Pacific Northwest
NATIONAL LABORATORY

Gateway to Energy Efficiency Retrofits: The Quick Building Assessment Tool

March 5, 2024

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U.S. DEPARTMENT OF ENERGY BATTELLE

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Overview and Roadmap

QBAT Overview:

- Goals of Quick Building Assessment Tool (QBAT)
- QBAT Features Walkthrough
- 2022 QBAT Case Study
- Demo

Discussion

- Feedback Session

Goals and Intended Users

Closing the Knowledge Gap:

- Facility managers and building owners often **lack the expertise or time** to perform detailed energy audits themselves
- This audience needs **a simplified assessment** to introduce energy efficiency opportunities with minimal data and expertise to:
  - Explore and identify high level opportunities for building improvements
  - Prioritize buildings with the highest levels of improvement
  - Provide additional information to guide them to the next steps for a more detailed assessment

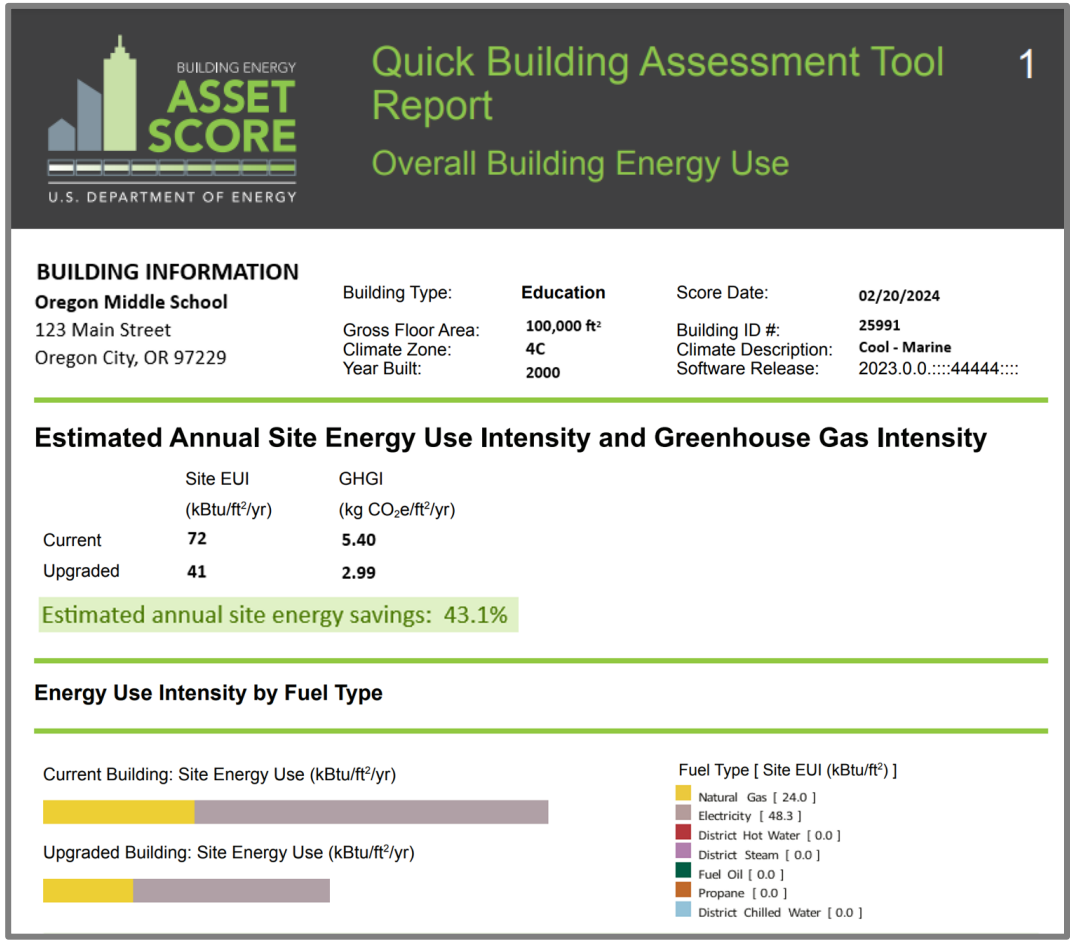
Solution:

The Quick Building Assessment (QBAT) Tool

Solution: Quick Building Assessment Tool (QBAT)

Requirements and Benefits

- Users provide **simple, accessible building parameters** to QBAT's recommendation engine to access:
  - List of retrofits for their building
  - Resources to learn more about each retrofit
  - Estimated energy and carbon savings for their selected measures
  - Health and safety benefits



BUILDING ENERGY ASSET SCORE
U.S. DEPARTMENT OF ENERGY

Quick Building Assessment Tool Report 1

Overall Building Energy Use

BUILDING INFORMATION

Oregon Middle School
123 Main Street
Oregon City, OR 97229

Building Type:	**Education**	Score Date:	**02/20/2024**
Gross Floor Area:	**100,000 ft²**	Building ID #:	**25991**
Climate Zone:	**4C**	Climate Description:	**Cool - Marine**
Year Built:	**2000**	Software Release:	2023.0.0.:::44444::::

