Building Envelope Improvements for Decarbonization Objectives – IREC – CGE – Feb 24, 2023

David Katz – President

Sustainable Environmental Solutions Inc. – Will address windows
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Building Envelope Improvements for Decarbonization Objectives

The decarbonization challenges of existing buildings are noted in the U.S. Inflation Reduction Action (IRA) funding, and similar decarbonization funding is provided in Canada.

The IRA provides unprecedented investment in energy efficiency in residential, public, and commercial buildings, with a focus on electrification and full building retrofits. Residential and public sectors are expected to benefit the most, creating significant opportunities for OEMs and energy service companies in these markets. However, decarbonization in commercial buildings is also expected to accelerate thanks to new and expanded incentives.

The Canada Infrastructure Bank is providing significant loans for deep retrofits with the interest rate on the funds lower when the projects have greater reductions of greenhouse gases (GHGs), even if they cost more initially. The federal government suggests using a 40-year life cycle cost where fossil fuel savings should reflect the rising price of carbon up to $300/ton.

Building Envelope Improvements for Decarbonization Objectives

Clean Prosperity Canada has a new working paper that is the first to quantify the gaps between Canada and the US on incentives for low-carbon investment. Also: How to bring DAC back to Canada, new innovations in carbon removal, and optimistic signs of Canadian climate progress.

How do Canada close the gaps?

There's been a lot of talk about how the US Inflation Reduction Act is a game-changer for investment in decarbonization. A **working paper released this week** with the Transition Accelerator does the math and finds big incentive gaps between Canada and the US — as well as some opportunities.

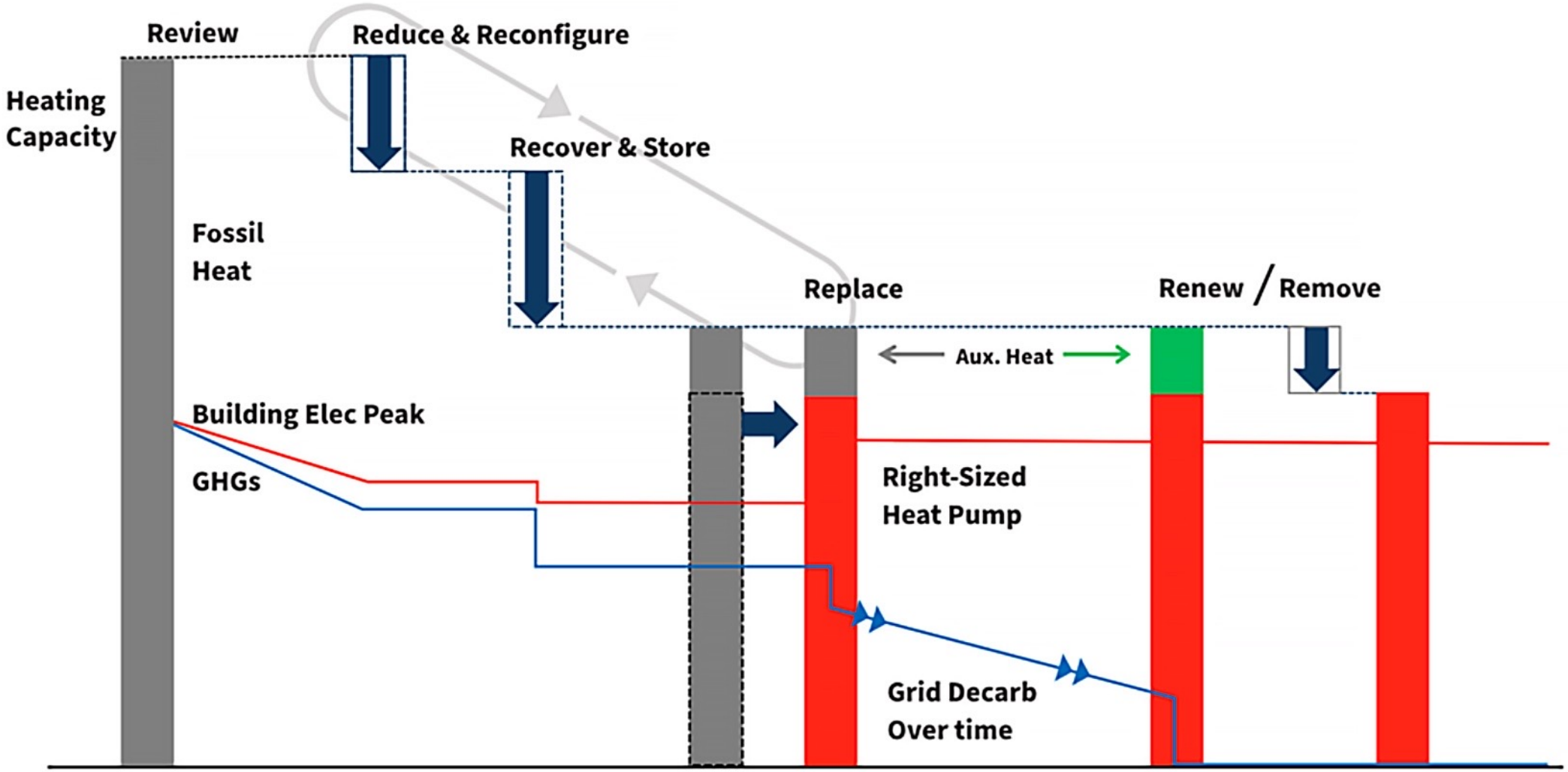
We can't compete dollar-for-dollar with the US, but there are strategic moves we can make to increase Canadian competitiveness.

