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U.S. DEPARTMENT OF ENERGY

JUNE 8–11

2020 SUMMIT

A Virtual Leadership Symposium

Learn more: betterbuildingssolutioncenter.energy.gov/summit

U.S. DEPARTMENT OF ENERGY

Unsealed: The Building Envelope Campaign

Wednesday, June 10th, 2020

11:00 AM – 12:30 PM ET

Hayley McLeod

Oak Ridge National Laboratory (ORNL)

Slido

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using your mobile device or web browser

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#BBSummit

Select "Unsealed: The Building Envelope Campaign" from the dropdown

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Welcome!
Wordcloud Poll #1

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Select “Unsealed: The Building Envelope Campaign” from the dropdown

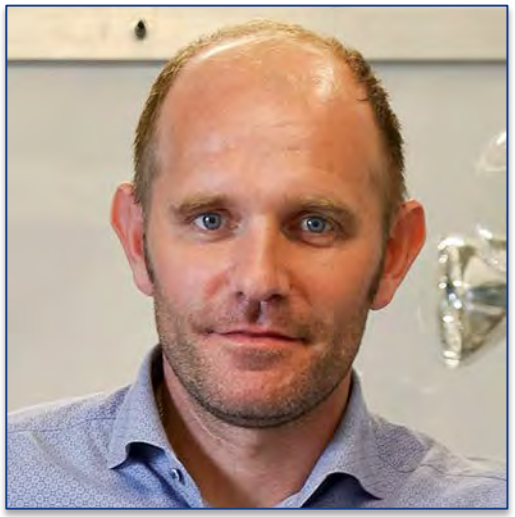
U.S. DEPARTMENT OF ENERGY

Agenda

1. Hayley McLeod, ORNL: Welcome, Program Introduction
2. Dr. Simon Pallin, ORNL: Metric and Tool Walkthrough
3. Jessica Abralind, Arlington County: The User’s Perspective
4. Q&A Session

Today's Presenters

Hayley McLeod
Oak Ridge National Laboratory (ORNL)



Dr. Simon Pallin
Oak Ridge National Laboratory (ORNL)

Jessica Abralind
Arlington County Dept. of Environmental Services

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BUILDING ENVELOPE CAMPAIGN

Unsealed! The Building Envelope Campaign Launch

June 10, 2020

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BUILDING ENVELOPE CAMPAIGN

ORNL Video

June 10, 2020

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Poll #2

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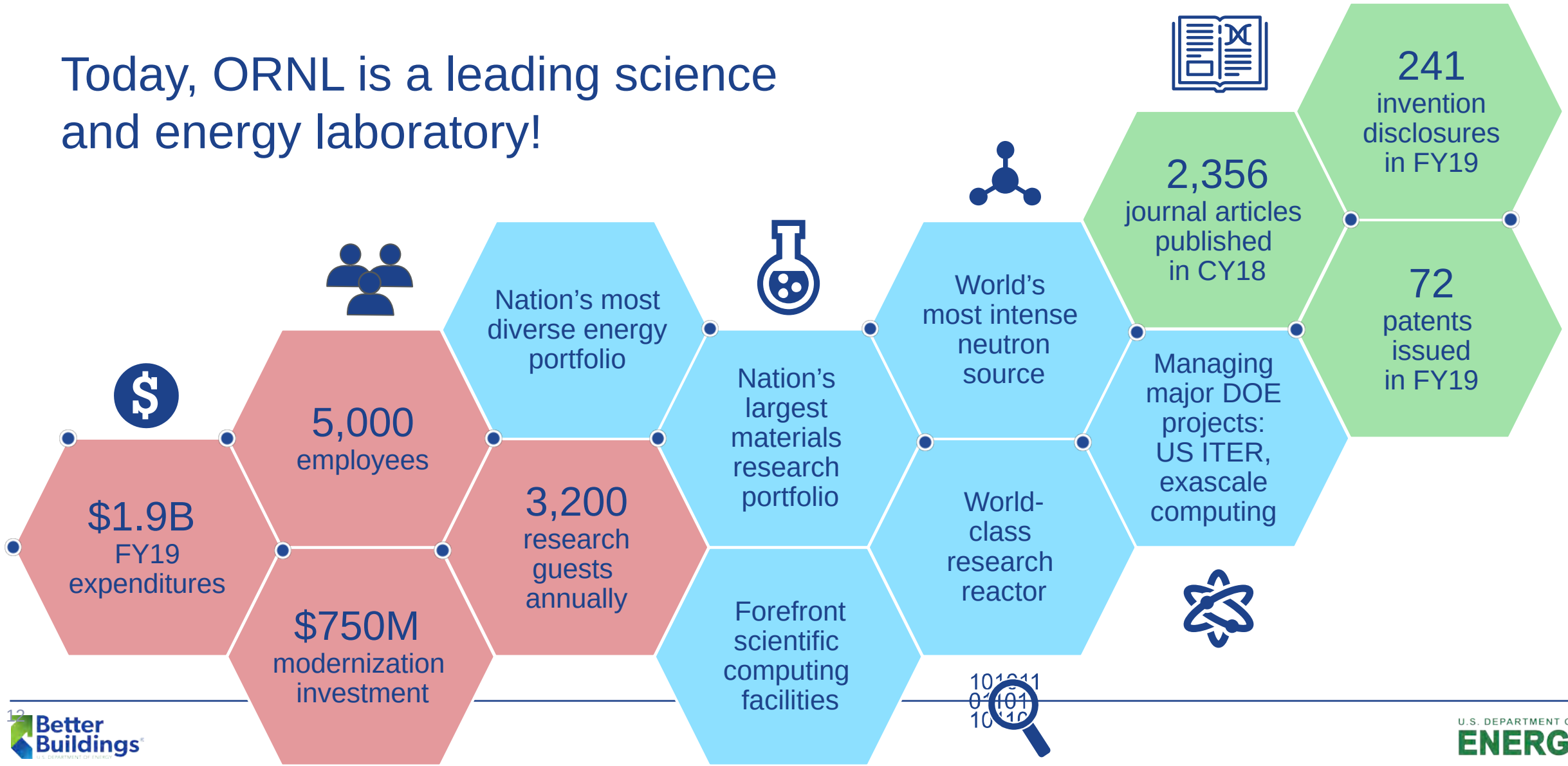
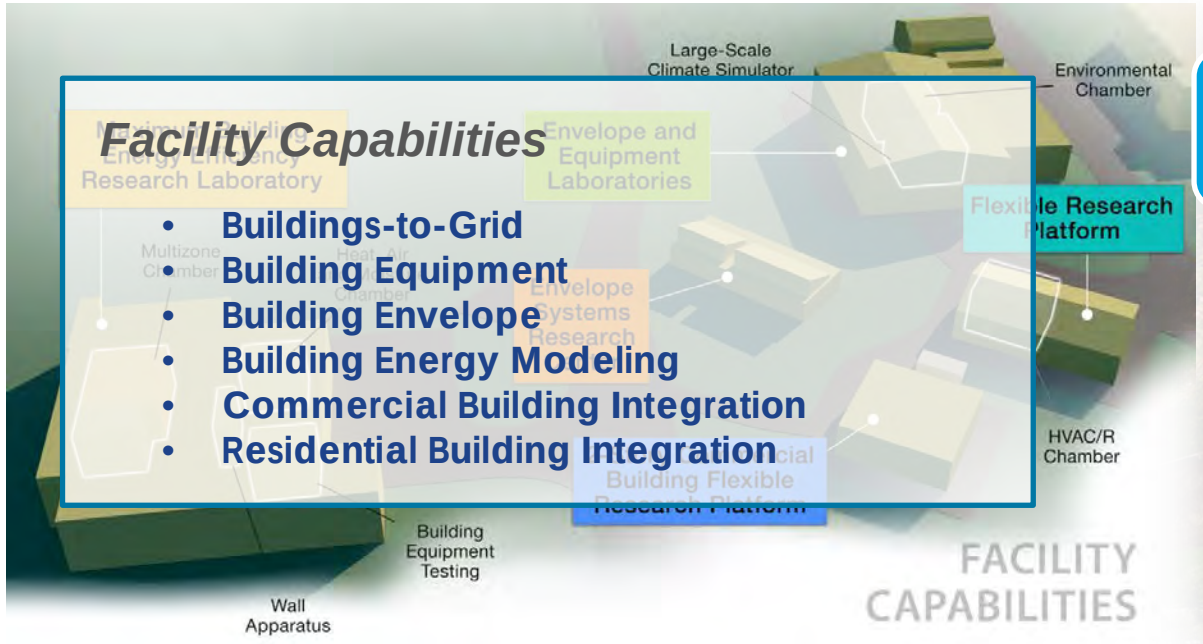
Oak Ridge National Laboratory