Estimated Annual Site Energy Use Intensity and Greenhouse Gas Intensity

	Site EUI (kBtu/ft²/yr)	GHGI (kg CO_2e/ft²/yr)
Current	**72**	**5.40**
Upgraded	**41**	**2.99**

Estimated annual site energy savings: 43.1%

Energy Use Intensity by Fuel Type

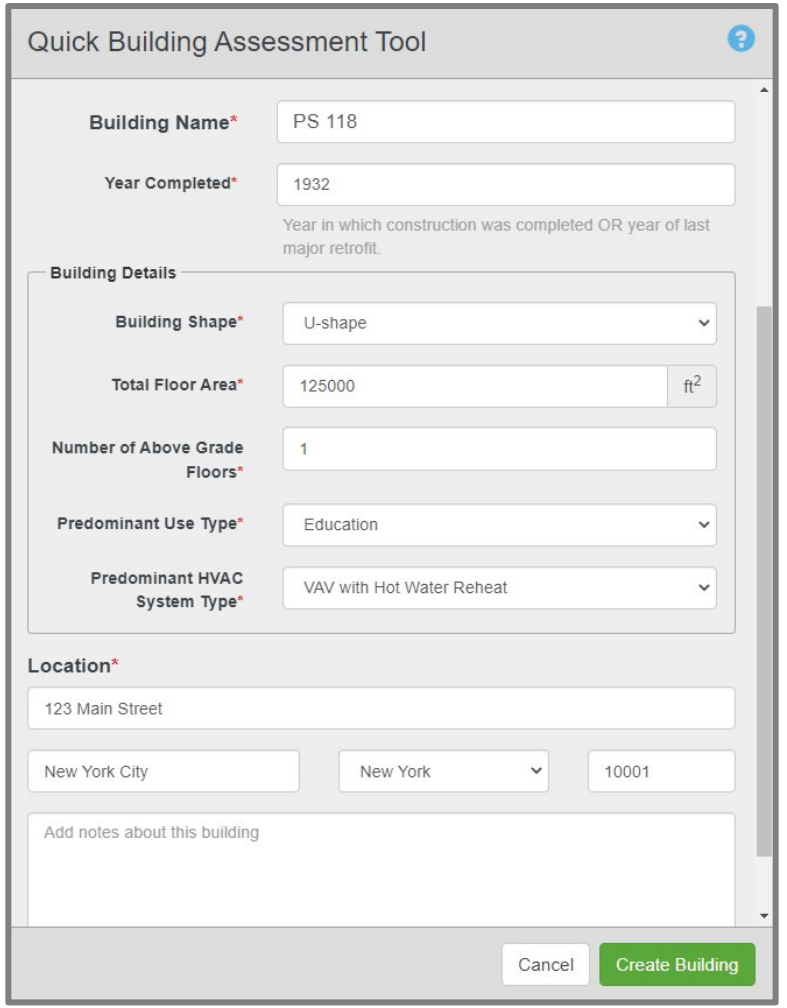
Current Building: Site Energy Use (kBtu/ft²/yr)

Upgraded Building: Site Energy Use (kBtu/ft²/yr)

