Using Buildings as Classrooms: City of Seattle Building Tune-Ups as Curriculum for Climate Action

Washington/Oregon Higher Education Sustainability Conference

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About Us

Steve Abercrombie

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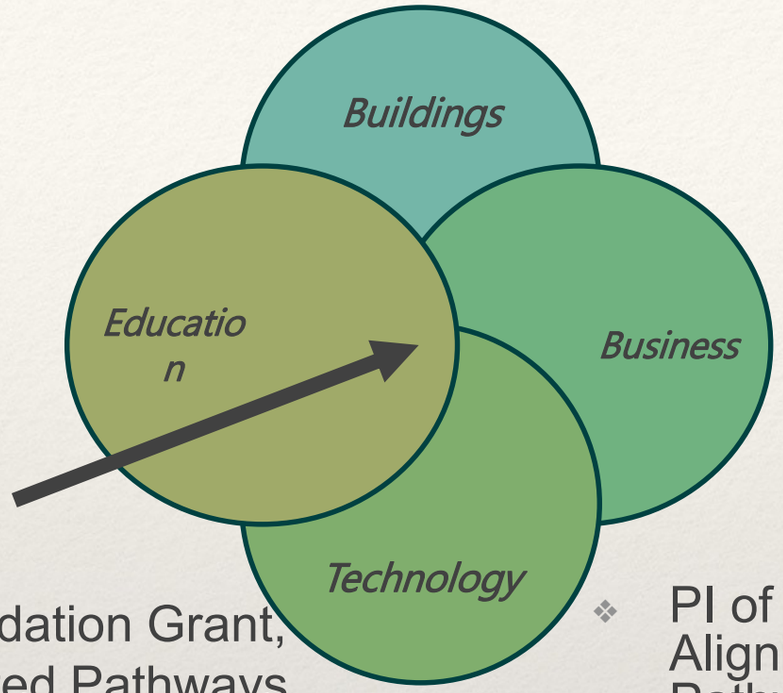

- Co-PI of National Science Foundation Grant, Aligning Students into Accelerated Pathways (ASAP)
- Full time consultant / commissioning agent
- Adjunct Faculty – South Seattle
- 12 years teaching in higher-ed
- Specialist in building-related adult education

- PI of National Science Foundation Grant, Aligning Students into Accelerated Pathways (ASAP)
- Faculty & Faculty Coordinator of SBST
- Former PI and Co-PI of 2 successfully completed NSF Grants
- Former Department Chair and Faculty of Energy Management associate's program at Edmonds Community College
- MBA in Sustainable Business

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SOUTH SEATTLE COLLEGE
One of the Seattle Colleges

Who is South Seattle College?

- One of three community colleges in the Seattle College District
- Seattle Colleges serves the city of Seattle and offers programs to nearly 50,000 students
- The Georgetown campus (shown) is a satellite campus of South Seattle College
  - Largest apprenticeship training center in the Northwest (63 trades)
  - Home to the Sustainable Building Science Technology bachelor's program (SBST)

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What is the SBST Program?

- 2-year cohort program confers a Bachelor of Applied Science (BAS) degree
- ~15 students per year
- Most students work full-time
- Includes internship and capstone
- Graduates are qualified (with experience) to perform Seattle Building Tune-ups

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The Opportunity – City of Seattle Building Tune-Up Ordinance

- The Ordinance was adopted March 2016
- "Key piece of **Seattle's Climate Action Plan**, our roadmap to achieving carbon neutrality, by helping ensure buildings don't waste energy and water."
- Energy Benchmarking → Transparency & Disclosure → Tune-Ups

- Tune-Up: Low- and no-cost operational efficiencies that improve building performance and on average reduce building energy use 10-15%
- By 2021, all commercial buildings ≥ 50,000 SF must undergo a tune-up every 5 years.
- Seattle Colleges - 14 buildings that need to comply
- Students need training

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The Opportunity – Project-Based Learning is Good for Students

- Project-Based learning (PBL) supports active/experiential learning
- Active learning = engaging students in the process
- Contextualizing learning for students and exposing them to real-world problems is “a key aspect in improving persistence and completion.” (as cited in NASEM 2016)
- Challenge – PBL does not rely on 1 solution

