SEATTLE

BUILDING TUNE-UP ACCELERATOR

Tune-Up Accelerator Provider Training

September 14 & 15, 2017

SMART BUILDINGS CENTER

WELCOME & INTRODUCTIONS

Program Partners

Seattle
Office of Sustainability
& Environment

SEATTLE
building
tune-ups

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Seattle City Light

U.S. DEPARTMENT OF
ENERGY
Energy Efficiency &
Renewable Energy

Training Agenda at a Glance

Day 1

- Welcome & Introductions
- Seattle Building Tune-Ups Requirement
- Building Tune-Up Accelerator
- Asset Score
- Building Re-Tuning

Day 2

- On-Site Building Re-Tuning
- Tool Lending Library
- Building Renewal
- Utility Incentives

Definitions: Tune-Ups & Re-Tuning

Seattle Building Tune-Ups Mandate

- Seattle policy requiring owners of non-residential buildings 50K SF or greater to tune-up their buildings.
- Specific required O&M actions to assess and correct.
- No incentives.

Seattle Tune-Up Accelerator Program

- Voluntary, time-limited alternative compliance path to meet Building Tune-Ups mandate.
- Buildings 100K SF or less are eligible.
- Specific required O&M actions to assess and correct.
- Incentives available.

PNNL Building Re-Tuning™

- Method & training created by PNNL to detect and correct O&M problems in buildings.
- Methods and O&M actions overlap with Seattle Tune-Up programs.

Tune-Up Accelerator: Provider Training

Seattle Building Tune-Ups Policy

REBECCA BAKER, Building Tune-Ups Program Manager
September 14, 2017

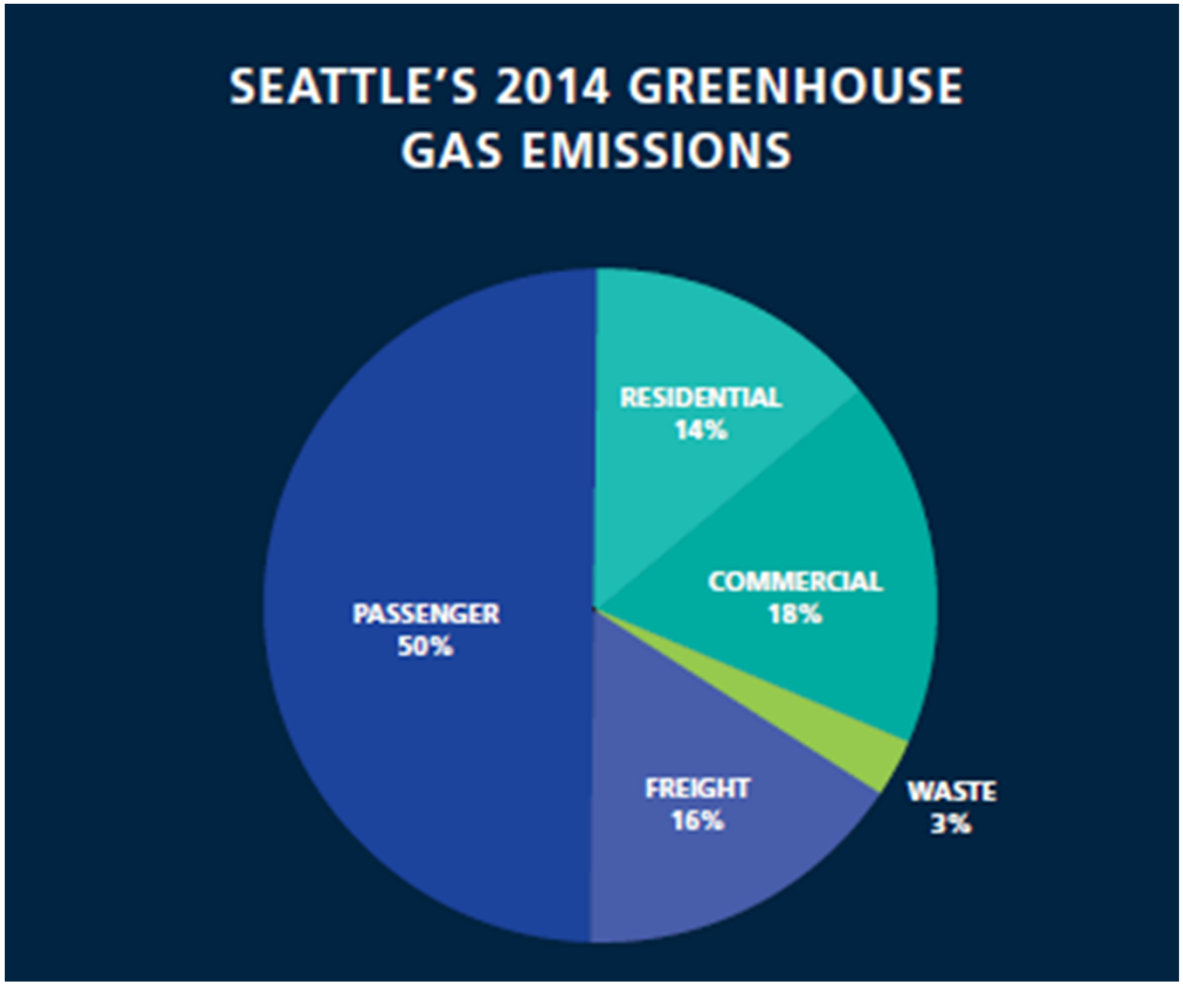
Seattle
Office of Sustainability
& Environment

What is a Tune-Up?

- RCx “lite”
- Operational improvements, not capital
- Generate energy and water savings through low to no-cost measures
- Currently a best practice for managing an energy efficient building

Why is the City mandating Building Tune-Ups?

Buildings are a significant contributor to carbon pollution

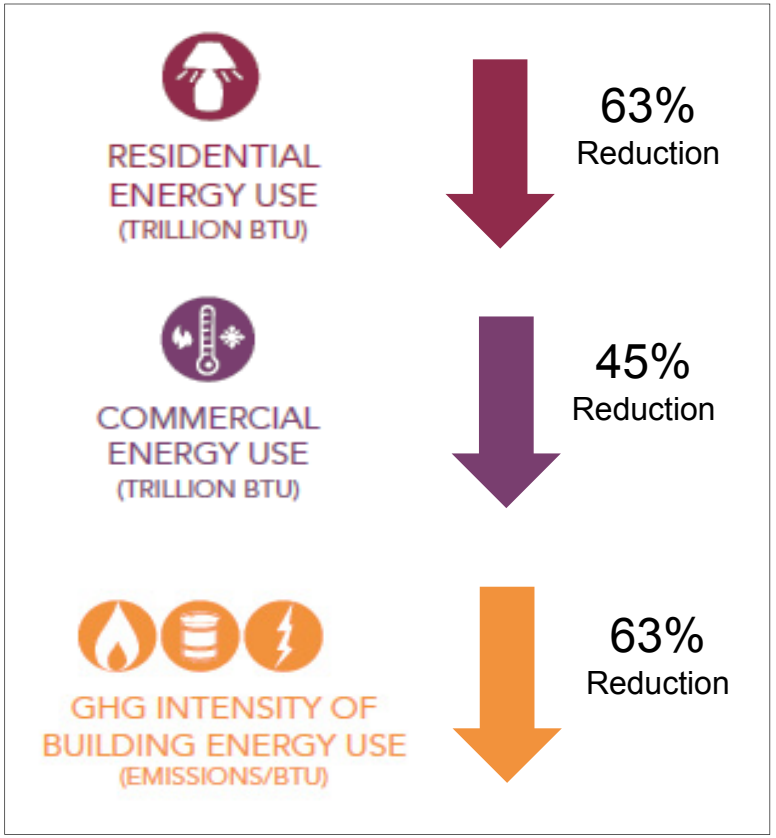


Source: 2014 Seattle Community GHG Inventory

Seattle has a bold mandate to achieve carbon goals

SEATTLE CLIMATE ACTION PLAN

2050 Energy & Carbon Goals



We have work to do…

- Wanted immediate savings for us and you
- A cost-effective approach (not a document on a shelf with no action)
- Practical, current best practice


Who, What, When?

Who does this mandate apply to? Who is excluded?

All non-residential buildings and commercial spaces > 50k SF (excluding parking)

Tune-up every 5 years

Excluded from mandate

- **Single-family** residential buildings
- **Multifamily** residential buildings
- **Mixed-use** buildings < 50k SF of nonresidential space
- Buildings used primarily for **manufacturing or industrial uses**
- **Buildings previously exempted** from the annual benchmarking requirement

Who can conduct the Tune-Ups?

Tune-Up Specialists must meet following qualifications

At least seven years experience ***plus*** one of the following:

- Professional Engineer
- Certified Energy Manager
- Existing Building Commissioning Professional
- Certified Commissioning Professional
- Commissioning Authority certification
- Level II Building Operator certification
- Bachelor in Sustainable Building Science Technology

TUNE-UP SCHEDULE

Ongoing, every five years

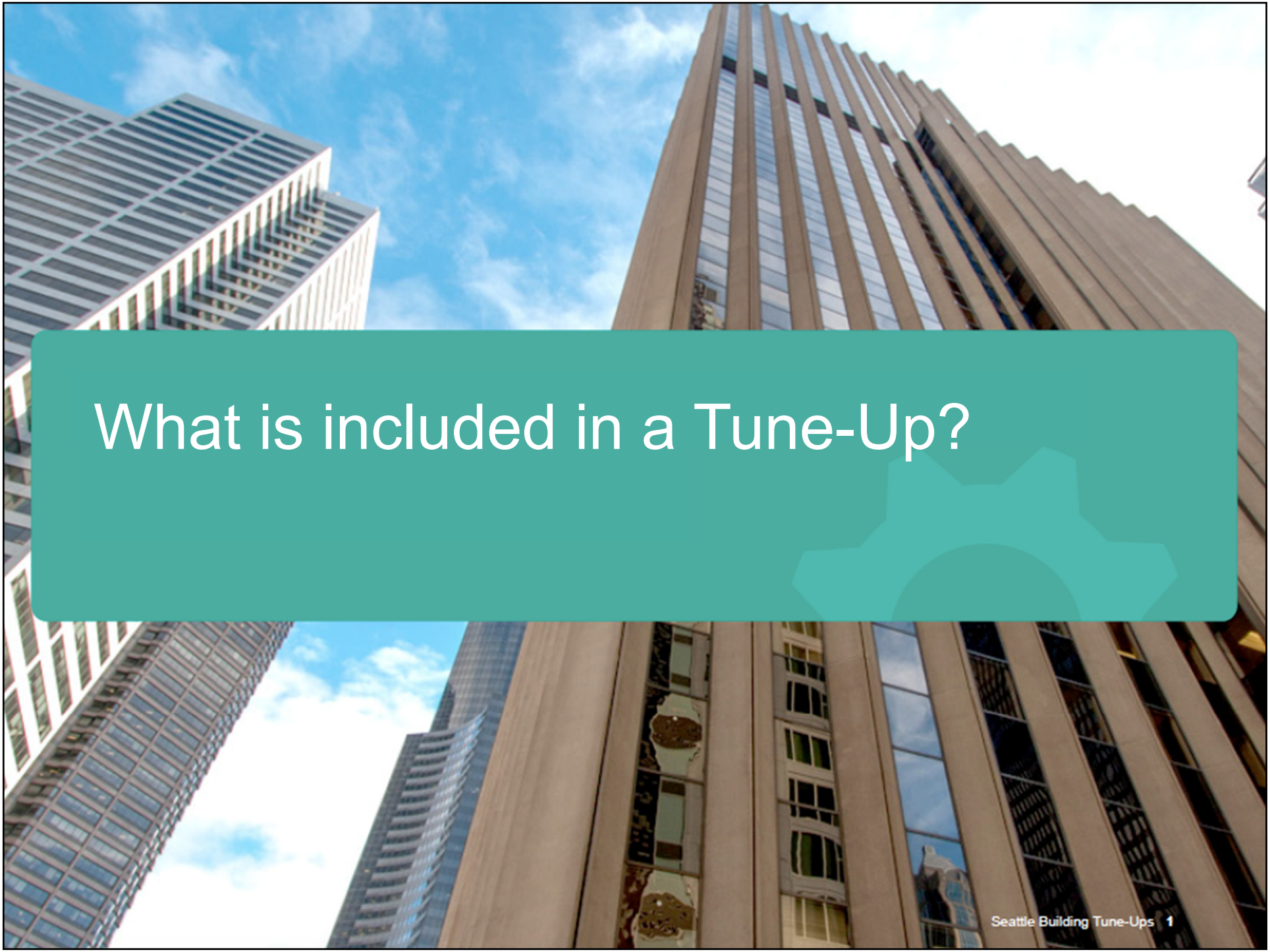
BUILDING SIZE*	DUE
200,000+ SF	10/01/2018
100,000-199,999 SF	10/01/2019
70,000-99,999 SF	10/01/2020
50,000-69,999 SF	10/01/2021

** Excluding parking*

Leading by Example

All municipal buildings must meet Building Tune-Ups deadlines one year ahead of privately-owned buildings.

Municipal Tune-Ups will save the City money and help us meet our energy reduction goals.



What is included in a Tune-Up?

The Tune-Up Process:

- An **ASSESSMENT** of building systems to identify operational or maintenance issues;
- **RECOMMENDATIONS** to building owner;
- **CORRECTIONS** to operational and maintenance issues identified in the inspection;
- **VERIFICATION** that corrections were made; and
- Submittal of a **SUMMARY REPORT** to OSE that notes the issues identified and actions taken.

The **ASSESSMENT** (by Tune-Up Specialist) includes:

- Review and verify ENERGY STAR Portfolio Manager account information.
- Review and evaluate monthly energy and water billing data.
- Documentation of basic building characteristics: HVAC systems, lighting, occupancy, space types, electric vehicle charging, other high use systems.
- On-site assessment of building systems.

Site Assessment: Energy & Water

(by Tune-Up Specialist)

Operational Protocols, Calibration, and Sequencing, e.g.

- Review HVAC equipment schedules
- Verify irrigation rain sensors are calibrated and functioning properly

Maintenance, Cleaning and Repair, e.g.

- Verify HVAC equipment is clean and adequately maintained
- Check water flow fixtures

Tune-Up Specialist Recommendations to Owner

- Identifies “Corrective Actions” required by Seattle Tune-Ups mandate, and
- Identifies voluntary measures included in the mandate.
- May also include recommendations for additional opportunities (other O&M, capital energy measures, etc.)

Format of report to owner per owner-provider contract and standard provider protocols.

Corrections: Energy & Water

(by Tune-Up Specialist, Contractor or Facilities Staff)

Operational Protocols, Calibration, and Sequencing, e.g.

- Set HVAC schedules to optimize for actual building occupancy patterns.
- Adjust calibrate or repair, as appropriate

Maintenance, Cleaning and Repair, e.g.

- Clean HVAC equipment where adversely impacting system performance
- Recommend low flow fixture of aerator replacements.

+

Additional measures requested by Owner

Verification & Report Submittal

The Tune-Up Specialist

- Verifies that corrective actions have been implemented, and
- Completes the Seattle Tune-Up Summary Report.
- Both Owner and Specialist confirm that report is accurate.

- Report is submitted by either the Owner or the Specialist on the Owner's behalf.

Building Tune-Ups Summary Report

C. BUILDING CHARACTERISTICS

C1. Total nonresidential gross floor area (excluding parking area)

C2. Parking garage area (per Portfolio Manager) if applicable

C3. Year built

C4. Year and description of any major building remodels (e.g. permitted as substantial alteration, major change of building use or function that would alter energy use)

C5. Primary building use (per Portfolio Manager)

C6. Was the building originally designed for the current use?

C7. Overall building occupancy

C8. Does the building have electric vehicle (EV) charging stations?

C9. Are they separately metered?

C11. Does the building have on-site renewables/self-generated energy?

C12. Average annual generation (if known) in kwh

C13. Provide information for the five most energy intensive space uses in the building.

Space Use (Up to five largest energy users)	Square Feet	Primary Heating System		Primary Cooling
		Type		Type
		Age		Age
		Condition		Condition

Building Tune-Ups Summary Report

Detailed Findings & Corrections

Assessment Element	Corrective Action	Tune-Up Finding	Status of Tune-Up Correction	Corrective Action Description	End Condition

1. HVAC
2. Lighting
3. Domestic Hot Water
4. Water Usage
5. Envelope


Alternative Compliance

Alternative Compliance Pathways

High Performance

- Certified ENERGY STAR Score
- LEED Gold for O&M
- Living Building, Petal, or Net Zero Energy
- Low Energy Consumption

Equivalent Process

- Active Monitoring & Continuous Cx
- Completed RCx
- Implemented ASHRAE L2 Audit Recs
- Reduced EUI
- New Construction or Substantial Alteration

Tune-Up Accelerator

- Program for buildings 100K SF or less
- Funding sunsets after 2018

Under Limited Circumstances

Single-Round Waiver	• Demolition • Major Renovation • Financial Distress
Extension Requests	• Change of Ownership • High Vacancy Rate • Existing Mechanical Improvements • Demonstrated 15% EUI Reduction


seattle.gov/buildingtuneups
BuildingTuneups@seattle.gov
206.727.TUNE (206.727.8863)
Seattle Building Tune-Ups 1

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BUILDING TUNE-UP ACCELERATOR

Tune-Up Accelerator Program Overview

PRESENTED BY:

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Tune-Accelerator Program Manager
Seattle Office of Sustainability & Environment
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Seattle
Office of Sustainability
& Environment

Presentation Outline

TIME	TOPICS
10 min	Accelerator Background & Goals
5 min	Market Overview
15 min	Accelerator Overview – 3 Phases
5 min	Program Evaluation – M & V
10 min	Tune-Up Accelerator Summary Report Demo
10 min	Q & A

SEATTLE
BUILDING TUNE-UP ACCELERATOR

ACCELERATOR BACKGROUND & GOALS

Tune-Up Accelerator Program Goals

1. Accelerate tune-ups in small-medium buildings
2. Advance market expertise to support tune-ups
3. Generate voluntary market action towards even greater savings
4. Ensure that the mandate is effective for this market sector

Accelerator DOE Support

- Awarded to City of Seattle in 2016
- Small-Medium Commercial Buildings (100,000 SF or less)
- Implementing through August 2019

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Program Partners

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SEATTLE building tune-ups

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Program Partner Roles

PARTNER	PRIMARY ROLES
Seattle OSE	Program Management, Enrollment, Coordination w/ Building Tune-Ups requirement, Reporting to DOE
SBC	Provider Training & Curricula, Tool Lending Library, Project Tracking, Help Desk
PNNL	Building Re-Tuning Training, Asset Score Support & Research on energy-savings from tune-ups
City Light	Tune-Up and Energy Conservation Incentives
UW IDL	Building Renewal Support, Spark Tool
US DOE EERE	Federal funding and project oversight

Accelerator Energy & Cost Savings Goals

✓Average 20% energy savings across 100 buildings or tenant spaces

✓Total Savings 99.7 Million kBtu/year

✓$1.5 Million annual cost savings

Getting to 20% Average Savings

A.	**Basic Tune-Up** Tune-Up Meets BTU Requirements	**+/- 10% Savings** (35-40 Buildings)
B.	**Tune-Up Plus** Meets Requirement + Energy Conservation Measures	**+/- 20% Savings** (+35-40 Buildings)
C.	**Building Renewal** Technical Support for Buildings Pursuing Deeper Upgrades	**+/- 35% Savings** (+20-30 Buildings)

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BUILDING TUNE-UP ACCELERATOR

SMALL – MEDIUM BUILDINGS

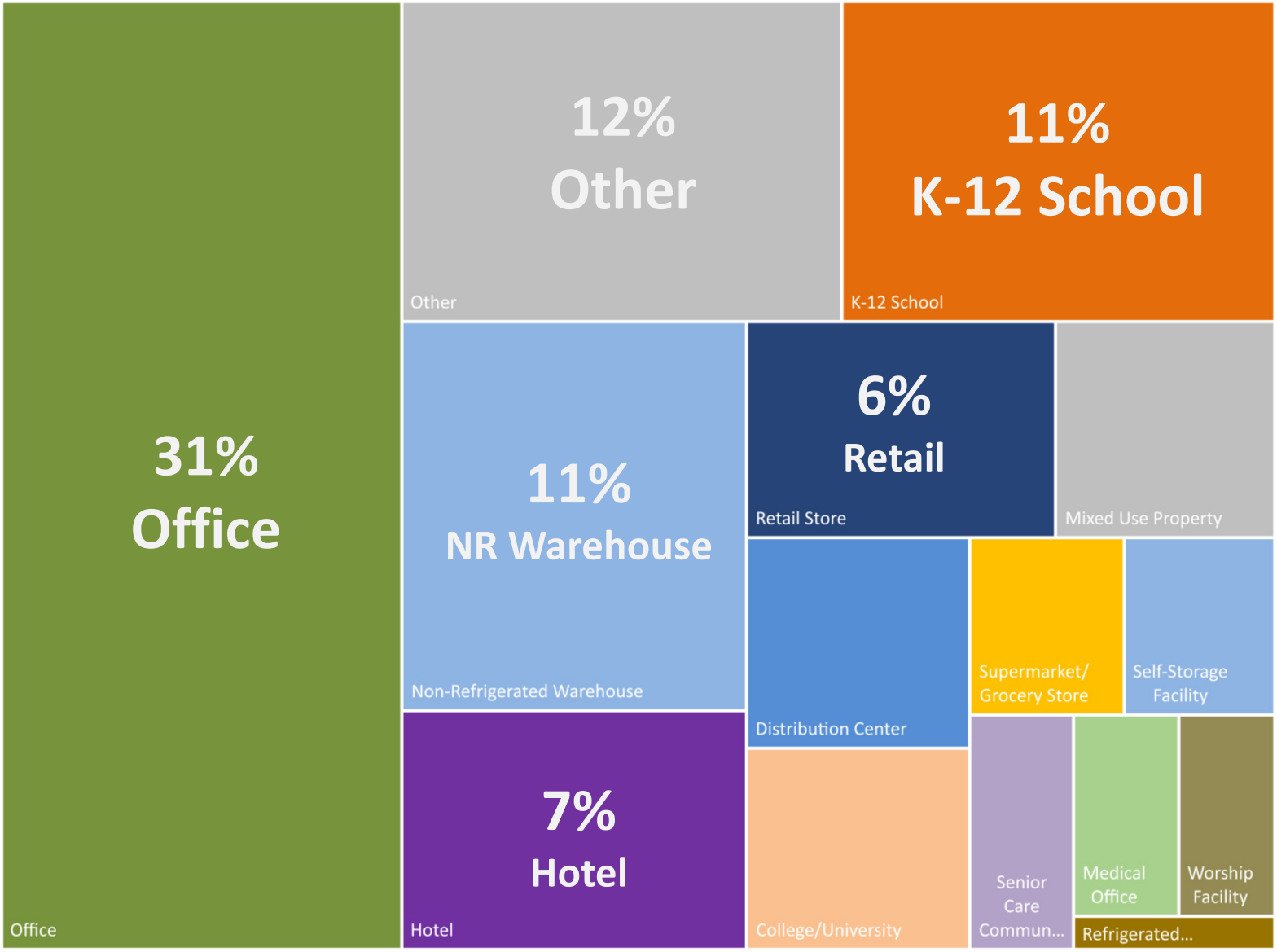
SEATTLE MARKET OVERVIEW

Seattle Market Overview

SMALL TO MEDIUM BUILDINGS			ALTERNATIVE COMPLIANCE PATH POTENTIAL		
Square Footage	**Tune-Up Compliance**	**Est. Number of Buildings**	**ENERGY STAR >=85**	**"Certified" >=85**	**EUI <=20**
70k-99,999	2020	160	45	4	14
50k-69,999	2021	230	31	4	26
20k-49,999	Optional	820	146	4	119
		1,210			

Source: 2015 Seattle Energy Benchmarking Data

Primary Use Type – Percent of Total SF, 50-100K SF (excl. parking)



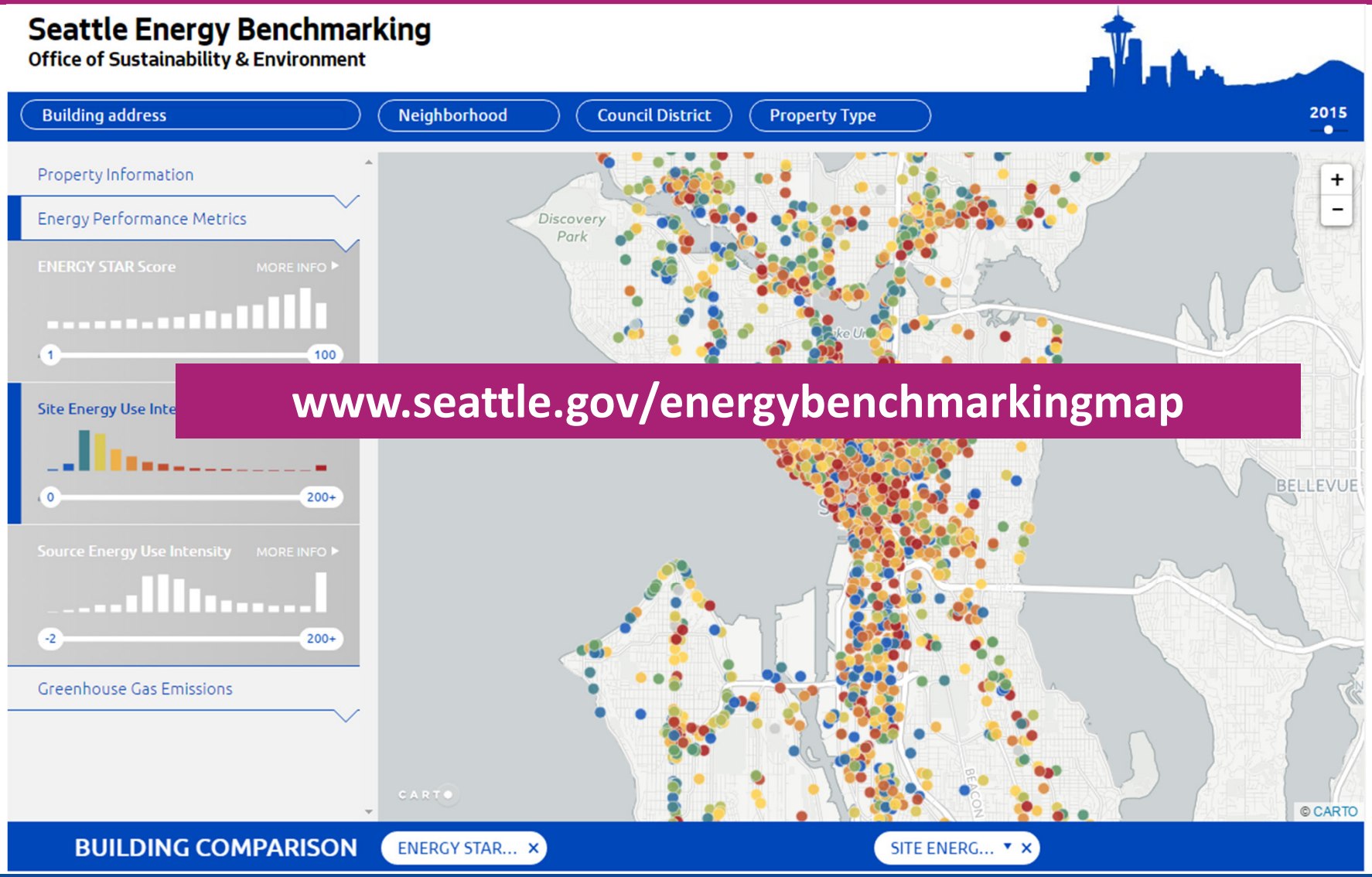
Source: 2015 Seattle Energy Benchmarking Data

Seattle Buildings 50K-100K (excl. parking)

	Est. Total #	Total SF	% SF	Total kBtu	% kBtu
Office	119	8,435,756	31%	565,944,283	30%
K-12 School	48	3,084,879	11%	97,929,277	5%
Other	47	3,134,608	12%	329,483,698	17%
Non-Ref. Warehouse	44	2,986,904	11%	96,202,490	5%
Hotel	25	1,825,005	7%	177,519,562	9%
Retail Store	22	1,484,968	6%	112,908,731	6%
Distribution Center	16	1,047,498	4%	32,877,322	2%
Mixed Use Property	16	1,053,418	4%	79,538,047	4%
College/University	14	995,990	4%	175,220,180	9%
Supermarket/Grocery Store	10	610,833	2%	106,865,395	6%
Self-Storage Facility	8	595,368	2%	8,414,018	0%
Senior Care Community	8	539,737	2%	69,802,929	4%
Medical Office	6	470,299	2%	48,294,149	3%
Worship Facility	6	428,535	2%	11,022,960	1%
Refrigerated Warehouse	2	148,072	1%	3,116,077	0%
	391	**26,841,870**	**100%**	**1,915,139,116**	**100%**

Source: 2015 Seattle Energy Benchmarking Data

Want More Building Information?



What's in it for Owners?

