2011 Commercial Retro-Commissioning Technical Services Program

Program Manual

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Updates to this manual and program enrollment materials will be provided at
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Introduction

The Commercial Technical Services Program (TSP) is a new segment of the CenterPoint Energy Retro-commissioning (RCx) Program, available for the 2011 program year. It includes a comprehensive energy audit by a professional engineer or certified energy manager at no cost to qualifying customers. Energy and demand savings are realized through the systematic evaluation of facility systems and implementation of both capital expenditures on energy efficient technologies and low-cost measures targeted to improve heating ventilation and air conditioning (HVAC) and lighting system operations. The customer will use the results of this audit to evaluate and implement energy efficiency measures, and may apply to the City of Houston's Energy Efficiency Incentive Program (EEIP) for incentives based on qualifying implementation. This program is available to commercial customers in the City of Houston to reduce their office building's energy consumption and energy costs.

This Program Manual includes detailed information about the Technical Services Program and guidelines for project implementation under this program. Nexant, Inc. is the Program Administrator (PA) for this program offered by CenterPoint Energy.

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1. Introduction

1.1 Background

In partnership with the City of Houston's EEIP, the TSP is offered by CenterPoint Energy to provide an opportunity for a free energy audit at qualifying Houston office buildings. The technical services offered through the TSP provide a comprehensive energy assessment at qualifying facilities. This assessment is intended to identify a wide range of energy efficiency measures that the customer can implement at their facility to optimize and upgrade existing facility system efficiencies, thereby reducing peak summer demand and saving annual energy consumption.

Participants in the 2011 TSP must meet minimum eligibility criteria, comply with all program rules and procedures, submit documentation describing their facilities, and enter into a building owner document with CenterPoint Energy. The PA, shall screen the applications and approve projects based on meeting the eligibility requirements and savings potential

1.2 Customer Eligibility

Customers may qualify to participate in the program if they satisfy the following criteria:

- Businesses or Building Owners of the commercial office facility under the CenterPoint Energy service territory within the City of Houston.
- Applicant must join the Houston Green Office Challenge (GOC): www.houstongoc.org and commit to participating in the Energy Efficiency Incentive Program (EEIP) http://www.houstongoc.org/?q=node/47 , to qualify for incentives. Applicants may submit no more than three (3) applications (one (1) application per building).
- Applicant must submit the Technical Services Program application to the Program Administrator.
- A customer must install energy efficiency measures measuring a minimum of $100,000 within the specified project deadline. Preferably, the selected energy efficiency measures shall be implemented before the end of 2011, but may extend into 2012 in compliance with the City of Houston EEIP deadlines.
- .
- A customer must sign a Building Owner Document (BOD), issued by the Program Administrator. This is an agreement between the customer and the Program Administrator regarding the scope and terms of the program.

1.3 Facility Requirements

- Applicant's building shall be a minimum of 100,000 square feet (sq. ft.) of commercial office space, although this can be flexible based on the savings potential of the facility.
- The facility must have a high Energy Utilization Index (EUI). This includes Watts /sq. ft/ and kWh /sq. ft.
- All pertinent engineering mechanical design documentation shall be available.
- Pre- and post-installation utility bills and their corresponding occupancy rates shall be available.
- The facility must have motivated in-house operations and maintenance staff that are available to support the project.
- The facility must have the potential for annual energy savings of 15%, which must be demonstrated by each facility through the energy audits to be qualified for the EEIP incentives.

1.4 Cash Rebates /Incentives

Cash incentives may be available through the EEIP offered by the City of Houston for 2011. The EEIP is an initiative of the recently launched Green Office Challenge of Houston. The EEIP offers the potential for incentives to offset 20% of the up-front implementation costs (labor and materials), with the incentives ranging from $20,000 to $200,000 maximum per building upon completion of the project within the deadline and with minimum energy savings achieved. No cash incentives will be available from CenterPoint Energy for participants in the 2011 Technical Services Program.

1.5 Technical Services

CenterPoint Energy will be assisted by Nexant, Inc. to provide technical audit services for the customers. A Professional Engineer (PE) or Certified Energy Manager (CEM) will perform an Energy Audit and make energy conservation recommendations that will project a minimum of 15% energy savings from the baseline for each building. The site visit will be followed by a submitted report with recommended energy conservation measures and associated savings calculations.

1.6 Contact Information

The Technical Services Program's main contact will be as designated below.