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The Opportunity – National Science Foundation-ATE Grant Funding

- SBST Program developed as part of *Expanding Lifelong STEM Career Pathways in Sustainable Building Science Technology* NSF-ATE grant ($862k)
- New NSF-ATE grant proposed and funded, *Aligning Students into Accelerated Pathways in Engineering, Technology, and Building Science* ($492k)

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New NSF Project Goals

1. Increase access to accelerated STEM pathways for underrepresented populations with a focus on veterans and incumbent workers in order to ready them for mid-skilled STEM positions in high demand.
2. Incorporate authentic STEM field experiences into the new associate's degree and the existing BAS degree programs in STEM that will expose students to direct industry work while increasing the energy efficiency of the city of Seattle's commercial building stock.

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Select SBST Curriculum

- Year 1
  - Building Science
  - Building Codes
  - Energy Auditing and Analysis
  - Building Controls
  - Facility finance & management
  - Utility Policy
- Year 2
  - Professional Communications
  - Energy Efficiency Finance
  - Energy Policy

Focus on Living Laboratory learning

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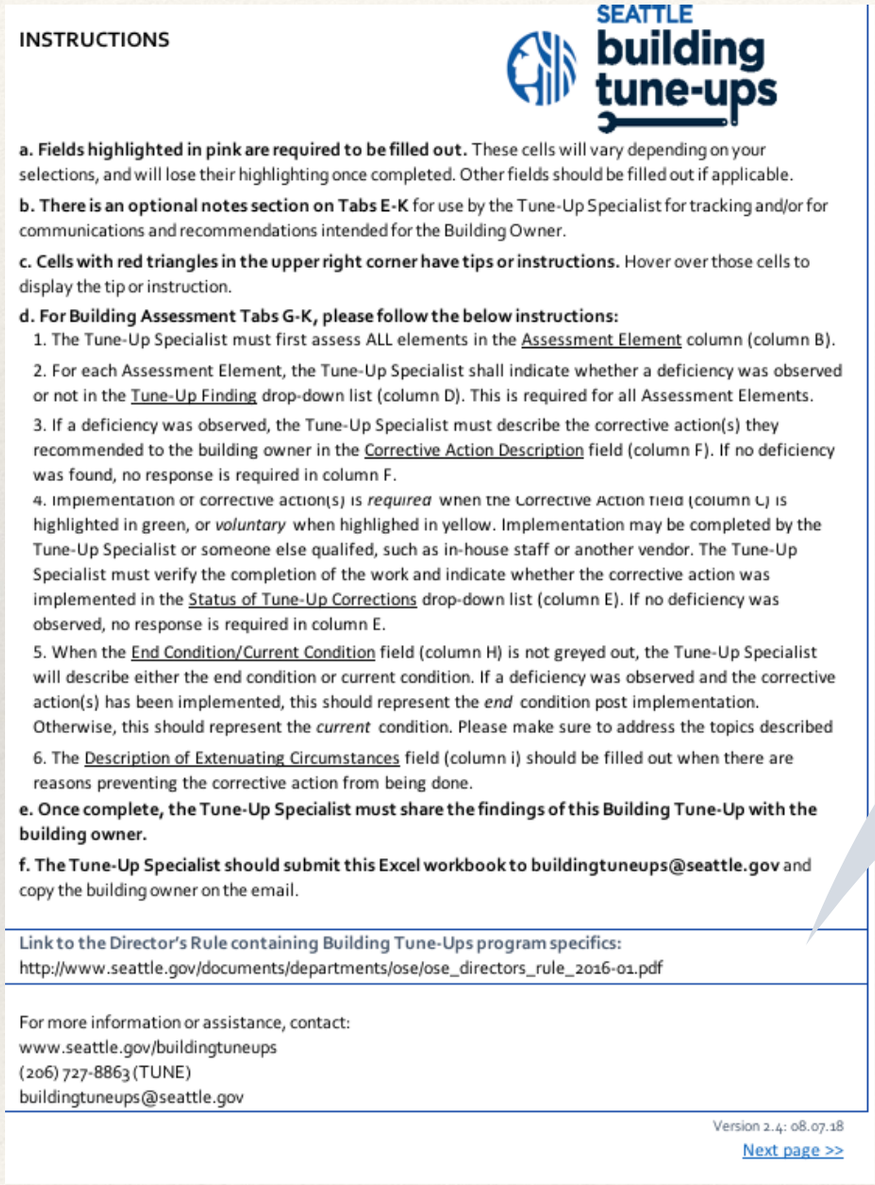
What is a Building Tune-Up?