Today, ORNL is a leading science and energy laboratory!



Building Technologies Research & Integration Center (BTRIC)

- Established in 1993
- DOE's only designated user facility focused on building technologies
- Over 38,000 ft^2 research space

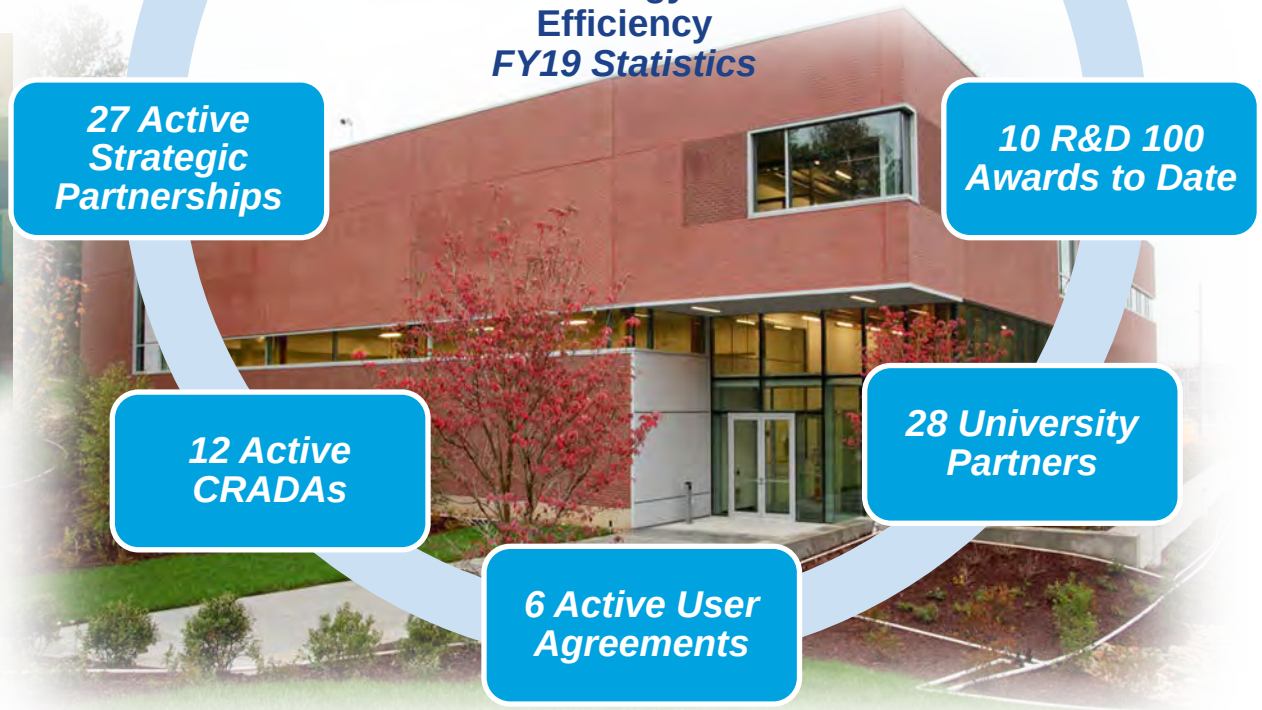


Facility Capabilities

- **Buildings-to-Grid**
- **Building Equipment**
- **Building Envelope**
- **Building Energy Modeling**
- **Commercial Building Integration**
- **Residential Building Integration**

Breaking New Ground in Energy Efficiency
FY19 Statistics

- ***~500 visitors annually***
- ***146 Industry R&D Partners***
- ***10 R&D 100 Awards to Date***
- ***28 University Partners***
- ***6 Active User Agreements***
- ***12 Active CRADAs***
- ***27 Active Strategic Partnerships***
- ***227 Publications***



Better Buildings

U.S. DEPARTMENT OF ENERGY

Better Buildings Alliance – Background

Better Buildings Alliance – Background

- The Alliance includes more than 230 organizations, representing over 11 billion commercial square feet across 5 key market sectors:
  - commercial real estate,
  - healthcare,
  - higher education,
  - hospitality, and
  - retail, food service, and grocery.
- Previous Alliance technology campaigns, led by DOE's National Labs, aim to accelerate the adoption of efficient building technologies by providing technical assistance, resources, and guidance on implementation best practices.

Previous Better Buildings Alliance Campaigns

Campaign	Launch Year	Result
Lighting Energy Efficiency Campaign (LEEP)	2012	**$23.6 million** in electricity cost savings through energy use savings of 227 million kWh annually across 560 million ft^2 of parking facilities
Interior Lighting Campaign (ILC)	2013	**$24 million** in electricity cost savings through energy use savings of nearly 229 million ft^2 of building space
Advanced Rooftop Campaign (ARC)	2013	**$90 million** in electricity cost savings through energy use savings of 903 million kWh annual from of 114,000 RTUs
Smart Energy Analytics (SEA)	2016	**$9 million** in electricity cost savings through 400 billion Btu/year savings across 15 participants' portfolios with energy management and information systems (EMIS) installed

Envelope Technology Research Team (ETRT)

Connecting Better Buildings partners with advanced building envelope technology solutions

- ✓ Technology verification studies
- ✓ Specification documents
- ✓ Case studies and fact sheets
- ✓ Calculators and analytic tools

Envelope technologies account for approximately 30% of the primary energy consumed in commercial buildings, playing a key role in determining levels of comfort, natural lighting, ventilation, and how much energy is required to heat and cool a building.

