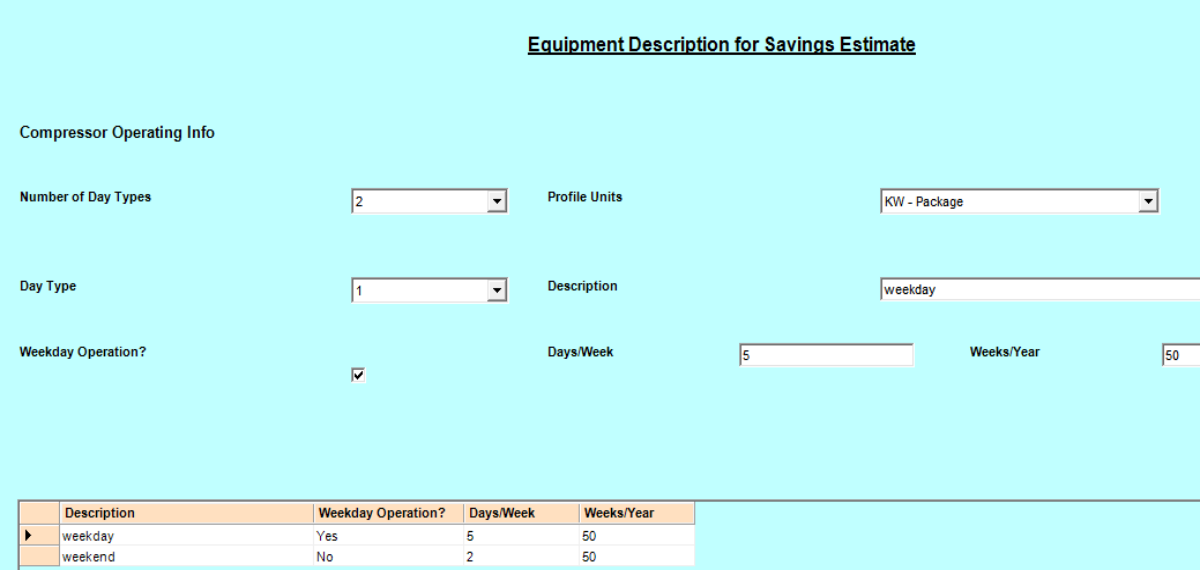
Fourth input – Existing Compressor Drive Motor



Data information of the existing compressor drive motor – Example shown in blue below:

- Manufacture **Baldor**
- Size (horsepower) **75HP**
- Service Factor **1.25**
- NEMA Nominal Efficiency (full load) **98%**
- Model **R**
- Speed (RPM) **3600 RPM**
- Enclosure Type **ODP**
- EPACT minimum Efficiency **93.6**

Fifth Input – Compressor Operating Information, Schedule



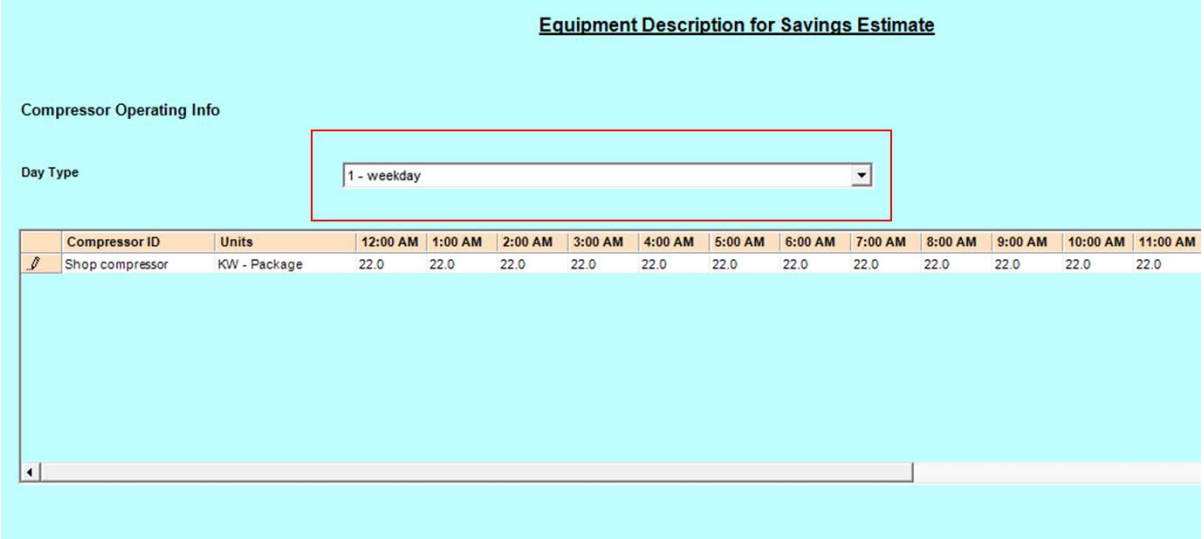
The fifth input sheet requires the input of operation schedule.

- **Description** – Weekday or Weekend
- **Weekday Operation** – Yes or No
- **Days / Week** – enter a numeric number 0 – 7
- **Weeks / Year** – enter a numeric number 0 – 52

Note: *In the example you see the following inputs:*

- Weekday – operation five days a week 50 weeks per year
- Weekend - operation two days a week 50 weeks per year

Sixth Input – Compressor Operating Information, Hourly Data



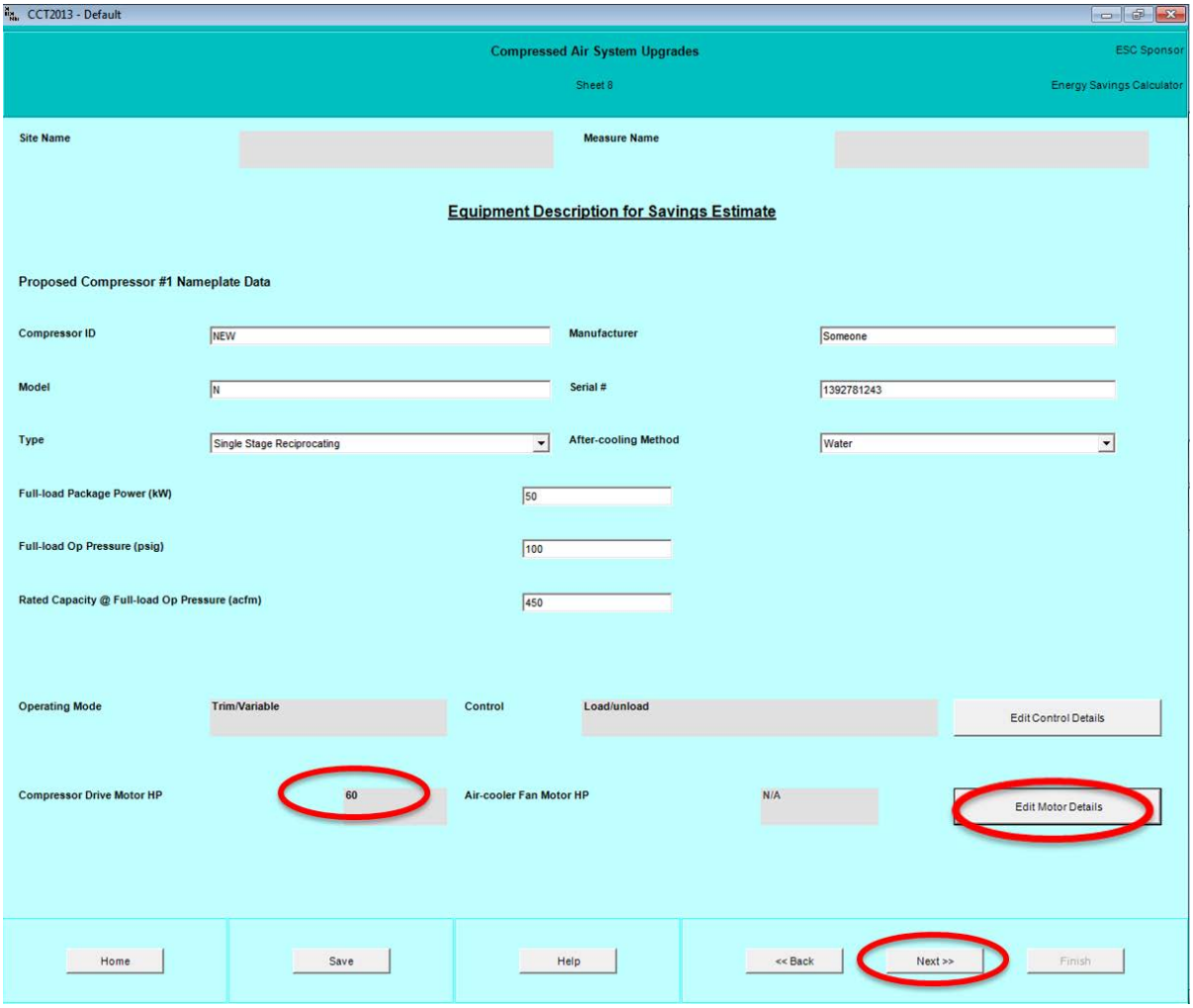
The six input sheet begin with entering the Day Type from the drop-down.

- Weekday – Type 1
- Weekend – Type 2

Select the Pencil Icon to edit and enter hourly kW data.

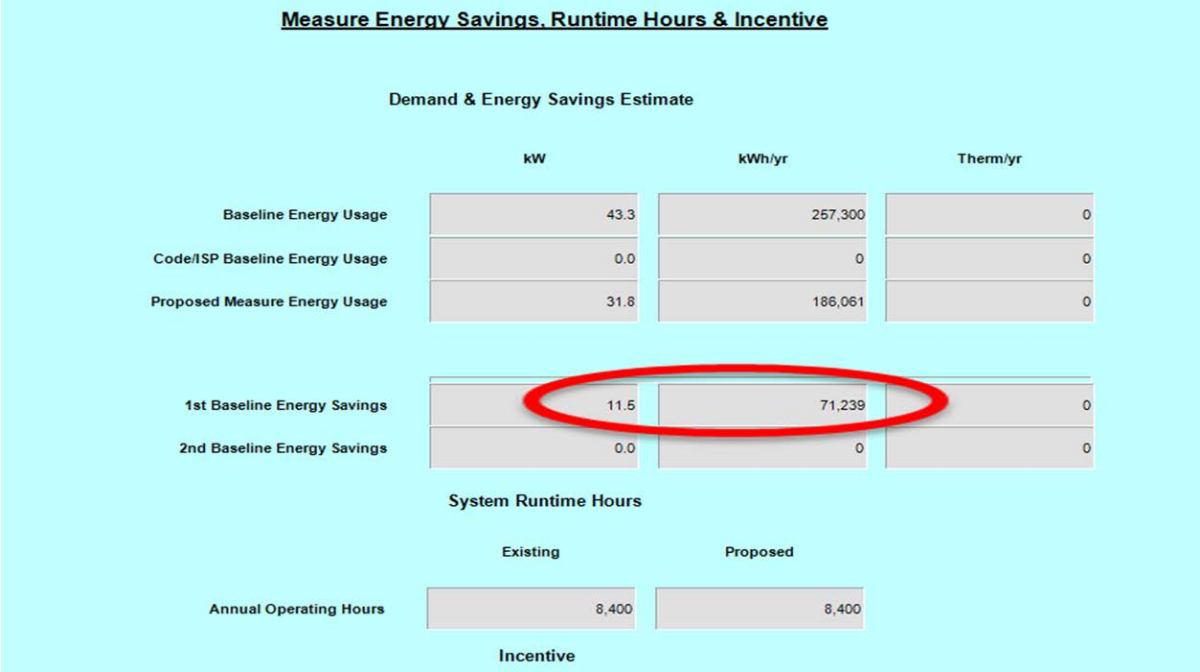
Note: *In the example the units are consistently 22.0 kW for the entire 24 hours.*

Seventh Input – Proposed Compressor Nameplate Data



Details about the proposed compressor are entered.

Output Sheet – Demand & Energy Savings Estimate



Measure Energy Savings, Runtime Hours & Incentive

Demand & Energy Savings Estimate

	kW	kWh/yr	Therm/yr
Baseline Energy Usage	43.3	257,300	0
Code/ISP Baseline Energy Usage	0.0	0	0
Proposed Measure Energy Usage	31.8	186,061	0
1st Baseline Energy Savings	11.5	71,239	0
2nd Baseline Energy Savings	0.0	0	0

System Runtime Hours

	Existing	Proposed
Annual Operating Hours	8,400	8,400

Incentive

Based on the data inputs, the Demand & Energy Savings Estimate is provided. The kW baseline and kW proposed is different.

The example shows a kW reduction from 43.3 kW to 31.8 kW, which renders a savings of **11.5kW**. The kWh/yr. reduction from 257,300 kWh/yr. to 186,061kWh/yr. with the proposed measure, which renders a savings of **71,239 kWh** annually on the 8,400 operating hours.

Energy Savings Sheet – Equipment Baseline Summary

Energy Savings Sheet

Statewide Customized Offering Program 2013

MEASURE #1 SUMMARY INFORMATION

Customized Calculation Tools - Compressed Air System Upgrades

Site Name ESC Site
Meter ID # ESC
Measure Name air compressor
Life of Measure in Years 0
Description

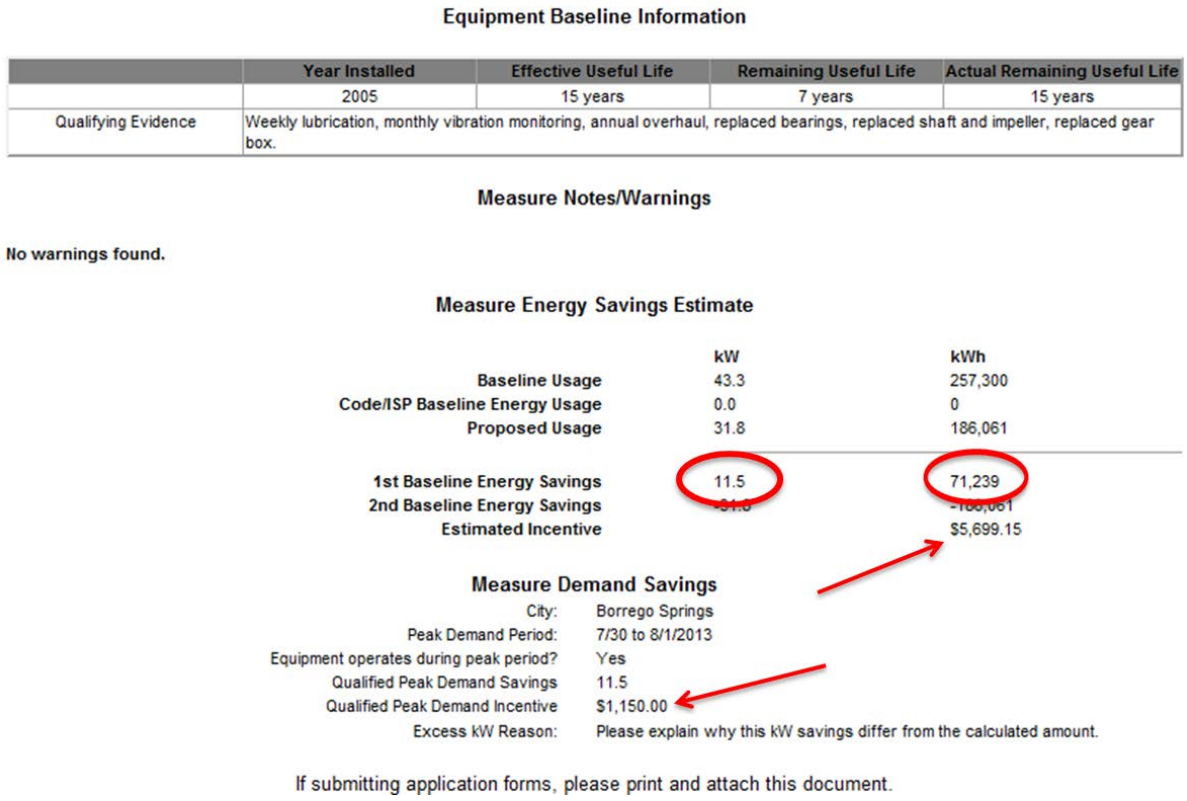
Site Characteristics

City	Borrego Desert PK (San Diego)		
Site Elevation	805	**Average Ambient Temperature**	73.3
Number of Existing Compressors	1	**Multi-compressor Control?**	No Sequencer
Nominal System Operating Pressure	90 psig	**Nominal Supply Pressure**	100 psig
Total System Volume	100 ft^3	**Receiver Volume**	90 ft^3

Equipment Specification

COMPRESSOR #1 INFORMATION			
Compressor ID	Shop compressor	**Manufacturer**	No Name
Model	T	**Serial Num**	1248163264128256512
Compressor Type	Single Stage Reciprocating	**After-cooling Method**	Water
Full-load Package Power (kW)	75.0		
Full-load Op Pressure	100 psig		
Rated Capacity at Full-load pressure	500 acfm		

Energy Savings Sheet – Savings Information Sheet



Equipment Baseline Information

	Year Installed	Effective Useful Life	Remaining Useful Life	Actual Remaining Useful Life
	2005	15 years	7 years	15 years
Qualifying Evidence	Weekly lubrication, monthly vibration monitoring, annual overhaul, replaced bearings, replaced shaft and impeller, replaced gear box.			

Measure Notes/Warnings

No warnings found.

Measure Energy Savings Estimate

	kW	kWh
Baseline Usage	43.3	257,300
Code/ISP Baseline Energy Usage	0.0	0
Proposed Usage	31.8	186,061
1st Baseline Energy Savings	11.5	71,239
2nd Baseline Energy Savings		
Estimated Incentive		$5,699.15

Measure Demand Savings

City:	Borrego Springs
Peak Demand Period:	7/30 to 8/1/2013
Equipment operates during peak period?	Yes
Qualified Peak Demand Savings	11.5
Qualified Peak Demand Incentive	$1,150.00
Excess kW Reason:	Please explain why this kW savings differ from the calculated amount.

If submitting application forms, please print and attach this document.

The Energy Savings Sheet summarizes each of the measures in the project. The sheet is displayed by the specification of the compressor. The Equipment Baseline Information provides the qualifying evidence based on the year the equipment was installed and renders the effective useful life and remaining useful life.

The bottom portion of the summary sheet provides the energy savings and the Qualified Peak Demand Incentive.

Custom Energy Savings Calculations

Hourly Load Profile – Recorded Weekly Demand Profile

hourly load Profile from recorded "Weekly demand profile"

												total
hour of the day	6	7	8	9	10	11	12	13	14	15	16	
acfm	15	23	29	25	26	27	28	28	32	24	29	
baseline Curtis RS20 Load/ no load compressor												
baseline compressor full load acfm	92	92	92	92	92	92	92	92	92	92	92	
% time loaded	16.30%	25.00%	31.52%	27.17%	28.26%	29.35%	30.43%	30.43%	34.78%	26.09%	31.52%	
full load power	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	
no load power	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	
fan kW = .5 hip x .746/.9	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	
hourly compressor + fan kW	9.0	10.0	10.8	10.3	10.4	10.5	10.7	10.7	11.2	10.2	10.8	114.6
annual total kWh - 5 days per week 50 weeks per year												28658

baseline compressor logged operation - load and no-load hours		%	
measured loaded time	12 hr.	0.285714	
measured unloaded time	30 hr.	0.714286	
average kW		10.4573	
annual hours		2750	
		28758 kWh	(agrees with load profile calculations, above)

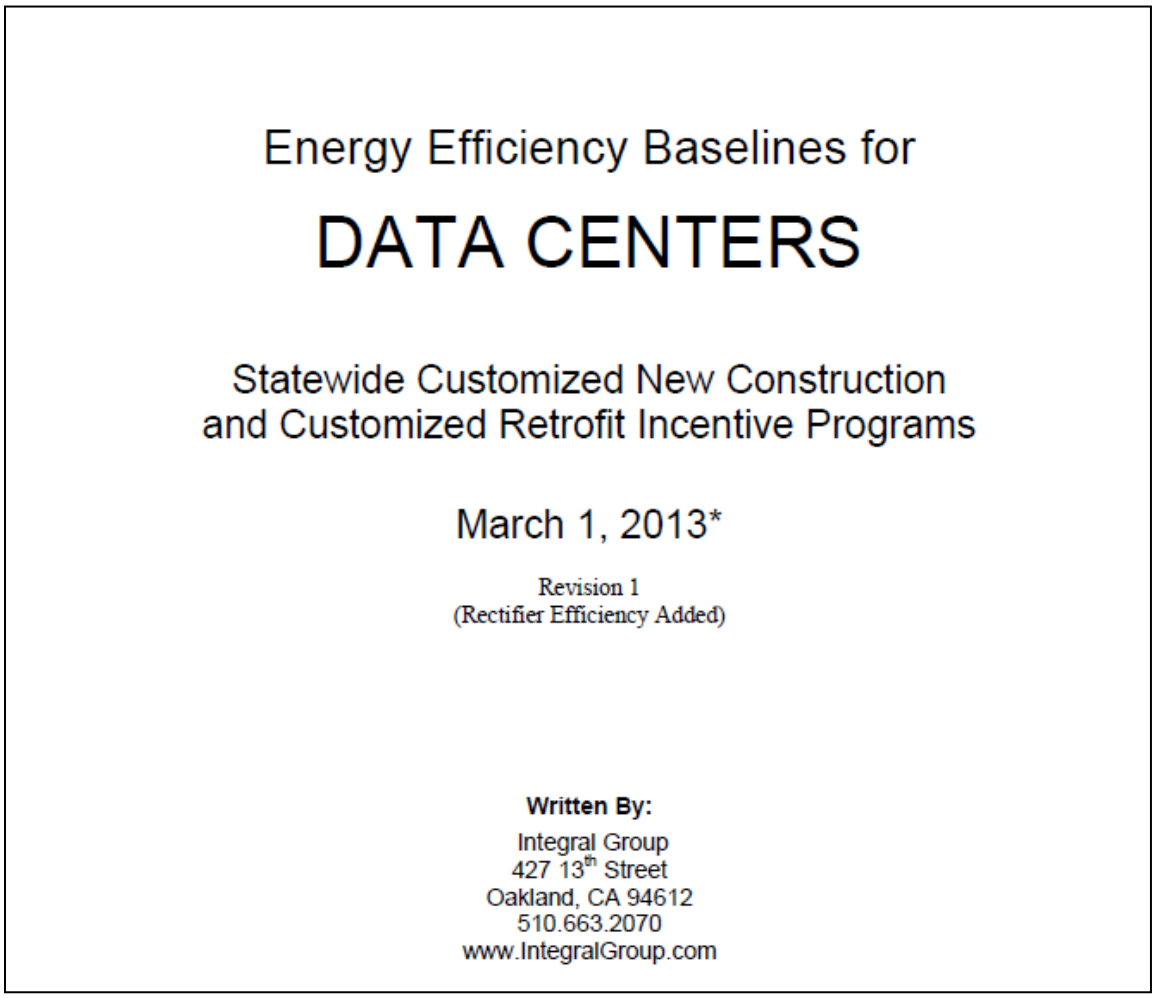
proposed VSD Compressor												
full load acfm	78.4	78.4	78.4	78.4	78.4	78.4	78.4	78.4	78.4	78.4	78.4	
% full load	19.13%	29.34%	36.99%	31.89%	33.16%	34.44%	35.71%	35.71%	40.82%	30.61%	36.99%	
full load power, kW	11	11	11	11	11	11	11	11	11	11	11	
no load power, kW	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	
fan kW =.3 hip x .746/.9	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
hourly compressor + fan kW	4.1	5.0	5.7	5.3	5.4	5.5	5.6	5.6	6.0	5.1	5.7	59.0
annual total kWh - 5 days per week 50 weeks per year												14759
estimated annual energy savings												13898

The above spreadsheet is used for small compressor systems. This is a manual process using a spreadsheet to enter the load profile, operating hours, and populating the hourly demand.

The incentive is not calculated, since this project is considered a deemed measure and is rebated through EEBR.

The deemed savings for the above 25HP compressor is **10,541 kWh** versus the calculated savings of **13,898 kWh**.

Computer Room A/C (CRAC)/CRAH



Energy Efficiency Baselines for

DATA CENTERS

Statewide Customized New Construction
and Customized Retrofit Incentive Programs

March 1, 2013*

Revision 1
(Rectifier Efficiency Added)

Written By:

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This section describes processes and industry standard practices (ISP) for data centers, which includes Computer Room Air Conditioning (CRAC) and Computer Room Air Handling (CRAH) systems.

Because data centers require a much high internal load, DEER does not handle data center building types. A consortium of utilities have identified and established industry standard practices for these types of projects. A downloadable publication of *Data Center Statewide Customized New Construction and Customized Retrofit Incentive Program* is available at www.integralgroup.com

The publication provides the user with industry standard practices for data centers.

Data Center Baselines

Link to download the *Energy Efficiency Baselines for Data Centers – Statewide Customized New Construction and Customized Retrofit Incentive Programs* study:

http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/incentivesbyindustry/hightech/data_center_baseline.pdf

The study discusses the following topics:

- Air Delivery Systems (recirculation, ventilation, exhaust)
- Hydronic Systems (chilled, condenser, heating)
- Cooling Systems (air cooled dx, water cooled plant)
- Heating Systems (preheat make-up air unit (MAU), humidification)
- Humidity Control Systems (humidification, dehumidification, reheat)
- Electrical (motors, fans, VSD's, Uninterruptible Power Supply (UPS), transformers, rectifiers, servers)

Refer to the website for the current version of the publication.

Energy Modeling Tools

Combined with actual field data, the list of tools below are used to complete the studies:

- eQUEST®
- EnergyPro®
- EnergyPlus®
- Custom Spreadsheets

Note: These models do not have a data center building type. These models are designed to be used for office, restaurant, hospital, or hotel building types.

Component Efficiencies

- 18 Separate Tables with Baselines
- Does not replace Title-24 nor ASHRAE 90.1

The publication will include 18 different tables with baselines for various sub-components with regards to data centers. These baselines are industry standard practices specifically for Uninterruptible Power Supply (UPS). Conversion efficiencies are detailed for UPS' to establish the baseline for installation of a new UPS. The utility cannot take the actual consumption. The conversion efficiency specified in the study must be used.

Prescriptive Requirements

- Economizers
- Reheat
- Humidification
- Fan Power Consumption
- Fan Control
- Containment

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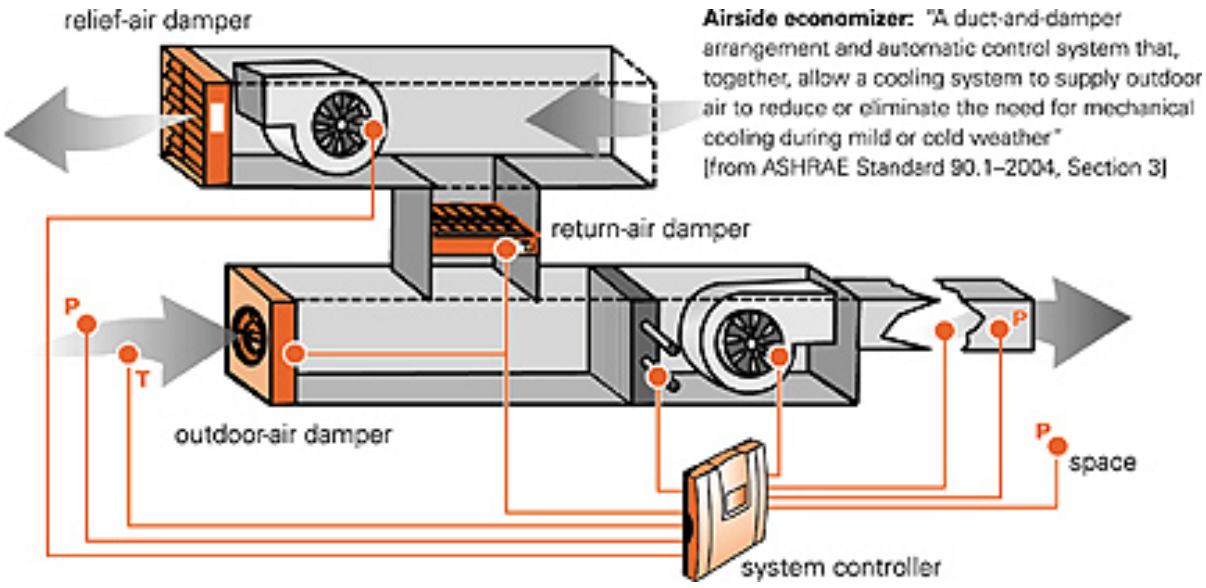
Economizers



Economizers – Title 24, 2013

Each cooling fan system with a design total mechanical cooling capacity over 54,000 BTU/hr. shall include either:

A. An air economizer capable of modulating outside-air and return-air dampers to supply 100 percent of the design supply air quantity as outside-air;

or

B. A water economizer capable of providing 100 percent of the expected system cooling load as calculated in accordance with a method approved by the Commission, at outside air temperatures of 50°F dry-bulb/45°F wet-bulb and below. (with some exceptions, 140.4(e)1)

EXCEPTION 4 to Section 140.4(d): Zones in which specific humidity levels are required to satisfy exempt process loads.

Computer Rooms or other spaces where the only process load is from IT equipment may not use this exception.

