



**N O R T H W E S T**  
**ENERGY EFFICIENCY COUNCIL**

## Taking the Long View:

Maximizing the Whole Building Life Cycle with Effective O&M



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# Envisioning a World with Net-Zero Carbon Emissions

NEEC's mission is to eliminate carbon emissions from building energy use through market-based thought leadership, education, and advocacy.

[www.neec.net/programs/](http://www.neec.net/programs/)

## NEEC PROGRAMS



### Smart Buildings Center

A multi-functional energy efficiency headquarters in Seattle, Washington. This facility is a place to meet, train and access our Tool Lending Library.



### Tool Lending Library

Diagnostic tools for short term loan available to building owners, managers and energy service professionals in Washington and Oregon.



### Building Operator Certification

A training program that offers facilities personnel skills and knowledge to transform workplaces to be more comfortable, energy-efficient and environmentally friendly.



### Technical Assistance Helpdesk

The Clean Buildings Performance Standard Helpdesk

# Tool Lending Library

Often the first step is achieving operational excellence is gaining an understanding of how systems in the building are actually operating.



- Diagnostic & Monitoring Tools
- 85 Tool Types
- Online reservation system
- Loan period up to 4 weeks
- Local pickup or shipped



**FREE!!!**



Search Within...

Per Page 15 View Grid Sort By Relevance

Availability


In stock now

Type

Electronics (1)


Tools (986)

9




Dent ElitePro XC Logging Power Meter

Overdue



Flir E6 Infrared Camera


In Stock Now



Fluke 971 Temperature & Humidity Meter


In Stock Now

22




Fluke 1730 3 Phase Logging Power Meter

In Stock Now



Glass Thickness Meter & Low E Detector

In Stock Now



Luminance Meter

Overdue

Scan to browse our inventory & request tools!



# Building Operator Certification<sup>®</sup> (BOC)

THE ESSENTIAL CREDENTIAL

- Leading training and credentialing program for building engineers and maintenance personnel
- Graduates gain skills to make their buildings more:
  - Comfortable
  - Efficient
  - Environmentally friendly
- Graduates help their organizations substantially **cut operating costs** (as much as \$20,000 per year)
- BOC Level II graduates can fulfill the role of **Qualified Person** for the CBPS



Photo courtesy of Resource Media



Scan to find  
upcoming  
courses near  
you!





# BOC PROGRAM

## TRAINING



FUNDAMENTALS OF  
ENERGY EFFICIENT  
BUILDING OPERATIONS  
CERTIFICATE



LEVEL I  
TRAINING CERTIFICATE  
OF COMPLETION (TCOC)



LEVEL II  
TRAINING CERTIFICATE  
OF COMPLETION (TCOC)

## CERTIFICATION



EXAM

## BOC CERTIFICATION



CERTIFIED BUILDING  
OPERATOR (CBO)

Scan to find upcoming  
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# Agenda

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Discuss O&M in the context of whole building life cycle

Illustrate the benefits of following a long-term strategy

Outline components of an effective O&M program

Identify tools and resources for developing, implementing, and managing your O&M program



# O&M and Whole Building Life Cycle

"Effective O&M is one of the most cost-effective methods for ensuring reliability, safety, and energy efficiency."