SEATTLE

BUILDING TUNE-UP ACCELERATOR

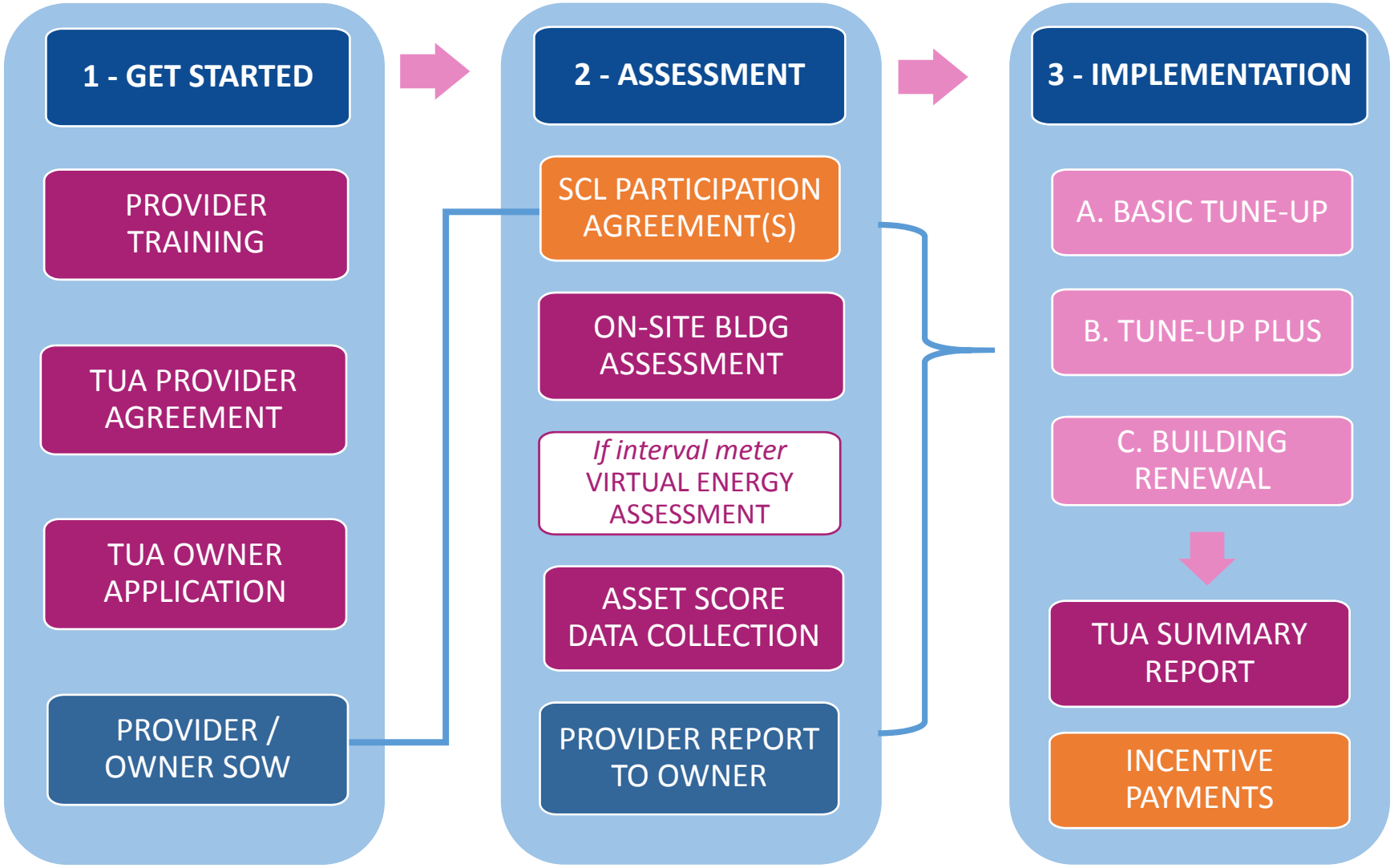
1
GET STARTED

2
BUILDING ASSESSMENT

3
IMPLEMENTATION

2017 → **Q2 2019**

Accelerator Overview – 3 Phases



GET STARTED: Training & Agreement

- Complete Provider Training
- Listed as participating service provider in Accelerator Program
- TUA Provider Agreement by September 30, 2017 or sooner

TUA PROVIDER AGREEMENT

PROVIDER TRAININGS

GET STARTED: Connect with Building Owner

- Contact your existing clients
- OSE is notifying building owner contacts
- Owner or Authorized Agent complete **TUA Owner Application** by December 1, 2017

TUA OWNER APPLICATION

GET STARTED: Develop Your Scope w/ Owner

- Your own contract with owner.
- SCL will also need for the incentive Participation Agreement.
- TUA considering a high level “market report” to provide after program completion.

PROVIDER / OWNER SOW

SCL PARTICIPATION AGREEMENT

GET STARTED: Explore Implementation Options

As part of SOW, consider options:

- *Client/owner just wants a tune-up that meets Seattle BTU?*
  - **Basic Tune-Up**
    SCL Incentives for Assessment & Corrective Actions
- *Considering other ECMs or RCx*?
  - **Tune-Up Plus**
    SCL or PSE Incentives, PSE CBTU Program
- *Needing comprehensive work or energy modeling support?*
  - **Building Renewal Options**
    SPARK analysis, energy modeling

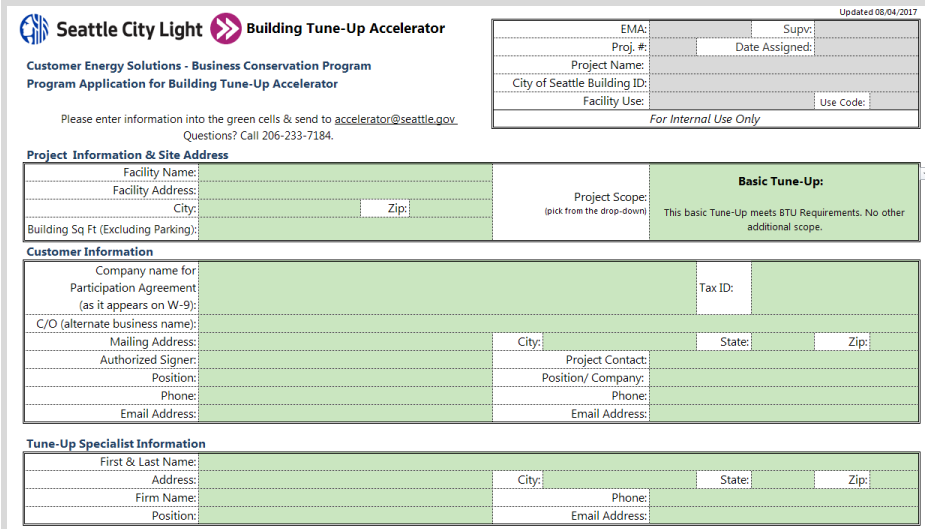
GET STARTED: Working with an Owner?

- Please let us know.
- OSE will send **TUA Summary Report Form** (also online)
- The Form will be prepopulated with some Portfolio Manager information.

OSE SENDS TUA SUMMARY REPORT FORM(S)

GET STARTED: Deliverables

- ✓Tune-Up Accelerator Provider Agreement by 9/30/2017
- ✓Tune-Up Accelerator Owner Application by 12/1/2017
- ✓Service Provider SOW with Owner
- ✓Start work on utility incentive agreements (owner)



Seattle City Light Building Tune-Up Accelerator

Updated 08/04/2017

EMA:		Supv:	
Proj. #:		Date Assigned:	
Project Name:			
City of Seattle Building ID:			
Facility Use:		Use Code:	

For Internal Use Only

Customer Energy Solutions - Business Conservation Program
Program Application for Building Tune-Up Accelerator

Please enter information into the green cells & send to accelerator@seattle.gov
Questions? Call 206-233-7184.

Project Information & Site Address

Facility Name:			Project Scope: (pick from the drop-down)	**Basic Tune-Up:** This basic Tune-Up meets BTU Requirements. No other additional scope.
Facility Address:				
City:		Zip:		
Building Sq Ft (Excluding Parking):				

Customer Information

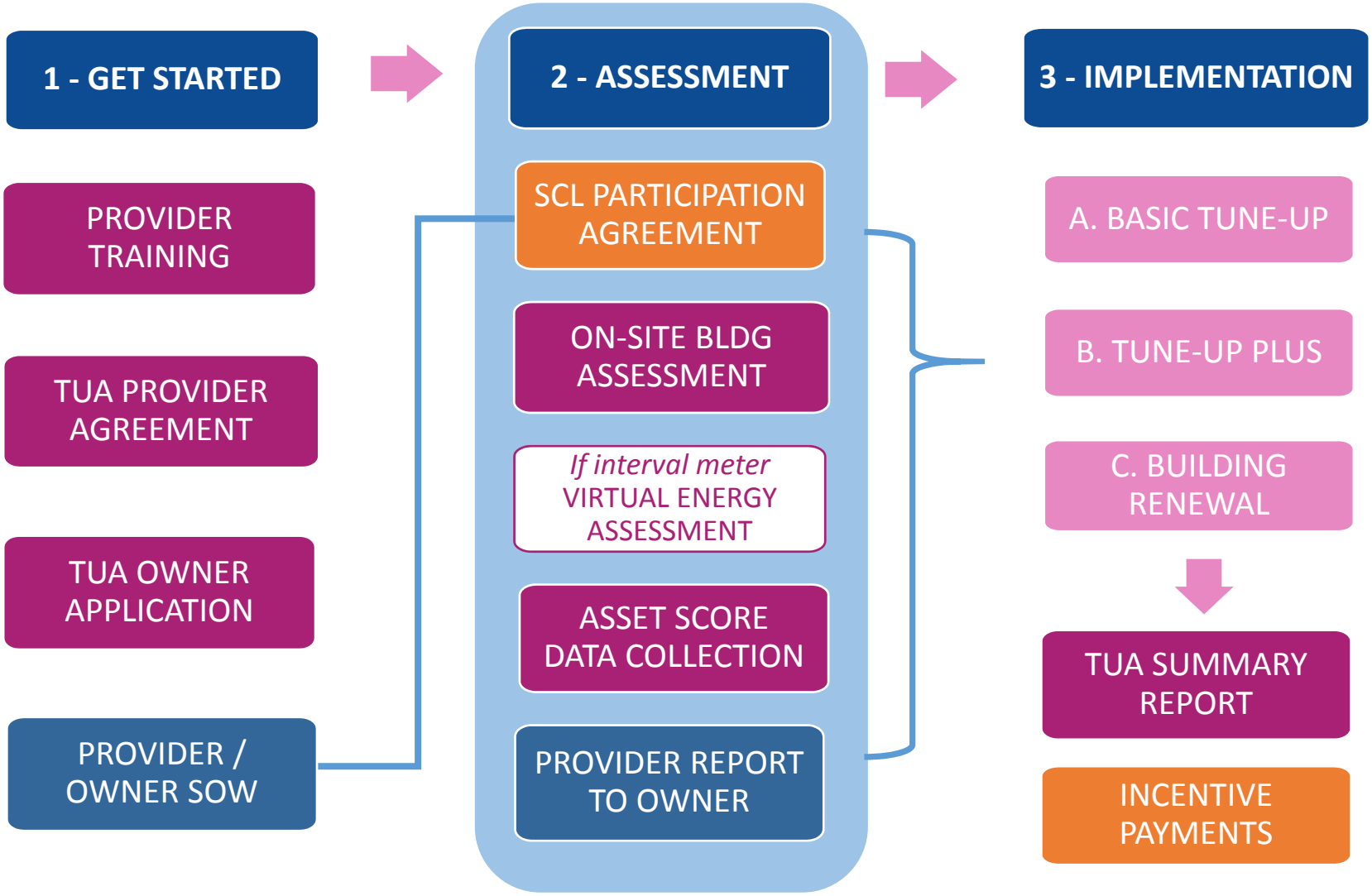
Company name for Participation Agreement (as it appears on W-9):				Tax ID:	
C/O (alternate business name):					
Mailing Address:		City:		State:	Zip:
Authorized Signer:		Project Contact:			
Position:		Position/ Company:			
Phone:		Phone:			
Email Address:		Email Address:			

Tune-Up Specialist Information

First & Last Name:					
Address:		City:		State:	Zip:
Firm Name:		Phone:			
Position:		Email Address:			

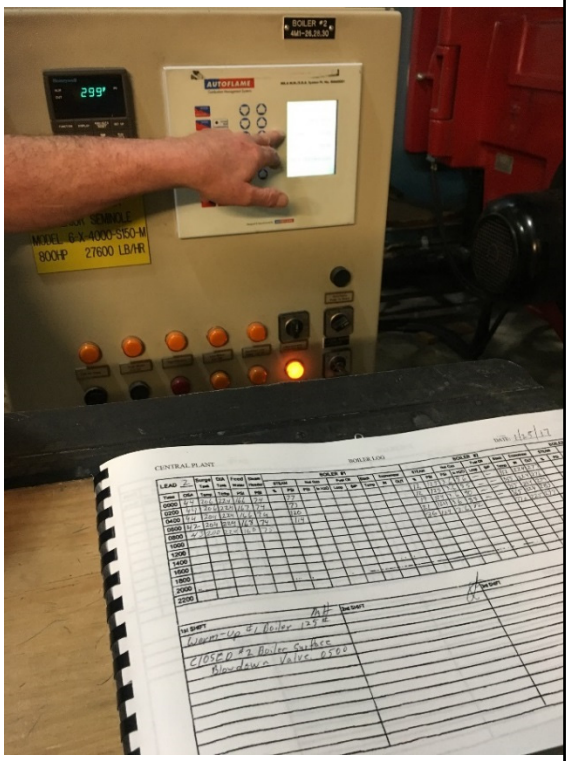
Application and Provider List Available at:
www.seattle.gov/buildingtuneups click on Accelerator
"How to Enroll in the Accelerator"

Accelerator Overview – Assessment Phase



ASSESSMENT: On-Site Building Assessment

- SCL **Participation Agreement** in place?
- "Walkthrough" / BAS trending and billing analysis
- Borrow tools from **SBC Tool Lending Library**
- Assess **Seattle Building Tune-Ups** elements (at minimum) & Benchmarking Verification
- Collect **Asset Score** required fields.



SCL PARTICIPATION AGREEMENT

ON-SITE BLDG ASSESSMENT

ASSET SCORE DATA COLLECTION

ASSESSMENT: Got City Light Interval Data?

- About 50 downtown buildings in the 50K-100K range have 15-minute electric interval data
- Pilot test of **Virtual Energy Assessment (VEA)** for these buildings to use with your Assessment.
- We will let owners know if **VEA** is an option.

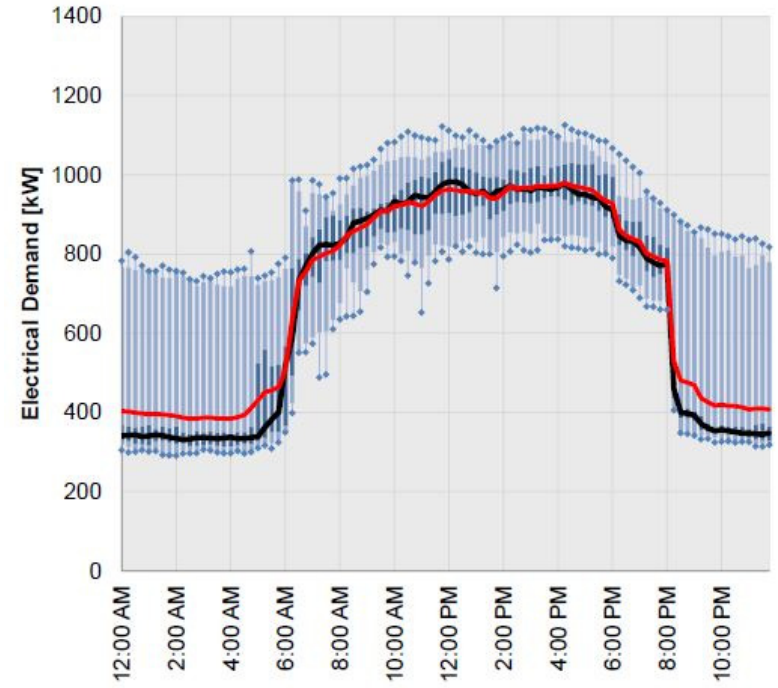


Image source: SBW

ASSESSMENT: Asset Score Data Collection

- Free web-based tool developed by that generates a “score” and suggest potential improvements.
- Accelerator Program is using to collect more building asset details to inform retrofit opportunities.
- Program wants to determine if this information helps motivate owners to take action beyond what is required by the tune-up.

https://buildingenergyscore.energy.gov

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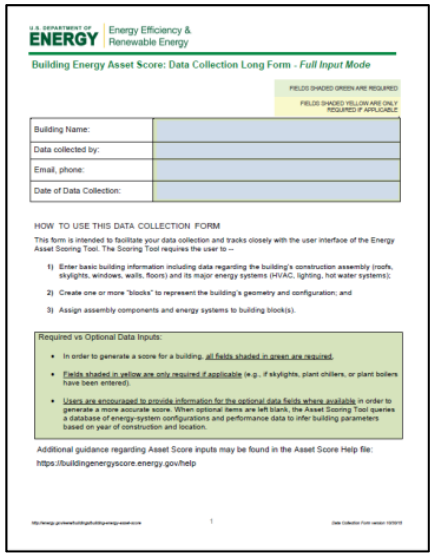
U.S. DEPARTMENT OF ENERGY

ASSESSMENT: Asset Score Incentive Options

A – $600 Incentive to Provider

- Return completed PDF form to OSE no later than 15 days after Assessment
- Provider sends invoice to OSE
- Asset Score Report provided to you and Owner.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Building Energy Asset Score: Data Collection Long Form - *Full Input Mode*

FIELDS SHADED GREEN ARE REQUIRED

FIELDS SHADED YELLOW ARE ONLY REQUIRED IF APPLICABLE

Building Name:	
Data collected by:	
Email, phone:	
Date of Data Collection:	

HOW TO USE THIS DATA COLLECTION FORM

This form is intended to facilitate your data collection and tracks closely with the user interface of the Energy Asset Scoring Tool. The Scoring Tool requires the user to –

1) Enter basic building information including data regarding the building's construction assembly (roofs, skylights, windows, walls, floors) and its major energy systems (HVAC, lighting, hot water systems);
2) Create one or more "blocks" to represent the building's geometry and configuration; and
3) Assign assembly components and energy systems to building block(s).

Required vs Optional Data Inputs:

- In order to generate a score for a building, all fields shaded in green are required.
- Fields shaded in yellow are only required if applicable (e.g., if skylights, plant chillers, or plant boilers have been entered).
- Users are encouraged to provide information for the optional data fields where available in order to generate a more accurate score. When optional items are left blank, the Asset Scoring Tool queries a database of energy-system configurations and performance data to infer building parameters based on year of construction and location.

Additional guidance regarding Asset Score inputs may be found in the Asset Score Help file:
https://buildingenergyscore.energy.gov/help

B – $1,000 Incentive to Provider

- Enter data into online tool, run report & provide to Owner
- Share online report with Accelerator (see handout)
- Provider sends invoice to OSE

https://buildingenergyscore.energy.gov

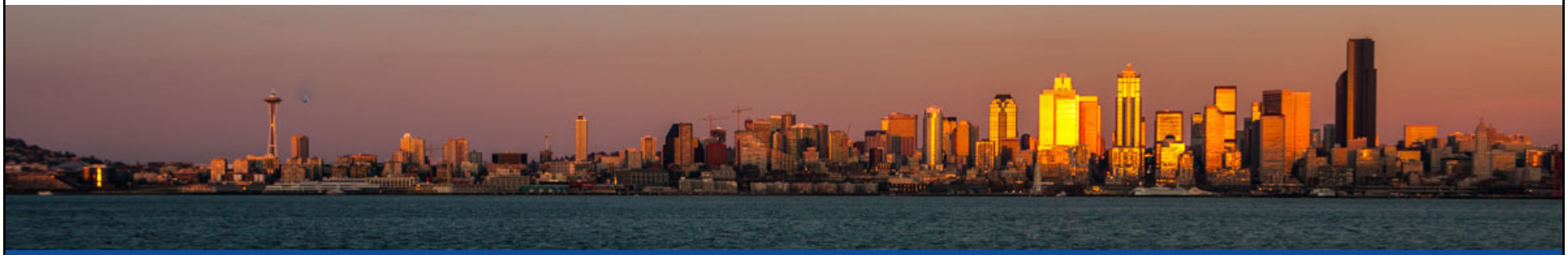
ASSESSMENT: Your Provider Report to Owner

- After Assessment is complete, your own report to Owner
  - Identifies “Corrective Actions” to meet BTU requirements
  - Recommendations additional opportunities (Capital ECMs, other O&M, Renewal, etc.)
  - Your firm, owner staff or other vendor might implement
- Report needed for SCL Basic Tune-Up incentive

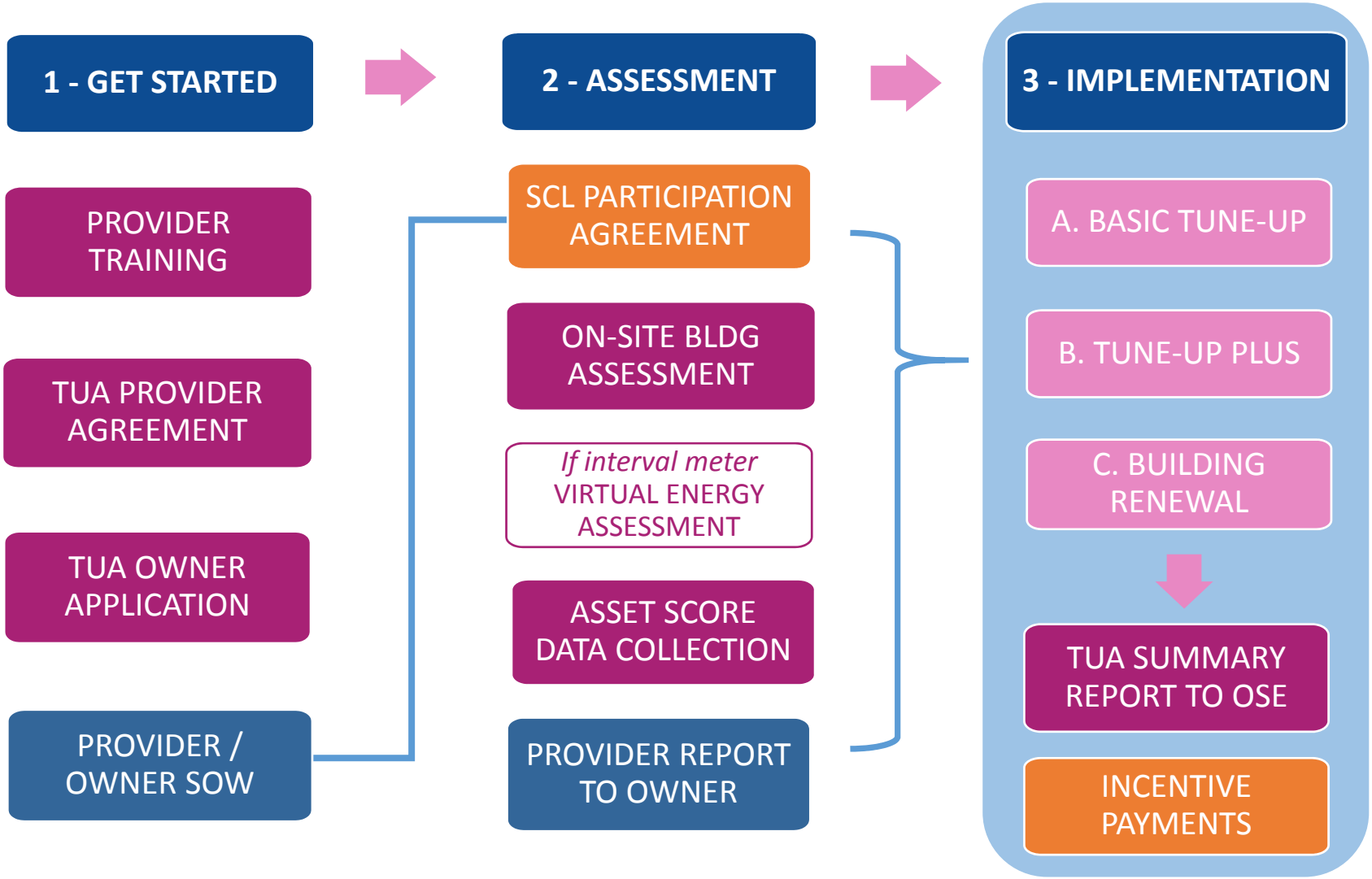
PROVIDER REPORT TO OWNER

ASSESSMENT: Accelerator Deliverables

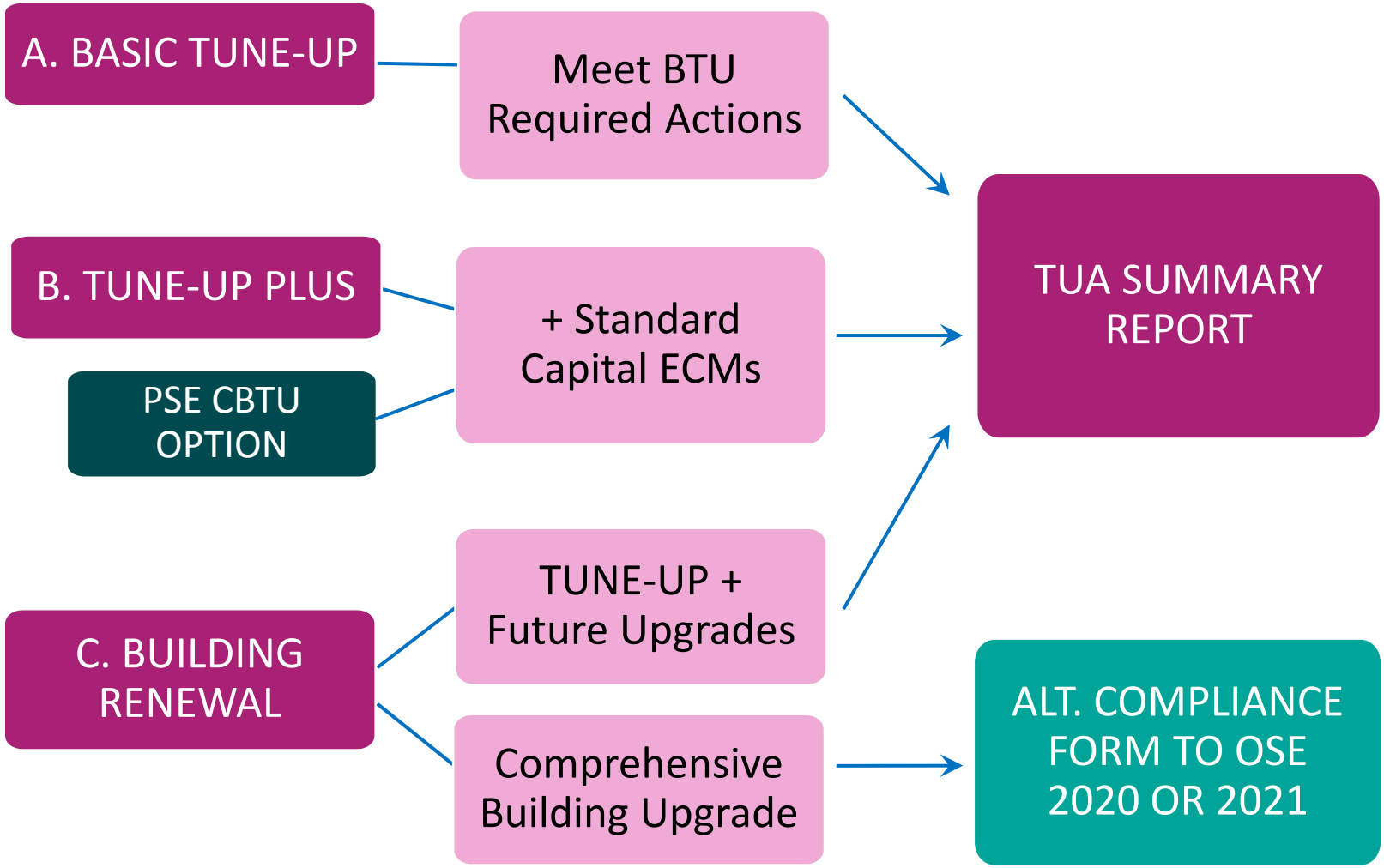
- ✓Building Assessment *by 8/30/2018*
- ✓Complete Asset Score data collection (15 days after assessment)
- ✓**Building Assessment incentive issued to Building Owner**



Accelerator Overview – Implementation Phase



IMPLEMENTATION: Options



A. BASIC TUNE-UP INCENTIVE

Incentives **per SF**

A. BASIC TUNE-UP

Seattle City Light

- ☐ Up to **$0.12*** per SF
  - **$.03 per SF** City Light incentive for on-site Building Assessment
  - **$.09 per SF** City Light incentive for Required Actions
- ☐ **Complete all required corrective actions for Seattle Building Tune-Ups & submit Summary Report**
- ☐ Pilot test of Virtual Energy Assessments
  - Available for ~60 buildings w/ interval meters

EXAMPLE:

75,000 SF Building

- Up to $9,000 Total
- $2,250 after assessment
- Up to $6,750 at completion

**Incentive capped at 70% of tune-up costs*

B. TUNE-UP PLUS INCENTIVE

Incentives **per SF**

B. TUNE-UP PLUS

Seattle City Light

☐ Basic Tune-Up (up to $0.12 per SF)

☐ **PLUS Capital ECMs (SCL or PSE)** with incentives based on standard programs

- Lighting, HVAC, etc.
- Advanced Rooftop Controller Rebate
- PSE incentives as applicable

EXAMPLE:

75,000 SF Building

- Up to $9,000 Total
- $2,250 after assessment
- Up to $6,750 at completion*

+ ECM Example

- Standard SCL lighting retrofit covers 40-70% of project cost

**Incentives capped at 70% of tune-up costs*

B. TUNE-UP PLUS – CBTU OPTION

- Building has significant heating and/or cooling natural gas use?
- Does owner wish to pursue a more comprehensive commissioning approach?
- Pre-approval by PSE & use of PSE approved provider required.
- Discuss first with PSE to see if gas use and potential savings qualifies – then work with City Light.

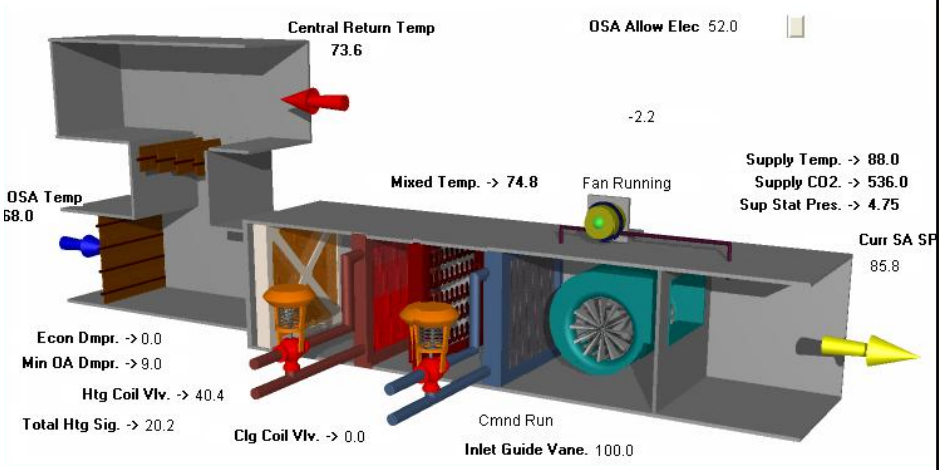
PSE PUGET SOUND ENERGY

PSE CBTU ASSESSMENT AGREEMENT

C. BUILDING RENEWAL – DEEPER SAVINGS

Resources for up to **25 participant buildings** pursuing deeper energy savings through building renewal at **three levels of project engagement**.

