Envelope Team: Virtual Technology Showcase

Envelope Technology Research Team Meeting

May 17, 2018
2 to 3pm ET

Envelope Technology Showcase Agenda

- Welcome, Introductions
- Get Attached: Efficient Window Solutions for Better Buildings
  - Mike Hatten, Solarc Energy Group
- Addressing Air Leakage: Air Barrier Technologies
  - Laverne Dalgleish, Air Barriers Association of America
- Building Enclosure Commissioning: Getting Performance
  - Dr. Simon Pallin, ORNL
- Q&A

Poll Question 1

Which type of organization best describes you or the work you do?

- ❑ Building Owner/Manager
- ❑ Architect/Engineer
- ❑ Manufacturer
- ❑ Energy Service Providers
- ❑ Researcher/Academia

If your organization type isn't listed, please type into your Questions Window the kind of organization you represent.

U.S. DEPARTMENT OF ENERGY

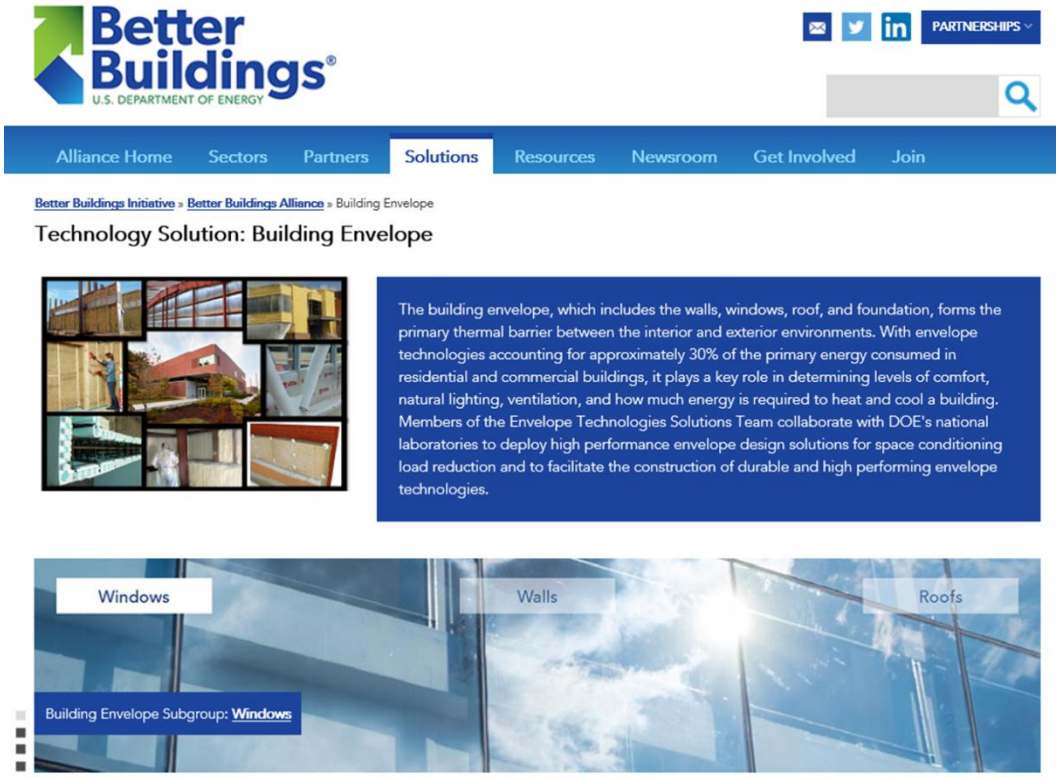
Collaboration: the Envelope Tech Team

Engage and support Members in efforts to accelerate adoption of building envelope technologies

- **Build awareness** with guidance and information on envelope technology solutions
- Conduct envelope technology **verification studies**
- Offer **technical assistance** for envelope projects

Check out the Envelope Tech Team Web Resources

- Topic Areas
  - Windows
  - Walls
  - Roofs
- Resources
  - Case Studies
  - Calculators
  - Design Guides
  - Fact Sheets
  - Toolkits
  - …and more…



https://betterbuildingsinitiative.energy.gov/alliance/technology-solution/building-envelope

Get Attached: Efficient Window Solutions for Better Buildings

Mike Hatten, Solarc Energy Group

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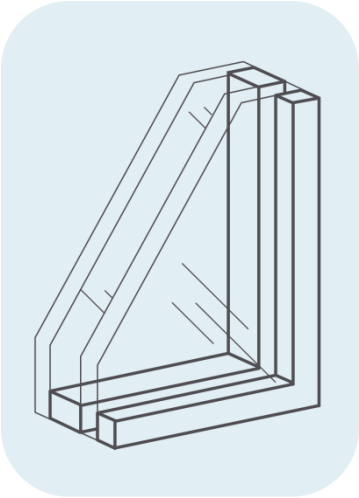
Get Attached: Efficient Window Solutions for Better Buildings

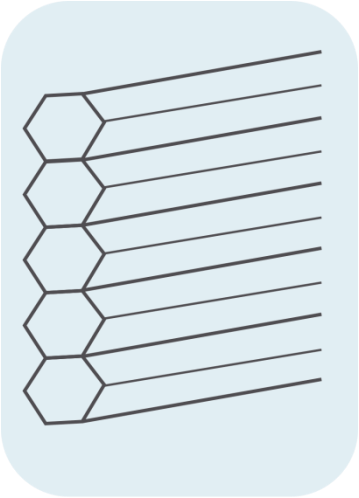
Mike Hatten, P.E.
SOLARC Energy Group
May 17, 2018

BETTERBRICKS
Powerful Energy Ideas. Delivered by NEEA.

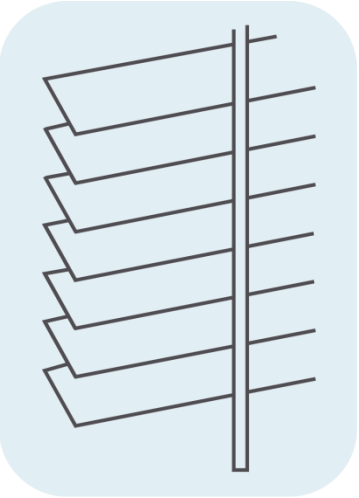
What are window attachments?



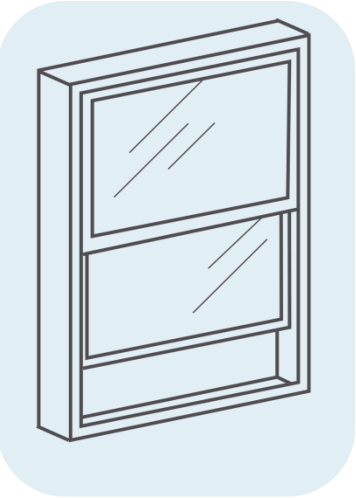
Secondary glazing systems



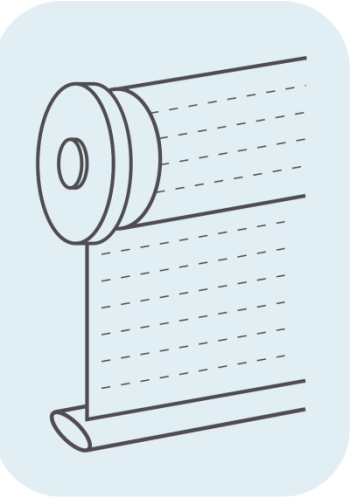
Cellular shades



Blinds



Storm windows



Roller shades

What are the performance benefits?