For starters, the federal government could offer carbon contracts for difference — a kind of insurance policy on the future value of carbon credits. With guarantees in place, Canada becomes a much more appealing place to invest in carbon capture and storage, hydrogen production, and other low-carbon technologies.

What is Decarbonization and the Net Zero Objectives

- Achieving complete decarbonization by 2050 is possible, but it must start now by eliminating fossil fuel fired heating in existing buildings. The question becomes how to start on the path to doing this?

- In a high-electrification scenario, high performance buildings, good design integration, and heat networks work at electric capacity. It won't be an instant flip, but over a 30 year period, one of the first steps is using unmitigated air source heat pumps (ASHPs). These drive up peak winter month electric consumption by almost 50%, as well as cause the winter peaks to triple the summer electric peak, according to the presentation made at an ACEEE event.



Resource Efficient Decarbonization (RED) is an incremental methodology and integrated design process combined with strategic capital planning that creates a path towards carbon neutral buildings.

Photo courtesy Kleinginna/Rodriguez Source: Arup Foresight

The way the industry should be thinking or the evolved way of thinking is doing deep decarbonization by:

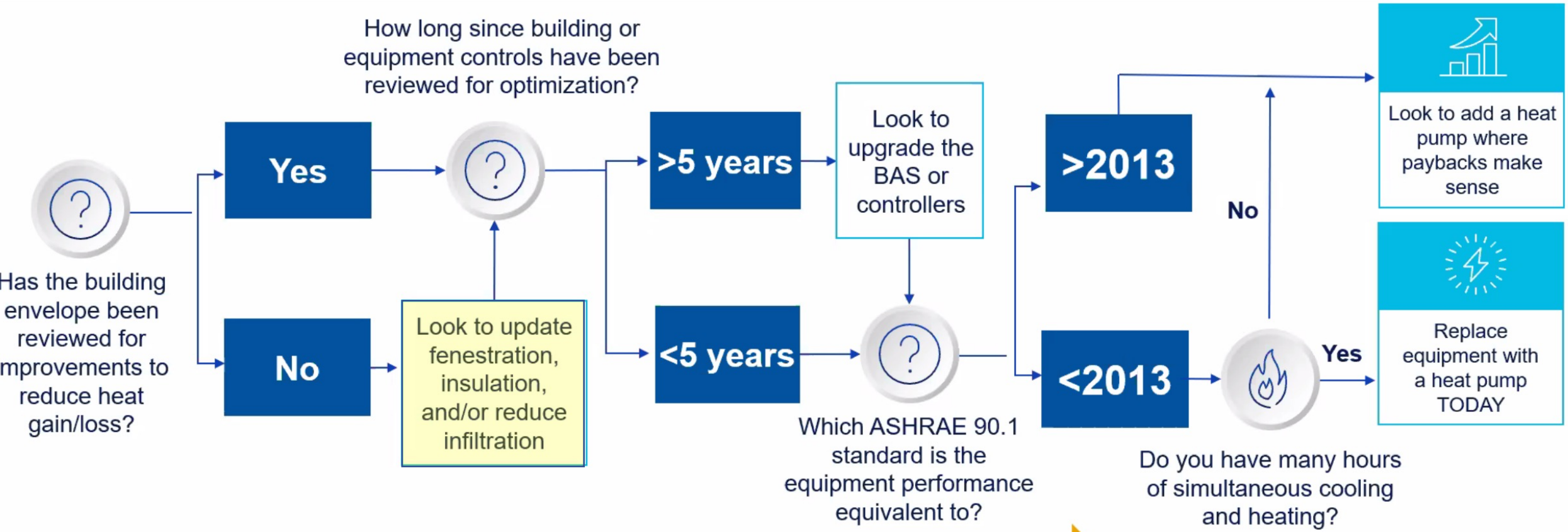
- ***Reducing or eliminating combustion***
- ***Increasing efficiency at low design temperatures***
- ***Remaining resilient during extreme weather conditions***
- ***Using solutions that are energy grid-interactive***
- ***Reducing thermal waste by recycling as many thermal flows as possible***
- ***Incorporating realistic strategies by optimizing and scheduling phase-in of low carbon retrofits***
- ***Providing transparency to all stakeholders***
- ***Integrating heat pump and storage technologies in a heat source/cost optimized thermal dispatch***