- SPARK Analysis
- Technical Assistance for Goal Setting/Lighting/Controls Retrofit Evaluation/Envelope upgrades
- Engineering Analyses
- SCL and PSE standard incentives could apply for deep retrofits



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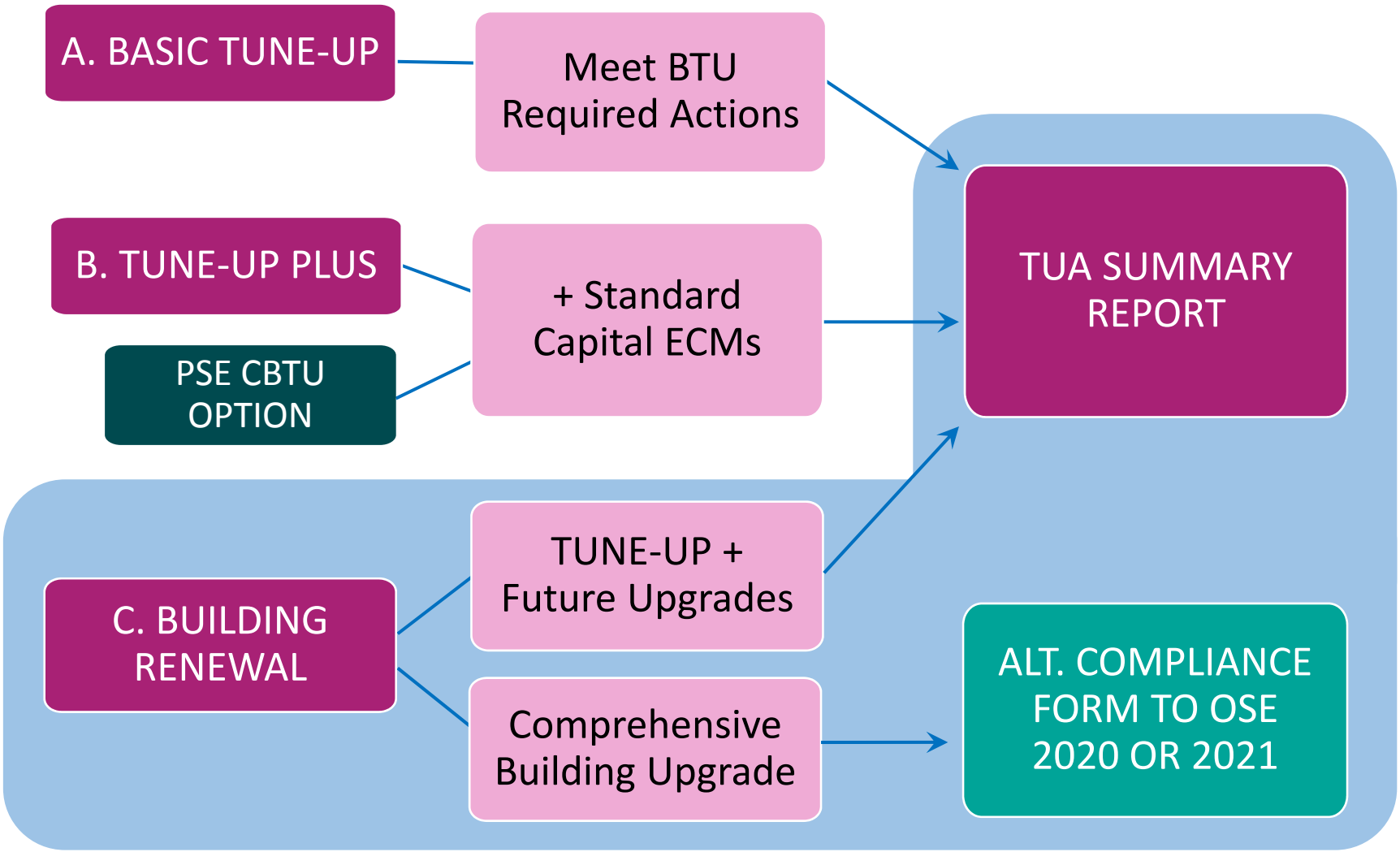
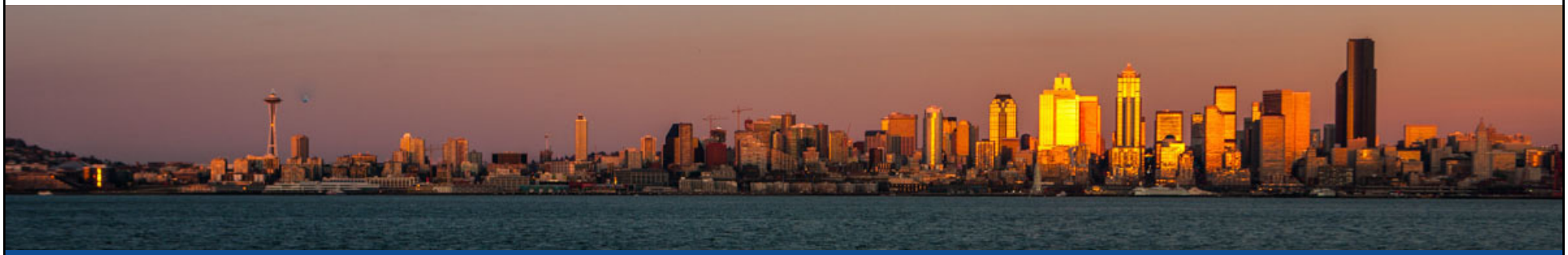
IMPLEMENTATION: Options



IMPLEMENTATION: Accelerator Deliverables

- ✓Send complete **TUA Summary Report** to OSE by June 30, 2019 or sooner
- ✓Complete all utility deliverables needed for incentive payments to building owner
- ✓**Final Tune-Up incentive $ issued to Building Owner**
- ✓Additional incentive $ if enrolled in Tune-Up Plus or Building Renewal



Accelerator M & V of Buildings

- About 10% of buildings will be asked to participate in Measurement and Verification (M & V)
- Goal is to look at projected vs. measured savings.
- May require one or more site visits to set up & retrieve data loggers.
- Results will not impact utility incentives.

Accelerator – Evaluation & Refinement

Program Final Report to DOE

- Energy and GHG savings analysis for program impact
- Pre and post tune-up energy use by fuel source (as available)
- Effectiveness of Asset Score as an analytic tool
- High level review of tune-up measures implemented
- Qualitative assessment of what motivated owners – tools, support, data, incentives.
- Case Studies

Program Refinement and Scalability

- Recommendation for establishing long-term owner assistance and engagement
- Recommendation to OSE for Building Tune-Ups Rule updates

Data Privacy

- All building data in public reports will be anonymized or in aggregate groupings.
- Building owner, service provider names and identifying project details will only be used with permission.
- Personal information is subject to Washington Public Records Act, and may be subject to disclosure to a third-party requestor.

Helpdesk Support from SBC

Help Desk Hotline

206-800-7211

Help Desk Email

accelerator@seattle.gov

SMART BUILDINGS CENTER A project of NEEC

Next Steps

- Financing options under consideration
- Service Provider agreement
- Sign-up buildings to participate!

QUESTIONS ?

TUNE-UP ACCELERATOR SUMMARY REPORT DEMO

SEATTLE
BUILDING TUNE-UP ACCELERATOR

15 Minute Break

SEATTLE
BUILDING TUNE-UP ACCELERATOR

DOE Building Energy Asset Score

PRESENTED BY:

Richard Fowler and Juan Gonzalez, PNNL
Energy Asset Score Technical Support
asset.score@pnnl.gov
buildingsenergyscore.energy.gov

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U.S. DEPARTMENT OF ENERGY

Learning Objectives and Course Outline

Learning Objectives

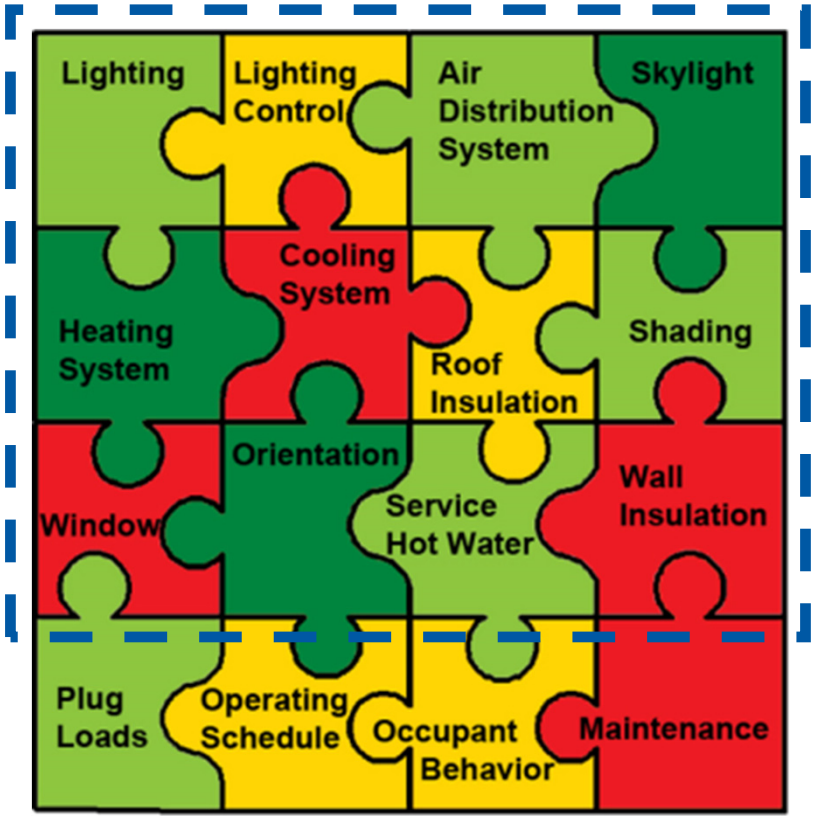
- Awareness of the Asset Score tool
- Understand basics of data collection, tool navigation, data entry, and score reports
- Insight into tool best practices
- Know where to go for help and additional resources

Course Outline

I. Introduction to Asset Score
II. Data Collection
III. Using Asset Score: Entering Data and Generating Score Reports

What is Building Energy Asset Score?

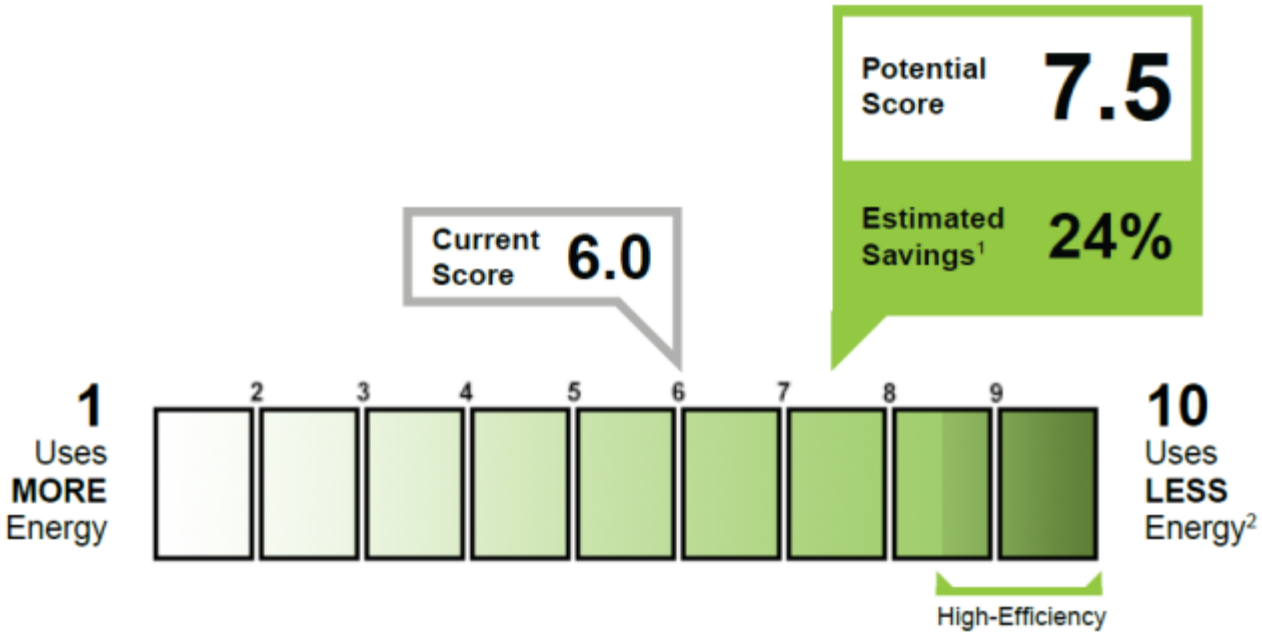
- Free web-based tool for assessing the physical and structural energy efficiency of commercial and multifamily residential buildings
- Evaluates building energy "assets": envelope and major energy-related systems and equipment
- Identifies opportunities for improvement



BUILDING ENERGY ASSET SCORE

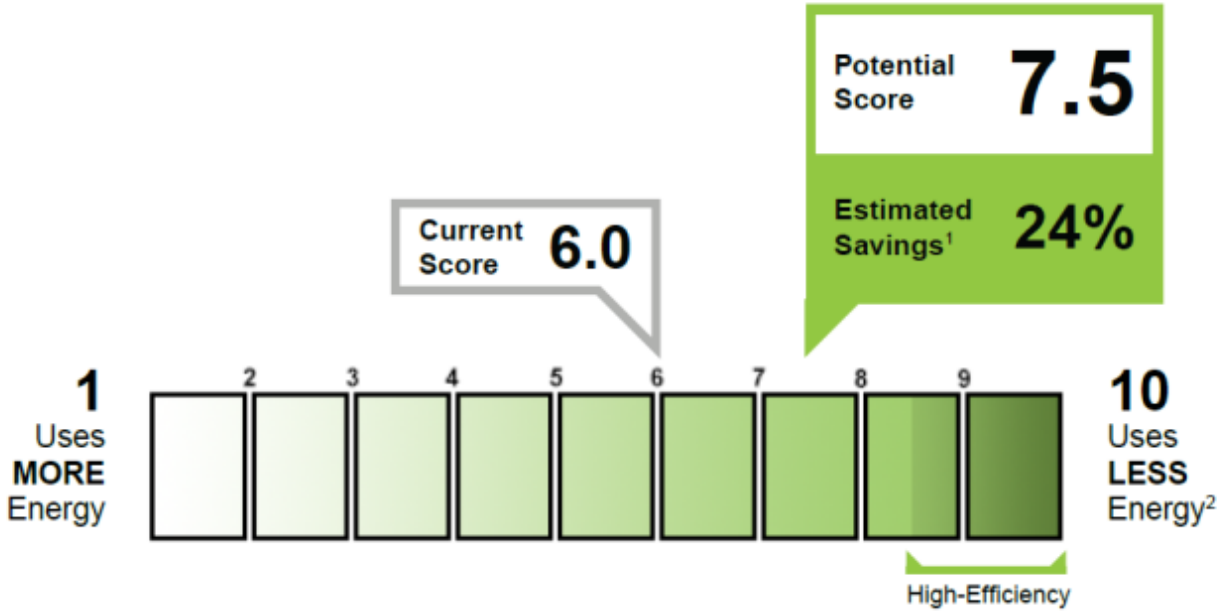
What Does the Asset Score Tool Do?

- Generates an energy **asset score** and produces an **asset score report**



BUILDING ENERGY ASSET SCORE

Asset Score Scale



Key components:

- Shaded 10-point gradient represents a building's efficiency
- Current Score
- Potential Score
- Estimated savings

BUILDING ENERGY ASSET SCORE

Why was the Asset Score Tool Developed?

- Expand nationwide awareness of opportunities to invest in building energy upgrades.
- Quick, easy to use tool to help guide energy improvement decisions and investments.
- Not intended as a replacement for building energy usage benchmarking or building energy audits, but a complimentary tool
- Help make your job easier and faster
- Thousands in savings identified to date by users such as NOAA, Murphy & Miller, Inc., Missouri Department of Economic Development




BUILDING ENERGY ASSET SCORE

Asset Score and the Tune-Up Accelerator Program

- Why is Asset Score a part of the Tune-Up Accelerator Program?

- What will DOE/OSE do with the collected data?

BUILDING ENERGY ASSET SCORE

How Do I Score a Building?

Three Steps:

1. Collect Building Data During “Assessment” Phase
2. Enter Data into the Asset Score Tool
3. Generate an Asset Score Report

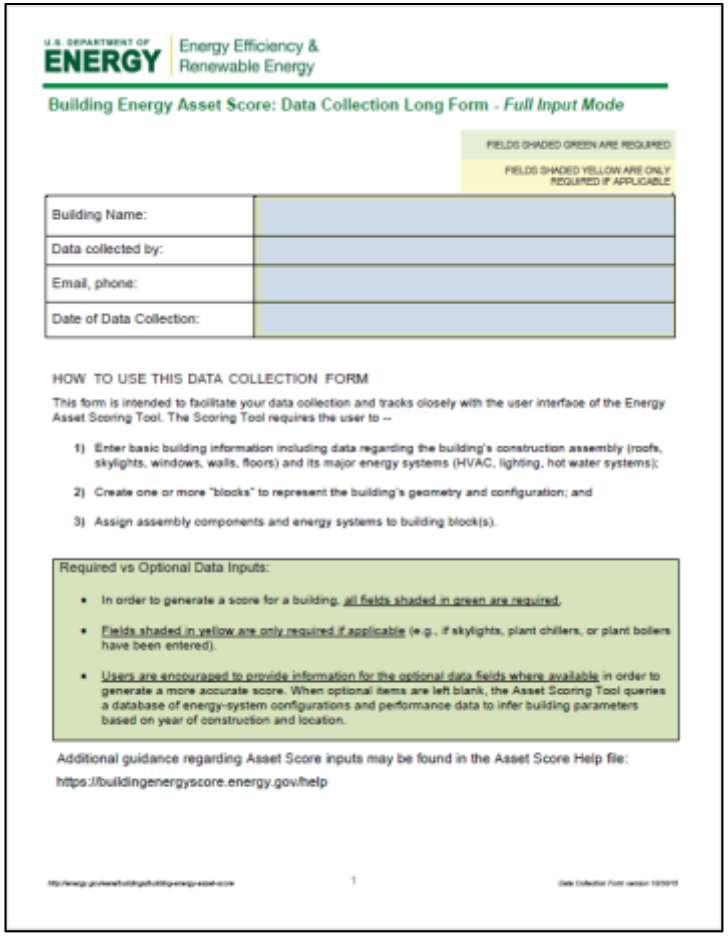
BUILDING ENERGY ASSET SCORE

Data Collection Method and Forms

- Perform a building walkthrough
- Record data
- Asset Score Data Collection Form:

Short form: minimum required data fields necessary to generate an Asset Score; simple building and limited knowledge of asset details

Long form: all building shapes, mixed use types, complex HVAC systems, all tool input fields



U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Building Energy Asset Score: Data Collection Long Form - *Full Input Mode*

FIELDS SHADED GREEN ARE REQUIRED

FIELDS SHADED YELLOW ARE ONLY REQUIRED IF APPLICABLE

Building Name:	
Data collected by:	
Email, phone:	
Date of Data Collection:	

HOW TO USE THIS DATA COLLECTION FORM

This form is intended to facilitate your data collection and tracks closely with the user interface of the Energy Asset Scoring Tool. The Scoring Tool requires the user to --

1) Enter basic building information including data regarding the building's construction assembly (roofs, skylights, windows, walls, floors) and its major energy systems (HVAC, lighting, hot water systems);
2) Create one or more "blocks" to represent the building's geometry and configuration; and
3) Assign assembly components and energy systems to building block(s).

Required vs Optional Data Inputs:

- In order to generate a score for a building, all fields shaded in green are required.
- Fields shaded in yellow are only required if applicable (e.g., if skylights, plant chillers, or plant boilers have been entered).
- Users are encouraged to provide information for the optional data fields where available in order to generate a more accurate score. When optional items are left blank, the Asset Scoring Tool queries a database of energy-system configurations and performance data to infer building parameters based on year of construction and location.

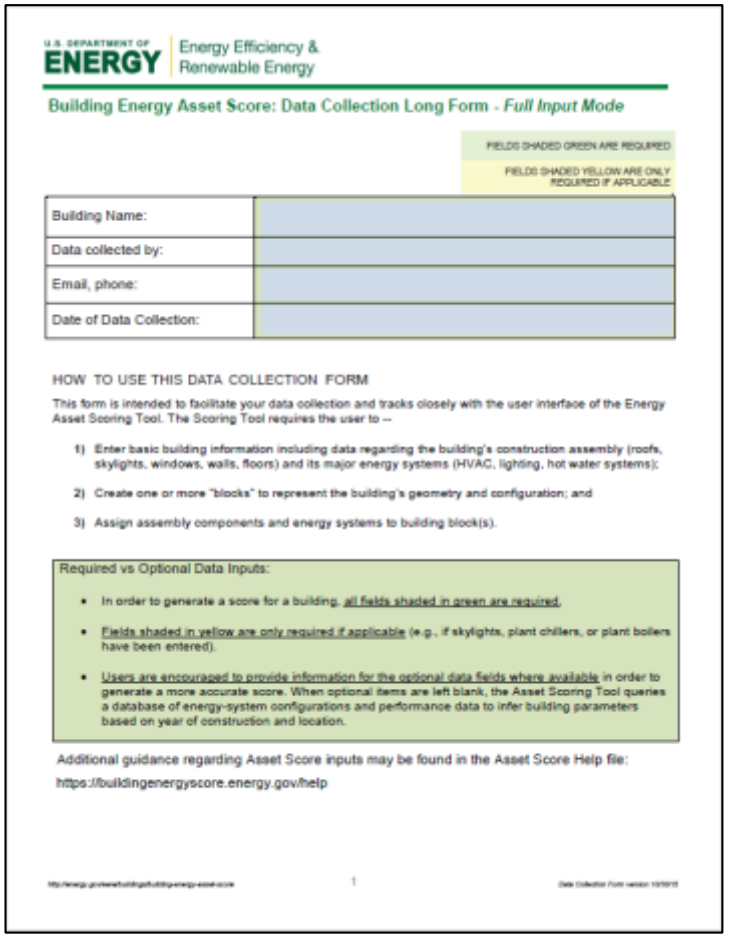
Additional guidance regarding Asset Score inputs may be found in the Asset Score Help file:
https://buildingenergyscore.energy.gov/help

https://buildingenergyscore.energy.gov/resources

BUILDING ENERGY ASSET SCORE

Data Collection Long Form

- Complete electronically or print out and complete manually
- Organized to match the data entry steps in the tool user interface
- **All fields shaded in green are required**
- Fields shaded in yellow are only required if applicable



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Additional guidance regarding Asset Score inputs may be found in the Asset Score Help file:
https://buildingenergyscore.energy.gov/help

BUILDING ENERGY ASSET SCORE

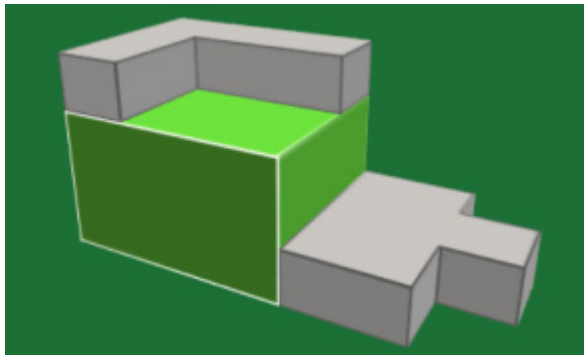
Data Collection Form - Required Fields

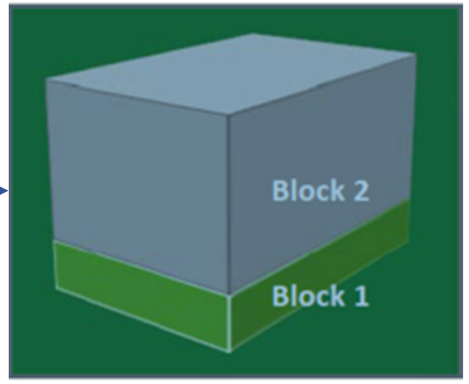
Required input fields for the following sections of the Data Collection Form and the Asset Score Tool include:

- **General Building Information:** Year of completion; gross floor area; location; building use type
- **Construction Properties (Envelope components):** Roof, exterior wall, and floor types; fenestration types and window to wall ratio
- **Lighting:** Fixture and mounting types, lamp wattage and lamps per fixture (to calculate lighting power density)
- **Heating and Cooling:** Heating and cooling source, distribution equipment type
- **Geometry:** Building ("block") footprint shape and dimensions, number of floors, floor-to-floor/ceiling height, orientation

Building Blocks

Graphical representations of your building's footprint and shape

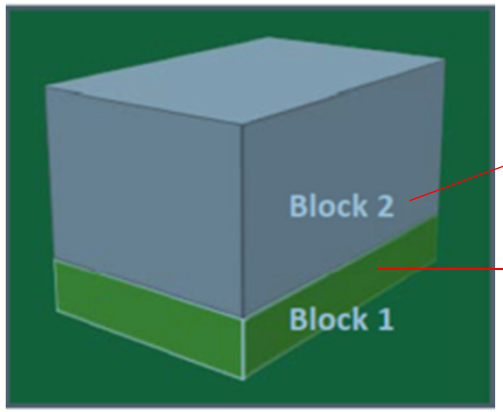




BUILDING ENERGY ASSET SCORE

General Building Information

- Accounts for the age of the building, its size, location, and use
- Building use type
  - Select from the 19 available use types
  - Make note of the square feet for each use type
  - For mixed-use buildings, choose up to 5 use types. Each use type must be >2500 sq ft and >5% of the total building GFA
  - See Use Type handout to compare to Tune-Up selections



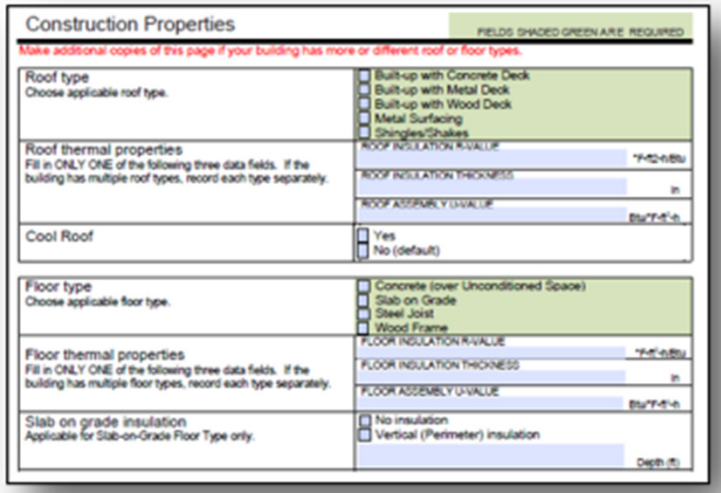
Office

Retail

BUILDING ENERGY ASSET SCORE

Construction Properties

- Physical characteristics of the building envelope: roofs, floors, walls, fenestration types
- Thermal properties
- Surface entries for walls and windows
- Window to Wall Ratio: calculate manually (continuous), or have the tool calculate (discrete); may use estimates



Construction Properties

FIELDS SHADED GREEN ARE REQUIRED

Make additional copies of this page if your building has more or different roof or floor types.