- Energy cost savings
- Reduced cooling and heating loads
- Improved thermal and visual comfort
- Enhanced occupant health and wellness
- Reduced UV deterioration of furnishings

What is AERC?

AERC is a DOE-funded, independent, **public interest** organization whose mission is to **rate, label and certify** the **energy performance** of **window attachments**.

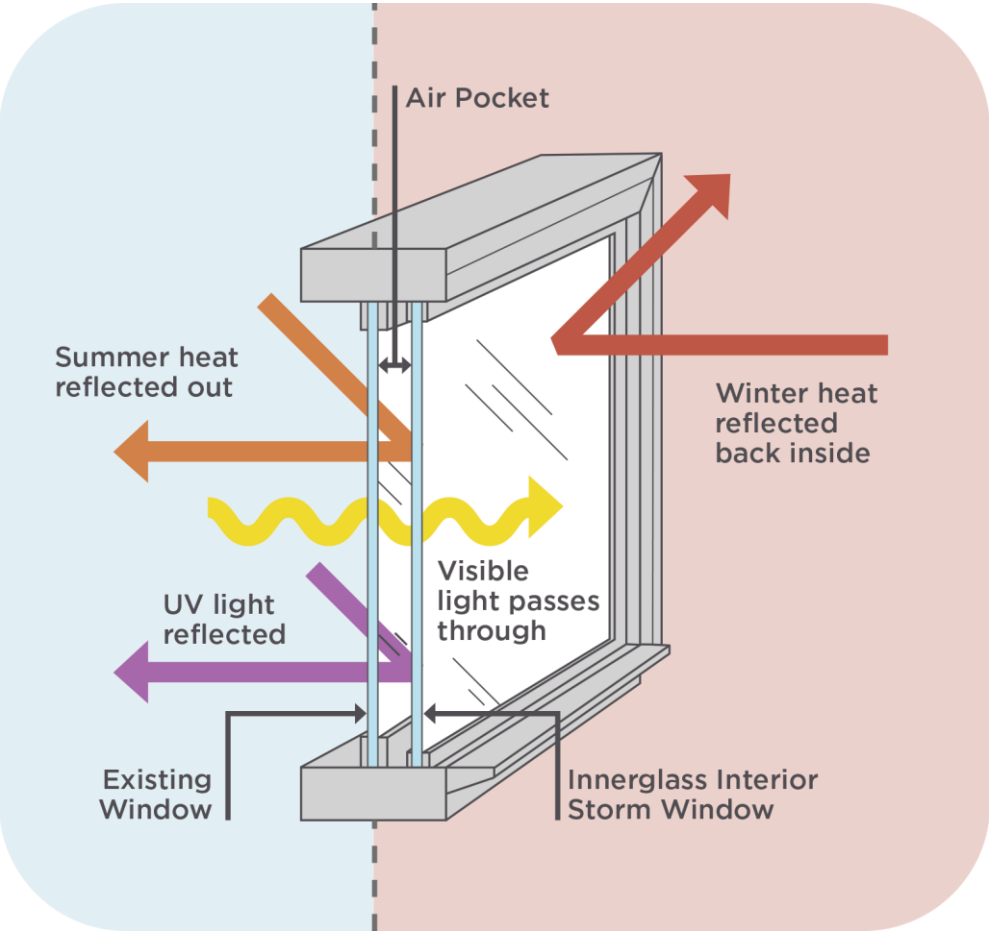
Secondary Glazing Systems (SGS)

50%

the cost of existing window replacement

Source: Savings and Economic Analysis of Secondary Glazing Systems, February 2016, Northwest Energy Efficiency Alliance.

Low-E Storm Window Attachments



- Low-emissivity (low-e)
- Attach to interior or exterior
- Fully operable

Lower costs and energy use

- Lower upfront costs
- Lower monthly operating costs
- Reduce heating and cooling peak demand

Lower energy use

SIMPLIFIED ENERGY SAVINGS CALCULATOR			SECONDARY GLAZING SYSTEMS (SGS)
Ver. 3_beta			5/7/2018
Annual Electric Energy Savings, kWh/yr			**536,721**
Annual Natural Gas Energy Savings, therms/yr			**57,180**

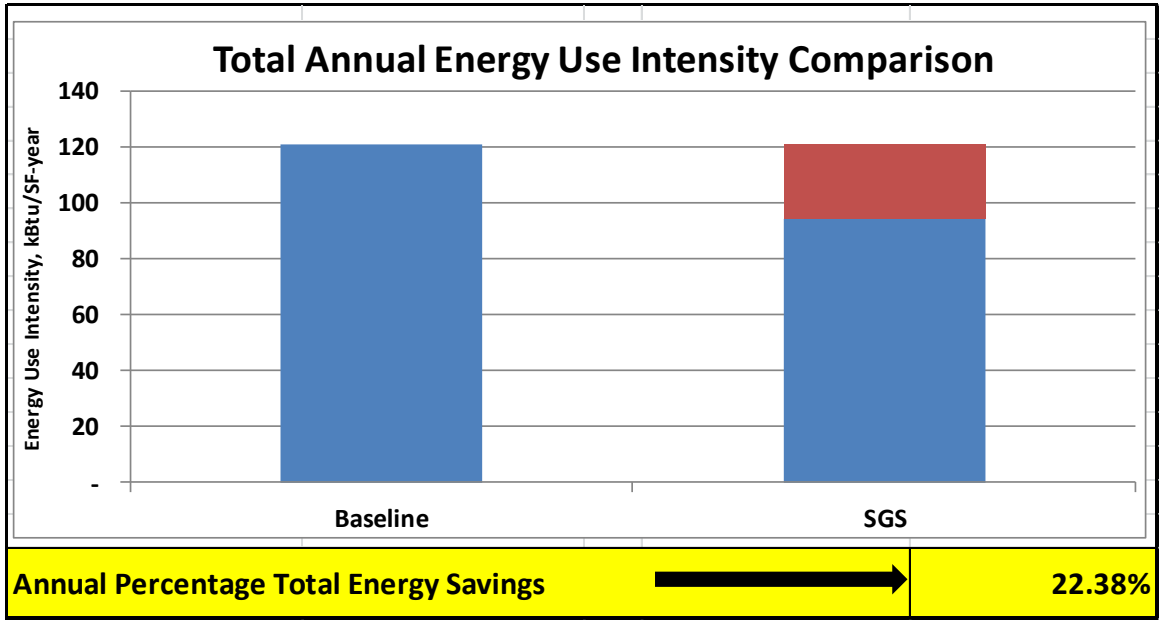
Information About Your Building Location	
Project Location (State)	Washington
Project Location (City)	Seattle
Electric Utility	SCL
Natural Gas Utility	PSE
Location HDD (Base 65)	4,800
Location CDD (Base 65)	116

Information About Your Building		
Electric Rate, $/kWh	$	0.08
Natural Gas Rate, $/therm	$	0.75

Information About Your Building	
Building Area, Sq.Ft.	278102
No. of Floors	12
HVAC System Type	Built-up VAV with hydronic reheat
Dominant Heating Fuel	Natural Gas
Annual Operating Hours	5500