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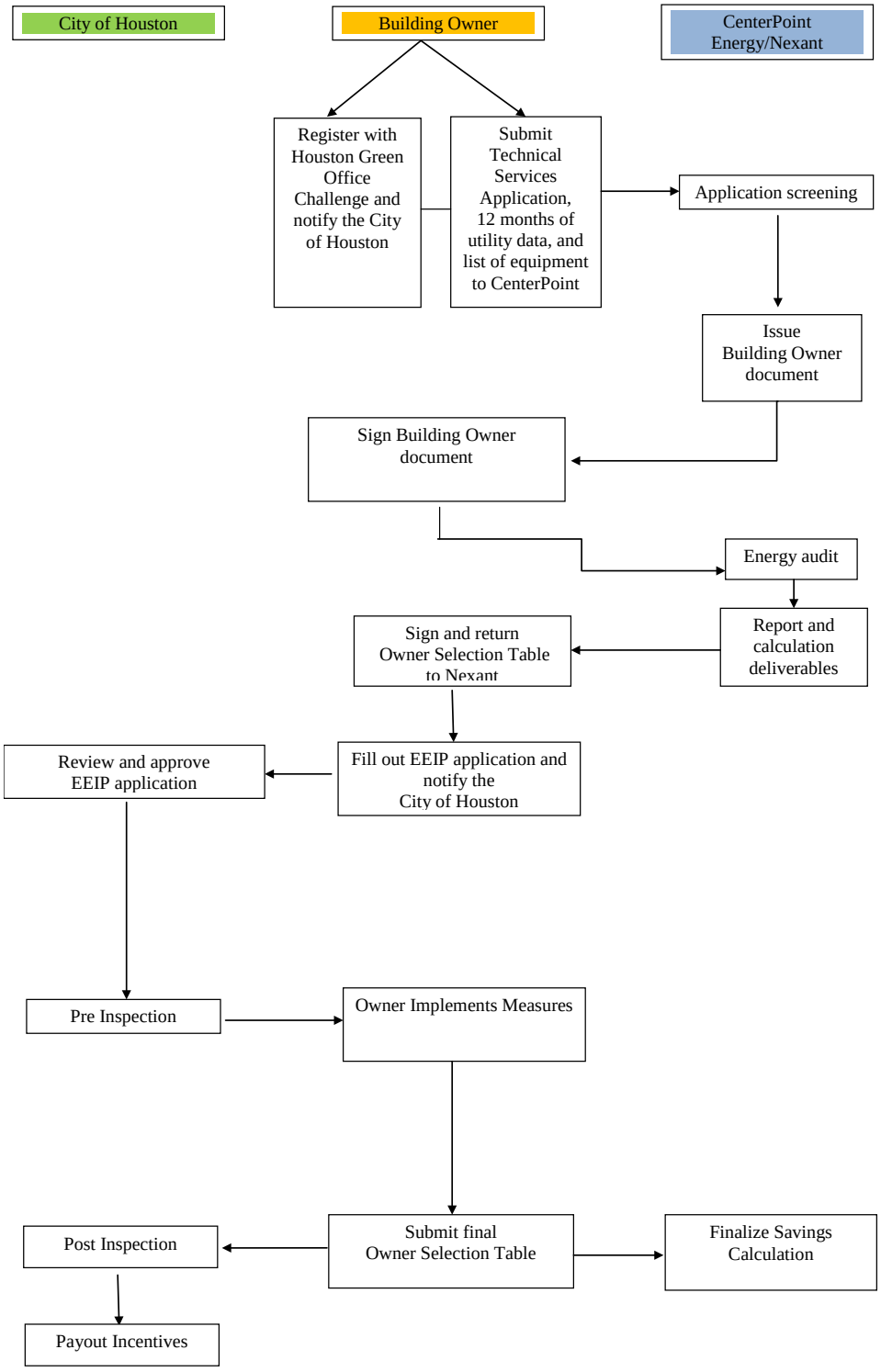
2. Program Process

Program Structure



2.2 Program Process

The Program process follows three basic program steps.

1. Application Screening
2. Energy Audit
3. Implementation

2.2.1 Application Screening

The program begins with the Application Screening phase. The project application is completed by the facility representative and submitted to the Program Administrator or CenterPoint Energy, along with their equipment list and utility bills. The Program Administrator will review the application and perform the initial assessment of the facility to evaluate if it is a good candidate for participation. If the application is accepted, all documents pertaining to facility information, (i.e., facility drawings, occupancy hours, operating hours, etc.) will be required. Upon project approval, the customer must sign a BOD with the PA.

Deliverables

- Signed application
- Fourteen (14) months of utility and natural gas bills in MS Excel Format
- ESID number (located on electric bill)
- Facility documents submitted to PA upon request
- Signed BOD if application is accepted.

2.2.2 Energy Audit

Overview

During this stage, the PA will commission a comprehensive energy audit. This audit will be supervised by a PE or CEM. The audit report will include a detailed description of the facility and its current equipment and system operations. It will include recommended energy conservation measures (ECMs) and other improvements, annual energy and electricity cost savings projections, implementation cost estimates and a simple payback. The report will contain the assumptions and detailed calculations to support the recommendations.

Steps

The auditor will follow the steps below during the site visit.

- Define customer's requirements. The expectations and interest of the building owner in comfort improvements, utility cost reductions and maintenance cost reductions will be discussed and documented in detail.
- Gather data to assess equipment operation. Engineers may take preliminary measurements of equipment operating parameters. Collect any available measured whole building level or sub-metered energy consumption data from stand-alone meters or the building automation system.
- Identify the preliminary ECMs and estimate the peak period demand savings and energy savings.
- Deliver an energy audit report.
- Review the results of the audit report with the customer.

Data Collection

- Existing system conditions
- Existing operational and maintenance schedules
- Existing comfort conditions
- Existing energy performance
- Energy efficiency projects of interest to the customer

Potential Energy Conservation Measures

Most energy conservation measures, in retrofit construction applications, that reduce electric energy consumption and/or summer daytime peak electric demand are eligible for the TSP. However, the facility assessment provided with the TSP will also specify other measures that offer energy efficiency improvements at the facility. Therefore, the auditor might propose the inclusion of any measures in the energy audit report that meets the following requirements:

- Measures may produce a potential electric demand reduction during the peak summer period or may reduce energy consumption, or may produce both peak demand and energy savings.
- Measures must produce savings through an increase in energy efficiency or a substitution of another energy source for electricity supplied through the transmission and distribution grid.
- Measures must exceed minimum equipment standards as established in the Program Manual (located in the Appendix).
- Measures may provide for self-generation through the use of renewable technologies, such as

  - Solar
  - Wind
  - Geothermal
  - Hydroelectric
  - Wave/tidal
  - Biomass

Some typical capital investment and retro-commissioning/system optimization measures that are eligible for the TSP are listed below as an example.

a. Typical deemed capital measures (refer to Table 1**)**

- Equipment replacements (chillers, packaged cooling units, cooling towers and compressors)
- Fan and pump motor efficiency upgrades
- High efficiency indoor and outdoor lighting upgrades (T12 to T8's, incandescent to CFL's, adding lighting controls, etc.)
- Adding window films
- Roofing replacements
- Air cooling and refrigeration compressor replacements
- Renewable technologies (solar, wind, tidal, geothermal, etc.)

b. Typical custom measures

- Re-scheduling of HVAC systems (AHU's, chillers, pumps, etc.)