INSTRUCTIONS

SEATTLE building tune-ups

a. Fields highlighted in pink are required to be filled out. These cells will vary depending on your selections, and will lose their highlighting once completed. Other fields should be filled out if applicable.

b. There is an optional notes section on Tabs E-K for use by the Tune-Up Specialist for tracking and/or for communications and recommendations intended for the Building Owner.

c. Cells with red triangles in the upper right corner have tips or instructions. Hover over those cells to display the tip or instruction.

d. For Building Assessment Tabs G-K, please follow the below instructions:

1. The Tune-Up Specialist must first assess ALL elements in the Assessment Element column (column B).
2. For each Assessment Element, the Tune-Up Specialist shall indicate whether a deficiency was observed or not in the Tune-Up Finding drop-down list (column D). This is required for all Assessment Elements.
3. If a deficiency was observed, the Tune-Up Specialist must describe the corrective action(s) they recommended to the building owner in the Corrective Action Description field (column F). If no deficiency was found, no response is required in column F.
4. Implementation of corrective action(s) is *required* when the Corrective Action Field (column C) is highlighted in green, or *voluntary* when highlighed in yellow. Implementation may be completed by the Tune-Up Specialist or someone else qualifed, such as in-house staff or another vendor. The Tune-Up Specialist must verify the completion of the work and indicate whether the corrective action was implemented in the Status of Tune-Up Corrections drop-down list (column E). If no deficiency was observed, no response is required in column E.
5. When the End Condition/Current Condition field (column H) is not greyed out, the Tune-Up Specialist will describe either the end condition or current condition. If a deficiency was observed and the corrective action(s) has been implemented, this should represent the *end* condition post implementation. Otherwise, this should represent the *current* condition. Please make sure to address the topics described
6. The Description of Extenuating Circumstances field (column i) should be filled out when there are reasons preventing the corrective action from being done.

e. Once complete, the Tune-Up Specialist must share the findings of this Building Tune-Up with the building owner.

f. The Tune-Up Specialist should submit this Excel workbook to buildingtuneups@seattle.gov and copy the building owner on the email.

Link to the Director's Rule containing Building Tune-Ups program specifics:
http://www.seattle.gov/documents/departments/ose/ose_directors_rule_2016-01.pdf

For more information or assistance, contact:
www.seattle.gov/buildingtuneups
(206) 727-8863 (TUNE)
buildingtuneups@seattle.gov