Source: Institute of Engineering Technology and Compass Intelligence Analysis.

The Path to Electrify Existing Facilities

How do you prioritize the right decarbonization solutions? And what makes the most sense?

Don't assume to just "electrify"! Make sure you treat the root cause – not the symptoms!



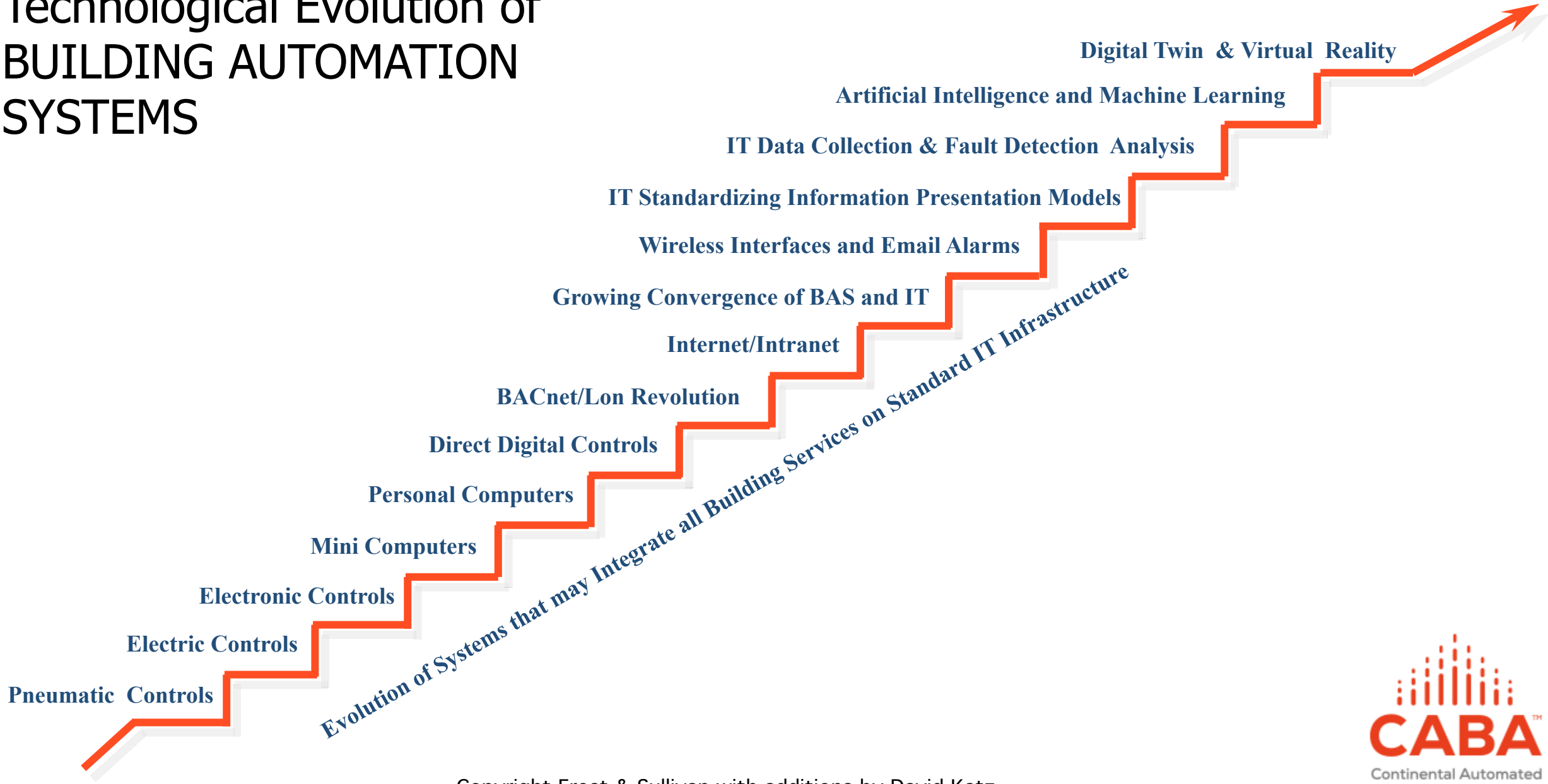
CO_2 Emissions Reduction!