Economizers – READI Tool Example

Packaged Systems

Energy Impacts

Measure Description: Economizer - Packaged System

Energy Impact ID: D03-058

Measure ID (linked): D03-058

DEER Energy Impact Values: *All impacts are "per Cap-Tons"*

	Whole Building Impacts			Direct End-Use Impacts		
	kWh/unit	kW/unit	therm/unit	kWh/unit	kW/unit	therm/unit
Above Pre-Existing	555	0.0031	0.000127	0	0	0
Above Code/Standard:	555	0.0031	0.000127	0	0	0

IOU	Building Type	Building Vintage	Building Location	Building HVAC Type
SDG&E	Office - Small	Existing	San Diego	Any

Normalizing Units	Number of Units	Measure Area	Scale Basis	Result Type
Cap-Tons	35.87	10002	None	Direct

Energy Impacts List

click on column titles to filter the list of impacts

Index	IOU	Building Type	Building Vintage	Location	HVAC Type	WB-Pre_kWh	WB-Pre_kW	WB-Pre_therm	WB-Std_kWh
105429445	SDG	Asm	Ex	CZ07	Any	141.3	0.000	-0.03	141.3
105429463	SDG	ECC	Ex	CZ07	Any	1062.7	0.000	-0.03	1062.7
105429474	SDG	Gro	Ex	CZ07	Any	80.5	0.000	0.00	80.5
105429480	SDG	Hsp	Ex	CZ07	Any	411.2	0.000	-0.02	411.2
105429490	SDG	Htl	Ex	CZ07	Any	1227.8	0.000	-0.01	1227.8
105429485	SDG	Nrs	Ex	CZ07	Any	253.5	0.000	-0.01	253.5
105429508	SDG	OfS	Ex	CZ07	Any	554.9	0.003	0.00	554.9
105429526	SDG	RtL	Ex	CZ07	Any	685.0	0.000	-0.01	685.0
105429532	SDG	RtS	Ex	CZ07	Any	535.2	0.000	-0.01	535.2

Central Systems – Now an EEBR, rebate measure dm-41

Energy Impacts

Measure Description: Economizer - Central system

Energy Impact ID: D03-059

Measure ID (linked): D03-059

DEER Energy Impact Values: *All impacts are "per Cap-Tons"*

	Whole Building Impacts			Direct End-Use Impacts		
	kWh/unit	kW/unit	therm/unit	kWh/unit	kW/unit	therm/unit
Above Pre-Existing	383	0.000234	-13.7	0	0	0
Above Code/Standard:	383	0.000234	-13.7	0	0	0

IOU	Building Type	Building Vintage	Building Location	Building HVAC Type
SDG&E	Office - Large	Existing	San Diego	Any

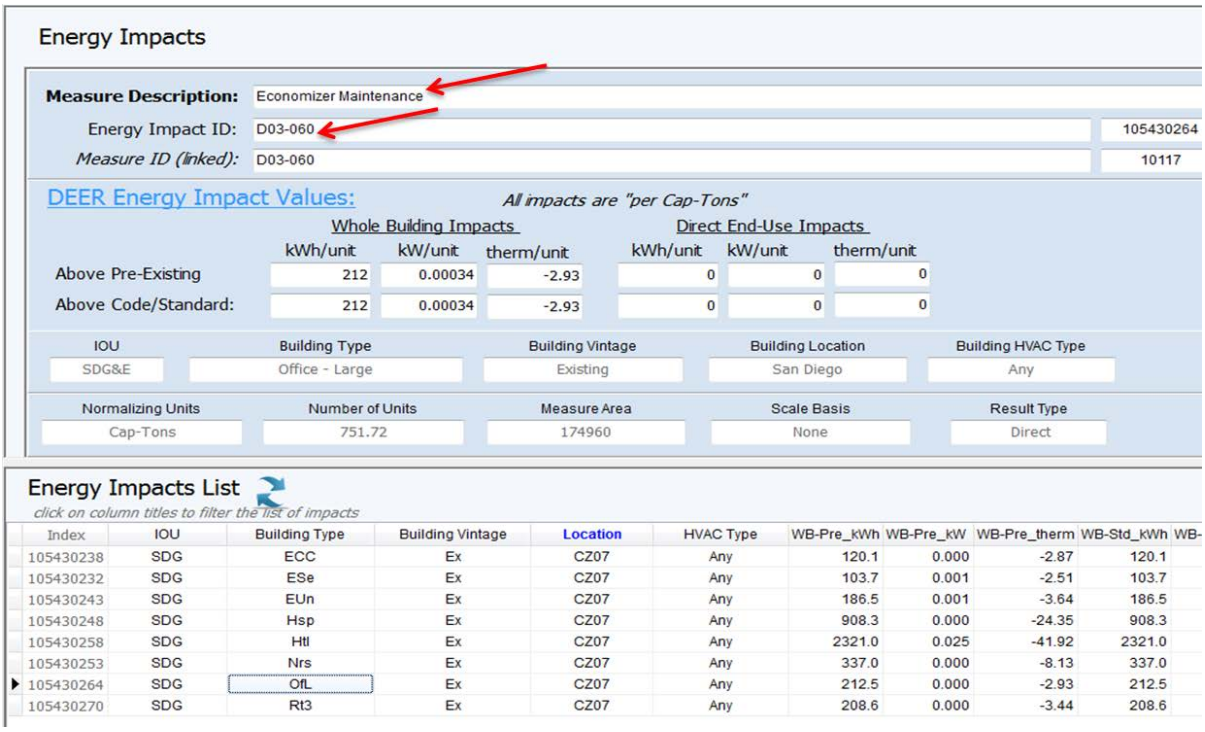
Normalizing Units	Number of Units	Measure Area	Scale Basis	Result Type
Cap-Tons	951.11	174960	None	Direct

Energy Impacts List

click on column titles to filter the list of impacts

Index	IOU	Building Type	Building Vintage	Location	HVAC Type	WB-Pre_kWh	WB-Pre_kW	WB-Pre_therm	WB-Std_kWh
105429942	SDG	ECC	Ex	CZ07	Any	208.4	0.000	-8.53	208.4
105429936	SDG	ESe	Ex	CZ07	Any	159.5	0.001	-4.53	159.5
105429947	SDG	EUn	Ex	CZ07	Any	269.8	0.000	-10.34	269.8
105429952	SDG	Hsp	Ex	CZ07	Any	1169.1	0.000	-31.83	1169.1
105429962	SDG	Htl	Ex	CZ07	Any	3622.7	0.017	-41.38	3622.7
105429957	SDG	Nrs	Ex	CZ07	Any	864.7	0.000	-26.78	864.7
105429968	SDG	OfL	Ex	CZ07	Any	382.8	0.000	-13.69	382.8
105429974	SDG	Rt3	Ex	CZ07	Any	309.1	-0.002	-12.15	309.1

Maintenance – Central Systems only



Energy Impacts

Measure Description: Economizer Maintenance

Energy Impact ID: D03-060 105430264

Measure ID (linked): D03-060 10117

DEER Energy Impact Values: *All impacts are "per Cap-Tons"*

	Whole Building Impacts			Direct End-Use Impacts		
	kWh/unit	kW/unit	therm/unit	kWh/unit	kW/unit	therm/unit
Above Pre-Existing	212	0.00034	-2.93	0	0	0
Above Code/Standard:	212	0.00034	-2.93	0	0	0

IOU	Building Type	Building Vintage	Building Location	Building HVAC Type
SDG&E	Office - Large	Existing	San Diego	Any

Normalizing Units	Number of Units	Measure Area	Scale Basis	Result Type
Cap-Tons	751.72	174960	None	Direct

Energy Impacts List

click on column titles to filter the list of impacts

Index	IOU	Building Type	Building Vintage	Location	HVAC Type	WB-Pre_kWh	WB-Pre_kW	WB-Pre_therm	WB-Std_kWh	WB-
105430238	SDG	ECC	Ex	CZ07	Any	120.1	0.000	-2.87	120.1	
105430232	SDG	ESe	Ex	CZ07	Any	103.7	0.001	-2.51	103.7	
105430243	SDG	EUn	Ex	CZ07	Any	186.5	0.001	-3.64	186.5	
105430248	SDG	Hsp	Ex	CZ07	Any	908.3	0.000	-24.35	908.3	
105430258	SDG	Htl	Ex	CZ07	Any	2321.0	0.025	-41.92	2321.0	
105430253	SDG	Nrs	Ex	CZ07	Any	337.0	0.000	-8.13	337.0	
105430264	SDG	OfL	Ex	CZ07	Any	212.5	0.000	-2.93	212.5	
105430270	SDG	Rt3	Ex	CZ07	Any	208.6	0.000	-3.44	208.6	

Economizers – BOA Tool Example

General Information & Inputs

General Information & General Inputs

General Project Information	
Facility Name	(facility name)
Facility Address	(facility address)
Utility Account Number	(utility account number)

Provider Information	
Name	(provider name)
Company	(provider company)
Address	(provider address)
Email	(provider email)
Phone number	(provider phone)
Date	(date)

General Inputs	
Building Type	Office
Primary Ventilation System Type	VAV AHU / RTU w/ zone reheat
Primary Cooling System Type	Water-Cooled Chiller(s)
HVAC Heating System Type	Natural Gas Water Boiler
Zip Code	92123 (CZ7) San Diego
CA Climate Zone	7
Year Building Constructed	2001
Facility Gross Area (ft^2)	70,000

Baseline Building Energy Use	
Baseline Annual Electric Use (kWh)	1,500,000
Baseline Annual Gas Use (Therms)	15,000
Electric EUI (kWh/ft^2)	21.4
Gas EUI ($therms/ft^2$)	0.2
Total EUI ($kBTU/ft^2$)	94.6

Savings Calculator

Savings Calculator: Airside Economizer

Project Information	
Facility Name	(facility name)
Facility Address	(facility address)
Utility Account Number	(utility account number)
Provider Name	(provider name)
Provider Company	(provider company)
Address	(provider address)
email	(provider email)
Telephone number	(provider phone)
Date	(date)

Finding & Measure Descriptions	
Finding / Measure Number	(user to enter finding / measure number)
Finding Description	(user to enter finding description)
Measure Description	(user to enter measure description)

Baseline Project Building Characteristics	
VAV or CAV air handlers?	VAV
Water-cooled or air-cooled chillers?	WC
CHWST reset?	NO
HWST reset?	NO
Fixed or variable CWST setpoints?	Fixed

These inputs are for use in determining tool applicability, and do not impact the savings calculations.
If baseline project building characteristics do not match tool applicability, contact your utility program administrator.

Inputs	
Building Type	Office
CA Climate Zone	7
Year Building Constructed	2001
Baseline Lockout Temp or % Outside Air	55 Deg Lockout
Air Handler Cooling Capacity (tons)	200

Savings Output		
Annual Electric Savings	41,701 kWh/yr	2.8% % of Annual Use
DEER Peak Electric Demand Savings	1.6 kW	
Annual Natural Gas Savings	-162 Therms/yr	-1.1% % of Annual Use

Warnings and Errors: No warnings or errors exist for this measure

Economizer Spreadsheet Calculation

Range		Hours	Pre MAT	Econ MAT	Pre Hours	Post Hours	kW	Baseline kWh	Post kWh	
32	34	0	53	55	0	0	8.1	0	0	
34	36	0	54	55	0	0	8.3	0	0	
36	38	16	54	55	0	0	8.4	0	0	
38	40	14	55	55	0	0	8.6	0	0	
40	42	57	56	55	57	0	8.8	500	0	
42	44	71	57	55	71	0	8.9	634	0	
44	46	165	57	55	165	0	9.1	1,502	0	
46	48	163	58	55	163	0	9.3	1,508	0	
48	50	207	59	55	207	0	9.4	1,950	0	
50	52	312	60	55	312	0	9.6	2,991	0	
52	54	422	61	55	422	0	9.8	4,117	0	
54	56	585	61	55	585	0	9.9	5,805	0	
56	58	686	62	57	686	686	10.1	6,908	6,908	
58	60	902	63	59	902	902	10.2	9,235	9,235	
60	62	794	64	61	794	794	10.4	8,262	8,262	
62	64	951	64	63	951	951	10.6	10,056	10,056	
64	66	875	65	65	875	875	10.7	9,399	9,399	
66	68	674	66	66	674	674	10.9	7,339	7,339	
68	70	471	67	67	471	471	11.1	5,208	5,208	
70	72	363	68	68	363	363	11.2	4,075	4,075	
72	74	346	68	68	346	346	11.4	3,942	3,942	
74	76	247	69	69	247	247	11.6	2,856	2,856	
76	78	176	70	70	176	176	11.7	2,061	2,061	
78	80	113	71	71	113	113	11.9	1,342	1,342	
80	82	68	71	71	68	68	12.0	819	819	
82	84	38	72	72	38	38	12.2	464	464	
84	86	25	73	73	25	25	12.4	310	310	
86	88	17	74	74	17	17	12.5	213	213	
88	90	1	75	75	1	1	12.7	13	13	
90	92	1	75	75	1	1	12.9	13	13	
92	94	0	76	76	0	0	13.0	0	0	
94	96	0	77	77	0	0	13.2	0	0	
96	98	0	78	78	0	0	13.3	0	0	
98	100	0	78	78	0	0	13.5	0	0	
100	102	0	79	79	0	0	13.7	0	0	
102	104	0	80	80	0	0	13.9	0	0	
104	106	0	81	81	0	0	14.0	0	0	
106	108	0	82	82	0	0	14.2	0	0	
108	110	0	82	82	0	0	14.3	0	0	savings kWh
		8,760						90,386	72,513	17,873
									DEER2014	11,484

Boiler Systems

This section reviews examples of the types of boiler technology that is eligible for a rebate.

Boiler Technologies

- Steam boilers
- Heating hot water boilers
- Domestic hot water boilers
- Condensing boilers
- Boiler economizers
- Temperature lockout
- Temperature resets

Boiler Measures

Below are examples of boiler measures which are eligible for a rebate.

- One for one replacement
- New hot water reset
- Matching boiler system

Custom Boiler Measures

- Existing system redesign
- Removal of the heat exchanger and/or decoupling system.

Energy Savings Evaluation Tools

The tools used by the utility to evaluate the savings are located on the company website, which include:

- Energy Efficiency Business Rebate List.

  http://www.sdge.com/rebates-finder/earn-rebates-your-improvements

- Remote Ex-Anti Database Interface (READI) Tool

  http://www.deeresources.com/

- Click on Login Form:
  - Username: DEER
  - Password: 2008

- Custom Calculation Tool

  http://www.aesc-inc.com/download/spc/

- eQUEST – Quick Energy Simulation Tool

  http://doe2.com/equest/index.html

- Spreadsheet Calculation – A spreadsheet format, which allows the user to include the raw data.

References

Below is a list of references to assist the user:

- New Title 24 Code, 2013 – Summary of Non-Residential Building Energy Efficiencies: Database for Energy Efficient Resources (DEER)
- Energy Efficiency Business Incentives
- Local climate zones for California
- Seminar Reference Guide

Rebates or Incentives

How do you choose between a rebate and an incentive? Some measures have been mandated through the California Public Utilities Commission. The order states that the utility must push everything as a rebate if it has been identified as a deemed measure on the EEBR list. Measures not included on the EEBR list can be processed through a custom program and possibly be incentivized.

- Rebate Measure on EEBR list – Mandatory

These changes allow for greater efficiencies through the process.

- Streamline application process
- Funds may be reserved up to 45 days
- Energy Star Portfolio Manager Benchmark Report
- Pre or post installation inspections – may or may not be required
- Equipment Installation – Easier
- Proof of Purchase
- Payment Release
- Rebate checks mailed within 30-45 days
- No Calculations Tools required
- No Measurement and Verification

Complete the application online and notify the utility that the installation has been completed. A check is cut and mailed – Process completed!

Water Heating Measures – Example:

Looking at a condensed version of the water heating measures, the rebate list below, highlights Solution, Product Code, Description, and $/Mbtuh - Incentive per energy use.

The example shows a storage water heater is $2.00 per thousand BTU. Instantaneous water heater is $2.00 per thousand BTU greater than 200 thousand BTU, and Direct Contact water heaters for both small and large are $2.00 per thousand BTUs.

Solution	Product Code	Description	$/Mbtuh
Storage Water Heater	G-A1	Storage Water Heater	$2.00
Space Heating	G-B1 G-B2 G-B3	Space Heating Boiler (Stm) Space Heating Boiler (Sm) Space Heating Boiler (Lg)	$0.25 $0.25 $0.50
Commercial Boiler	G-C1	Commercial	$0.50
Instantaneous Water Heater	G-D1 G-D2	Small (>200MBtuh) Large (<200MBtuh)	$2.00 $0.50
Process Boiler	G-E1 G-E2	Steam Water	$0.50
Direct Contact Water Heater	G-G1 G-G2	Small (>300MBtuh) Large (<300MBtuh)	$2.00

DEER to DEEMED Rebate Table

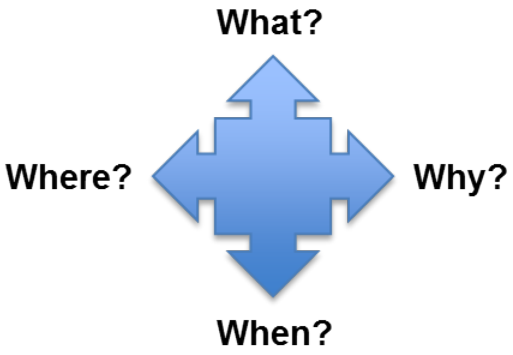
Locate the rebate table DEER to DEEMED Rebate Table in the Appendix. This new list identifies measures that were incentives in the past and are now quantified as a rebate. The list is also available on the utility website:

http://www.sdge.com/rebates-finder/save-energy-earn-incentives

This provides user with quick access to the READI measures. Users can see descriptions and the rebate per dollar amount.

Tools for Incentives

What tools does the utility use for incentives? This is dependent on the Scope of Work (SOW) for the Project.



Complete a site visit.

Questions to consider:

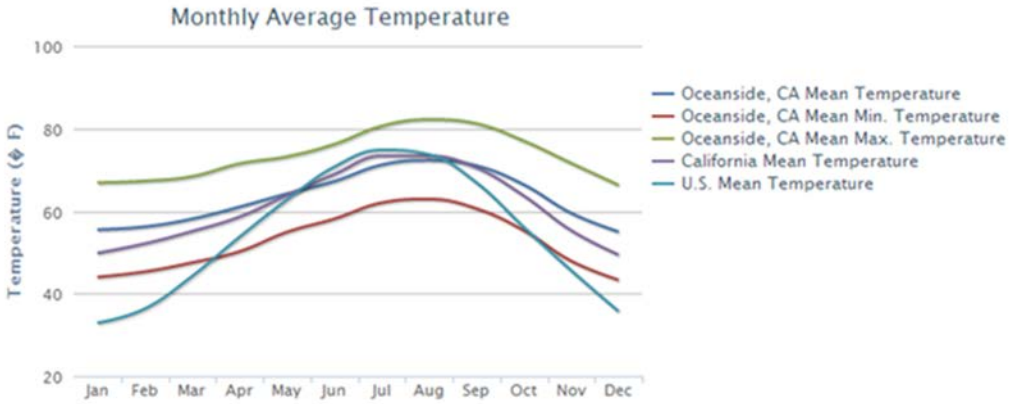
- Is this one for one replacement?
- Is it an upgrade to a backup or lead boiler?
- Are there multiple system types?
    - Is it a steam hot water, domestic hot water
- Is it multiple or increased capacity?
- Is it a retrofit add-on or modification

Engineering needs to collect this data in order to begin the analysis.

Key Data Collection

- Hours of Operation
- Climate Zone / Zip code
- Building Type, Vintage, and Conditioned Area (sq. ft.)
- Operating Conditions – baseline vs post installation (EWT, LWT, gpm, resets, etc.)
- New Boiler Type, MBH input/output, Efficiency
- Boiler Operation- Lead-Lag? Shared Load? Age?

For Custom Operation – load factor schedule and capacity



Heating Hot Water (HHW) Boiler Example (EEBR)

Building and Equipment Characteristics::

- Large Office located in **92058**
- Vintage of building is pre **1990**
- Existing Boiler: Manufacturer A **WNG2500** HHW BOILER
- Proposed Boiler: Manufacturer R **MVB-H7-2003** (non-condensing); 1999-MBH; efficiency = 87%
- Retrofit Add-on (REA): Direct Digital Controls System for OSA lockout, boiler reset schedule. **{Rebate –EEBR}**
- DEER EUL = 20 years; Title 24 = 80%

Energy Efficiency Business Rebate (EEBR) to Energy Efficiency Business Incentive (EEBI) Comparison

How does the rebate compare to the incentive?

Rebate Calculation

For a new space heating boiler the rebate is calculated based on the code and dollar per unit, using the formula below:

- Product code: G-B3
- Units in MBH = 1999
- $/MBH = $.50

Calculation for Rebate: $(\#\ Units\ in\ MBH)\ (\frac{\$}{MBH})$ = rebate

New Space Heating Boiler: $(2000)\ (\frac{\$.50}{MBH})$ = **$1000**

READI Measure Hot Water Reset– D03-045

- Product Code: DM-03
- Units = per controller

Calculation for Rebate = ($681/unit) (1 controller) = **$681**

Total rebate would be **$1681**

Mandates from the California Public Utilities Commission are the primary reason why the utility is required to choose a rebate over an incentive. If the commission has deemed the product on the list, the utility is required to verify the technology against the list.

Secondary reasons why the utility would chose a rebate versus an incentive would be

- Manufactures equipment specifications cut-sheet
- Sequence of Operations
- Engineer of Record and or Trade Professional Contractor
- SDG&E Pre & Post Inspections (Mandatory)
- Measurement and Verification Plan (may be required)
- Installation must be completed within Program Year (refer to website)
- Custom Calculations require SDG&E Engineering and/or CPUC review
- Processing delays
- Post M&V SDG&E review
- Must notify SDG&E of equipment or design changes

In many cases, customers have received larger rebates compared to an incentive. In addition, the process is streamlined and funds are paid out in less time.

Fan VSDs – AHUs

All HVAC fans are eligible for the program up to a maximum of 100hp for each unit. This is an Energy Efficiency Business Rebate (EEBR) program pays directly for $/HP. The program's order of evaluation –

1. Rebate
2. READI
3. CCT

VSD for HVAC Fans – Rebates

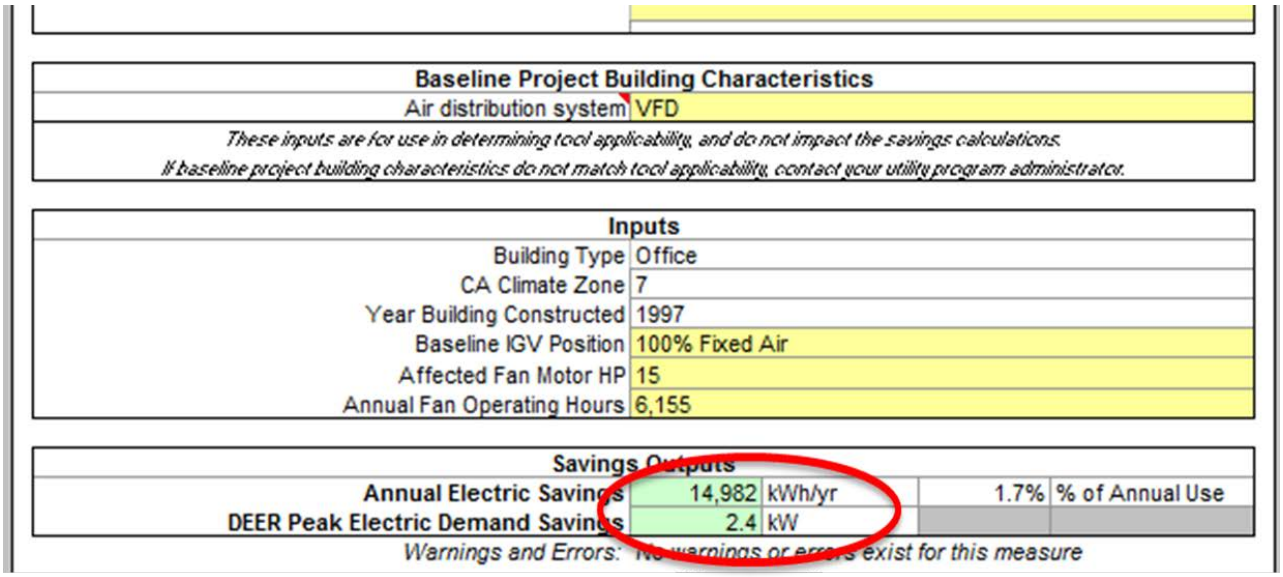
This measure is a rebated program for fan applications with VSD's used on supply, return, and exhaust systems. The maximum size would be 100hp and it is eligible only if the existing throttling devices are either removed or permanently disabled. The current rebate is $110 per horsepower must be an SDG&E customer for new equipment only installed and operational prior to the application.

VSD for HVAC Fans – Incentives

All HVAC fans with each fan over 100HP are eligible for the Energy Efficiency Business Incentive (EEBI). The program requires a completed application with estimated savings. These would be for HVAC supply, return, and exhaust systems and in this case it would be for larger than 100hp motors. Eligible only if the throttling devices are removed or permanently disabled. Incentives are available for replaced or failed VSDs, providing the failed VSD has not been paid within the previous five years. The current incentive rate is $0.08 per kilowatt hour saved and $150 per kW saved.

Supply Fan VSD Example - BOA Tool

Air Handler with Inlet Guide Vanes and 15HP motor



Baseline Project Building Characteristics	
Air distribution system	VFD

These inputs are for use in determining tool applicability, and do not impact the savings calculations.
If baseline project building characteristics do not match tool applicability, contact your utility program administrator.

Inputs	
Building Type	Office
CA Climate Zone	7
Year Building Constructed	1997
Baseline IGV Position	100% Fixed Air
Affected Fan Motor HP	15
Annual Fan Operating Hours	6,155

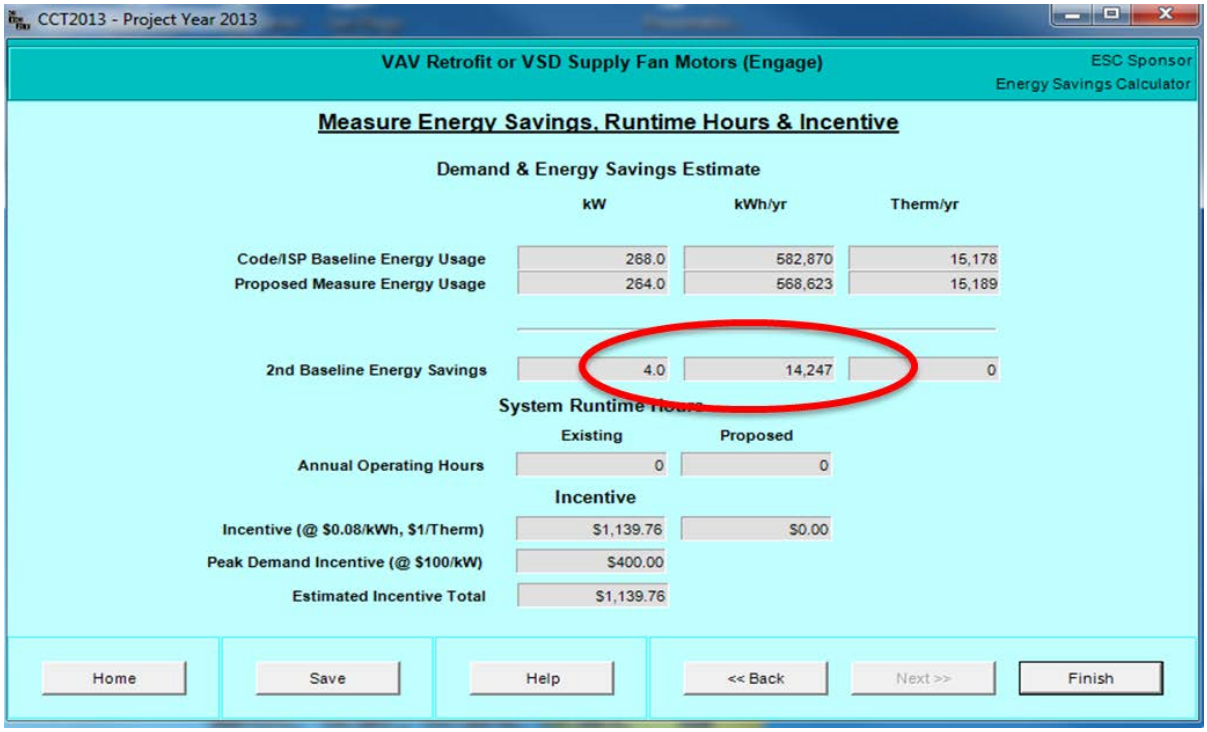
Savings Outputs				
Annual Electric Savings	14,982	kWh/yr	1.7%	% of Annual Use
DEER Peak Electric Demand Savings	2.4	kW		

Warnings and Errors: No warnings or errors exist for this measure

Using the BOA Tools, the utility looks at a supply fan VSD on an air handler that has an existing inlet guide vane and is a 15 HP motor, and verify the calculations and compare the results to determine between a rebate and an incentive.

The engineers enter the necessary data to come up with the energy savings. In the example above, the annual electric savings is calculated at 14,982 kWh per year and a reduction in the demand of 2.4 KW.

Supply Fan VSD Example – CCT Tool



CCT = 14,247kWh saved, and 4.0 kW reduced

When the CCT tool is used, the savings is similar. A total energy savings of 14,247 kWh saved is calculated. For reduced demand of kilowatts, these two tools use slightly different calculation methods but have a similar output.

Supply Fan VSD Example – Rebate or Incentive

Comparing the results on whether to take a rebate or an incentive, the example above is a prime example of where the rebate is a better choice.

The rebate is calculated using the formula of 15HP multiplied by $110, which would award a rebate of $1650.00 with minimal effort. The customer contacts the utility to notify the department that the unit has been installed. Once the utility verifies the installation, a request is submitted to process a rebate check.

Using a customized tool for an incentive would require added time and paperwork to complete the process and rendering a smaller $1500.00 incentive. The incentive process requires a pre-inspection and a post-inspection. It is obvious in this case that a rebate is not a penalty and is it is a better choice.

Note: This is an example. Recall, 15HP motor must be a rebate item (less than 100HP) and cannot be an incentive measure.

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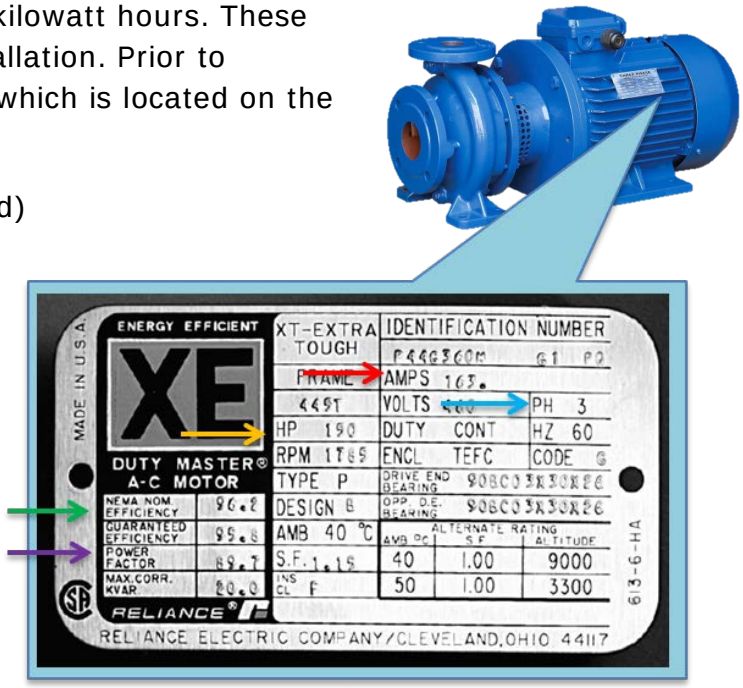
Pumps with VSDs

Section provides information about energy efficiency measures when adding Variable Speed Drives (VSDs) on chilled water pumps, hot water loop pumps, circulating water pumps, condenser water pumps. Booster pumps for domestic hot water systems and other application processes will also be discussed. Dual baseline considerations will also be highlighted.

These types of projects will require a pre-installation inspection.

VSDs on Circulating Water Pumps (WSHPs):

Circulating water pumps for water source heat pump (WSHP) projects can yield between 10% to 60% energy savings. However, the average savings is usually estimated at 30% of the baseline kilowatt hours. These percentages are verified after installation. Prior to installation, the utility needs data which is located on the motor nameplate:



- HP – Horsepower (Goldenrod)
- PF – Power factor (Purple)
- Efficiency (Green)
- FLA – Full Loan amps (Red)
- PH – Phase (Blue)

Additional measured data that is needed

- Amps
- Voltage

The engineers will also need:

- How many pumps
- How the pumps operate together (Are there lead lags and whether either one is on a standby.)

VSDs on Circulating Water Pumps (WSHPs) – Example

In this example, the baseline kilowatt hours, which is equal to the kW of the pump times the operating hours annual operating hours.