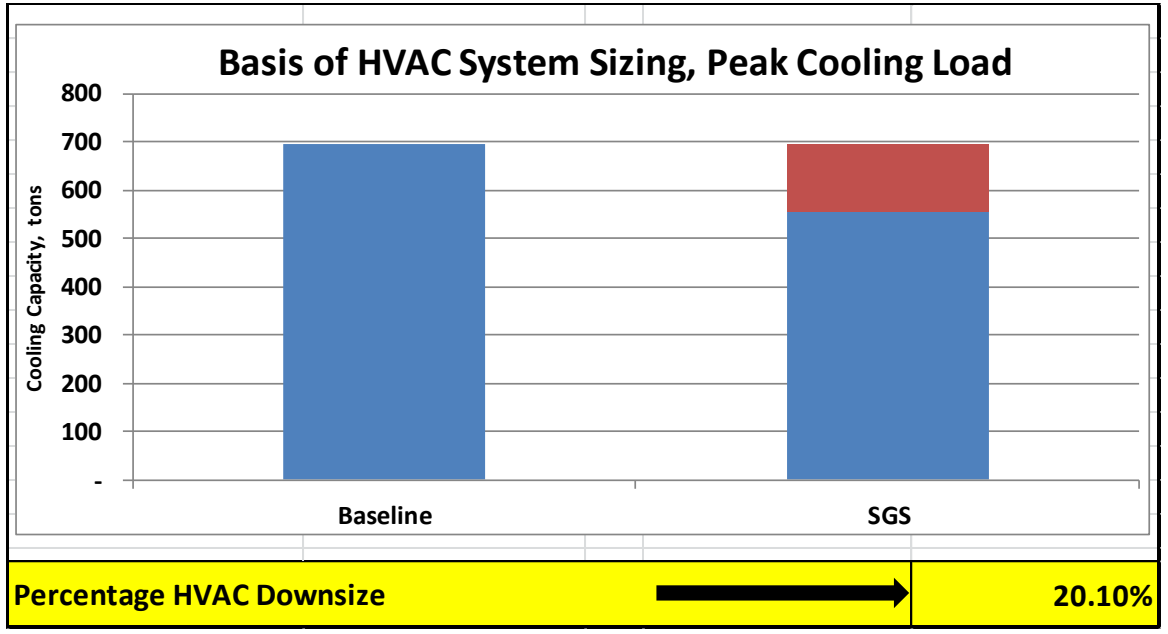
Information About Your Proposed SGS Project	
Type of SGS Analyzed	Double
Sq.ft. of SGS Installed	45504
SGS Sq.Ft Limit (Max.)	109,608

Savings Output					
Heating, kWh/SF		-	Electric Savings, kWh/yr		536,721
Cooling & Fans, kWh/SF		11.80			
Heating, therms/SF		1.26	Gas Savings, therms/yr		57,180
Electric Cost Savings, $/yr	$	42,938	Total Savings, kBtu/SF-yr		27.15
Gas Cost Savings, $/yr	$	42,885	Total Savings, $/yr	$	85,822



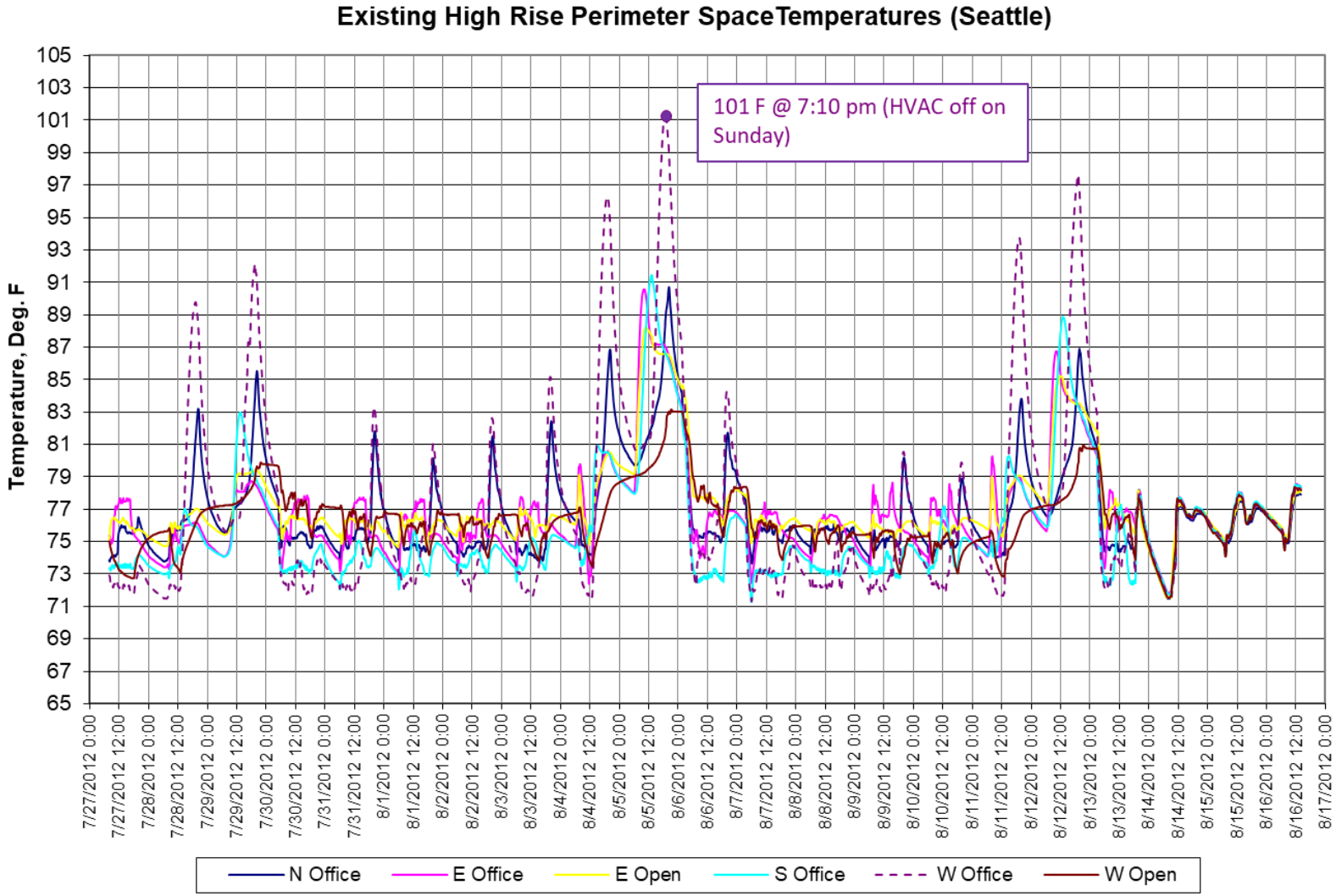
Annual Percentage Total Energy Savings		22.38%

Lower peak heating and cooling demand



- Translates to an average of 17% first cost savings on HVAC upgrade project

Improve comfort, health and wellness



Improve comfort, health and wellness

- Minimize drafts and increase comfort
- Reduce glare and noise
- Improve health and wellness

Applications and case studies

- Bullitt Center / Seattle: Exterior motorized shades

- 6 story office / 50,000 SF / Built in 2013
- Exterior motorized blinds on floors 3, 4, & 5 to control solar heat gain and glare
- Integral to passive cooling design strategy / limits mechanical cooling needs
- World's "most efficient" office building with EUI at about 12 kBtu/SF-year
- Net positive energy

Applications and case studies

- Kiln Apartments / Portland: Applied Window Films

- 4 story multi-family residential building / Passive House design / Built in 2015
- Perimeter apartments on S, E, W: Overheating (90 to 100 deg. F on summer afternoons)
- Window films applied to reduce solar heat gain coefficient
- Dropped temperature extremes into the mid-80’s

Applications and case studies

- 195 Church Street / New Haven: Secondary Glazing

- 18 story office / 224,000 SF / Built in 1974
- Energy retrofit project: Secondary glazing and LED lighting upgrade
- 29% energy savings / $203,000 per year
- System type: VAV with electric reheat
- Increase in number of hours when windows are predominantly open: 21%
- SGS calculator indicates about 19% of 29% saved is due to SGS units.