- Balancing of HVAC systems
- Optimization control of HVAC (pressure resets, temperature resets, etc.)
- Installing lighting controls (occupancy sensors, daylighting, etc)
- Outside air optimization (outside air reduction, Demand Control Ventilation, etc.)
- HVAC system and building repairs (compressed air, AHU, etc.)
- Variable speed drive (VSD) installations on motors (cooling tower fans, CHW pumps, AHU fans, etc.)

The energy audit may include other miscellaneous measures that are not eligible for other CenterPoint programs, but that may be eligible for the City of Houston's EEIP. These miscellaneous measures may include operations & maintenance (i.e., AHU filter change-outs, cooling coil cleaning), reduced plug load, etc. Ineligible measures will not be included in the energy audit, such as those that result in negative environmental or health effects, and those that involve fuel switching to electric.

Savings Calculation Methodology

For the 2011 TSP, the demand and energy savings resulting from a project are determined through either deemed or custom savings estimation approach.

Deemed Approach

Deemed approach refers to a savings estimation approach that is based on pre-approved assumptions and calculation methods, and does not require short-term testing or long-term metering. Instead, demand and energy savings are stipulated based on evaluation data from past demand side management (DSM) programs or other publicly available industry data. This data is used to make assumptions about typical operating characteristics, manufacturer's nameplate efficiency data, and types of equipment likely to be installed. The deemed savings approach is appropriate for energy efficiency measures for which savings are relatively certain.

The eligible measures that fall under this category are given below in Table 1, and the peak demand and annual energy savings calculation for each of these measures are outlined in the Appendix. These assumption and calculation methods have been approved by the Public Utilities Commission of Texas.

The energy conservation measures that are identified through the TSP and are designated by the PA as utilizing the deemed approach will not be eligible for CenterPoint Program incentives. However, the customer may apply to the City of Houston's EEIP for incentives in that program for these measures.

Table 1 – Deemed Measures

Deemed Measures
Chiller replacement
Packaged cooling unit replacement
Fan and pump motor efficiency upgrades
Indoor and outdoor lighting upgrades
Lighting controls to reduce operating hours
Lighting equipment upgrade
Roofing replacement
Window films installation

Custom Approach

Any eligible energy conservation measure that does not fall into the deemed savings approach will be defined as a custom measure, and the demand and energy consumption reduction will be estimated through a custom approach. The custom measure may be either capital expenditure type or non-capital expenditure type. CenterPoint has defined the peak period as weekdays from June 1 to September 30, between the hours of 1:00 PM and 7:00 PM, excluding Independence Day and Labor Day, resulting in a total of 516 hours for the year 2011. The peak demand reduction of capital expenditure custom measures is defined as the maximum 1-hour demand reduction that occurs during the peak period. The peak demand reduction of non-capital expenditure custom measures is defined as the average demand reduction that occurs during the peak period.

Table 2 - 2011 Peak Hour Period

Year 2011			
Month	**Number of days**	**Peak Period : M:F 1:00 PM to 7:00 PM (hrs per day)**	**Peak Period Hours**
June	22	6	132
July	20	6	120
August	23	6	138
September	21	6	126
Total	**86**		**516**

Equation 1

$$Peak\ Demand\ Reduction\ (kW) = \frac{Energy\ Savings\ during\ the\ "peak\ period"\ in\ kWh}{Peak\ period\ Hours}$$

Example

A building has 1 large outside-air handling unit, with a 100 HP fan motor. The systems in the building are turned on between 6:00 am – 9:00 pm Sunday through Saturday, all-year-round. The proposed measure will be to turn off the outside-air handling unit at 6:00 pm, to coincide with the occupancy in the building. This will result in a total reduction of 3 hours per day annually, and 1 hour per day during the peak period. The motor load factor is 80%.

Equation 2

$$Annual\ Energy\ Savings = Fan\ horsepower\ *\ 0.746\frac{kW}{hp} *\ Load\ Factor\ *\ Total\ Hours/Day\ Reduced\ *Number\ of\ Days$$

$$100\ hp * 0.746 * 0.8 * 3 * 365 = 65{,}350\ kWh$$

*Energy Savings during Peak period = Fan horsepower * 0.746 kW/hp * Load Factor * Hours/Day Reduced during peak period * Number of Days in the Peak Period*

100 hp 0.746 *0.8*1*86= 5,132.5 kWh*

Peak Demand Reduction due to the Fan = Energy Savings during Peak period / Total Hours in Peak Period

=5,132.5 kWh/516 hrs = 9.95 kW

Owner Selection Table

The owner is expected to review and complete the Owner Selection Table (OST). The owner will designate the measures that they have implemented or intend to implement during the project. The owner will sign the completed OST and return it to the PA. The owner then completes and submits the EEIP application form and gets approval from the City of Houston's Program. Pre-inspection will then be performed by the City of Houston's representative.

2.2.3 Implementation

Completing the implementation is the responsibility of the building owner. The owner confirms that the energy conservation measures have been implemented as recommended by the energy audit report, and submits the final signed owner selection table to the PA. The owner also must submit a detailed accounting of actual cost of the project. Post inspection and verification will be the responsibility of the City of Houston EEIP program. The EEIP incentives will be based on several factors, including the total project costs, completion of project within the deadline, achieving minimum energy savings, etc.