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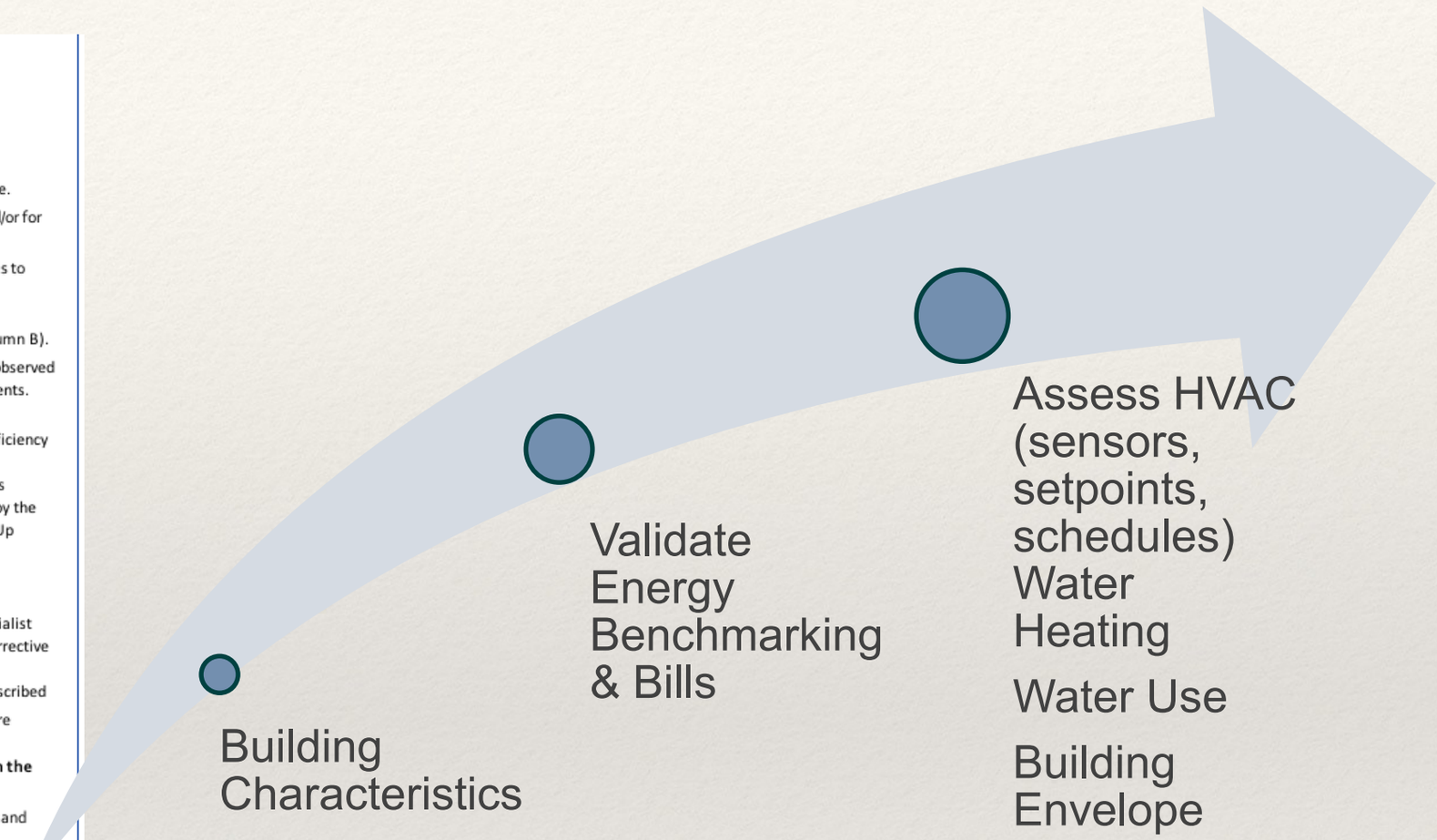