Hayley McLeod, M.S.P.P.

Building Envelope Campaign Lead

Simon Pallin, Ph.D.

Building Envelope Technical Lead

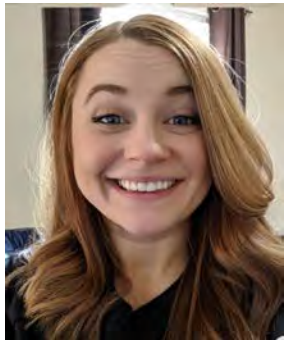
Mahabir Bhandari, Ph.D.

Building Envelope Tech Team Support

Jason DeGraw, Ph.D.

Building Envelope Tech Team Support

Kita Cranfill



Full Stack Developer

Building Envelope Campaign Goals

- **Motivate action and increase awareness** of the value of investing in high performance building envelope technologies for both new and existing commercial buildings
- **Recognize leaders** adopting and achieving high performing building envelope systems
- **Demonstrate and document** energy and cost savings with integrated design, construction, commissioning, and maintenance from implementation of high performing envelope systems

How are we going to achieve the goals?

- Work with a Technical Advisory Group (TAG)
- Thank you!
  - Chris Mathis, Mathis Consulting
  - Liz Fischer, BCxA
  - Dean Stanberry, IFMA
  - Paul Romano, ConEd
  - Michael Loughlin, Eversource NH
  - Jonathan Flaherty (Chair LEED Steering Committee), Tishman-Speyer
  - Anica Landreneau, (LEED Advisory Committee Member), HoK

How are we going to achieve the goals?

- Broad Industry Engagement
- Supporters
  - Access technical expertise regarding envelope technologies
  - Partner with the BEC technical team to spread the word about the campaign
  - Gain recognition through the BEC website
- Participants
  - Access campaign resources and technical expertise in evaluating envelope options
  - Stay informed on envelope technologies and resources produced through the campaign
  - Gain recognition through the BEC website, achievement of awards, and participation in case studies (pending submitting validation information and building completion)
    - Projects completed since January 2019 are eligible to submit

How are we going to achieve the goals?

- Thank you to our organizers, AIA, IIBEC and IFMA!

- Early Participants
  - Mathis Consulting
  - Energineers
  - Redhorse Corp
  - Judicial Council of California
  - Tenderloin Neighborhood Development Corporation
  - Arlington County Department of Environmental Services