Learn more.

For information, case studies, resources and more:

Northwest Energy Efficiency Alliance (NEEA): BetterBricks.com/solutions/windows
Attachments Energy Rating Council (AERC): aercnet.org/resources/window-attachments
195 Church Street case study: betterbricks.com/case-studies/
Bullitt Center case study: casestudies.uli.org/bullitt-center/

BETTERBRICKS
Powerful Energy Ideas. Delivered by NEEA.

Addressing Air Leakage: Air Barrier Technologies

Laverne Dalgleish, ABAA

U.S. DEPARTMENT OF ENERGY

Air Barrier Technology

Mr. Laverne Dalgleish

LEARNING OBJECTIVES

- Why install an air barrier
- How tight can you make a building
- Can you make a building too tight – buildings need to breathe
- Air barriers - vapor permeable or impermeable?
- Installation issues with air barriers

Air Barriers

Six Sides of the Building

roof – walls – foundation

Twelve intersections

air barrier
abaa
association of
america

Penetrations, terminations and connections are where the building leaks air

AIR BARRIERS

Reasons for an air barrier

- Energy savings
- Moisture issues 
- Sound
- Smell
- Insects
- Equipment efficiency
- Reduce drafts

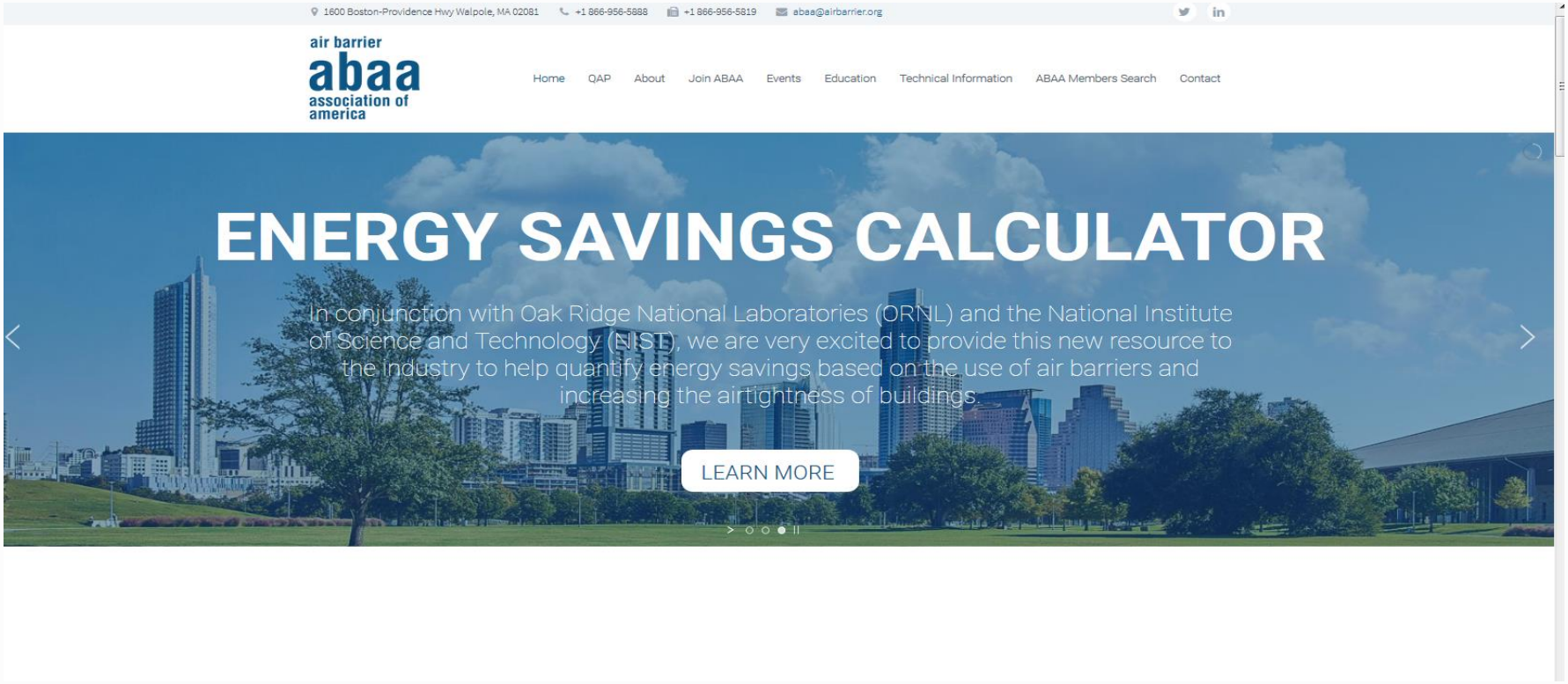
AIR BARRIERS

Air Barriers Impact

- Thermal insulation performance
- Windows performance
- HVAC efficiency
- Occupant behavior

which all impact the energy use and moisture issues in a building

ENERGY SAVINGS CALCULATOR



ENERGY SAVINGS CALCULATOR

wall_expert

Gina

localhost:3000/#//infiltration

Development

ORNL Web Tools v0.0.1-SNAPSHOT

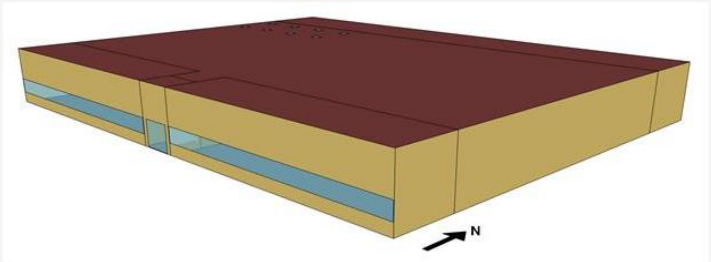
Home | Infiltration | Account

Infiltration Calculator

Location: Canada | Manitoba | Winnipeg

Building Type: Standalone Retail

Floor Area (ft^2): 24692



Leakage Rates ($L/s.m^2$ at 75 Pa)