Roof type Choose applicable roof type.	☐ Built-up with Concrete Deck ☐ Built-up with Metal Deck ☐ Built-up with Wood Deck ☐ Metal Surfacing ☐ Shingles/Shakes
Roof thermal properties Fill in ONLY ONE of the following three data fields. If the building has multiple roof types, record each type separately.	ROOF INSULATION R-VALUE ROOF INSULATION THICKNESS ROOF ASSEMBLY U-VALUE
Cool Roof	☐ Yes ☐ No (default)
Floor type Choose applicable floor type.	☐ Concrete (over Unconditioned Space) ☐ Slab on Grade ☐ Steel Joist ☐ Wood Frame
Floor thermal properties Fill in ONLY ONE of the following three data fields. If the building has multiple floor types, record each type separately.	FLOOR INSULATION R-VALUE FLOOR INSULATION THICKNESS FLOOR ASSEMBLY U-VALUE
Slab on grade insulation Applicable for Slab-on-Grade Floor Type only.	☐ No insulation ☐ Vertical (Perimeter) insulation Depth (ft)

BUILDING ENERGY ASSET SCORE

Lighting

- Asset Scoring Tool needs a lighting power density (watts per square foot) value for each block
- Lighting fixture types and numbers, lamps and wattage
- Total # of fixtures vs. % area served: percent served is simpler and quicker in most situations

Fixture	Lighting type	Total Number of Fixtures	% Area Served	Occupancy Controls (yes/no)
a.	Compact fluorescent			
b.	Fluorescent T5			
c.	Fluorescent T5 - High Output			
d.	Fluorescent T8			
e.	Fluorescent T8 - High Efficiency			
f.	Fluorescent T12			
g.	High-pressure sodium			
h.	Incandescent/Halogen			
i.	LED			
j.	Mercury vapor			
k.	Metal halide			

BUILDING ENERGY ASSET SCORE

HVAC Systems

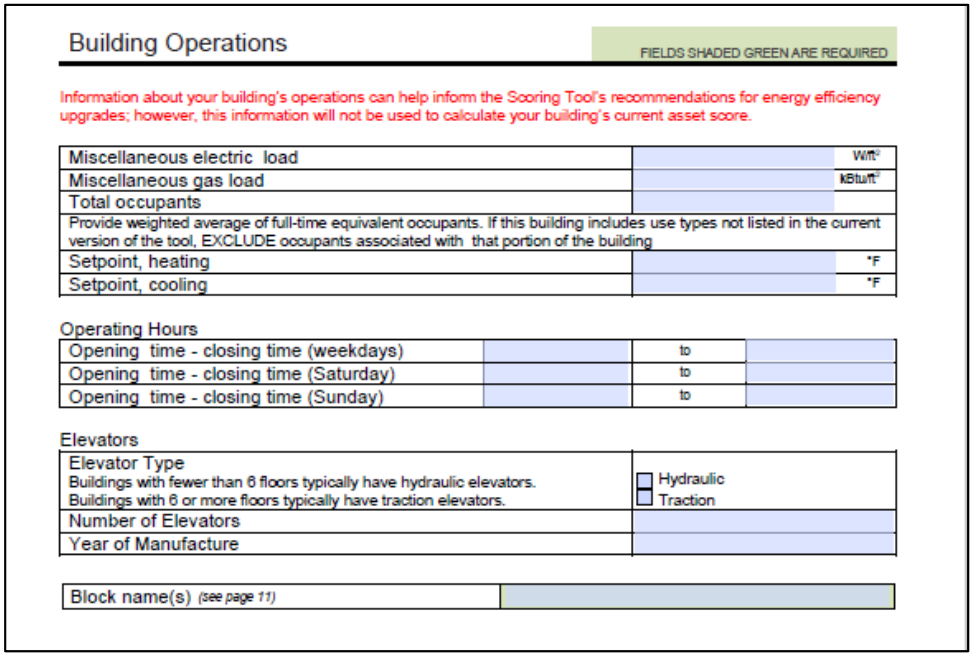
- HVAC System Types: helpful for data entry and/or if additional details are unknown
- Heating and Cooling Sources: Complete plant loop pages as necessary
- Equipment Details: Additional settings and options may be configured for quantity, capacity, efficiency
- Distribution Equipment (AHU vs. Zone Equipment): Additional settings and options may be configured for fan motors, controls, etc.
- Enter closest match if equipment or system is not listed, or see Users Guide or contact Help Desk for advice

https://help.buildingenergyscore.com

BUILDING ENERGY ASSET SCORE

Building Operations

- Optional: Inputs are not used to calculate the building's Asset Score
- Used to identify upgrade opportunities, which are considered in generating the potential score
- Operational and Equipment Sizing Assumptions:



Building Operations

FIELDS SHADED GREEN ARE REQUIRED

Information about your building's operations can help inform the Scoring Tool's recommendations for energy efficiency upgrades; however, this information will not be used to calculate your building's current asset score.

Miscellaneous electric load		W/ft²
Miscellaneous gas load		kBtu/ft²
Total occupants		
Provide weighted average of full-time equivalent occupants. If this building includes use types not listed in the current version of the tool, EXCLUDE occupants associated with that portion of the building		
Setpoint, heating		°F
Setpoint, cooling		°F

Operating Hours

Opening time - closing time (weekdays)		to	
Opening time - closing time (Saturday)		to	
Opening time - closing time (Sunday)		to	

Elevators

Elevator Type Buildings with fewer than 6 floors typically have hydraulic elevators. Buildings with 6 or more floors typically have traction elevators.	☐ Hydraulic ☐ Traction
Number of Elevators	
Year of Manufacture	

Block name(s) *(see page 11)*	

https://buildingenergyscore.energy.gov/assets/energy_asset_score_assumptions.pdf

BUILDING ENERGY ASSET SCORE

How Do I Score a Building?

Three Steps:

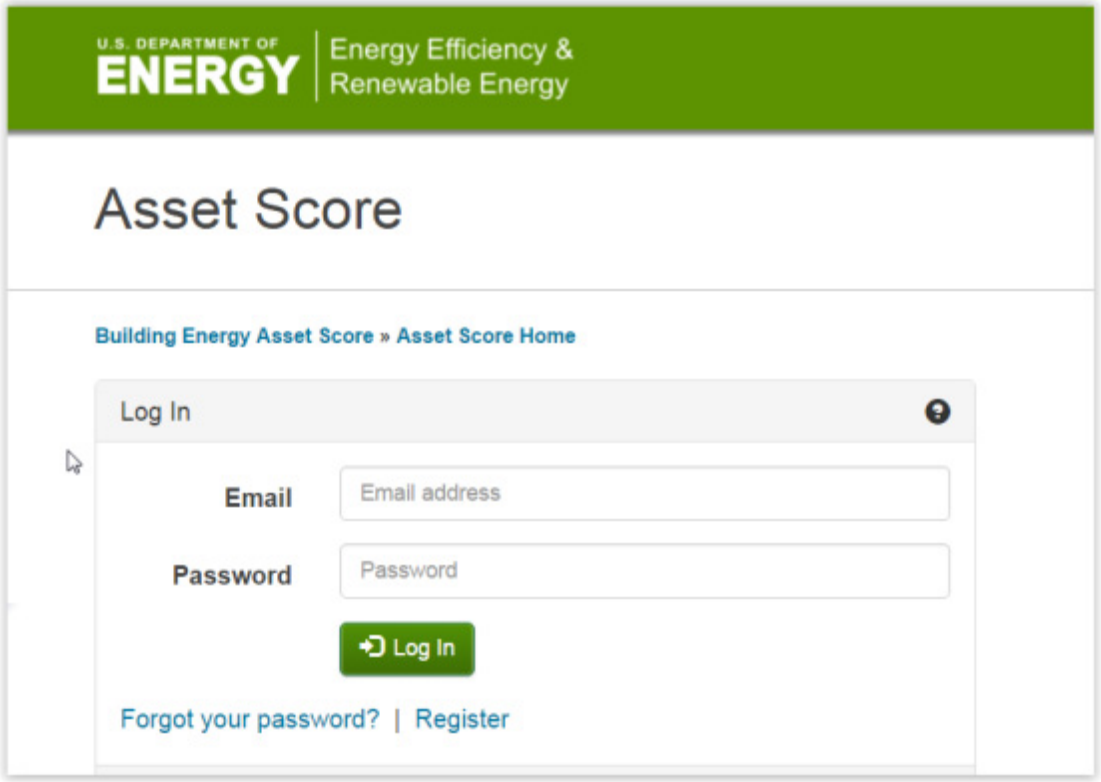
1. *Collect Building Data During "Assessment" Phase*
2. Enter Data into the Asset Score Tool
3. Generate an Asset Score Report

BUILDING ENERGY ASSET SCORE

Asset Score Tool

Create an account, register, log in:

https://buildingenergyscore.energy.gov



Create a Building

Quick Start Guide -- 6-Step Process

https://buildingenergyscore.energy.gov/assets/asset_score_quick_start_guide.pdf

Step 1: Input Basic Building Information

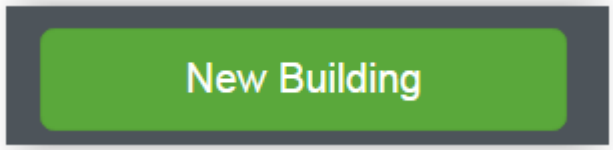
Step 2: Identify Building Use Types

Step 3: Create Inventory of Building Features

Step 4: Create a 3-D Image of the Building

Step 5: Assign Use Types and Components

Step 6: Score your Building and Review Asset Score Report



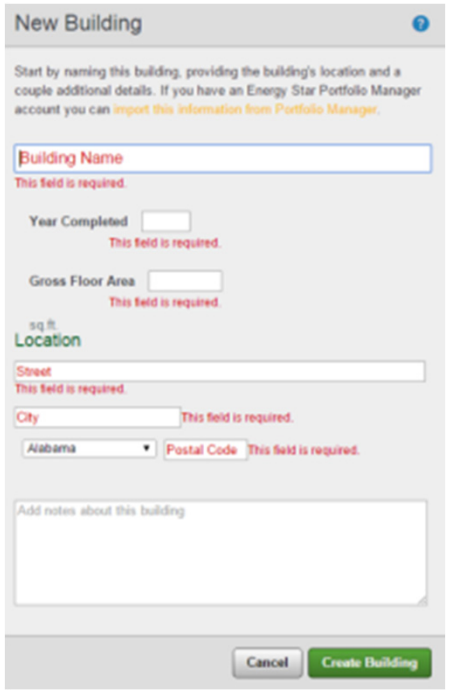
BUILDING ENERGY ASSET SCORE

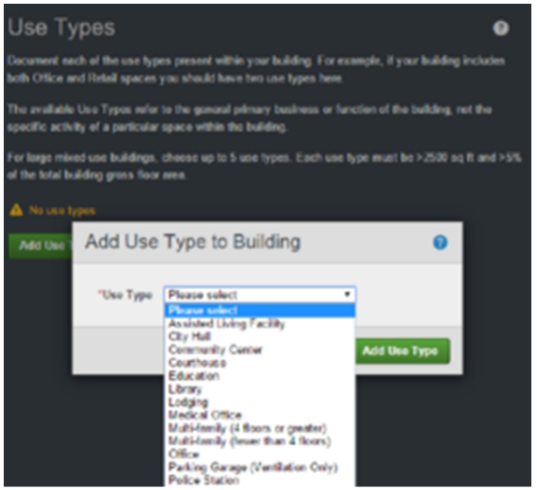
Steps 1-3: Input Data

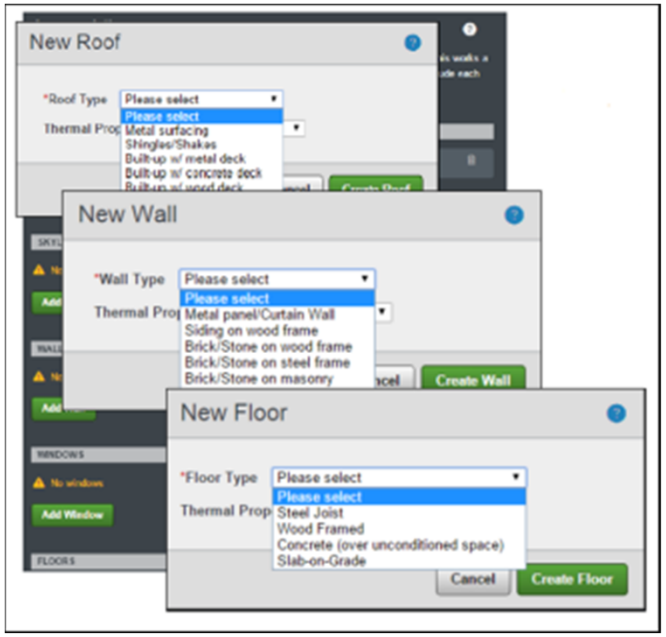
Step 1: Input Basic Building Information *(Optional: may import from ESPM)*

Step 2: Identify Building Use Types

Step 3: Create Inventory of Building Features

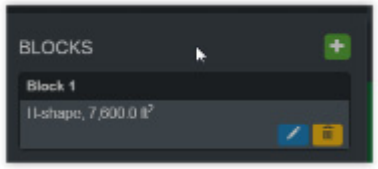


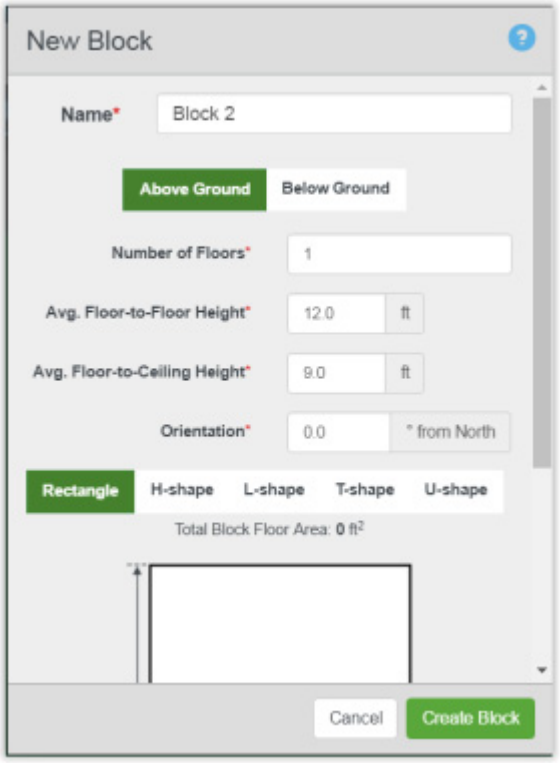


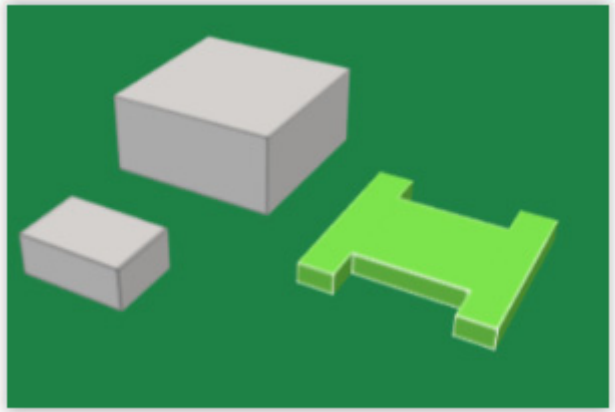


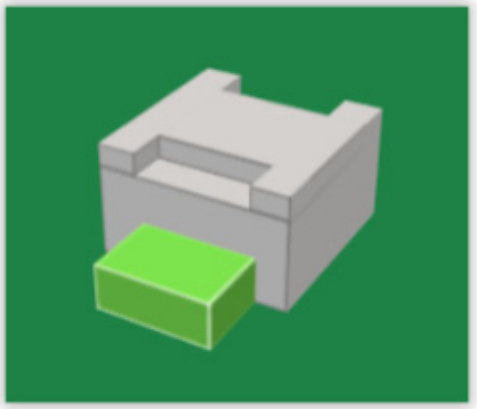
BUILDING ENERGY ASSET SCORE

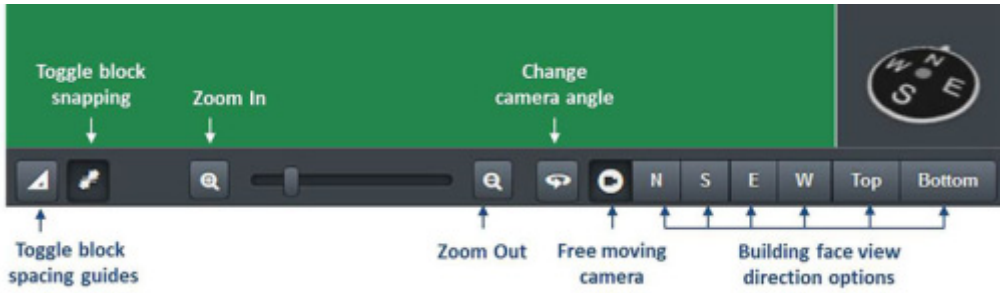
Step 4: Create a 3-D Image of the Building







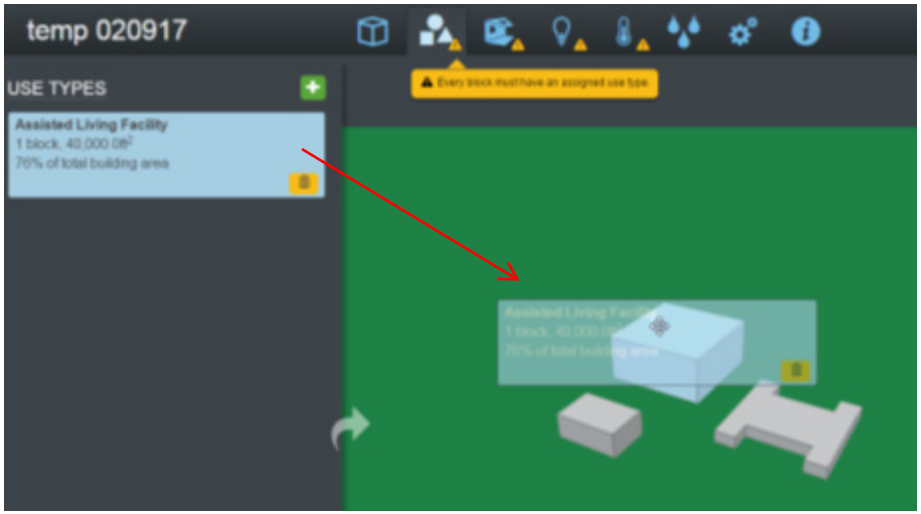


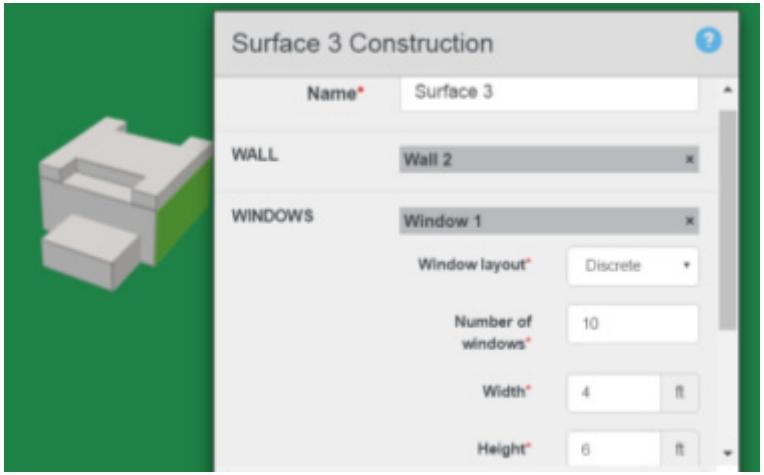


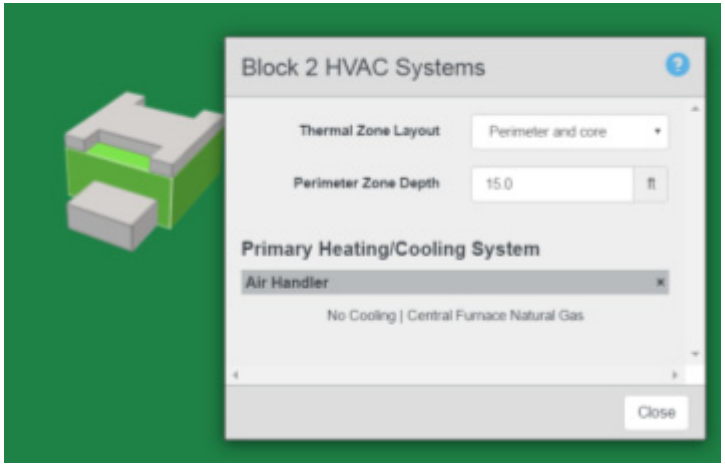
BUILDING ENERGY ASSET SCORE

Step 5: Assign Use Types and Components

- Drag and drop assets onto blocks
- Click blocks to add details for surfaces, lighting, HVAC, water heaters

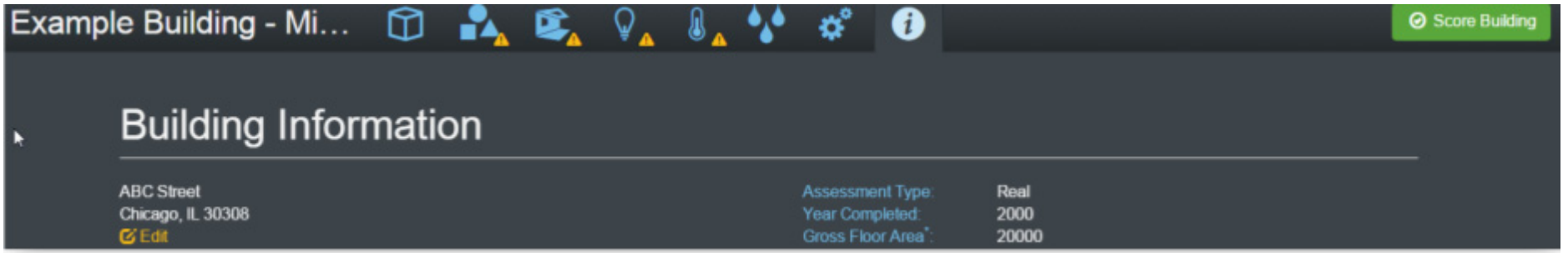






BUILDING ENERGY ASSET SCORE

Step 6: Score Building and Review Score Report



- Review inputs
- Select Score button
- Wait for Email notification
- My Buildings page status icons
- Download report
- Return to edit mode
- Duplicate buildings

BUILDING ENERGY ASSET SCORE

Asset Score Report

- Review score results and report sections
- See score report and building upgrade guides for details – available from the Resources page

Overall Building Score

Upgrade Opportunities

Structure and Systems

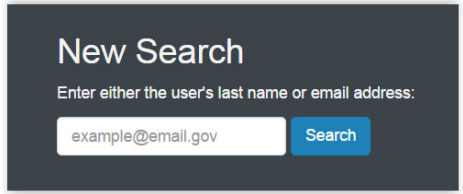
Building Assets

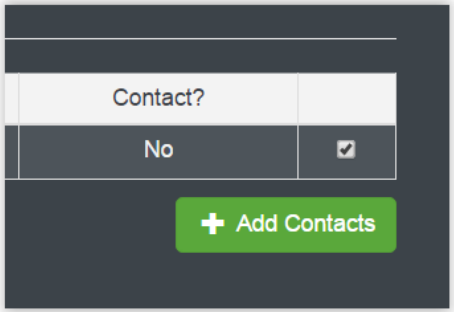
BUILDING ENERGY ASSET SCORE

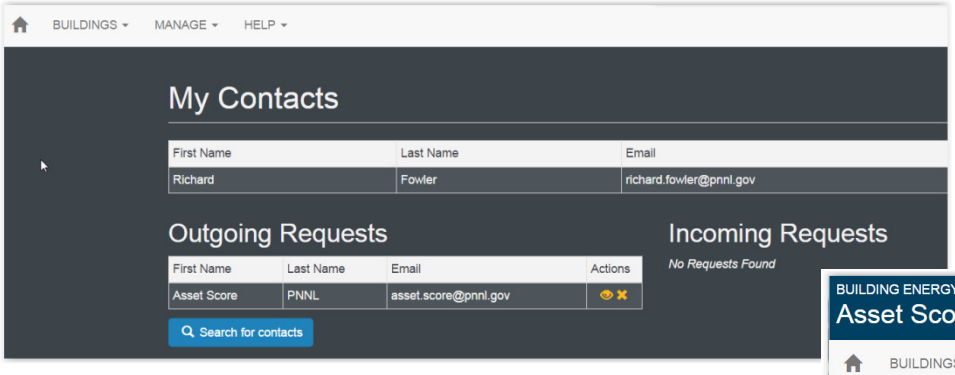
Creating Contacts and Sharing Buildings

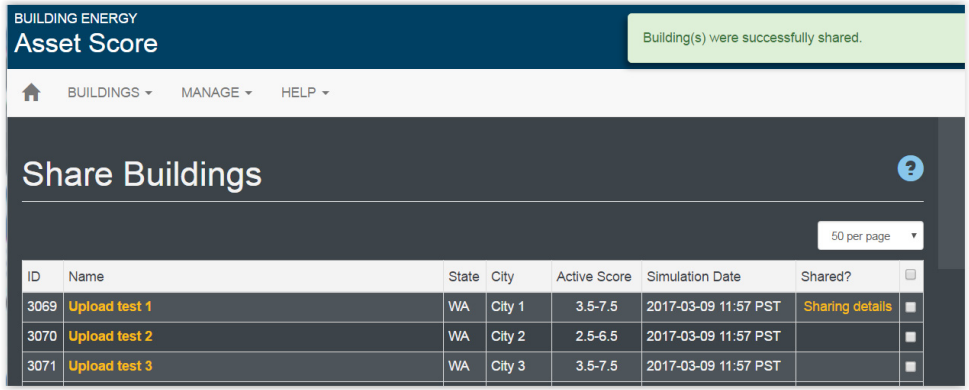
Share buildings with contacts:

- Add Contacts
- Share Buildings







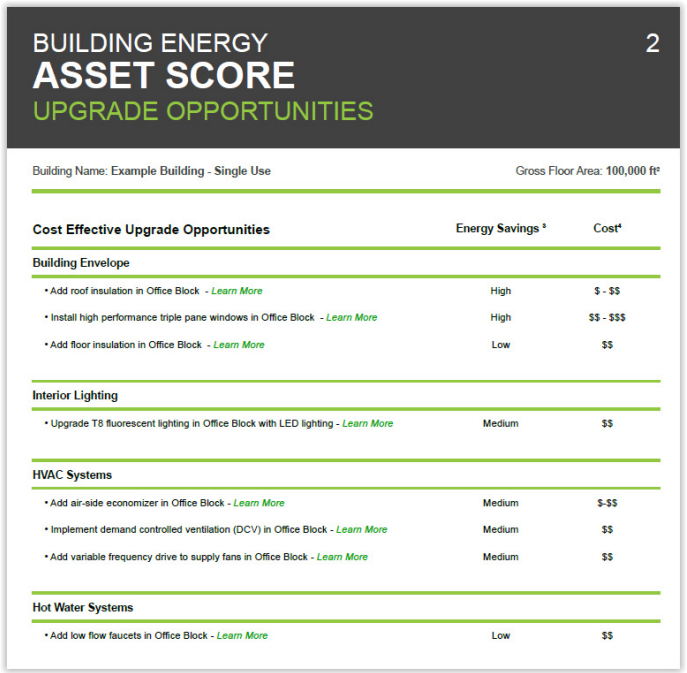


Using Asset Score with the Accelerator Program

- Share building entries with the Tune-Up Accelerator Program: see handout for instructions
- Options for help with entering data: contact Nicole Ballinger, Building Tune-Up Accelerator Program Manager

- Where to go from here?
  - Take action on recommended upgrades
  - Identify opportunities for deeper energy savings analysis and goal setting
  - Building Renewal - University of Washington Integrated Design Lab

Seattle
Office of Sustainability
& Environment



BUILDING ENERGY
ASSET SCORE 2
UPGRADE OPPORTUNITIES

Building Name: Example Building - Single Use — Gross Floor Area: 100,000 ft²

Cost Effective Upgrade Opportunities	Energy Savings [3]	Cost[4]
Building Envelope		
• Add roof insulation in Office Block - *Learn More*	High	$ - $$
• Install high performance triple pane windows in Office Block - *Learn More*	High	$$ - $$$
• Add floor insulation in Office Block - *Learn More*	Low	$$
Interior Lighting		
• Upgrade T8 fluorescent lighting in Office Block with LED lighting - *Learn More*	Medium	$$
HVAC Systems		
• Add air-side economizer in Office Block - *Learn More*	Medium	$-$$
• Implement demand controlled ventilation (DCV) in Office Block - *Learn More*	Medium	$$
• Add variable frequency drive to supply fans in Office Block - *Learn More*	Medium	$$
Hot Water Systems		
• Add low flow faucets in Office Block - *Learn More*	Low	$$

BUILDING ENERGY
ASSET SCORE

Future Asset Score tool feature: Audit Template

- Collect, store and report building energy audit data
- Includes fields present in an ASHRAE Level 2 audit
- Audit data report may be submitted to cities to demonstrate audit completion
- Report includes calculated tables and charts outlining building energy use
- Contact asset.score@pnnl.gov for beta access

BUILDING ENERGY 1
AUDIT DATA REPORT
OVERVIEW

BUILDING INFORMATION

Example Building
123 Main Street
Washington, DC 20037

Report Type: Alternate City Report
Gross Floor Area: 418,000 ft²
Year Built: 1975

Report Date: October 31, 2016
Building ID #: 979
Software Release: 2.1.0

AUDIT TEAM

Energy Services, Inc.
123 Park Street
Washington, DC 20037
(202) 123-4567

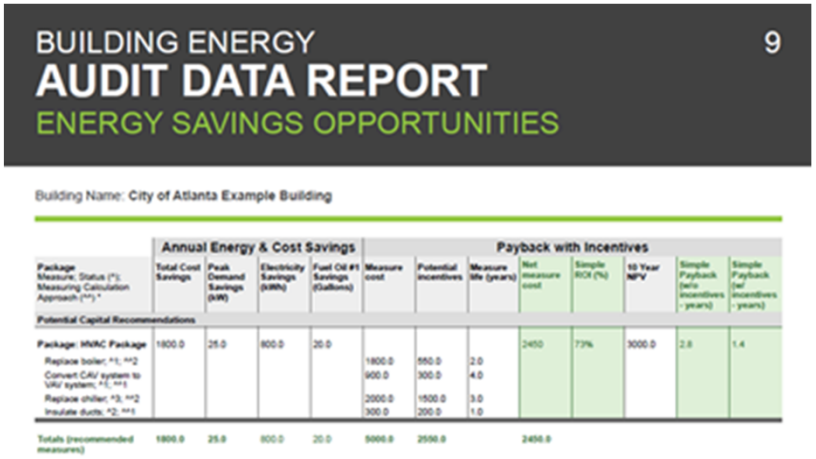
DATA SUMMARY

This report was generated from data entered into the Building Energy Asset Score (Asset Score) tool, developed by the Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy (DOE). Asset Score is a national standardized tool for assessing the physical and structural energy efficiency of commercial and multifamily residential buildings. It also facilitates building energy audit data collection and reporting.

This report follows the ASHRAE/ACCA Standard 211P, Standard for Commercial Building Energy Audits. It also includes additional data fields required by specific cities, where applicable. The icons below identify data categories.

ASHRAE Level 2 inputs
City specific inputs

If this report is used to comply with a local energy audit ordinance, the fields marked with "*" indicate the minimum data to be reported. The audit team listed above is responsible for any information entered and reported through Asset Score. DOE and PNNL do not warranty data accuracy, completeness, legality, and reliability.