Calculate Baseline kWh → kWh = kW*(operating hours)

Calculating kW = *Amps* multiplied by *Volts*, multiplied by *Power factor, multiplied by* square root of *Phase*, divided by the conversion factor will be equal to *Horsepower* multiplied by its *Conversion*, multiplied by *Load factor* divided by the *Efficiency*.

For a slip load calculation, the load factor is calculated at 60%, which is multiplied by the 25HP motor, which renders 15HP. Then taking the identified *Poles*, plug the integer in the equation to calculate the free kilowatt hour savings.

$$kW = \frac{(Amps * Volts * PF * \sqrt{PH})}{1000\,W/kW} = hp\,(.7457)\left(\frac{LF}{Eff}\right)$$

LF = Load Factor = Ratio of operating RPM, Amps, BHP/Rated RPM, Amps, or HP

Example: Slip Load Calculation

Given: Synchronous speed in rpm = 1800
Nameplate full load speed = 1750
Measured speed in rpm = 1770
Nameplate rated horsepower = 25 hp

Determine actual output horsepower.

From Equation 5

$$Load = \frac{1800 - 1770}{1800 - 1750} \times 100\% = 60\%$$

Actual output horsepower would be 60% *x* 25 hp = 15 hp

Poles	60 Hertz
2	3600
4	1800
6	1200

$$Load = \frac{I}{I_r} \times \frac{V}{V_r} \times 100\%$$

Where:
Load = Output power as a % of rated power
I = RMS current, mean of 3 phases
I_r = Nameplate rated current
V = RMS voltage, mean line-to-line of 3 phases
V_r = Nameplate rated voltage

Alternative Estimation Approach: BIN Analysis

Using a BIN Analysis, the utility can use an alternative estimation approach going into the project, pre-installation. The utility assigns operating frequencies to various temperature ranges based on minimum and maximum current in these percentages. The engineers determine the annual hours that the pumps will be running in each temperature range and use standard TMY3 Data.

OAT (ºF)	VSD Frequency (HZ) Min = 35	Total BIN Hours
88 - 90	60	1
86 - 88	60	15
84 - 86	60	12
82 - 84	60	27
80 - 82	60	33
78 - 80	56.9	45
76 - 78	53.8	93
74 - 76	50.6	182
72 - 74	47.5	239
70 - 72	44.4	374
68 - 70	41.3	527
66 - 68	38.1	691
64 - 66	35	671
62 - 64	35	598
60 - 62	35	577
58 - 60	35	687
56 - 58	38.6	498
54 - 56	42.1	356
52 - 54	45.7	249
50 - 52	49.3	155
48 - 50	52.9	100
46 - 48	56.4	70
44 - 46	60	37
42 - 44	60	12
40 - 42	60	7
38 - 40	60	7
36 - 38	60	1

Figure 1

Note: *TMY3 data is available at various websites – DOE Energy Plus Website (reference manual)*

Then we can calculate a new brake horsepower using the pump affinity laws. The new kW equals the full load kW multiplied by a frequency reduction raised to an exponent. This exponent is normally *three* in the engineering books and in theory. However, in application, what has been seen and measured is often different. Therefore, the Public Utilities Commission has approved an alternative calculation method that the utility has adopted.

Calculate the new BHP (kW) using pump affinity laws

$$kW_{new} = \frac{kW_{full} * \left(\frac{frequency}{60}\right)^{2.4}}{eff_{VFD}}$$

Note: *The 2.4 is a conservative exponent. The savings will be verified with post-installation. Measurement and Verification (M&V).*

Pump Affinity Law Applied: (real world / non ideal)

PUMP LAW		
(kW1 / kW2)	=	(gpm1 / gpm2)^n
kW	=	pump power
gpm	=	gallons per minute
n	=	3 (ideal conditions)

FAN LAW		
(kW1 / kW2)	=	(cfm1 / cfm2)^n
kW	=	fan power
cfm	=	cubic feet per minute
n	=	3 (ideal conditions)

The applied Pump Affinity Law in the real world is not an ideal application. The above chart would apply to chilled water pumping and IT cooling systems where the geometry is fixed in a fully or mostly closed application.

"n" FOR AIR / WATER LOOPS			
	Fully or Mostly Closed	Semi-Closed	Mostly or Fully Open
Fixed Geometry:	2.4	2.2	2.0

In a semi-closed application, this would apply to a condenser water loop for open cooling tower and CRAC/CRAH units for hot/cold aisles.

In mostly or fully open applications, this would apply to unobstructed underfloor plenum or an open return system and you have to use these exponents in the pump affinity calculation.

Post-Installation: Verify estimated savings

Calculating estimated savings post-installation will require the placement of data loggers to capture any nonstandard changes. The data loggers remain on the units for a minimum of four weeks. The engineering group will then identify the best two week data, and then eliminate some of the anomalies in the data set.

Operating Amps and OAT

Calculate Post-installation kW and kWh similarly

$$kW = \frac{(Amps * Volts * PF * \sqrt{PH})}{1000\ W/kW}$$

Note: *kWh – Average the kW in each OAT bin*

By measuring the outside air temperature as well as the *operating amps*, the calculation of the post-installation kilowatts and kilowatt hours can be completed using the above formula. Using the average kilowatts in each temperature BIN (See Figure 1-previous page), the utility can extrapolate data annually using the TMY3 temperature data.

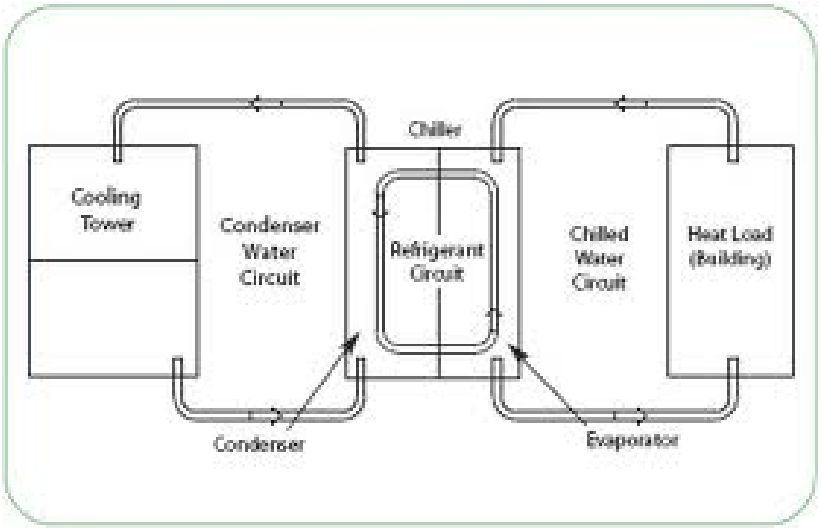
Calculated Energy Savings

Annual Savings are calculated by taking the pre-installation kilowatt hours minus the post-installation kilowatt hours.

Then the kilowatt reduction in demand would be calculated from the established DEER peak hours of 2:00 PM – 5:00 PM on September 1st, 2nd, and 3rd.

VSDs on Condenser Water Pumps

Condenser water pump projects will require a Measurement & Verification (M&V). One month of pre-measured data and one month of post-measured data on the whole system is required.



Chiller consumption needs to be considered because the water circuits on both sides will affect the performance of the chiller. Reduced flow rates will take place, which affects the pressure and the operating efficiency. Pumping energy will be reduced, and additionally, the chiller will require less energy too. The utility is looking to capture that savings along with the pump energy savings.

VSDs on Process Pumps

Energy Savings for Process Pumps would be independent of outside air temperature, so a different method is used for estimating these savings.

Item	Value	Comment
Total Pumping Horsepower (hp)	250.00	
Average Pump Load Factor	85%	
Pump Motor Efficiency	92%	
Total Pump Operating Hours	8,760	Obtain from EMCS, site personell, or operating logs.
% Hours Operating at 100% Load	10%	
% Hours Operating at 90% Load	20%	
% Hours Operating at 80% Load	50%	
% Hours Operating at 70% Load	20%	kWh = $(70\%)^{2.5}$ * 8760 * 20%
% Hours Operating at 60% Load	0%	
% Hours Operating at 50% Load	0%	
% Hours Operating at 40% Load	0%	
% Hours Operating at 30% Load	0%	
Sum of % Hours Operating at Various Loads	100%	Should always equal 100%
Electric Cost ($/kWh)	0.13	Total Consumption Cost ($) / Total Consumption (kWh)
Pre-Retrofit Energy Consumption (kWh)	1,509,433.70	HP * 0.7457 * LF / EFF * HOURS
Post-Retrofit Energy Consumption (kWh)	938,710.90	Sum of kWh @ 100% - 30%

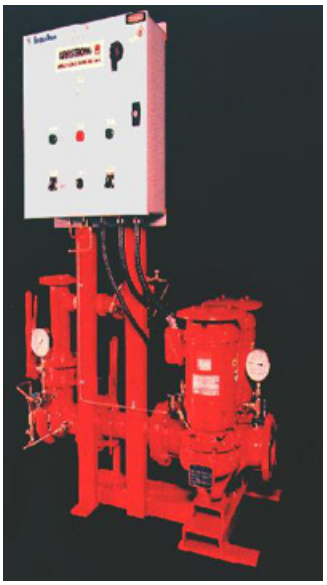
The spreadsheet above shows the pumping horsepower on operating conditions where the load is 100%, 90%, 80%, 70%, etc. The value for estimated time of operation is 10% at the 100% load, 20% at the 90% load, 50% at the 80% load, etc. The conditions are applied as well as the pump information. In this example, the 250HP pump would calculate a savings and a consumption drop of pre-installation kWh and post-installation kWh to provide a 500,000 kWh savings.

VSDs/Booster Pumps on Domestic Water

Booster pumps on domestic water require M&V with a four week measured baseline kW. The constant flow hours of operation are reviewed as well as the monitoring of post-installation consumption.

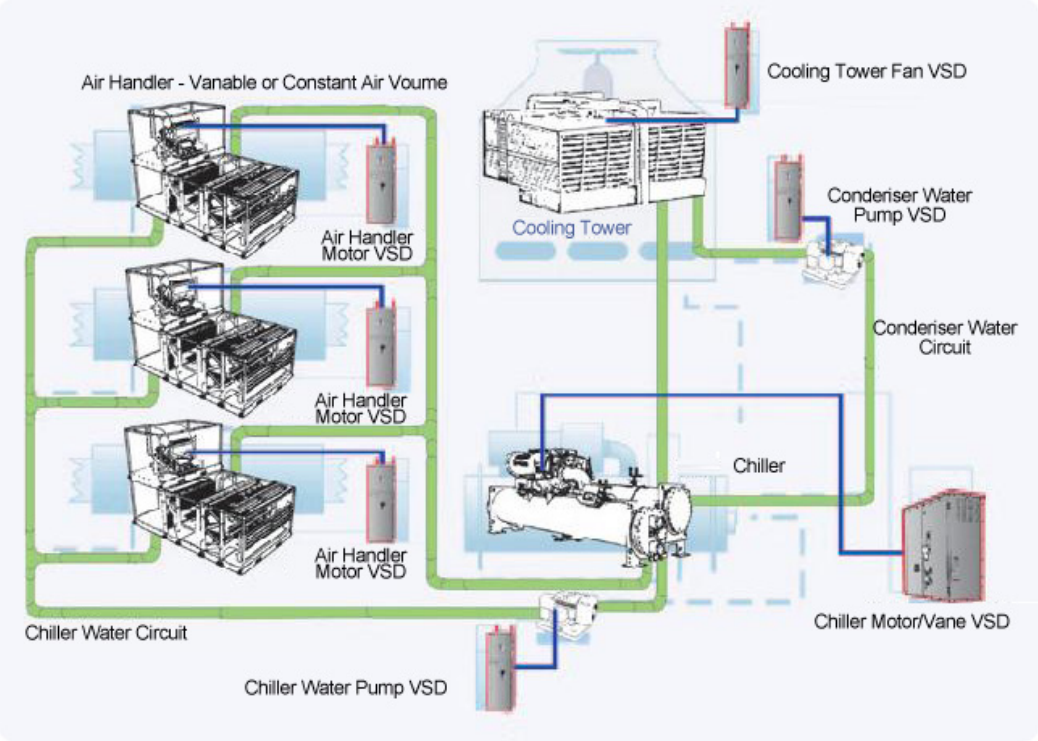
Additional documentation of occupant behavior and/or schedules may be required for these projects; allowing the utility to extrapolate the annual use and savings.

Typically, the schedules vary on a daily basis, but not seasonally.



Dual Baseline Considerations

Dual baseline considerations would be for the VSD effective useful life (EUL). Retrofit add-ons, would have no dual baseline requirement. However, the useful life for a VSD is 15 years with various applications on the chilled water system.



In reality, pump life is dependent on water quality and will be compared to maintenance records to determine the frequency of pump repair and actual operating life.

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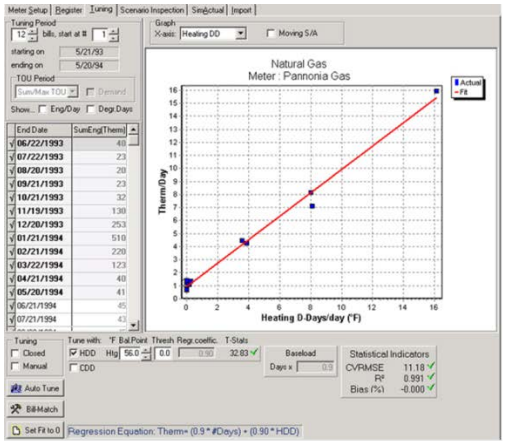
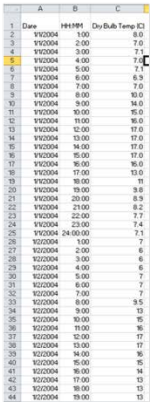
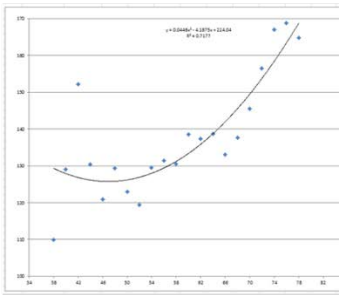
Measurement & Verification (M&V)

Measurement and Verification (M&V) is performed on projects that are proposed at greater than 20% higher than deemed and/or DEER savings.







Collection Information:

The utility will require the following information for all M&V projects:

- Lighting Levels; Current; Power; Voltage; Temperature; Nameplate data

Time frame for completion of these projects is dependent on the complexity. The data requires a range of two weeks up to four weeks. More complex, whole building approach will require:

- Full year data (12 months for 10%bonus – in incentive dollars)
- 15-Minute Intervals is sufficient

Sources:

Customer or Sponsor can supply information and data from the building EMS. The utility can provide HOBO data loggers and the customer can install them on the equipment. The utility will also review the Monthly Billing Data, which is recorded by the meter.

Limits:

To perform M&V projects the project must be a minimum of 50,000 kWh savings or requested by utility engineers or CPUC staff.

If the limits to this approach are less than that of an incentive, the cost benefit is not justifiable to use this method.

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Terms, Acronyms, and Websites

TERMS	DEFINITION
_programs	*http://www.SDGE.com/rebates-finder/business/*
"/kFP"	**"per 1000 square feet of building**" used with READI to define Impact units (See READI, UES)
"Cap-Tons"	**Capacity in Tons** (for Chillers, Cooling Towers, AHUs, ACs, HPs) used with READI to define Impact units (See READI, and UES).
3P, 3rd Party	SDG&E has agreements with outside contractors (3rd parties) to provide energy efficiency related programs.
AE	San Diego Gas & Electric "Account Executive".
AHU	Air Handling Unit
Aircuity	A control system for demand control ventilation. See website: *http://www.aircuity.com/technology/*
Air-Master	**AIRMaster+** is a free online software tool that helps users analyze energy use and savings opportunities in industrial compressed air systems. Download at: *http://www1.eere.energy.gov/manufacturing/tech_assistance/software_airmaster.html*
Baseline	Historic point of comparison used to track changes and improvements to your building or equipment or systems over time.
BHP	Brake Horsepower
Bin Analysis	Calculations are done using weather bins, which are created by accumulating all hourly occurrences of closely related weather data as if they had the same values. Hours that fall into a certain range of a defined parameter, most often dry bulb temperature, are collected and characterized by the mid-point of the range.
BOA Tool	**Building Optimization Analysis** (BOA) tool is an Excel® spreadsheet-based tool designed to streamline and standardize the energy savings calculation process for engineering service providers working under the Retrocomissioning (RCx) programs for five California utilities. The BOA tool targets commercial buildings and allows providers to calculate energy and peak demand savings for thirteen common controls- and schedule-based optimization measures. Download at: *http://www.cacx.org/resources/rcxtools/spreadsheet_tools.html#energy_analysis_tools*

Building Creation Wizard	A building modeling option used in the eQUEST (Quick Energy Simulation Tool)
California utilities	Pacific Gas and Electric Company (**PG&E**), Southern California Edison Company (**SCE**), Southern California Gas Company (**SoCal Gas**), San Diego Gas and Electric (**SDG&E**), and the Sacramento Municipal Utility District (**SMUD**).
CCT	**Customized Calculation Tool** (2013) used with the SDG&E Incentive Program. Download at: *http://www.aesc-inc.com/download/spc/*
CEC	California Energy Commission
CFL	Compact Fluorescent Light
CHW	Chilled Water
CW	Condenser Water
Climate Zone	**California Climate Zone** weather data set for weather related measures. The Climate Zone list is from the California Energy Commissions (CEC) website: *http://www.energy.ca.gov/maps/renewable/building_climate_zones.html*
Closed loop	A cooling water system with cooling water closed to the atmosphere. Closed loop systems generally do not require pumping against a fixed static head
CMPA	Custom Measure Project Archive
CPUC	California Public Utilities Commission. Governmental panel of 5 commissioners appointed by the Governor for 6 yr. terms.
CRAC /CRAH	Computer Room Air-Conditioner/ Computer Room Air Handler
CT	Current Transformer, or Cooling Tower
Data Center	Energy Efficiency Baselines for Data Centers available at: *http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/incentivesbyindustry/hightech/data_center_baseline.pdf*
Deemed	“Deemed” incentives have a predetermined agreed upon amount of savings (per energy unit). Rebate programs and DEER provided Deemed savings
DEER	**Database for Energy Efficient Resources** a California Energy Commission and California Public Utilities Commission (CPUC) sponsored database designed to provide well-documented estimates of energy and peak demand savings values, measure costs, and effective useful life (EUL) all within one data source.

DOE	U.S. Department of Energy. DOE sponsored building energy software tools for download: *http://apps1.eere.energy.gov/buildings/tools_directory/doe_sponsored.cfm*
DRP	**Demand Response Program**. Program to reward/influence customers to reduce their consumption during peak hours. This may or may not result in overall reduction in consumption – Objective is to use less during peak periods.
DSM	Demand Side Management
Dual Baselines	The first baseline in a dual-baseline project uses the existing equipment parameters to determine the baseline energy usage. Savings calculated using this baseline are eligible throughout the RUL of the existing equipment. The second baseline uses industry standard practice (ISP) or building code standards to determine the baseline energy usage, because this baseline represents the period of time that is beyond the existing equipment's EUL. Savings calculated using this baseline are eligible for the time period beyond the RUL of the existing equipment, through the EUL of the proposed equipment.
EAR	Ex Ante Review
ECM	Energy Conservation Measure
ED	Energy Division (a division of the California Public Utilities Commission)
EE	Energy Efficiency
EEBI	**Energy Efficiency Business Incentive**, The SDG&E version of the Statewide Customized Offering. The 2013 Statewide Customized Offering provides financial incentives for the installation of high-efficiency equipment or systems.
EEBR	**Energy Efficiency Business Rebate**, The SDG&E version of the Statewide Customized Offering. Provides rebates to eligible business customers for installing energy-efficient lighting, refrigeration, food service, natural gas, and other technologies.
EEGA	**Energy Efficiency Groupware Application**, Consolidated public repository of California Investor Owned Utility (IOU) submitted reports on energy efficiency (EE) programs and savings achievements. Website: *http://eega.cpuc.ca.gov/*
EMS	Energy Management System
EM&V	Evaluation, Measurement, and Verification
EE Measurement Wizard	A building modeling option used in the eQUEST, Quick Energy Simulation Tool.

eQuest	eQUEST-the QUick Energy Simulation Tool. Download at: *http://www.doe2.com/equest/*
EUL	**Effective Useful Life** is an estimate of the median number of years that a piece of equipment will function cost-effectively (without prohibitively expensive maintenance costs and frequent breakdowns). For estimating energy savings, the PUC has developed a list of EUL's in the DEER database, used by the READI tool.
Ex-Ante	Expected savings based upon calculations, before installation.
Ex-Post	Actual savings based upon measurements, following installation.
HHW	Heating Hot Water
HVAC	Heating, Ventilating, and Air Conditioning
Incremental Cost	The differential cost between full measure cost and Code or Industry Standard Practice cost.
IDSM	Integrated Demand Side Management
IOU	Investor Owned Utility
IR	Installation Report
ISP	Industry Standard Practice
kW	Kilowatt; rate of energy flow per unit time (1000 Joules per second, 3415 BTU's per hour)
kWh	Kilowatt hour; unit of energy (3600 kilojoules, 3412 BTU's)
LabPro	A laboratory airflow system modeling software provided by Phoenix Controls Corporation, see: *http://www.newmatic.net/resources/pdf/energysavings/LabPro-User-Manual-and-Appendix.pdf*
LED	Light Emitting Diode
Lighting Tool	**2013 Calculated Lighting Equipment Survey Table** is an interactive excel spreadsheet tool for calculating existing lighting LPD's, 1st and 2nd baselines, and estimated energy savings. Download at: *http://www.SDGE.com/rebates-finder/save-energy-earn-incentives*
LPD	Lighting Power Density, LPD values for various building applications can be found in current California Title 24 Code (watts per square foot).
Lumens	Amount of light produced by a lamp (bulb), the "brightness" level.

M&V	**Measurement And Verification**, The calculation approach for some EE projects requires baseline and/or post-retrofit measurement and verification (M&V) to confirm the energy savings. The M&V requirements vary widely depending on the size and type of a project. Projects with variable loads generally require more measurement and verification than constant-load projects.
M&V Option B	**International Performance Measurement and Verification Protocol Option B** –Savings are determined by measuring energy use of the systems to which the ECM was applied, separate from the energy use of the rest of the facility. Short-term or continuous measurements are taken through the post-retrofit period.
M&V Option C	**International Performance Measurement and Verification Protocol Option C-** Savings are determined by measuring energy use at the whole facility level. Short-term or continuous measurements are taken throughout the post-retrofit period.
MBCx	Monitoring Based Commissioning
Measure	A capital investment that reduces energy cost in an amount sufficient to recover the total cost of purchasing and installing such a measure. May also qualify for a rebate or incentive through SDG&E's customer programs.
Measure Life	See EUL and RUL
Motor-Master	**MotorMaster+** is a free online software tool that helps users to analyze energy use and savings opportunities in systems. Download at: *http://www1.eere.energy.gov/manufacturing/tech_assistance/software_motormaster.html*
NTG	**Net To Gross** - The ratio or percentage of net program impacts divided by the gross or total impacts. NTG is used to estimate and describe the free- ridership that may be occurring within efficiency programs.
Open loop	A cooling water system with cooling water exposed to the atmosphere. Open loop systems generally require pumping against a fixed static head.
OBF	On Bill Financing - Program to finance "zero" interest loans to customers who install replacement energy efficient equipment. See website: *http://www.SDGE.com/business/bill-financing*
OR	Operating Report
PA	Program Assistant
PUC	California Public Utilities Commission (also CPUC)
RCx	Retrocomissioning. See program website: *http://www.sandiegorcx.com/*

READI	**Remote Ex-Ante Database Interface** Download READI (Version 2.0.1) at: *http://www.deeresources.com/index.php/deer2013-update-for-2014-codes* All of the DEER2013 Unit Energy Savings (UES) values and measure data are stored on a remote database server. A database access tool has been developed that provides live access to the database. The tool, READI (Remote Ex-Ante Database Interface) connects to the database over the internet utilizing a secure and encrypted connection over port 22 or a standard remote database connection over port 5432. The program allows users to view and download all of the data associated with the DEER2013, DEER2013 Alternate and DEER2011 databases. The program allows users to view and download any of the data associated with the DEER2013 update, in a CSV file format.
Rebuild	Equipment that has received major service or reconditioning.
ROB	**Replace on Burnout**- category includes retrofits where the existing equipment is either non-functional or has less than one year of RUL. The energy savings for ROB measures are calculated as the difference in energy use between the high-efficiency equipment and the standard-efficiency equipment that would have been purchased without program intervention.
RET	**Retrofit,** Replacing equipment that still has at least one year of remaining useful life (RUL)
Retrofit/ Add-ons	**Retrofit/Add-on** measures typically involve adding equipment or controls on to existing equipment in order to save energy. Typically, a building owner is not compelled to install new controls in order to comply with code. Therefore, REA energy savings are typically calculated as the difference between the proposed system's energy consumption and the existing system's consumption.
RUL	**Remaining Useful Life** of a piece of equipment is the estimated remaining time that a given piece of equipment will operate cost-effectively. If the exact equipment vintage is known, as in the example above, then the RUL is calculated as the difference between the EUL and the equipment's age. Otherwise, it is estimated to be 1/3 of the EUL.
Smart Controls	Smart controls provide comprehensive integrated control of electric or natural gas end uses to minimize overall system energy consumption. Smart controls employ algorithms and control sequences to optimize (minimize) energy consumption. In addition, smart controls may employ algorithms and control sequences to automatically regulate energy systems in response to demand response events.
SPC	Standard Performance Contract (expired program, rolled into EEBR/EEBI)
Space Types	Generally, building types listed in DEER
Title 20	2012 California Appliance Efficiency Regulations, Section 1601 et seq. Download at: *http://www.energy.ca.gov/appliances/*

Title 24	2013 California Building Energy Efficiency Standards, Part 6. Download at: *http://www.energy.ca.gov/title24/2013standards/index.html*
TMY3	**Typical Meteorological Year** Weather Data, (TMY3) data sets derived from the 1991-2005 National Solar Radiation Data Base (NSRDB) archives, Download at: *http://doe2.com/Download/Weather/TMY3/*
TOU	**Time Of Use** rate structure.
TRAV	**Terminal Regulated Air Volume** (TRAV) is an HVAC and lighting control strategy that has been made possible with the introduction of high- performance full-DDC systems, developed by Thomas Hartman. See: *http://www.hartmanco.com/pdf/p02.pdf*
UES	**Unit Energy Savings** - UES values are the annual savings associated with a specific measure. Savings include annual total electric savings in kWh, annual total gas savings in therms and peak period demand reduction in kW. Savings are expressed in terms of a "common unit" such as; tons of cooling capacity; a single appliance such as a clothes washer; a single dwelling unit such as a single family home or individual apartment; square foot of conditioned floor area; lighting fixture or lamp.
VFD/ VSD	Variable Frequency Drive/ Variable Speed Drive – used interchangeably.
Vintage	The age of a facility or equipment.
Whole Building Method	Energy saving analysis method that uses Whole Building Modeling calibrated to annual electric bills.
Work Paper	A Work Paper is a living engineering document that provides comprehensive information and calculations on energy efficiency measures commonly installed in the residential and /or nonresidential market segments. The document contains a description of the measure under consideration, as well as its delivery mechanism, and baseline data. It also gives an explanation and reasoning behind using a specific calculation method that differs from the Database of Energy Efficiency Resources (DEER). A work paper serves as a starting point in the planning and forecasting of the impacts and cost-benefit analysis of energy efficiency and demand response programs.
WSHP	Water Source Heat Pump
Qualified Lighting Products	Commercial Lighting Qualifying Products List. Available at: *http://library.cee1.org/content/commercial-lighting-qualifying-products-lists*

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Appendix

Energy Efficiency Business Incentives Program Checklist

Energy Efficiency Business Incentives Program Checklist

SDGE connected
A Sempra Energy utility

1 STARTING POINT FOR ALL SUBMITTALS

- **Submit Completed Application** *(Forms 1, 2, 3)*
- **Submit Completed IRS Form W-9** *(if you have not already submitted this form for our records)*
- **Submit Manufacturer Specification Sheets**
- **Trade Professional Agreement**

DEFINE THE TOTAL PROJECT COSTS FOR NEW EQUIPMENT
- Include quantity, materials, labor, and other pertinent information

DEFINE THE ANNUAL ENERGY USAGE FOR NEW EQUIPMENT*
- Define the efficiency, run hours, load factor, horsepower, tons, or any other pertinent equipment information
- Calculate the total kW, kWh and/or therms that each piece of equipment will consume annually
- Provide calculation tools

DEFINE ANNUAL ENERGY USAGE FOR THE EXISTING EQUIPMENT*
- Define the efficiency, run hours, load factor, horsepower, tons, or any other pertinent equipment information
- Calculate total kW, kWh and/or therms that each piece of equipment consumes annually
- Provide calculation tools

* If lighting is included the **2013 Calculated Lighting Equipment Survey Table** is required

2 REPLACE ON BURN OUT

Projects Must Fulfill Items Listed Below and Section 1

DEFINE EFFECTIVE USEFUL LIFE OF NEW EQUIPMENT
- Information can be located on manufacturer specification sheets

DEFINE THE ANNUAL ENERGY USAGE USING MINIMUM CODE OR INDUSTRY STANDARD PRACTICE (ISP)
- Provide Title 24 minimum code efficiencies or the industry standard efficiencies for the equipment in question

3 EARLY RETIREMENT PROJECTS

Projects Must Fulfill Items Listed Below and Section 1 & 2

DOCUMENT INSTALL DATE OF EXISTING EQUIPMENT
- Include invoices, receipts, and any other pertinent information; commissioning documents; contact equipment manufacturer with serial number to verify a sale year

DEFINE EFFECTIVE USEFUL LIFE OF EXISTING EQUIPMENT
- Refer to the manufacturer specification sheet; use the install/commissioning date to define the years left for the equipment

PROVIDE MAINTENANCE RECORDS FOR THE EXISTING EQUIPMENT
- Include history of all service (preferably dating back to the date of purchase); HVAC maintenance companies or internal maintenance staff can provide this information

P.O. Box 129831 | San Diego, CA 92112-9831 | 1-800-411-7343 | Connect at **sdge.com**

Energy Efficiency Business Rebates (EEBR) Measures Table

*Rebate $/Units are subject to change without notice. Refer to www.sdge.com for current values.