Base case: 5.4

Retrofitted building: 2.0

Energy Costs

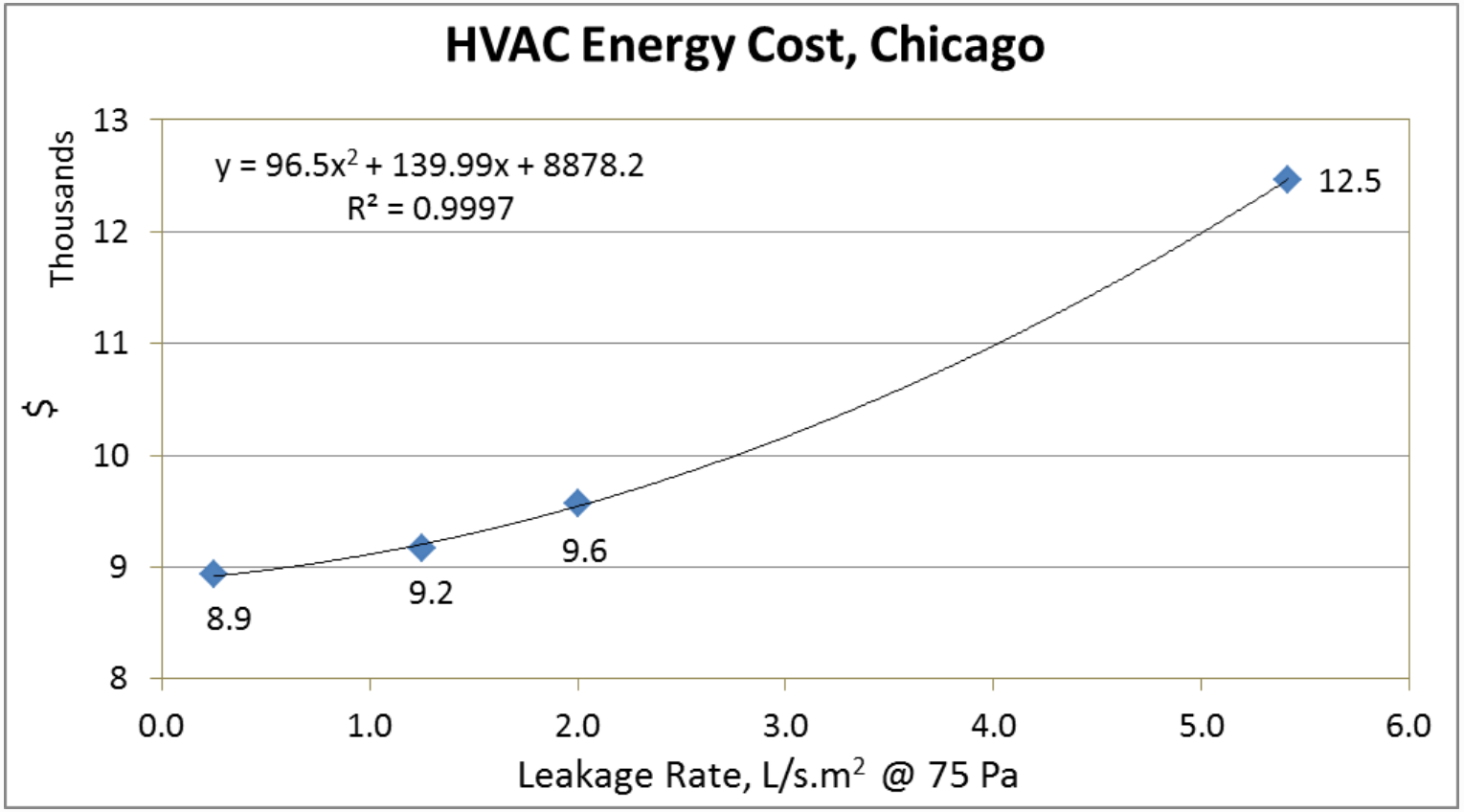
Electricity (C$/kWh): 0.14

Natural Gas (C$/$m^3$): 0.16

Calculate >>

- **52 cities in the US, 5 cities in Canada, and 5 cities in China.**
- Selection of cities based on trying to obtain a reasonable distribution of major metropolitan areas
- If specific city does not appear, select a city that has similar meteorological conditions (wind, temperature, solar radiation, and rain).

Results

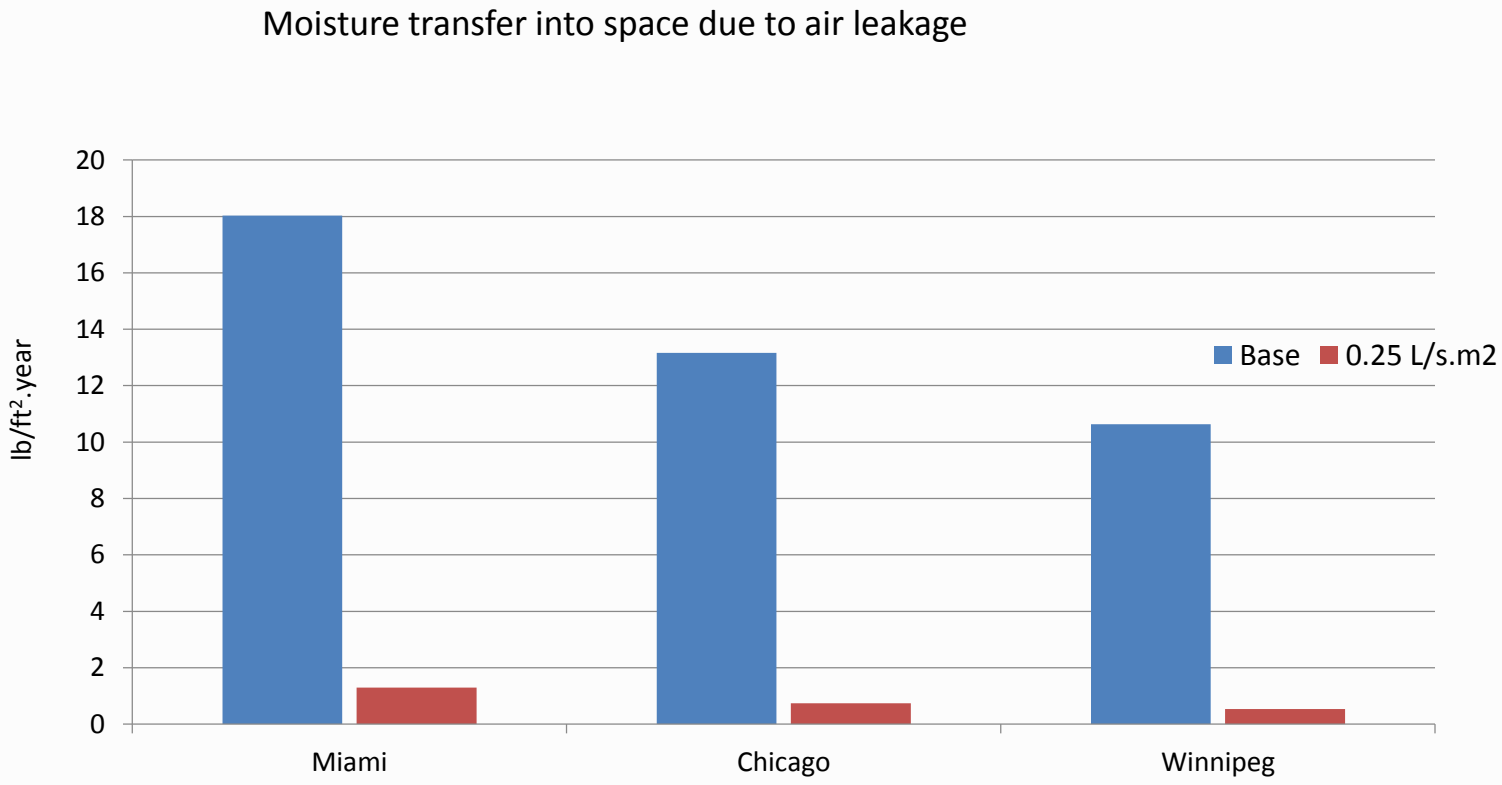


HVAC energy cost for a prototype standalone retail building in Chicago

AIR BARRIERS

AIR LEAKAGE IMPACTS ON THERMAL INSULATION

- Increase moisture with building enclosure



AIR BARRIERS

AIR LEAKAGE IN BUILDINGS

How airtight can you make buildings?