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

READY FOR HEAT PUMPS!

- Insulation, airtightness, and vapour management MUST be done first to ensure occupant comfort and improved energy efficiency
- Efficient mechanicals, correctly sized for the new heating and cooling loads to realize energy savings
- Cold climate air-source heat pumps
- HRV / ERV for constant ventilation

Technological Evolution of BUILDING AUTOMATION SYSTEMS



CABA™
Continental Automated Buildings Association

Evolution of Windows and Coverings.

Safety Glass—1909

Edouard Benedictus was a French painter and chemist who made his discovery by accident.

Double-Paned Glass—1934

Double-glazed windows were reportedly in use in Europe, but in the US, in October of 1934, Charles D. Haven filed a patent for a “multi-ply glass sheet glazing unit” for his Thermopane Company.

Non Reflective Glass Coatings—1939

Several engineers worked to develop glass coatings that would allow higher percentages of light to pass through a pane, reducing reflection.

Clear Float Glass—1952

Sir Alistair Pilkington developed the process of float production, simplifying the process, making a better product and significantly lowering costs.

Low-E Glass—1980s

The energy crisis of the 1970s shifted attention toward energy-efficiency initiatives. With low-E glass, the end result is a window that allows light to pass through but reflects away heat. The Department of Energy estimates that “low-E coatings alone reduce the energy lost through typical windows by 35%.”

Composite Window Frames—1994

Ideal for moist, cold climates like those of the Pacific Northwest, composite window frames can be constructed of engineered wood, pultruded fiberglass or other proprietary inorganic materials.

Future Window Technology You Need To Know About

Now, smart technologies are developing into automated, integrated window systems that will not only control themselves but also interact with other systems to maintain perfect environmental conditions inside a home. Many of these advancements are still in development or only available for large architectural and commercial applications, but they are on our radar to keep watching as they move into residential windows.

Shading Technology

The problems of controlling heat transfer and blocking harmful rays from the sun while allowing light to pass remain a key challenge for manufacturers. Some promising glazing technologies approach the problem in very different ways: There are automated blinds using AI and the pattern of the sun to automatically lower the blinds at the right times to lower HVAC loads.

Photochromic glazing responds automatically to light, darkening to block heat and glare.

Electrochromic glazing uses electricity to activate lithium ions that darken a ceramic coating microns thick. It blocks near the infrared spectrum and can let in light and heat as desired.

Thermochromic glazing is a passive system that tints when direct sunlight heats it, blocking UV rays and solar heat gain.

Gaschromic glazing relies on a single-micron coating of tungsten oxide to sense light and trigger either diluted hydrogen to tint the window cavity or oxygen to clear or “bleach” the tinting.

Photovoltaic Technology

Rather than simply blocking sunlight, photovoltaics—also known as PVs—**add solar energy collection to the mix**. The crystalline solar cells are comparable to top-of-the-line silicon cell panels in efficiency, yet their components are less expensive. Meanwhile, the coatings offer tinting and shade—all the best of both worlds.

Future Window Technology You Need To Know About

.**Privacy Technology**

Liquid crystal technology allows privacy controls once seen only in sci-fi movies. Laminated between two panes of glass, a liquid crystal package turns a window either clear, with crystals aligned, or diffused, with crystals scattering light to create privacy.