BUILDING ENERGY 9
AUDIT DATA REPORT
ENERGY SAVINGS OPPORTUNITIES

Building Name: City of Atlanta Example Building

Package Measure; Status (*); Measuring Calculation Approach (**) *	Annual Energy & Cost Savings: Total Cost Savings	Peak Demand Savings (kW)	Electricity Savings (kWh)	Fuel Oil #1 Savings (Gallons)	Payback with Incentives: Measure cost	Potential incentives	Measure life (years)	Net measure cost	Simple ROI (%)	10 Year NPV	Simple Payback (w/o incentives - years)	Simple Payback (w/ incentives - years)
Potential Capital Recommendations												
Package: HVAC Package	1800.0	25.0	800.0	20.0				2450	73%	3000.0	2.8	1.4
Replace boiler; *1; **2					1800.0	550.0	2.0					
Convert CAV system to VAV system; *1; **					900.0	300.0	4.0					
Replace chiller; *3; **2					2000.0	1500.0	3.0					
Insulate ducts; *2; **					300.0	200.0	1.0					
Totals (recommended measures)	1800.0	25.0	800.0	20.0	5000.0	2550.0		2450.0				

BUILDING ENERGY ASSET SCORE

Additional Resources

- Resources page

  https://buildingenergyscore.energy.gov/resources

- Asset Score Help Desk

  https://help.buildingenergyscore.com/

- DOE FAQ page

  https://energy.gov/eere/buildings/building-energy-asset-score-frequently-asked-questions

- Handouts
- PNNL and OSE staff

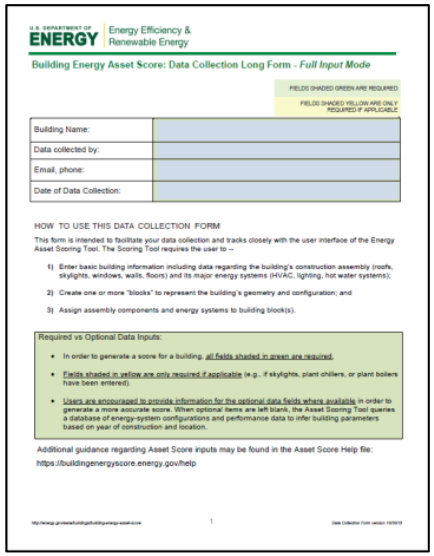
Conclusion

- Review objectives
- Thank you!
- Questions?

ASSESSMENT: Asset Score Incentive Options

A – $600 Incentive to Provider

- Return completed PDF form to OSE no later than 15 days after Assessment
- Provider sends invoice to OSE
- Asset Score Report provided to you and Owner.


U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Building Energy Asset Score: Data Collection Long Form - *Full Input Mode*

FIELDS SHADED GREEN ARE REQUIRED

FIELDS SHADED YELLOW ARE ONLY REQUIRED IF APPLICABLE

Building Name:	
Data collected by:	
Email, phone:	
Date of Data Collection:	

HOW TO USE THIS DATA COLLECTION FORM

This form is intended to facilitate your data collection and tracks closely with the user interface of the Energy Asset Scoring Tool. The Scoring Tool requires the user to --

1) Enter basic building information including data regarding the building's construction assembly (roofs, skylights, windows, walls, floors) and its major energy systems (HVAC, lighting, hot water systems);
2) Create one or more "blocks" to represent the building's geometry and configuration; and
3) Assign assembly components and energy systems to building block(s).

Required vs Optional Data Inputs:

- In order to generate a score for a building, all fields shaded in green are required.
- Fields shaded in yellow are only required if applicable (e.g., if skylights, plant chillers, or plant boilers have been entered).
- Users are encouraged to provide information for the optional data fields where available in order to generate a more accurate score. When optional items are left blank, the Asset Scoring Tool queries a database of energy-system configurations and performance data to infer building parameters based on year of construction and location.

Additional guidance regarding Asset Score inputs may be found in the Asset Score Help file:
https://buildingenergyscore.energy.gov/help

B – $1,000 Incentive to Provider

- Enter data into online tool, run report & provide to Owner
- Share online report with Accelerator (see handout)
- Provider sends invoice to OSE

https://buildingenergyscore.energy.gov

QUESTIONS ?

SEATTLE

BUILDING TUNE-UP ACCELERATOR

LUNCH BREAK

Program Partners

Seattle
Office of Sustainability
& Environment

SEATTLE
building
tune-ups

INTEGRATED DESIGN LAB
UNIVERSITY of WASHINGTON // W

SMART
BUILDINGS
CENTER A project of NEEC

Pacific Northwest
NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

Seattle City Light

U.S. DEPARTMENT OF
ENERGY
Energy Efficiency &
Renewable Energy

SEATTLE
BUILDING TUNE-UP ACCELERATOR

Observation & Data-Driven Building Re-Tuning Training for Seattle Buildings

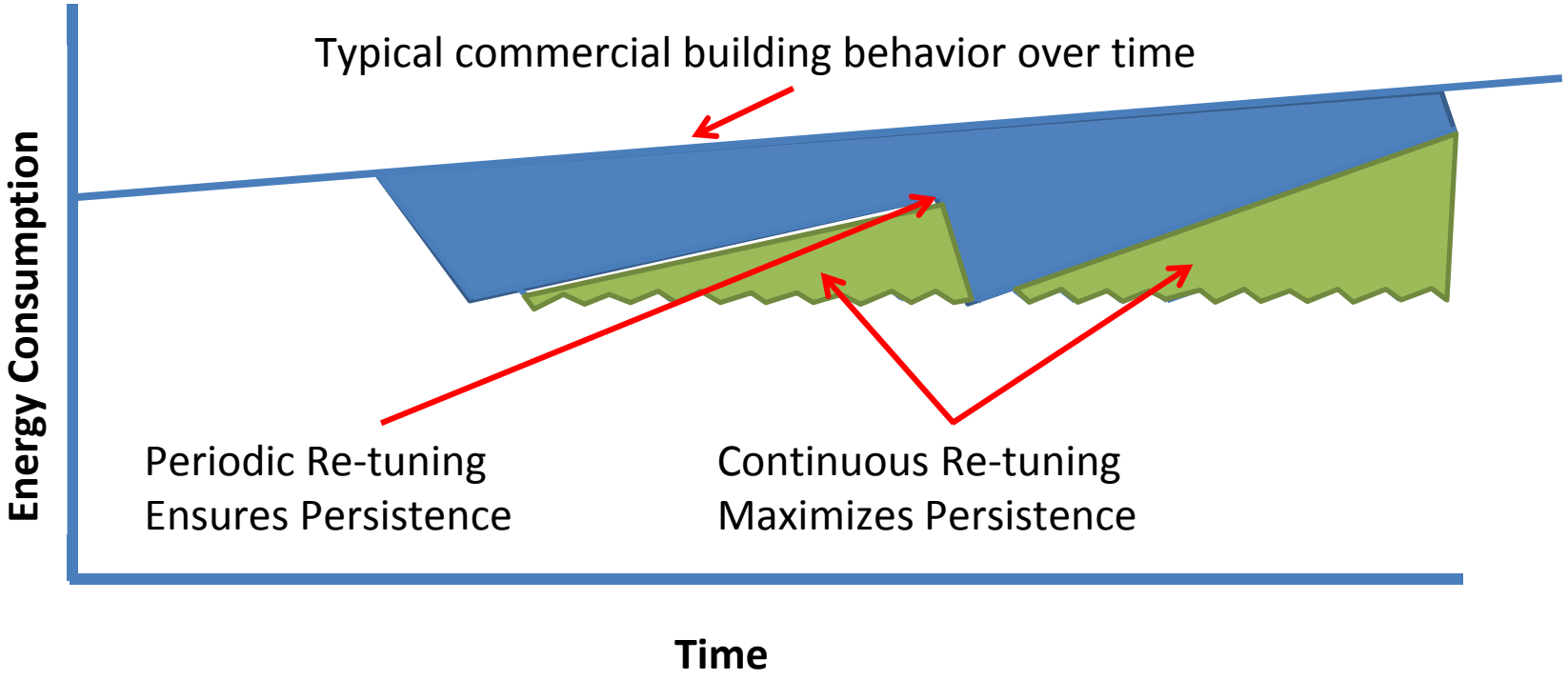
PRESENTED BY:
Duane Lewellen
Smart Buildings Center

Supported by:
Pacific Northwest
NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

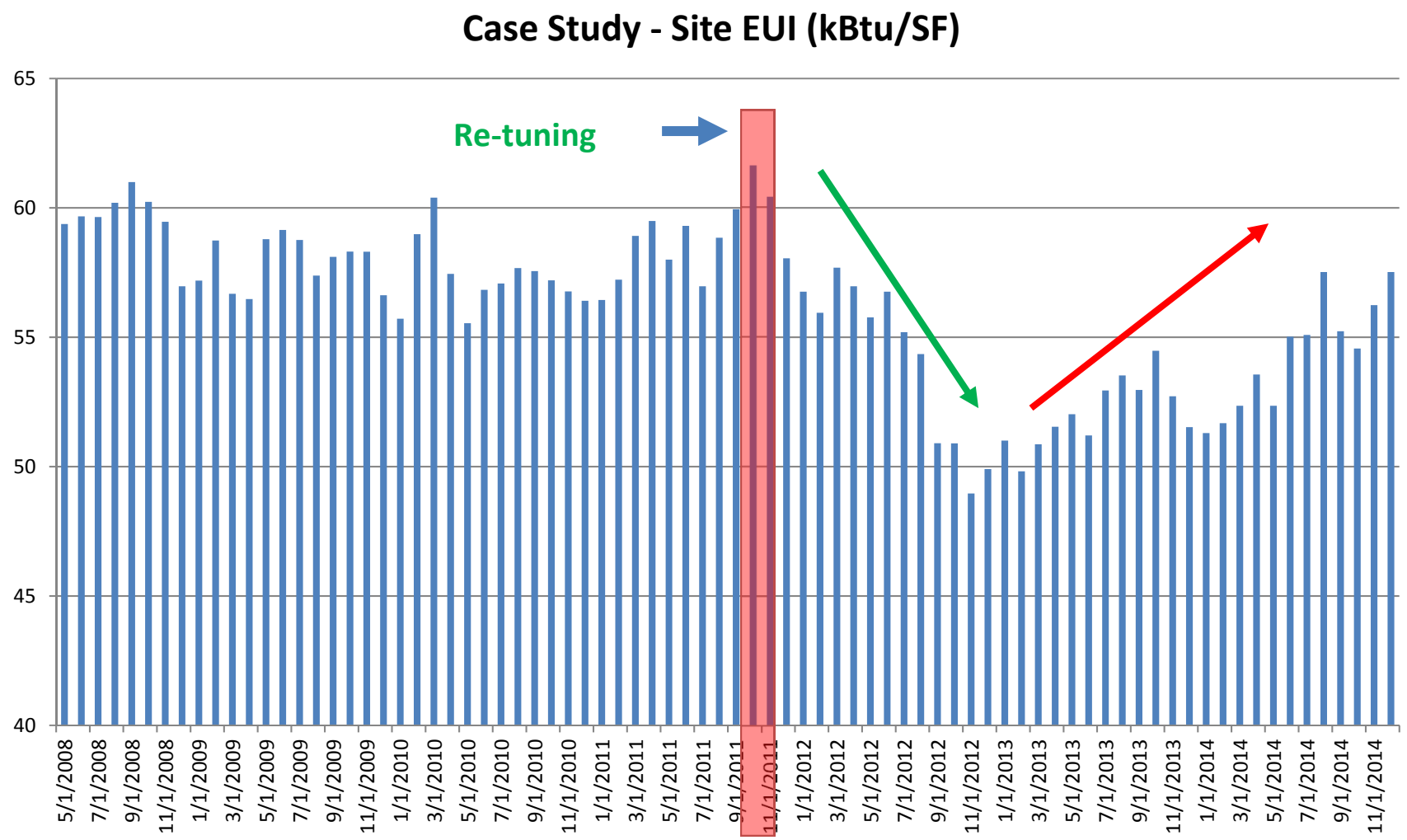
Goals for this portion of training

- Review building Re-tuning best practices for non-BAS and BAS applications
- Discuss applicability to buildings in the City of Seattle
  - as requirement for buildings >50K SF
  - encouraging re-tuning as a best practice in buildings <50K SF
- Provide opportunities for attendees to ask questions and get clarification on the re-tuning process and the SBTU requirement

Life Cycle of Retro-Commissioning/Re-Tuning



Observation-Driven Building Re-tuning Training: Definition



Summary of Meta-Data Results Relevant to Small- and Medium-Size Buildings without Building Automation Systems

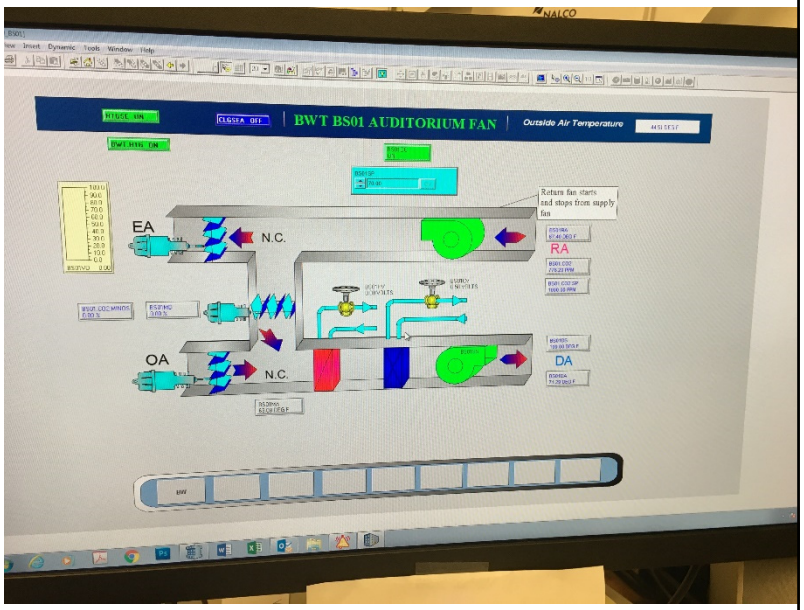
	Small Office	Medium Office	Strip Mall	StandAlone Retail	Primary School	Supermarket
EEM01: Re-calibrate Faulty Sensors	1%	0%	1%	1%	0%	0%
EEM04: Shorten HVAC Schedules	**6%**	**12%**	**9%**	**12%**	**8%**	**10%**
EEM05: Supply Air Temperature Reset		11%			4%	
EEM07: Exhaust Fan Control	3%	1%		2%	1%	
EEM08: Static Pressure Reset		4%			0%	
EEM14: Hot Water Temperature Reset					5%	
EEM15: Minimum VAV Terminal Box Damper Flow Reductions		19%			6%	
EEM16: Wider Deadbands and Night Setbacks	**12%**	**10%**	**11%**	**13%**	**16%**	**12%**
EEM27: Optimal Start	**6%**	**8%**	**10%**	**12%**	**6%**	
EEM28: Optimal Stop		0%	1%	2%	1%	

Summary of Meta-Data Results Relevant to Large Buildings with Building Automation System

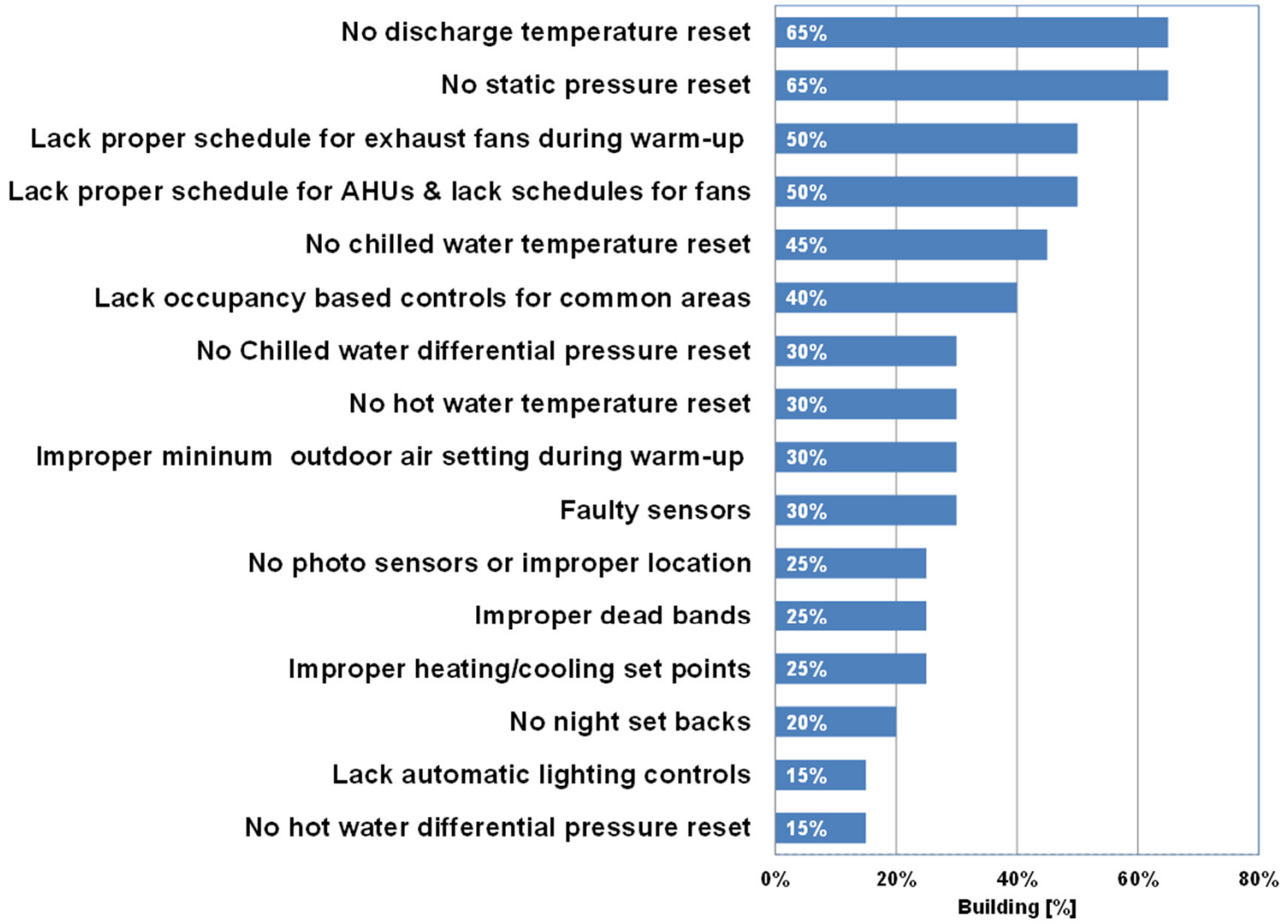
	Large Office	Large Hotel	Secondary School
EEM01: Re-calibrate Faulty Sensors	1%	0%	0%
EEM04: Shorten HVAC Schedules	**14%**		**16%**
EEM05: Supply Air Temperature Reset	**10%**	**11%**	**2%**
EEM07: Exhaust Fan Control	1%		1%
EEM08: Static Pressure Reset	**4%**	**2%**	**0%**
EEM10: Chilled Water Differential Pressure Reset	0%	0%	0%
EEM11: Chilled Water Temperature Reset	1%	0%	0%
EEM13: Hot Water Differential Pressure Reset	0%	0%	0%
EEM14: Hot Water Temperature Reset	1%	0%	1%
EEM15: Minimum VAV Terminal Box Damper Flow Reductions	**18%**	**0%**	**3%**
EEM16: Wider Deadbands and Night Setbacks	**10%**	**8%**	**12%**
EEM27: Optimal Start	**10%**		**14%**
EEM28: Optimal Stop	3%		2%

Data-driven Re-tuning

- Approach: use the building's building automation system (BAS) to identify and correct building operational problems that lead to energy waste
- For buildings with BAS
  - Typically 50,000 square feet or more
  - Front-end data drives re-tuning process



Common Re-tuning Measures: PNNL Meta Analysis of 100 Buildings



Building Tune-Up Focus Areas With BAS

- **Occupancy Scheduling**
- AHU Discharge Air Temperature Control
- **AHU Discharge Air Static Pressure Control**
- AHU Heating and Cooling Control
- AHU Outdoor Air Operation
- **AHU Economizer Operation**
- **Zone Conditioning**
- Heating Plant
- Cooling Plant
- Meter Profiles

Observation-Driven Building Re-tuning Training: Definition

Building re-tuning is a systematic process to identify and correct no/low cost operational problems that lead to energy waste

- Many of the recommendations for efficiency improvements will be prescriptive

Observation-Driven Building Re-tuning Training: Approach

It will use a **four step approach**

1. **Initial data collection phase:** Collection of information about the building
2. **Investigation phase:** Building walk down to identify and characterize the building operations
3. **Implementation phase:** Application of prescriptive re-tuning measures
4. **Documentation phase:** Reporting of measures implemented and calculation of energy savings

Initial Building Data Collection

Tune Up Accelerator Summary Report

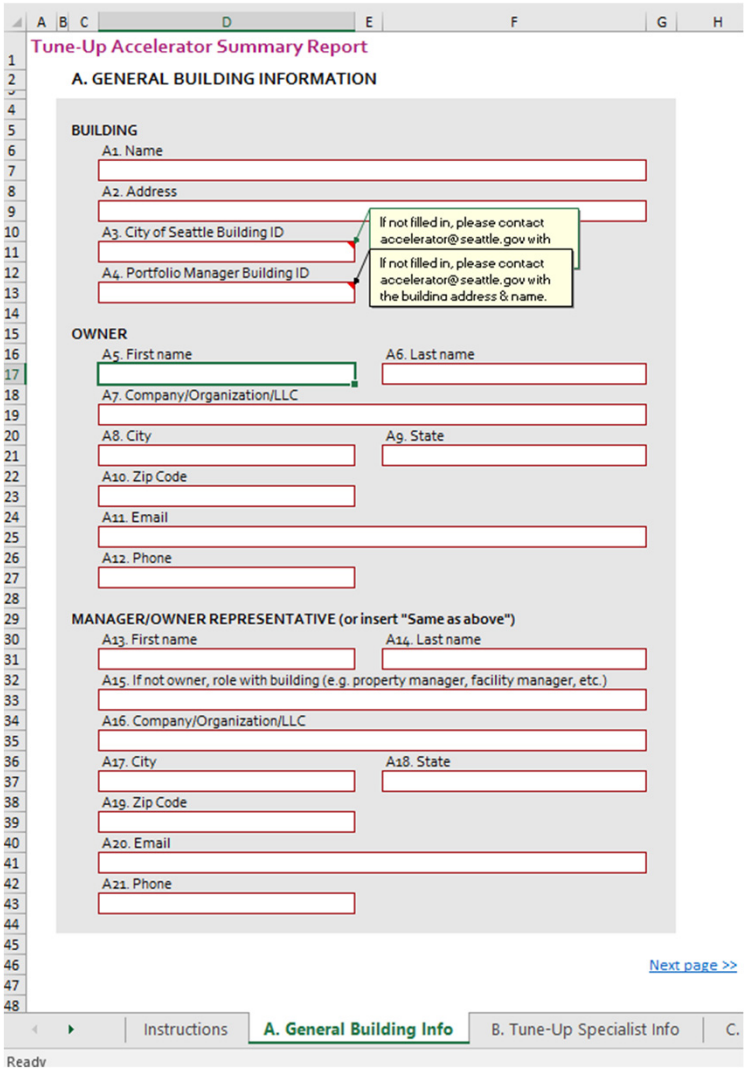
A. General building information

B. Tune up specialist credentials

C. Building characteristics

D. Benchmarking validation

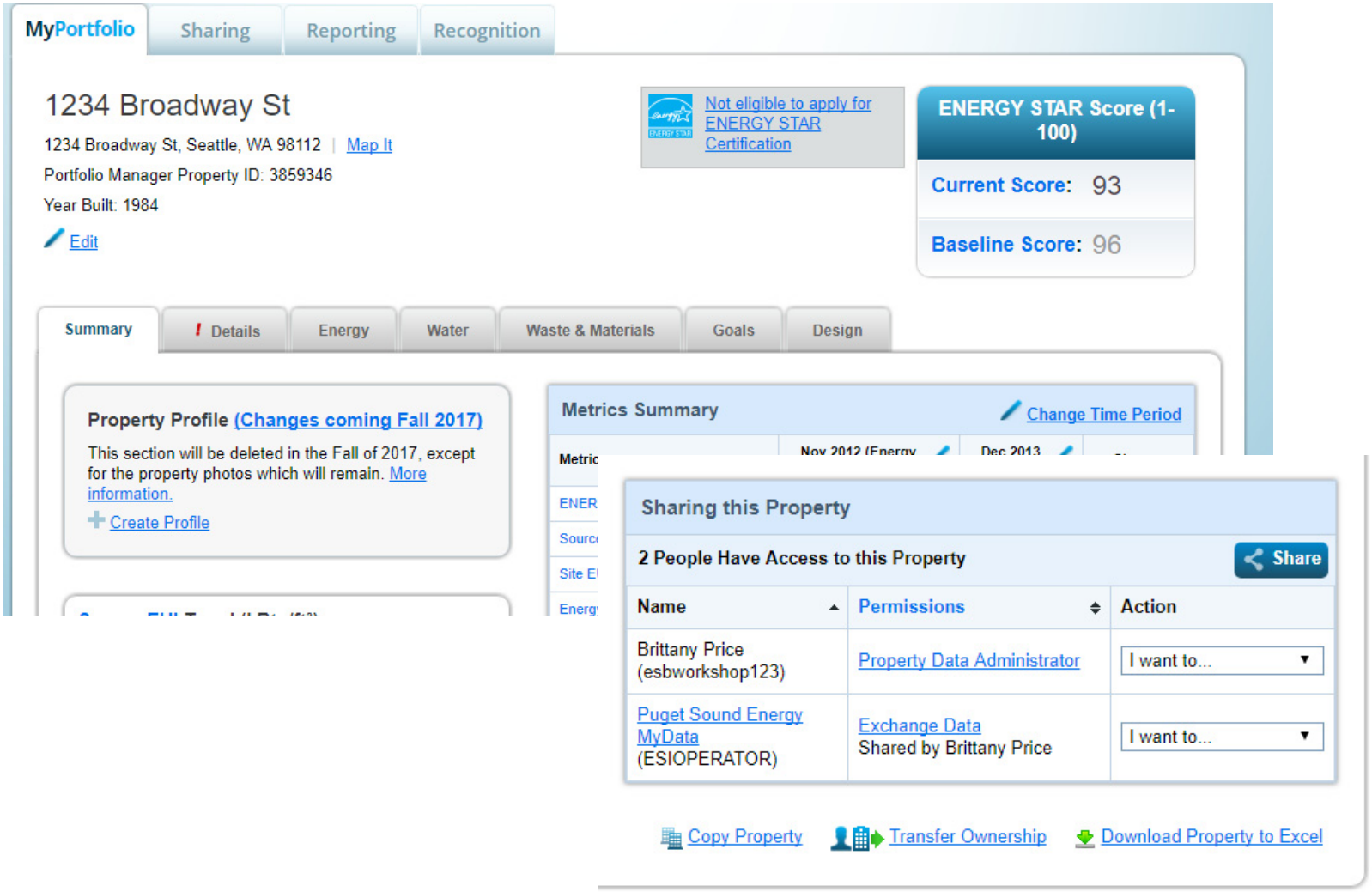
E. Utility billing analysis



Basic Building Information Resources…

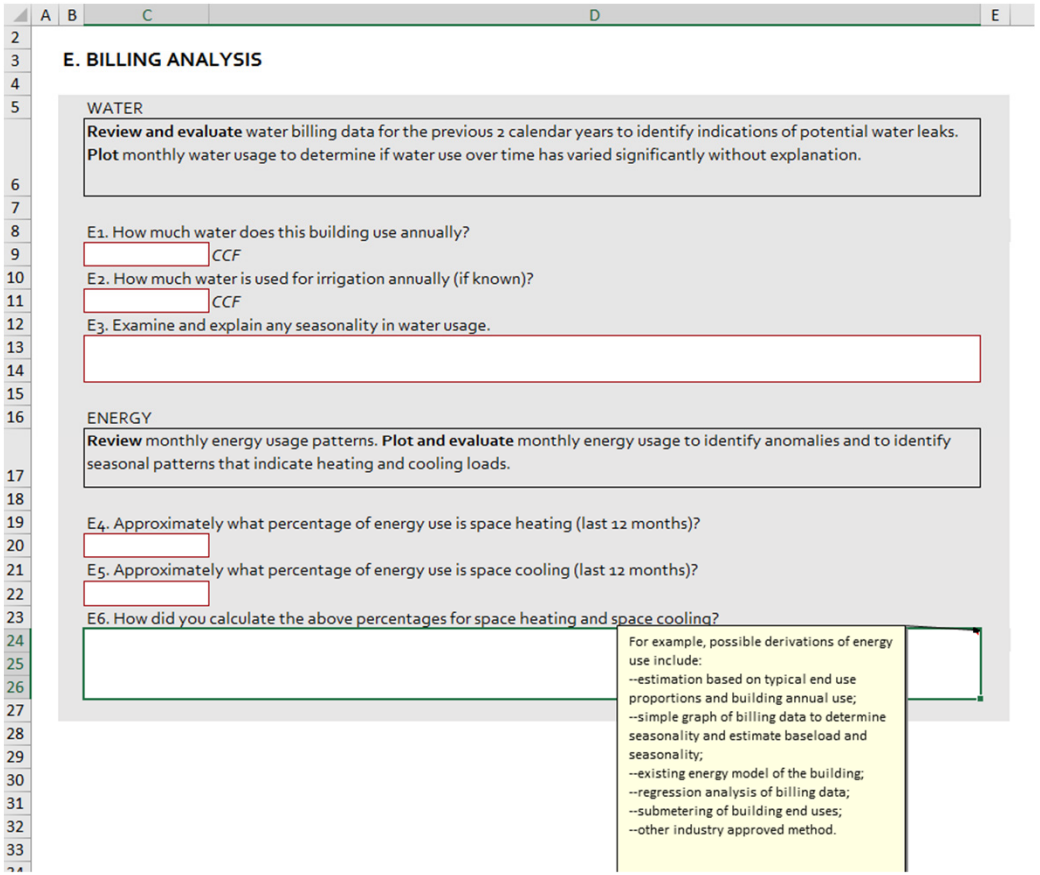
- Size, age and type of building
- As-built and construction documents
- O&M Manuals, Sequence of Operations (SOO)
- Types of equipment, recent repairs
- Equipment maintenance schedules
- Review logs (e.g. tenant complaints, etc.)
- Construction or changes to the building
- Building occupancy/equipment schedules
- Use/mission of the building
- Meter data (Utility for Electric, Gas, Oil, etc…)

Portfolio Manager Data Export



Utility Billing Analysis

1. Annual water use
2. Irrigation water use
3. Seasonal water use variation
4. Monthly energy use patterns
5. Annual heating & cooling energy use



E. BILLING ANALYSIS

WATER

Review and evaluate water billing data for the previous 2 calendar years to identify indications of potential water leaks. **Plot** monthly water usage to determine if water use over time has varied significantly without explanation.