Agricultural Products				
Solution	**Product Code**	**Production Description**	**Units**	**$/Units**
Irrigation	O-C1	Sprinkler to Drip Irrigation	Acre	$44.00
Sprinkler Nozzles	O-D1	Low Pressure Sprinkler Nozzles	Nozzle	$1.15
Greenhouse Heat Curtain	G-K1	Greenhouse Heat Curtain - **Requires Pre-inspection**	Square Foot	$0.40
Infrared Film	G-L1	Infrared Film for Greenhouses	Square Foot	$0.05

Food Service Products				
Solution	**Product Code**	**Production Description**	**Units**	**$/Units**
Steam Cooker	FS-A1	Electric	Steamer	$1,250.00
	FS-A21	Gas		$2,000.00
Insulated Holding Cabinet	FS-B1	Full Size	Unit	$300.00
	FS-B2	Three Quarter Size		$200.00
Fryer	FS-C1	Electric Fryer (vat width less than 18 inches)	Vat	$200.00
	FS-C2	Gas Fryer (vat width less than 18 inches)		$749.00
Ice Machine	FS-D8	101-200 lbs. per 24 hrs. (ENERGY STAR®)	Unit	$50.00
	FS-D9	201-300 lbs. per 24 hrs. (ENERGY STAR)		$50.00
	FS-D10	301-400 lbs. per 24 hrs. (ENERGY STAR)		$75.00
	FS-D11	401-500 lbs. per 24 hrs. (ENERGY STAR)		$75.00
	FS-D12	501-1,000 lbs. per 24 hrs. (ENERGY STAR)		$125.00
	FS-D13	1,001-1,500 lbs. per 24 hrs. (ENERGY STAR)		$200.00
	FS-D14	Greater than 1,500 lbs. per 24 hrs. (ENERGY STAR)		$250.00
	FS-D15	101-200 lbs. per 24 hrs. (CEE Tier III)		$100.00
	FS-D16	201-300 lbs. per 24 hrs. (CEE Tier III)		$100.00
	FS-D17	301-400 lbs. per 24 hrs. (CEE Tier III)		$150.00
	FS-D18	401-500 lbs. per 24 hrs. (CEE Tier III)		$150.00
	FS-D19	501-1,000 lbs. per 24 hrs. (CEE Tier III)		$250.00
	FS-D20	1,001-1,500 lbs. per 24 hrs. (CEE Tier III)		$400.00
	FS-D21	Greater than 1,500 lbs. per 24 hrs. (CEE Tier III)		$500.00
Griddle	FS-E1	Electric	Griddle	$300.00
	FS-E2	Gas		$125.00
Combination Oven	FS-F1	Electric	Oven	$1,000.00
	FS-F2	Gas		$750.00
Convection Oven	FS-G1	Electric		$350.00
	FS-G2	Gas		$500.00

Solution	Product Code	Production Description	Units	$/Units
Solid-Door Reach-In Refrigerator	FS-H11	Refrigerator < 15 ft3	Unit	$65.00
	FS-H21	Refrigerator 15-29 ft3		$75.00
	FS-H31	Refrigerator 30-49 ft3		$125.00
	FS-H41	Refrigerator 50 ft3 and over		$200.00
Solid-Door Reach-In Freezer	FS-I11	Solid-Door Reach-In Freezer < 15 ft3		$100.00
	FS-I21	Solid-Door Reach-In Freezer 15-29 ft3		$200.00
	FS-I31	Solid-Door Reach-In Freezer 30-49 ft3		$300.00
	FS-I41	Solid-Door Reach-In Freezer 50 ft3 and over		$600.00
Glass-Door Reach-In Refrigerator	FS-J51	Glass-Door Reach-In Refrigerator < 15 ft3		$75.00
	FS-J61	Glass-Door Reach-In Refrigerator 15-29 ft3		$100.00
	FS-J71	Glass-Door Reach-In Refrigerator 30-49 ft3		$125.00
	FS-J81	Glass-Door Reach-In Refrigerator 50 ft3		$150.00
Glass-Door Reach-In Freezer	FS-N11	Glass-Door Reach-In Freezer < 15 ft3		$200.00
	FS-N21	Glass-Door Reach-In Freezer 15-29 ft3		$250.00
	FS-N31	Glass-Door Reach-In Freezer 30-49 ft3		$500.00
	FS-N41	Glass-Door Reach-In Freezer 50 ft3 and over		$1,000.00
Commercial Gas Rack Oven	FS-K1	Single or Double	Unit	$2,000.00
Commercial Conveyor Oven	FS-L1	Conveyor Oven	Deck	$750.00
Commercial Kitchen Ventilation Control	FS-M1	New Hood or Retrofit Electric	Fan HP	$350.00

Lighting Products				
Solution	**Product Code**	**Product Description**	**Units**	**$/Unit**
Compact Fluorescent Fixtures	L-C41	New Fixture wattage from 193 to 244	Fixture	$60.00
	L-C51	New Fixture wattage from 245 to 360		$45.00
	L-C31	New Fixture wattage from 129 to 192		$50.00
	L-C21	New Fixture wattage from 71 to 128		$40.00
	L-C11	New Fixture wattage less than or equal to 70 watt		$15.00
Exterior Compact Fluorescent Fixtures	L-C61	New Fixture less than or equal to 70 watt		$10.00
Interior Induction Fixtures	L-D41	New Fixture wattage from 181 to 250		$90.00
	L-D51	New Fixture wattage from 251 to 360		$50.00
	L-D31	New Fixture wattage from 121 to 180		$60.00
	L-D21	New Fixture wattage from 71 to 120		$50.00
	L-D11	New Fixture wattage less than or equal to 70 watt		$25.00
Exterior Induction Fixtures	L-D01	New Fixture wattage from 181 to 250		$100.00
	L-D91	New Fixture wattage from 121 to 180		$35.00
	L-D81	New Fixture wattage from 101 to 120		$40.00
	L-D71	New Fixture wattage from 71 to 100		$45.00
	L-D61	New Fixture wattage less than or equal to 70 watt		$25.00
Interior Linear Fluorescent Fixtures	L-H11	New Fixture wattage from 361 to 600		$100.00
	L-H21	New Fixture wattage from 193 to 244		$80.00
	L-H31	New Fixture wattage from 245 to 360		$45.00
	L-H41	New Fixture wattage from 129 to 192		$50.00
	L-H51	New Fixture wattage from 65 to 128		$30.00
	L-H61	New Fixture wattage less than or equal to 64 watt		$15.00
Interior Pulse Start or Ceramic Metal Halide Fixtures	L-F81	New Fixture wattage from 251 to 600		$20.00
	L-F71	New Fixture wattage from 601 to 750		$15.00
	L-F61	New Fixture wattage from 176 to 250		$10.00
	L-F51	New Fixture wattage from 126 to 175		$10.00
	L-F41	New Fixture wattage less than or equal to 125 watt		$10.00
	L-F21	New Fixture wattage less than or equal to 70 watt **(PSMH only)**		$5.00
Exterior Pulse Start or Ceramic Metal Halide Fixtures	L-P61	New Fixture wattage from 251 to 750	Fixture	$25.00
	L-P51	New Fixture wattage from 176 to 250		$20.00
	L-P41	New Fixture wattage from 126 to 175		$15.00
	L-P31	New Fixture wattage from 101 to 125		$10.00
	L-P21	New Fixture wattage from 71 to 100		$15.00
	L-P11	New Fixture wattage less than or equal to 70		$10.00
Ceramic Metal Halide Fixture	L-G11	New Fixture less than or equal to 75 watt		$45.00

Solution	Product Code	Product Description	Units	$/Unit
Interior High Bay LED Fixture	L-K11	High Bay LED: 40 to 131 watts		$100.00
	L-K21	High Bay LED: >131 to 160 watts		$110.00
	L-K31	High Bay LED: >160 to 187 watts		$125.00
	L-K41	High Bay LED: >187 to 220 watts		$145.00
	L-K51	High Bay LED: >220 to 262 watts		$160.00
	L-K61	High Bay LED: >262 to 280 watts		$190.00
	L-K71	High Bay LED: >280 to 320 watts		$225.00
	L-K81	High Bay LED: >320 to 500 watts		$250.00
	L-K91	High Bay LED: >500 to 750 watts		$300.00
Interior LED Fixture	L-M11	LED: 22 to 39 watts		$70.00
	L-M21	LED: 40 to 131 watts		$100.00
	L-M31	LED: >131 to 160 watts		$110.00
	L-M41	LED: >160 to 220 watts		$125.00
Exterior LED Fixtures (Street and Area Lighting)	L-S51	New Fixture wattage from 193 to 350		$125.00
	L-S61	New Fixture wattage from 151 to 192		$125.00
	L-S71	New Fixture wattage from 111 to 150		$80.00
	L-S81	New Fixture wattage from 81 to 110		$80.00
	L-S91	New Fixture wattage less than or equal to 80		$50.00
Accent or Directional Lighting	L-U11	New Surface, Pendant, and Recessed Down Lighting LED Fixture wattage less than or equal to 15 watt		$25.00
LED Display Case Lighting (Non-Refrigerated)	L-O11	New Linear LED Strip (T8 base case)	Linear Foot	$12.00
	L-O21	New Linear LED Strip (T12 base case)		$12.00
	L-O31	New Linear LED Strip (Bi-pin Halogen base case)		$12.00
LED Refrigerator or Freezer Case Lighting	L-R11	New Premium 5' Case Door	Door	$90.00
	L-R21	New Standard 5' Case Door		$45.00
	L-R31	New Premium 6' Case Door		$125.00
	L-R41	New Standard 6' Case Door		$75.00
Screw-in CFL	L-B41	New Screw-in Compact Fluorescent Lamp 14 to 28 watt reflector	Lamp	$5.00
8 Foot T8 Linear Fluorescent Lamps with Electronic Ballasts	L-E41	New T8 Lamp and Electronic Ballast - 8 Foot		$12.00
	L-E81	T8 Lamp - 8 Foot Lamp Removed		$15.00
Low or Reduced Wattage (T8)	L-T11	T8 32 watt to 4 Foot 25 watt Lamp	Lamp	$1.50
	L-T21	T8 32 watt to 4 Foot 28 watt Lamp		$1.00
	L-T51	T8 32 watt 4 Foot Lamp Removed		$8.00

Solution	Product Code	Product Description	Units	$/Unit
Interior LED Integral Lamps	L-W11	Up to 6 watt Interior LED Integral MR 16 Lamp		$5.00
	L-W21	7 to 10 watt Interior LED Integral MR 16 Lamp		$12.50
	L-W31	Up to 10 watt Interior LED Integral PAR-20 Lamp		$12.50
	L-W41	Up to 15 watt Interior LED Integral PAR30 Lamp		$7.50
	L-W51	16 to 21 watt Interior LED Integral PAR30 Lamp		$17.50
	L-W61	Up to 16 watt Interior LED Integral PAR38 Lamp		$10.00
	L-W71	17 to 22 watt Interior LED Integral PAR38 Lamp		$20.00
	L-W81	23 to 25 watt Interior LED Integral PAR38 Lamp		$20.00
	L-W91	Up to 2 watt Interior LED Integral Globe Lamp		$5.00
	L-X11	3 to 10 watt Interior LED Integral Globe Lamp		$5.00
	L-X21	Up to 4 watt Interior LED Integral Candelabra Lamp		$5.00
	L-X31	Up to 7 watt Interior LED Integral A-lamp Lamp		$5.00
	L-X41	8 to 10 watt Interior LED Integral A-lamp Lamp		$5.00
	L-X51	11 watt Interior LED Integral A-lamp Lamp		$15.00
	L-X61	12 to 17 watt Interior Integral A-lamp Lamp		$15.00
	L-X71	18 to 30 watt Interior Integral A-lamp Lamp		$15.00
Lighting Controls	L-J11	Wall-box Occupancy Sensor	Sensor	$5.00
	L-J21	Wall or Ceiling Mounted Occupancy Sensor controlling less than 500 watt		$35.00
	L-J31	Wall or Ceiling Mounted Occupancy Sensor controlling greater than or equal to 500 watt		$55.00
	L-J41	Fixture Integrated Occupancy Sensors greater than or equal to 150 wattage controlled		$15.00
	L-J51	Fixture Integrated Occupancy Sensors less than 150 watts controlled		$10.00
	L-J61	Bi-level Stairwell/Hall/Garage Fixtures	Fixture	$15.00
	L-L11	Time Clock	Time Clock	$15.00

Natural Gas Products				
Solution	Product Code	Product Description	Units	$/Units
Storage Water Heater	G-A1	Storage Water Heater	MBtuh	$2.00
Space Heating Boiler	G-B1	Space Heating Boiler (Steam)		$0.25
	G-B2	Space Heating Boiler (Water)		$0.25
	G-B3	Space Heating Boiler (Large)		$0.50
Commercial Boiler	G-C1	Commercial Boiler		$0.50
Instantaneous Water Heater	G-D1	Instantaneous Water Heater, Small (less than or equal to 200 MBtuh)		$2.00
	G-D2	Instantaneous Water Heater, Large (greater than 200 MBtuh)		$0.50
Process Boiler	G-E1	Process Boiler (Steam)		$0.50
	G-E2	Process Boiler (Water)		$0.50
Direct Contact Water Heater	G-G1	Direct Contact Water Heater, greater than 300 MBtuh		$2.00
	G-G2	Direct Contact Water Heater, less than or equal to 300 MBtuh		$2.00
Pipe Insulation	G-H11	Pipe Insulation Low Pressure (≤ 15 psi) Steam Application < 1 in	Linear foot	$3.00
	G-H21	Pipe Insulation Low Pressure (≤ 15 psi) Steam Application > 1 in		$3.00
	G-H31	Pipe Insulation Hot Water Application < 1 in		$3.00
	G-H41	Pipe Insulation Hot Water Application ≥ 1 in		$3.00
	G-H51	Pipe Insulation Medium Pressure (> 15 psi) Steam Application < 1 in		$4.00
	G-H61	Pipe Insulation Medium Pressure (> 15 psi) Steam Application ≥ 1 in		$4.00
	G-H71	Pipe Insulation High Pressure (≥ 15 psi) Dry Cleaner Steam Application ≥ 1 in		$4.00
Tank Insulation	G-I1	Tank Insulation High Temperature Application 1 in	Square foot	$3.00
	G-I2	Tank Insulation High Temperature Application 2 in		$4.00
	G-I3	Tank Insulation Low Temperature Application 1 in		$2.00
	G-I4	Tank Insulation Low Temperature Application 2 in		$3.00
Residential Clothes Washer	G-J1	High Efficiency Clothes Washer, CEE Tier 2 and 3A Models	Unit	$35.00
	G-J2	High Efficiency Clothes Washer, CEE Tier 3B Models		$75.00
Steam Trap	G-M1	Steam Trap Replacement, Large Commercial operating system 12-24 hrs./day Dry cleaners, Agricultural, and Industrial accounts excluded		$115.00
Ozone Laundry	G-N11	Ozone Laundry System	lb.	$39.00

Other Technology Products				
Solution	**Product Code**	**Product Description**	**Units**	**$/Unit**
Reflective Window Film	O-A1	Reflective Window Film (Coastal)	Square Foot	$1.35
	O-A2	Reflective Window Film (Inland)		$1.35
	O-A3	Reflective Window Film (Desert)		$1.35
Low Flow Showerhead	SD-B1	Low Flow Showerhead	Showerhead	$20.00
Network Power Management Software	SD-C1	Network Power Management Software	Desktop Computer	$15.00
Refrigerator	SD-E1	Early Retirement Refrigerator	Unit	$275.00
Vending Machine Controller	R-O1	Vending Machine Controller	Controller	$100.00
Variable Frequency Drives	O-B1	Variable Frequency Drives (VFDs) (Max.100HP, HVAC Only)	HP	$110.00

Refrigeration Products				
Solution	**Product Code**	**Production Description**	**Units**	**$/Units**
Night Covers for Multi-deck and Horizontal Display Cases	R-A11*	Medium Temp	Linear Foot	$3.50
	R-A21	Low Temp		$3.50
New Refrigeration Display Case with Doors	R-C11	Low Temp		$175.00
	R-C21	Medium Temp		$75.00
New High Efficiency Refrigeration Display Case	R-D11	Display Case with Special Doors (low temp)		$75.00
Doors with Low/No Anti-Sweat Heat	R-E11	Doors with Low/No Anti-Sweat Heat on Low Temp Display Case	Door	$100.00
Anti-Sweat Heat (ASH) Controls	R-F11*	Controls	Linear Foot	$25.00
Insulation for Bare Suction Lines	R-G11*	Insulation for Bare Suction Lines		$2.00
Auto-Closer	R-J11*	for Main Cooler Doors	Closer	$75.00
	R-J21*	for Main Freezer Doors		$75.00
Evaporative Fan Controller	R-K1	for Walk-in Coolers	Controller	$90.00
	R-K2	for Walk-in Freezers		$75.00

DEER to Deemed Rebate Table

Energy Efficiency Business Rebates DEER Catalog

DEER PRODUCTS				
Product Code	Product Description	Units	$/Unit	Page #
DM-02	Chilled Water Reset	Controller	$681.00	3
DM-03	Hot Water Reset		$681.00	3
DM-04	Variable Flow Chilled Water Loop	HP	$170.00	4
DM-05	VSD Chilled Water Loop Pump		$73.00	4
DM-06	Variable Flow Hot Water Loop		$159.00	4
DM-07	VSD Hot Water Loop Pump		$12.00	5
DM-08	Variable Air Volume Box	Area-1kR	$1,512.00	5
DM-09	Evaporative Cooling Indirect - Central System	Capacity Tons	$38.00	5
DM-10	Evaporative Cooling Indirect - Packaged System		$65.00	6
DM-11	Reducing Over-ventilation	Area-1kR	$29.00	6
DM-12	Air To Air Heat Exchanger		$81.00	6
DM-13	Rotary Heat Recovery		$4.00	7
DM-14	Cooling Tower for Packaged System	Capacity Tons	$72.00	7
DM-15	VSD Cooling Tower Fans		$2.00	7
DM-16	Efficient Water Source Heat Pump		$102.00	8
DM-17	Hydronic Heat Pump Variable Flow Valve		$4.00	8
DM-20	Water Side Economizer		$2.00	8
DM-21	Grocery, Low Temperature Mechanical Subcooling		$141.00	9
DM-22	Grocery, Low and Medium Temp Mechanical Subcooling		$77.00	9
DM-23	Grocery, Floating Suction Pressure		$29.00	9
DM-24	Grocery, Floating Head Pressure, Fixed Set-point (air-cooled)		$29.00	10
DM-25	Grocery, Floating Head Pressure, Fixed Set-point (evap-cooled)		$29.00	10
DM-26	Grocery, Floating Head Pressure, Variable Set-point (air-cooled)		$51.00	10
DM-27	Grocery, Floating Head Pressure, Variable Set-point (evap-cooled)		$51.00	10
DM-28	Grocery, Floating Head Pressure, Variable Set-point & Speed (air-cooled)		$200.00	11
DM-29	Grocery, Floating Head Pressure, Variable Set-point & Speed (evap-cooled)		$200.00	11
DM-30	Refrigerated Warehouse, Floating Suction Pressure		$44.00	11
DM-31	Refrigerated Warehouse, Floating Head Pressure, Fixed Set-point (evap-cooled)		$29.00	11
DM-32	Refrigerated Warehouse, Floating Head Pressure, Variable Set-point (evap-cooled)		$51.00	12
DM-33	Refrigerated Warehouse, Floating Head Pressure, Variable Set-point & Speed (evap-cooled)		$239.00	12
DM-34	Two-Speed Cooling Tower Fans		$2.00	12
DM-41	Economizer – Central System		$45.00	12

DM-48	Efficient Packaged Gas Furnace - AFUE 95 – 95.9	Area – 1kFP	$5.00	13
DM-49	Efficient Packaged Gas Furnace - AFUE ≥ 96		$6.00	13
DM-52	Package Heat Pump EER = 10.0 (>= 760 kBtuh), COP = 3.2	Capacity Tons	$69.00	13
DM-53	Package Heat Pump EER = 10.2 (>= 760 kBtuh), COP = 3.2		$73.00	13
DM-54	Package Air Conditioner EER = 10.2 (>= 760 kBtuh)		$70.00	14
DM-55	Hot water boiler (< 300 kBtuh, 94.0 AFUE, condensing)	kBtuh	$1.14	14
DM-56	Duct Sealing	Capacity Tons	$2.00	14

GENERAL REQUIREMENTS

- Customer must have a San Diego Gas & Electric® (SDG&E®) commercial, industrial or agricultural electric account
- Carefully read the specifications and definitions to determine whether you are installing a qualifying product(s)
- All equipment must be installed and operational before a rebate application is submitted
- It is the responsibility of the customer to ensure the equipment to be installed adheres to all state, local and national building codes and ordinances, as well as the manufacturer's requirements
- All rebates apply toward the purchase of new or replacement energy-efficient equipment, unless otherwise indicated. Used or rebuilt equipment is not eligible.
- All applications for DEER measures listed in this catalog must have a pre-inspection & post-inspection. To schedule your pre-inspection please call our Energy Savings Center at 1-800-644-6133

Energy Efficiency Business Incentives (EEBI) Measures Table

ENERGY EFFICIENCY BUSINES INCENTIVE MEASURES	INCENTIVE CATEGORY	INCENTIVE RATE	BONUS CATEGORY
Lighting - Exterior Linear Fl. Lighting	Basic	$ 0.03	Lighting
Lighting - Exterior Pulse Start MH	Basic	$ 0.03	Lighting
Lighting - Exterior Induction	Basic	$ 0.03	Lighting
Lighting - Exterior LED	Targeted	$ 0.08	Lighting
Data Center Free Cooling	Basic	$ 0.03	Lighting
Lighting - Interior LED - Dual Baseline	Targeted	$ 0.08	Lighting
HVAC - Split & Packaged A/C units	Targeted	$ 0.15	HVAC
HVAC - Chiller	Targeted	$ 0.15	HVAC
HVAC - VFD	Basic	$ 0.08	HVAC
HVAC - Non Conditioned Space Ventilation	Basic	$ 0.08	HVAC
HVAC - Controls/Controlling Equipment	Basic	$ 0.08	HVAC
HVAC - Other HVAC	Basic	$ 0.08	HVAC
Refrigeration - Compressor and Condenser Upgrades	Basic	$ 0.08	Refrigeration
Refrigeration - Insulation	Basic	$ 0.08	Refrigeration
Refrigeration - Other Refrigeration	Basic	$ 0.08	Refrigeration
Motors - Non HVAC Motors (ROB)	Basic	$ 0.08	HVAC
Lighting - Interior Linear Fixtures - Dual Baseline	Basic	$ 0.03	Lighting
Lighting - Interior CF Fixtures	Basic	$ 0.03	Lighting
Lighting - Interior CFLs	Basic	$ 0.03	Lighting
Lighting - Interior Lighting Controls	Basic	$ 0.03	Lighting
Lighting - Other Interior lighting - Dual Baseline	Basic	$ 0.03	Lighting
Lighting - Exterior Lighting Fixtures	Basic	$ 0.03	Lighting
Lighting - Exterior Lighting Controls	Basic	$ 0.03	Lighting
Gas - W/H Lg Storage	Basic	$ 1.00	HW/Steam
Gas - Boiler Upgrades	Basic	$ 1.00	HW/Steam
Gas - Process Other	Basic	$ 1.00	Process Heat
Misc. Custom Electric	Basic	$ 0.03	Case-by-case
Lighting - LED Interior Linear Fixtures	Targeted	$ 0.08	Lighting
Lighting - Interior LED	Targeted	$ 0.08	Lighting
Lighting - Other Interior lighting	Basic	$ 0.03	Lighting
Lighting - Interior Linear Fixtures	Basic	$ 0.03	Lighting
Motors - Non HVAC Motors (ER)	Basic	$ 0.08	Process

Lighting Controls- Exterior	Basic	$	0.03	Lighting
Smart Controls/Energy Management System	Targeted	$	0.15	Smart Controls
Building Shell Improvements	Basic	$	0.08	Building Envelope
Non Ag-Pump/PETS	Basic	$	0.08	Process
Non-HVAC VFD	Basic	$	0.08	Process
Constant Air Volume to Variable Air Conversions	Targeted	$	0.15	HVAC
Data Center Free Cooling	Targeted	$	0.15	HVAC
HVAC Condensers	Targeted	$	0.15	HVAC
HVAC Compressor	Basic	$	0.08	HVAC
Cooling Tower Upgrades or Replacements	Basic	$	0.08	HVAC
Heat Recovery	Basic	$	1.00	Heat Recovery
Ag-Misc	Basic	$	0.08	Process
Ag-Pump/PETS	Targeted	$	0.15	Process
Emerging Technologies-Non Lighting/Non Gas	Targeted	$	0.15	Case-by-case
Emerging Technologies-Lighting	Basic	$	0.08	Lighting
Evaporative Cooling Installations	Targeted	$	0.15	HVAC
Evaporative Pre-Cooling Unit Installations	Targeted	$	0.15	HVAC
Evaporative Cooling Indirect (single & dual stage)	Targeted	$	0.15	HVAC
Heat Transfer	Targeted	$	0.15	HVAC
Ref. Head Controller Installations	Targeted	$	0.15	Refrigeration
Central Plant Tie-In/Consolidation	Targeted	$	0.15	HVAC
Pneumatic to DDC controls (only if hard-wired)	Targeted	$	0.15	HVAC
Centrifugal to Vertical Turbine Pumps (for Ag only)	Targeted	$	0.15	Process
Compressor replacement (A/C or Refrigeration)	Targeted	$	0.15	HVAC/Refrigeration
Variable Refrigerant Flow (VRF) system	Targeted	$	0.15	HVAC
Adv. Air Compress Controls 2 or More	Targeted	$	0.15	Smart Controls
Lighting-Smart Controls-Interior	Targeted	$	0.15	Smart Controls
Lighting-Smart Controls-Exterior	Targeted	$	0.15	Smart Controls
VSD Install Existing AC/Refrig Compressor Mtrs	Targeted	$	0.15	HVAC/Refrigeration
Refrigeration-EMS	Targeted	$	0.15	Smart Controls
VSD Chiller Plant Optimization	Targeted	$	0.15	Smart Controls
VAV Laboratory Exhaust Installations	Targeted	$	0.15	HVAC

READI List and Measure ID Summary

Index	MeasureID	Description
Refrigeration	**Refrigeration**	**Refrigeration**
10185	D03-205	Grocery, Night Covers for Display Cases (medium temp)
10186	D03-206	Grocery, Medium Temp Glass Doors (open display cases)
10187	D03-207	Grocery, New Medium Temp Refrig Display Case with Doors
10198	D03-218	Grocery, Low Temperature Mechanical Subcooling
10199	D03-219	Grocery, Low and Medium Temp Mechanical Subcooling
10200	D03-220	Grocery, Floating Suction Pressure
10201-10206	D03-221 to 226	Grocery, Floating Head Pressure, Fixed & Variable
10214	D03-306	Ref Warehse, Floating Suction Pressure
10215-10217	D03-307 to 309	Ref Warehse, Floating Head Pressure, Fixed & Variable
Windows & Skylights	**Windows & Skylights**	**Windows & Skylights**
10074-10081	D03-017 to 024	Low SHGC Windows -15% - 30% WWR
10082-10087	D03-025 to 030	Hi Perf. Glass, PI=0.81 to PI=1.38, Side Ltg., Std glass types
10088-10096	D03-031 to 039	Hi Perf. Glass, PI=0.81 to PI=1.38, Top Ltg. Skylights
Hot Water - Steam	**Hot Water - Steam**	**Hot Water - Steam**
107	NE-WtrHt-LrgInst-Elec-gt12kW	High Efficiency Large Electric Instantaneous Water Heater
108	NE-WtrHt-LrgStrg-Elec-gt12kW	High Efficiency Large Electric Storage Water Heater
101	NE-WtrHt-SmlInst-Elec-lte12kW-lt2G	High Efficiency Small Electric Instantaneous Water Heater
102-106	NE-WtrHt-SmlStrg-Elec-lte12kW-	High Efficiency Small Electric Storage Water Heater - 30-75 Gal.
63-65	NG-HVAC-Blr-HW-300to2500kBtuh-	Hot water boiler (300-2500 kBtuh, 85.0% thermal efficiency, atmospheric)
66-67	NG-HVAC-Blr-HW-gt2500kBtuh-	Hot water boiler (> 2500 kBtuh)
68-70	NG-HVAC-Blr-HW-lt300kBtuh-	Hot water boiler (< 300 kBtuh)
71-72	NG-HVAC-Blr-Stm-300to2500kBtuh-	Steam boiler (300-2500 kBtuh)
73-74	NG-HVAC-Blr-Stm-gt2500kBtuh-	Steam boiler (> 2500 kBtuh)
75-76	NG-HVAC-Blr-Stm-lt300kBtuh-	Steam boiler (< 300 kBtuh)
96-98	NG-WtrHt-LrgInst-Gas-gt200kBtuh-	High Efficiency Large Gas Instantaneous Water heater
99-100	NG-WtrHt-LrgStrg-Gas-gte75kBtuh-	High Efficiency Large Gas Storage Water Heater
93-95	NG-WtrHt-MedInst-Gas-76to200kBtuh-	High Efficiency Medium Gas Instantaneous Water heater
77	NG-WtrHt-SmlInst-Gas-lte75kBtuh-lt2G-0p8	High Efficiency Small Gas Instantaneous Water Heater - <2 Gallons
78-92	NG-WtrHt-SmlStrg-Gas-lte75kBtuh-30G-75G	High Efficiency Small Gas Storage Water Heater - 30-75Gal
Insulation	**Insulation**	**Insulation**
10071	D03-013	Ceiling/Roof Insulation
10073	D03-016	Light Colored Roof
10179	D03-123	Floor Insulation
HVAC	**HVAC**	**HVAC**
299	airAC-SpltPkg-gte760kBtuh-10p0eer-wtd	Pkg AC EER = 10.0 (>= 760 kBtuh) - Combined EER 9.7 and EER 10.2
48	Com-RefrigCharge-wtd	Adjust refrigerant charge of small, packaged AC (commercial) from off-charge to factory spec
10101	D03-044	Chilled Water Reset
10102	D03-045	Hot Water Reset
10103	D03-046	Variable Flow Chilled Water Loop
10104	D03-047	VSD Chilled Water Loop Pump
10105	D03-048	Variable Flow Hot Water Loop
10106	D03-049	VSD Hot Water Loop Pump
10107	D03-050	Variable Air Volume Box
10108	D03-051	VSD Supply Fan Motors
10110	D03-053	Evap Cool Indirect - Central System
10111	D03-054	Evap Cool Indirect - Packaged Sys
10112	D03-055	Reducing Overventilation
10113	D03-056	Air To Air Heat Exchanger
10114	D03-057	Rotary Heat Recovery
10115	D03-058	Economizer - Packaged System
10116	D03-059	Economizer - Central system
10117	D03-060	Economizer Maintenance
10119	D03-062	Cooling Tower for Packaged System
10120	D03-063	Two-Speed Cooling Tower Fans
10121	D03-064	VSD Cooling Tower Fans
10122	D03-065	Efficient Gas Furnace
10237-10245	D03-065+	Efficient Packaged Gas Furnace-
10126	D03-069	Efficient Water Source Heat Pump
10127	D03-070	Hydronic Heat Pump Var Flow Valve
10128	D03-071	Time Clocks (heating/cooling)
10130	D03-073	Setback Programmable Thermostats
10131	D03-075	Duct Insulation Material
10138-10239	D03-082 to 083	H.E. Evap/Water-Cooled Pkg A/C
10140-10141	D03-084 to 085	H.E. Package Terminal A/C & HP
10142-10144	D03-086 to 088	Efficient HVAC Motors - Fans
10145-10147	D03-089 to 091	Effic. Motors - Pumps

READI List and Measure ID Summary – Cont.