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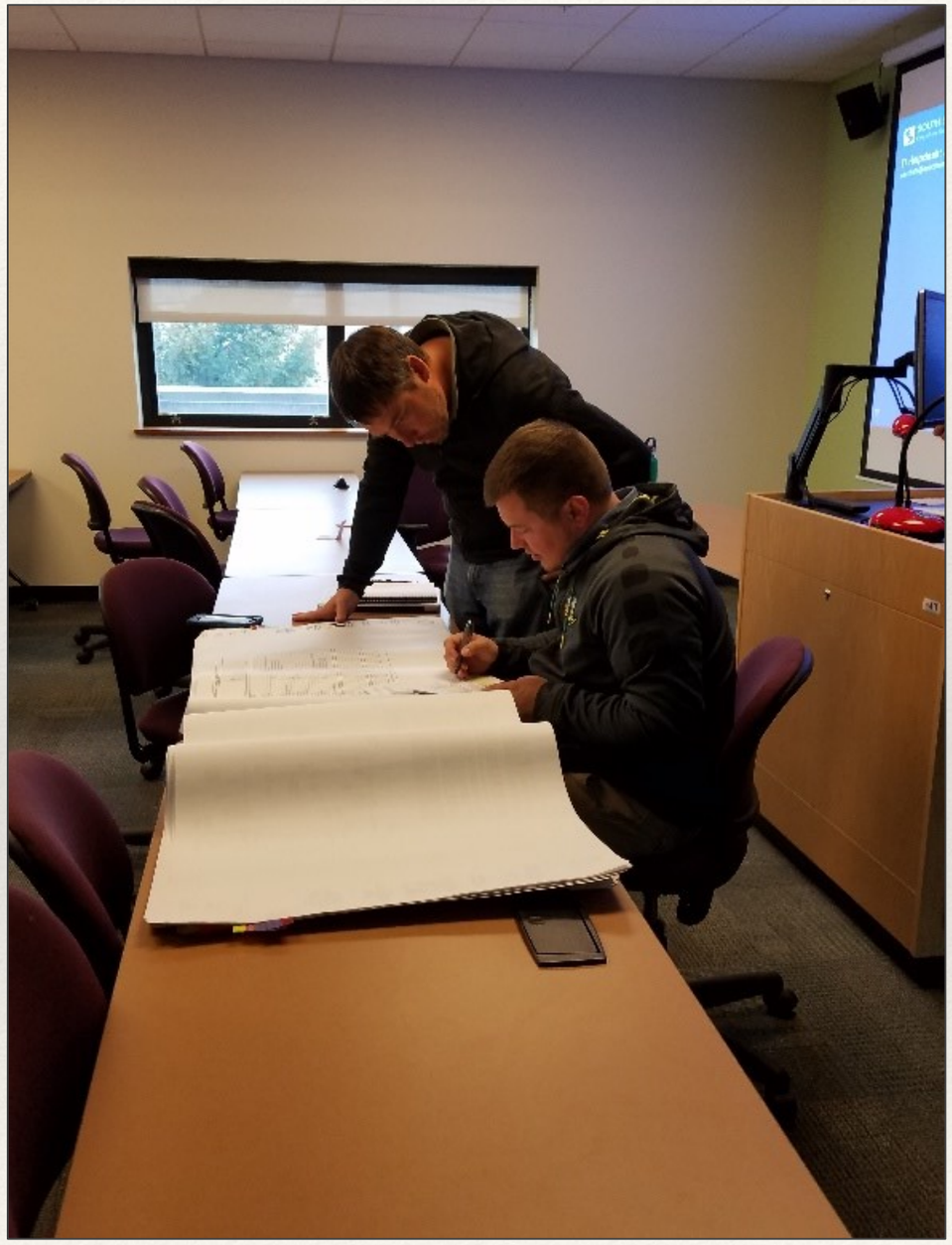
Building Tune-Ups Project Assignment

- 2-quarter project assignment with incorporated Tune-Up elements
  - 4 Seattle Colleges Buildings
  - Support from McKinstry & Seattle Colleges facilities and admin staff



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The Assignment

Q1 – Fall

- DoE Asset Score / ENERGY STAR Portfolio Manager/ NBI FirstView
- Building Tune-Up plan
- Review of Tune-Up measures spreadsheet

Q2 – Winter

- Building controls
- Facility finance & budgeting

Both quarters culminated in a final presentation

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Student Findings

BENCHMARKING Baseline Data is Skewed

JOSH

Seattle.gov

Seattle Energy Benchmarking
Office of Sustainability & Environment

1814 HARVARD AVE | Neighborhood | Council District | Prope

Property Information

Energy Performance Metrics

ENERGY STAR Score MORE INFO ▶

1 — 100

Site Energy Use Intensity MORE INFO ▶

0 — 200+

Source Energy Use Intensity MORE INFO ▶

SEATTLE COMMUNITY COLLEGE SCIENCE AND MATH
1814 HARVARD AVE
98122
Seattle Benchmarking building ID: **33548**
Property Type: **College/University**
Property Size (ft²): **84,000**
Year Built: **2006**
Total GHG Emissions (Metric Tons CO_2e): **416.59**
GHG Intensity (Kilograms CO_2e/ft^2): **4.96**
ENERGY STAR Score: **N/A**
Site Energy Use Intensity (kBTU/ft²): **146.1**
Source EUI (kBTU/ft²): **270.1**
Comments: **N/A**
more details...