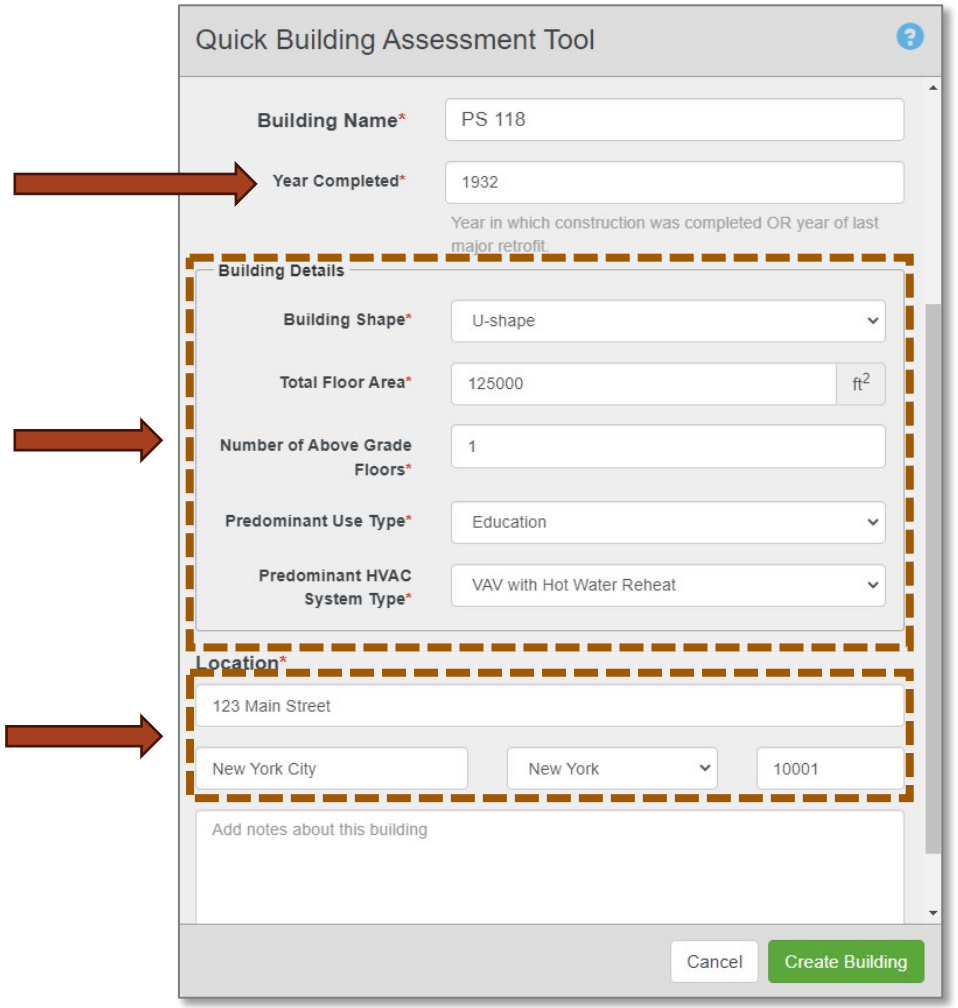
Fuel Type [Site EUI (kBtu/ft²)]
- Natural Gas [24.0]
- Electricity [48.3]
- District Hot Water [0.0]
- District Steam [0.0]
- Fuel Oil [0.0]
- Propane [0.0]
- District Chilled Water [0.0]

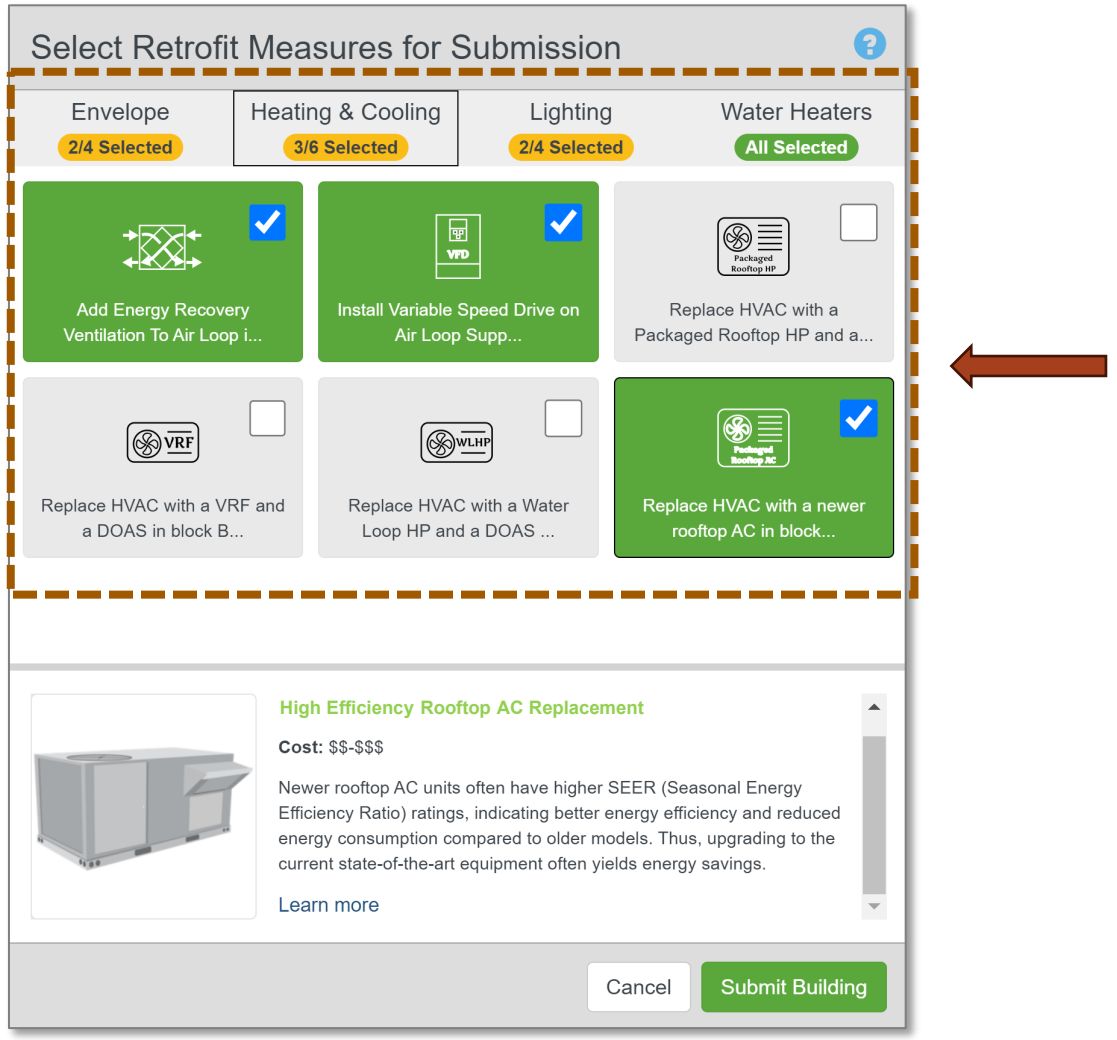
What is the Quick Building Assessment Tool (QBAT)