Index	MeasureID	Description
10151	D03-095	Circulation Pump Timeclock Retrofit
10154	D03-098	Water Side Economizer
10155-10158	D03-099 to 102	H.E. Package Terminal A/C & HP
26	dxHP-pkgEER-135to239kBtuh-11p5eer-3p2c	Pkg HP EER = 11.5 (135-239 kBtuh), COP = 3.2
27	dxHP-pkgEER-135to239kBtuh-12p0eer-3p2c	Pkg HP EER = 12.0 (135-239 kBtuh), COP = 3.2
28	dxHP-pkgEER-240to759kBtuh-10p5eer-3p2c	Pkg HP EER = 10.5 (240-759 kBtuh), COP = 3.2
29	dxHP-pkgEER-240to759kBtuh-10p8eer-3p2c	Pkg HP EER = 10.8 (240-759 kBtuh), COP = 3.2
38	dxHP-pkgEER-65to89kBtuh-11p5eer-3p4cop	Pkg HP EER = 11.5 (65-89 kBtuh), COP = 3.4
39	dxHP-pkgEER-65to89kBtuh-12p0eer-3p4cop	Pkg HP EER = 12.0 (65-89 kBtuh), COP = 3.4
40	dxHP-pkgEER-90to134kBtuh-11p5eer-3p4co	Pkg HP EER = 11.5 (90-134 kBtuh), COP = 3.4
41	dxHP-pkgEER-90to134kBtuh-12p0eer-3p4co	Pkg HP EER = 12.0 (90-134 kBtuh), COP = 3.4
30	dxHP-pkgEER-gte760kBtuh-10p0eer-3p2cop	Pkg HP EER = 10.0 (>= 760 kBtuh), COP = 3.2
31	dxHP-pkgEER-gte760kBtuh-10p2eer-3p2cop	Pkg HP EER = 10.2 (>= 760 kBtuh), COP = 3.2
33	dxHP-pkgSEER-lt65kBtuh-13p0seer-7p7hspf	Pkg HP SEER = 13.0 (< 65 kBtuh), EER = 11.07, HSPF = 7.70, COP = 3.28
35	dxHP-pkgSEER-lt65kBtuh-14p0seer-8p0hspf	Pkg HP SEER = 14.0 (< 65 kBtuh), EER = 11.6, HSPF = 8.00, COP = 3.52
297	dxHP-pkgSEER-lt65kBtuh-14p5seer-wtd	Pkg HP SEER = 14.5 (< 65 kBtuh) - Combined SEER 14 and SEER 15 hp
37	dxHP-pkgSEER-lt65kBtuh-15p0seer-8p5hspf	Pkg HP SEER = 15.0 (< 65 kBtuh), EER = 12.0, HSPF = 8.50, COP = 3.74
32	dxHP-spltSEER-lt65kBtuh-13p0seer-7p7hspf	Split HP SEER = 13.0 (< 65 kBtuh), EER = 11.07, HSPF = 7.70, COP = 3.28
298	dxHP-spltSEER-lt65kBtuh-14p0seer-wtd	Split HP SEER = 14.0 (< 65 kBtuh) - Combined SEER 13 and SEER 14.5 hp
34	dxHP-spltSEER-lt65kBtuh-14p5seer-8p5hspf	Split HP SEER = 14.5 (< 65 kBtuh), EER = 12.00, HSPF = 8.50, COP = 3.74
36	dxHP-spltSEER-lt65kBtuh-15p0seer-9p0hspf	Split HP SEER = 15.0 (< 65 kBtuh), EER = 12.5, HSPF = 9.00, COP = 3.96
42-43	NB-HVAC-DuctSeal-high	Duct Sealing (Total leakage reduced to 18%)
1-5	NE-HVAC-airAC-Pkg-lt65kBtuh-	Pkg AC
6-10	NE-HVAC-airAC-Split-lt65kBtuh-	Split AC
11-25	NE-HVAC-airAC-SpltPkg-135to239kBtuh-	Pkg AC
49	NE-HVAC-Chlr-AirPkgRecip-AllSizes-1p008k	Air cooled package reciprocating chiller (1.008 kW/ton)
50	NE-HVAC-Chlr-AirScrew-AllSizes-1p008kwp	Air cooled screw chiller (1.008 kW/ton)
51-58	NE-HVAC-Chlr-Cent	Water cooled centrifugal chiller
59	NE-HVAC-Chlr-Screw	Water cooled screw chiller
62	NE-HVAC-Chlr-WtrRecip-AllSizes-0p672kwp	Water cooled reciprocating chiller (0.672 kW/ton)

Summary Review Data Request

Summary Review by SDG&E Engineer (for CPUC Review)	
Description	**SDGE Ex Ante Data**
Program Year	2013-14
EEBI #	
Measure Name	
Project Name	
Preliminary review date by SDGE Engineer	
Project Description	
Project Baseline (ER, ROB,RET)	
Project Cost Basis (Full Cost, Incremental Cost- and how incremental cost determined)	
RUL and source	
EUL and source	
First year kWh savings	
First year Peak kW savings	
First Year Peak Therm Savings	
RUL kWh savings	
RUL kW savings	
RUL therm savings	
Savings assumptions	
Calculations Methods/ Tools used	
Pre or Post M&V Plan	
Additional Notes	

Measure Life – EUL/RUL Table

End Use	Measure Description	EUL	RUL	Sector
Agriculture	Greenhouse Heat Curtain	5	1.67	Ag
Agriculture	Infrared Film for Greenhouses	5	1.67	Ag
Agriculture	Low Pressure Sprinkler Nozzles (permanent)	5	1.67	Ag
Agriculture	Low Pressure Sprinkler Nozzles (portable)	3	1	Ag
Agriculture	Milk Pre-Cooler	15	5	Ag
Agriculture	Milk Transfer Pump Variable Speed Drive	15	5	Ag
Agriculture	Milking Vacuum Pump Variable Speed Drive	15	5	Ag
Agriculture	Sprinkler to Drip/Micro Irrigation	20	6.67	Ag
Agriculture	Well Pump Variable Speed Drive	10	3.33	Ag
Agriculture	Wine Tank Insulation	15	5	Ag
Appliance	80 PLUS Power Supply	4	1.33	Com
Appliance	High Efficiency Clothes Washer (CEE Tiers 1,2,3)	11	3.67	Com
Appliance	High Efficiency Copiers	6	2	Com
Appliance	Occupancy sensors	8	2.67	Com
Appliance	Vending Machine Controller	5	1.67	Com
Building Envelope	Cool Roof	15	5	Com
Building Envelope	Daylighting - controls	8	2.67	Com
Building Envelope	Floor Insulation	20	6.67	Com
Building Envelope	High Performance Windows for Daylighting	20	6.67	Com
Building Envelope	Low Solar Heat Gain Coefficient Windows	20	6.67	Com
Building Envelope	Reflective Window Films & Sunscreens	10	3.33	Com
Building Envelope	Roof/Ceiling Insulation	20	6.67	Com
Food Sevrice	Combination Oven	12	4	Com
Food Sevrice	Commercial Gas Rack Ovens	12	4	Com
Food Sevrice	Commercial Insulated Holding Cabinet	12	4	Com
Food Sevrice	Commercial Reach-In Refrigerator / Freezer	12	4	Com
Food Sevrice	Convection Ovens	12	4	Com
Food Sevrice	Electric Fryer	12	4	Com
Food Sevrice	Gas Fryer	12	4	Com
Food Sevrice	Griddle	12	4	Com
Food Sevrice	Steam Cooker (electric)	12	4	Com
Food Sevrice	Steam Cooker (gas)	12	4	Com
Food Sevrice	Vat Fryer	12	4	Com
HVAC	Add Economizer	10	3.33	Com
HVAC	Air Conditioners (split and unitary)	15	5	Com
HVAC	Air To Air Heat Exchanger	14	4.67	Com
HVAC	Cooling Tower for Packaged System	15	5	Com
HVAC	Duct Insulation Material	20	6.67	Com
HVAC	Duct Sealing - Single Zone Package System	18	6	Com
HVAC	Energy Management System	15	5	Com
HVAC	Evap Cool Indirect	15	5	Com
HVAC	Fan Powered Mixing Boxes	10	3.33	Com
HVAC	Heat Pumps (split and unitary)	15	5	Com
HVAC	High Efficiency Boiler	20	6.67	Com

Measure Life – EUL/RUL Table – Cont. (2)

HVAC	High Efficiency Chillers	20	6.67	Com
HVAC	High Efficiency Furnace	20	6.67	Com
HVAC	High Efficiency Water Source Heat Pump	15	5	Com
HVAC	HVAC Fan Motors	15	5	Com
HVAC	Hydronic Heat Pump Var Flow Valve	10	3.33	Com
HVAC	Reducing Overventilation	10	3.33	Com
HVAC	Refrigerant Charge	10	3.33	Com
HVAC	Repair Economizer	5	1.67	Com
HVAC	Rotary Heat Recovery	14	4.67	Com
HVAC	Setback Programmable Thermostats	11	3.67	Com
HVAC	Steam Traps	6	2	Com
HVAC	Time Clocks (heating/cooling)	11	3.67	Com
HVAC	Two-Speed Fan	15	5	Com
HVAC	Variable Air Volume Box, VSD Fan	15	5	Com
HVAC	Variable Flow Water Loop, VSD Pump	15	5	Com
HVAC	VSD Supply Fan Motors	15	5	Com
HVAC	Water Loop Reset	10	3.33	Com
HVAC	Water Side Economizer	15	5	Com
HVAC-PTACCtrl	Package Terminal AC - Controller	15		Com
Lighting	Display Case Lighting LED Lighting	16	5.33	Com
Lighting	HID Lighting - High Pressure Sodium	15	5	Com
Lighting	HID Lighting - Metal Halide	15	5	Com
Lighting	Linear Fluorescent - Fixtures	16	5.33	Com
Lighting	Linear Fluorescent with Electronic Ballast	15	5	Com
Lighting	Linear Fluorescent with Electronic Ballast	14.26	4.75	Com
Lighting	Linear Fluorescent with Magnetic Ballast	15	5	Com
Lighting	Linear Fluorescent with Magnetic Ballast	9.16	3.05	Com
Lighting	Linear Fluorescent with Magnetic Ballast	8.56	2.85	Com
Lighting	Linear Fluorescent with Magnetic Ballast	12.75	4.25	Com
Lighting	Linear Fluorescent with Magnetic Ballast	13.98	4.66	Com
Lighting	Linear Fluorescent with Magnetic Ballast	10.82	3.61	Com
Lighting	Linear Fluorescent with Magnetic Ballast	9.32	3.11	Com
Lighting	Linear Fluorescent with Magnetic Ballast	13.31	4.44	Com
Lighting	Linear Fluorescent with Magnetic Ballast	13.16	4.39	Com
Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	7.66	2.55	Com
Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	8.26	2.75	Com
Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	9.35	3.12	Com
Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	8.06	2.69	Com
Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	4.07	1.36	Com
Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	3.8	1.27	Com
Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	10.26	3.42	Com
Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	5.67	1.89	Com
Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	6.21	2.07	Com
Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	12.9	4.3	Com
Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	4.81	1.6	Com
Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	7.58	2.53	Com
Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	5.92	1.97	Com
Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	4.68	1.56	Com

Measure Life – EUL/RUL Table – Cont. (3)

Lighting	Linear Fluorescent with T12 Lamp + Magnetic Ballast	4.19	1.4	Com
Lighting	Timeclock with or without photocell	8	2.67	Com
Lighting - Indoor	CFL Fixtures	12	4	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	4.13	1.38	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	4.46	1.49	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	3.85	1.28	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	4.29	1.43	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	2.57	0.86	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	2.38	0.79	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	5.99	2	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	3.24	1.08	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	7.3	2.43	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	2.8	0.93	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	3.36	1.12	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	2.08	0.69	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	2.7	0.9	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	2.3	0.77	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	2.49	0.83	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	3.62	1.21	Com
Lighting - Indoor	CFL Lamps - 10,000 Hour	2.11	0.7	Com
Lighting - Indoor	Exit Lighting	16	5.33	Com
Lighting - Indoor	HID Lighting - Metal Halide	15	5	Com
Lighting - Indoor	HID Lighting - Metal Halide	14.26	4.75	Com
Lighting - Indoor	HID Lighting - Metal Halide	13.31	4.44	Com
Lighting - Indoor	HID Lighting - Metal Halide	14.46	4.82	Com
Lighting - Indoor	HID Lighting - Metal Halide	14.68	4.89	Com
Lighting - Indoor	HID Lighting (T-5)	15	5	Com
Lighting - Indoor	HID Lighting (T-5)	14.26	4.75	Com
Lighting - Indoor	HID Lighting (T-5)	13.31	4.44	Com
Lighting - Indoor	HID Lighting (T-5)	14.46	4.82	Com
Lighting - Indoor	HID Lighting (T-5)	14.68	4.89	Com
Lighting - Indoor	Occupancy Sensors	8	2.67	Com
Lighting - Indoor	Timeclocks	8	2.67	Com
Lighting - Outdoor	HID Lighting - High Pressure Sodium	15	5	Com
Lighting - Outdoor	HID Lighting - High Pressure Sodium	14.26	4.75	Com
Lighting - Outdoor	HID Lighting - High Pressure Sodium	13.31	4.44	Com
Lighting - Outdoor	HID Lighting - High Pressure Sodium	14.46	4.82	Com
Lighting - Outdoor	HID Lighting - High Pressure Sodium	14.68	4.89	Com
Lighting - Outdoor	LED Lighting	12		CC
Lighting - Outdoor	Outdoor CFL Lamps - 10,000 Hour	2.44	0.81	Com
Lighting - Outdoor	Outdoor HID Lighting (T-5)	15	5	Com
Lighting - Outdoor	Outdoor Linear Fluorescent with Electronic Ballast	15	5	Com
Lighting - Outdoor	Outdoor Linear Fluorescent with Magnetic Ballast	10.98	3.66	Com
Lighting - Outdoor	Timeclock with or without photocell	2.44	0.81	Com
Lighting - Outdoor	Timeclock with or without photocell	8	2.67	Com
Motors	Premium-Efficiency Motors	15	5	Com
Motors	Water Loop Pumps	15	5	Com

Measure Life – EUL/RUL Table – Cont. (4)

Process	High Efficiency Boiler	20	6.67	Com
Process	Insulation for Bare Suction Lines	11	3.67	Com
Process	Refrigerator Upgrades (Condenser)	15	5	Com
Process	Refrigerator Upgrades (Head Pressure)	15	5	Com
Process	Refrigerator Upgrades (Subcooling)	15	5	Com
Process	Refrigerator Upgrades (Suction Pressure)	15	5	Com
Process	Refrigerator Upgrades (Variable Speed Compressors)	15	5	Com
Process	Scroll Compressors for Bulk Tanks	12	4	Com
Process	Steam Traps	6	2	Com
RCx	Retrocommissioning	10	3.33	Com
Recreation	Commercial Pool Heater	5	1.67	Com
Refrigeration	Anti-Sweat Heat (ASH) Controls	12	4	Com
Refrigeration	Auto-Closer for Walk-In Cooler/Freezer Doors	8	2.67	Com
Refrigeration	Commercial Reach-In Refrigerator / Freezer	12	4	Com
Refrigeration	Display Case Lighting Control	8	2.67	Com
Refrigeration	Door Gaskets on Cooler/Freezer Doors	4	1.33	Com
Refrigeration	Evaporator Fan Controller for Walk-In Coolers	16	5.33	Com
Refrigeration	Heat Recovery from Central Refrigeration System	10	3.33	Com
Refrigeration	High Efficiency Evaporator Fan Motors	15	5	Com
Refrigeration	Ice Machine	10	3.33	Com
Refrigeration	New case with Doors	12	4	Com
Refrigeration	Night Covers for vertical & horizontal refrigerated display cases	5	1.67	Com
Refrigeration	Strip Curtains for Walk-Ins	4	1.33	Com
Refrigeration	Zero Heat Reach-in Glass Doors	12	4	Com
Service	Clean Condenser Coils	3	1	Com
Water Heating	Circulation Pump Timeclock Retrofit	15	5	Com
Water Heating	Compressor Heat Recovery (w/electric water heating)	14	4.67	Com
Water Heating	Faucet Aerators	10	3.33	All
Water Heating	High Efficiency Central Water Heater	15	5	Com
Water Heating	High Efficiency Commercial Storage Water Heater	15	5	Com
Water Heating	Instantaneous Water Heater	20	6.67	Com
Water Heating	Pipe Insulation - Electric Water Heater	13	4.33	Com
Water Heating	Pipe Insulation - Gas Water Heater	11	3.67	Com
Water Heating	Water Heater Tank Wrap	7	2.33	Com

Tools and Tips for Estimating Energy Efficiency

Custom Energy Savings Calculations Workshop

"Enabling Customers in Energy Efficiency"

April 8, 2015

Tools for Estimating Energy Savings

INTRODUCTION

SDG&E's Team of Energy Efficiency Engineers

- Conserve Resources, Save Energy, Reduce Demand
- Verify Energy Calculations & Program Compliance
- Consolidate Documentation
- Approve Cash Incentives

Rocky Harmstead
Rod Houdyshel
Ed Reynoso
Toan Trinh
Kelvin Valenzuela
Manny Windmiller

Tools for Estimating Energy Savings

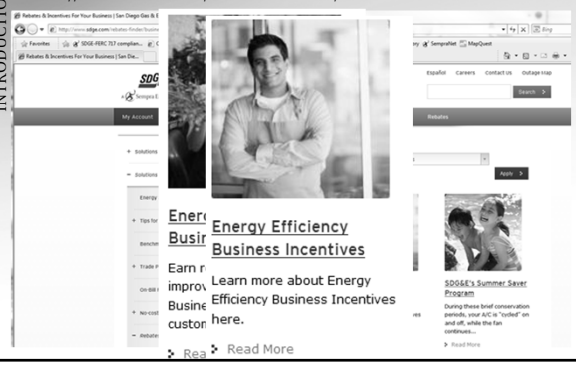
INTRODUCTION

- Workshop Goals:
  - Understand the program
  - Describe Tools and Calculators
  - Define Terms and Abbreviations
  - Discuss CPUC requirements for custom projects (California Public Utilities Commission)
  - Provide instruction on how to meet these requirements (with typical examples)
  - Address Questions and Concerns

Tools for Estimating Energy Savings

INTRODUCTION

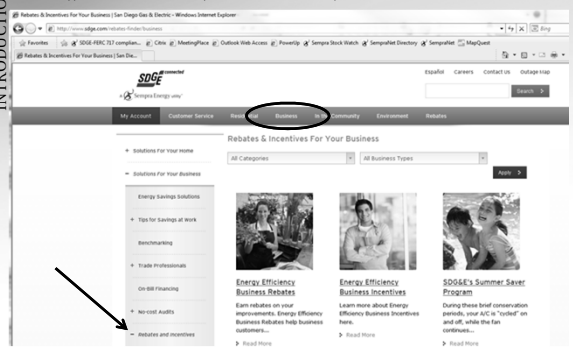
- http://www.sdge.com/rebates-finder/business



Tools for Estimating Energy Savings

INTRODUCTION

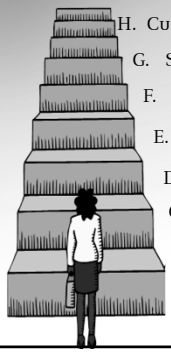
- http://www.sdge.com/rebates-finder/business



Tools for Estimating Energy Savings

INTRODUCTION

$$$ ***Follow the Steps to Collect Your Incentives:***



H. Customer Receives Incentive Check (60/40 M&V)

G. SDG&E Review / Post-Inspect / Savings Adjst.

F. Notify SDG&E after Installation

E. SDG&E sends Contract and NTP

D. SDG&E Review and Approve Application

C. Free Ridership Screening & Pre-Inspection

B. Submit Appl., Documentation, & Calcs

A. Read Manual (download @ website)

Tools for Estimating Energy Savings

INTRODUCTION


Energy Efficiency Business Incentives Program Checklist

1 STARTING POINT FOR ALL SUBMITTALS

2 REPLACE ON BURN OUT AND NEW LOAD PROJECTS

3 EARLY RETIREMENT PROJECTS

Include a written:
"Scope of Work"
or
"Proposal"

Tools for Estimating Energy Savings

INTRODUCTION

- Required Documentation:
  - Scope of Work
    - Written Description of Proposed Efficiency Measures
    - Equipment List (Existing and Proposed)
    - Manufactures Spec Sheets (watts, eff., EER, IPLV)
  - Calculations for Energy Savings Estimates-
    - READI, CCT, BOA, C-BOA
    - eQuest, ePro, Proprietary software (input & output)
    - Excel Spreadsheets Only for Smaller projects (unprotected)
    - Lighting Survey Table (for Lighting Measures)
  - Application (www.sdge.com/rebates-finder/save-energy-earn-incentives)
  - Completed W-9 Form
  - Proposal and/or Invoice

Tools for Estimating Energy Savings

INTRODUCTION

- CPUC Requirements:
  - Order of project evaluation – "Deemed" measures then "Custom" measures
  - Custom projects use Standard tools, Building Codes and Standards, and Industry Standard Practice
  - Concurrent review of projects by CPUC Staff (commission staff - CS) and more site data collection
  - Documentation to show Utility Influence

Tools for Estimating Energy Savings

INTRODUCTION

- Order of Project Evaluation:
  - 1- Rebate (Install first, Application after)
  - 2- DEER (Database for Energy Eff. Resources)
    READI (Remote Ex-Ante Database Interface)
  - 3- Modified DEER (Interpolation between points)
  - 4- Standard Tools:
    - ❖Customized Calculation Tool (CCT2013)
    - ❖Building Optimization Analysis Tool (BOA)
    - ❖Energy Modeling (eQUEST)
    - ❖Measurement and Verification (M&V)

Tools for Estimating Energy Savings

INTRODUCTION

- Tools and Calculators:
  - Remote Ex-Anti Database Interface (**READI**)
    - ❖http://www.deeresources.com/
  - Customized Calculation Tool (**CCT2013**)
    - ❖http://www.sdge.com/save-energy-earn-incentives
    - ❖http://www.aesc-inc.com/download/spc/
  - Building Optimization Analysis Tool (**BOA /C-BOA**)
    - ❖http://cacx.org/resources/rcxtools/spreadsheet_tools.html
  - Energy Modeling (**eQUEST** ver.3.64)
    - ❖http://www.doe2.com/equest/
  - Measurement and Verification (**M&V**)
    - ❖http://www.sdge.com/save-energy-earn-incentives
  - EEBI Lighting Tool
    - ❖http://www.sdge.com/save-energy-earn-incentives

Tools for Estimating Energy Savings

INTRODUCTION

- Building Codes, Standards, and Industry Standard Practice (C&S, ISP):
  - If the existing equipment is worn-out, then New equipment installed would have a minimum efficiency requirement based on current code or industry standard;
  - Shouldn't incentivize entire savings for worn-out equipment, only savings above current minimum standards;

Tools for Estimating Energy Savings

INTRODUCTION

- Industry Standard Practice (ISP):

Industry Type	Machine Size – Tons of Clamping Force		
	200 or Less	200 – 500	500 or Greater
Automotive	All-electric	Hybrid 1	Hybrid 1
Medical	All-electric	All-electric	All-electric
Packaging	All-electric	Hybrid 1	Hybrid 1
Consumer products	All-electric	Hybrid 1	Hybrid 1

Load Factor	Chiller	CHW Pumps	Cooling Tower	CW Pumps	Chilled Water Plant (Total kW/ton)
0.2	0.803	0.146	0.001	0.278	1.228
0.3	0.661	0.1	0.002	0.19	0.953
0.4	0.58	0.075	0.003	0.143	0.8
0.5	0.542	0.06	0.003	0.114	0.719
0.6	0.524	0.05	0.004	0.095	0.673
0.7	0.519	0.045	0.005	0.081	0.65
0.8	0.518	0.048	0.005	0.071	0.643
0.9	0.528	0.051	0.006	0.063	0.649
1	0.539	0.054	0.007	0.057	0.657

Fan Motor Horsepower	Baseline Fan Efficiency
0.5	0.42
1	0.5
1.5	0.5
2	0.5
3	0.5
5	0.5
7.5	0.533
10	0.556
15	0.587
20	0.608
25	0.624
30	0.638
40	0.658
50	0.675
60	0.686
75	0.698
100	0.715
125	0.727
150	0.736
200	0.75

Tools for Estimating Energy Savings

INTRODUCTION

- Concurrent Review by CPUC Staff (CS):
  - DEER Measures excluded
  - Custom Measure Project Archive (CMPA)
    - ❖ Projects may be reviewed when Application is Received
    - ❖ Projects may be reviewed when Installation Report is Received

Tools for Estimating Energy Savings

INTRODUCTION

- Check List For SDG&E Review: (see reference guide)
  - Project Scope
  - Location
  - Building Type and Vintage
  - General description and savings premise
  - Estimated savings
  - Live spread sheets supporting the savings estimates
  - 3rd party audit reports
  - Inspection reports
  - Raw data
  - Energy Models
  - M&V plan
  - Existing equipment age
  - New equipment cut sheets & Performance
  - Incremental cost
  - Documents to support baseline
  - Control Strategy
  - Existing system capacity & output
  - Schematics and Drawings
  - Interaction among multiple measures
  - Production output
  - Billing history (pre- and post- install
  - Alternatives (repair/replace w/hi eff./replace w T24)
  - Proposals
  - Invoices
  - Measured savings

❖ **More is Better**

❖ **Less can cause Delay**

Tools for Estimating Energy Savings

INTRODUCTION

- Documenting Utility Influence:
  - Applicant must prove that the incentive payment is a major factor driving the project.
    - Audit report showing energy savings;
    - ROI calculations for the proposed measure;
    - Payback analysis with multiple ECM options;
    - On-Bill Financing (OBF);
    - Emails and Correspondence;
    - Program Manual, pgs. 1-13 and 1-14;

Tools for Estimating Energy Savings

INTRODUCTION

- KEY TERMS: (more in the Reference Guide)
  - CMPA — Custom Measure Project Archive
  - CS — Commission Staff (CPUC)
  - Deemed — Incentive measure with predetermined values
  - DEER — Database for Energy Efficient Resources
  - EEBI/EEBR — Energy Efficiency Business Incentive/Rebate
  - EUL/RUL — Effective Useful Life / Remaining Useful Life
  - Ex-Ante — Expected savings based on calculations
  - Ex-Post — Actual savings measured after installation
  - MBCx — Monitoring Based Commissioning
  - PPP — Public Purpose Programs
  - ROB/RET — Replace On Burnout / Retrofit
  - Workpaper — Alternate calculation engineering document

Tools for Estimating Energy Savings

INTRODUCTION

- PROGRAM INCENTIVE LIMITS:
  - 50% FMC — Early Retirement (ER)
  - 50% FMC — Retrofit Add On (REA)
  - 100% IMC — New Added Equipment (New)
  - 100% IMC — Replace on Burnout (ROB)
  - $150.00/kW — Peak Demand Reduction (increase)
  - Cap on Incentive: FMC – SMC / (1+0.0736)^RUL

Tools for Estimating Energy Savings

INTRODUCTION

- Calculation Examples to follow:
  - Lighting Table ➢ *Toan*
  - Hotel OCC Sensors & T'stats ➢ *Kelvin*
  - Chillers ➢ *Kelvin*
  - Chillers w/ VSDs ➢ *Rocky*
  - Controls ➢ *Rocky*
  - CAV to VAV ➢ *Rocky*
  - Air Compressors ➢ *Manny*
  - CRAC / CRAH ➢ *Manny*
  - Economizers ➢ *Ed*
  - Boilers ➢ *Ed*
  - Fan VSDs – AHUs ➢ *Rod*
  - Pumps w/ VSDs ➢ *Rod*
  - Measurement & Verification ➢ *Rod*

Custom Energy Savings Calculations

LIGHTING

- LIGHTING CALCULATIONS:

Toan Trinh

Custom Energy Savings Calculations

LIGHTING

- ENERGY EFFICIENCY BUSINESS INCENTIVES:
  - New Lighting Table
  - http://www.sdge.com/eebi
- Approved lighting fixtures and LEDs must be on:
  - Appendix E (website)
  - Appendix F (website)
- Approved fluorescent lamps & ballasts must be on:
  - http://www.cee1.org

Custom Energy Savings Calculations

LIGHTING

- LIGHTING CALCULATIONS:
- California Public Utilities Commission (CPUC) Has mandated utilities to calculate current Title 24 code as existing base-case.
- Title 24 – Indoor Lighting (Allowed Lighting Power)
  - –2013 Building Energy Efficiency Standard
  - –Allowed Lighting Power (Wattage)

Custom Energy Savings Calculations

LIGHTING

- 2013 Title 24 Update- New Mandatory Code Lighting Controls
  - – Automatic daylighting controls in primary daylit zones
  - – Hotel/Motel guest room captive card or occupancy sensing lighting controls, occupancy sensing receptacles
  - – Automated lighting controls for Multifamily and Hotel/ Motel corridors
  - – Occupancy sensors in warehouses, libraries, offices, classrooms, conference rooms, multipurpose rooms
  - – Occupancy sensing lighting in parking garage spaces
  - – Outdoor luminars <24 ft. -motion sensors to reduce light level

Custom Energy Savings Calculations

LIGHTING

- LIGHTING POWER DENSITY (LPD) and DUAL BASELINE :
- Lighting Table will calculate 2nd-baseline and LPD.
  - – 1st baseline is calculated by lighting audit
    - ❖Calculate Actual Lighting Power
  - – 2nd baseline and LPD is automatically calculated
    - ❖Title 24 Maximum Allowed Lighting Power (LPD)
    - ❖LPD = Watts/Sq.ft

Custom Energy Savings Calculations

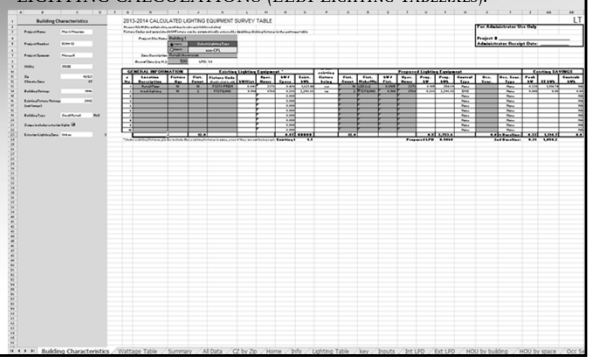
LIGHTING

- CALCULATING LPD – Data Collection:
  - Collect wattage and count for all permanent ceiling, wall, and floor mounted lighting in each zone. Decorative, task, and egress lighting is not included.
  - Collect Square Footage of space or building.
  - If existing LPD is lower than current code LPD, then 1st baseline and 2nd baseline are the same.