Incentives

CenterPoint Energy is offering the specified energy auditing services in lieu of cash incentives for this program. Energy efficiency measures identified in TSP are not eligible to receive incentives from other CenterPoint programs. However, cash incentives may be available through the City of Houston's 2011 EEIP for implementation of energy efficiency measures identified by the TSP audit. EEIP participants may be eligible to receive cash incentives to offset 20% of the implementation costs (labor and materials), if all of the conditions for the EEIP have been met (i.e., implemented measures exceed a total cost of $100,000, minimum of 15% of energy consumption savings is achieved, timely completion, etc.). The owner is responsible for their participation in the EEIP program, including adherence to EEIP regulations, obtaining EEIP incentives, etc.

Project Timeline

The duration of a typical TSP project is anticipated to be approximately 2 – 4 months from application submittal to audit report submittal. The summary of the length of each milestone is given below.

The sample timeline for completion of a project under the TSP is given below in Table 3.

Sample Energy Audit Phase

Table 3 - Technical Services Process Timeline

Dates	Activity and/or Milestone
4/15/11	Owner submits TSP application and PA screens it
4/29/11	Owner reviews and signs the BODs
5/6/11	Kick-off meeting
5/6/11 – 5/13/11	On-site interviews, data collection, field inspection, measurements
5/17/11 – 6/20/11	Calculate savings, prepare energy audit report
6/21/11	**PA issues energy audit report to the customer**
6/28/11	PA meets with owner to review report results
6/28/11 – 7/5/11	Owner evaluates and selects ECMs to be implemented, and signs OST

Appendix

Capital Upgrade measures

Lighting Efficiency and Controls

These measures include replacement of existing lamps and ballasts with new energy efficient lamps and ballasts. Deemed savings are based on coincident loading factors and changes in lighting load as determined using standard lighting fixture wattage values listed in the CenterPoint Energy Table of Standard Fixture Wattages. Operating hours have been established for certain building types.

Table 4 - Deemed Operating Hours, Co-incidence Factors for Select Building Types

Building Type	Annual Operating Hours	Coincidence Factor
24-Hour Supermarket/Retail	6,900	95%
College/University	2,085	67%
Education (K-12; no summer session)	2,150	82%
In-Patient Health Care	3,750	60%
Multi-Family Housing, Common Areas	4,772	87%
Non 24-Hour Supermarket/Retail/Restaurant	4,250	95%
Office	3,760	80%
Parking Structure	7,884	100%

Controls

The addition of controls such as occupancy sensors and daylighting are measures eligible for the TSP. Energy Savings resulting from reduced operating hours can be claimed with the installation of controls.

Deemed Control Savings

This method requires the use of the deemed hours and a Power Adjustment Factor (PAF).

Table 5 - List of Power Adjustment Factors (ASHRAE Standard 90.1-1989, Table 6-3)

Control Type	PAF
No Controls	1.00
Daylight controls (DC) – continuous dimming	0.70
DC – multiple-step dimming	0.80
DC – ON/OFF	0.90
Occupancy sensor (OS)	0.70
OS w/DC – continuous dimming	0.60
OS w/DC – multiple-step dimming	0.65
OS w/DC – ON/OFF	0.65

Calculation of Demand and Energy Savings

Appended below are equations relating to peak demand and energy savings calculations.

Equation 3

$$kW_{saved} = \sum_{i=1}^{n} \left(\left(\left(N_{fixture(i)} \times kWfixture(i) \right)_{pre} - \left(N_{fixture(i)} \times kWfixture(i) \right)_{post} \right) \times CF_i \times AC\ factor_1 \right)$$

Equation 4

$$kWh_{saved} = \sum_{i=1}^{n} \left(\left(\left(N_{fixture(i)} \times kWfixture(i) \times PAF_i \times Hours_{annual,i} \right)_{pre} - \left(N_{fixture(i)} \times kWfixture(i) \right)_{post} \times PAF_i \times Hours_{annual,i} \right) \times AC\ factor_2 \right)$$

Where:

$N_{fixture(i)}$ = Number of fixtures in line item i (pre or post)

$kW_{(fixture\ i)}$= Deemed fixture wattage from standard wattage table for fixture type listed (pre or post).

CF_i = Coincident demand factor based on input

PAF_i = Power adjustment factors based on controls type

$AC\ factor_1$ = If space is conditioned, value is 1.1. If unconditioned, value is 1.

$AC\ factor_2$= If space is conditioned, value is 1.05. If unconditioned, value is 1.

Replacement of Cooling Equipment

Overview

Cooling equipment retrofits involve the replacement of the existing equipment with high-efficiency equipment. Potential qualifying equipment includes:

- Unitary air conditioners (DX, air-cooled, evaporative, or water-cooled)
- Heat pumps (air-cooled, evaporative, or water-cooled)
- Chillers (air-cooled centrifugal, water-cooled centrifugal, air-cooled screw, etc.)
- Compressors (centrifugal, screw, reciprocating)
- Fuel switching from electric to gas engine-driven cooling equipment

The retrofits must have the following characteristics:

- The newly installed electric cooling equipment capacity must be within 80% to 120% of the replaced electric cooling equipment capacity.
- The newly installed electric cooling equipment must not be redundant, backup or off –peak use only equipment.
- No additional measures are being installed that directly affect the operation of the cooling equipment (i.e., control sequences, cooling towers, and condensers).

Savings Methodology

The deemed savings approach to measurement for cooling equipment is applicable to both one-for-one equipment replacement as well as equipment replacement involving a change in equipment type (e.g., changing from air-cooled DX units to a water-cooled chiller). An air-cooled to water-cooled equipment measure requires an additional step to account for the auxiliary devices to support a water-cooled chiller.