- The **Quick Building Assessment Tool (QBAT**) is a module built on **Building Energy Asset Score (Asset Score)**
- QBAT only requires **high-level, easily identifiable inputs** to simulate characteristic buildings for a given climate zone, HVAC system, building size, and vintage
- Designed for **users of all backgrounds** to identify energy efficiency, health, and safety opportunities for their buildings

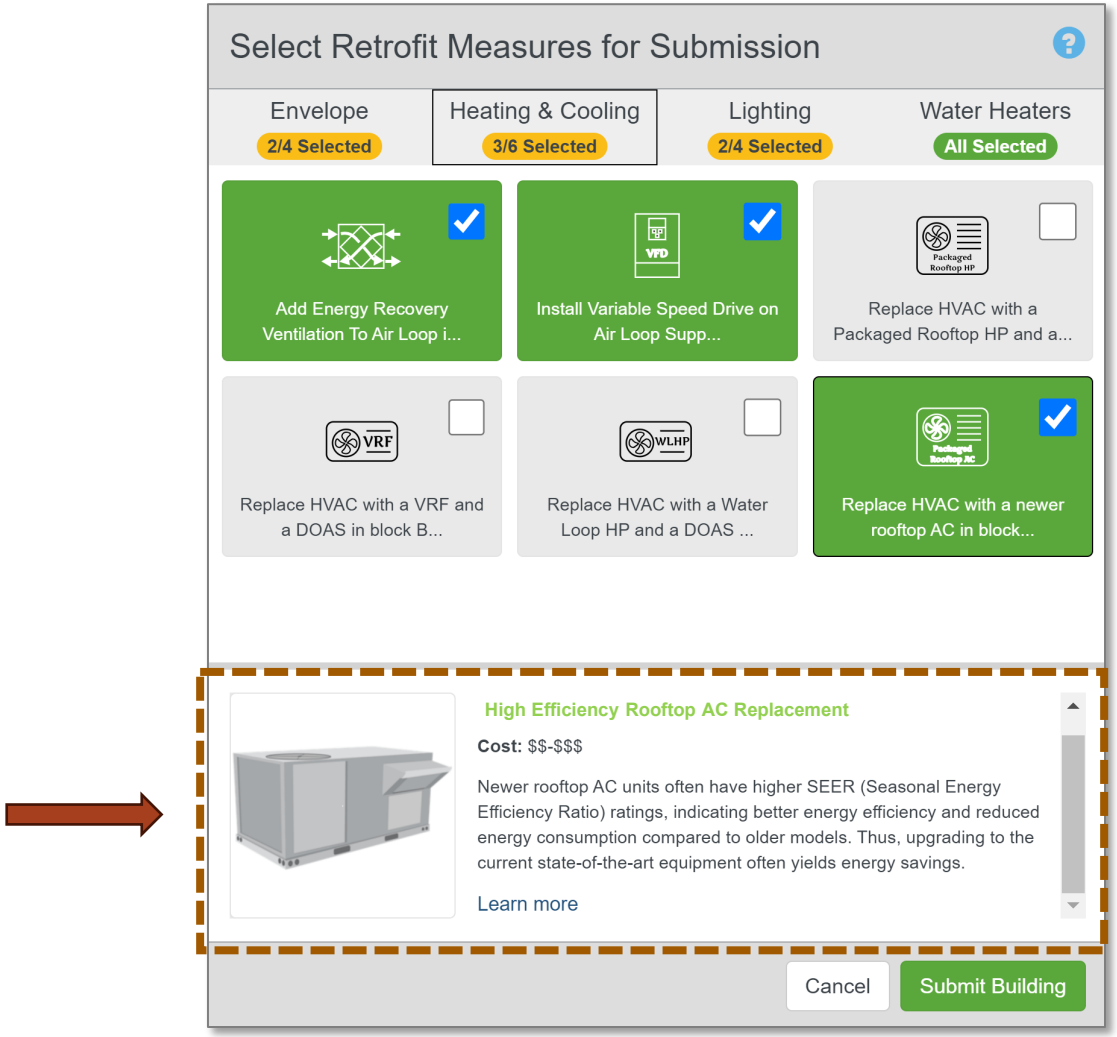


QBAT User Experience:





QBAT User Experience: Learn More



5. High Efficiency Rooftop AC Replacement

Cost: $$-$$$

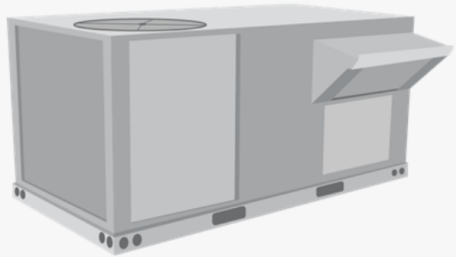


Image 11: Packaged Rooftop Air Conditioner (Source: Berkeley Lab)

Rooftop AC units are self-contained systems, installed on the roof of a building, that house all the components necessary for air conditioning in a single unit. These components typically include a compressor, condenser, evaporator, fans, and sometimes a heating element for year-round climate control. The units are designed to be compact, making efficient use of rooftop space.

Newer units often have higher SEER (Seasonal Energy Efficiency Ratio) ratings, indicating better energy efficiency and reduced energy consumption compared to older models. Thus, upgrading to the current state-of-the-art equipment often yields energy savings.

Resources:

1. https://www.energy.gov/eere/buildings/articles/whats-your-roof-rooftop-unit-rtu-efficiency-advice-and-guidance-advanced

QBAT Recommendation Engine Measures

Envelope, Lighting, Service Hot Water	HVAC Controls	HVAC Replacement	Decarb/Electrification Measures
Upgrade floor cavity insulation	Add demand control ventilation sensors	High Efficiency Boiler Replacement	Replace HVAC with VRF and DOAS w/ ERV
Upgrade roof insulation	Add economizer to air handler	High Efficiency Chiller Replacement	Replace HVAC with WLHP and DOAS w/ ERV
Upgrade wall insulation	Install VSDs on chilled water loop	High Efficiency Furnace Replacement	Replace HVAC with PSZ HP and DOAS w/ ERV
Install a cool roof	Add VFD to air handler supply fan	High Efficiency Rooftop Heat Pump Replacement	
Seal building envelope to reduce air infiltration	Add VFD to cooling tower fan	High Efficiency PTAC Replacement	
Upgrade to high efficiency skylights	Lower VAV box minimum flow setpoints	High Efficiency PTHP Replacement	
Upgrade to high efficiency windows	Implement chilled water reset control	High Efficiency Rooftop AC Replacement	
Add occupancy sensors	Implement fan static pressure reset	High Efficiency WLHP Replacement	
Upgrade to LED fixtures	Implement supply air temperature reset		
Install low flow water fixtures	Install energy recovery ventilator		

QBAT: Example Report Output

Energy and Carbon Savings Estimates

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Health and Safety Benefits for Measures

Building Name: **PS 118** Gross Floor Area: **125,000 ft²**

Health and Safety Impact of Upgrade Opportunities

• Lower VAV box minimum flow setpoints in block Block 1	Lowering VAV box minimum flow setpoints can improve thermal comfort by avoiding overcooling in summer and overheating during the winter. However, this may impact the outside air ventilation rate. Therefore, increase attention is needed to make sure that adequate outside air ventilation rate is provided to maintain indoor air quality.
• Add air-side economizer in block Block 1	Adding an economizer will increase outside air and can improve indoor air quality. In offices and schools, studies found that more outside air can reduce building-related symptoms and improves work performance and learning. Increasing ventilation can also mean more outdoor air pollutants may be brought indoors, such as vehicle exhausts if the outside air intake is near an area with significant traffic. It is therefore even more important to use high efficiency air filters, such as MERV 13 or better, to removal particulate matter (PM).
• Add variable frequency drive to condenser pumps in block Block 1	This measure is not expected to directly impact occupant health and safety. Follow commissioning, operation and maintenance, and performance monitoring best practices to enable efficient operation.
• Implement chilled water temperature reset in block Block 1	Adjustment of HVAC system control can affect thermal comfort by impacting zone or room level relative humidity. Monitor indoor temperature, relative humidity, and supply air flow, or conduct occupancy survey, to check for potential impact.
• Upgrade cooling plant pumping system to constant primary -variable secondary pumping system in block Block 1	This measure can affect thermal comfort as the pumping system upgrade may improve chilled water flow compared to current condition. Monitor indoor temperature, relative humidity, and supply air flow, or conduct occupancy survey, to check for potential impact.
• Implement demand controlled ventilation (DCV) in block Block 1	For DCV with zone level CO2 sensors, the control system can reduce the risk of having insufficient outside air ventilation when the space is occupied. Adequate ventilation is important for occupant health, work performance and learning. Adequate ventilation is also important for reducing building-related symptoms and mitigating infectious disease airborne transmission risks. For proper functioning of DCV, it is

How to use QBAT Information

Information provided by QBAT:

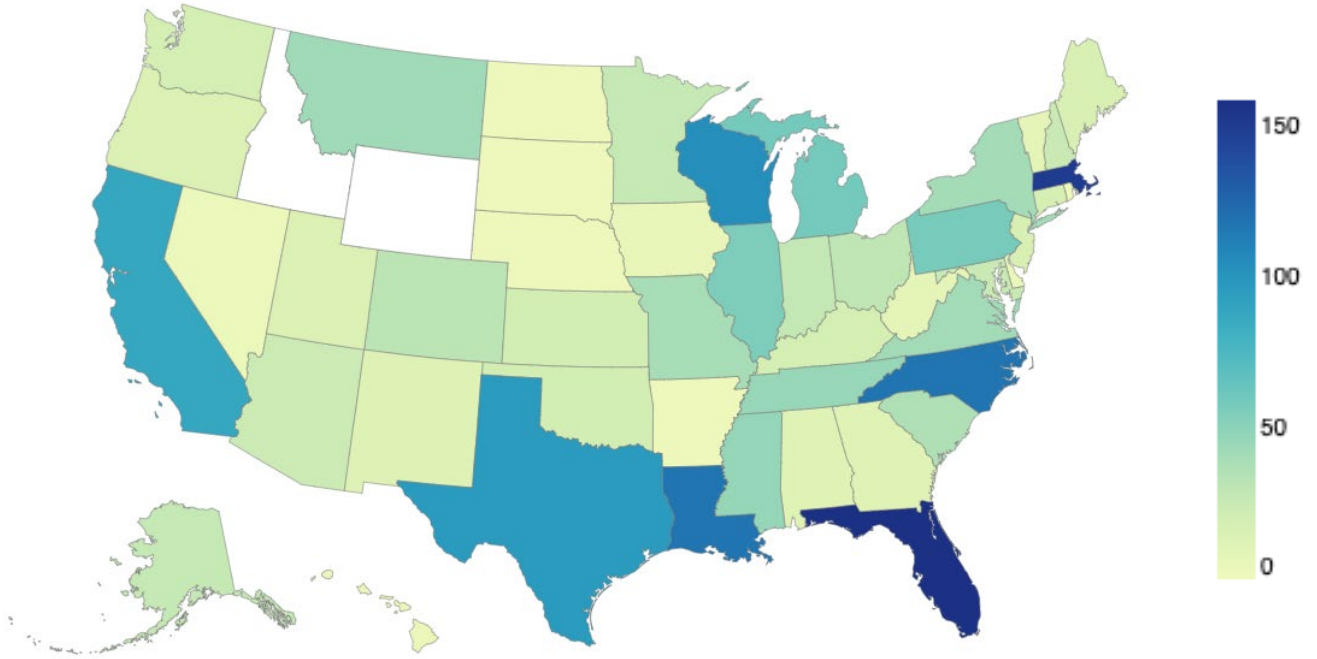
- List of retrofit opportunities available for your building
- Resources to learn more about each energy and carbon saving opportunity
- Energy and carbon emission savings estimates for their selected measures
- Health and safety improvement opportunities for their selected measures

Where to go from here?

- Contact a qualified assessor to perform a more detailed assessment of their selected measures
- Use this detailed energy audit to either apply for energy efficiency funding opportunities or take action on their own

QBAT Application and Impact

- QBAT's design helps users generate **baseline energy need assessments**
- Over 2,000 schools in 48 states completed QBAT buildings between October 2022 and February 2023
- Many FOA applicants for the **Bipartisan Infrastructure Law (BIL) to Renew America's Schools** used their QBAT building records to apply for funding opportunities