84,000 ft² includes the unheated parking structure on ground level. **Should be closer to 67,000 ft²**

Source:
http://www.seattle.gov/energybenchmarkingmap

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Student Findings

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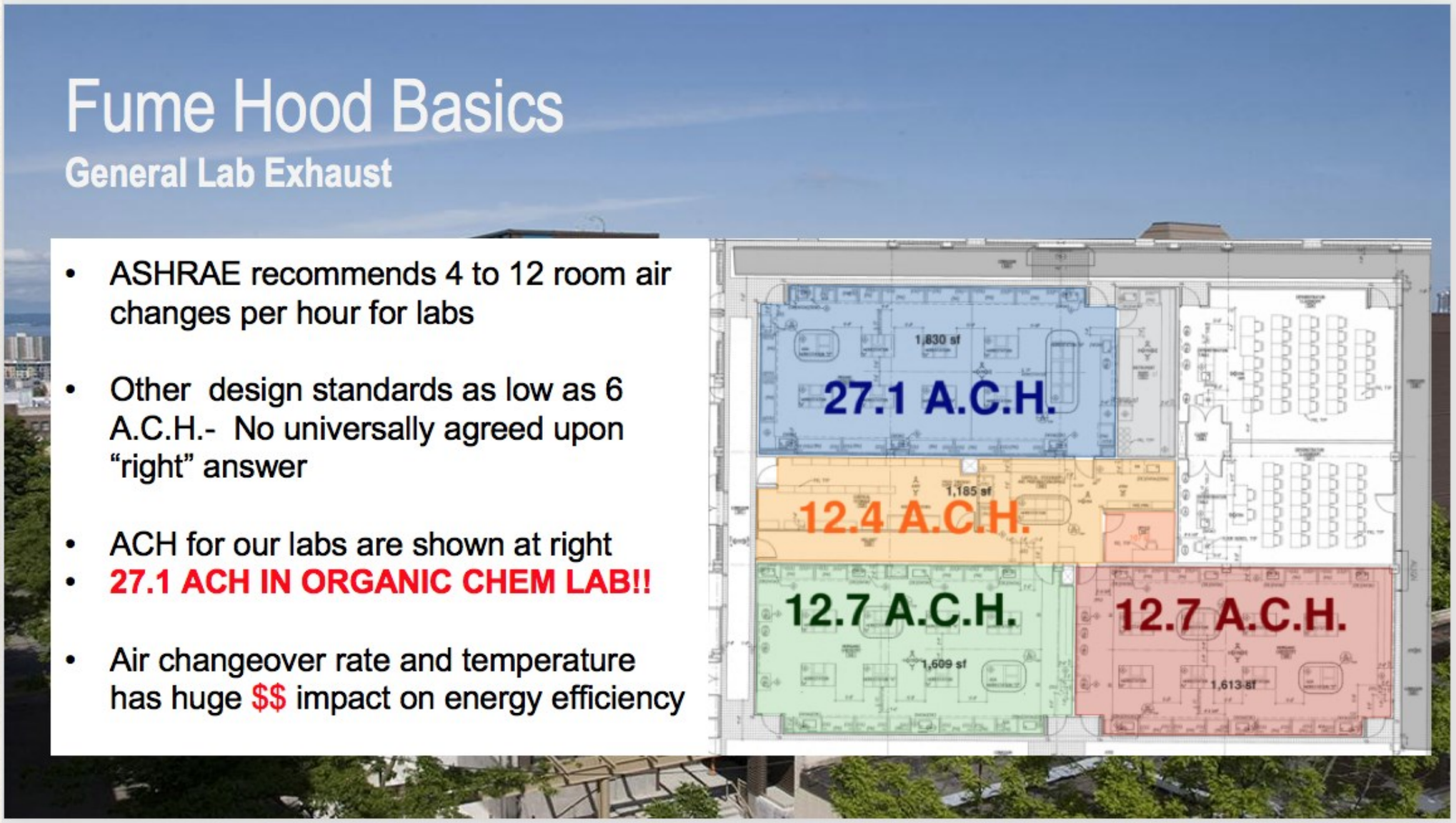

