

LADWP RCx

Measure Specific Data Collection Forms

Standard Version

Notes:

These data collection forms present all the data requirements for all the BOA Tool measures. Using these forms, you will gain an understanding of the LADWP RCx measures and the BOA Tool requirements. You do not need to complete all of the forms—only those that pertain to the measures that the customer is pursuing as part of their RCx project.

Use these forms to collect the relevant data, then enter the data into the BOA Tool to calculate the energy savings from the proposed measure.

Completing a form does not guarantee acceptance of the measure into the program—a successful pre-inspection verification site visit is required in order for a measure to be accepted into the program. Note that you will not be compensated for materials purchased or work performed prior to the site receiving an official "Authorization to Proceed" from the program administrator.

General Instructions

Multiple Equipment, Measures, or Building Types

Wherever possible, multiple pieces of similar equipment, systems or spaces that have similar optimization measure characteristics should be grouped into one measure, for utility program reporting purposes. For example, if five air handlers are found to have their economizer dampers stuck at 60% open and another five have their dampers stuck 40% open, all ten air handlers should be grouped into one economizer measure.

However, in this example situation you would use the economizer tab in the BOA Tool twice—once for the 60% open air handlers and again for the 40% open air handlers. For instances of multiple pieces of equipment with different operating characteristics, the measure tabs can be copied and renamed as needed.

If the grouped measure savings, calculated using the tool for each piece of equipment and then summed together, is less than 75,000 kWh or 5,000 therms, then the savings calculated by the tool may be used. Otherwise, a custom analysis may need to be performed. Contact your utility program administrator when questions arise related to calculating savings with the BOA Tool for measures affecting multiple pieces of equipment.

For projects that include multiple building types (e.g., office and retail), select the building type that is applicable to the measures being installed. If the measure mix spans multiple building types, use one BOA Tool workbook for each building type.

Abbreviations

AHU	Air handling unit
BUR	Built up roof
CA	California
CAV	Constant air volume
CHW	Chilled water
CHWST	Chilled water supply temperature
CMU	Concrete masonry unit
CPUC	California Public Utilities Commission
CWST	Condenser water supply temperature
DEER	CPUC's Database for Energy Efficient Resources
DSP	Duct static pressure
DX	Direct expansion (refrigerant)
EPS	Expanded polystyrene insulation
EUI	Energy Use Index
HP	Horsepower
HW	Hot water
IGV	Inlet guide vanes
LO	Lockout
OAT	Outside air temperature
PTAC	Packaged terminal air conditioning units
RTU	Packaged rooftop unit
SAT	Supply air temperature
SF	Supply Fan
VAV	Variable air volume
VFD	Variable frequency drive

Please enter the following general data that is applicable to all projects:

Facility Name: _____ Date: _____
Facility Address: _____ Zip Code: _____
Utility _____ Account _____ Number: _____
Facility Gross Area (ft2): _____ Year Building Constructed: _____

RCx provider information

Name: _____
Company: _____
Address: _____
Email: _____ Phone Number: _____

General system inputs (select one from each group)

Building Type:
Office Hotel Education - Secondary
Retail Hospital Education – University

Primary Ventilation System Type:
VAV AHU / RTU w/ zone reheat Heat Pump
Single zone CAV AHU / RTU

Primary Cooling System Type:
Water-Cooled Chiller(s) Direct Expansion (DX)
Air-Cooled Chiller(s) Heat Pump Water Loop

HVAC Heating System Type:
Natural Gas Water Boiler Electric (Boiler or Coils)
Natural Gas Steam Boiler Gas Furnace, Heat Pump

Baseline Building Energy Use

Baseline Annual Electric Use (kWh): _____
Baseline Annual Gas Use (Therms): _____

Reduce Supply Fan Operating Schedule

The "Reduce Supply Fan Operating Schedule" measure relates to reducing the number of air handler operating hours to better match the building operating schedule.

BOA Tool tab: SF Schedule (Supply Fan Schedule).

Applicable Baseline Condition

- The air handler is operating for more hours than needed.

Applicable Measure

- Reduce the number of air handler operating hours.