E1. How much water does this building use annually?

CCF

E2. How much water is used for irrigation annually (if known)?

CCF

E3. Examine and explain any seasonality in water usage.

ENERGY

Review monthly energy usage patterns. **Plot and evaluate** monthly energy usage to identify anomalies and to identify seasonal patterns that indicate heating and cooling loads.

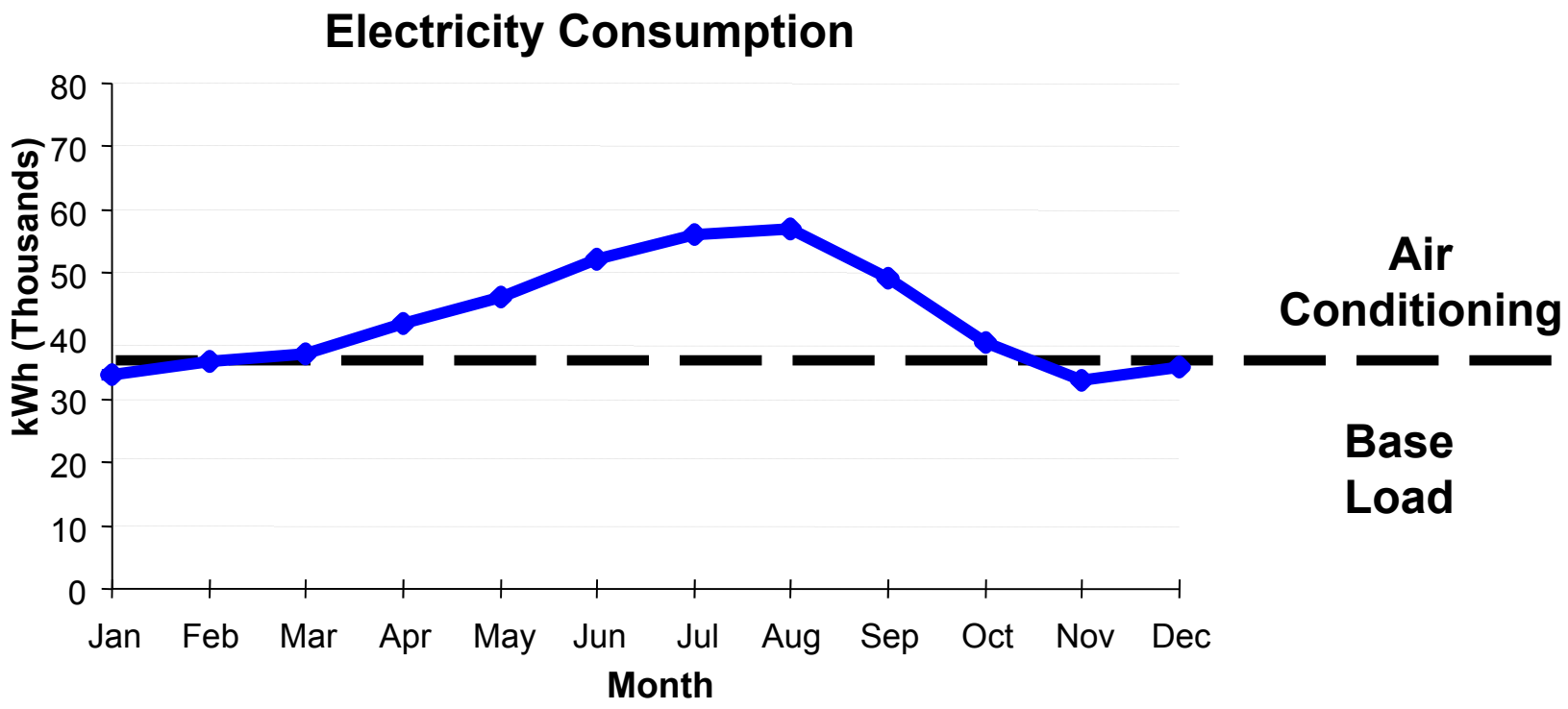
E4. Approximately what percentage of energy use is space heating (last 12 months)?

E5. Approximately what percentage of energy use is space cooling (last 12 months)?

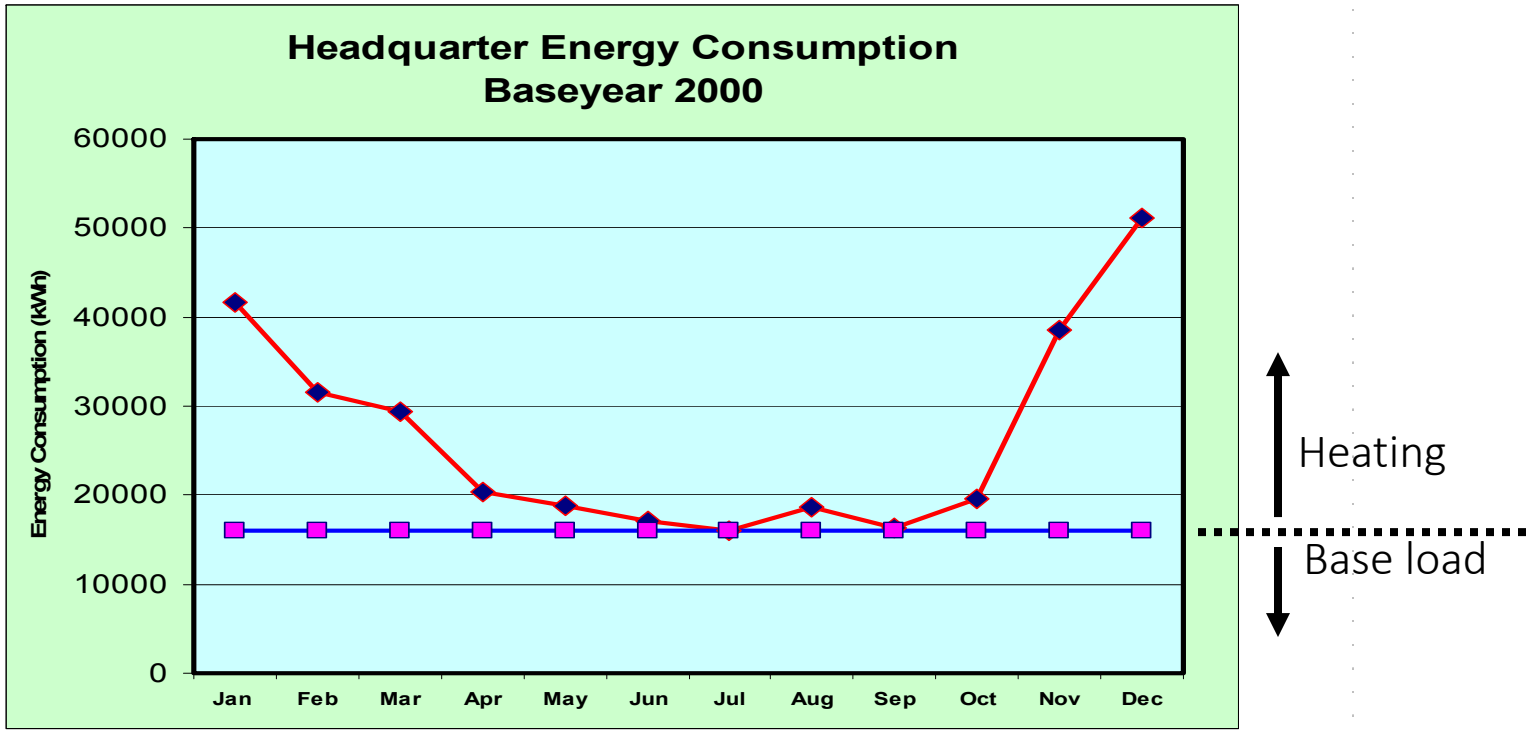
E6. How did you calculate the above percentages for space heating and space cooling?

For example, possible derivations of energy use include:
--estimation based on typical end use proportions and building annual use;
--simple graph of billing data to determine seasonality and estimate baseload and seasonality;
--existing energy model of the building;
--regression analysis of billing data;
--submetering of building end uses;
--other industry approved method.

Base & Seasonal Loads - Cooling



Base & Seasonal Loads - Heating

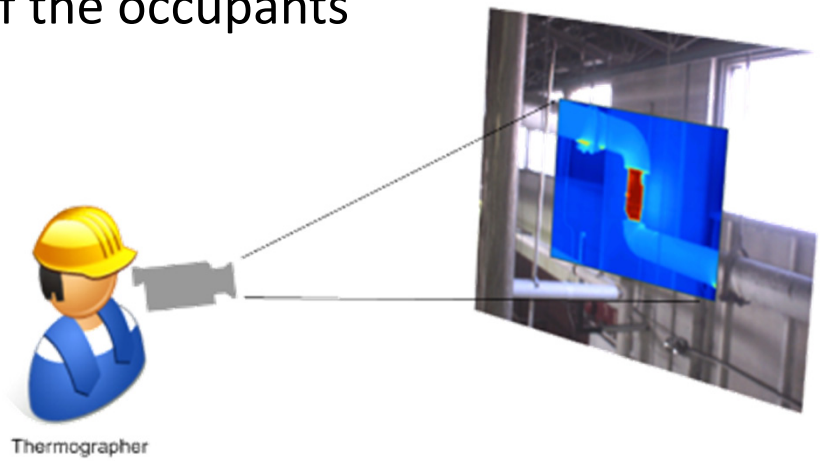


Small/Medium-Sized Building Re-tuning Training: Major Focus Areas

1. Heating, Ventilation and Air-Conditioning Systems and Controls
2. Lighting System and Controls
3. Domestic Hot Water
4. Water Use
5. Building Envelope

Observation-Driven Building Re-tuning Training: Basic Energy Management Principles

- If you don't need it, turn it off
- If you don't need it at full power, turn it down
- Make "smart" energy decisions when adjusting systems to the real building needs
- Save energy without negatively impacting the comfort of the occupants



Building Walk Down: Investigation Phase

- This is the second step in the building re-tuning process – the Investigation Phase
- Information collected in this step is used to identify the operational problems and energy saving opportunities that are fed into the plan for implementation of re-tuning measures

Reminder: Sample Size Tune-up Mandate

- In buildings where there are multiple pieces of similar equipment, the City's mandate requires:
  - Minimum sample size of at 12%
  - But no fewer than a sample size of 10 for buildings <100,000 sf and no fewer than 20 for buildings >=100,000 sf

Hydronic Heat Pumps

VAV Terminal Units

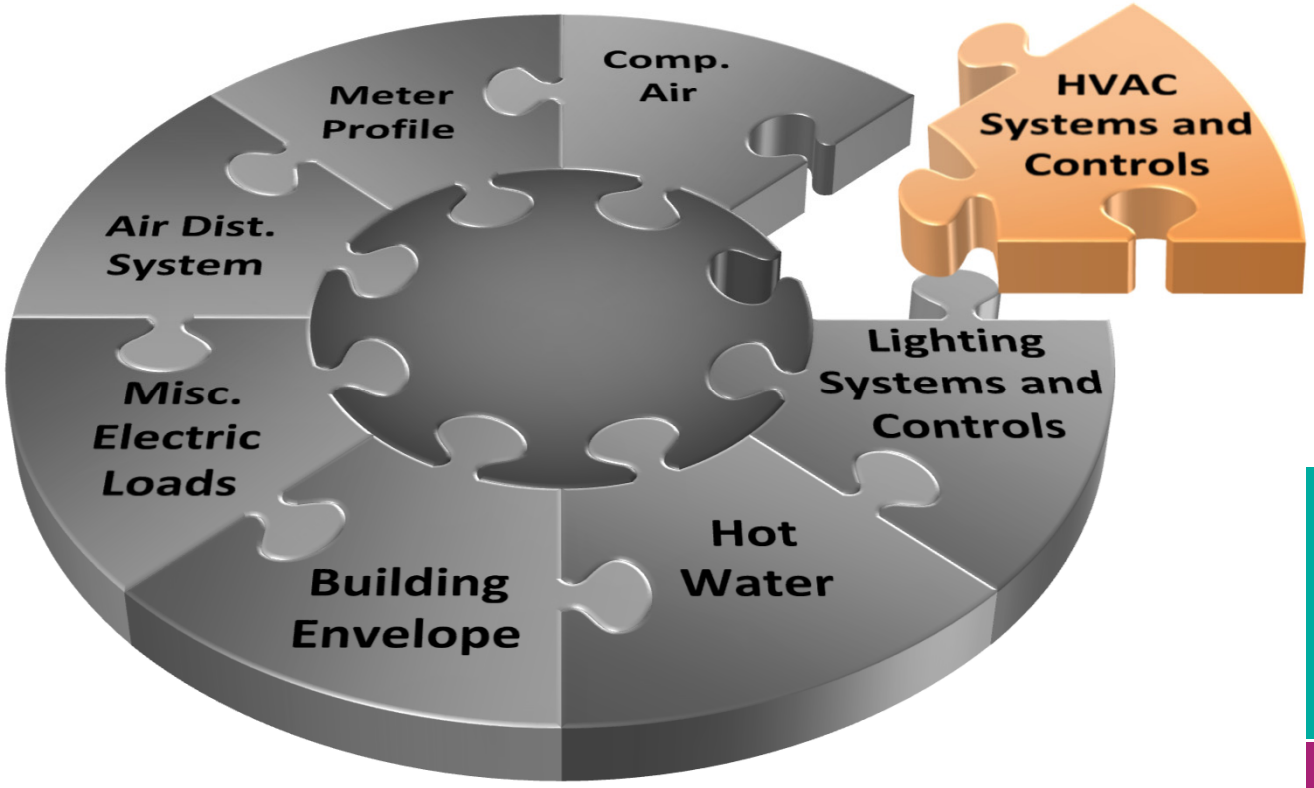
Building Walk Down: Guidance

- While walking down to investigate the building's condition and operations, be vigilant, use your senses – look, listen, smell and touch (be careful!)
- If possible, perform the walk down during both occupied hours and unoccupied hours
- A lot of energy waste typically occurs during unoccupied periods and holidays
- **Walk down at least once during the heating season and the cooling season**
- Log all information on the log sheets – this will help you calculate energy savings

"You can observe a lot by just watching."
—Yogi Berra

Building Walk Down: Tools to Carry

Building Walk Down: **HVAC Systems and Controls**



HVAC

- HVAC Systems
- Economizers
- Distribution systems
- Pumps
- Thermostats

Seattle Building Tune-Ups Rule:
Table 1: 1.a-g & 1.j
Table 2: 1.a-c & 1.e

Tab G on Report

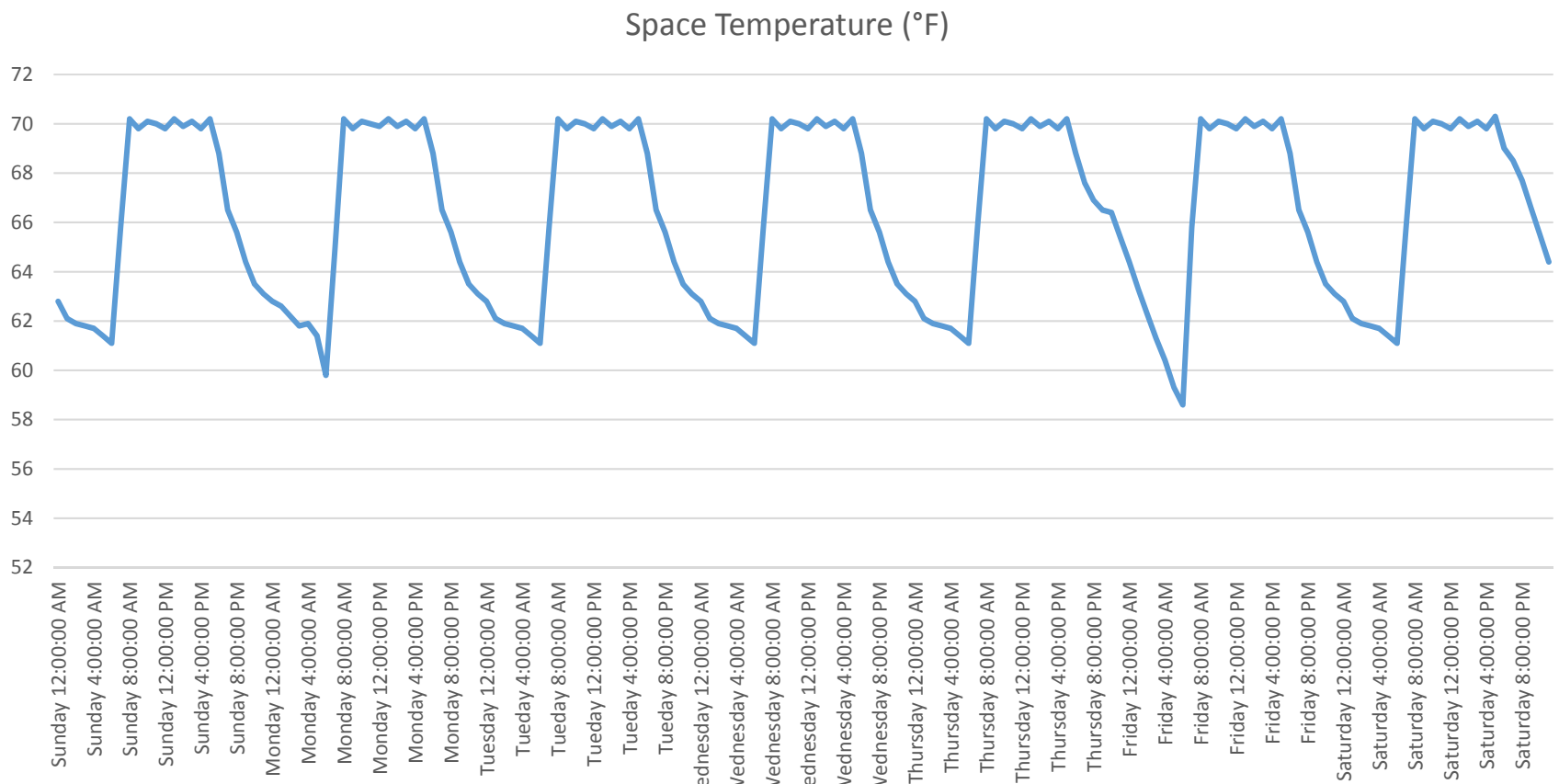
11 HVAC Assessment Elements –Directors Rule Table 1 (Tab G on Tune-Up Accelerator Summary Form)

1. Equipment scheduling
2. Review setpoints
3. Review reset schedules and setpoints
4. Review optimum start/stop if applicable
5. Sensor calibration (critical sensors)
6. Controls functional testing
7. Simultaneous heating and cooling
8. Air balance issues
9. Ventilation
10. Identify any “rogue” temperature zones on multi-zone systems
11. Recommended maintenance, cleaning and repair

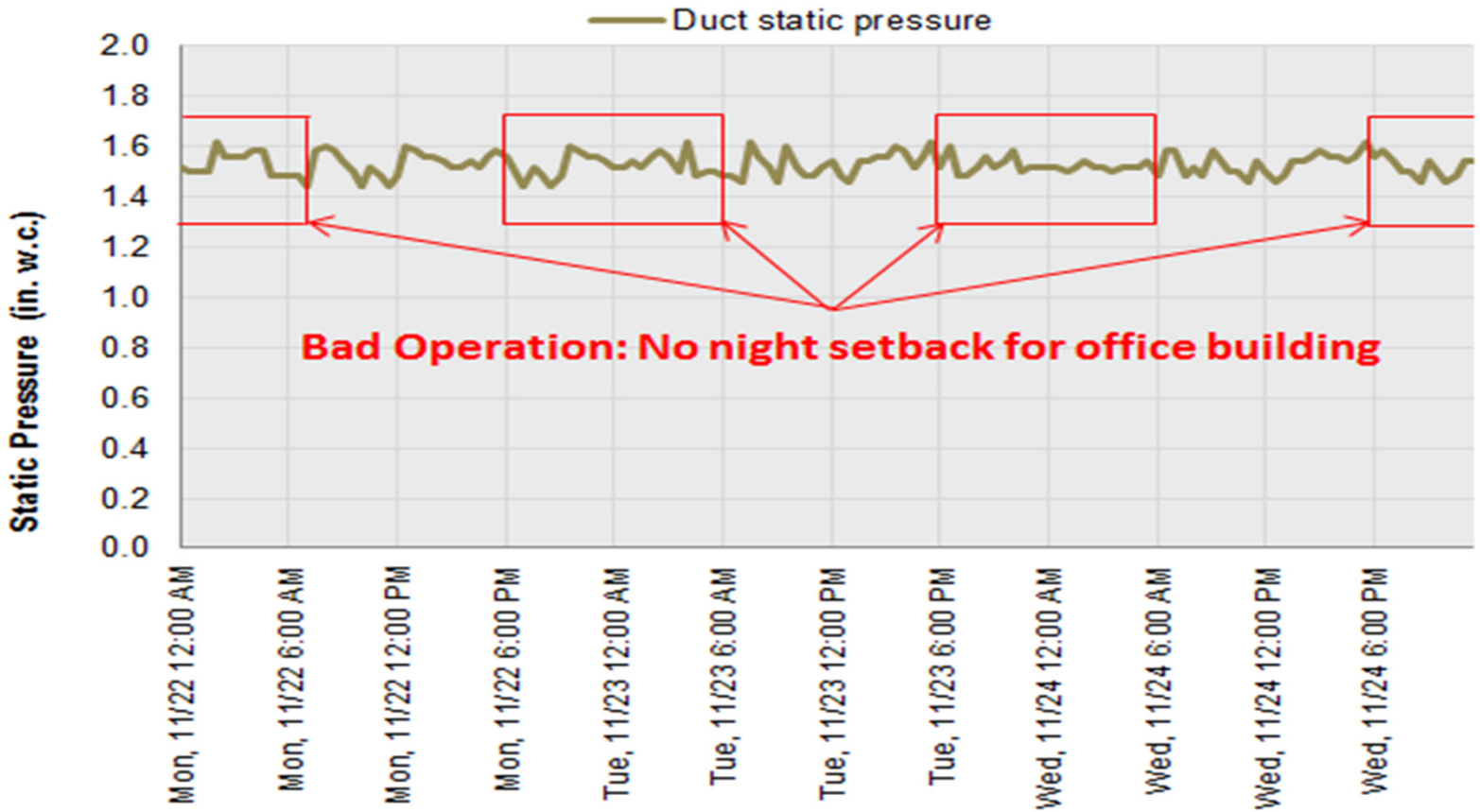
HVAC Equipment Scheduling

- Small/medium-sized commercial buildings typically lack central controls
- Typically have wall mounted thermostats to control both heating and cooling systems
- While surveying the thermostats and their capabilities, check:
  - Type of thermostat?
  - Mechanical or digital?
  - If digital, is it programmable?
  - If mechanical, replacing it with a programmable digital thermostat will save energy, if it is properly programmed

Equipment Scheduling – BAS Trend Data



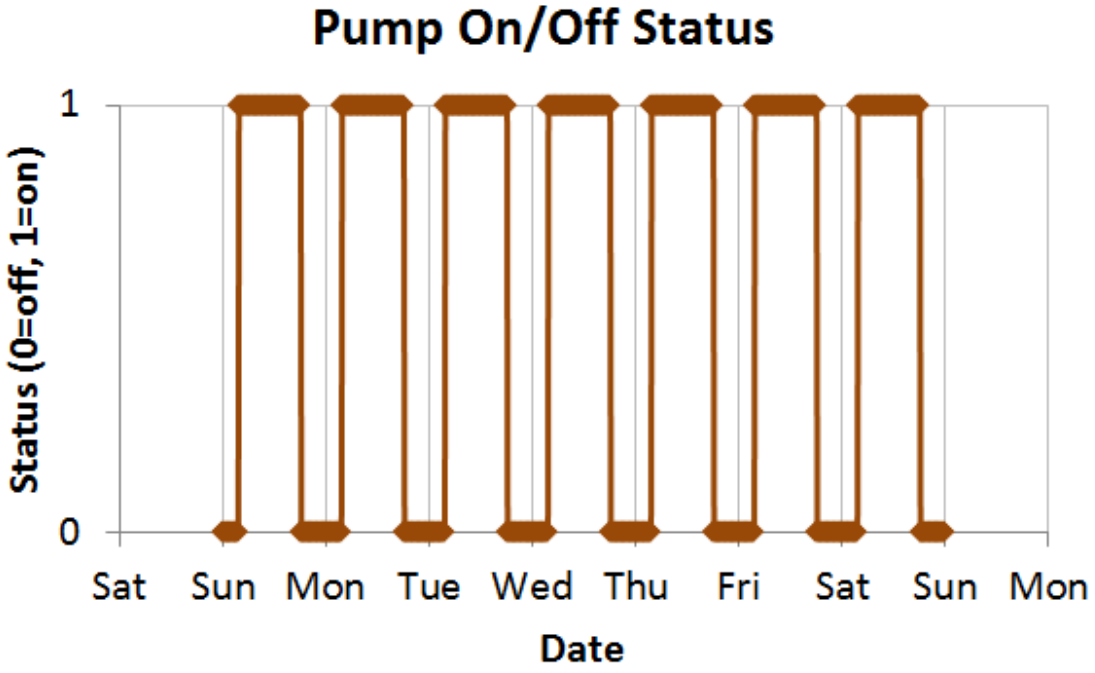
Occupancy Scheduling: Set back for Unoccupied Hours?



During unoccupied hours, the system should be set back so that the system does not continue to operate

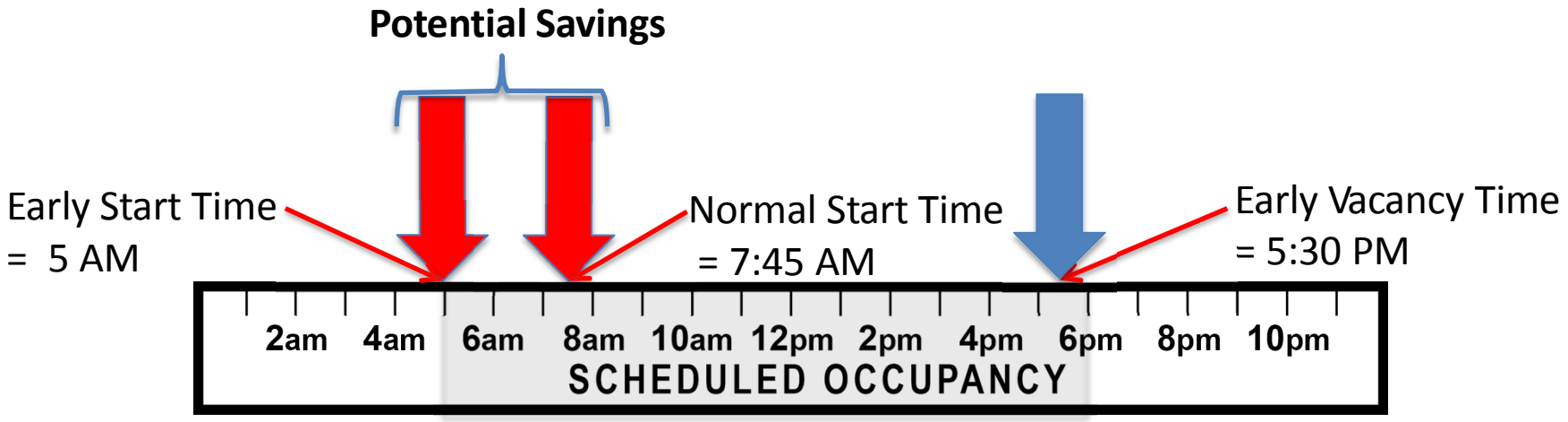
Equipment Scheduling – BAS Trend Data

Use BAS trend data or data logger to verify start/stop scheduling of fans and pumps



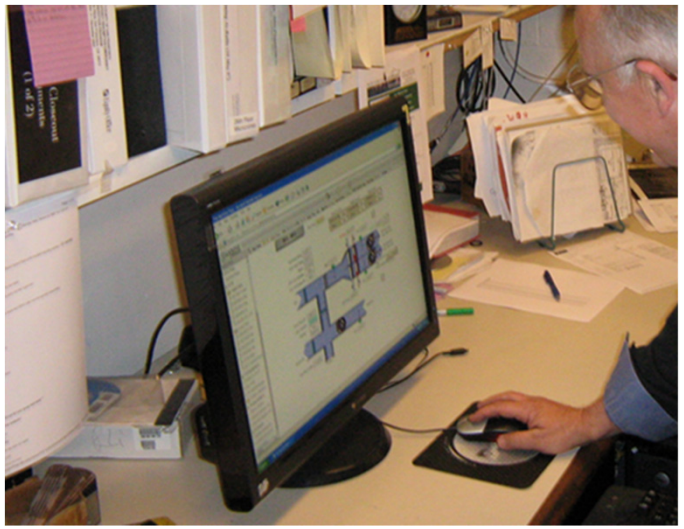
Building Walk Down:
HVAC System Controls – Thermostats Optimal Start

- Optimal Start (OS) is a feature that can save energy over traditional scheduling programs
- Most schedules are configured to start the HVAC system at the time it would take to heat or cool the space under worst case conditions
- OS will automatically "learn" over time, the optimum time to start the HVAC system to bring space temperatures within 1 to 2°F of occupied requirements at the start of the occupied time period



Review Setpoints

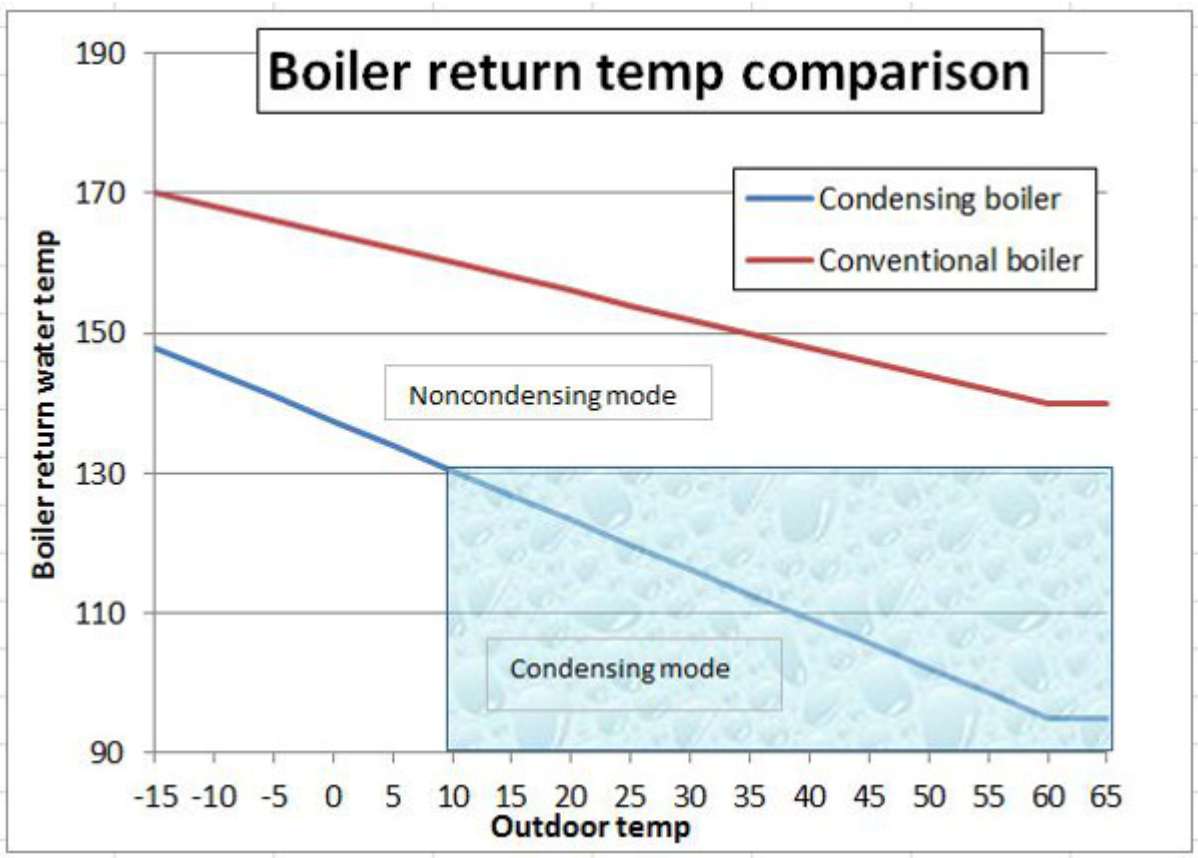
1. Zone temperatures
2. Discharge air temperature
3. Discharge air pressure
4. Minimum OA
5. HW & CHW supply
6. Condenser water supply
7. Differential pump pressure
8. Economizer changeover
9. OA lockouts
10. Miscellaneous equipment such as exhaust and process driven systems (elevator machine rooms, data rooms, garage exhaust, etc..)