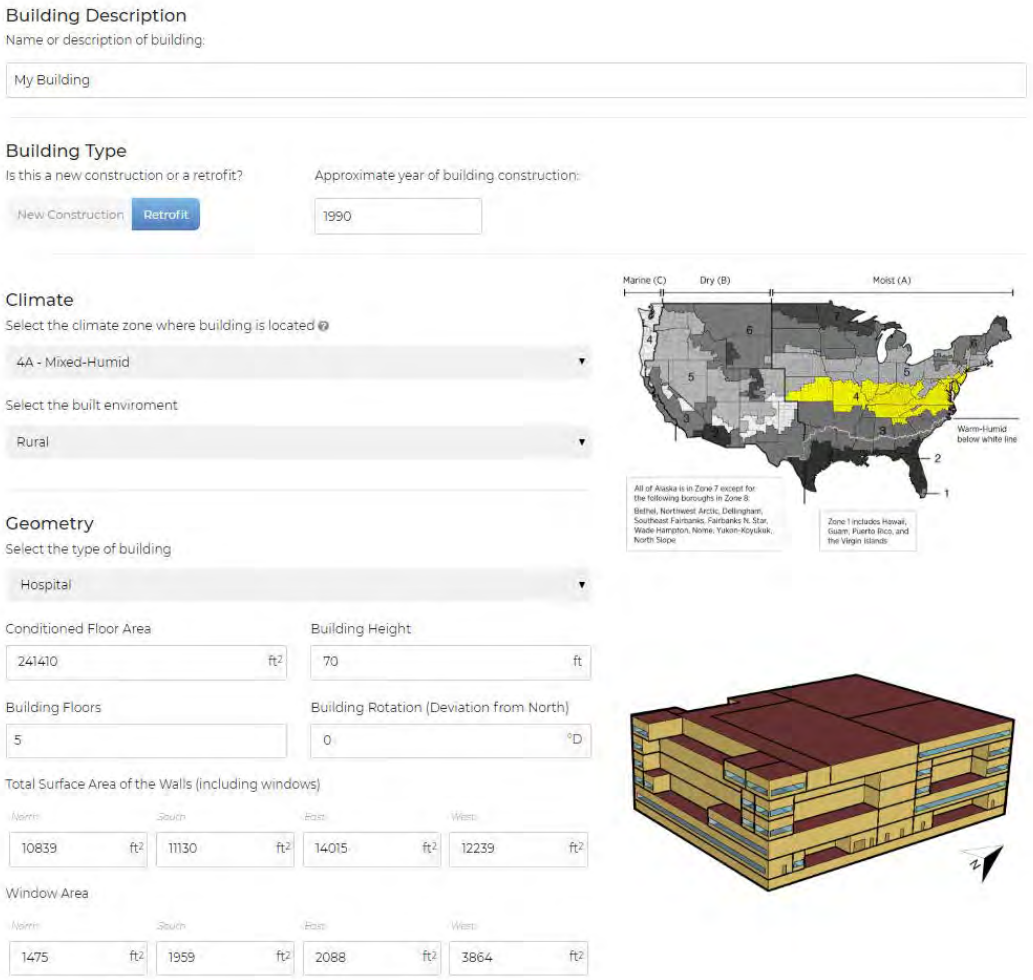
The American Institute of Architects

IBEC International Institute of Building Enclosure Consultants

IFMA™ International Facility Management Association

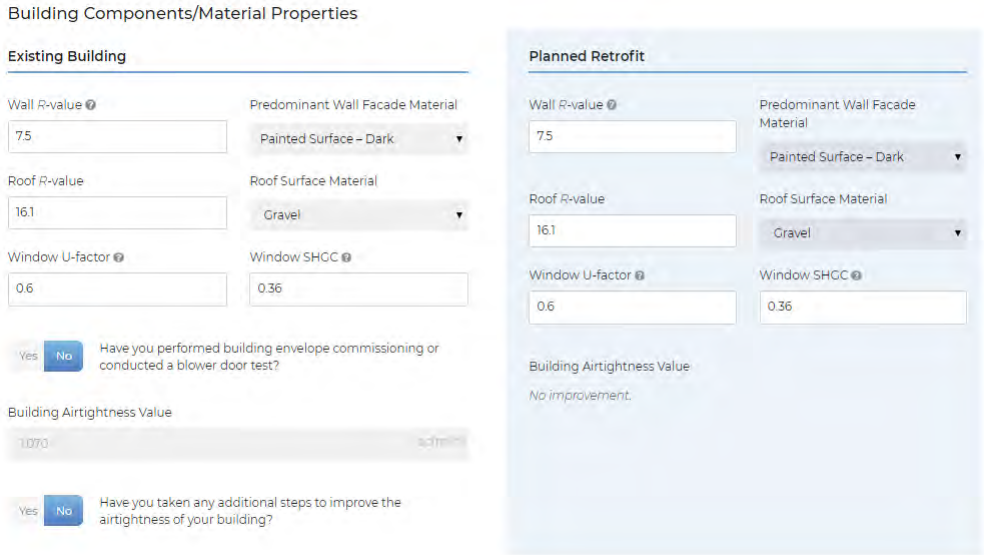
- Early Supporters
  - Lawrence Berkeley National Laboratory
  - Walter P. Moore
  - Ghafari Associates
  - NRG Insulated Block
  - Arc Green Consultant
  - Becker Morgan Group, Inc.
  - Fabreeka International, Inc.
  - ThenDesign Architecture

How are we going to achieve the goals?



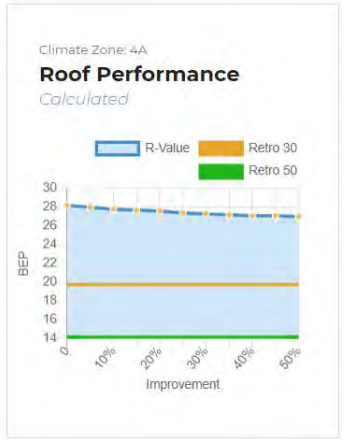
By determining your Building Envelope Performance (BEP) metric

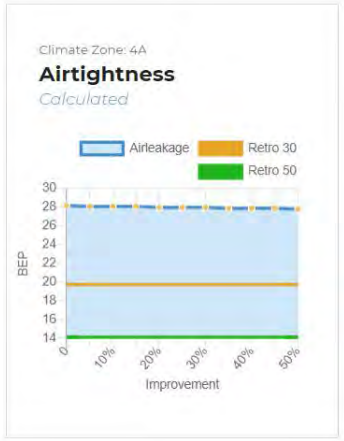
- Basic building information
- Slightly different for new construction vs retrofit

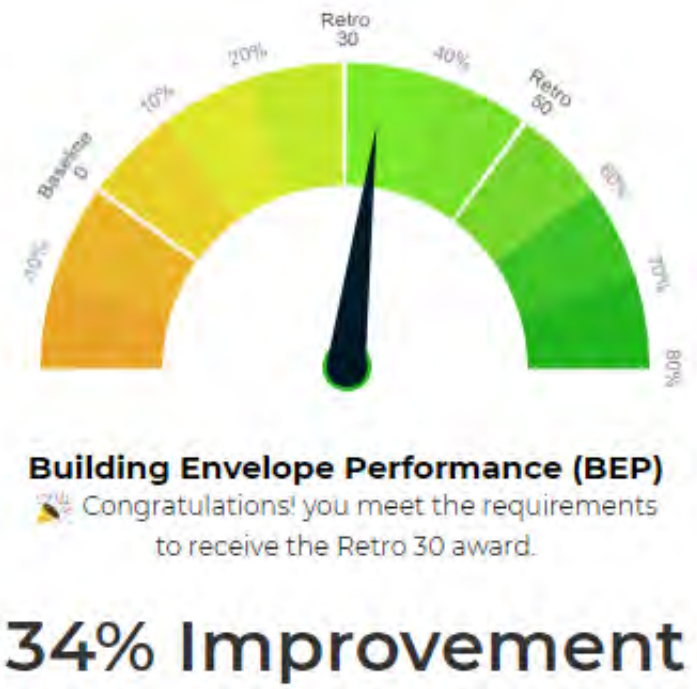


How are we going to achieve the goals?

- Results
  - If satisfied, great! Time to submit!
  - If dissatisfied, your building has been saved and information can be edited.
  - The building characteristic with the most room for improvement has been identified.







How are we going to achieve the goals?

- Results
  - Use available resources to assist in design decisions
  - Once finalized and construction is completed, submit for recognition

- Resource categories
  - Commercially available technologies
  - Case studies
  - Additional resources

Recognition Tiers and Categories

Existing Building – Envelope Retrofit

Recognition Tiers
Retro 30 Building envelope heat loss/gain reduction of 30%[a], due to implementation of building envelope improvements
Retro 50 Building envelope heat loss/gain reduction of 50%[a], due to implementation of building envelope improvements

(a) Reduction may consist of any energy retrofit measure that involve the building envelope thermal performance (R-value, Air leakage, Attachments, etc.)

Recognition Tiers and Categories

New Construction

Recognition Tiers
Novel 20 Building envelope heat loss/gain reduction of 20%[a] over code[b], due to incorporation of emerging high-performance envelope technologies
Novel 40 Building envelope heat loss/gain reduction of 40%[a] over code[b], due to incorporation of emerging high-performance envelope technologies

(a) Follow ASHRAE Advanced Energy Design Guides Reduction
(b) Most recent national energy code (ASHRAE 90.1 - 2016)

Recognition Tiers and Categories

Additional Recognition

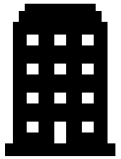
Role Models

An additional level of recognition will be available to those buildings which meet a campaign recognition tier and *also* incorporate an additional advanced strategy or technology into their building envelopes, serving as role models within the industry.

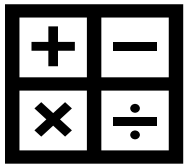
Honorable Mentions

Buildings which do not meet a campaign recognition tier but still make a noteworthy impact on the campaign (e.g., substantial square footage) may apply for an Honorable Mention.

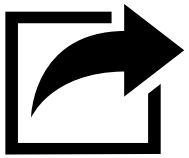
Campaign Process Overview



Enter your building data into the website



Determine your BEP and review energy efficient solution options



Submit your final results and provide verification documentation

Be recognized by DOE!

Thank you!