Measure Tool Applicability

The tool applies to various types of air handling systems, depending on the building type. Following are the building types and related air handling systems supported by the tool:

- Education - Secondary School: DX (packaged) unit CAV, chilled water VAV
- Education - University: Chilled water VAV
- Hotel: Chilled water VAV, DX (packaged) unit VAV, DX (packaged) unit CAV. Tool does not apply to guest rooms.
- Office: Chilled water VAV, chilled water CAV, DX (packaged) unit VAV, DX (packaged) unit CAV
- Hospital: Chilled water VAV, chilled water CAV, DX (packaged) unit VAV, DX (packaged) unit CAV
- Retail: Chilled water VAV, DX (packaged) unit VAV, DX (packaged) unit CAV

Note that for some building types, there are additional HVAC system options beyond those indicated on the "Building Types" worksheet.

The tool applies to draw-through chilled water VAV systems, blow-through DX (packaged) VAV systems, and blow-through CAV systems (chilled water and DX). For VAV systems, the tool applies to systems that use a VFD to modulate fan speed to vary airflow. The tool does not apply to other arrangements.

The tool applies to reductions in operating hours up to the following values:

- 3,872 hours / year for retail
- 5,328 hours / year for office
- 2,208 hours / year for hotels
- 3,256 hours / year for education

For chilled water systems, the tool applies to systems that use a water-cooled chiller system with constant speed chillers and chilled water pumps. For VAV systems, the tool applies to gas-fired 80% efficient heating water boilers with constant speed pumps. For DX (packaged) systems, the tool applies to gas-fired 80% efficient packaged equipment.

Measure Data

Select a HVAC system type and enter HP and Hours indicated below.

Chilled Water CAV Chilled Water VAV Package CAV Package VAV

Total Motor HP Affected by Measure _____ Annual Hours Reduced _____

Reduce Lighting Operating Schedule

The "Reduce Lighting Operating Schedule" measure relates to reducing the number of lighting operating hours to better match the building operating schedule.

BOA Tool tab: Lighting Schedule

Applicable Baseline Condition

- The lighting is on for more hours than needed.

Applicable Measure

- Reduce the number of lighting operating hours.

Measure Tool Applicability

This measure applies to all types of typical HVAC systems with natural gas heating, since the lighting savings related to reduced lighting operation is typically much greater than the related HVAC electric energy savings or natural gas penalty. It does not apply to the following space types:

- Lobby / corridor in hotel and university
- Guest rooms in hotel and university
- Clinical (medical) spaces in hospital.

Note that the tool assumes a reduction in lighting across a blend of conditioned space types found in the various building types. For lighting schedule reduction in unconditioned spaces, the calculation is relatively easy and can be performed outside of the tool.

The tool applies to reductions in annual lighting operating hours from zero hours to 8,760 hours. However, if the annual reduction is greater than 6,212 hours (5,304 for the office), the savings at 6,212 hours (5,304 for the office) reduction is used. The tool can be used for a range of connected lighting power densities, from 0 W/sf to 2.5 W/sf.

Use the tool with care when the lighting reduction will vary by season. The tool assumes that the lighting reduction will happen throughout the year, not just during specific seasons. For example, if the lighting schedule reduction occurs only during the wintertime, consider performing custom calculations instead of using the BOA Tool since the type and level of HVAC system interaction will be different than that assumed by the tool. Since the reduction in lighting operation is assumed to take place during off-hours, the DEER peak electric demand savings is assumed to be zero. However, if lighting reduction will occur between 2 pm and 5 pm on weekdays, you are encouraged to calculate the DEER peak electric demand savings outside of this tool. Also, for calculating the annual dollar savings related to monthly demand reduction, you are encouraged to calculate this value outside of this tool as well.

Measure Data

Please enter the total affected lighting kW and annual hours reduced as indicated below.

Total Lighting kW Affected by Measure _____ Annual Hours Reduced _____

Restore Lighting Occupancy Sensors

The "Restore Lighting Occupancy Sensors" measure relates to reducing the number of lighting operating hours to reflect light use only when the space is occupied by restoring malfunctioning occupancy sensors.