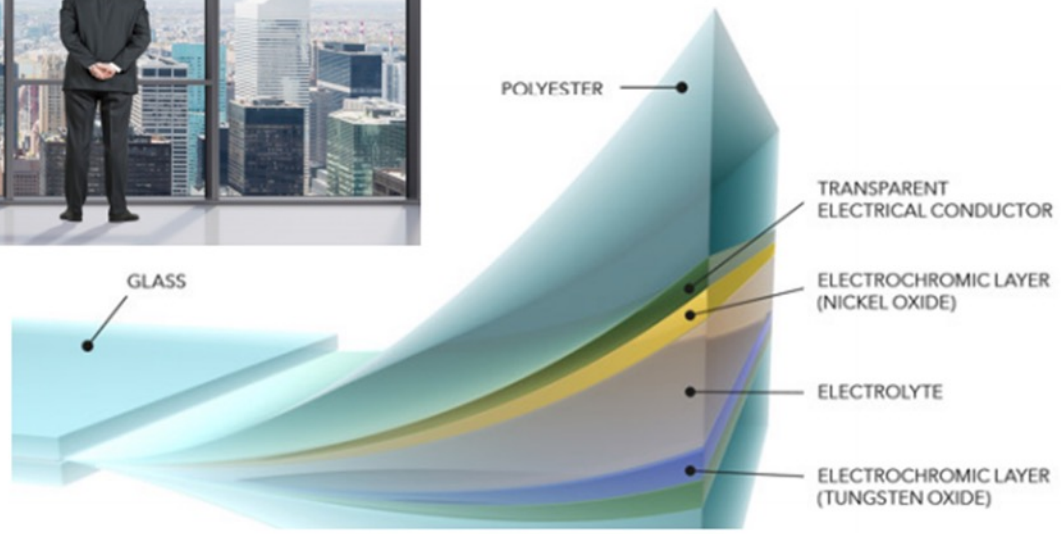
Security Technology

Security is a logical starting point for remote window control technologies, with remote control of more complex window features potential for development.

Home Integration Technology

With smart technology and the internet of things becoming an integral part of nearly everything we buy—home systems included—smart windows will be able to communicate with other smart systems. Perhaps a thermostat will be able to tell a window to lighten up a bit and let some heat in so that the furnace doesn’t have to work so hard, or an air-conditioning system and a PV window system will work together to keep a home cool and use the collected solar energy to power the air-conditioning.

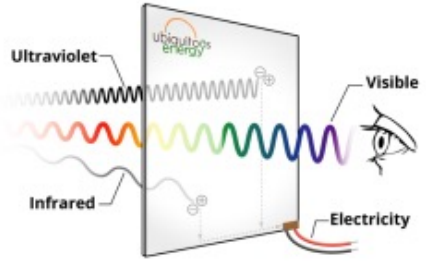
Future Window Technology You Need To Know About



Source: CPEIA Flexible & Printable Electronics Workshop, 2017 CABA Forum

Future Window Technology You Need To Know About

Photovoltaic transparent glass - Onyx Solar

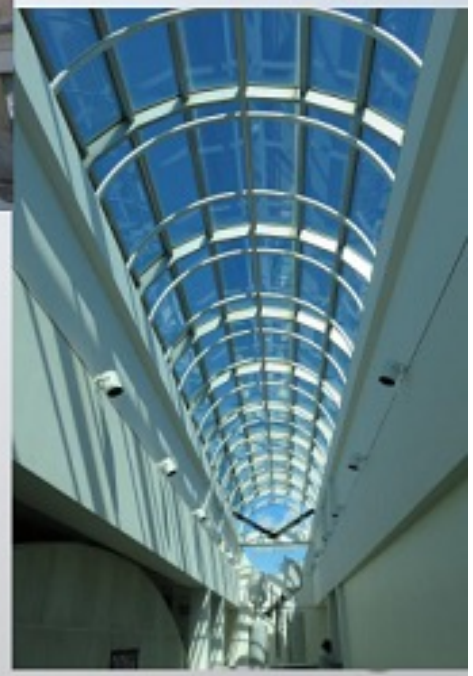


Source: CPEIA Flexible & Printable Electronics Workshop, 2017 CABA Forum

Is this Tinted Glass Building Green and Intelligent ?
What are the tradeoffs in HVAC, Daylighting & Productivity

Fenestrations

- Windows
  - Fixed
  - Casement
  - Awning
  - Dual Action / Tilt and Turn
  - Sliding (Vertical and Horizontal)
  - Combination (Combo)
- Doors
- Skylights/Sloped Glazing
  - Architectural Systems
  - Structural Systems



ABSI.CA

Factors affecting energy efficiency

Energy balance

All fenestration products experience some heat loss:

radiation—heat energy is absorbed by the glass and radiates toward the cooler side

conduction—heat energy moves through solid materials that make up the frame, sash or spacer bars

convection—heat energy is transferred to the air between and around the glass

air leakage—heat energy is transferred to air moving through seals or gaps in the frame

Windows can also gain passive solar energy through the glass to help offset energy costs during the heating season. This balance is reflected in the energy-performance ratings.

What are Window Problems?

Low R value:

Single Pane glass in metal, wood or fibreglass frames. Builders choose lowest first cost just to meet code:

Condensation:

Delta Temperature from inside to outside in cold weather leads to condensation on interior and/or between double panes when seals are broken.