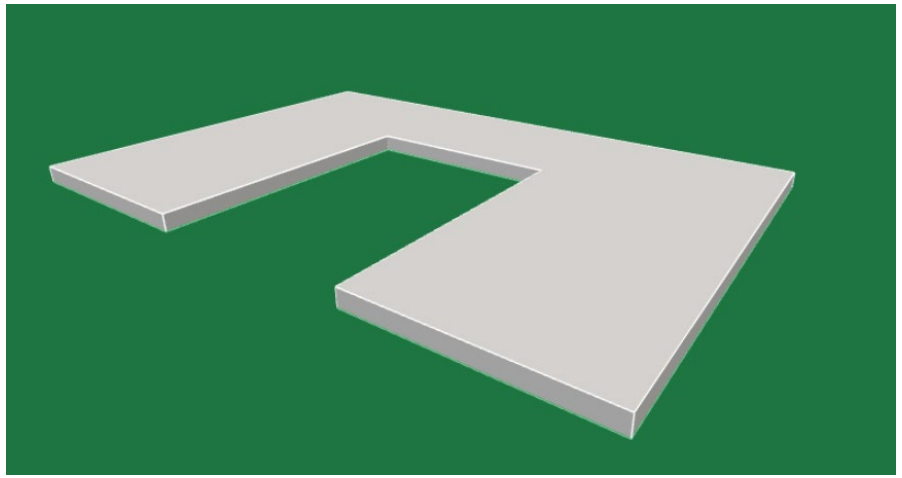


QBAT Building Count – First Round of BIL Renew America's School program

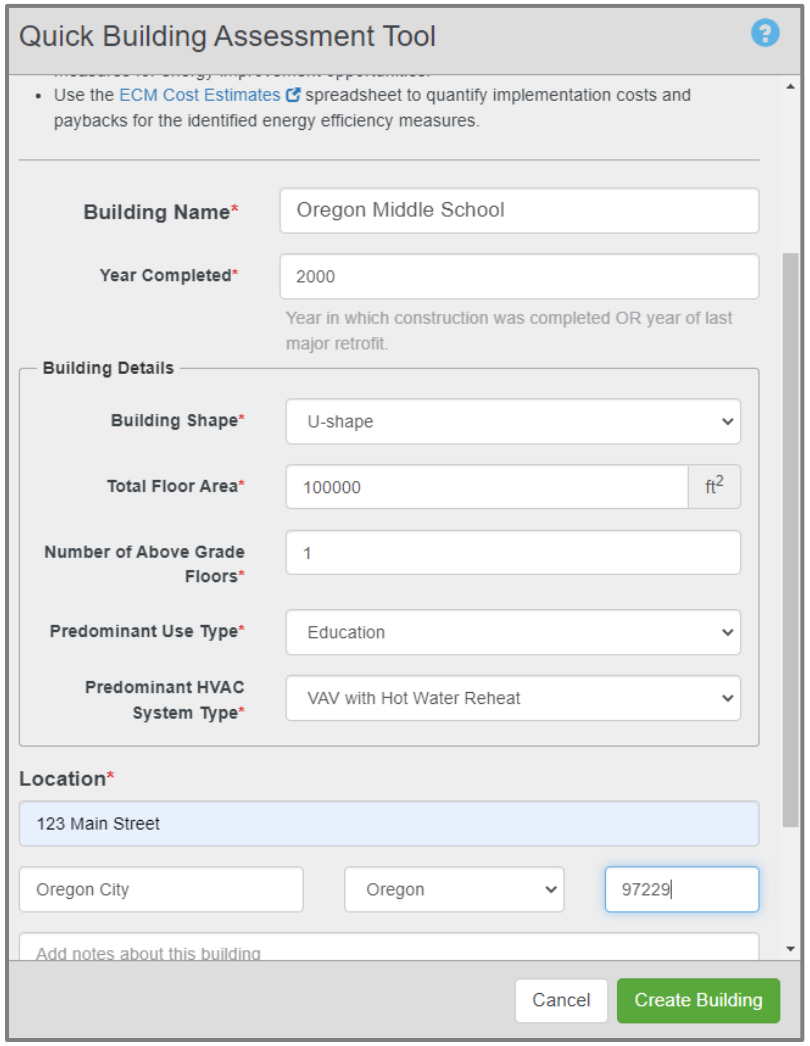
Case Study: School in Oregon

- A ~100,000 ft^2 Oregon school built in early 2000s is interested in retrofitting their school through the **BIL to Renew America's Schools**

- **Goals**:
  - Identify energy efficiency opportunities for their school
  - Estimate the impact of the retrofits