Projects that are eligible to use the deemed savings approach must meet the following requirements:

- The existing and proposed cooling equipment are electric
- The Cooling Equipment is **not used** for process loads

Calculation

Equation 5

$$kW_{saved} = Capacity \times (a \times \eta_{baseline} - b \times \eta_{post})$$

$$kWh_{saved} = Capacity \times (c \times \eta_{baseline} - d \times \eta_{post})$$

Where:

Capacity = the rated equipment cooling capacity at ARI standard conditions, ton

a =the demand coefficient from table 3.2j in the Appendix for the appropriate climate zone, building type and baseline equipment type

$\eta_{baseline}$ =efficiency of the baseline equipment, $^{kw}/_{ton}$

b =the demand coefficient from table 3.2j in the Appendix for the appropriate climate zone, building type and retrofit equipment type

η_{post} =full load rated efficiency of the installed equipment at standard ARI conditions, $^{kw}/_{ton}$

c =the energy coefficient from table 3.2j in the Appendix for the appropriate climate zone, building type and baseline equipment type

d =the energy coefficient from table 3.2j in the Appendix for the appropriate climate zone, building type and retrofit equipment type

Upgrade to Premium Efficiency Motor

The installed premium efficiency motor must meet the NEMA efficiency standards listed in the table below.

Table 6 - NEMA Full Load Efficiencies

HP	NEMA Full Load Efficiencies (%)					
	1,200 RPM		1,800 RPM		3,600 RPM	
	ODP	TEFC	ODP	TEFC	ODP	TEFC
1	82.50%	82.50%	85.50%	85.50%	77.00%	77.00%
1.5	86.50%	87.50%	86.50%	86.50%	84.00%	84.00%
2	87.50%	88.50%	86.50%	86.50%	85.50%	85.50%
3	88.50%	89.50%	89.50%	89.50%	85.50%	86.50%
5	89.50%	89.50%	89.50%	89.50%	86.50%	88.50%
7.5	90.20%	91.00%	91.00%	91.70%	88.50%	89.50%
10	91.70%	91.00%	91.70%	91.70%	89.50%	90.20%
15	91.70%	91.70%	93.00%	92.40%	90.20%	91.00%
20	92.40%	91.70%	93.00%	93.00%	91.00%	91.00%
25	93.00%	93.00%	93.60%	93.60%	91.70%	91.70%
30	93.60%	93.00%	94.10%	93.60%	91.70%	91.70%
40	94.10%	94.10%	94.10%	94.10%	92.40%	92.40%
50	94.10%	94.10%	94.50%	94.50%	93.00%	93.00%
60	94.50%	94.50%	95.00%	95.00%	93.60%	93.60%
75	94.50%	94.50%	95.00%	95.40%	93.60%	93.60%
100	95.00%	95.00%	95.40%	95.40%	93.60%	94.10%
125	95.00%	95.00%	95.40%	95.40%	94.10%	95.00%
150	95.40%	95.80%	95.80%	95.80%	94.10%	95.00%
200	95.40%	95.80%	95.80%	96.20%	95.00%	95.40%

Savings Calculations

The savings are calculated based on Equations below.

Equation 6

$$kW_{saved} = \ 0.746 \times hp \times \%Load \times CF \times (\frac{1}{\eta_{EPACT}} - \frac{1}{\eta_{NEMA}})$$

$$kWh_{saved} = \ kW_{saved} \times Hours_{annual}$$

kW_{saved} = The kilowatt savings realized during the year

kWh_{saved} = The kilowatt-hour savings realized during the year

hp =The horsepower of the motor

$\%Load$ =Stipulated %load of the motor

CF =Stipulated coincident factor

η_{EPACT}=Baseline efficiency standard. Based on 1992 EPACT standards

η_{NEMA}=New motor efficiency standard. Based on NEMA premium efficiency standards

$Hours_{annual}$= Stipulated Operating hours

Window Films

The installation of window films decreases the window shading coefficient and reduces the solar heat transmitted to the building space. During months when perimeter cooling is required in the building, this measure decreases cooling energy use.

Calculation of Energy Savings

The window film demand and energy savings result from a reduction in demand and energy use of cooling equipment.

The savings estimates rely on tabulated values of solar heat gain factors (SHGF) as published in the 1997 ASHRAE Fundamentals, Chapter 29, Table 17. The ASHRAE data represent the amount of solar radiation that is transmitted through single-pane clear glass for a cloudless day at 32^{o} N Latitude for the 21st day of each month by hour of day and solar orientation. The solar gain values are translated to electric energy savings by considering the cooling equipment efficiency. In the calculation, the cooling equipment efficiency equals the rated efficiency of the installed equipment or the ASHRAE Standard 90.1-1989 minimum cooling equipment efficiency (see the Standard Cooling Equipment Tables – Appendix 3.1), whichever is more efficient.

To determine the coincident, peak summer demand savings associated with window films, the highest, hourly, ASHRAE SHGF value that occurs during the summer peak period is identified for each of the south and west building orientations. The available data nearest the CenterPoint Energy service territory are presented in Table 6. The building demand savings are determined from the maximum of these peak SHG values for the applicable window orientations.

To determine cooling energy savings associated with window films, the ASHRAE SHGF data are aggregated into daily totals for weekdays during the months of April through October. These totaled, SHG values are presented in Table 7. In the table, orientations that are symmetrical relative to the southern sky have the same SHGF values.

Table 7 - Solar Heat Gain Determined for 32 deg N Latitude

Orientation	Solar heat gain, a.k.a SHG (Btu/ft^2-year)	Peak hour solar heat gain, a.k.a. SHGF (Btu/hr-ft^2-year)
SE	158,323	59
SSE	133,894	119
S	120,095	164
SSW	133,894	189
SW	158,323	219
WSW	168,978	228
W	162,388	220
WNW	139,995	208
NW	106,876	176

The data from Table 7 are used to determine the demand and energy savings associated with the window film measure using the equations below. Equation below presents the demand savings calculation. Demand savings are determined for the window orientation that results in the highest savings. Demand savings by orientation are not additive.