IECC	CFM/ft² @ 1.57 lbs/ft²	0.40
Original USACE	CFM/ft² @ 1.57 lbs/ft²	0.25
Updated USACE	CFM/ft² @ 1.57 lbs/ft²	0.15
Now producing	CFM/ft² @ 1.57 lbs/ft²	0.03

AIR BARRIERS

AIR LEAKAGE IN BUILDINGS

Can you make a building too tight?

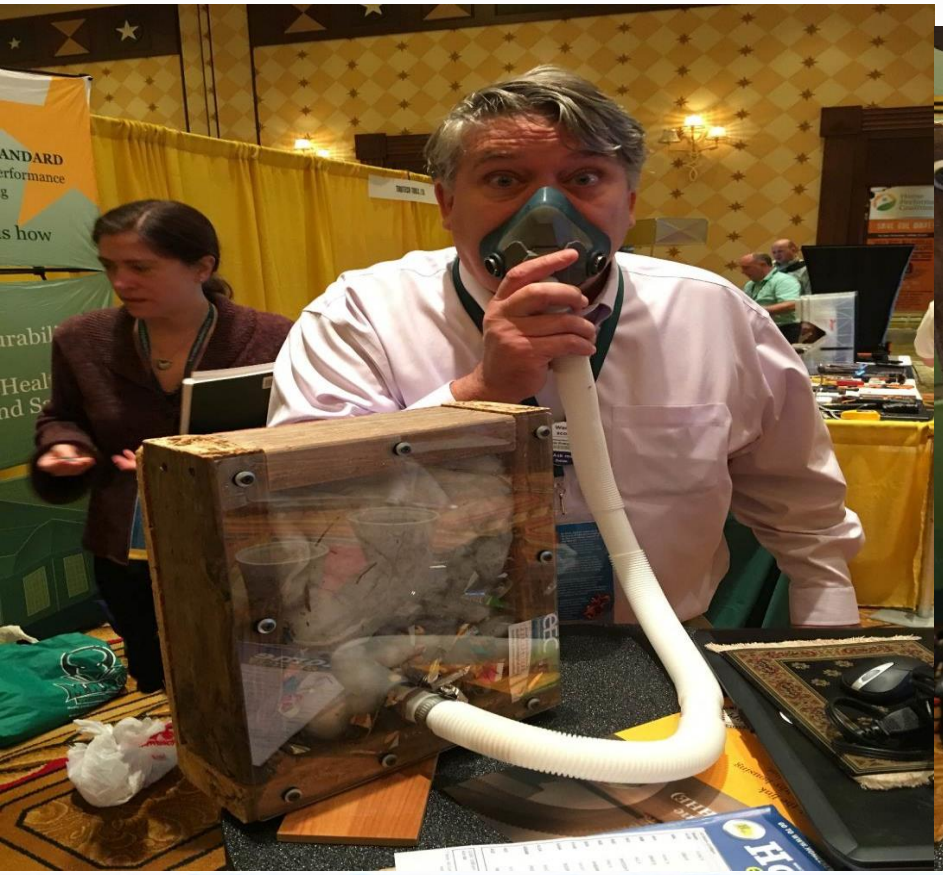
Do not confuse air for ventilation from air leakage in a building
Natural ventilation is not air leakage in a building

Build tight – Ventilate right

AIR BARRIERS

AIR LEAKAGE IN BUILDINGS

Misconception of having a building breathing



AIR BARRIERS

AIR LEAKAGE IN BUILDINGS

PERMEABLE OR IMPERMEABLE

It depends
Does it really matter?
No matter what you do, at some time during the year, it is wrong

This is Air Leakage!

You cannot see air leakage!

You cannot see air leakage!

Installation is key to an airtight building

Experience equals better quality installations

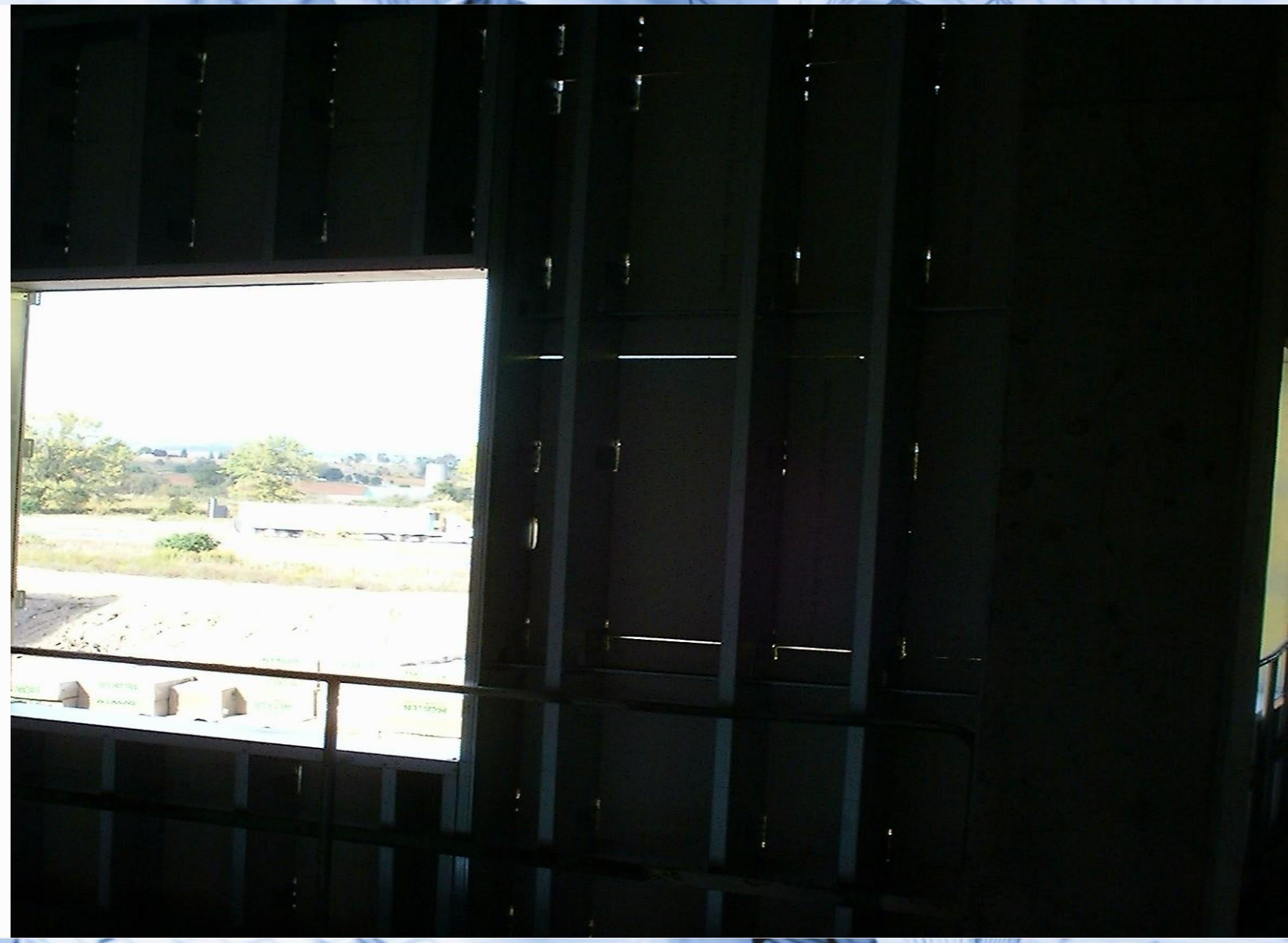
Test on site to confirm during construction