Custom Energy Savings Calculations

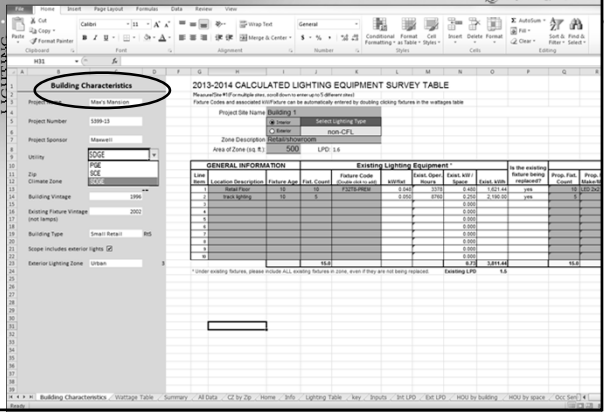
LIGHTING

- LIGHTING CALCULATIONS (EEBI Lighting Table.xls):



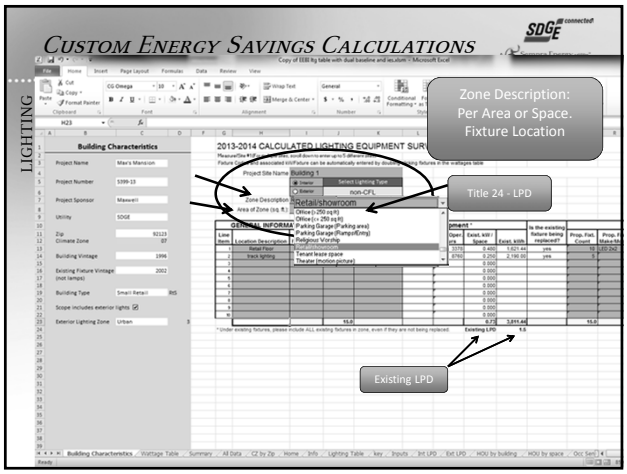
Custom Energy Savings Calculations

LIGHTING



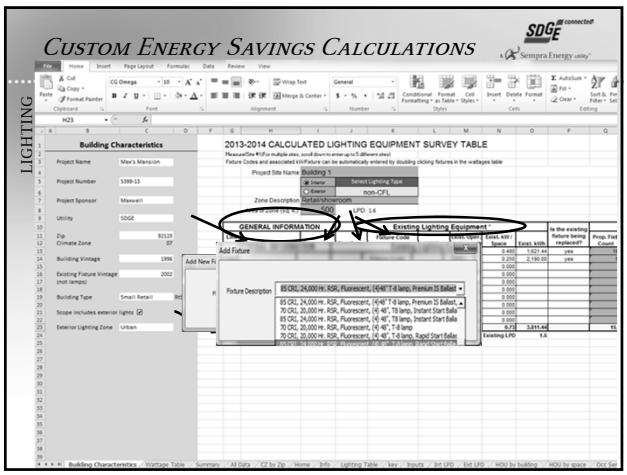
Custom Energy Savings Calculations

LIGHTING



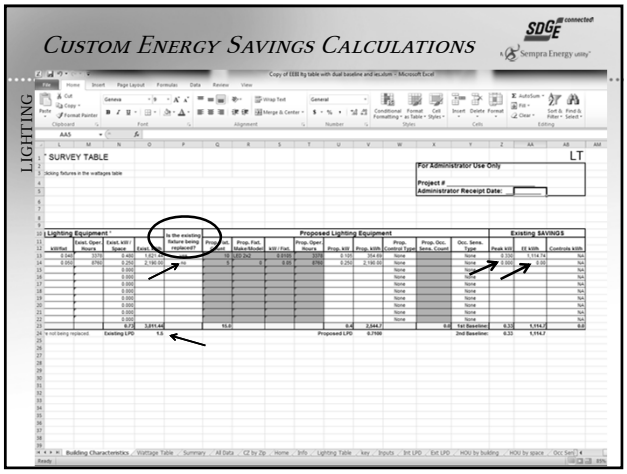
Custom Energy Savings Calculations

LIGHTING



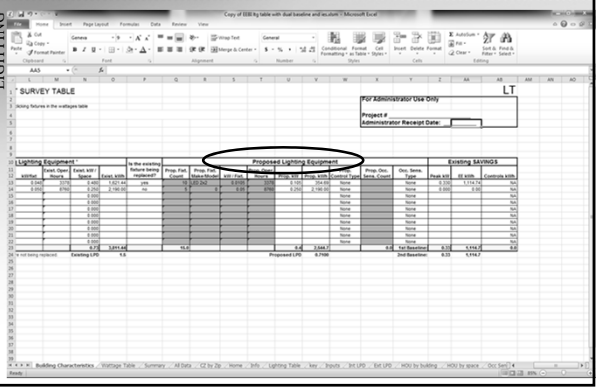
Custom Energy Savings Calculations

LIGHTING



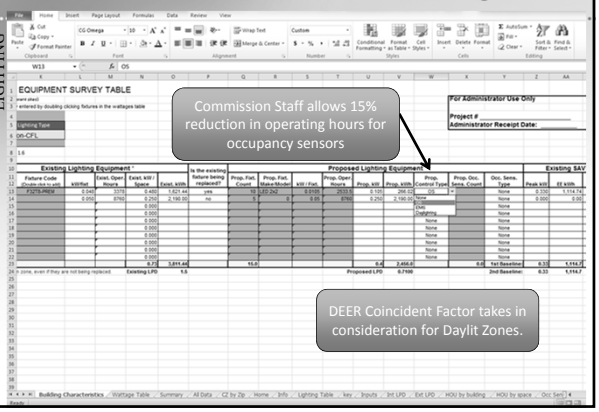
Custom Energy Savings Calculations

LIGHTING



Custom Energy Savings Calculations

LIGHTING

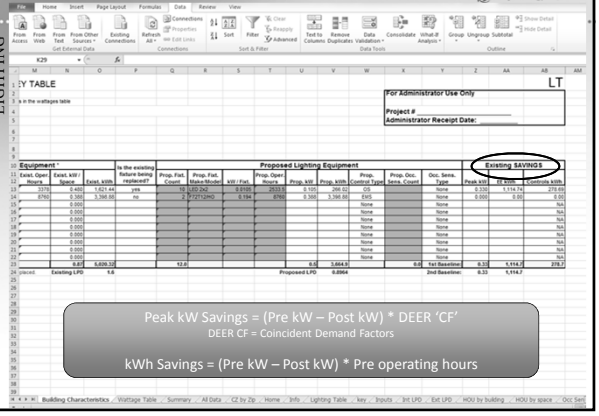


Commission Staff allows 15% reduction in operating hours for occupancy sensors

DEER Coincident Factor takes in consideration for Daylit Zones.

Custom Energy Savings Calculations

LIGHTING



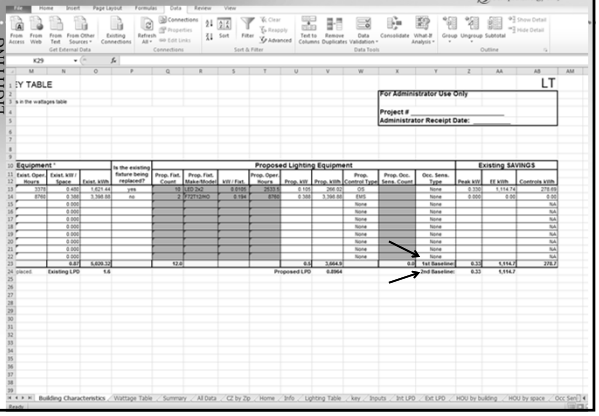
Peak kW Savings = (Pre kW – Post kW) * DEER 'CF'

DEER CF = Coincident Demand Factors

kWh Savings = (Pre kW – Post kW) * Pre operating hours

Custom Energy Savings Calculations

LIGHTING



Custom Energy Savings Calculations

LIGHTING

- MEASUREMENT & VERIFICATION:
  - M&V performed on projects that are proposed >20% higher than Deemed and/or DEER savings
  - M&V projects must be minimum 50,000 kWh savings
  - Or requested by utility engineers or CPUC

Custom Energy Savings Calculations

HOTELS

- HOTEL/MOTEL GUESTROOM CONTROLS:

  Kelvin Valenzuela

Custom Energy Savings Calculations

HOTELS

- HOTEL GUESTROOM CONTROLS (**M&V**):
  - Used When estimated savings exceeds 50,000 kWh
  - Measure performance of units in selected rooms
  - Number of sample sizes is dictated based on total number of guestrooms & IPMVP standards for sampling
  - Sample needs to include different orientation and booking rates
  - From trending and Billing Data, develop specific conditions to calibrate eQUEST model to generate energy savings potential
    - Include documentation of actual guestroom thermostat set points to substantiate the "occupied" thermostat schedule, and
    - Verification of the installed guestroom thermostat settings, e.g. the setback temperature set point for heating and cooling modes.

Custom Energy Savings Calculations

HOTELS

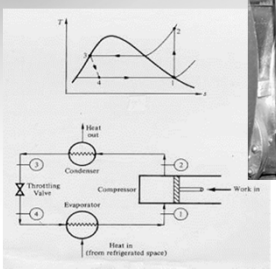
- Section 120.2 (e)4 from 2013 Title 24:
  - Hotel and motel guest rooms shall have captive card key controls, occupancy sensing controls, or automatic controls.
  - Activated no longer than 30 minutes after the guest room has been vacated
  - Setpoints are:
    - Set-up at least +5°F in cooling mode
    - Set-down at least -5°F in heating mode
  - Lighting is also switched OFF
  - If remaining useful life (RUL) >1 on existing thermostats, can be eligible for incentives

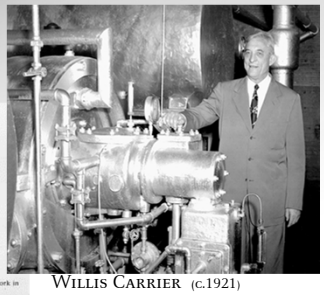
Custom Energy Savings Calculations

CHILLERS

- CHILLERS:

Kelvin Valenzuela





Willis Carrier (c.1921)
- "Centrifugal Refrigeration Machine"

Custom Energy Savings Calculations

CHILLERS

- TOOLS:
  - READI Tool (ver.2.1.0) (DEER 2013 Code Update)
  - Customized Calculation Tool (CCT2013, v.15.2.015830)
  - Quick Energy Simulation Tool (eQUEST, ver. 3.65)
  - Spreadsheet calculations (w/ raw data) (excel, etc.)
- REFERENCES:
  - Title 24, Part 6 (Current vs. 2013)
  - New 2013 T-24 Efficiencies are located under 4.2.2 of 2013 T-24 NonRes Compliance Manual (July1, 2014)
  - Database for Energy Efficient Resources (DEER) http://www.deeresources.com/index.php/deer2013-update-for-2014-codes
  - Energy Efficiency Business Incentive: http://www.sdge.com/save-energy-earn-incentives
  - Climate Zone Locations: http://www.energy.ca.gov/maps/renewable/building_climate_zones.html

Custom Energy Savings Calculations

CHILLERS

- WHAT TOOLS DO I USE?
- Depends on Scope of Project:
  - One for one replacement?
  - Upgrade back-up chiller to lead chiller?
  - Multiple Chillers at site?
  - Multiple Capacities / Increased Capacity
  - Modifications

Custom Energy Savings Calculations

CHILLERS

- Key Data for Collection:
  - Building Type, Vintage, and Conditioned Area (s.f.)
  - Hours of Operation
  - Climate Zone / Zip code
  - Operating Conditions – water temps, gpm flow, etc.
  - New Chiller Type, Tons, Efficiency (kW/ton), VSD
  - Chiller Operation- Lead-Lag? Shared Load? Age?
  - Additional Plant Chillers- type, capacity, operation

Custom Energy Savings Calculations

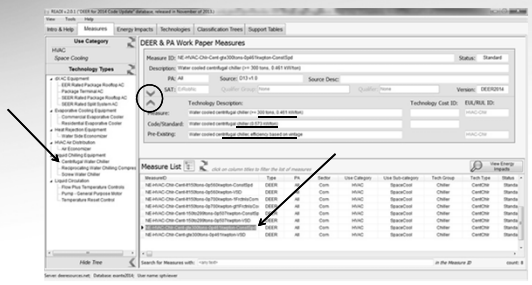
CHILLERS

- CENTRIFUGAL CHILLER EXAMPLE (READI):
  - Large Office located in 92128
  - Vintage of building is 1997
  - Existing Chiller: 350 tons, water-cooled, centrifugal
  - Proposed Chiller: 350 tons, water-cooled, centrifugal, efficiency = 0.461 kW/ton
  - DEER EUL = 20 years; Title 24 = 0.573 kW/ton

Custom Energy Savings Calculations

CHILLERS

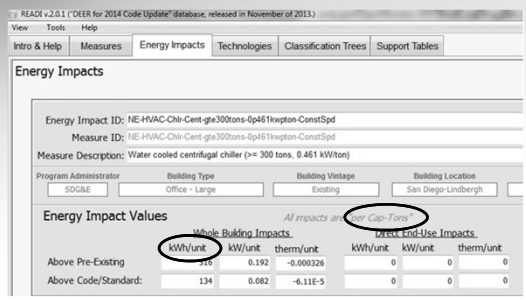
- CENTRIFUGAL CHILLER EXAMPLE (READI):



Custom Energy Savings Calculations

CHILLERS

- CENTRIFUGAL CHILLER EXAMPLE (READI):



Custom Energy Savings Calculations

CHILLERS

- CENTRIFUGAL CHILLER EXAMPLE (READI):
  - Vintage = 1997, RUL = 3 years (20 years – 17 years); qualifies for Early Retirement (ER).
  - If RUL < 1 years; Replace on Burnout (ROB)

Whole Building Impacts			
	kWh/unit	kW/unit	therm/unit
Above Pre-Existing	316	0.192	-0.000326
Above Code/Standard:	134	0.082	-6.11E-5

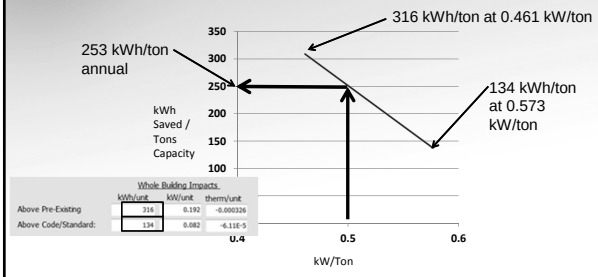
Calcs	kWh Savings	kW Savings	Measure
RUL>1	(350 x 316) = 110,600	(350 x 0.192) = 67.2	ER
RUL<1	(350 x 134) = 46,900	(350 x 0.082) = 28.7	ROB

  - First Baseline savings = 110,600 kWh & 67.2 kW
  - Second Baseline savings = 46,900 kWh & 28.7 kW

Custom Energy Savings Calculations

CHILLERS

- CENTRIFUGAL CHILLER EXAMPLE (Modified READI):
  - Interpolated Savings for New **0.5 kW/ton** Chiller



Whole Building Impacts			
	kWh/unit	kW/unit	therm/unit
Above Pre-Existing	316	0.192	-0.000326
Above Code/Standard:	134	0.082	-6.11E-5

Custom Energy Savings Calculations

- CENTRIFUGAL CHILLER EXAMPLE (Modified READI):
- Linear Interpolation Equation:

$$y = y_0 + (y_1 - y_0)\frac{x - x_0}{x_1 - x_0}$$

Where y = Modified-READI Savings; x = 0.500 kW/ton

y_0 = 316 kWh/ton; x_0 = 0.461 kW

y_1 = 134 kWh/ton; x_1 = 0.573 kW

Whole Building Impacts			
	kWh/unit	kW/unit	therm/unit
Above Pre-Existing	316	0.192	-0.000326
Above Code/Standard:	134	0.082	-6.11E-5

Custom Energy Savings Calculations

CHILLERS

- CENTRIFUGAL CHILLER EXAMPLE (Modified READI):
  - Vintage = 1997, RUL = 3 years (20 years – 17 years); qualifies for Early Retirement (ER).
  - If RUL < 1 years; Replace on Burnout (ROB)

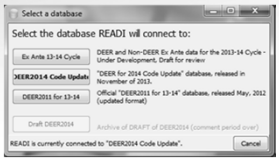
Calcs	kWh Savings	kW Savings	Measure
RUL>1	(350 x 253) = 88,550	(350 x 0.154) = 53.9	ER
RUL<1	(350 x 134) = 46,900	(350 x 0.082) = 28.7	ROB

  - First Baseline savings = 88,550 kWh & 53.9 kW
  - Second Baseline savings = 46,900 kWh & 28.7 kW

Custom Energy Savings Calculations

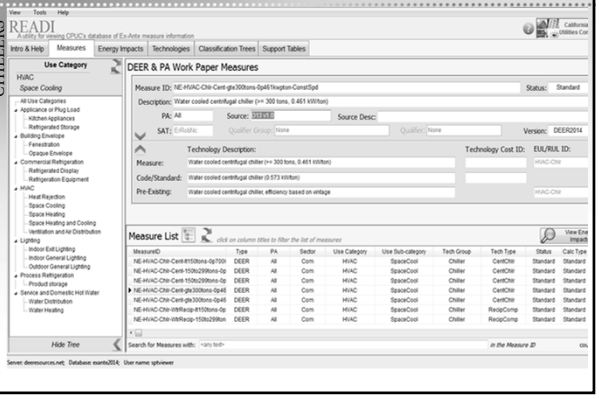
CHILLERS

- Option for when dealing with projects complying with Title 24, 2013, Part 6:



Custom Energy Savings Calculations

CHILLERS



Custom Energy Savings Calculations

CHILLERS

- CENTRIFUGAL CHILLER EXAMPLE (CCT-2013):
  - For Compressor Upgrade or New Chiller
  - Restrictions –only for most common building types and sizes:
    - ❖Education
    - ❖Health/Medical
    - ❖Lodging – Hotel
    - ❖Large & Small Offices
    - ❖Retail

Customized Calculation Tool

Custom Energy Savings Calculations

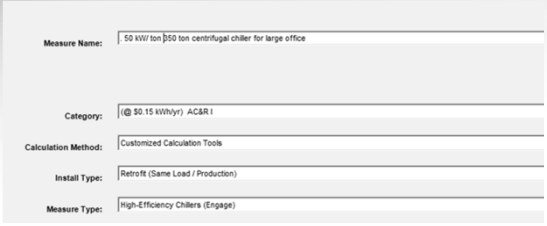
CHILLERS

- CENTRIFUGAL CHILLER EXAMPLE (CCT-2013):
  - Large Office located in 92128
  - Vintage of building is 1997
  - Existing Chiller: 350 tons, water-cooled, centrifugal
  - Proposed Chiller: 350 tons, water-cooled, centrifugal, efficiency = 0.5 kW/ton
  - DEER EUL = 20 years

Custom Energy Savings Calculations

CHILLERS

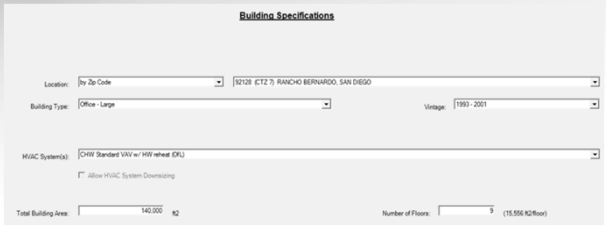
- CENTRIFUGAL CHILLER EXAMPLE (CCT-2013):
  - First Input Sheet- Measure Description



Custom Energy Savings Calculations

CHILLERS

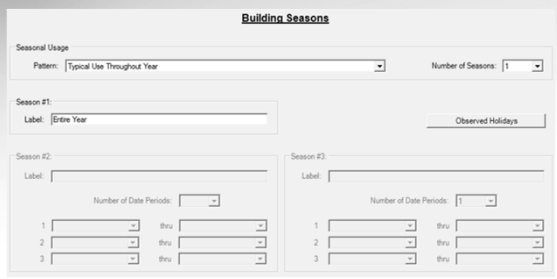
- CENTRIFUGAL CHILLER EXAMPLE (CCT-2013):
  - Second Input Sheet - Climate zone, building description



Custom Energy Savings Calculations

CHILLERS

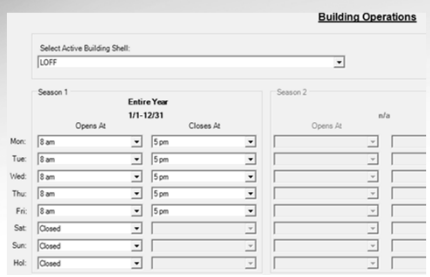
- CENTRIFUGAL CHILLER EXAMPLE (CCT-2013):
  - Third Input Sheet – Define seasons



Custom Energy Savings Calculations

CHILLERS

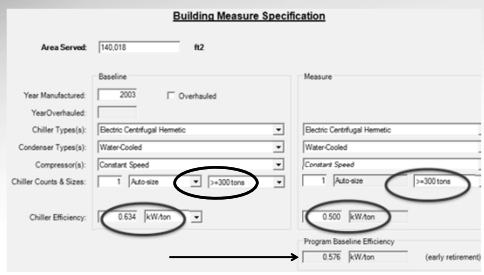
- CENTRIFUGAL CHILLER EXAMPLE (CCT-2013):
  - Fourth Input sheet – Building schedules (from operator)



Custom Energy Savings Calculations

CHILLERS

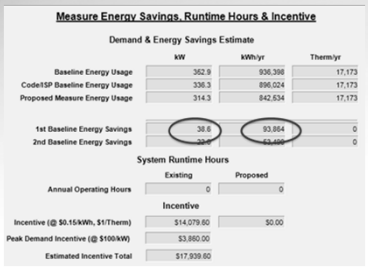
- CENTRIFUGAL CHILLER EXAMPLE (CCT-2013):
  - Fifth Input Sheet –Chiller Information



Custom Energy Savings Calculations

CHILLERS

- CENTRIFUGAL CHILLER EXAMPLE (CCT-2013):
  - Output



Custom Energy Savings Calculations

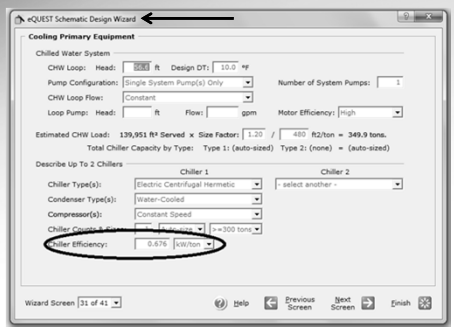
CHILLERS

- CENTRIFUGAL CHILLER EXAMPLE (eQUEST):
  - Large Office located in 92128
  - Vintage of building is 1997
  - Existing Chiller: 350 tons, water-cooled, centrifugal
  - Proposed Chiller: 350 tons, water-cooled, centrifugal, efficiency = 0.5 kW/ton
  - DEER EUL = 20 years

Custom Energy Savings Calculations

CHILLERS

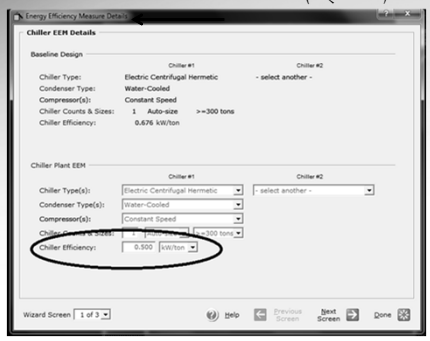
- CENTRIFUGAL CHILLER EXAMPLE (eQUEST):



Custom Energy Savings Calculations

CHILLERS

- CENTRIFUGAL CHILLER EXAMPLE (eQUEST):



Custom Energy Savings Calculations

CHILLERS

- CENTRIFUGAL CHILLER EXAMPLE (eQUEST):
  - –Energy Savings

Annual Energy and Demand (pg 1 of 2)

		Ann. Source Energy		Annual Site Energy		Lighting	HVAC Energy			Peak	
		Total MBtu	EUI kBtu/sf/Yr	Elect kWh	Nat Gas Therms	Electric kWh	Electric kWh	Nat Gas Therms	Total MBtu	Elect kW	Cooling Tons
Annual Energy USE or DEMAND											
0	Base Design	19,444	138.93	1,871,966	2,768	332,785	759,242	55	2,597	737	354
1	0=Chiller Plant EEM	18,255	130.44	1,755,847	2,768	332,785	643,123	55	2,200	663	354

Incremental SAVINGS (values are relative to previous measure (% savings are relative to base case use), negative entries indicate increased use)

1	0=Chiller Plant EEM	1,189	8.50 (6%)	116,119 (6%)	0 (0%)	0 (0%)	116,120 (15%)	0 (0%)	396 (15%)	74 (10%)	0 (0%)

Custom Energy Savings Calculations

CHILLERS

- CENTRIFUGAL CHILLER EXAMPLE (eQUEST):
  - Demand Reduction

Annual Electric Coincident Peak Demand by Enduse (pg 2 of 4)

	Ambient Lights	Task Lights	Misc Equip	Space Heating	Space Cooling	Heat Reject	Pumps & Aux	Vent Fans	Dom Ht Wtr	Exterior Usage	Total
Annual Energy Coincident Demand (kW)											
0 Base Design	148.2	22.7	152.8	0.0	268.3	49.8	61.4	33.4	0.0	0.0	736.6
1 0+Chiller Plant EEM	148.2	22.7	152.8	0.0	198.3	47.7	60.0	33.4	0.0	0.0	663.0

Incremental SAVINGS (kW) (values are relative to previous measure (% savings are relative to base case demand); negative entries indicate increased demand)

1 0+Chiller Plant EEM	0.00 (0%)	0.00 (0%)	0.00 (0%)	--	69.94 (26%)	2.18 (4%)	1.4 (2%)	0.00 (0%)	--	--	73.56 (10%)

Custom Energy Savings Calculations

CHILLERS

- CENTRIFUGAL CHILLER EXAMPLE (**M&V**):
  - Measurement & Verification may be Required
  - Using CCT, eQUEST, or spreadsheet calculations
  - Typical **M&V** is based on kW/ton vs OSA (Option B, Key Parameter, IPMVP-III)
  - If scope of work is complex, **M&V** could use Option C, Whole Building Method

Efficiency Differences T-24 '08 vs. '13

Equipment Type	Size Category	Efficiency	Test Procedure
Air Cooled, With Condenser, Electrically Operated	< 150 Tons	2.80 COP 3.05 IPLV	ARI 550/590
	≥ 150 Tons		
Air Cooled, Without Condenser, Electrically Operated	All Capacities	3.10 COP 3.45 IPLV	
Water Cooled, Electrically Operated, Positive Displacement (Reciprocating)	All Capacities	4.20 COP 5.05 IPLV	ARI 550/590
Water Cooled, Electrically Operated, Positive Displacement (Rotary Screw and Scroll)	< 150 Tons	4.45 COP 5.20 IPLV	ARI 550/590
	≥ 150 Tons and < 300 Tons	4.90 COP 5.60 IPLV	
	≥ 300 Tons	5.50 COP 6.15 IPLV	
Water Cooled, Electrically Operated, Centrifugal	< 150 Tons	5.00 COP 5.25 IPLV	ARI 550/590
	≥ 150 Tons and < 300 Tons	5.55 COP 5.90 IPLV	
	≥ 300 Tons	6.10 COP 6.40 IPLV	
Air Cooled Absorption Single Effect	All Capacities	0.60 COP	ARI 560
Water Cooled Absorption Single Effect	All Capacities	0.70 COP	
Absorption Double Effect, Indirect-Fired	All Capacities	1.00 COP 1.05 IPLV	
Absorption Double Effect, Direct-Fired	All Capacities	1.00 COP 1.00 IPLV	
Water Cooled Gas Engine Driven Chiller	All Capacities	1.2 COP 2.0 IPLV	ANSI Z21.40.4

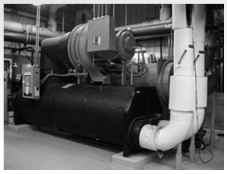
Equipment Type	Size Category	Path A Efficiency	Path B Efficiency	Test Procedure
Air Cooled, with condenser Electrically Operated	< 150 tons	EER ≥ 12.5 IPLV		AHRI 550/590
	≥ 150 tons	EER ≥ 12.75 IPLV		
Air Cooled, without condenser Electrically Operated	All Capacities	Air-cooled chillers without condensers must be rated with matching condensers and comply with the air-cooled chiller efficiency requirements.		
Water Cooled, Electrically Operated, Reciprocating	All Capacities	Reciprocating units must comply with the water-cooled positive displacement efficiency requirements.		
Water Cooled, Electrically Operated Positive Displacement	< 75 tons	≤ 0.780 kW/ton ≤ 0.630 IPLV	≤ 0.800 kW/ton ≤ 0.600 IPLV	
	≥ 75 tons and < 150 tons	≤ 0.775 kW/ton ≤ 0.615 IPLV	≤ 0.790 kW/ton ≤ 0.586 IPLV	
	≥ 150 tons and < 300 tons	≤ 0.680 kW/ton ≤ 0.580 IPLV	≤ 0.718 kW/ton ≤ 0.540 IPLV	
	≥ 300 tons	≤ 0.620 kW/ton ≤ 0.540 IPLV	≤ 0.639 kW/ton ≤ 0.490 IPLV	
Water Cooled, Electrically Operated, Centrifugal	< 150 tons	≤ 0.634 kW/ton ≤ 0.596 IPLV	≤ 0.639 kW/ton ≤ 0.450 IPLV	
	≥ 150 tons and < 300 tons	≤ 0.634 kW/ton ≤ 0.596 IPLV	≤ 0.639 kW/ton ≤ 0.450 IPLV	

Custom Energy Savings Calculations

CHILLER VSD

- CHILLER VSDs:

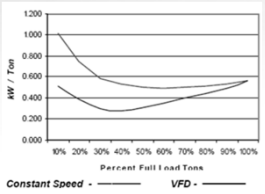
  Rocky Harmstead



Custom Energy Savings Calculations

CHILLER VSD

- Savings Calculations:
  - Modified READI
  - Customized Calculation Tool (CCT)
  - eQUEST



- Project Type:
  - Retrofit Add On (15yr life)

Custom Energy Savings Calculations

CHILLER VSD

- CHILLER DATA:
  - Manufacturer/Model
  - Age
  - Serial Number(s)
  - Number of Chillers
  - Capacity (Tons)
  - Type
  - Full Load Efficiency
- BUILDING DATA:
  - Type
  - Vintage
  - Location
  - Conditioned Area
  - System Operating Hours
  - Economizer

Custom Energy Savings Calculations

CHILLER VSD

- CHILLER VSD EXAMPLE:
  - Large Office located in 92128 zip code
  - Vintage of building is 1997
  - Existing Chiller: 350 tons, water-cooled, centrifugal, constant speed
  - Proposed Chiller: existing chiller, with added **VSD**

Custom Energy Savings Calculations

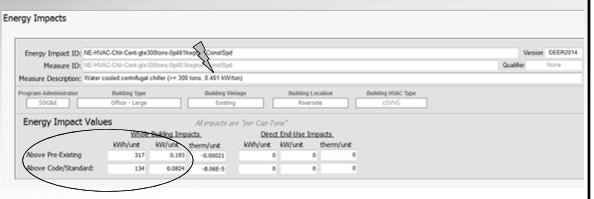
CHILLER VSD

- CHILLER VSD Example - MODIFIED READI:
  - VSD centrifugal chiller

Custom Energy Savings Calculations

CHILLER VSD

- CHILLER VSD - MODIFIED READI:
  - Constant Speed Centrifugal Chiller



Custom Energy Savings Calculations

CHILLER VSD

- CHILLER VSD – MODIFIED READI:

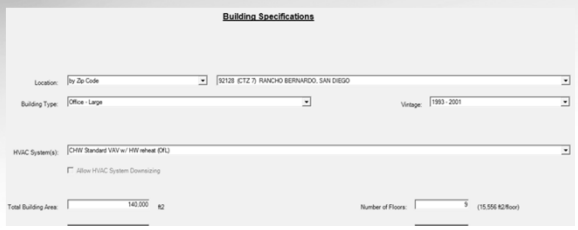
	READI VSD Chiller	READI Chiller	VSD kWh savings
Above Pre-Existing savings, kWh/ton	497	317	180
Above Code savings, kWh/ton	314	134	180
	READI VSD Chiller	READI Chiller	VSD kW savings
Above Pre-Existing savings, kWh/ton	0.277	0.193	0.084
Above Code savings, kWh/ton	0.167	0.082	0.084