Pacific Northwest National Laboratory, U.S. Dept. of Energy

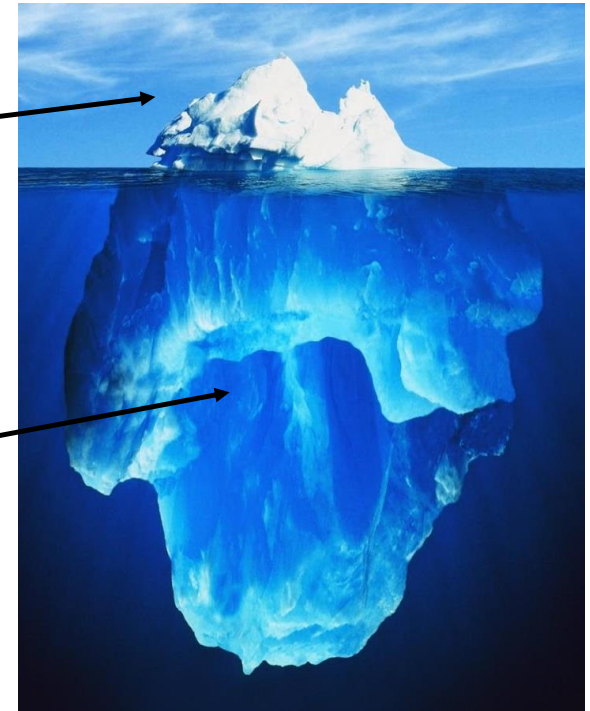




# Total Cost of Building Ownership

Total cost of ownership (TCO) is the purchase price of an asset plus the cost of operating the asset over the course of its lifetime.

- Purchase price
- Administrative Costs
- Training
- Operation/Maintenance/Labor/Parts
- Sustainability
  - **Energy/water consumption**
  - Recycling
  - Chemicals
- Decommissioning/Trade-Ins
- Etc.



# Total Cost of Building Ownership

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# Operations & Maintenance (O&M)

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# “Operation” Tasks

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Specific operating settings of equipment and controls, e.g.:

- Room temperature setpoint
- Supply air temperature
- Equipment schedules
- Ventilation/economizer
- Fan speed and CFM delivery
- Pump speed and GPM water circulation
- Control valves and damper settings
- Sequence of operation



# “Maintenance” Tasks

Tasks required to maintain a piece of equipment in good operation condition, e.g.:

- Changing filters
- Adjusting belt tension
- Lubricating bearings
- Cleaning heat transfer coils
- Water treatment
- Other servicing recommended by manufacturer



# Types of Maintenance

Reactive

Preventive

Predictive

Reliability-centered



# Reactive Maintenance

## Advantages:

- Lower cost short term due to reduced staff time

## Disadvantages:

- Decreased equipment life
- Increased risk of catastrophic equipment failure and secondary equipment failure
- Increased cost due to unplanned downtime of equipment
- Increased labor cost if overtime is needed
- Inefficient use of staff resources



# Preventive Maintenance

## Advantages:

- Cost effective in many capital intensive processes.
- Allows for the adjustment of maintenance schedule.
- Increased component life cycle.
- Energy savings.
- Reduced equipment or process failure.

## Disadvantages:

- Catastrophic failures still likely to occur.
- Labor intensive.
- Includes performance of unneeded maintenance.







### **Dirty Cooling Coil**

- ✓ Impact on cooling?
- ✓ Impact on energy?
- ✓ Impact on reliability?
- ✓ Impact on IAQ?

# Predictive Maintenance

## Advantages:

- Increased component operational life/availability.
- Allows for preemptive corrective actions.
- Decrease in equipment or process downtime.
- Decrease in costs for parts and labor.
- Energy savings.

## Disadvantages:

- Increased investment in diagnostic equipment.
- Increased investment in staff training.
- Savings potential not readily seen by management.