Whole building test to prove installation correct

air barrier
abaa
association of
america

air barrier
abaa
association of
america

air barrier
abaa
association of
america



Thank you for your time!

Question and Answer Period

Laverne Dalgleish

Air Barrier Association of America

ldalgleish@airbarrier.org

Ph. 866-956-5888

Building Enclosure Commissioning: Getting Performance

Dr. Simon Pallin, ORNL

U.S. DEPARTMENT OF ENERGY

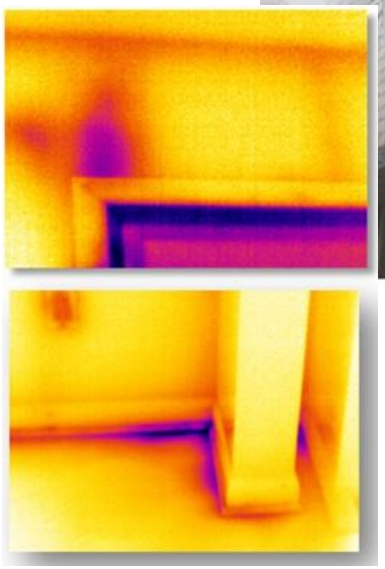
Current R&D Efforts

- Building Enclosure Commissioning
  - Benefits and Costs Study
  - Exploration of new enclosure performance metric
- Examination of Airtightness Requirements
  - Landscape Study
  - Sampling of air leakage rates

Why conduct Building Enclosure Commissioning?

Benefits

- Improve the design process
- Built as designed
- Reduce building energy loads
- Address human health and safety needs
- Prevent moisture from compromising building
- Maintain thermal comfort
- Maintain air quality
- Improve overall quality of building
- Comply with building codes



Credit: Anica Landreneau, HOK, ETRT presentation 1/31/18

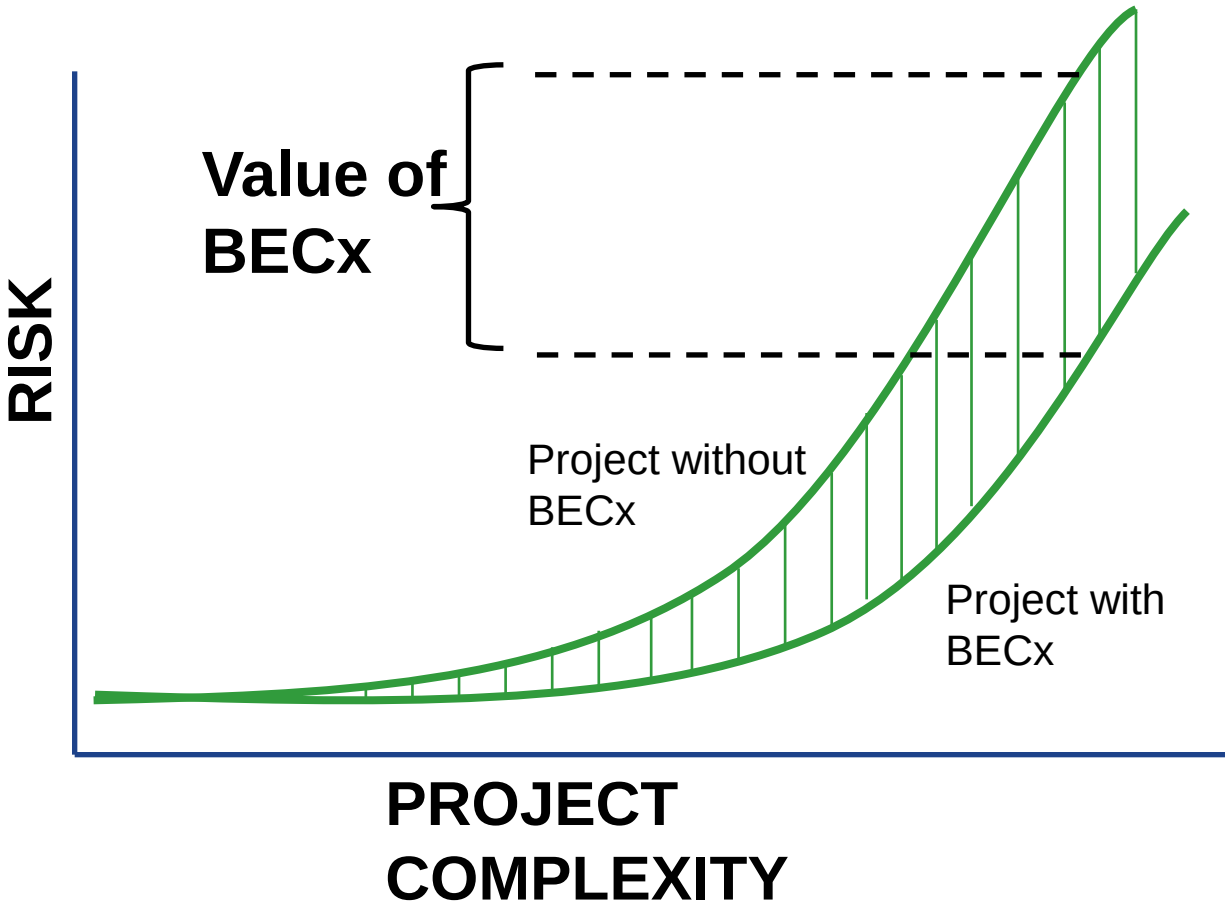
Why conduct Building Enclosure Commissioning?