- Hayley McLeod, ORNL, *mcleodhd@ornl.gov, envelopecampaign@ornl.gov*

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Dr. Simon Pallin

Oak Ridge National Laboratory (ORNL)

Submit Questions
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The Building Envelope Performance (BEP) Metric

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The Building Envelope Performance (*BEP*) Metric

Target - Fuel Economy

Variables

- Engine
  - Size
  - # of Cylinders
  - Valve resistance + timing
  - Combustion time
  - etc.
- Fuel System
- Air Supply
- Shape (aerodynamics)
- …

Performance Indicator

The Building Envelope Performance (*BEP*) Metric

Target – Energy Efficiency

Variables

Performance Indicator

The Building Envelope Performance (*BEP*) Metric

Target – Energy Efficiency

Variables

- R-value
  - Walls
  - Roof
  - Foundation
  - Fenestration
- Thermal Bridges
- Installation Quality
  - Joints
  - Penetrations
  - Perforations
- Airtightness
- Building Type
- Thermostat Setpoints
- HVAC Characteristics
- User Behavior
- Indoor Climate
- Outdoor Climate
- …

Performance Indicator

- EUI [kBtu/ft^2]
- Predicted EUI (Simulations)
- …

The Building Envelope Performance (*BEP*) Metric

Variables

- R-value
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- …

Performance Indicator

- EUI [kBtu/ft^2]
- Predicted EUI (Simulations)
- …

- **Only Applicable to Existing Buildings**
- **One-way Connection**
- **Highly Influenced by Building Usage**

The Building Envelope Performance (*BEP*) Metric

Variables

- R-value
  - Walls
  - Roof
  - Foundation
  - Fenestration
- Airtightness
- Building Type
- Thermostat Setpoints
- HVAC Characteristics
- User Behavior
- Indoor Climate
- Outdoor Climate
- …

Performance Indicator

- EUI [kBtu/ft^2]
- Predicted EUI (Simulations)

EUI is not equivalent to "mpg"!

- **Complicated**
- **Time Consuming**

The Building Envelope Performance (*BEP*) Metric

HVAC Cooling and Heating Demand = **Building Envelope Energy Load** + **Internal Loads**

Building Envelope Energy Load = **BEP** (Building Envelope Performance) **X** **Building Envelope Area**

Building Envelope Performance [kBtu/ft²]

The Building Envelope Performance (*BEP*) Metric

Overall Building Thermal Resistance

$$\mathcal{R} = \frac{1}{\frac{1}{\sigma \cdot R_{env}} + \frac{1}{R_{air}} + \frac{1}{R_{gain}}}$$

R_{env} = Building envelope conductive thermal resistance, *R*-value ((m²·K)/W [(°F·ft²·hr)/Btu]),

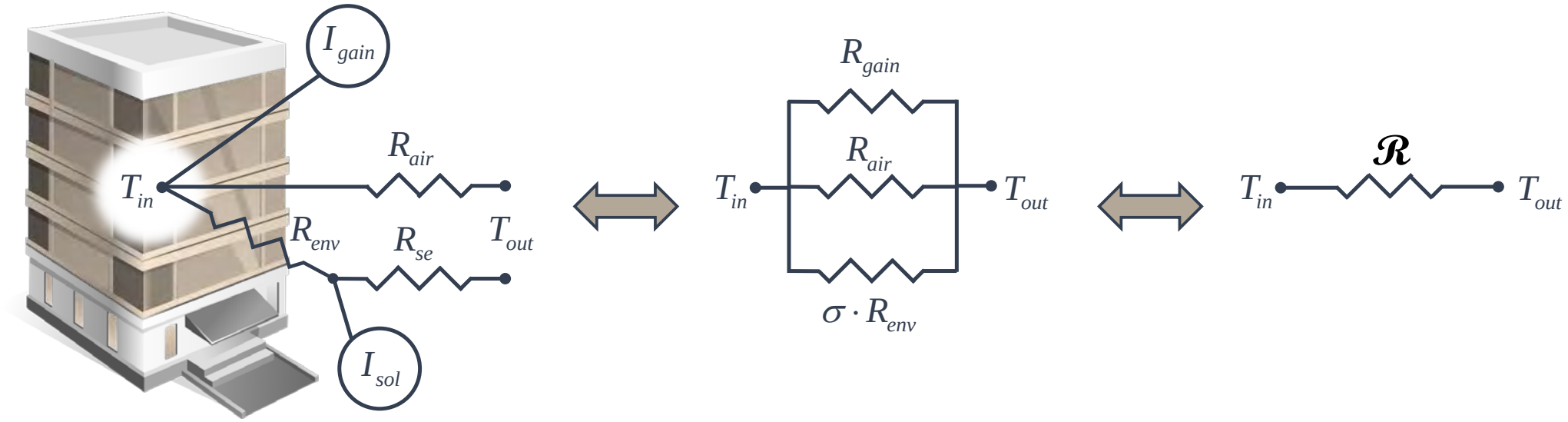
σ = Opaque envelope solar and thermal radiation correction factor (-),

R_{air} = Air leakage resistance ((m²·K)/W [(°F·ft²·hr)/Btu]),

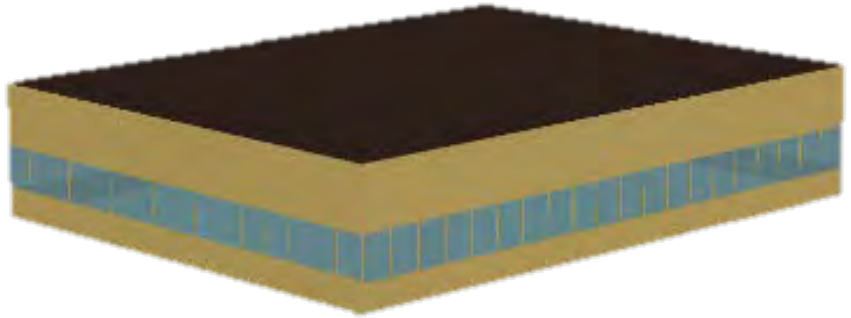
R_{gain} = Window solar internal heat gain resistance ((m²·K)/W [(°F·ft²·hr)/Btu]),