# Reliability-Centered Maintenance

## Advantages:

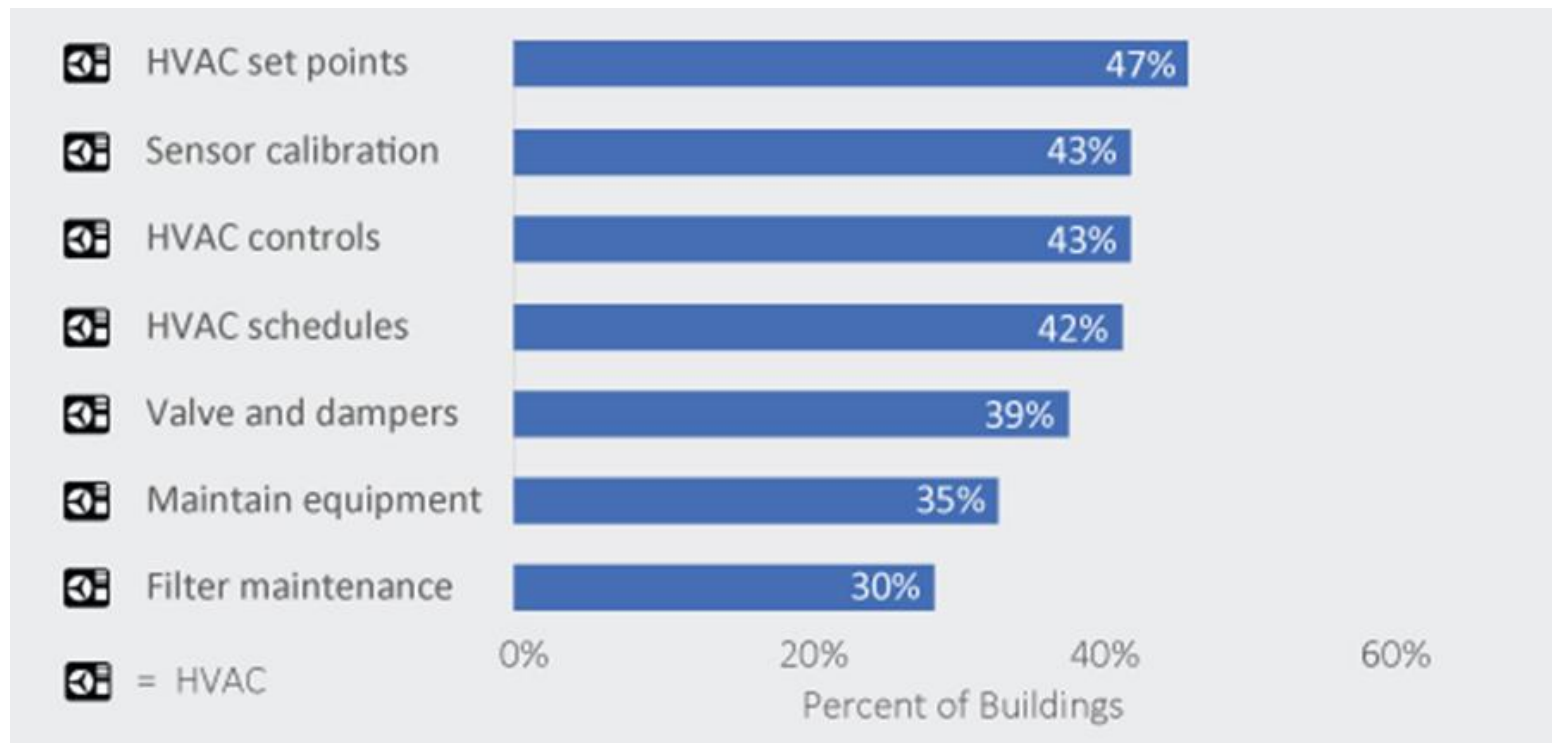
- Cost effectiveness
- Improved asset performance
- High customer satisfaction
- Better safety and environmental integrity

## Disadvantages:

- Initial implementation costs
- Complexity



# Most Common O&M Problems



Source: City of Seattle



# Four Opportunities

Four common opportunities for low-cost operational improvement:

- Equipment scheduling
- Sensor error
- Simultaneous heating and cooling
- Outside air usage