Equation 7

$$\mathrm{kW_{saved}} = \max_{i} \frac{\mathrm{A_{film,i}} \times \mathrm{SHGF_i} \times (\mathrm{SC_{pre,i}} - \mathrm{SC_{post,i}})}{\text{Conversion Factor} \times \mathrm{COP}}$$

$$\mathrm{kWh_{saved}} = \sum_{i=1}^{n} \frac{\mathrm{A_{film,i}} \times \mathrm{SHG_i} \times (\mathrm{SC_{pre,i}} - \mathrm{SC_{post,i}})}{\text{Conversion Factor} \times \mathrm{COP}}$$

Where:

kW_{saved} = The peak kilowatt savings realized during the year

kWh_{saved} = The kilowatt-hour savings realized during the year

$A_{film,i}$= Area of window film applied to orientation i, ft2

$SHGF_i$= Peak solar heat gain factor for orientation i of interest from Table 3.1c on vertical glazing at 32N latitude, Btu/hr-ft2-yr

SHG_i= Peak solar heat gain for orientation i of interest from Table 3.1d on vertical glazing at 32N latitude, Btu/ft2-yr

$SC_{pre,i}$= Shading coefficient for existing glass/interior-shading device applied to orientation i

$SC_{post,i}$= Shading coefficient for new glass/interior-shading device applied to orientation i

COP= Cooling equipment COP or SEER based on ASHRAE Standard 90.1-1989 or actual COP of equipment, whichever is greater

Standard Cooling Equipment Tables

Overview

This document contains reference data for estimating demand and energy savings for cooling equipments. Cooling equipment installed under the program must exceed the minimum new equipment efficiency standards shown in the tables. In addition, the minimum baseline efficiencies define the baseline for calculating energy savings. For the following types of cooling equipment, baseline efficiency ratings are provided in Tables 8 through Table 15 below:

- Unitary air conditioners and heat pumps (air cooled, evaporatively cooled, or water cooled)
- Packaged-terminal air conditioners and heat pumps
- Room air conditioners and heat pumps
- Water-source and ground-water source heat pumps
- Water- and air-cooled water chilling packages

Tables 8 through Table 15 are based on American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 90.1-1989 and ASHRAE Standard 90.1-1999. The tables present the minimum efficiencies of particular types of cooling equipment. The performance standard data in these tables should be used to determine the rated baseline equipment efficiencies.

The baseline efficiency for existing equipment shall be established as the 1989 standard efficiency. The baseline for equipment for which rating conditions are not provided shall be defined as the energy consumption of the actual existing equipment.

Table 16 of this document presents the cooling degree-days (CDD) for a weather station located in the CenterPoint Energy distribution service territory. Cooling degree-day data are used to normalize metered energy consumption to a typical meteorological year (TMY2).

Table 17 provides the coefficients necessary to complete the air-conditioning equipment deemed savings calculation

Table 8 - Standard rating conditions and minimum performance for unitary air conditioners and heat pumps, air cooled, electric, <135,000 Btu/hr (< 11.25 tons) capacity, - Except packaged terminal and room air conditioners.

Mode	Cooling Capacity Btu/hr	Cooling Capacity tons	Rating Condition, °F db	Type	Baseline Performance Standard1	Minimum Performance Standard2
Cooling mode	< 65,000	< 5.42	Seasonal	Split	13 SEER12a	13 SEER
	< 65,000	< 5.42	Seasonal	Packaged	13 SEER12a	13 SEER
	≥ 65,000 & < 135,000	≥ 5.42 & < 11.25	95	Packaged and split	8.9 EER	11.0 EER†

† Deduct 0.2 from the required EERs for units with a heating section other than electric resistance heat.

Equation 8

$$Performance\left(\frac{kW}{ton}\right) = \frac{1}{EER}\left(\frac{Watt \cdot hr}{Btu_{out}}\right) * 12{,}000\left(\frac{Btu_{out}}{ton \cdot hr}\right) * \frac{1}{1{,}000}\left(\frac{kW}{Watt}\right) = \frac{12}{EER}\left(\frac{kW}{ton}\right)$$

Table 9 - Standard rating conditions and minimum performance for unitary air conditioners and heat pumps – evaporatively cooled, electric, <135,000 Btuh (< 11.25 tons) cooling capacity.

Cooling Capacity Btuh	Cooling Capacity tons	Rating indoor air °F db / °F wb	Rating outdoor air °F db/°F wb	Baseline Performance Standard3	Minimum Performance Standard4
< 65,000	< 5.42	80/67	95/75	9.3 EER	12.1 EER
≥ 65,000 & < 135,000	≥ 5.42 & < 11.25	80/67	95/75	10.5 EER†	11.5 EER†

† Deduct 0.2 from the required EERs for units with a heating section other than electric resistance heat.

1 Reference: ASHRAE Standard 90.1-1989, Table 10-1. 12aNew Federal guidelines

2 Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.A and Table 6.2.1.B.

3 Reference: ASHRAE Standard 90.1-1989, Table 10-2.

4 Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.A.

Table 10 - Standard rating conditions and minimum performance for water-cooled air conditioners and heat pumps, electric, <135,000 Btuh (< 11.25 tons) capacity.

Equipment	Cooling capacity, BTU/h	Rating Condition, air °F db / °F wb	Rating Condition, entering water °F	Baseline Performance Standard5	Minimum Performance Standard6
Water cooled heat pumps	< 65,000	80/67	85	9.3 EER	-
			86	-	12.0 EER†
	≥ 65,000 and <135,000	80/67	85	10.5 EER	-
			86	-	12.0 EER
Ground water cooled heat pumps	< 135,000	80/67	70	11.0 EER	-
			59	-	16.2 EER
Water cooled unitary air conditioners	< 65,000	80/67	85	9.3 EER	-
			86	-	12.1 EER
	≥ 65,000 and <135,000	80/67	85	10.5 EER	-
			86	-	11.5 EER††

† For units with capacities less than 17,000 Btu/h, the minimum efficiency is 11.2 EER.