I_{gain} = Window solar internal heat gain (W/m² [Btu/(hr·ft²)]),

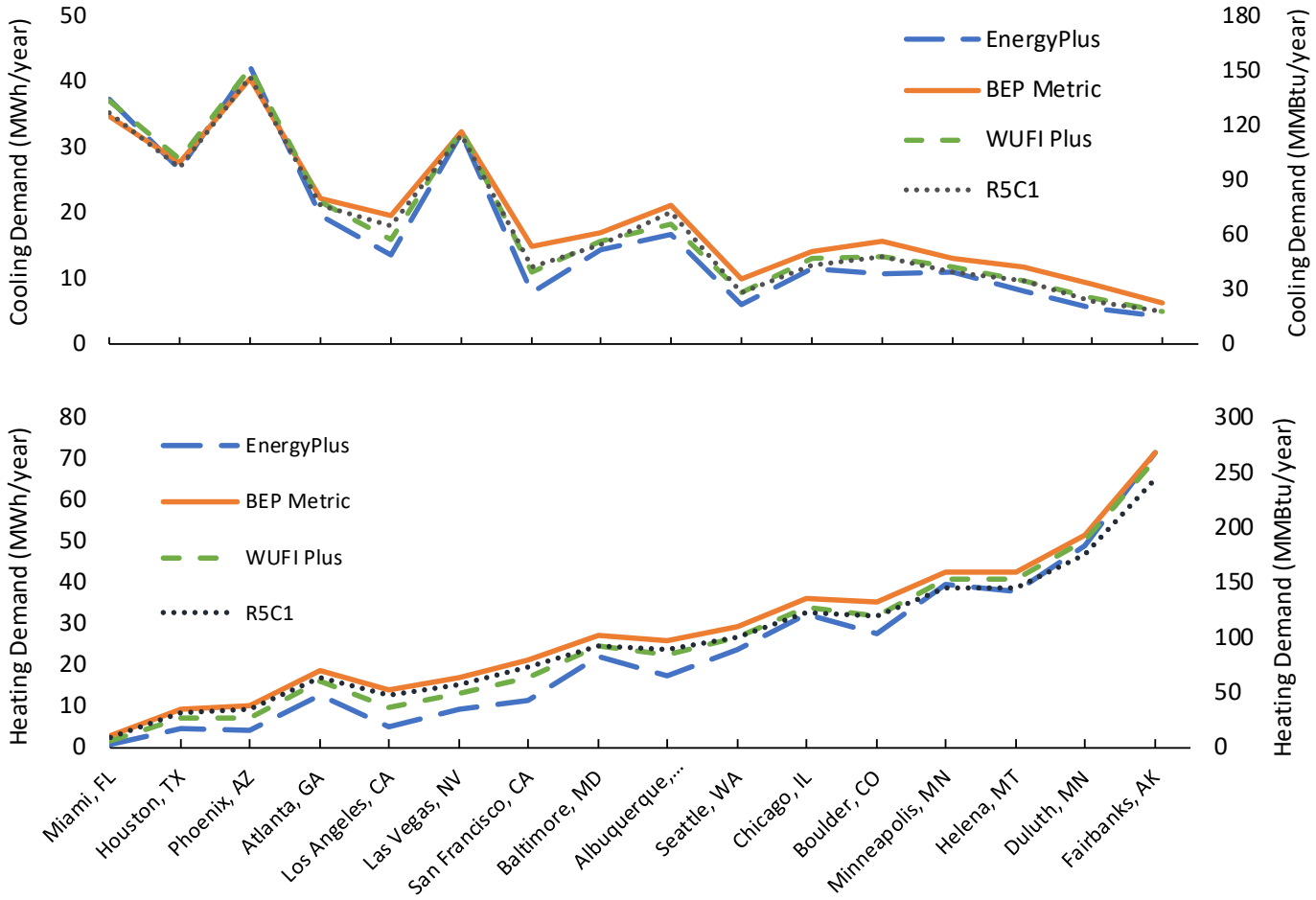
I_{sol} = Opaque envelope exterior solar heat gains (W/m² [Btu/(hr·ft²)]),



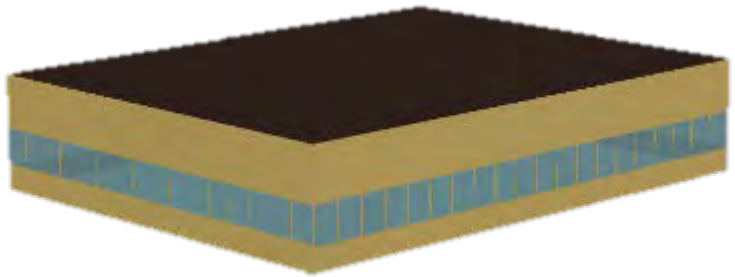
The Building Envelope Performance (*BEP*) Metric

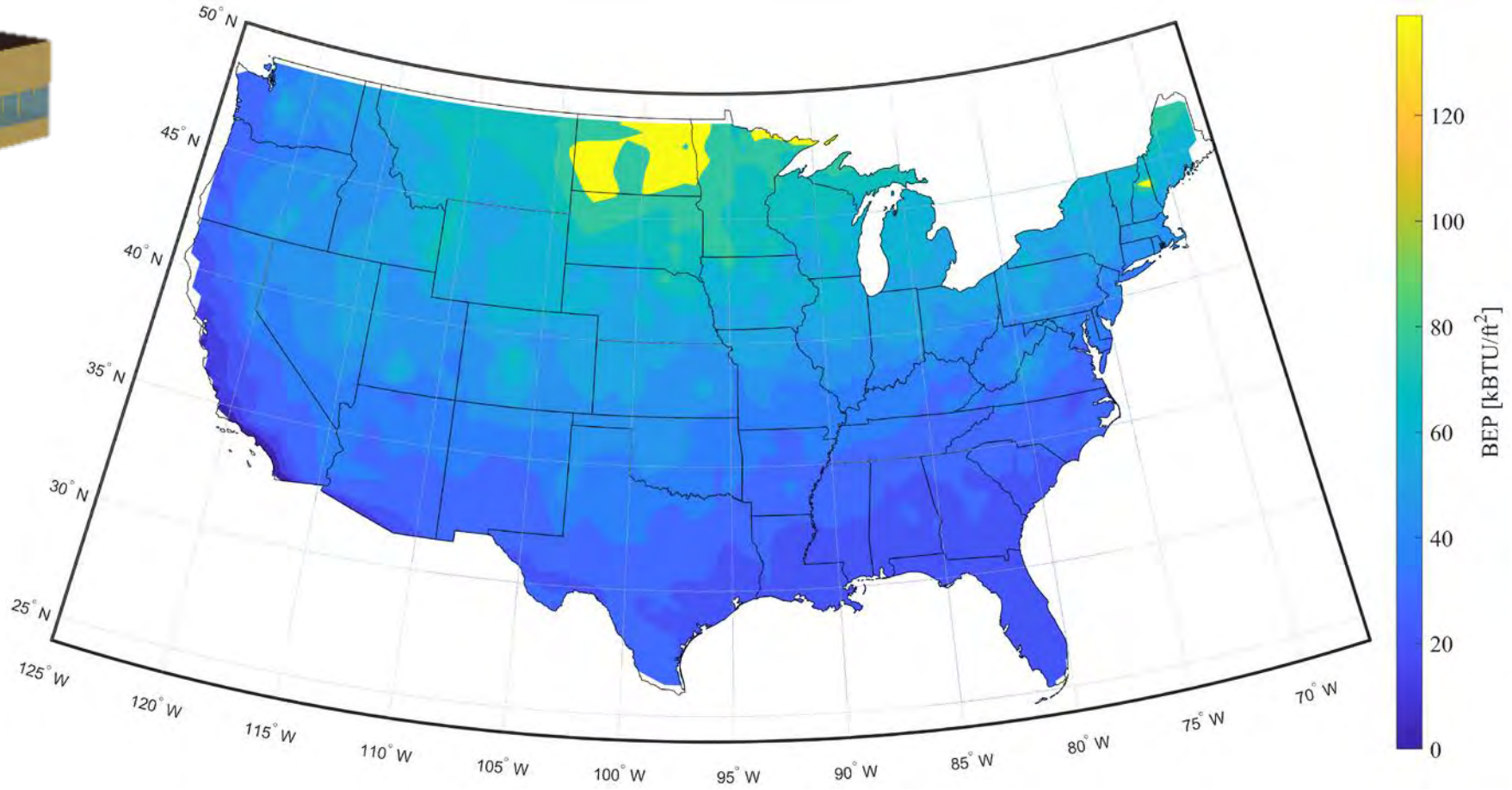


Length x Width x Height	20 x 15 x 4 m [65.6 x 49.2 x 13.1 ft]
Window Area	84 m^2 [275.6 ft^2]
SHGC	0.352 (-)
R-value Wall/Roof/Window/Slab	1.013/3.509/0.391/adiabatic (m^2·K)/W
Solar absorptance Wall/Roof	0.92/0.7
Surface heat transfer coefficient Interior/Exterior	8/25 W/(m^2·K)



The Building Envelope Performance (*BEP*) Metric





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Link to Demo- https://www.youtube.com/watch?v=agyzlDVSzRI&feature=youtu.be

Thank you!