# Building Re-tuning

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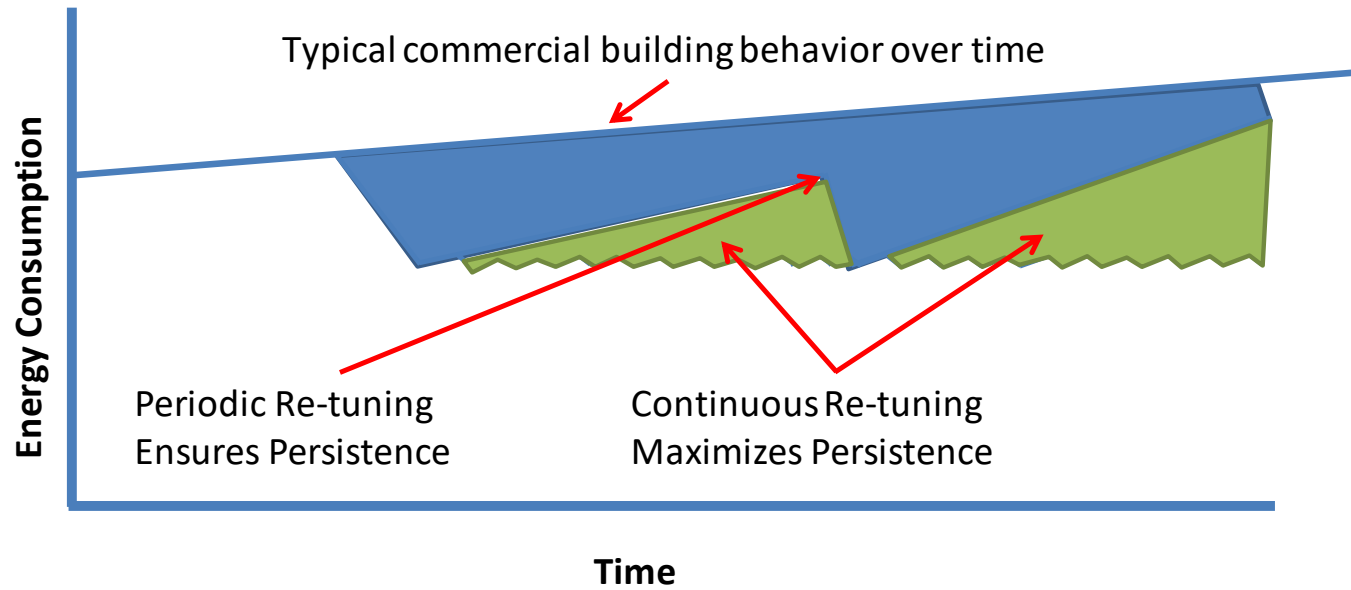
A systematic process to identify and correct no/low-cost operational problems that lead to energy waste.



An effective O&M program includes re-tuning activities.



# Life Cycle of Re-Tuning



# O&M Practices

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O&M measures should be considered prior to the installation of energy conservation measures. Why?

- Most are low-cost or no-cost in nature.
- Many are easily implemented by in-house personnel.
- Many have immediate payback.
- Few require the design time, bid preparation, evaluation, and response that capital projects do, which can take up to a year to implement.





# Value of O&M Best Practices

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- Reduce the cost of building ownership.
- Maintain the value of building assets.
- Maintain efficiency of equipment.
- Improve productivity of O&M staff.
- Improve coordination between staff.



# Value of O&M Best Practices

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- Increase productivity of building occupants.
- Maintain healthy indoor environments.
- Avoid litigation caused by poor building performance.
- Improve reliability of major equipment.
- Supports facility ‘sustainability’ goals.



# Case Study - O&M Best Practices

- Kaiser Permanente, Portland OR
- Urgent Care Medical Office Building
- 51,000 square feet
- Improved Comfort
- \$33,000/Yr Energy Savings



# Case Study - Financial Analysis

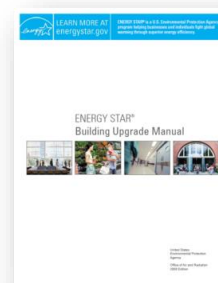
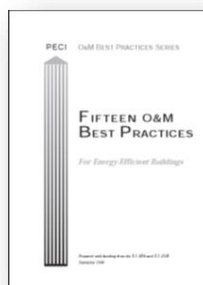
- Project cost: ~\$44,000
- Project savings: ~\$33,000/year
- Simple Payback = Cost / Savings
- Simple Payback = ~\$44,000 / \$33,000
- Project Payback = 1.3 years
- Payback with rebate = 1 year
- Is a payback of 1 year good?