BOA Tool tab: Lighting Occ Sensor (Lighting Occupancy Sensor)

Applicable Baseline Condition

- The existing lighting occupancy sensors are malfunctioning.

Applicable Measure

- Restore the occupancy sensors to operational status.

Measure Tool Applicability

This measure applies to all types of typical HVAC systems with natural gas heating, since the lighting savings related to reduced lighting operation is typically much greater than the related HVAC electric energy savings or natural gas penalty. The tool does not apply to unconditioned spaces. It applies to the following space types:

Office: Office (Open Plan), Office (Executive/Private), Corridor, Conference Room, Copy Room (photocopying equipment), Restrooms

Hospital: Laboratory, Medical, Office (General),

Hotel: Office (General), Corridor, Guest Room

University: Classroom / Lecture, Office (General), Computer (Instruc/PC Lab)

For lighting schedule reduction in unconditioned spaces, the calculation is relatively easy and can be performed outside of the tool. The tool can be used for a range of connected lighting power densities, from 0 W/sf to 2.5 W/sf.

The lighting is controlled directly by user or time clock. The measure does not apply to unconditioned spaces. The tool only applies to lighting power densities between 0 W/sf and 2.5 W/sf.

Measure Data

Please select only one from the applicable space type for the sensor project and enter the affected lighting kW:

Office: Open Executive/Private Corridor Conference Copy Restrooms

Hospital: Laboratory, Medical Office (General)

Hotel: Office (General) Corridor Guest Room

University: Classroom/Lecture Office (General) Computer

Total Lighting kW Affected by Measure _____

Adjust Airside Economizers

This measure relates to either raising the dry bulb lockout temperature of an integrated airside economizer system, or restoring proper operation of the outside and return air dampers from a fixed position.

Integrated airside economizer systems allow for 100% outside air when the outside air temperature is between the supply air temperature and the return air temperature, even when mechanical cooling is called for.

BOA Tool tab: Economizer (Airside Economizer)

Applicable Baseline Conditions

- Economizer damper lockout temperature is 55° F, 60° F, or 65° F.
- Dampers are stuck in a fixed position that is drawing in either 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, or 100% outside air.

Applicable Measures

- The economizer damper lockout temperature is raised to at least 70F.
- Proper modulating operation of the outside air and return air dampers is restored.

Measure Tool Applicability

The tool applies to VAV systems in Hospital, Office, and Retail building types:

- VAV air handlers with chilled water cooling coils and airside economizer sections serving the occupied spaces, with typical minimum ventilation rates.
- Natural gas-fired 80% efficient heating water boilers
- Chilled water systems with constant speed chillers and constant speed chilled water pumps. No chilled water supply temperature reset for buildings older than 1999, load-based reset for buildings built more recently than 2000.
- Heating water systems with no heating water supply temperature reset for buildings older than 1999, load-based reset for buildings built more recently than 2000.
- Water-cooled chillers. Cooling towers with either single speed, two speed, or
- VFD-controlled fans. Fixed condenser water temperature setpoints. For Education and Hotel building types, contact your utility program administrator.

The tool applies to constant speed chilled water systems with airside VAV in Hospital, Office, and Retail building types:

Measure Data

Select the appropriate baseline condition, "Lockout" or "Damper Position":

Economizer damper lockout temperature is **55° F, 60° F, 65° F (circle one)**

OR

Dampers are stuck in an outside air fixed position that is drawing in either:

0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100% (circle one)

Total Affected Air Handler Cooling Capacity (Tons) _____

Add / Optimize Boiler Lockout

This measure relates to adding, optimizing or restoring an outside air temperature-based lockout of the boilers and heating water pumps serving a VAV air handling system.

BOA Tool tab: Boiler LO (Boiler Lockout)

Applicable Baseline Conditions

- The boilers and heating water pumps operate continuously during scheduled operating hours, regardless of outside air temperature (OAT).
- The boilers and heating water pumps operate with an OAT lockout of approximately 85°F during scheduled operating hours.