Leakage:

Every window assembly has places of separation whether fixed or operable. The places of connection in window assemblies and to the building envelope deteriorate over time. Constant air exchange occurs.

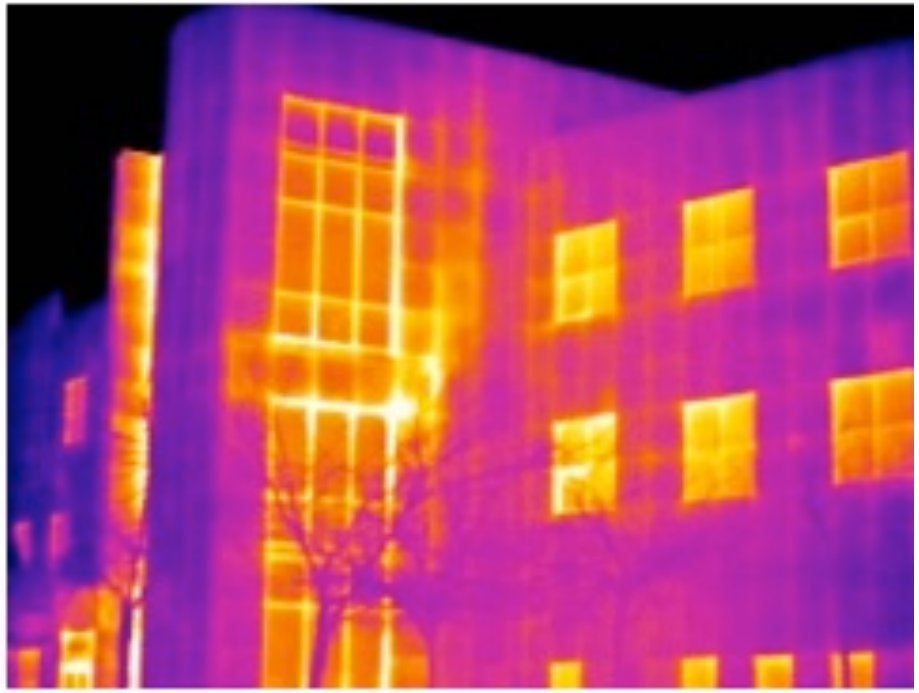
What are Window Problems?

Toronto City Core Building

If a picture is worth a thousand words, then an infrared image is worth a million.

Make an infrared inspection part of your next building study.

The infrared shows where the heat loss is and the intensity appears to be greater around the edges showing the need to improve both the glazing and the framing.



Toronto City Core Building

What are Window Solutions?

Replace your existing windows with New Windows

Exterior Storm windows for the low rise homes that are easily accessible.

High rise buildings would not have exterior storms installed.

Interior Storm Window Panels using magnetic seals and other adhesion methods.

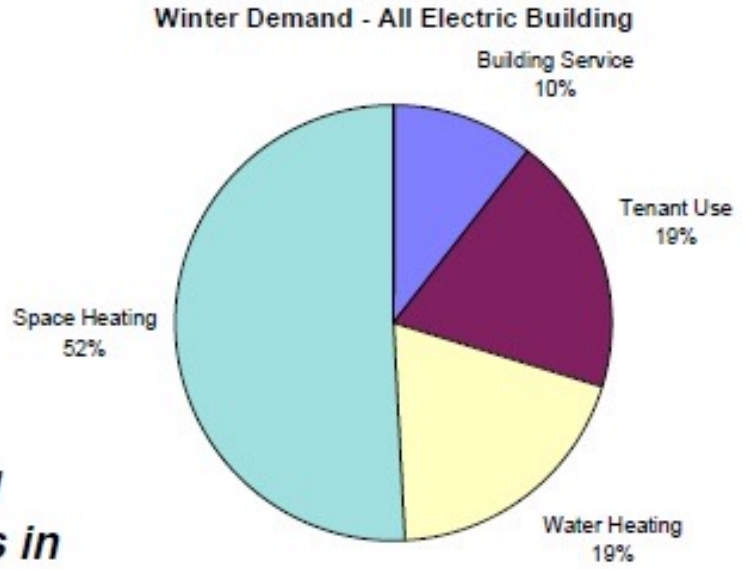
Insulating blinds that save energy but are not transparent and are not always opened or closed when needed.