# Resources for O&M Best Practices

## Resources

- FEMP O&M Best Practices
- PECI O&M Best Practices
- ENERGY STAR Building Upgrade Manual
- ASHRAE Standard 180-2018



# Benefits of Taking the Long View

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Save Money

Extend Equipment Life/Avoid Catastrophic Failures

Conserve Resources

Maximize staff time

Improve safety/comfort for occupants

Cost-effective capital planning



# Opportunities for Capital Planning

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Point-in-time evaluation

Avoid catastrophic failures/replacing like-for-like



# Policy Trends - Decarbonization

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Seattle's Tune-Up Program

WA Clean Buildings Performance Standard

Seattle's Building Emissions Performance Standards





# Environmental Drivers: GHG Emissions

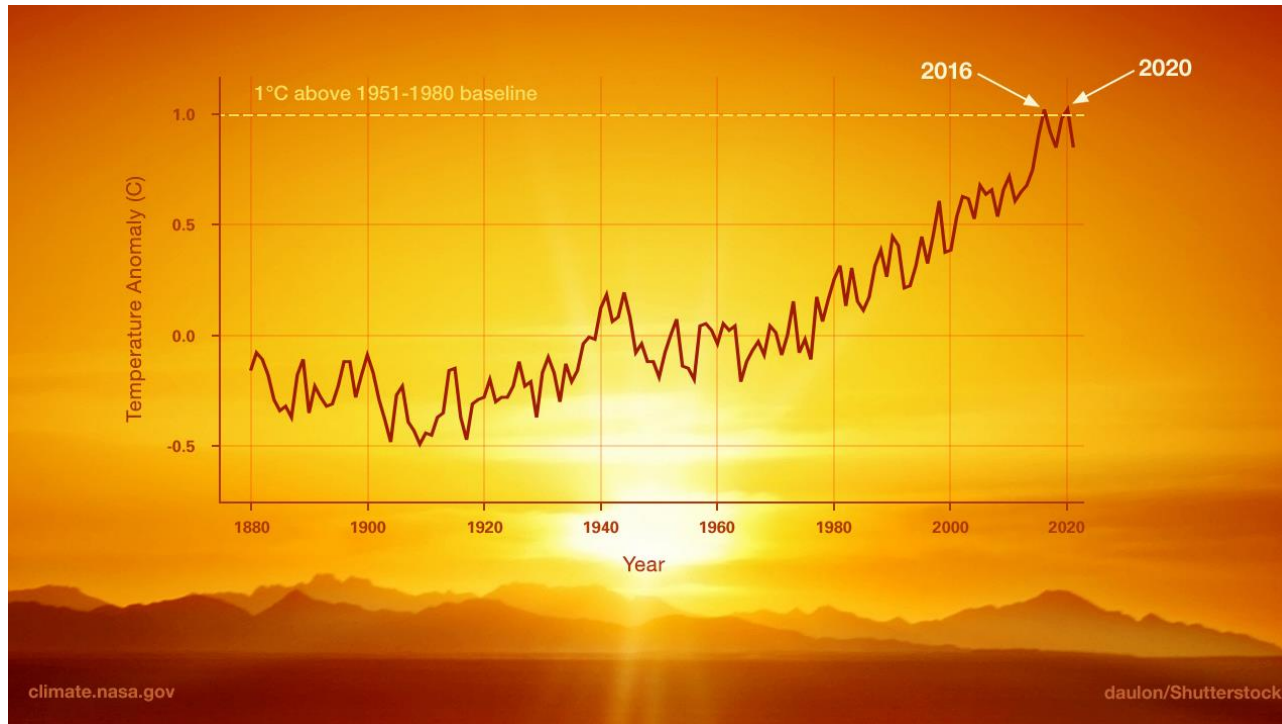


Image credit: NASA/JPL-Caltech



# Policy Trends

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2025  
NO COAL  
STANDARD



2030  
GHG NEUTRAL  
STANDARD



2045  
100% CLEAN  
STANDARD



# What is Electrification?

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Replacing technologies that use fossil fuels