Case Study: Identify Measures



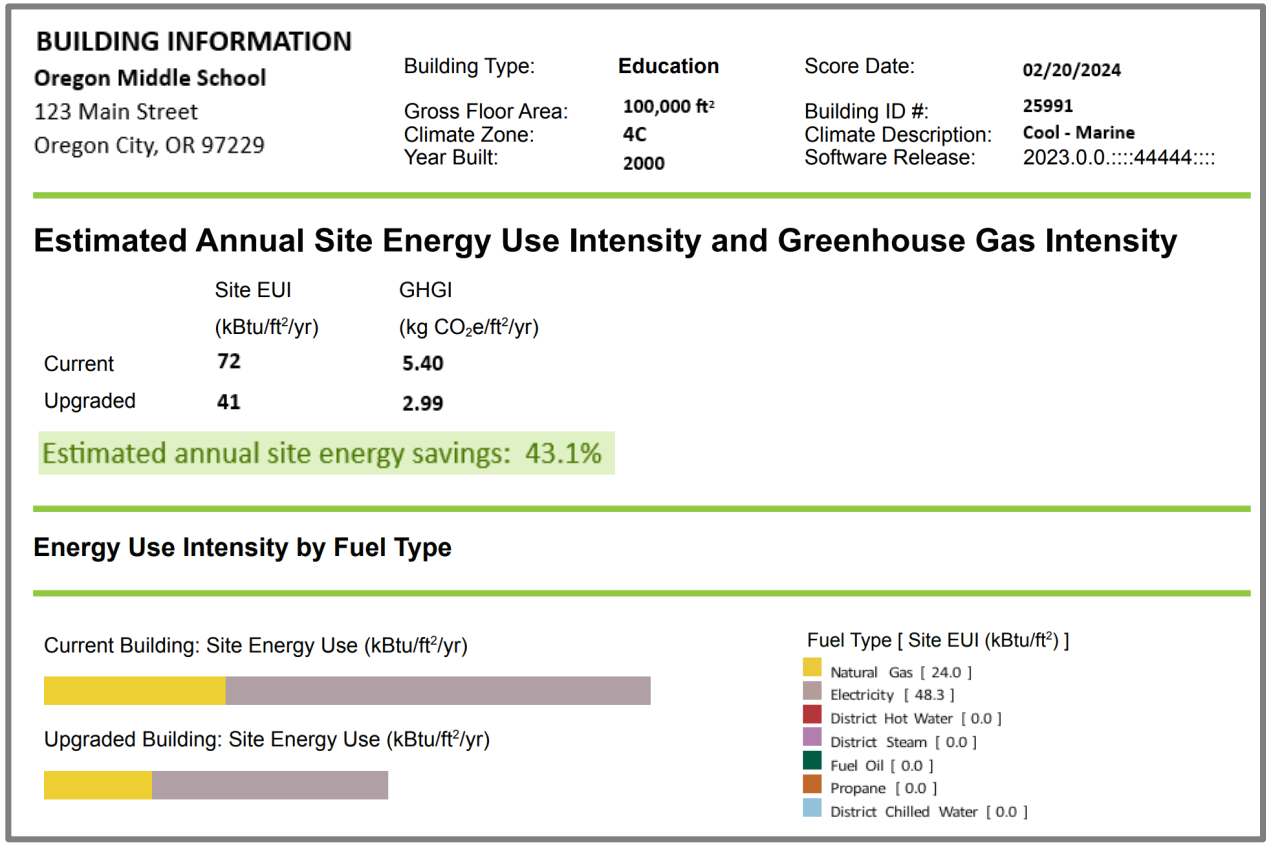
Upgrade opportunities	Energy Savings [3]	Cost[4]
Building Envelope		
• Upgrade roof insulation in block Block 1 for Roof 1.† - *Learn More*	Low	$-$$
• Seal building envelope reducing air infiltration† - *Learn More*	Low	$$
• Upgrade wall insulation in block Block 1 for Wall 1.† - *Learn More*	Low	$$-$$$
• Upgrade to high efficiency windows in block Block 1 for Window 1.† - *Learn More*	Medium	$$-$$$
Lighting Systems		
• Upgrade to LED fixtures in block Block 1 for Fixture 1.† - *Learn More*	Medium	$
• Upgrade to LED fixtures in block Block 1 for Fixture 2.† - *Learn More*	Medium	$
• Install occupancy sensors for interior lighting control in block Block 1 - *Learn More*	Low	$-$$
HVAC Systems and Controls		
• Lower VAV box minimum flow setpoints in block Block 1 - *Learn More*	High	$$
• Add air-side economizer in block Block 1 - *Learn More*	Medium	$-$$
• Add variable frequency drive to condenser pumps in block Block 1 - *Learn More*	Low	$$
• Implement demand controlled ventilation (DCV) in block Block 1 - *Learn More*	Medium	$$
• Implement fan static pressure reset in block Block 1 - *Learn More*	Medium	$
• Implement supply air temperature reset in block Block 1 - *Learn More*	Medium	$

Case Study: Measure Impact

Measure Impact:

Estimated to save **43%** energy for a school under typical operating conditions if **ALL measures applied**

NOTE: QBAT allows the user the flexibility to select fewer measures and re-simulate their building



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Case Study: School in Oregon

QBAT Identified Measures

DDC Measures:

- Demand controlled ventilation
- Static pressure reset
- Supply air temperature reset

Lighting upgrade

Boiler Replacement

Roof and Window Insulation

Window replacement

VAV minimum flow setpoints

Economizer

Energy Audit Recommendations

DDC Measures:

- Demand controlled ventilation
- Static pressure reset
- Supply air temperature reset

Lighting upgrade

DEMO

Detailed instructions can be found at:
https://www.energy.gov/scep/school-needs-and-benefits-assessment-resources

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Discussion

Discussion

QBAT can

- help prioritize buildings for improvements.
- raise awareness about additional resources, system specifications, qualified product lists and also qualified assessors who can provide a more detailed assessment.
- provide more information about incentives
- Hence, reduce barriers to assessments and guide builder owners/property managers to the next steps.

QBAT is intended as a simple assessment tool, as a first step for understanding potential for improvement which provides some guidance on where to go next.

Discussion

QBAT could

- Expand to other use types (including MF, restaurants, hotels)
- add support for SWH systems assessment and measure recommendation
- Incorporate NW specific resources in the ‘learn more’ links
- Link to more detailed assessment tools for the next steps

QBAT could be the means to raise awareness of resources, programs and incentives in the NW and provide the means to disseminate this information

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Thank you