- Simon Pallin, PhD

Oak Ridge National Laboratory
pallinsb@ornl.gov,
envelopecampaign@ornl.gov

BUILDING ENVELOPE CAMPAIGN

U.S. DEPARTMENT OF ENERGY

Jessica Abralind

Office of Sustainability & Environmental Management,
Arlington County Dept. of Environmental Services

Submit Questions
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Unsealed: The Building Envelope Campaign

Jessica Abralind, Green Building Planner
Arlington County, VA
June 10, 2020

ARLINGTON VIRGINIA | CARBON 2050 NEUTRAL

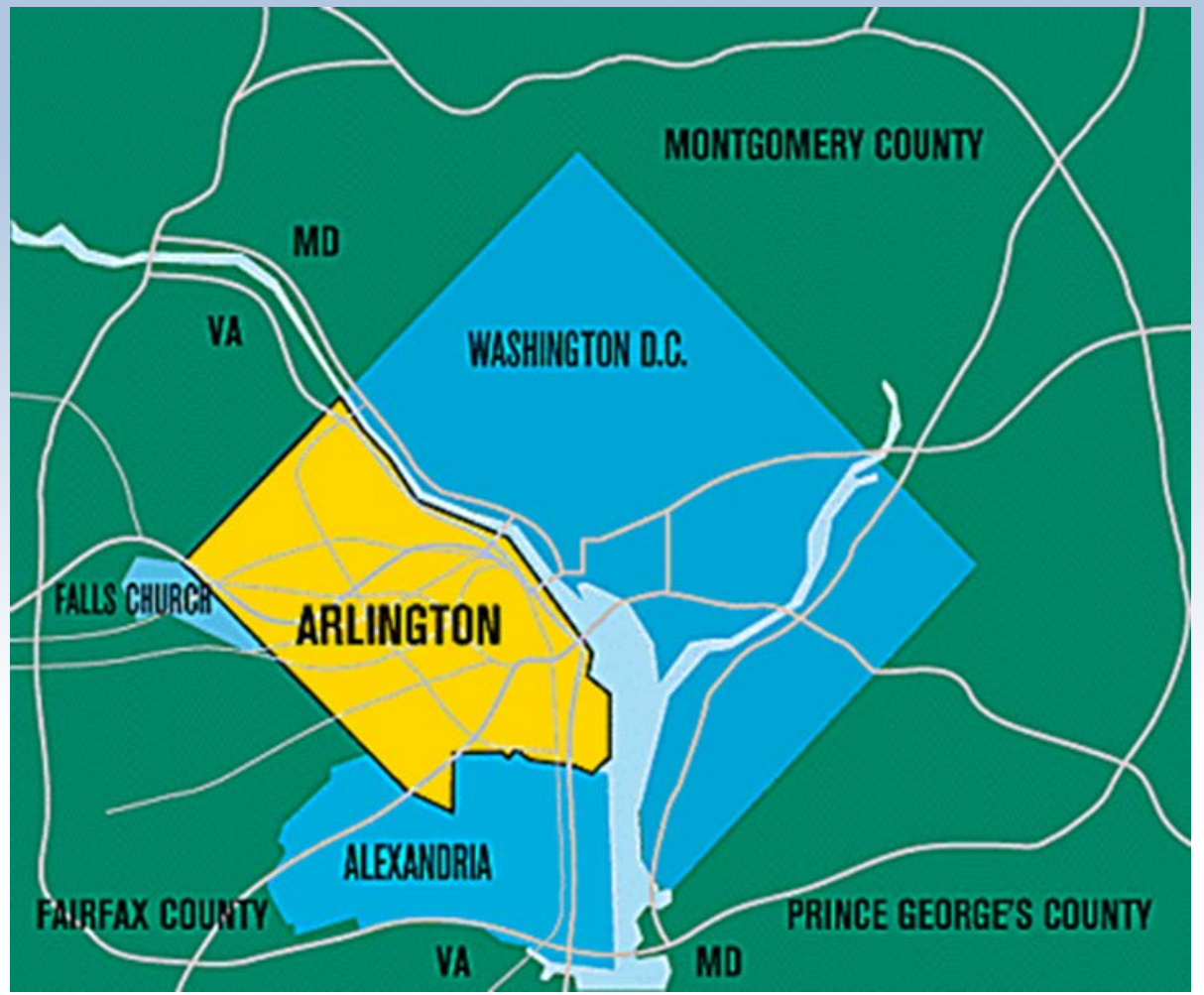
Outline

- About Arlington
- Arlington's Participation in Better Buildings programming
- Beta testing the Building Envelope Campaign tool
  - –New Construction example – Lubber Run Community Center

ARLINGTON VIRGINIA | CARBON 2050 NEUTRAL

Arlington, Virginia Overview

- 26 square miles
- Population 236,000
- Population density
  - 8,399 persons/sq mile
- 11 Metrorail Stations
- Home of the Pentagon, Amazon HQ2
- **Arlington Community Energy Plan – Carbon Neutral by 2050**