Applicable Measures

- Implement an OAT-based lockout (approximately 70F lockout temperature) of the boilers and heating water pumps during scheduled operating hours.

Measure Tool Applicability

The tool applies to gas-fired heating water systems with 80% boiler efficiency and constant speed heating water pumps serving air handlers with heating water coils.

The tool applies to heating water system scheduled operating hours close to the following:

- Office: M-Sat 5a-6p, off on Sundays and holidays
- Hotel and Hospital: Continuous (24 / 7 / 365)
- Retail: M-F 8a-10p, Sa-Su 8a-8p, holidays 8a-8p
- Education - Secondary School: M-F 6a-7p weekdays, Sa 6a-5p, off on Sundays and holidays. School sessions are Mon 1/7 through Fri 4/5, Mon 4/15 through Fri 6/14, Mon 8/19 through Fri 12/13.

Measure Data

Please enter the baseline lockout setting and conditioned area served:

Baseline Lockout: None 85°F Conditioned Area Served (sf) _____

Adjust Zone Temperature Deadband

The "Adjust Zone Temperature Deadband" measure relates to widening the zone temperature deadband, which is defined as the difference between the heating and cooling setpoints. Widening the deadband can save energy through reduced simultaneous heating and cooling, higher cooling setpoints, and lower heating setpoints.

BOA Tool tab: Zone Temp Deadband

Applicable Baseline Conditions

- Zone temperature deadband is between zero and twelve degrees F.

Applicable Measures

- Zone temperature deadband is increased, up to a maximum fifteen degrees F. Note that this measure may affect occupant comfort, as it will change the temperatures in the space. Before proposing this measure, verify that the Owner's current facility requirements will still be met with a wider deadband.

Measure Tool Applicability

The tool applies to:

- VAV air handlers with chilled water cooling coils and airside economizer sections serving single duct VAV systems with hot water reheat; average minimum VAV box airflow setpoints ranging from 20% to 40% maximum cooling airflow; SATs ranging from 53° F to 60° F, with or without SAT reset; fan control through discharge dampers, IGVs, or VFDs. The tool also covers small CV air handlers serving other spaces (e.g., university labs, kitchens, hotel bar).
- Chilled water systems with air- or water-cooled chillers. Chillers of any typical efficiency with or without VFDs, and systems with or without chilled and condenser water supply temperature setpoint reset.
- Heating water systems with gas-fired heating water boilers, with or without heating water supply temperature reset.

The tool does not apply to guest rooms in the Hotel and University building types. It also does not apply to surgical or medical zones in the Hospital building type.

Measure Data

Please enter the required information in the spaces below:

Floor area affected by measure (sf) _____ Annual AHU Op Hours _____

Boiler Efficiency _____ Average VAV Box Minimum Flow Setpoint _____

Average Space Temperature Setpoint (mid between heating and cooling) (F) _____

Baseline Deadband (0-12° F) (F) _____ Proposed Deadband (<15° F) (F) _____

Add Supply Air Temperature Setpoint Reset Strategy

The "SAT Reset" measure relates to adding a supply air temperature setpoint reset strategy to a VAV system. Resetting the supply air upwards during periods of low load helps reduce the amount of simultaneous heating and cooling inherent in single duct VAV systems that use VAV boxes with minimum flow setpoints greater than zero. Flow setpoints are typically greater than zero to deliver minimum ventilation air to the occupied spaces.

BOA Tool tab: SAT Reset (Supply Air Temperature Reset)

Applicable Baseline Conditions

- Supply air temperature setpoint is constant.

Applicable Measures

- The supply air temperature setpoint is reset based on OAT or based on demand. The lowest SAT setpoint in the reset schedule is the same as the baseline SAT.

Measure Tool Applicability

The tool applies to:

- VAV air handlers with chilled water cooling coils, airside economizer sections, and VFD-controlled supply fans serving single duct VAV systems with hot water reheat. Average minimum VAV box airflow setpoints ranging from 20% to 40% maximum cooling airflow.
- Chilled water systems with air-cooled or water-cooled chillers. Chillers of any typical efficiency with or without VFDs, and systems with or without chilled and condenser water supply temperature setpoint reset.
- Heating water systems with gas-fired heating water boilers. Boilers of any typical efficiency, with or without heating water supply temperature reset.