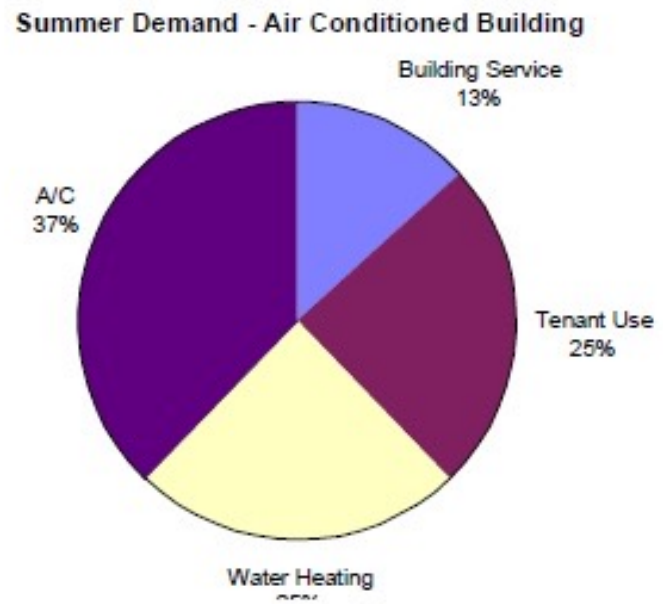
Window Film and new nano coatings. Offer improvement in SHGC and lower air conditioning costs but trade off heating savings.

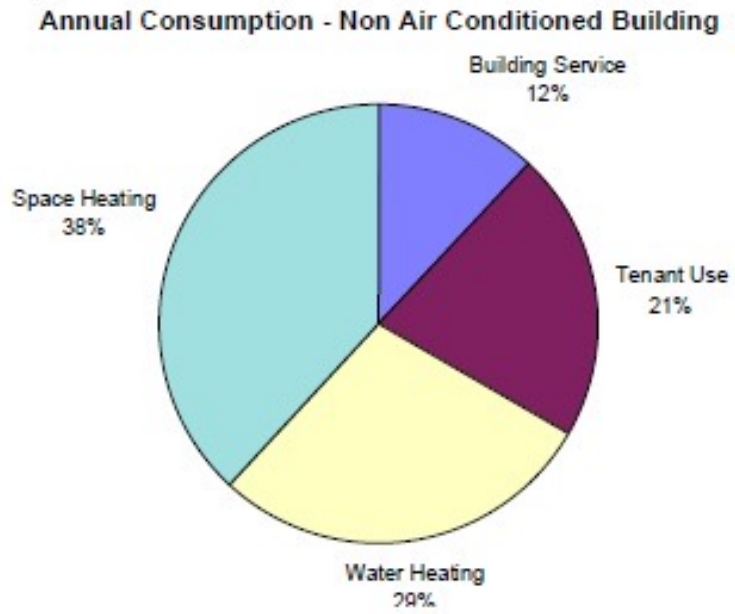
Weather stripping and Caulking are options to seal around the windows.

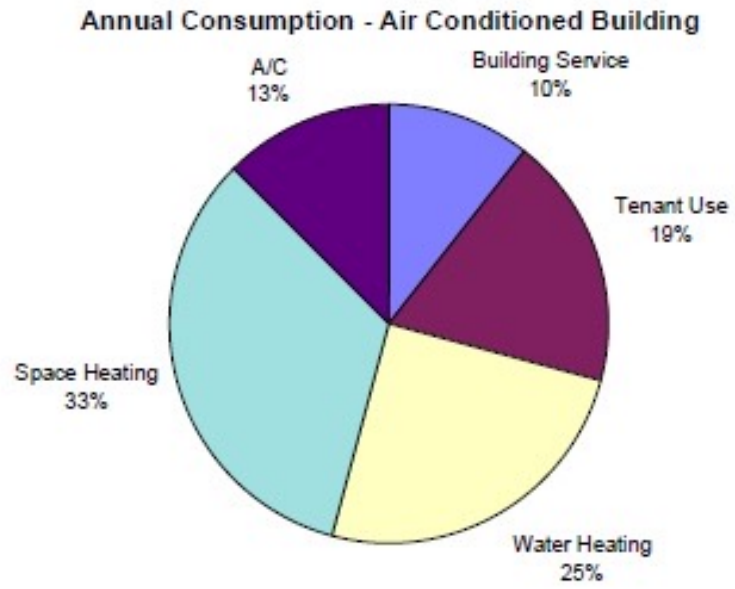
What does CMHC say about Energy in Multi Res?