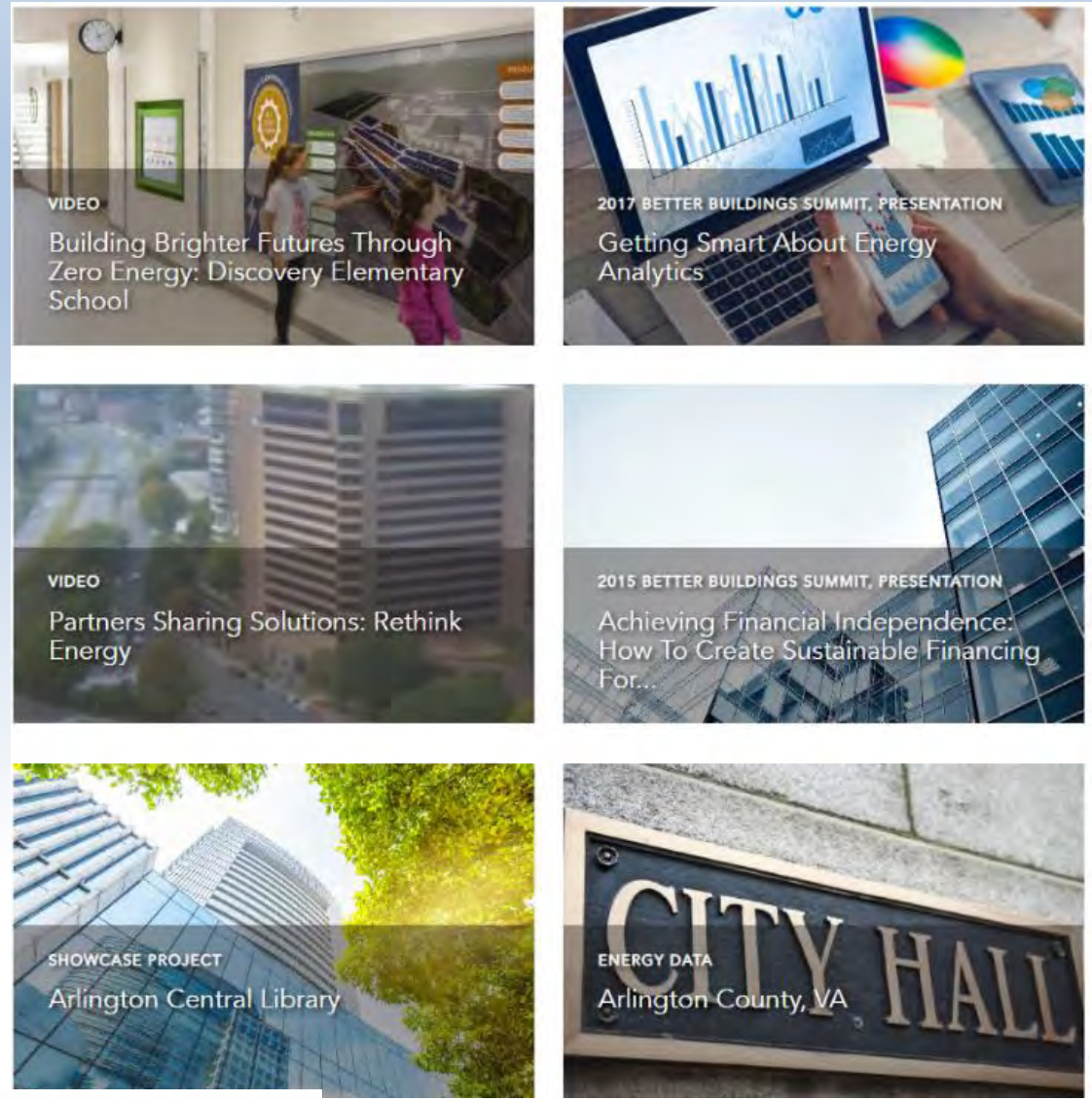


ARLINGTON VIRGINIA | CARBON 2050 NEUTRAL

Arlington, Virginia

Better Buildings DOE Partnership

- Better Buildings Challenge Participant since 2012
  - 18% reduction in facility Energy Use Intensity (EUI) in 2019
  - Collaboration on numerous case studies
- ORNL's Building Envelope Research Team Member since 2018
  - Beta tester of Building Envelope Campaign Tool



ARLINGTON VIRGINIA | CARBON 2050 NEUTRAL

Lubber Run Community Center

Design & Construction Team
- VMDO – Architect
- CMTA – MEP & Commissioning
- MCA – General Contractor

Building Characteristics
- 53,000 s.f. new construction
- Targeting:
  - ✓ Net Zero Energy “Ready”
  - ✓ Energy Use Intensity (EUI) of 24 kbtu/s.f./year
  - ✓ LEED Silver
  - ✓ Building Enclosure Test

ARLINGTON VIRGINIA | CARBON 2050 NEUTRAL

Lubber Run Community Center

Building Enclosure highlights

- ✓ 36% window to wall ratio (WWR)
- ✓ Window U-value - 0.3714; SHGC – 0.24
- ✓ East-West building orientation
- ✓ Thermomass® Concrete Sandwich Panel
- ✓ Blower Door test
- ✓ Vegetated Roof

ARLINGTON VIRGINIA | CARBON 2050 NEUTRAL

Thermomass® Concrete Sandwich Panel

ARLINGTON VIRGINIA | CARBON 2050 NEUTRAL

Thermomass® Concrete Sandwich Panel

ARLINGTON VIRGINIA | CARBON 2050 NEUTRAL

Building Envelope Campaign Tool Demo

Video can be seen in the webinar recording at 1:08:40

Building Envelope Campaign Demo

- Third Party Awards and certifications add legitimacy and prestige
- Easy to use – data gathering will be most time intensive
- Results page – recommendations and resources, instant results
- Guide for a building envelope discussion with your design team

ARLINGTON VIRGINIA | CARBON 2050 NEUTRAL

Thank you!

Jessica Abralind, Green Building Planner

Arlington County, Virginia

Office of Sustainability and Environmental Management

Quick Survey & Speaker Q & A

www.slido.com event code **#BBSummit**

Select “Unsealed: The Building Envelope Campaign” from the dropdown

Additional Resources

Building Envelope Campaign – Link

Building Envelope Landing Page – Link

Technology Campaigns Landing Page – Link

ORNL Building Technology Research and Integration Center – Link

Simon Pallin Tool Demo – Link

Introduction to the Building Envelope Campaign – Link

Better Buildings: Summer Webinar Series

BEHIND THE METER DISTRIBUTED ENERGY RESOURCES:
BEST PRACTICES FOR INTEGRATING DERS INTO COMMERCIAL BUILDINGS

July 8

NEXT-GENERATION BUILDING PERFORMANCE POLICIES:
MAXIMIZING ENERGY SAVINGS AND ENVIRONMENTAL IMPACTS

July 16

EVERYONE HAS A DATA CENTER:
HOW TO BE AN ENERGY CHAMPION FOR YOURS

July 28

PROGRAM DESIGN WITH EVERYONE IN MIND:
LOW-INCOME SOLAR PROGRAM STRATEGIES

July 9

STRATEGIES TO COMBINE ENERGY + HEALTH UPGRADES IN MULTIFAMILY HOUSING

July 21

SUCCEED WITH SUBMETERING:
HOW TO MAKE THE BUSINESS CASE

August 4

THE DYNAMIC DUO:
UNLEASH PUBLIC SECTOR ENERGY SAVINGS WITH FINANCING AND TECHNICAL ASSISTANCE

July 14

CASE IN POINT:
OREGON'S RECENT EFFORTS TO REDUCE PLUG LOAD ENERGY CONSUMPTION

July 22

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Additional Questions?

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Better Buildings Solution Center
https://betterbuildingssolutioncenter.energy.gov/

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