†† Deduct 0.2 from the required EERs for units with a heating section other than electric resistance heat.

5 Reference: ASHRAE Standard 90.1-1989, Table 10-3 and Table 10-5.

6 Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.B.

Table 11Standard rating conditions and minimum performance for packaged terminal air conditioners and heat pumps, air-cooled, electric

Mode	Rating condition, outside air °F db	Baseline Performance Standard†7	Minimum Performance Standard8
Cooling	95	10-(0.16 * Cap/1000) EER	12.5-(0.213 * Cap/1000) EER
Cooling	82	12.2-(0.20 * Cap/1000) EER	-

† Cap is the rated cooling capacity of the unit in Btu/h. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation

7 Reference: ASHRAE Standard 90.1-1989, Table 10-4A.

8 Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.D.

Table 12 - Standard rating conditions and minimum performance for room air conditioners and room air conditioner heat pumps, electric

Category	Capacity, BTUH	Baseline performance standard (EER)9	Minimum Performance Standard (EER)10
Without reverse cycle and with louvered sides	< 6,000	8.0	9.7
	≥ 6,000 and <8,000	8.5	9.7
	≥ 8,000 and <14,000	9.0	9.8
	≥ 14,000 and <20,000	8.8	9.7
	≥ 20,000	8.2	8.5
Without reverse cycle and without louvered sides	< 6,000	8.0	9.0
	≥ 6,000 and <20,000	8.5	8.5
	≥ 20,000	8.2	8.5
With reverse cycle and with louvered sides	< 20,000	8.5	9.0
	≥ 20,000	8.5	8.5
With reverse cycle and without louvered sides	< 14,000	8.0	8.5
	≥ 14,000	8.0	8.0

9 Reference: ASHRAE Standard 90.1-1989, Table 10-4B.

10 Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.D.

Table 13 - Baseline and minimum performance standards for large unitary air conditioners and heat pumps, electric, ≥ 135,000 Btuh (≥11.25 tons) capacities

Equipment Type	Cooling Capacity		Baseline Performance Standard11		Minimum Performance Standard12	
	Btuh	tons	EER	kW/ton	EER	kW/ton
Air cooled air conditioners	≥ 135,000 & <240,000	≥ 11.25 & < 20.00	8.5	1.412	11.0†	1.091
	≥ 240,000 & <760,000	≥ 20.00 & < 63.33	8.5	1.412	10.0†	1.200
	≥ 760,000	≥ 63.33	8.2	1.463	9.2†	1.304
Water or evaporatively cooled air conditioners	≥ 135,000	≥ 11.25	9.6	1.250	11.0	1.091
Air cooled heat pumps	≥ 135,000 & <240,000	≥ 11.25 & < 20.00	8.5†	1.412	10.6†	1.132
	≥ 240,000 & <760,000	≥ 20.00 & < 63.33	8.5†	1.412	9.5†	1.263
	≥ 760,000	≥ 63.33	8.7†	1.379	9.0†	1.333
Air cooled condensing units	≥ 135,000	≥ 11.25	9.9	1.212	10.1	1.188
Water or evaporatively cooled condensing units	≥ 135,000	≥ 11.25	12.9	0.930	13.1	0.916

† Deduct 0.2 from the required EERs for units with a heating section other than electric resistance heat.

Equation 9

$$Performance\left(\frac{kW}{ton}\right) = \frac{1}{EER}\left(\frac{Watt \cdot hr}{Btu_{out}}\right) * 12{,}000\left(\frac{Btu_{out}}{ton \cdot hr}\right) * \frac{1}{1{,}000}\left(\frac{kW}{Watt}\right) = \frac{12}{EER}\left(\frac{kW}{ton}\right)$$

11 Reference: ASHRAE Standard 90.1-1989, Table 10-6.

12 Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.A and Table 6.2.1.B.

Table 14 - Baseline and minimum performance standards for water chilling packages, electric.

Equipment Type	Cooling Capacity (tons)	Baseline Performance Standard[13]		Minimum Performance Standard[14]	
		COP	kW/ton	COP	kW/ton
Water cooled, positive displacement (rotary screw, scroll)	< 150	3.80	0.926	4.45	0.790
	≥ 150 and <300	4.20	0.837	4.90	0.718
	≥ 300	4.70	0.748	5.50	0.639
Water cooled, centrifugal	< 150	3.80	0.926	5.00	0.703
	≥ 150 and <300	4.20	0.837	5.55	0.634
	≥ 300	4.70	0.748	6.10	0.577
Air cooled with condenser	< 150	2.70	1.303	2.80	1.256
	≥ 150	2.50	1.407	2.80	1.256
Air cooled without condenser	All	3.10	1.135	3.10	1.135

Equation 10

$$Performance\left(\frac{kW}{ton}\right) = \frac{1}{COP}\left(\frac{Btu_{in}}{Btu_{out}}\right) * 12{,}000\left(\frac{Btu_{out}}{ton \cdot hr}\right) * \frac{1}{3{,}412}\left(\frac{kWh}{Btu_{in}}\right) = \frac{3.517}{COP}\left(\frac{kW}{ton}\right)$$

13 Reference: ASHRAE Standard 90.1-1989, Table 10-7.

14 Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.C.

Table 15 - Standard rating conditions and minimum performance for water chilling packages, gas absorption

Equipment Type	Cooling Capacity	Baseline Performance Standard15 (COP)	Minimum Performance Standard16 (COP)
Air-cooled absorption, single-effect	All capacities	0.48	0.60
Water-cooled absorption, single-effect	All capacities	0.60	0.70
Absorption double effect, indirect-fired	All capacities	0.95	1.00
Absorption double effect, direct-fired	All capacities	0.95	1.00

Table 16 - TMY2 Cooling Degree Days (base 65) for the CenterPoint Energy service territory

Weather Station	WBAN No.	CDD65 (^{o}F day)
Houston	12960	2,810

15 Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.C.