- Natural gas
- Petroleum/diesel



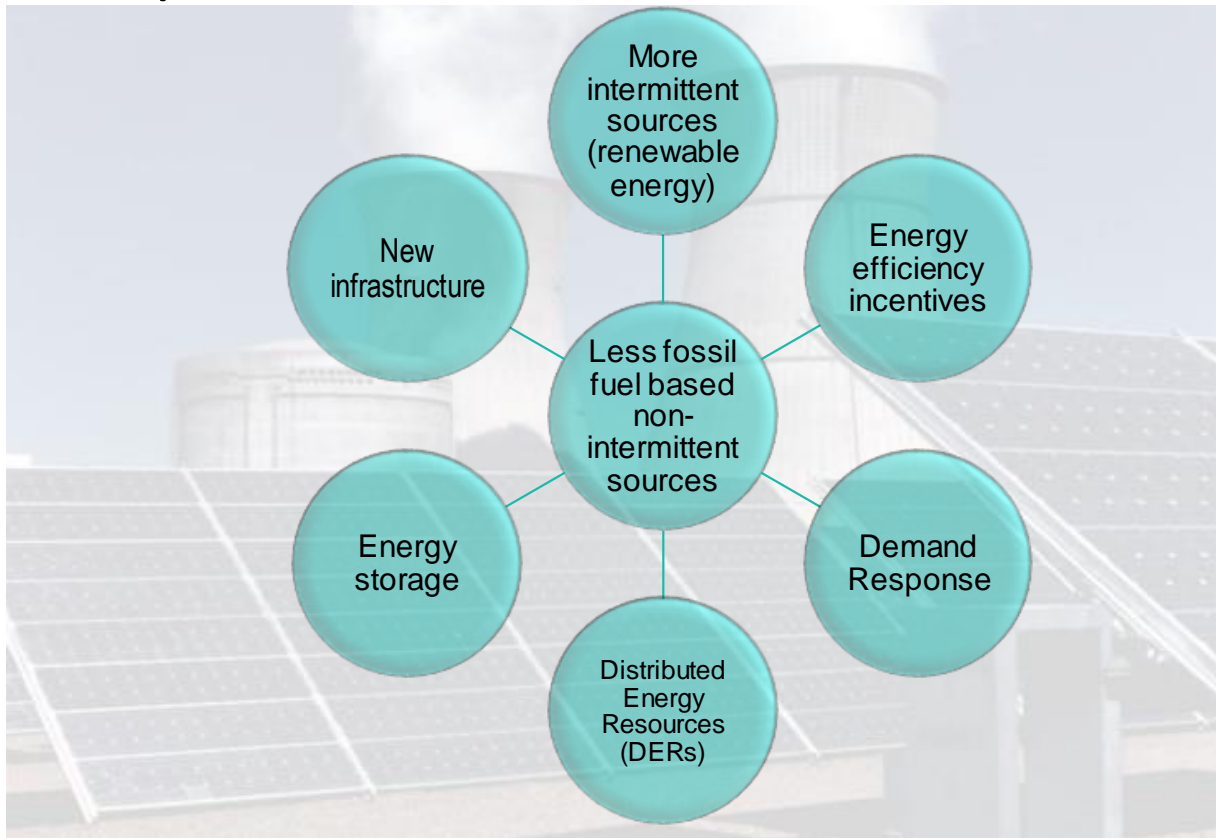
With technologies and systems that use electricity



Images source: energy.gov



# Utility Response



# Tools and Strategies



# Strategies & Solutions

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## Benchmarking

- You can't manage what you don't measure
- Seattle Benchmarking Helpdesk
- Clean Buildings Performance Standard Resources
- SBC Tool Lending Library

## Policy Requirements for O&M

## Future Policies



# Strategies & Solutions - Benchmarking

**You can't manage what you don't measure.**

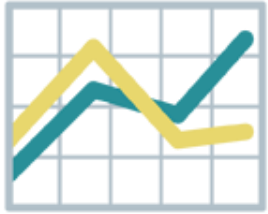
**Benchmarking is to measure your building's energy consumption and compare it to past consumption.**