Set or adjust to optimize function and energy efficiency – Use your judgement!

Review Reset Schedules & Setpoints

1. HW loop temperature
2. CHW loop temperature
3. HW loop differential pressure
4. CHW loop differential pressure



Set or adjust to optimize function and energy efficiency – Use your judgement!

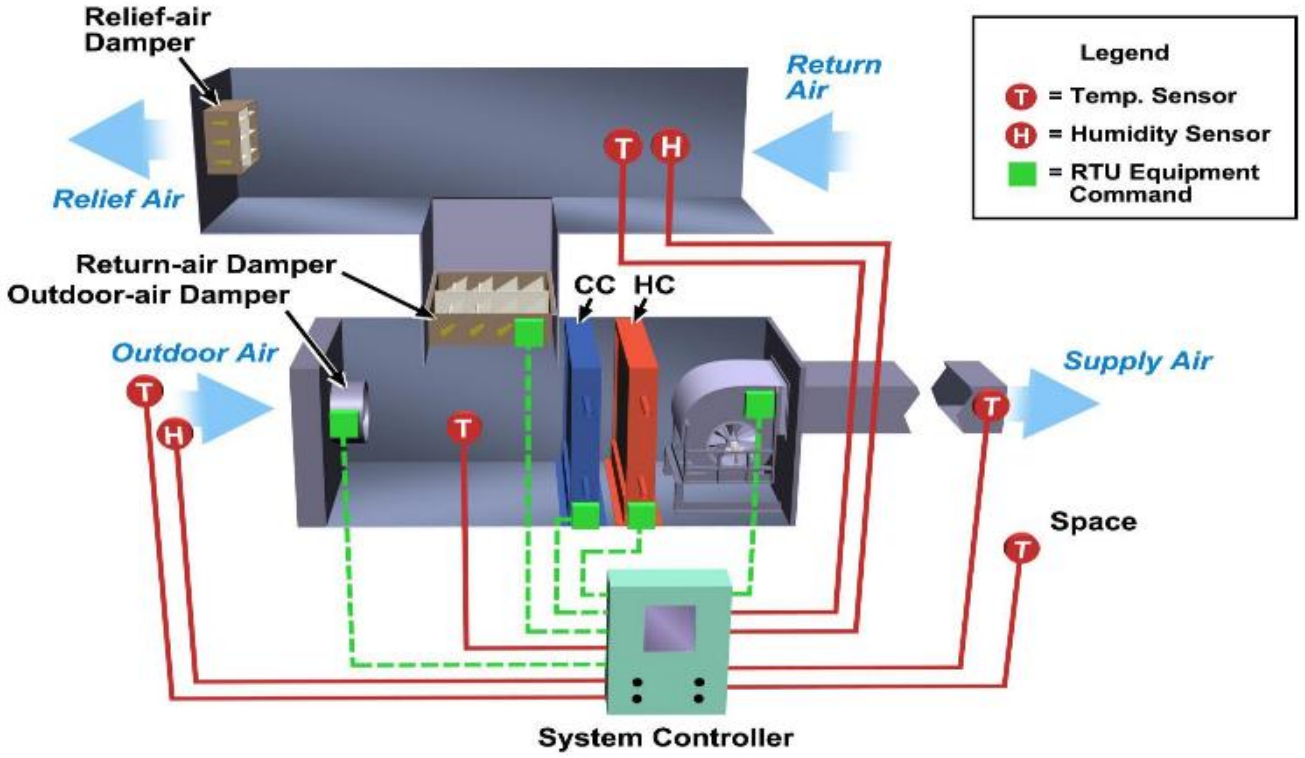
Sensor Calibration

Check sensor error for critical sensors

1. Outside air temperature
2. Discharge air temperature
3. HW loop supply & return temperature
4. CHW loop supply and return temperature
5. CO2 sensors
6. Condenser water supply and return temperature

Identify where sensors should be replaced. Adjust or recommend replacement as required.

HVAC Controls Functional Testing



Functionally test all modes of operation

- Occupied
- Unoccupied
- Warm-up
- Over-ride
- Others…

Adjust control sequences as appropriate for current facility requirements

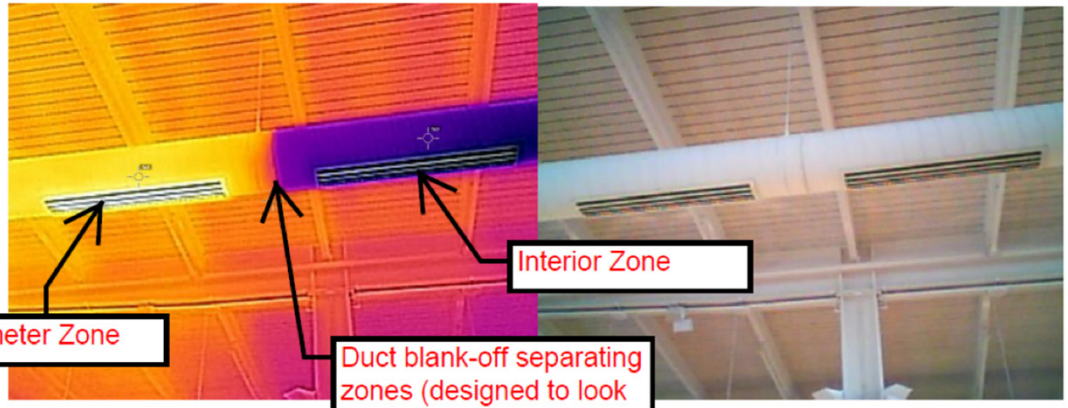
Simultaneous Heating & Cooling

Review HVAC control sequences for unintended instances of heating and cooling

- IR images of coils
- Cooling with perimeter heat
- 4-pipe fan-coils
- Large open spaces with multiple HVAC systems
- Heat/cool lockouts

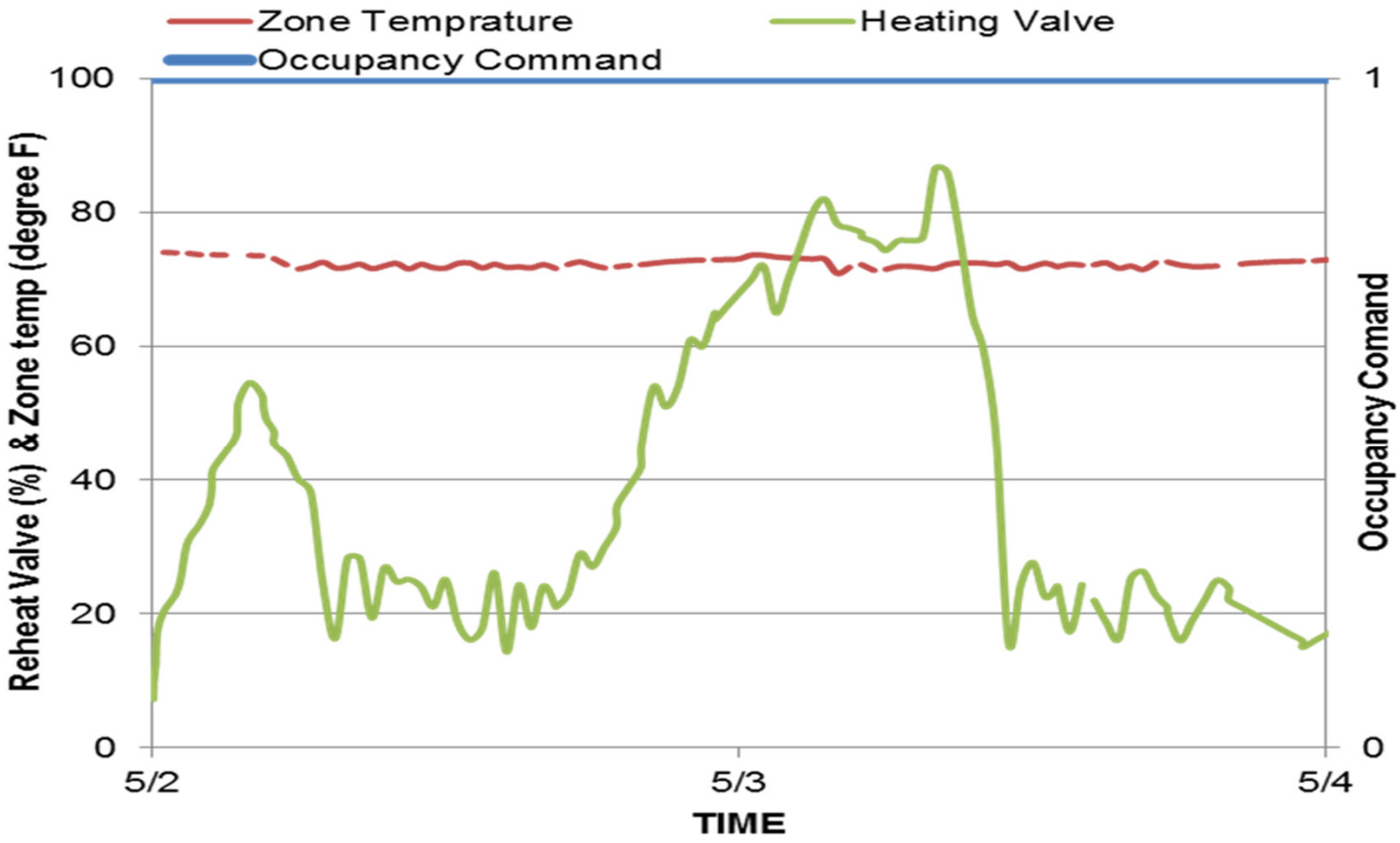
Open Office on Upper Level – VAV's serving same open area operating in both heating/cooling

Open Office on Upper Level – adjacent diffusers in heating and cooling



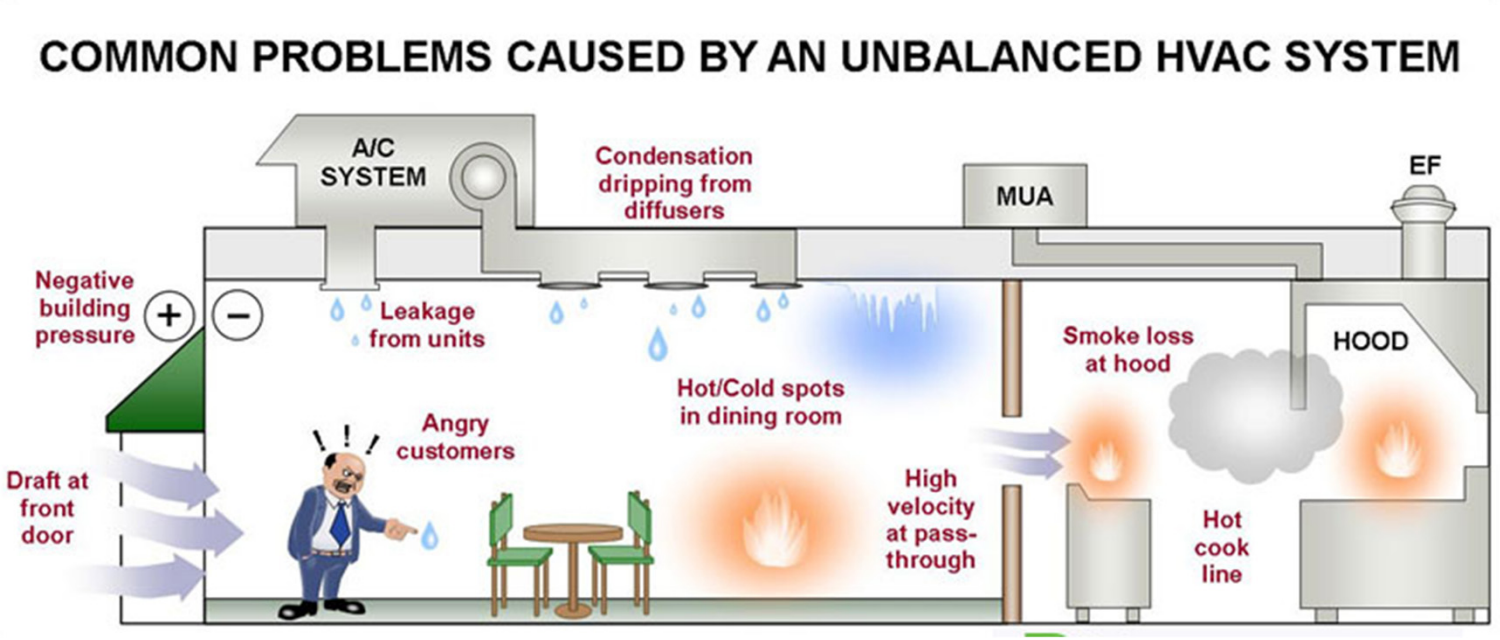
Adjust HVAC control sequences to reduce or eliminate any unintended or inappropriate simultaneous heating & cooling

Zone Conditioning: Continuous Reheat and No Schedule



- Zone occupancy schedule – missing?
- Reheat valve is active all the time (during unoccupied (night) periods)

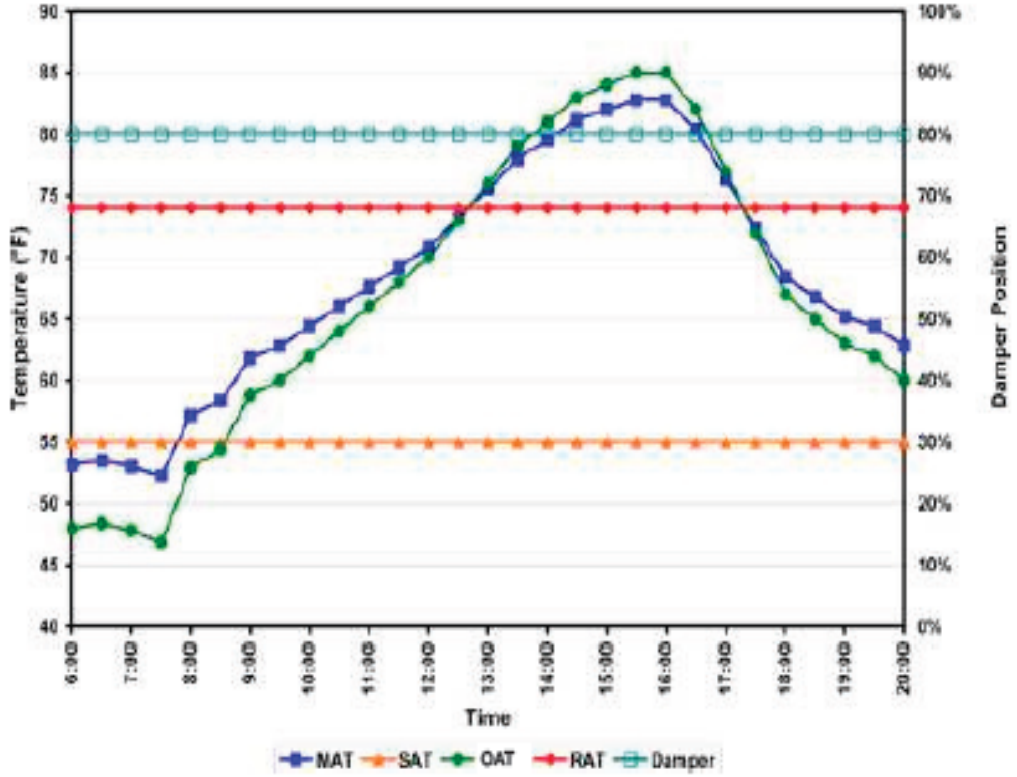
Air Balance Issues



Note any indications of significant air balancing issues.
Voluntary: Recommend re-balancing where significant efficiency or comfort improvements can be achieved

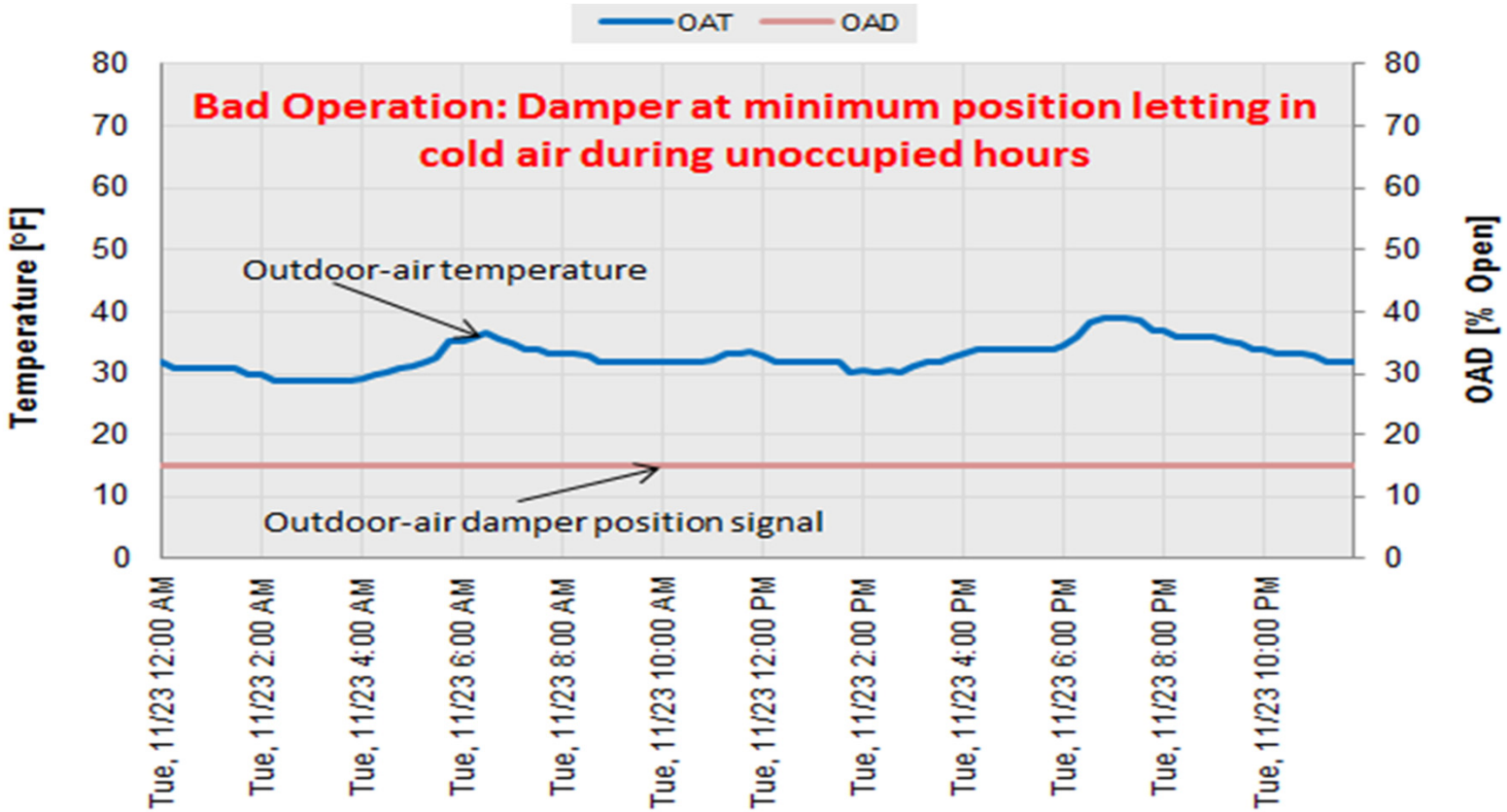
Excessive Ventilation Rates

Example trend of MAT, SAT, OAT, RAT & OSA Damper Position



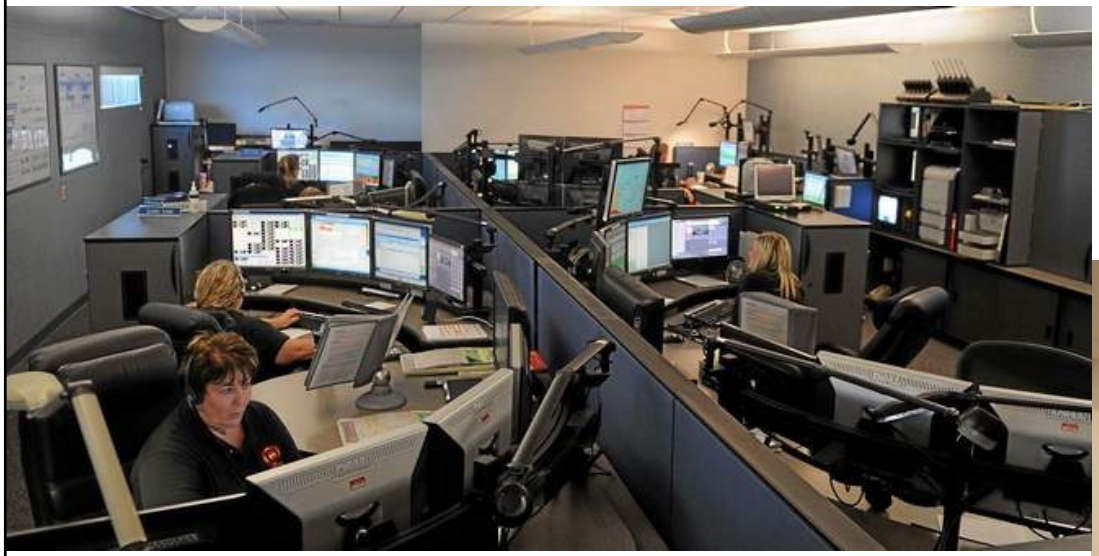
Identify any indications of excessive ventilation rates.
Voluntary: Recommend an analysis of the ventilation system if warranted.

Occupancy Scheduling: Outdoor Air Damper during Unoccupied Hours



The outdoor-air damper should not open up during morning warm-up/cool-down (unless the weather is appropriate for economizing), and then it should open 30 minutes prior occupancy to flush the building. It should close at the end of the occupied time, and stay closed overnight.

Multi-zone Systems



24/7 dispatch center in an office building

Server Rooms Served by Central HVAC

Identify zones that may be dominating multi-zone system operations.
Voluntary: Recommend solutions to isolate these zones.

HVAC Maintenance, Cleaning & Repair

What to look for:

- Dirty filters, ducting, grilles, coils
- Missing or damaged panels/access doors or seals
- Missing or damaged mechanical items (fan motors/blades/belts, pulleys)
- Missing or damaged duct and pipe insulation
- Stuck HVAC dampers
- Equipment at the end of its service life

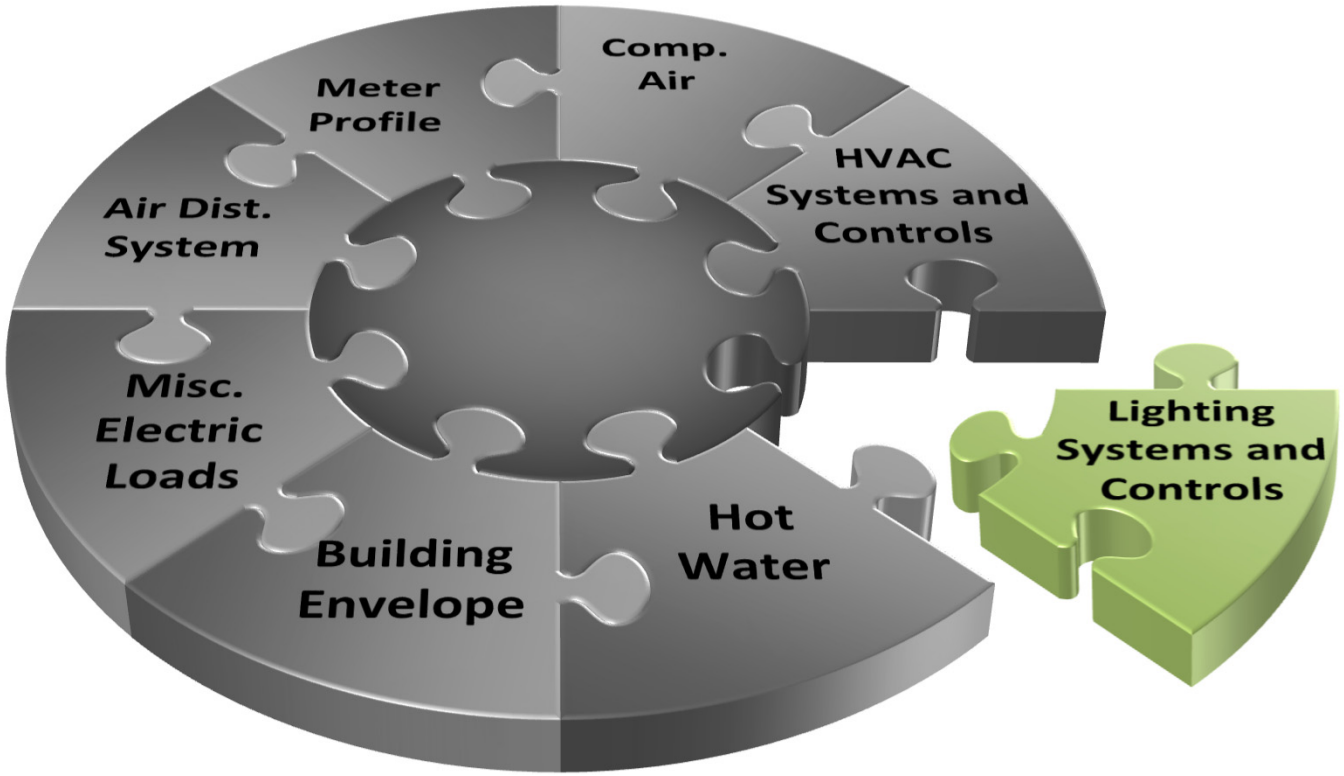
Three Required Actions: Clean or replace filters, repair damaged equipment, repair/adjust faulty dampers. Can make other voluntary recommendations.