16 Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.C.

Table 17 - Deemed savings coefficients for the Houston, TX climate for various building types and equipment types.

Building Type	Demand Coefficient			Energy Coefficient		
	Air Cooled Chiller	Water Cooled Chiller	DX Air Cooled	Air Cooled Chiller	Water Cooled Chiller	DX Air Cooled
College	0.80	0.84	0.85	1,858	2,099	2,175
Convenience			0.88			4,168
Fast Food			0.87			3,365
Grocery		0.88	0.87		3,012	2,935
Hospital	1.05	0.85		2,781	3,172	
Hotel	0.80	0.88	0.84	1,831	1,981	2,266
Motel			0.84			2,404
Nursing Home	0.80	0.84	0.84	1,960	2,172	2,368
Large Office	0.81	0.90	0.85	2,501	2,786	2,750
Small Office	0.81	0.87	0.85	1,860	1,990	2,158
Public Assembly	0.81	0.86	0.86	2,264	2,482	2,559
Restaurant			0.86			2,548
Religious Worship	0.83	0.84	0.87	1,474	1,594	2,028
Retail	0.80	0.84	0.84	2,003	2,162	2,381
School	0.80	0.84	0.85	1,280	1,489	1,639
Service			0.87			2,429
Warehouse	0.84	0.87	0.88	1,534	1,673	2,248

Table of Standard Motor Efficiencies Table

Overview

This document contains reference data for estimating demand and energy savings for energy efficient motors and related measures. For motors installed under the program, the equipment must exceed these minimum efficiency standards. In addition, the minimum efficiencies define the baseline for calculating demand and energy savings.

The efficiencies of permanently wired, poly-phase motors that are at least one (1) horsepower in size and that are used for fan, pumping, and conveyance applications are defined in Table 18. **Table 18** is based on ASHRAE Standard 90.1m-1995. Note, however, that the following motors are exempt from these requirements:

- Motors in appliances.
- Refrigeration compressor motors.
- Multi-speed motors.
- Motors that are used as components of cooling equipment where the motors are part of the efficiency ratings listed in the Standard Cooling Equipment Tables.

The efficiency values given in Table 18 should be used to determine the equipment baseline. Equipment installed under the TSP must be more efficient than the standards shown in order to be eligible for incentives.

Table 18 - Minimum nominal full-load motor efficiency for single speed poly-phase motors

Motor	Horsepower	2-Pole	4-Pole	6-Pole	8-Pole
Open	1.0	--	81.5	78.5	72.0
	1.5	81.5	82.5	82.5	74.0
	2.0	82.5	82.5	84.0	84.0
	3.0	82.5	85.5	85.5	85.5
	5.0	84.0	86.5	86.5	86.0
	7.5	86.5	87.5	87.5	87.5
	10.0	87.5	88.5	89.5	88.5
	15.0	88.5	90.2	89.5	88.5
	20.0	89.5	90.2	90.2	89.5
	25.0	90.2	91.0	91.0	89.5
	30.0	90.2	91.7	91.7	90.2
	40.0	91.0	92.4	92.4	90.2
	50.0	91.7	92.4	92.4	91.0
	60.0	92.4	93.0	93.0	91.7
	75.0	92.4	93.6	93.0	93.0
	100.0	92.4	93.6	93.6	93.0
	125.0	93.0	94.1	93.6	93.0
	150.0	93.0	94.5	94.1	93.0
	200.0	94.1	94.5	94.1	93.0
Enclosed	1.0	74.0	81.5	78.5	72.0
	1.5	81.5	82.5	84.0	75.5
	2.0	82.5	82.5	85.5	81.5
	3.0	84.0	86.5	86.5	82.5
	5.0	86.5	86.5	86.5	84.0
	7.5	87.5	88.5	88.5	84.0
	10.0	88.5	88.5	88.5	87.5
	15.0	89.5	90.2	89.5	87.5
	20.0	89.5	90.2	89.5	88.5
	25.0	90.2	91.7	91.0	88.5
	30.0	90.2	91.7	91.0	90.2
	40.0	91.0	92.4	92.4	90.2
	50.0	91.7	92.4	92.4	91.0
	60.0	92.4	93.0	93.0	91.0
	75.0	92.4	93.6	93.0	92.4
	100.0	93.0	94.1	93.6	92.4
	125.0	94.1	94.1	93.6	93.0
	150.0	94.1	94.5	94.5	93.0
	200.0	94.5	94.5	94.5	93.6

Table of Standard Fixture Wattages

Overview

The Table of Standard Fixture Wattages contains reference data for estimating demand and energy savings in the Technical Services Program for lighting measures. The Table assigns identification codes and demand values (watts) to common fixture types (fluorescent, incandescent, HID, LED, etc.) used in commercial applications. The Table wattage values for each fixture type are averages of various manufacturers' laboratory tests performed to ANSI test standards. By using standardized demand values for each fixture type, the Table simplifies the accounting procedures for lighting equipment retrofits.

CenterPoint Energy posts updated versions of the Table on the program website at http://www.centerpointefficiency.com as new fixtures are added.

Table

The Table is subdivided into fixture types such as linear fluorescent, compact fluorescent, mercury vapor, etc, with each subdivision sorted by fixture code. Each record, or row, in the Table contains a fixture code, which serves as a unique identifier. Each record also includes a description of the fixture, the number of lamps, the number of ballasts if applicable, and the fixture wattage. A legend explains the rules behind the fixture codes.

The fixture codes and the demand values listed in the watt/fixture column in the Table of Standard Fixture Wattages must be used in calculating energy and demand savings for any lighting efficiency project in the Technical Services.