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Student Findings

	External Capital	Costs	Notes
	Contractor Costs		
	Project Engineering	$ 10,000	
	Library AHU replacement	$ 90,000	Replace (6) Aaon Constant Volume AHUs with BACnet-enabled VAV AHUs
	VAV AHUs/Trane Intellipaks	$ 120,000	New BACnet controllers, sensors, wiring, communication, OSA flow stations, duct static pressure reset, supply air temp reset
	VAV Terminal units upgrade	$ 112,500	(45)* new VAV terminal units, DDC controllers, sensors, wiring, communication, min/max flow determination according to ASHRAE 62.1
			*Based on assumption of 1 VAV box per 1000 sq. ft. = 95 VAVs, and that half of those are pneumatic
			Note: May be able to use existing VAVs by removing pneumatic controls, replacing damper and adding flow sensor; this could substantially reduce cost
			Also included in scope:
			BAS BACnet upgrade
			High level air balancing
			ASHRAE 36P High Performance Sequence of Operations
			All work performed off hours (8pm to 6am)
	External Capital Subtotals	**$ 322,500**	
	Internal Capital		
	Project Management	$ 10,000	
	Information Technology	$ 900	
	Staff Training	$ 5,000	
	External Capital Subtotals	**$ 15,900**	
	TOTAL CAPITAL BEFORE INCENTIVES	$ 338,400	
	Incentives		
	Seattle City Light Rebate - Advanced Rooftop Controls	**-$ 81,000**	$225/ton x 30 ton x 12 rooftop units
	TOTAL CAPITAL AFTER INCENTIVES	**$ 257,400**	
	POTENTIAL ANNUAL ENERGY SAVINGS	**$ 47,500**	Based on $1/sq. ft./year energy savings with DCV implemented in half of building
	SIMPLE PAYBACK = 5.4 years		

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Student Skill Development

Technical Skills

Including building science, systems and components; energy analysis and auditing

Communication

Including accepting feedback and constructive criticism; presentations and communication

Teamwork

Including establishing rapport with teammates and industry; and listening to ideas of others.

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Real World Projects = Real World Lessons

- Out of synch with actual Seattle Colleges Tune-up Schedule
- Alignment with quarterly academic schedule is difficult
- Access and scheduling were a huge challenge!
- Need more Tune-Up specific curriculum in SBST program
- Third-party software will break at the most inopportune moment
- Beware the project trough of disillusionment!

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Resources

- Works cited
  - National Academies of Sciences, Engineering, and Medicine. (2016). Barriers and Opportunities for 2-Year and 4-Year STEM Degrees: Systemic Change to Support Diverse Student Pathways. Committee on Barriers and Opportunities in Completing 2-Year and 4-Year STEM Degrees. S. Malcom and M. Feder, Editors. Board on Science Education, Division of Behavioral and Social Sciences and Education. Board on Higher Education and the Workforce, Policy and Global Affairs. Washington, DC: The National Academies Press. doi: 10.17226/21739.
  - Scott Freeman, Sarah L. Eddy, Miles McDonough, Michelle K. Smith, Nnadozie Okoroafor, Hannah Jordt, and Mary Pat Wenderoth. (2014). Active learning boosts performance in STEM courses. Proceedings of the National Academy of Sciences Jun 2014, 111 (23) 8410-8415; DOI: 10.1073/pnas.1319030111
- NSF ATE Network
  - PBL Projects, NSF-ATE Project
  - BEST Center – Building Efficiency for a Sustainable Tomorrow, https://www.bestctr.org/
  - CREATE – Center for Renewable Energy Advanced Technological Education, www.createenergy.org
  - ATE Centers
    - http://www.atecenters.org/
    - ATE Subject Areas: advanced manufacturing, ag & bio-tech, energy & environmental tech, engineering tech, information tech, learning, evaluation & research, micro & nano tech, security tech
  - City of Seattle, Office of Sustainability and the Environment – Building Tune-Ups