- Energy Star Portfolio Manager is a free online platform for benchmarking
- Benchmarking assistance is available through various resources:
  - Office of Sustainability & Environment Benchmarking Helpdesk
  - SBC Clean Buildings Performance Standard Helpdesk
- SBC Tool Lending Library - Investigating abnormalities



# Tool Lending Library - Loggers

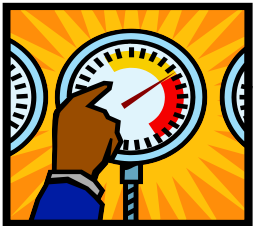
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- Trending with loggers/BAS.



- Troubleshooting with loggers.



- EUIs for end-use equipment.





# Strategies & Solutions – Policy Requirements for O&M

## Clean Buildings Performance Standard

- Section 6: OPERATIONS AND MAINTENANCE REQUIREMENTS
- INFORMATIVE ANNEX D: This annex is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard.
- NORMATIVE ANNEX L: This is a normative annex and is part of this standard.



# Strategies & Solutions – Policy Requirements for O&M

## NORMATIVE ANNEX L

- Inventory of equipment, systems, and controls to be inspected and maintained
- Maintenance Plan describing
  - Performance Objectives
  - Condition Indicators
  - Inspection and Maintenance Tasks
  - Inspection and Maintenance Task Frequency
  - Documentation



# Strategies & Solutions – Policy Requirements for O&M

## Documentation

A minimum inspection and maintenance documentation package shall consist of the following items:

1. Listings of building systems and system components with associated performance criteria pertinent to the facility.
2. Inspection and maintenance tasks and the method of tracking (automated or manual).
3. Identify building systems or components operating beyond their useful life.
4. Sufficient record detail and verification (written or electronic) to demonstrate implementation of the maintenance plan.
5. The inspection and maintenance document directory shall provide easy access and be well organized and clearly identified. Emergency information shall be immediately available and shall include emergency staff and/or agency notification procedures.



# Strategies & Solutions – Policy Requirements for O&M

## Resources

- Clean Buildings Performance Standard Accelerators
  - Check with your local utility
- Smart Buildings Center Clean Buildings Performance Standard Helpdesk
  - Individual Consultation
  - Training Videos
  - Resources, e.g. Lighting Schedule Workbook

### Building Details

• Under Space Type use the dropdown menu to select the type of use/space. The dropdown menu lists all use types found in the table to the right.  
 • Fill in the square footage of the floor area.  
 • Fill in the Commerce Building ID. You can find this ID in you notification letter from Commerce or your Secure Access Washington (SAW) account.

Commerce Building ID:

### Building Area Type

Use Type	Floor Area (SF)	Recommended LPD	Watts Per Space	Annual Energy Use (kWh)	Actual LPD	Retrofit LPD
<b>Total</b>	<b>0</b>	<b>0.00</b>		<b>0</b>	<b>0.00</b>	

\*To add additional rows simply right click anywhere in the table and select the "Insert > Table Rows Above" option.

Interior Lighting Power Densities (LPD) allowances according to WAC 51-11C-405054. The goal is to stay below these limits.  
<https://app.leg.wa.gov/WAC/default.aspx?cite=51-11C-405053&pdf=true>

Building Area Type	LPD (W/R <sup>2</sup> )
Automotive facility	0.64
Convention center	0.64
Court house	0.79
Dining: Bar lounge/leisure	0.79
Dining: Cafeteria/fast food	0.72
Dining: Family	0.71
Dormitory (a,b)	0.46
Exercise center	0.67
Fire station (a)	0.54
Gymnasium	0.75
Health care clinic	0.70



# Components of an Effective O&M Program

## Documentation

- Inventory
- Maintenance

## Staff Training & Resources

## Data/Feedback



# Takeaways

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O&M is a crucial component of the whole building life cycle

There are many benefits to following a long-term strategy

Components of an effective O&M program: Documentation, Training/Resources, Data/feedback

There are resources available for developing, implementing, and managing your O&M program



time for ...