Measure Data

Please enter the required information below:

Area Served By Air Handler (sf) _____ Annual AHU Operating Hours _____

Baseline SAT (must be constant) (° F) _____

Proposed Reset Type: Outside Air Demand Proposed °F of Reset _____

Reduce Supply Duct Static Pressure Setpoint

This measure relates to reducing a constant supply duct static pressure setpoint for a VAV air handling system.

BOA Tool tab: DSP Reduction (Duct Static Pressure Setpoint Reduction)

Applicable Baseline Conditions

- The system is operating to maintain a high constant duct static pressure setpoint.

Applicable Measures

- The duct static pressure setpoint is lowered between 0.1" and 1.0".

Measure Tool Applicability

The tool applies to:

- Single duct VAV air handling systems with VFD-controlled supply fan motors.
- Fan operating hours that are close to the following:
 - 4,888 hours / year for retail
 - 3,432 hours / year for office
 - 8,760 hours / year for hotels and hospitals
 - 2,911 hours / year for secondary schools

Measure Data

Please enter the affected fan motor HP and proposed setpoint reduction:

Affected Fan Motor HP _____ Proposed Setpoint Reduction _____ (0.1" increments)

Add Supply Duct Static Pressure Setpoint Reset Strategy

The "Add Supply Duct Static Pressure Setpoint Reset Strategy" measure relates to adding or restoring a supply duct static pressure setpoint reset strategy to a VAV air handling system.

BOA Tool tab: DSP Reset

Applicable Baseline Conditions

- The system is operating to maintain a constant duct static pressure setpoint.

Applicable Measures

- A duct static pressure setpoint reset strategy is implemented, with the reset based on either outside air temperature, VAV box damper position polling, or space temperature offset polling. The minimum reset duct static pressure setpoint is either 0.5", 0.75", or 1.0".

Measure Tool Applicability

The tool applies to:

- Single duct VAV air handling systems with VFD-controlled supply fan motors.
- Fan operating hours that are close to the following:
 - 4,888 hours / year for multi story retail
 - 3,432 hours / year for large office
 - 8,760 hours / year for hotels and hospitals
 - 2,911 hours / year for secondary schools

Measure Data

Please enter the affected fan motor HP and proposed minimum reset setpoint:

Affected Fan Motor HP _____ Proposed Min Reset Setpoint **0.5", 0.75", 1.0" (circle one)**

Add / Restore Supply Fan VFD

This measure relates to adding a VFD to an existing constant speed supply fan, or restoring operation of an existing supply fan VFD.

BOA Tool tab: SF VFD (Supply Fan VFD)

Applicable Baseline Conditions

- Supply fan operates at constant speed with malfunctioned inlet guide vanes (IGV) that are fixed or stuck open in either the 80%, 90%, or 100% position.
- Supply fan VFD is operating in bypass mode, or continually at 100% speed.

Applicable Measures

- The IGVs are removed, and a VFD is added to control the supply fan speed to maintain a fixed duct static pressure setpoint.
- Control of the existing supply fan VFD is restored. The supply fan speed varies to maintain a fixed duct static pressure setpoint.

Measure Tool Applicability

The tool applies to supply fans that serve single duct VAV boxes.

Measure Data

Please enter the baseline IGV position, the affected fan motor HP and annual fan operating hours:

Baseline IGV Position: **80%, 90%, 100% (circle one)**

Affected Fan Motor HP _____ Annual Fan Operating Hours _____

Add Chilled Water Supply Temperature Setpoint Reset Strategy

This measure relates to adding or restoring a chilled water supply temperature setpoint reset strategy to a water-cooled chilled water system. Since chiller efficiency increases with increasing chilled water supply temperature, overall chilled water system efficiency can be increased by implementing this measure.