- Chiller VSD energy savings = 350tons x 180kWh/ton = 63,000 kWh
- Chiller VSD demand savings = 350tons x 0.084 kW/ton = 29 kW

Custom Energy Savings Calculations

CHILLER VSD

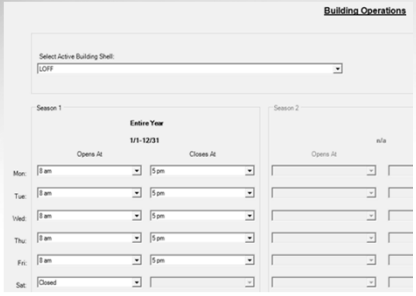
- CHILLER VSD Example – CCT:
  - Input Sheet-Climate zone, building description



Custom Energy Savings Calculations

CHILLER VSD

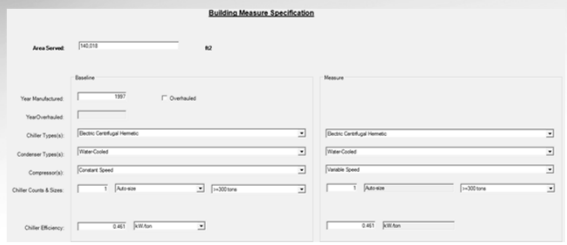
- CHILLER VSD Example - CCT:
  - Building Schedules



Custom Energy Savings Calculations

CHILLER VSD

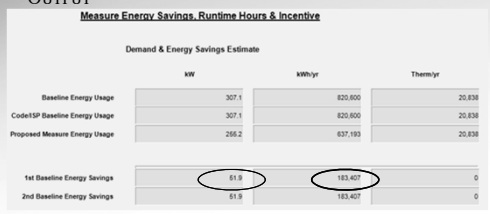
- CHILLER VSD Example - CCT:
  - Chiller Information



Custom Energy Savings Calculations

CHILLER VSD

- CHILLER VSD Example- CCT:
  - Output



  - 183,407 kWh saved, 51.9 kW demand reduced

Custom Energy Savings Calculations

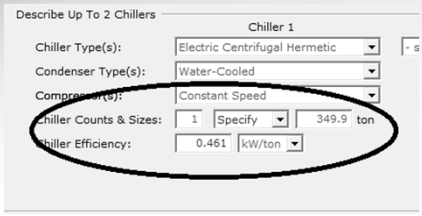
CHILLER VSD

- CHILLER VSD Example – eQUEST (Alternate Approach):
  - Calibrate Baseline Model to Monthly Bills
  - Use Building Creation Wizard
  - Use Energy Efficiency Measure Wizard

Custom Energy Savings Calculations

CHILLER VSD

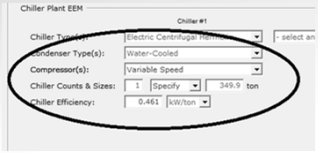
- CHILLER VSD Example – eQUEST Input:
  - Building Creation Wizard - Baseline



Custom Energy Savings Calculations

CHILLER VSD

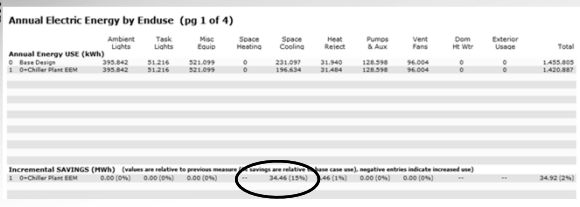
- CHILLER VSD Example – eQUEST input:
  - Energy Efficiency Measure Wizard - Proposed



Custom Energy Savings Calculations

CHILLER VSD

- CHILLER VSD Example – eQUEST Output:



  - Energy Saved = 34,460 kWh

Custom Energy Savings Calculations

CHILLER VSD

- CHILLER VSD Example – eQUEST Output:

Annual Electric Coincident Peak Demand by Enduse (pg 2 of 4)

	Ambient Lights	Task Lights	Misc Equip	Space Heating	Space Cooling	Heat Reject	Pumps & Aux	Vent Fans	Dom Ht Wtr	Exterior Usage	Total
Annual Energy Coincident Demand (kW)											
0 Base Design	148.2	22.7	152.8	0.0	165.7	31.1	46.6	43.5	0.0	0.0	610.6
1 0=Chiller Plant EEM	148.2	22.7	152.8	0.0	173.5	31.9	46.6	37.3	0.0	0.0	613.0

Incremental SAVINGS (kW) (values are relative to previous measure (% savings are relative to base case demand), negative entries indicate increased demand)

1 0=Chiller Plant EEM	0.00 (0%)	0.00 (0%)	0.00 (0%)	--	-7.79 (-5%)	-0.74 (-2%)	0.00 (0%)	6.16 (14%)	--	--	-2.39 (-0%)

– Demand Saved? = -2.4 kW (increased)

Custom Energy Savings Calculations

CHILLER VSD

- CHILLER VSD Example – Tool Savings Comparison

	kWh saved	kW saved
Modified READI	63,000	29
CCT	183,407	51.9
eQUEST	34,460	-2.4

?

– Modified READI Considered First

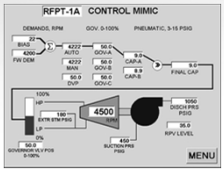
– M&V Required for larger savings claims

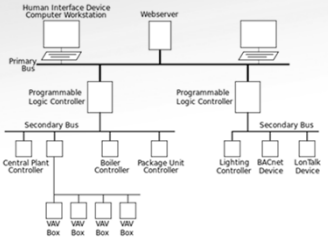
Custom Energy Savings Calculations

CONTROLS

- Calculation Tools for CONTROLS:

  Rocky Harmstead





Custom Energy Savings Calculations

CONTROLS

- 2013 Title 24 Update- New Mandatory Code Controls:
  - Setback thermostats when there is no EMS
  - Isolation area valves or dampers w/ automatic control
  - Vary outside air as operating conditions change w/occupancy sensor/ ventilation control device
  - Hotel/ Motel guest room captive key card or occupancy sensing control
  - Variable flow Systems w/ >5 hp pumps have VSDs

Custom Energy Savings Calculations

CONTROLS

- Savings Calculation Tools:
  - READI
  - Building Optimization Analysis (BOA) Tool
  - eQUEST
  - Spreadsheet Analysis and M&V
- Project Type:
  - Retrofit-Add-On, 15 year life for EMS, per DEER database

Custom Energy Savings Calculations

CONTROLS

- CONTROLS – BOA Tool:
- Air Handlers:
  - Scheduling
  - Temperature dead band
  - Supply air reset
  - Duct static pressure reset
- Central Plant:
  - Add / optimize boiler lockout
  - Condenser water supply temperature reset

Custom Energy Savings Calculations

CONTROLS

- CONTROLS – eQUEST MODEL:
  - Similar control options as BOA
  - Requires calibrated model
  - Magnitude of total savings >20% site consumption to use a model
  - Simplify -Use the Wizards
  - Will check inputs and outputs
  - Submit entire model(s)

Welcome to:
eQUEST
Quick Energy Simulation Tool

Custom Energy Savings Calculations

CONTROLS

- CONTROLS – SPREADSHEET ANALYSIS:
  - For simple equipment scheduling (pumps, air handlers, etc.) turned on & off
  - Trending required to confirm pre- and post-scheduling

Custom Energy Savings Calculations

CONTROLS

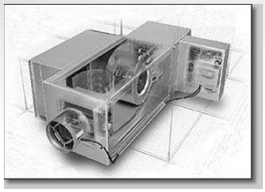
- CONTROLS – OPTIMIZATION PROJECTS:
  - M&V for central plants – Pre and post plant performance VS. Dry Bulb temperature
  - M&V for air handlers –Pre and post fan power and tons trended

Custom Energy Savings Calculations

CAV to VAV

- Constant Air Volume to Variable Air Volume:

  Rocky Harmstead



Custom Energy Savings Calculations

CAV to VAV

- Savings Calculation Tools:
  - DEER to Deemed Rebate Table (see Ref. Guide)
  - Spreadsheets
  - Energy Models

- Project Type:
  - Retrofit-Add-On, 15 year life, per DEER database

DEER To Deemed Rebate Table

HVAC & Refrigeration Products

Program Code	READI Measure ID	Description	Units	Rebate $/Unit
DM-02	D03-044	Chilled Water Reset	per controller	TBD
DM-03	D03-045	Hot Water Reset	per controller	TBD
DM-04	D03-046	Variable Flow Chilled Water Loop	Rated-HP	TBD
DM-05	D03-047	VSD Chilled Water Loop Pump	Rated-HP	TBD
DM-06	D03-048	Variable Flow Hot Water Loop	Rated-HP	TBD
DM-07	D03-049	VSD Hot Water Loop Pump	Rated-HP	TBD
DM-08	D03-050	Variable Air Volume Box	Area-SFP	TBD

Custom Energy Savings Calculations

CAV to VAV

- CAV to VAV – Lab Conversion Spreadsheet Analysis:

XYZ Pharmaceuticals
Building energy use reduction-Phase I

AH 1-01 CV to Phoenix VAV Conversion &

Air Handling System Energy Saving

Existing Air Handling System	CFM	ESP in. H2O	Motor HP	Fan Eff.	Remarks	kWh
AH 1-01	15,500	2.6	50	7.9	24 hours, constant volume	68,220
Total	15,500		50	7.9		68,220
New Air Handling System						
AH 1-01	9,940	2.08	20	4.4	24 Hours, variable volume, VSD was added	25,200
Total	9,940		20	4.4		25,200
AH 1-01 Fan Saving						
AH 1-01 Cooling Saving						
AH 1-01 Heating/Reheat Saving						
CV conversation to VAV Phoenix system						
MUSS and EF 1-1	CV kWh	VAV kWh				
Fan Saving	145,340	54,760				
Cooling Saving	56,700	53,300				
	CV Therm	VAV Therm				
	16,813	6,639				
Savings				3.5		

Exhaust Fan System Energy Savings

Existing Exhaust Fan System	CFM	ESP in. H2O	Motor HP	Fan kW	Remarks	kWh
EF 1-01	26,000	2.25	20	12.4	24 hr. Const Vol.	108,648
EF 1-02	26,000	2.25	20	12.4	24 hr. Const Vol.	108,648
EF 1-03	1,500	2	0.5	0.5	24 hr. Const Vol.	2,190
EF 1-04	4,000	2	2	1.6	24 hr. Const Vol.	14,016
EF 1-21	2,500	2	1	0.5	24 hr. Const Vol.	4,380
EF 1-22	26,000	2.5	20	12.8	24 hr. Const Vol.	120,010
Total	86,700		63.5	40.8		358,170
New Exhaust Fan System						kWh at 40%full load
EF 2-1	10,500	1.6	9.45	3.6	24 hr. Const Vol. Variable volume with VSD	20,430
EF 2-3	7,000	0.7	3.17	1.0	24 hr. Const Vol. Constant volume with VSD	6,900
EF 2-3	11,140	1.11	6.12	2.7	24 hr. Const Vol. Constant volume with VSD	15,472
EF 2-21	1,380	0.35	0.66	0.1	24 hr. Const Vol.	870
Total	30,250		18.8	7.4		64,776
Savings				33.5		

Custom Energy Savings Calculations

CAV to VAV

- CAV to VAV – eQUEST Model:
- What we Check:
  - Schedules
  - Temperature set-points
  - Fan HP
  - Chiller performance
  - Economizer
  - Cold deck features – set-points and reset
  - Sequential changes in Energy Efficiency Wizard
  - Baseline outputs calibrated to Bills

Custom Energy Savings Calculations

AIR COMPRESSORS

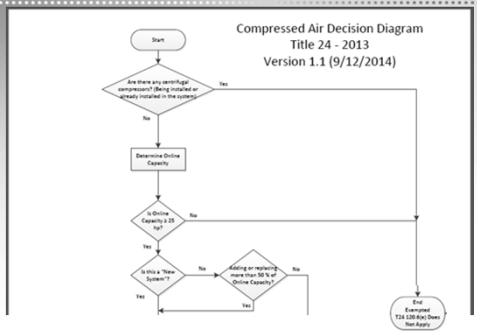
- AIR COMPRESSORS:

Manny Windmiller

k7923610 www.fotosearch.com

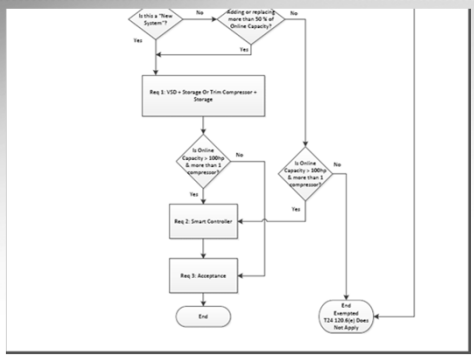
Custom Energy Savings Calculations

AIR COMPRESSORS



Custom Energy Savings Calculations

AIR COMPRESSORS



Custom Energy Savings Calculations

AIR COMPRESSORS

5-25 HP Air Compressors: Deemed Measure

		Annual Electric Savings (kWh/HP/year)	Demand Reduction (kW/HP)
	5 up to 15 HP Variable Speed Drive on Air Compressor Control	491.48	0.15264
	15 up to 25 HP Variable Speed Drive on Air Compressor Control	421.65	0.13095

Custom Energy Savings Calculations

AIR COMPRESSORS

Compressed Air *- Title 24 requirement:*

- New compressed air systems, and all additions or alterations of compressed air systems where the total combined compressor power is > 25 hp;
- The compressed air system shall be equipped with an appropriate sized trim compressor and primary storage to provide acceptable performance across the range of a system and to avoid control gaps;
- Compressed air systems with more than one compressor, having a combined horsepower rating > 100 hp, must operate with an approved controller that is able to choose the most energy efficient combination of compressors within the system based on the current air demand as measured by a sensor.

Custom Energy Savings Calculations

AIR COMPRESSORS

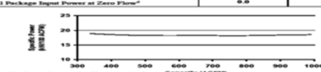
- AIR COMPRESSOR DATA SHEET:

Ingersoll Rand

COMPRESSOR DATA SHEET

Rotary Screw Variable Frequency Drive Compressor

	MODEL DATA - FOR COMPRESSED AIR		
1	Manufacturer: Ingersoll Rand	Date: Aug 11th 2009	
2	Model Number: IRN200H-2S [X] Air-cooled [ ] Water-cooled [X] Oil-injected [ ] Oil-free	# of Stages: 2 VALUE	UNIT
3	Full Load Operating Pressure [b]	125	psig[b]
4	Maximum Full Flow Operating Pressure [c]	125	psig[c]
5	Drive Motor Nameplate Rating	200	hp
6	Drive Motor Nameplate Nominal Efficiency	96.3	percent
7	Fan Motor Nameplate Rating (if applicable)	10	hp
8	Fan Motor Nameplate Nominal Efficiency	88.5	percent
9	Input Power (kW)	Capacity (acfm) [a,e]	Specific Power (kW/100 acfm)[e]
	183.4	990.0	18.52
	161.6	881.1	18.34
	142.3	782.1	18.19
	121.5	666.6	18.23
	101.2	555.8	18.20
	81.2	441.7	18.38
	63.9	338.6	18.87
10	Total Package Input Power at Zero Flow[d]	0.0	kW[d]
11			



Note: Graph is only a visual representation of the data in section 9

NOTES:

a. Measured at the discharge terminal point of the compressor package in accordance with the Annex E to ISO 1217. acfm is actual cubic feet per minute at inlet conditions.
b. The operating pressure at which the Capacity and Electrical Consumption were measured for this data sheet.
c. Maximum pressure attainable at full flow, usually the unload pressure setting for load/no load control or the maximum pressure attainable before capacity control begins. May require additional power.
d. No Load Power. Total package input power at other than reported operating points will vary with control strategy.
e. Tolerance is specified in the Annex E to ISO 1217) as follows:

Member CAGI

Custom Energy Savings Calculations

AIR COMPRESSORS

- AIR COMPRESSOR 2013 CODE REQUIREMENTS:
  - Subsection 120.6(e): The proposed regulations add this subsection to add requirements for compressed air systems 25hp or more:
    - Trim compressor- (compressors with variable speed capability so that they can be operated to specifically meet the compressed air load), storage, and system controls;
    - Construction, inspection, and functional testing.

Custom Energy Savings Calculations

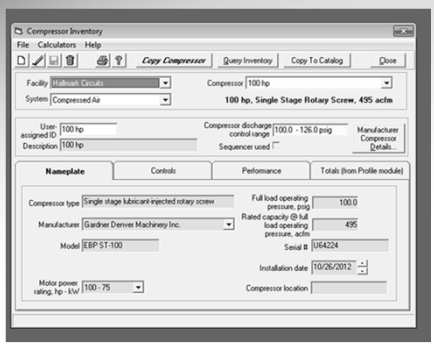
AIR COMPRESSORS

- AIR MASTER SOFTWARE PROGRAM:

Custom Energy Savings Calculations

AIR COMPRESSORS

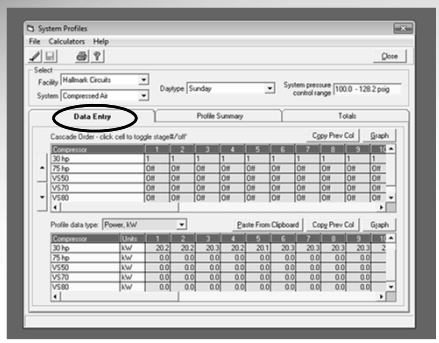
- AIR MASTER SOFTWARE PROGRAM:



Custom Energy Savings Calculations

AIR COMPRESSORS

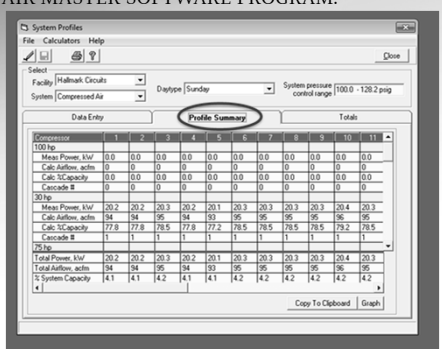
- AIR MASTER SOFTWARE PROGRAM:



Custom Energy Savings Calculations

AIR COMPRESSORS

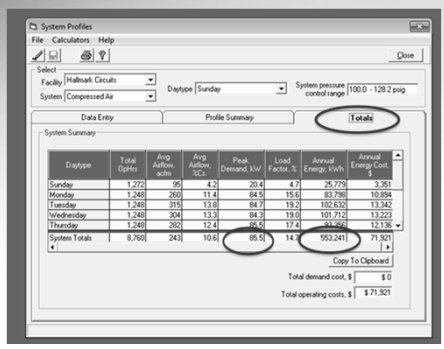
- AIR MASTER SOFTWARE PROGRAM:



Custom Energy Savings Calculations

AIR COMPRESSORS

- AIR MASTER SOFTWARE PROGRAM:



Custom Energy Savings Calculations

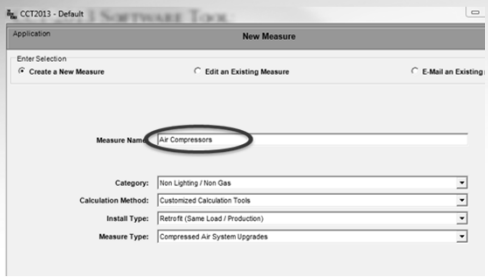
AIR COMPRESSORS

- CCT-2013 Software Tool:

Custom Energy Savings Calculations

AIR COMPRESSORS

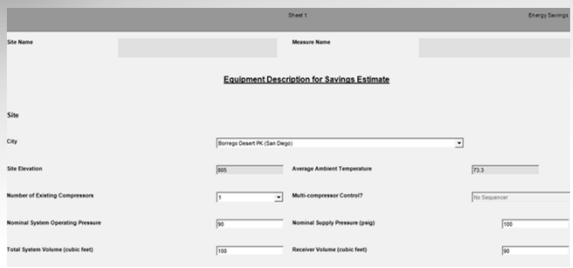
- CCT-2013 Software Tool:
  - Create a new Measure



Custom Energy Savings Calculations

AIR COMPRESSORS

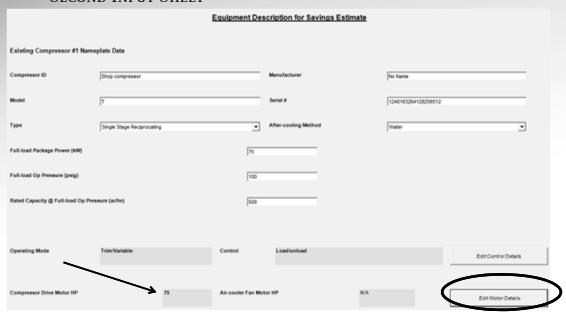
- CCT-2013 Software Tool:
  - First Input Sheet



Custom Energy Savings Calculations

AIR COMPRESSORS

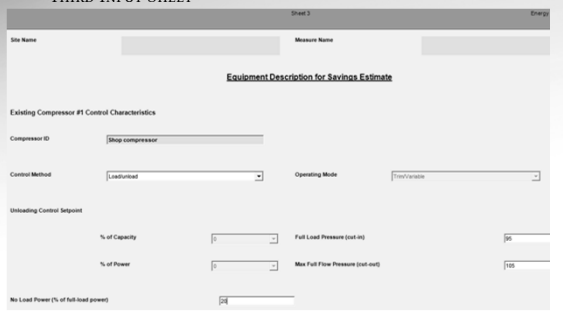
- CCT-2013 Software Tool:
  - Second Input Sheet



Custom Energy Savings Calculations

AIR COMPRESSORS

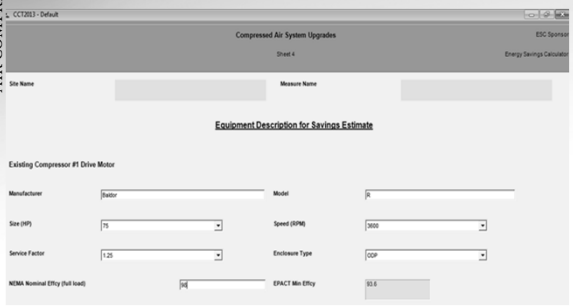
- CCT-2013 Software Tool:
  - Third Input Sheet



Custom Energy Savings Calculations

AIR COMPRESSORS

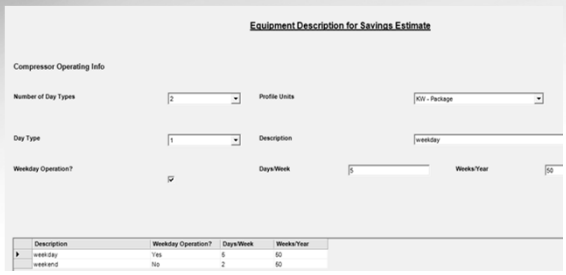
- CCT-2013 Software Tool:
  - Fourth Input Sheet



Custom Energy Savings Calculations

AIR COMPRESSORS

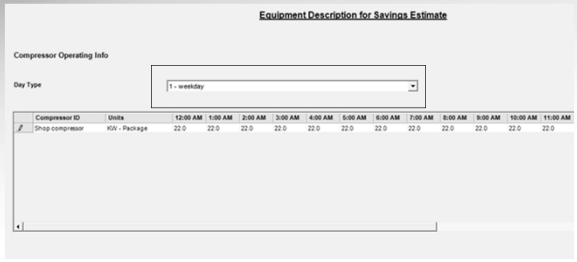
- CCT-2013 Software Tool:
  - Fifth Input Sheet



Custom Energy Savings Calculations

AIR COMPRESSORS

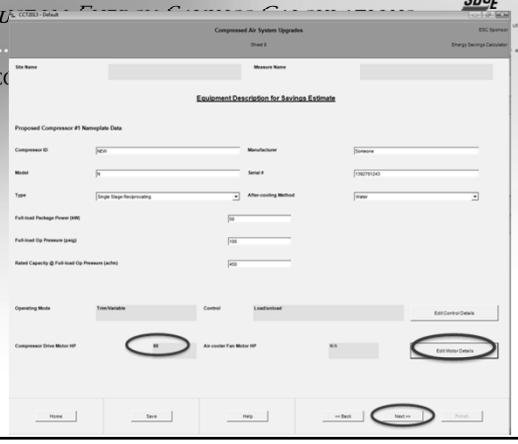
- CCT-2013 Software Tool:
  - Sixth Input Sheet



Custom Energy Savings Calculations

AIR COMPRESSORS

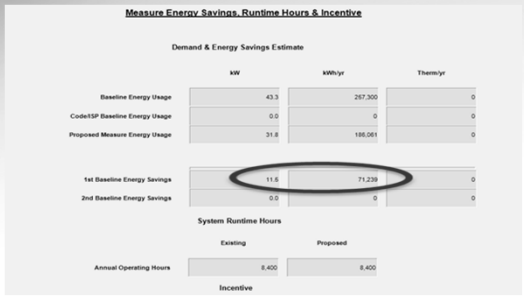
- CC



Custom Energy Savings Calculations

AIR COMPRESSORS

- CCT-2013 Software Tool:
  - Output Sheet



Measure Energy Savings, Runtime Hours & Incentive

Demand & Energy Savings Estimate

	kW	kWh/yr	Therm/yr
Baseline Energy Usage	43.3	267,300	0
Code/ESP Baseline Energy Usage	0.0	0	0
Proposed Measure Energy Usage	31.8	196,061	0
1st Baseline Energy Savings	11.5	71,239	0
2nd Baseline Energy Savings	0.0	0	0

System Runtime Hours

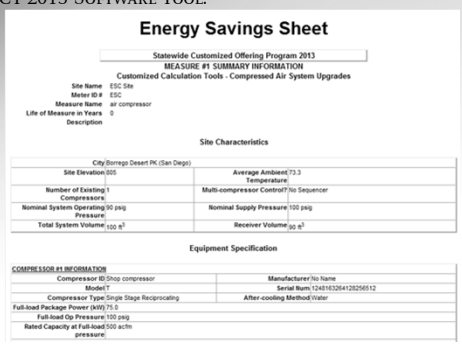
	Existing	Proposed
Annual Operating Hours	8,400	8,400

Incentive

Custom Energy Savings Calculations

AIR COMPRESSORS

- CCT-2013 Software Tool:



Energy Savings Sheet

Statewide Customized Offering Program 2013
MEASURE #1 SUMMARY INFORMATION
Customized Calculation Tools - Compressed Air System Upgrades

Site Name	ESC Site
Meter ID #	ESC
Measure Name	air compressor
Life of Measure in Years	0
Description	

Site Characteristics

City	Borrego Desert PK (San Diego)		
Site Elevation	805	Average Ambient Temperature	73.3
Number of Existing Compressors	1	Multi-compressor Control?	No Sequencer
Nominal System Operating Pressure	90 psig	Nominal Supply Pressure	100 psig
Total System Volume	100 ft³	Receiver Volume	90 ft³

Equipment Specification

COMPRESSOR #1 INFORMATION			
Compressor ID	Shop compressor	Manufacturer	No Name
Model	T	Serial Num	12481632641282565612
Compressor Type	Single Stage Reciprocating	After-cooling Method	Water
Full-load Package Power (kW)	75.0		
Full-load Op Pressure	100 psig		
Rated Capacity at Full-load pressure	500 acfm		

Custom Energy Savings Calculations

AIR COMPRESSORS

- CCT-2013 Software Tool:

Equipment Baseline Information

	Year Installed	Effective Useful Life	Remaining Useful Life	Actual Remaining Useful Life
	2005	15 years	7 years	15 years
Qualifying Evidence	Weekly lubrication, monthly vibration monitoring, annual overhaul, replaced bearings, replaced shaft and impeller, replaced gear box.			

Measure Notes/Warnings

No warnings found.

Measure Energy Savings Estimate

	kW	kWh
Baseline Usage	43.3	257,300
Code15P Baseline Energy Usage	0.0	0
Proposed Usage	31.8	186,061
1st Baseline Energy Savings	11.5	71,239
2nd Baseline Energy Savings		
Estimated Incentive		$5,699.15

Measure Demand Savings

City:	Borrego Springs
Peak Demand Period:	7/30 to 8/1/2013
Equipment operates during peak period?	Yes
Qualified Peak Demand Savings	11.5
Qualified Peak Demand Incentive	$1,150.00

If submitting application forms, please print and attach this document.

Custom Energy Savings Calculations

AIR COMPRESSORS

hourly load Profile from recorded "Weekly demand profile"

												total
hour of the day	6	7	8	9	10	11	12	13	14	15	16	
acfm	15	23	29	25	26	27	28	28	32	24	29	
baseline Curtis RS20 Load/ no load compressor												
baseline compressor full load acfm	92	92	92	92	92	92	92	92	92	92	92	
% time loaded	16.30%	25.00%	31.52%	27.17%	28.26%	29.35%	30.43%	30.43%	34.78%	26.09%	31.52%	
full load power	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	
no load power	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	
fan kW ~ .5 hp x .746/ .9	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	
hourly compressor + fan kW	9.0	10.0	10.8	10.3	10.4	10.5	10.7	10.7	11.2	10.2	10.8	114.6
annual total kWh - 5 days per week 50 weeks per year												28658

baseline compressor logged operation - load and no-load			
hours		%	
measured loaded time	12 hr.	0.285714	
measured unloaded time	30 hr.	0.714286	
average kW		10.4573	
annual hours		2750	
		28758 kWh	(agrees with load profile calculations, above)

proposed VSD Compressor												
full load acfm	78.4	78.4	78.4	78.4	78.4	78.4	78.4	78.4	78.4	78.4	78.4	
% full load	19.13%	29.34%	36.99%	31.89%	33.16%	34.44%	35.71%	35.71%	40.82%	30.61%	36.99%	
full load power, kW	11	11	11	11	11	11	11	11	11	11	11	
no load power, kW	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	
fan kW ~ .3 hp x .746/ .9	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
hourly compressor + fan kW	4.1	5.0	5.7	5.3	5.4	5.5	5.6	5.6	6.0	5.1	5.7	59.0
annual total kWh - 5 days per week 50 weeks per year												14759
estimated annual energy savings												13898

Custom Energy Savings Calculations

AIR COMPRESSORS

Compressed Air VSD IMC

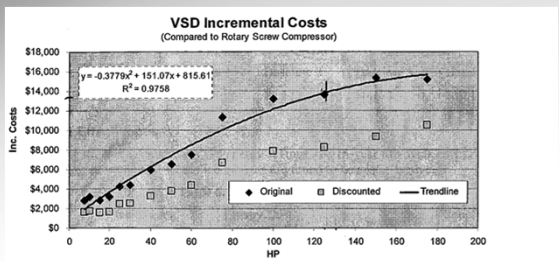


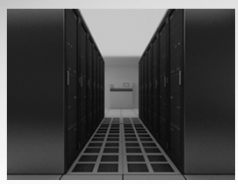
Figure 5: Incremental costs between a VSD compressor and a lubricant injected load/unload rotary screw compressor.