Jammed/Frozen Damper

Disconnected Damper

Wired poorly

Building Walk Down: **Lighting**



Lighting

- Interior Lighting Systems and Controls
- Exterior Lighting Systems and Controls

Seattle Building Tune-Ups Rule:
Table 1: 2.a-c
Table 2: 2.a

Tab H on Report

Lighting Levels

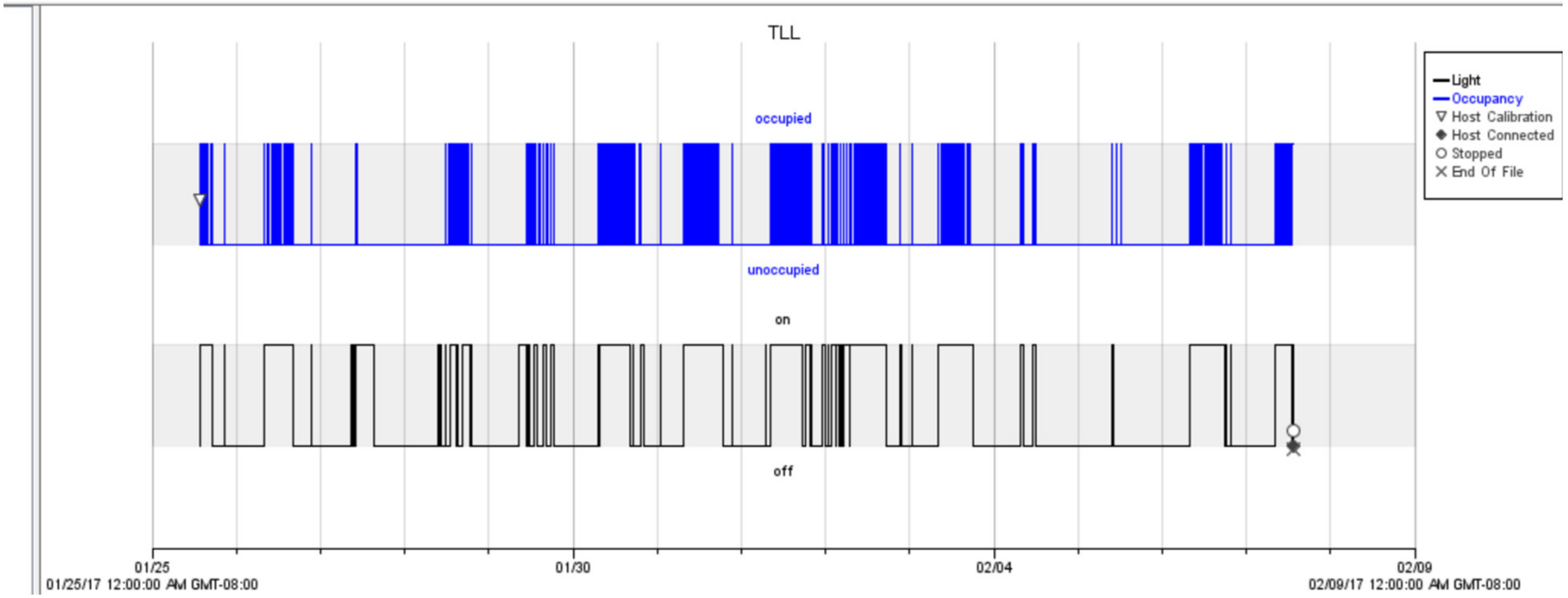
- Spot check lighting levels by use type
  - Voluntary: Recommend areas where the lighting power density could be reduced

Activity	Space Types	Recommended Illumination (lux)	Foot Candles (FC)
Public areas with dark surroundings	Parking garage	20 - 50	2-5
Simple orientation for short visits	Lobbies, storage areas, corridors	50 - 100	5-10
Working areas where visual tasks are only occasionally performed	Waiting areas, auditoriums	50 - 150	5-15
Easy Office Work, Classes	Certain offices and classrooms	200-300	20-30
Normal Office Work, PC Work, Study Library, Groceries, Show Rooms, Laboratories	Certain offices, classrooms, libraries	350-500	35-50
Retail	Supermarkets, Mechanical Workshops	300-800	30-80

Automatic Lighting Controls

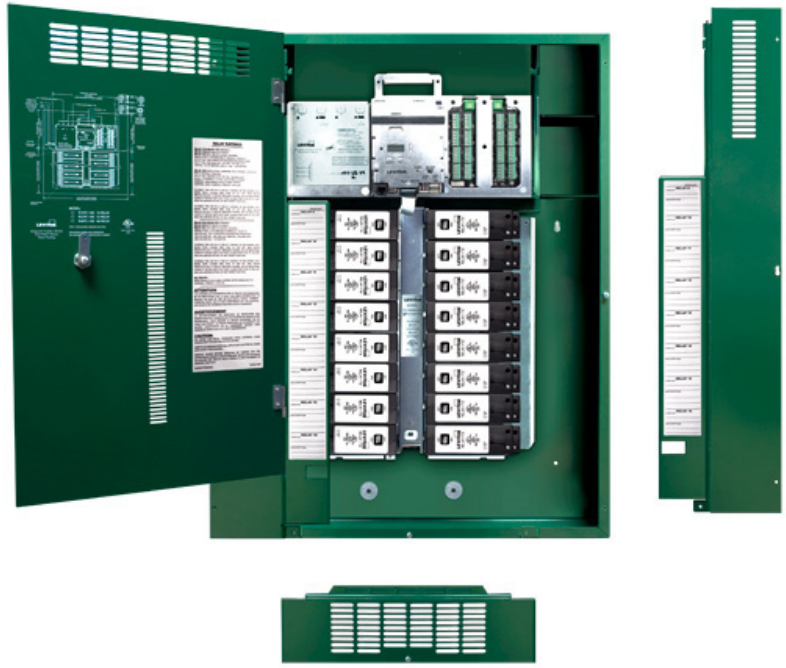
- Verify occupancy/vacancy sensors working correctly (sampling OK)
- Identify areas that could benefit from occupancy sensor or daylight harvesting
- Verify exterior lighting controls function correctly

light/occupancy logger



Lighting Control Schedules

- Verify lighting on/off schedules match occupancy. Set or adjust as appropriate.
  - Stand-alone control or BAS interface?
  - Correct time and day?
  - Overrides?
  - Override length?
  - All lights controlled?



Lighting control panel

Lighting Maintenance

- Identify inefficient lighting equipment and recommend replacement if appropriate (voluntary)
  - Incandescent or metal halide fixtures
  - T12 fluorescent fixtures
  - Magnetic ballasts
  - Replace 32-watt T8 lamps with 28 or 25-watt T8 lamps

T-12 lighting

Ballast checker

Replace 32-watt T8 lamps with 28 or 25-watt lamps

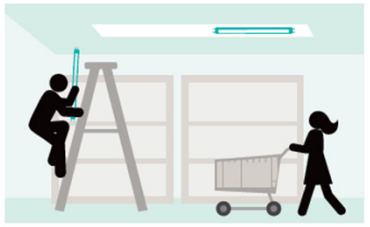
Northwest Lighting Network

NORTHWEST LIGHTING NETWORK

THE BIG BENEFITS OF SWITCHING

TO 28 OR 25 WATT T8 LAMPS

LESS MAINTENANCE



Up to 50% fewer trips up the ladder for your maintenance staff

REDUCED LIFETIME COSTS

Low wattage T8s are comparably priced to 32 watt T8s, and reduce lifetime costs by up to 23%

EASY TO INSTALL

Often compatible with existing ballasts for instant replacements

LONGER LIFE

Lifetimes up to 84,000 hours

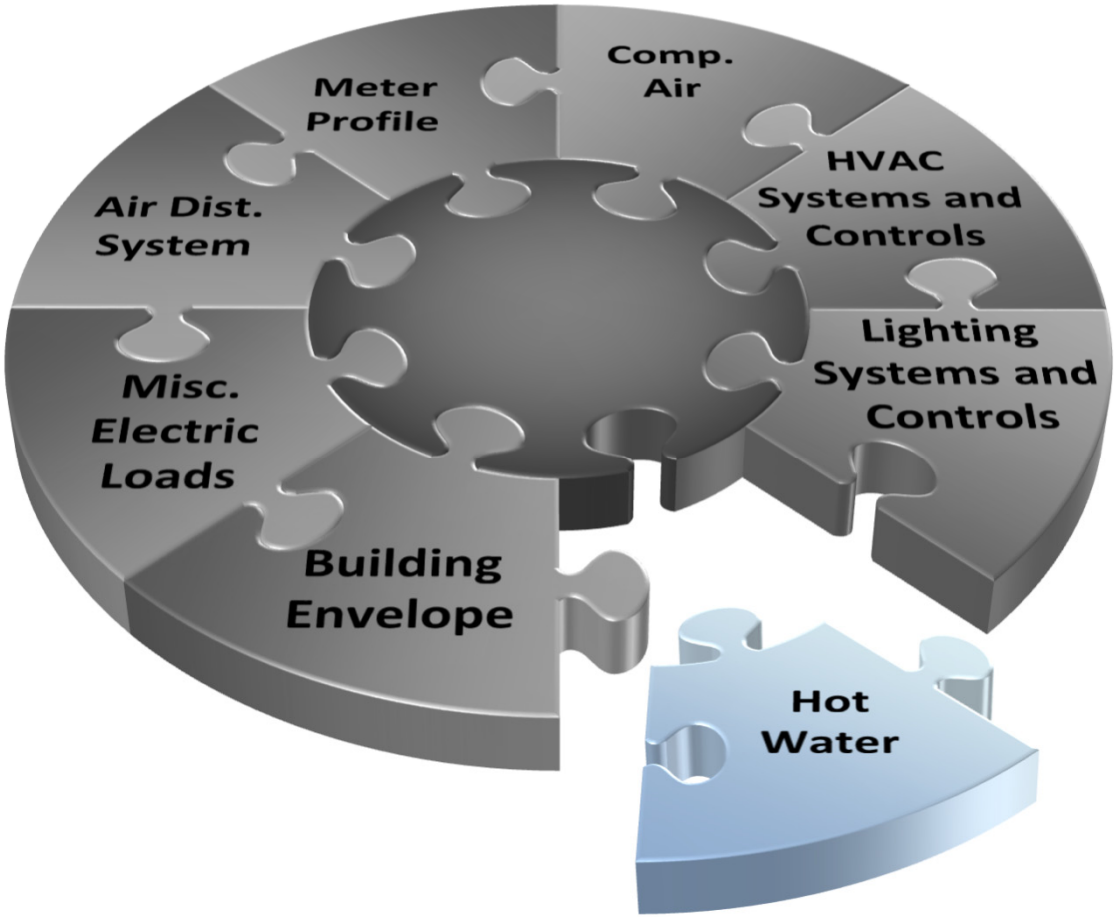
WHY WAIT?

SAVE NOW WITH LOW WATTAGE T8S

www.LowWattT8.com

Visit the site to find a participating distributor

Building Walk Down: Domestic Hot Water Systems



Hot Water

- **Water temperature**
- **Recirculation pumps**
- **Piping Insulation**

Seattle Building Tune-Ups Rule:
Table 1: 3.a-b
Table 2: 1.d

Tab I on Report

Domestic Hot Water Systems

- Measure hot water supply temperature
  - Adjust setpoint for occupancy and use if appropriate
  - *NOTE: Seattle Plumbing Code 407.3 maximum hot water temperature to public lavatories is 120F*
- Review circulation pump controls
  - Set or adjust as appropriate
  - No controls, Integral control or BAS?

BN64
DL [2]3

Control by BAS

No control

Integral control

Building Walk Down: **Water Usage**

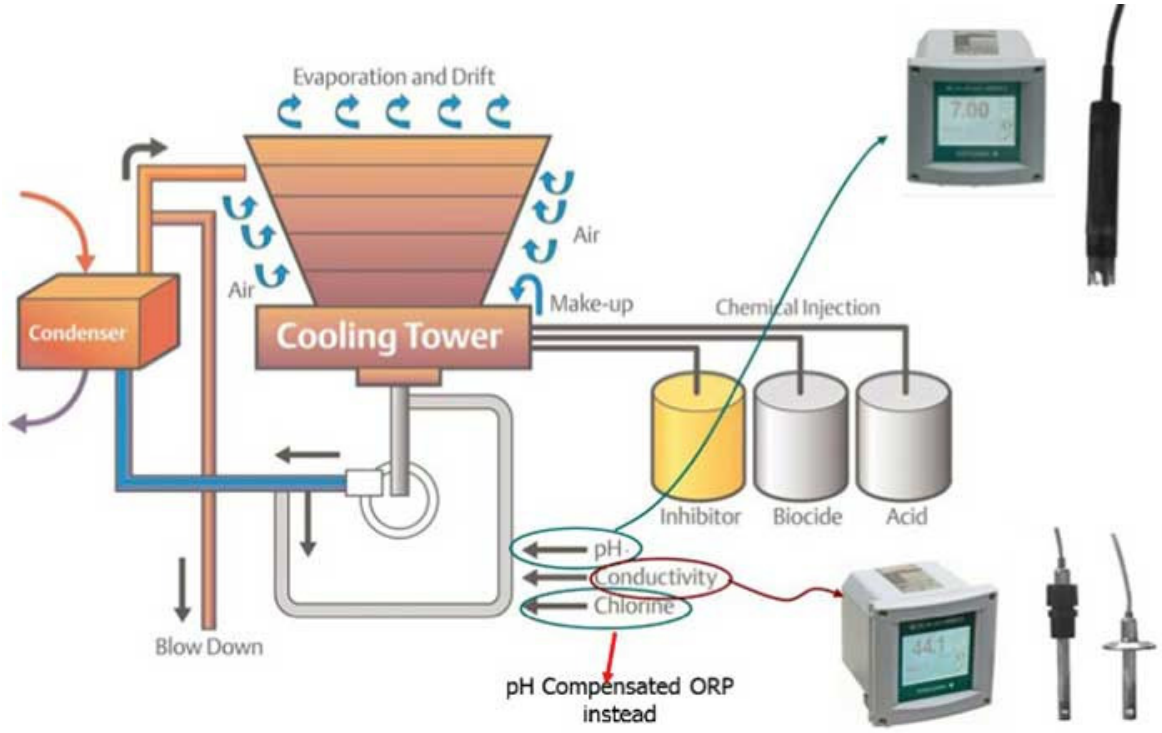
- Cooling Towers
- Irrigation
- Fixtures

Seattle Building Tune-Ups Rule:
Table 1: 4.a-d
Table 2: 3.a-e

Tab J on Report

Water Usage – Cooling Towers

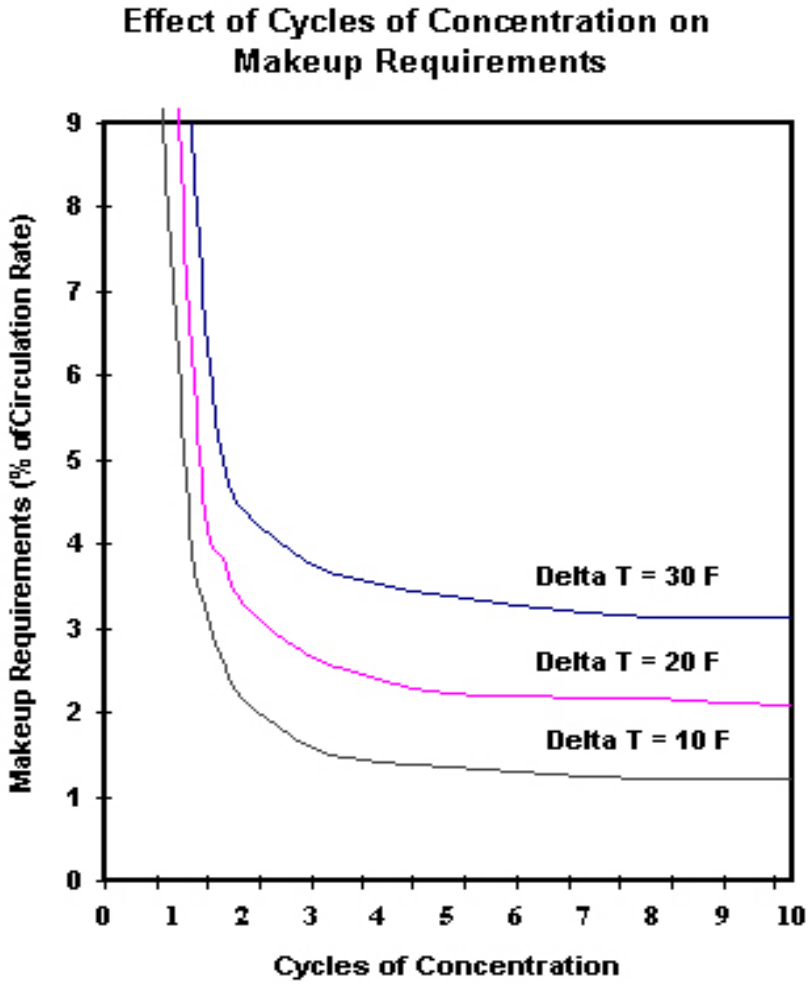
- Verify conductivity meter used to control blowdown is calibrated and functioning properly (required)
  - Measure sump conductivity
  - Calibrate water treatment controller
- Recommend repair if required (voluntary)



Water Usage – Maintenance, Cleaning & Repair

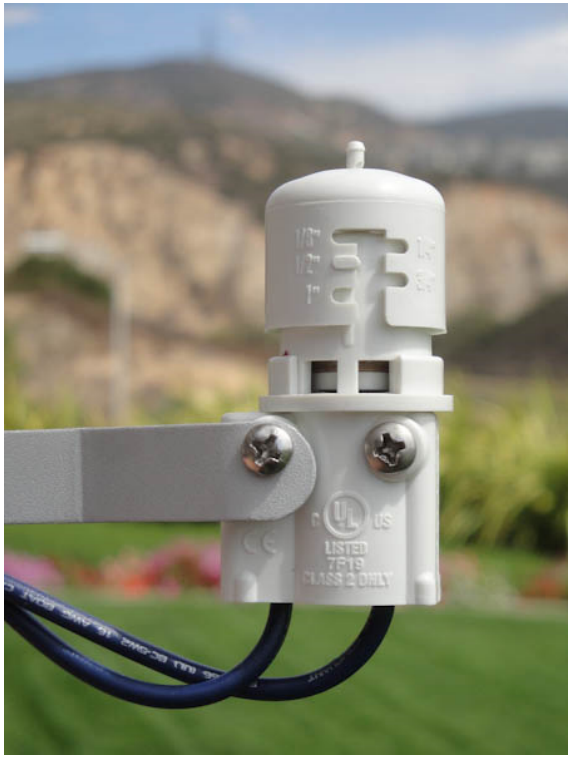
- Evaluate cooling towers for water leaks and excess water consumption
  - Repair or adjust as appropriate for standard or regular maintenance actions (required)
  - Recommend repairs if scope more than standard maintenance (voluntary)

Cycles of Concentration (COC) is the ratio of the maximum sump conductivity (or Total Dissolved Solids TDS) to the makeup water conductivity/TDS



Water Usage – Irrigation Systems

- Irrigated area >500 ft2
  - Review irrigation schedule for improvements (voluntary)
- Verify irrigation sensors are functioning properly (required)
  - Locate rain sensor. Override irrigation zone you can see and activate sensor
  - Test continuity
  - Adjust, calibrate or repair/replace as required



Rain sensor/switch

Water Usage – Water Features

- Review water feature schedules (required)
  - Set to shut-down during night time or unoccupied periods where appropriate

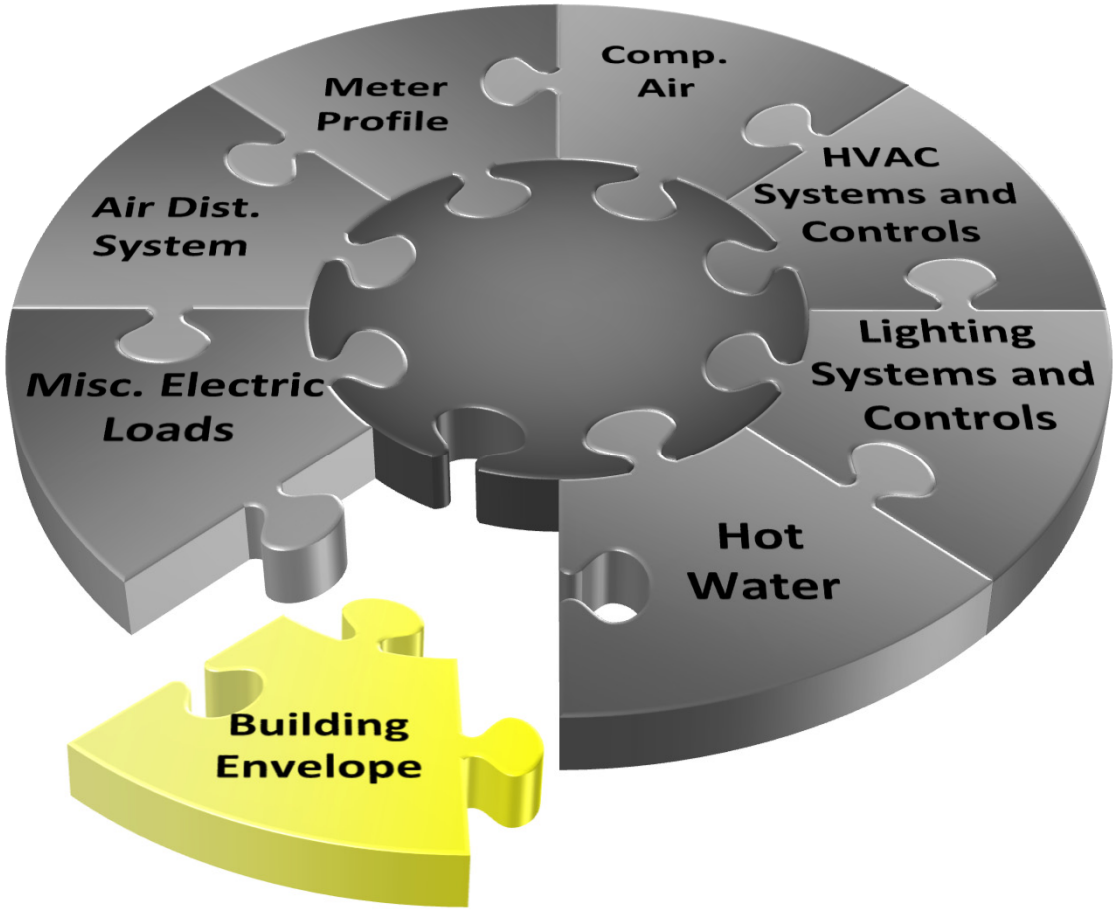
Water Usage – Maintenance, Cleaning & Repair

- Check irrigation system for leaks, overspray, broken heads, plugged nozzles or other operational problems (required)
  - Adjust and repair as appropriate
  - Recommend repair if scope of work more than routine maintenance (voluntary)

Water Usage – Maintenance, Cleaning & Repair

- Check hands free sensor-activated plumbing fixtures for proper operation (voluntary)
  - Recommend repair if scope of work more than routine maintenance (voluntary)
- Check water flow rate for fixtures (voluntary)
  - Recommend low-flow fixture or aerator replacement if appropriate
  - 2015 Seattle Plumbing Code Maximum Water Consumption
    - 0.25 GPM metered public faucets
    - 0.5 GPM public lavatories
    - 2.2 GPM private lavatories
    - 2.5 GPM kitchen faucet
    - 2.5 GPM shower head

Building Walk Down: **Envelope**



Envelope

- Walk outside & inside
- Doors
- Windows
- Openings
- Shades
- Exterior Plug Loads
- Insulation
- Roof
- Attic and Crawl Spaces
- Seal un-used penetrations in envelope (piping, duct work, etc.)

Seattle Building Tune-Ups Rule:
Table 2: 4.a, 4.b, 4.c

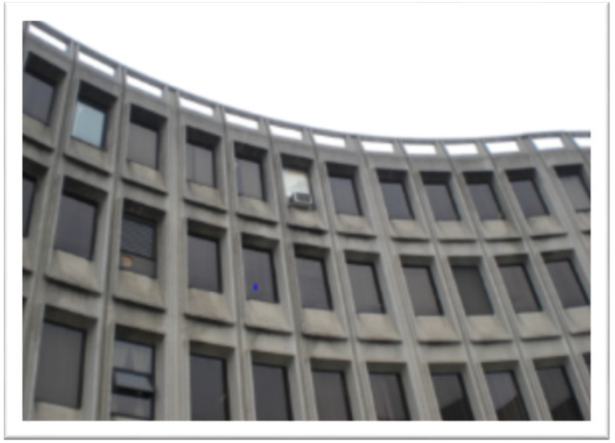
Tab K on Report

Building Envelope Walk Down: Doors and Windows

Focus on the exterior conditions of the building

Door and window type:

- Are the windows operable?
- Are the windows single, double or triple pane?
- Are any windows and outside doors open during the walk down?
- If windows and doors are open, this could indicate a problem related to heating, cooling or ventilation



Building Envelope: Maintenance, Cleaning, Repair

- Check for unsealed penetrations that allow for entry of air or water
- Check for missing weather-stripping at doors & windows
- Check elevator shaft dampers- stuck open or leaky
- Identify uninsulated attic areas or insulation damage
- Identify any significant duct leakage (disconnected ducting or holes)

Recommend repairs if scope of work is more than standard maintenance

Gaps under doorways

Failed roof insulation

OpenEIS: Open Energy Information System

- Cloud and desktop versions identical
- Desktop version will run on Windows 7 and 10, Mac or Linux operating systems
  - Currently have Windows installer
  - Mac installer coming soon
- Functionality implemented as web services
  - Simplifies replacing/customizing UI
  - Interaction with the system can skip UI completely (programs/scripts)
- Users can create an account before using the tool; especially important for Cloud version where multiple users will be using the same service

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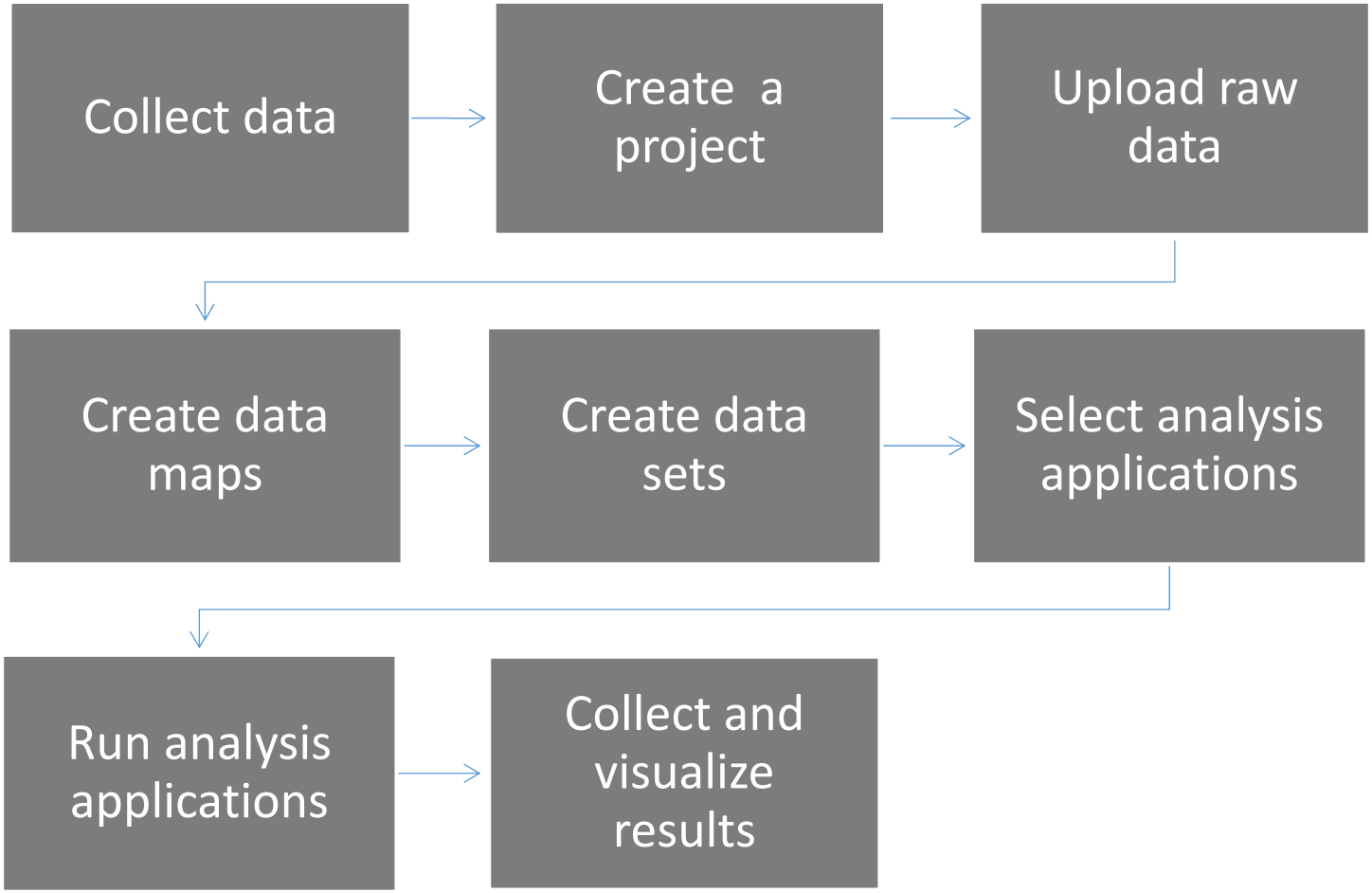
OpenEIS UI Workflow



OpenEIS Features: Importing

- Importing performance data
  - Loggers, automated meters (interval data), Green Button XML, building automation systems, etc.
  - Data can be either be comma or space delimited – may work with other forms of delimiters
- Date and timestamp can be in any number of formats
- Green Button XML
  - Importing process “automatically” coverts Green Button XML data to CSV “on the fly”, so the application can readily use the data
  - Once converted to CSV, workflow identical to the other data
- Imported data file can be
  - Renamed
  - Deleted
  - Re-exported or downloaded – useful to export XML data that is converted to CSV
- Other Features:
  - Merging raw data files into datasets
  - Merging mismatched time stamps (off a by few minutes)
  - Merging raw data from multiple files for analysis
  - Filling missing data
  - Time zone can be assigned
  - Data can be previewed

OpenEIS Applications

- **Heat Map**
- **Load Profile**
- **Load Profile – RCx**
- **Energy Savings – M&V**
- **Temperature Set Point Detection**
- **Compressor Cycling Detection**
- **Schedule Detection**
- AHU/RTU Economizer Diagnostics
- AHU/RTU Performance Diagnostics
- Auto-RCx: AHU Static Pressure Performance
- Auto-RCx: AHU Supply Temperature Control
- Auto-RCx: AHU/RTU Operation Schedule
- Hot Water Distribution System Performance
- Auto-RCx: Hot Water Distribution System Diagnostics
- Auto-RCx: AHU-VAV Zone Diagnostics

Where can you download the OpenEIS tool

- https://github.com/VOLTTRON/openeis/releases
- Get the setup file and not the source code files

Day 1 Review

- Seattle Building Tune Up Requirements
- Seattle Tune Up Accelerator Program
- Asset Score Tool
- Building Re-tuning

QUESTIONS ?

Day 2: Walk Down Logistics

8:30am – Gather for the onsite building walk down practice. Bring clip board or writing pad for notes, Asset Score form and any other tools for observing building conditions

10:10am – Wrap-up site visit

10:30am – Reconvene at Smart Buildings Center

Day 2 Site Location & Address

King County Metro Transit Power Distribution

- 2255 4th AVE S
- Office, Warehouse, Other, Parking
- 21,947 SF
- Built in 2004

Meet on sidewalk outside of gate on 4th Ave S.

SEATTLE
BUILDING TUNE-UP ACCELERATOR

THANK YOU & SEE YOU TOMORROW!