BOA Tool tab: CHWST Reset (Chilled Water Supply Temperature Reset)

Applicable Baseline Conditions

- The system is operating with a constant chilled water supply temperature setpoint between 41° F and 47° F.

Applicable Measures

- Implement a CHWST setpoint reset strategy. Reset off of load or outside air dry bulb temperature. The lowest CHWST setpoint in the reset schedule is the same as the baseline CHWST.

Measure Tool Applicability

The tool applies to:

- Chilled water systems with: constant speed or VFD-controlled chiller compressors of any typical efficiency; constant speed, two-speed, or VFD-controlled cooling tower fan(s); constant speed or VFD-controlled chilled water and condenser water pumps; constant or variable temperature condenser water supply between 70° F and 90° F.
- Chilled water systems that serve air handlers with chilled water cooling coils and airside economizer sections (70° F lockout temperature) serving the occupied spaces, with or without SAT reset. Note that for this measure, the tool does not apply to air-cooled chilled water systems. It only applies to water-cooled systems.

Measure Data

Please enter the required information below:

Floor area served by chiller (sf) _____ Chiller Annual Operating Hours _____

VFD on chiller compressor? (Y / N) (**circle one**)

SAT reset: **No**, **OAT reset**, **Demand reset** (**circle one**)

Proposed CHWST reset type: **OAT reset**, **Demand reset** (**circle one**)

Proposed CHWST reset range (° F) _____

Add Condenser Water Supply Temperature Setpoint Reset Strategy

This measure relates to adding or restoring a condenser water supply temperature setpoint reset strategy to a water-cooled chilled water system.

BOA Tool tab: CWST Reset (Condenser Water Supply Temperature Reset)

Applicable Baseline Conditions

- The system is operating with single speed cooling tower fan(s), with a constant condenser water supply temperature setpoint of 80° F, 85° F, or 90° F.
- The system is operating with variable frequency drive (VFD) controlled cooling tower fan(s), with a constant condenser water supply temperature setpoint of 80° F, 85° F, or 90° F.

Applicable Measures

- For systems using single speed cooling tower fan(s) in the base case, add VFD(s) to control the tower fan(s) and implement a CWST setpoint reset strategy. Reset off of load or wet bulb temperature, with a minimum setpoint of either 70° F or 75° F.
- For systems using VFD-controlled cooling tower fan(s) in the base case, implement a CWST setpoint reset strategy. Reset off of load or wet bulb temperature, with a minimum setpoint of either 70° F or 75° F.

Measure Tool Applicability

The tool applies to:

- Chilled water systems with constant speed chillers and constant speed condenser water pumps.
- Chilled water systems with no chilled water supply temperature reset for buildings older than 1999, load-based reset for buildings built more recently than 2000.
- Open cooling towers with centrifugal fans.

Measure Data

Please enter the required information below:

Baseline Cooling Tower Fan Speed: **Constant or Variable (circle one)**

Operating Chiller Capacity (tons) _____ Base CW Temp (° F) **80, 85, 90 (circle one)**

Proposed Condenser Water Minimum Temp (° F) **70, 75 (circle one)**

Restore Chilled Water Pump VFD

This measure relates to restoring operation of an existing VFD.

BOA Tool tab: CHW Pump VFD

Applicable Baseline Conditions

- Chilled water pump is operating at constant speed due to either a faulty VFD or a sub-optimal control sequence.

The chilled water control valves at the air handlers are either two-way or three-way control valves.

Applicable Measures

- Proper VFD control is restored. If the control valves are three-way valves in the baseline condition, they are converted to two-way valves.

Measure Tool Applicability

The tool applies to chilled water pumps that serve air handlers with chilled water cooling coils and airside economizer sections (70° F lockout temperature) serving the occupied spaces.

For buildings older than 1999, the tool applies to chilled water systems with no chilled water supply temperature reset. For buildings built more recently than 2000, the tool applies to chilled water systems with load-based chilled water supply temperature reset.

Measure Data

Please enter the required information below:

Baseline Cooling Coil Valve Control: **2-Way or 3-Way (circle one)**

Affected operating CHW Pump Motor (HP) _____ Pump Annual Operating Hours _____