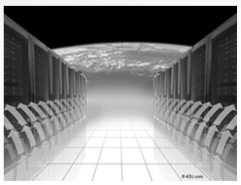
Custom Energy Savings Calculations

CRAC / CRAH

- COMPUTER ROOM AIR CONDITIONING:

  Manny Windmiller

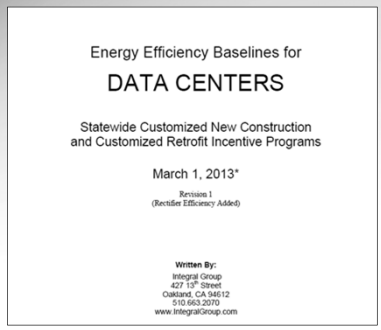




Custom Energy Savings Calculations

CRAC / CRAH

- DATA CENTER BASELINE: (60 page Report)



Energy Efficiency Baselines for

DATA CENTERS

Statewide Customized New Construction
and Customized Retrofit Incentive Programs

March 1, 2013*

Revision 1
(Rectifier Efficiency Added)

Written By:
Integral Group
427 13th Street
Oakland, CA 94612
510.663.2070
www.IntegralGroup.com

Custom Energy Savings Calculations

CRAC / CRAH

- DATA CENTER BASELINES:
  - http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/incentivesbyindustry/hightech/data_center_baseline.pdf
  - Air Delivery Systems (recirc, vent, exh)
  - Hydronic Systems (chilled, condenser, heating)
  - Cooling Systems (air cooled dx, water cooled plant)
  - Heating Systems (preheat mau, humidification)
  - Humidity Control Systems (humid, dehumid, reheat)
  - Electrical (motors, fans, VSD's, ups, transformers, rectifiers, servers)

Custom Energy Savings Calculations

CRAC / CRAH

- DATA CENTER BASELINES:
  - Energy Modeling Tools
    - ❖EnergyPro
    - ❖eQUEST
    - ❖EnergyPlus
    - ❖Custom Spreadsheets
  - Component Efficiencies
    - ❖18 Separate Tables with Baselines
    - ❖Does not replace Title-24 nor ASHRAE 90.1

Custom Energy Savings Calculations

CRAC / CRAH

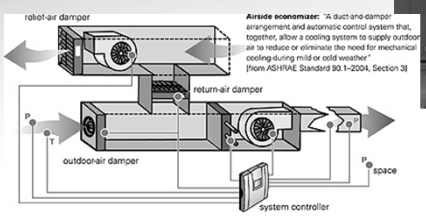
- PRESCRIPTIVE REQUIREMENTS:
  - ❖Economizers
  - ❖Reheat
  - ❖Humidification
  - ❖Fan Power Consumption
  - ❖Fan Control
  - ❖Containment

Custom Energy Savings Calculations

ECONOMIZERS

- ECONOMIZERS:

Ed Reynoso



Custom Energy Savings Calculations

ECONOMIZERS

- ECONOMIZERS – TITLE 24:
  - Each cooling fan system with a design total mechanical cooling capacity over 54,000 Btu/hr shall include either:
  - A. An air economizer capable of modulating outside-air and return-air dampers to supply 100 percent of the design supply air quantity as outside-air; **OR**
  - B. A water economizer capable of providing 100 percent of the expected system cooling load as calculated in accordance with a method approved by the Commission, at outside air temperatures of 50°F dry-bulb/45°F wet-bulb and below. (with some exceptions, 140.4(e)1)

Custom Energy Savings Calculations

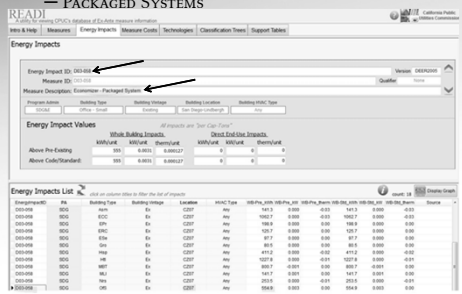
ECONOMIZERS

- **EXCEPTION 4 to Section 140.4(d):** Zones in which specific humidity levels are required to satisfy exempt process loads.
- Computer Rooms or other spaces where the only process load is from IT equipment **MAY NOT** use this exception.
- Economizers for Computer Room refer to code section 140.9(a)

Custom Energy Savings Calculations

ECONOMIZERS

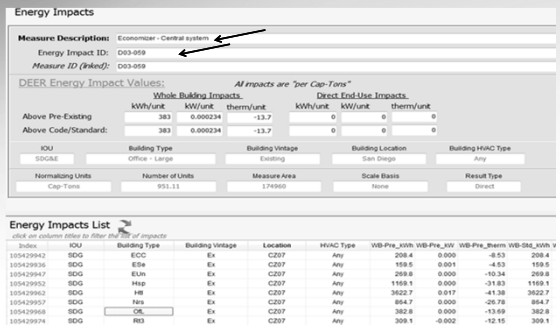
- ECONOMIZERS - READI TOOL (" DEER and Non-DEER Ex Ante data for the 2013-14 Cycle"):
  - Packaged Systems



CUSTOM ENERGY SAVINGS CALCULATIONS

ECONOMIZERS

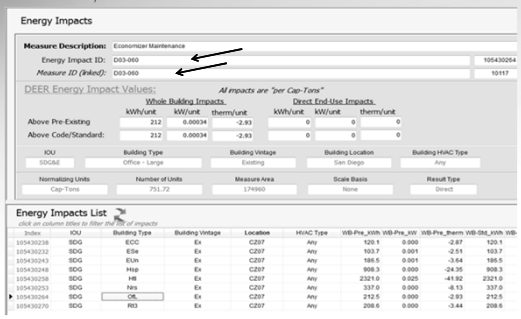
- ECONOMIZERS - READI TOOL (SELECT "DEER FOR 2014 CODE UPDATE" DATABASE): :



CUSTOM ENERGY SAVINGS CALCULATIONS

ECONOMIZERS

- ECONOMIZERS - READI TOOL (SELECT "DEER FOR 2014 CODE UPDATE" DATABASE):



CUSTOM ENERGY SAVINGS CALCULATIONS

ECONOMIZERS

- ECONOMIZERS - BOA TOOL:

General Information & General Inputs

General Project Information	
Facility Name	(facility name)
Facility Address	(facility address)
Utility Account Number	(utility account number)

Provider Information	
Name	(provider name)
Company	(provider company)
Address	(provider address)
Email	(provider email)
Phone number	(provider phone)
Date	(date)

General Inputs	
Building Type	Office
Primary Ventilation System Type	VAV AHU / RTU w/ zone reheat
Primary Cooling System Type	Water-Cooled Chiller(s)
HVAC Heating System Type	Natural Gas Water Boiler
Zip Code	92123 (CZ7) San Diego
CA Climate Zone	7
Year Building Constructed	2001
Facility Gross Area (ft²)	70,000

Baseline Building Energy Use	
Baseline Annual Electric Use (kWh)	1,500,000
Baseline Annual Gas Use (Therms)	15,000
Electric EUI (kWh/ft²)	21.4
Gas EUI (therms/ft²)	0.2
Total EUI (kBTU/ft²)	94.6

Custom Energy Savings Calculations

ECONOMIZERS

- ECONOMIZERS - BOA TOOL:

Savings Calculator: Airside Economizer

Project Information	
Facility Name	(facility name)
Facility Address	(facility address)
Utility Account Number	(utility account number)
Provider Name	(provider name)
Provider Company	(provider company)
Address	(provider address)
email	(provider email)
Telephone number	(provider phone)
Date	(date)

Finding & Measure Descriptions	
Finding / Measure Number	(user to enter finding / measure number)
Finding Description	(user to enter finding description)
Measure Description	(user to enter measure description)

Baseline Project Building Characteristics	
VAV or CAV air handlers?	VAV
Water-cooled or air-cooled chillers?	WC
CHWST reset?	NO
HWST reset?	NO
Fixed or variable CWST setpoints?	Fixed

These inputs are for use in determining tool applicability, and do not impact the savings calculations.

If baseline project building characteristics do not match tool applicability, contact your utility program administrator.

Inputs	
Building Type	Office
CA Climate Zone	7
Year Building Constructed	2001
Baseline Lockout Temp or % Outside Air	55 Deg Lockout
Air Handler Cooling Capacity (tons)	200

Savings Outputs			
Annual Electric Savings	[illegible] kWh/yr	2.8%	% of Annual Use
DEER Peak Electric Demand Savings	[illegible] kW		
Annual Natural Gas Savings	[illegible] Therms/yr	-1.1%	% of Annual Use

Warnings and Errors: [illegible]

Custom Energy Savings Calculations

ECONOMIZERS

Range		Hours	Pre MAT	Econ MAT	Pre Hours	Post Hours	kW	Baseline kWh	Post kWh	
32	34	0	53	55	0	0	8.1	0	0	
34	36	0	54	55	0	0	8.3	0	0	
36	38	16	54	55	0	0	8.4	0	0	
38	40	14	55	55	0	0	8.6	0	0	
40	42	57	56	55	57	0	8.8	500	0	
42	44	71	57	55	71	0	8.9	634	0	
44	46	165	57	55	165	0	9.1	1,502	0	
46	48	163	58	55	163	0	9.3	1,508	0	
48	50	207	59	55	207	0	9.4	1,950	0	
50	52	312	60	55	312	0	9.6	2,991	0	
52	54	422	61	55	422	0	9.8	4,117	0	
54	56	585	61	55	585	0	9.9	5,805	0	
56	58	686	62	57	686	686	10.1	6,908	6,908	
58	60	902	63	59	902	902	10.2	9,235	9,235	
60	62	794	64	61	794	794	10.4	8,262	8,262	
62	64	951	64	63	951	951	10.6	10,056	10,056	
64	66	875	65	65	875	875	10.7	9,399	9,399	
66	68	674	66	66	674	674	10.9	7,339	7,339	
68	70	471	67	67	471	471	11.1	5,208	5,208	
70	72	363	68	68	363	363	11.2	4,075	4,075	
72	74	346	68	68	346	346	11.4	3,942	3,942	
74	76	247	69	69	247	247	11.6	2,856	2,856	
76	78	176	70	70	176	176	11.7	2,061	2,061	
78	80	113	71	71	113	113	11.9	1,342	1,342	
80	82	68	71	71	68	68	12.0	819	819	
82	84	38	72	72	38	38	12.2	464	464	
84	86	25	73	73	25	25	12.4	310	310	
86	88	17	74	74	17	17	12.5	213	213	
88	90	1	75	75	1	1	12.7	13	13	
90	92	1	75	75	1	1	12.9	13	13	
92	94	0	76	76	0	0	13.0	0	0	
94	96	0	77	77	0	0	13.2	0	0	
96	98	0	78	78	0	0	13.3	0	0	
98	100	0	78	78	0	0	13.5	0	0	
100	102	0	79	79	0	0	13.7	0	0	
102	104	0	80	80	0	0	13.9	0	0	
104	106	0	81	81	0	0	14.0	0	0	
106	108	0	82	82	0	0	14.2	0	0	
108	110	0	82	82	0	0	14.3	0	0	savings kWh
		8,760						90,386	72,513	17,873
									DEER2014	11,484

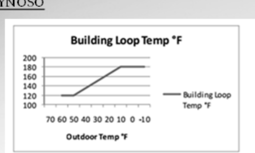
Economizer Spreadsheet Calculation

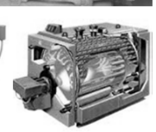
Custom Energy Savings Calculations

BOILERS AND DDC SYSTEMS

- BOILERS AND DDC SYSTEMS:

  Ed Reynoso





Custom Energy Savings Calculations

BOILERS AND DDC SYSTEMS

- BOILERS AND DDC SYSTEMS:

Example of Boiler Technologies

-Steam Boilers -Heating Hot Water Boilers -Domestic Hot Water Boilers

-Condensing Boilers -Boiler Economizers -OSA-T Lockout/ OSA T-Reset

Example of Boiler Measures

One for one replacement - Rebate

New Hot Water Reset - Rebate

Matching boiler system - Rebate

Existing System Redesign - Custom

Removal of Heat Exchanger and Decoupling - Custom

Custom Energy Savings Calculations

BOILERS AND DDC SYSTEMS

- TOOLS:
  - SDGE.com for EE Business Rebate List/ DEER Catalog
  - Remote Ex-Anti Database Interface (READI v.2.1.0)
  - Customized Calculation Tool (CCT2013, v.15.2.25018)
  - EnergyPro (ver. 6.4.0.3)
  - Spreadsheet calculations (w/ raw data) (excel, etc.)
- REFERENCES:
  - Seminar Reference Guide
  - New Title 24, 2013 Summary of Non-Residential Building Energy Efficiency
  - Database for Energy Efficient Resources (DEER)
  - Energy Efficiency Business Incentive
  - Climate Zone Locations

Custom Energy Savings Calculations

BOILERS AND DDC SYSTEMS

- REBATES OR INCENTIVES?
  - –Why go Rebate?
    - Rebate Measure on EEBR list – Mandatory
    - Streamline application process
    - Funds may be reserved up to 45 days
    - Energy Star Portfolio Manager Benchmark Report
    - Pre or post installation inspections – maybe
    - Equipment Installation
    - Proof of Purchase
    - Payment Release
    - Rebate checks mailed within 30-45 days
    - No Calculations Tools required
    - No Measurement and Verification

Custom Energy Savings Calculations

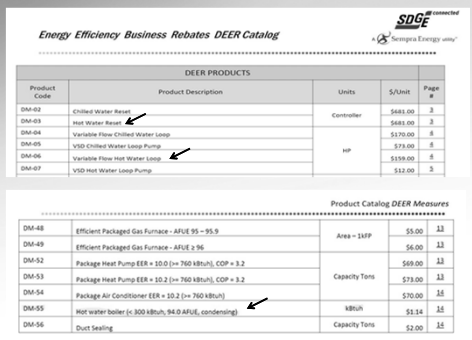
BOILERS AND DDC SYSTEMS

- REBATES OR INCENTIVES?
  - Natural Gas Boiler Rebates(EEBR): 1) SDGE.com 2)

Solution	Product Code	Description	$/Mbtuh
Storage Water Heater	G-A1	Storage Water Heater	$2.00
Space Heating	G-B1 G-B2 G-B3	Space Heating Boiler (Stm) Space Heating Boiler (Sm) Space Heating Boiler (Lg)	$0.25 $0.25 <300 MBH $0.50 >=300
Commercial Boiler	G-C1	Commercial	$0.50
Instantaneous Water Heater	G-D1 G-D2	Small (<200MBtuh) Large (>200MBtuh)	$2.00 $0.50
Process Boiler	G-E1 G-E2	Steam Water	$0.50
Direct Contact Water Heater	G-G1 G-G2	Small (<300MBtuh) Large (>300MBtuh)	$2.00

Custom Energy Savings Calculations

BOILERS AND DDC SYSTEMS



Energy Efficiency Business Rebates DEER Catalog

DEER PRODUCTS

Product Code	Product Description	Units	$/Unit	Page #
DM-02	Chilled Water Reset	Controller	$681.00	3
DM-03	Hot Water Reset		$681.00	3
DM-04	Variable Flow Chilled Water Loop	HP	$170.00	4
DM-05	VSD Chilled Water Loop Pump		$73.00	4
DM-06	Variable Flow Hot Water Loop		$159.00	4
DM-07	VSD Hot Water Loop Pump		$12.00	5

Product Catalog DEER Measures

DM-48	Efficient Packaged Gas Furnace - AFUE 95 – 95.9	Area – 1kFP	$5.00	13
DM-49	Efficient Packaged Gas Furnace - AFUE ≥ 96		$6.00	13
DM-52	Package Heat Pump EER = 10.0 (>= 760 kBtuh), COP = 3.2	Capacity Tons	$69.00	13
DM-53	Package Heat Pump EER = 10.2 (>= 760 kBtuh), COP = 3.2		$73.00	13
DM-54	Package Air Conditioner EER = 10.2 (>= 760 kBtuh)		$70.00	16
DM-55	Hot water boiler (<300 kBtuh, 94.0 AFUE, condensing)	kBtuh	$1.14	16
DM-56	Duct Sealing	Capacity Tons	$2.00	16

Custom Energy Savings Calculations

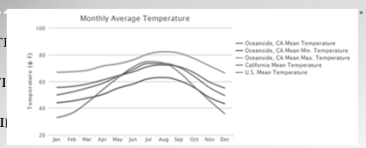
BOILERS AND DDC SYSTEMS

- WHAT TOOLS DO I USE FOR INCENTIVE?
- Depends on Scope of Project
  - One for one replacement?
  - Upgrade back-up boiler to lead boiler?
  - Multiple boilers types (Steam, HHW, DHW) at site?
  - Multiple Capacities / Increased Capacity?
  - Modifications or Retrofit Add-on (REA)?

Custom Energy Savings Calculations

BOILERS AND DDC SYSTEMS

- Key Data for Collecti
  - Hours of Operati
  - Climate Zone / Zi
  - Building Type, Vintage, and Conditioned Area (s.f.)
  - Operating Conditions – baseline vs post installation (EWT, LWT, gpm, resets, etc.)
  - New Boiler Type, MBH input/output, Efficiency
  - Boiler Operation- Lead-Lag? Shared Load? Age?
  - For Custom Operation – load factor schedule and capacity



Custom Energy Savings Calculations

BOILERS AND DDC SYSTEMS

- HEATING HOT WATER (HHW) BOILER EXAMPLE (EEBR):
  - Large Office located in 92058
  - Vintage of building is pre 1990
  - Existing Boiler: Manufacturer A "WNG2500" HHW BOILER
  - Proposed Boiler: Manufacturer R "MVB-H7-2003" (non-condensing); 1999 MBH; efficiency = 87%
  - Retrofit Add-on (REA): Direct Digital Controls System for OSA lockout, boiler reset schedule. *(Rebate –EEBR)*
  - DEER EUL = 20 years; Title 24 = 80%

Custom Energy Savings Calculations

BOILERS AND DDC SYSTEMS

- How Does EEBR compare to EEBI?
  - EEBR (New Boiler)
    - Space Heating Boiler Rebate based on code and $/Units
    - Product Code: G-B3 ; Units = MBH ; $/MBH = $0.50
    - Rebate = (1999 MBH)x ($0.50) = $1000
  - "READI Measure" Hot Water Reset– D03-045
    - Product Code: DM-03; Units = per controller;
    - Rebate = ($681/unit) x (1 controller)= $681
  - **Total Rebate = $1,681**

Custom Energy Savings Calculations

BOILERS and DDC SYSTEMS

- Reasons to Choose EEBR over EEBI
  - *Primary Reason:* *Boiler technology and measure match EEBR list*
  - Secondary Reasons:
    - Manufactures equipment specifications cut-sheet
    - Sequence of Operations
    - Engineer of Record and or Trade Professional Contractor
    - SDG&E Pre & Post Inspections (mandatory)
    - Measurement and Verification Plan (may be required)
    - Installation must be completed within Program Year (refer to website)
    - Custom Calculations require SDG&E Engineering and or CPUC review
    - Processing delays
    - Post M&V SDG&E review
    - Must notify SDG&E of equipment or design changes

Custom Energy Savings Calculations

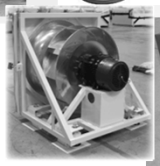
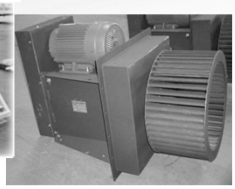
VSD's for FANS

- VSDs for Fans:

Rod Houdyshel





Custom Energy Savings Calculations

VSD's for FANS

- VSD FOR HVAC FANS – REBATES!
  - For Fan Applications on existing HVAC Systems
  - Supply, Return, Exhaust systems
  - Maximum size is 100 HP/fan motor
  - Eligible only if Throttling devices are Removed or Permanently disabled
  - Current Rebate is $110.00/hp
  - Must be SDG&E customer
  - Pre-Inspection will be required

Custom Energy Savings Calculations

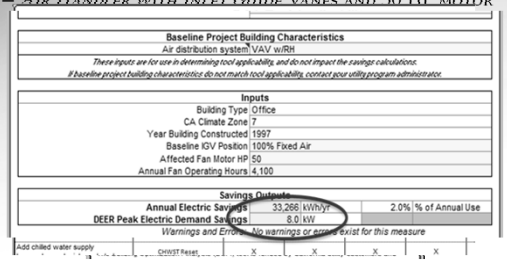
VSD's for FANS

- VSD FOR HVAC FANS – INCENTIVES:
  - For Fan Applications on existing HVAC Systems
  - Supply, Return, Exhaust systems
  - More than 100 HP Motors
  - Eligible only if Throttling devices are Removed or Permanently disabled
  - Incentives available for replacement of failed VSDs if an incentive on failed VSD had not been paid within previous 5 years
  - Current Incentive is $0.08/kWh and $150/kW

Custom Energy Savings Calculations

VSD's for FANS

- SUPPLY FAN VSD EXAMPLE - BOA Tool:
  - Air Handler with Inlet Guide Vanes and 50 HP motor



Baseline Project Building Characteristics	
Air distribution system	VAV w/RH

These inputs are for use in determining tool applicability, and do not impact the savings calculations.
If baseline project building characteristics do not match tool applicability, contact your utility program administrator.

Inputs	
Building Type	Office
CA Climate Zone	7
Year Building Constructed	1997
Baseline IGV Position	100% Fixed Air
Affected Fan Motor HP	50
Annual Fan Operating Hours	4,100

Savings Outputs			
Annual Electric Savings	33,266	kWh/yr	2.0% % of Annual Use
DEER Peak Electric Demand Savings	8.0	kW	

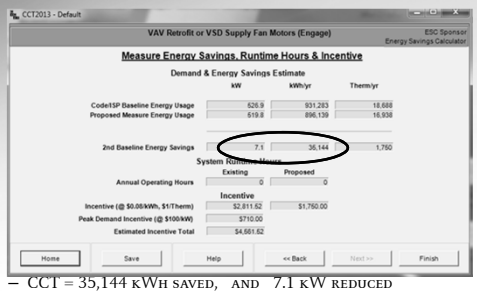
Warnings and Errors: No warnings or errors exist for this measure

Add chilled water supply | CHWST Reset | X | X | X | X

Custom Energy Savings Calculations

VSD's for FANS

- SUPPLY FAN VSD EXAMPLE - CCT Tool:



  - CCT = 35,144 kWh saved, and 7.1 kW reduced

Custom Energy Savings Calculations

VSD's for FANS

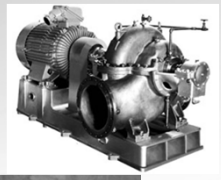
- SUPPLY FAN VSD EXAMPLE - Rebate or Incentive
  - Rebate is 50hp x $110.00 = $5,500.00 paid upon inspection
  - CCT=35,144kWh, BOA=33,266kWh
  - Incentive would be about $4,561.52 (additional paperwork and time)
  - Must be Rebate anyway

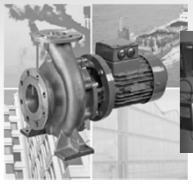
Custom Energy Savings Calculations

PUMPS

- PUMPS with VSDs:

Rod Houdyshel





Custom Energy Savings Calculations

PUMPS

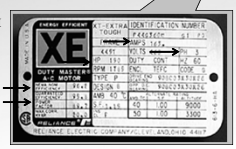
- PUMP ENERGY EFFICIENCY MEASURES:
  - VSDs on Circulating Water Pumps
  - VSDs on Condensing Water Pumps
  - VSDs/Booster Pumps on Domestic Hot Water
  - VSD on Other Applications / Process
  - Dual Baseline Considerations
  - *VSDs on CHW and HHW Loops =REBATE=*

Custom Energy Savings Calculations

PUMPS

VSDs on CIRCULATING WATER PUMPS:

- Pre-installation: Can assume 33% savings
  - Savings=33%*Baseline kWh
    - Verified post-installation
  - Needed Data:
    - Nameplate information
      - HP
      - PF
      - Efficiency
      - FLA
      - PH
    - Measured Data
      - Amperes
      - Voltage
    - ❖How many pumps and how they operate together



Custom Energy Savings Calculations

PUMPS

VSDs on CIRCULATING WATER PUMPS (WSHPs):

- Calculate Baseline kW → kWh = kW*(operating hours)
  - $kW = \frac{(Amps * Volts * PF * \sqrt{PH})}{1000\ W/kW} = hp * .7457 * \frac{LF}{Eff}$

Example: Slip Load Calculation

Given: Synchronous speed in rpm = 1800
Nameplate full load speed = 1750
Measured speed in rpm = 1770
Nameplate rated horsepower = 25 hp

Determine actual output horsepower.

From Equation 5

$$Load = \frac{1800 - 1770}{1800 - 1750} \times 100\% = 60\%$$

Actual output horsepower would be 60% *x* 25 hp = 15 hp

Poles	60 Hertz
2	3600
4	1800
6	1200

$$Load = \frac{I}{I_r} \times \frac{V}{V_r} \times 100\%$$

Where:
Load = Output power as a % of rated power
I = RMS current, mean of 3 phases
I_r = Nameplate rated current
V = RMS voltage, mean line-to-line of 3 phases
V_r = Nameplate rated voltage

Custom Energy Savings Calculations

PUMPS

VSDs on CIRCULATING WATER PUMPS(WSHPs):

- Alternative Estimation Approach: BIN Analysis
  - Assign VSD pump operating frequencies to temperature ranges
    - Justify **MAX/MIN** amps
  - Determine annual hours in each temperature range
    - TMY3 Data
      - DOE Energy Plus Website (reference manual)
  - Calculate the new BHP (kW) using pump affinity laws:

$$kW_{new} = \frac{kW_{full} * \left(\frac{frequency}{60}\right)^{2.4}}{eff_{VFD}}$$

OAT (°F)	
88	- 90
86	- 88
84	- 86
82	- 84
80	- 82
78	- 80
76	- 78
74	- 76
72	- 74
70	- 72
68	- 70
66	- 68
64	- 66
62	- 64
60	- 62
58	- 60
56	- 58
54	- 56
52	- 54
50	- 52
48	- 50
46	- 48
44	- 46
42	- 44
40	- 42
38	- 40
36	- 38

Custom Energy Savings Calculations

PUMPS

VSDs on CIRCULATING WATER PUMPS (WSHPs):

- Pump Affinity Law Applied: (real world / non ideal)

P	"n" FOR AIR / WATER LOOPS			
(kW1 / kW2)		Fully or Mostly Closed	Semi-Closed	Mostly or Fully Open
kW				
gpm				
n	Fixed Geometry:	2.4	2.2	2.0

(cfm1 / cfm2)^n
fan power
bic feet per minute (ideal conditions)

  - Fully or Mostly Closed
    - Chilled water pumping
    - IT cooling systems
  - Semi-Closed
    - Condenser water loop for open cooling tower
    - CRAC/CRAH for hot/cold aisles
  - Mostly or Fully Open
    - CRAC/CRAH for unobstructed underfloor plenums, open returns

Custom Energy Savings Calculations

PUMPS

VSDs on CIRCULATING WATER PUMPS (WSHPs):

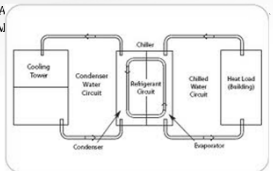
- Post-Installation: Verify estimated savings
  - Log for 2 weeks
    - Operating amps and OAT
- Calculate Post-installation kW and kWh similarly
  - $kW = \frac{(Amps * Volts * PF * \sqrt{PH})}{1000\ W/kW}$
  - ***kWh***: Average the kW in each OAT bin
    - Extrapolate annually using TMY3 temperature data
- Calculate **SAVINGS**
  - **Annual Savings** = (Pre-install kWh) – (Post-install kWh)
  - kW reduction only from 2-5 pm, September 1st, 2nd, 3rd

Custom Energy Savings Calculations

PUMPS

VSDs on CONDENSER WATER PUMPS:

- This will require **M&V**
  - 1 month+ Pre- and Post- measured data on whole system
  - Consider chiller consumption
    - ❖Reduced flow rate across the chiller will affect its pressure drop and operating efficiency
    - ❖May sa… energy consum…



Custom Energy Savings Calculations

VSDs on PROCESS PUMPS:

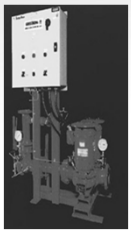
- Independent of outdoor air temperatures

Item	Value	Comment
Total Pumping Horsepower (hp)	250.00	
Average Pump Load Factor	85%	
Pump Motor Efficiency	92%	
Total Pump Operating Hours	8,760	From EMS, site personnel, operating logs
% Hours Operating at 100% Load	10%	
% Hours Operating at 90% Load	20%	
% Hours Operating at 80% Load	50%	
% Hours Operating at 70% Load	20%	kWh = (70%)$^{2.4}$ * 8760 * 20%
% Hours Operating at 60% Load	0%	
% Hours Operating at 50% Load	0%	
% Hours Operating at 40% Load	0%	
% Hours Operating at 30% Load	0%	
Sum of % Hours Operating at Various Loads	100%	Should always equal 100%
Electric Cost ($/kWh)	0.13	Total Consumption Cost ($) / Total Consumption (kWh)
Pre-Retrofit Energy Consumption (kWh)	1,509,433.70	HP * 0.7457 * LF / EFF * HOURS
Post-Retrofit Energy Consumption (kWh)	938,710.90	Sum of kWh @ 100% - 30%

Custom Energy Savings Calculations

PUMPS

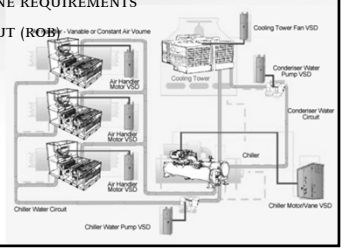
- VSDs/BOOSTER PUMPS ON DOMESTIC WATER:
  - Will require **M&V**
  - Measured baseline kW
  - Constant flow hours of operation
  - Monitored post-installation consumption
    - 2-4 weeks amp logging
  - May require documentation of occupant behavior/schedules to extrapolate annual use and savings



Custom Energy Savings Calculations

PUMPS

- DUAL BASELINE CONSIDERATIONS:
  - VSDs
    - Retrofit/Add-ons
      - No dual baseline requirements
    - Replace On Burnout (ROB)
    - EUL for VSDs
      - 15 years

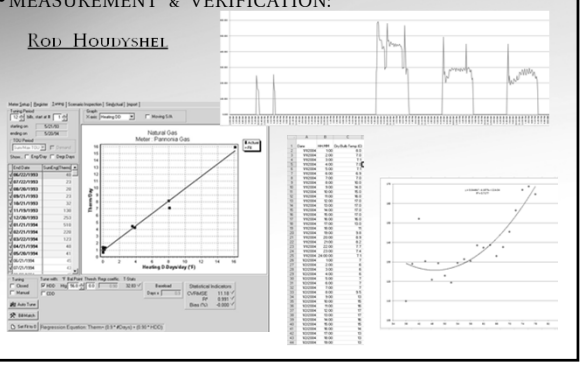


Custom Energy Savings Calculations

MEASUREMENT & VERIFICATION

- MEASUREMENT & VERIFICATION:

Rod Houdyshel



Custom Energy Savings Calculations

MEASUREMENT & VERIFICATION

- MEASUREMENT & VERIFICATION:
  - Collection:
    - ❖Lighting Levels, Current, Power, Voltage
    - ❖From 2 weeks up to 4 weeks
    - ❖Full year data (12 months for 10%bonus)
    - ❖15-Minute Intervals is Sufficient
  - Sources:
    - ❖Customer / Sponsor – Bldg EMS
    - ❖SDG&E - HOBO loggers
    - ❖SDG&E Monthly Billing Data
  - Limits:
    - ❖Minimum 50,000 kWh savings
    - ❖Requested by utility engineers or CPUC


SDGE
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