Costs

- Planning
- Testing
- Consultants
- Time
- Addressing findings
- Other

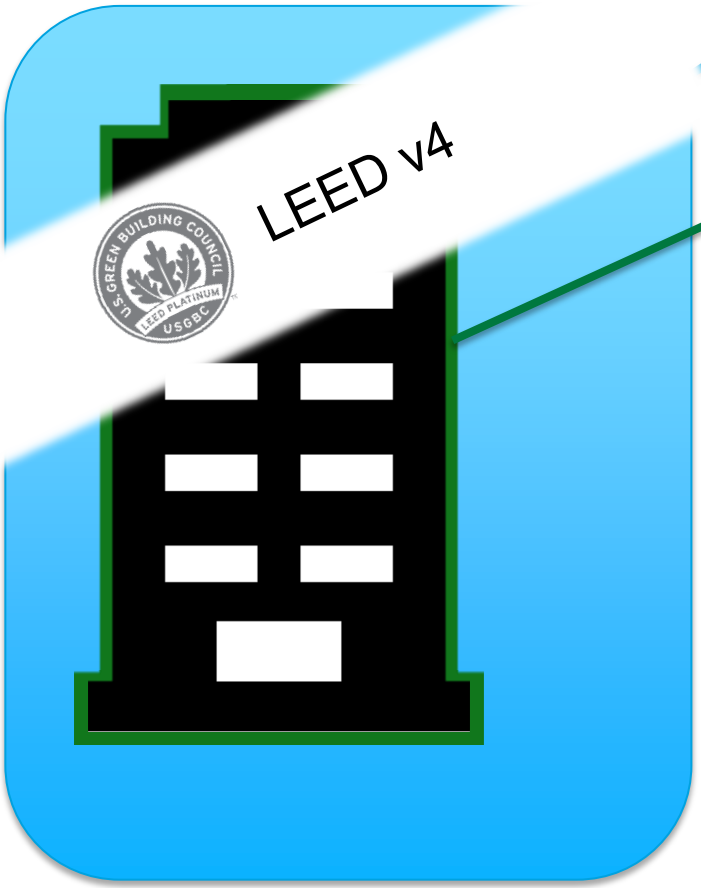
Where's the Value in BECx?

- Higher level of quality assurance = improved performance = reduced risk.
- Potential for risk reduction increases with complexity of building enclosure systems and materials.



Source Credit: Paul Totten, WSP, ETRT presentation, 6/13/17

BECx 101 - Standards, Guidelines, and Resources



ASHRAE Guideline 0-2013

- NIBS Guideline 3-2012
- ASTM 2947

Process

- ASTM 2813
- NIBS Guideline 3-2012

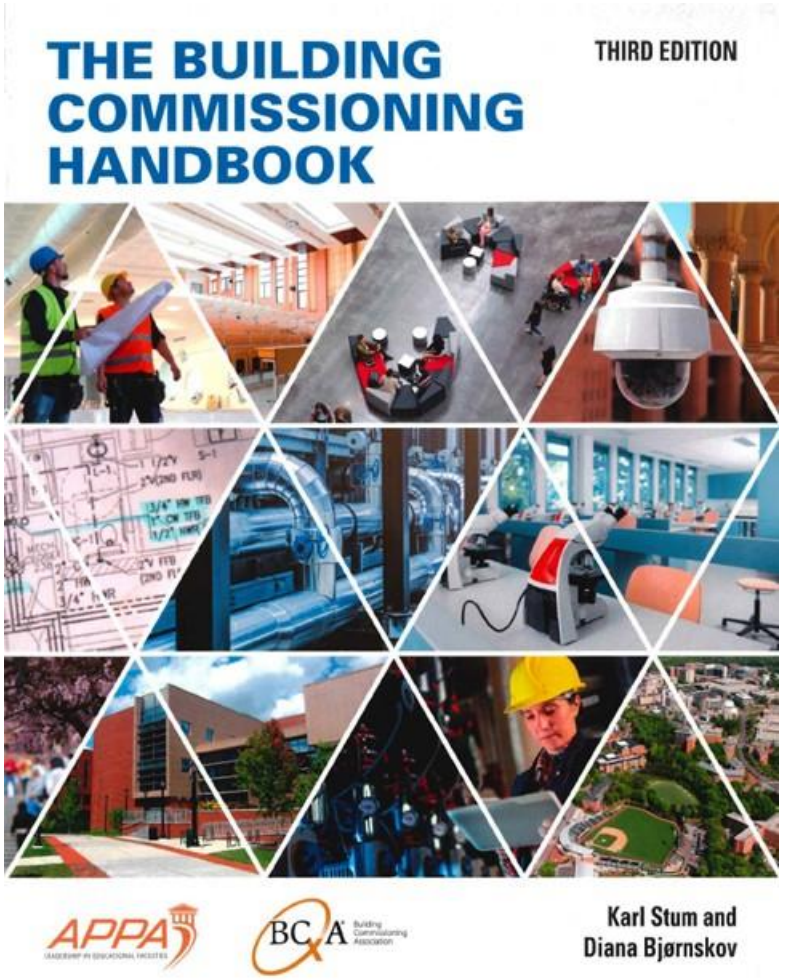
Laboratory

Field

Technical

BECx 101 - Standards, Guidelines, and Resources

Additional reading…

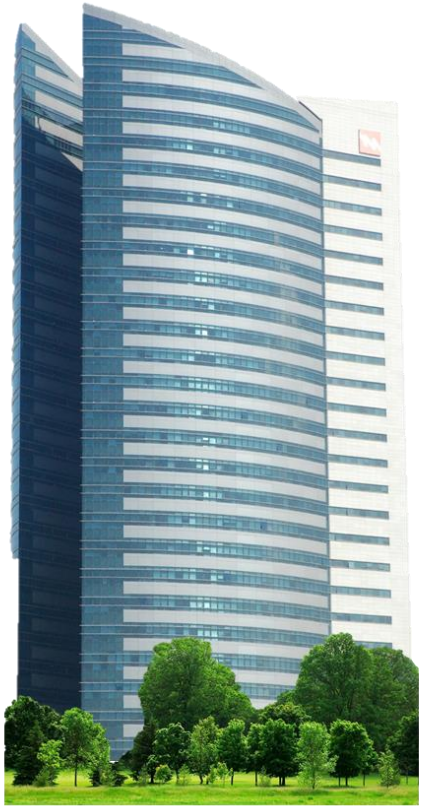


In progress: New performance metric

Thermal Resistance
- R-value
  - Walls
  - Roof
  - Foundation
  - Fenestration
- Thermal Bridges

Installation Quality

Reduction Factor
- Joints
- Penetrations
- Perforations
- Training



Air Infiltration
Thermal Resistance
- Airtightness (ACH75)
- Building Type
- Exposure

Indoor Climate
- Thermostat Setpoints
- HVAC Characteristics
- User Behavior

Weather Conditions
- Temperature
- Wind Loads

Building Enclosure Performance (BEP-value)

Questions and Answers

Mike Hatten
Laverne Dalgleish
Simon Pallin

Better Buildings
U.S. DEPARTMENT OF ENERGY

Poll Questions 2 & 3

Please type in your thoughts…

- How will you use the information shared today?
- Which enclosure technologies or topics would you like to hear about next?

Use your Questions Window to type in your suggestions and ideas

U.S. DEPARTMENT OF ENERGY

Join the Envelope Tech Research Team!

Email: lapsamv@ornl.gov

Building Owners

Building Managers

Architects and Engineers

Subject Matter Experts

Trade Associations

Manufacturers

Installers/ Builders

Energy Service Providers

Researchers

Engage in R&D:

- Addressing airtightness requirements
- Investigating Building Enclosure Performance Metric

- **Featured Enclosure Technology Sessions**

  Thursday Panel Session, Aug 23rd

  Improving Building Performance with Envelope Technologies

  - Showcasing advanced technologies & case study examples

  Friday Workshop, Aug. 24th

  Going Deep on Building Enclosure Commissioning (BECx)

  - 4 hour interactive session on BECx on best practices, member experiences and development of BECx implementation resources

For more information and to register:
2018energyexchange.com