Typical Energy Consumptions and Electrical Demands in Multi-Residential Buildings









Energy Consumption Trends of Multi-Unit Residential Buildings in the City of Toronto – TAF - University of Toronto

by: Clarissa Binkley, Marianne Touchie, Kim Pressnail

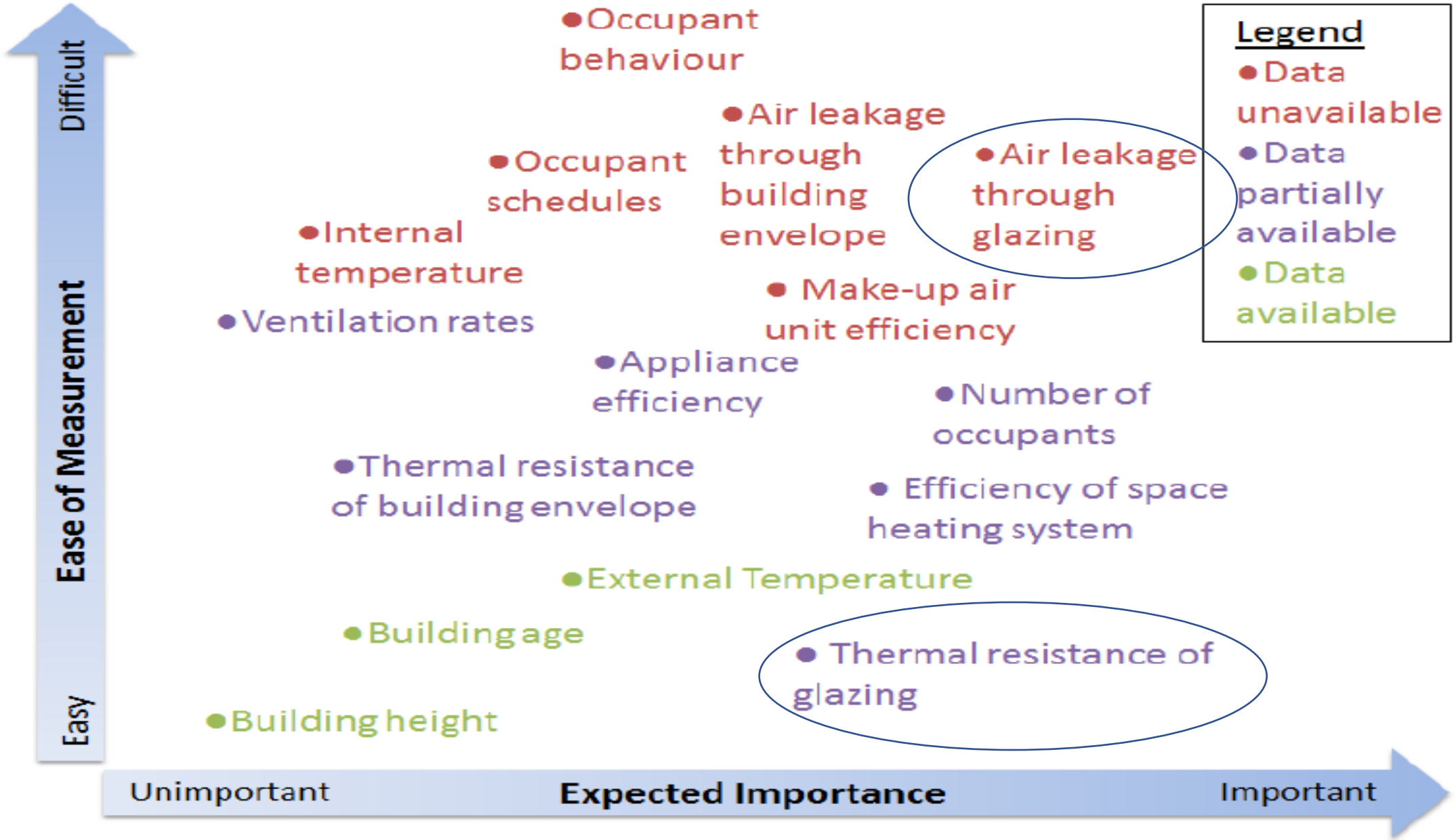
The findings of this report related to fenestration indicate that:

1) heating system efficiencies and glazing characteristics, including fenestration ratio in particular, as well as glazing U-value, are the variables that are most closely linked to energy intensity.

2) The actual efficiency of the whole heating system should be assessed before retrofit decisions are prioritized. Relatively strong correlations between fenestration ratio and variable natural gas intensity were found. However, the fenestration ratio is a variable that cannot be easily altered in an existing building.

3) However, different coefficients in the correlation between energy use and the fenestration ratio of single- and double-glazed units suggest that air-leakage may be more prevalent in single-glazed windows. Though further investigation of the air tightness of various existing window systems would be required to confirm this hypothesis, this finding could indicate the importance of window air-sealing measures particularly in buildings with single-glazing.

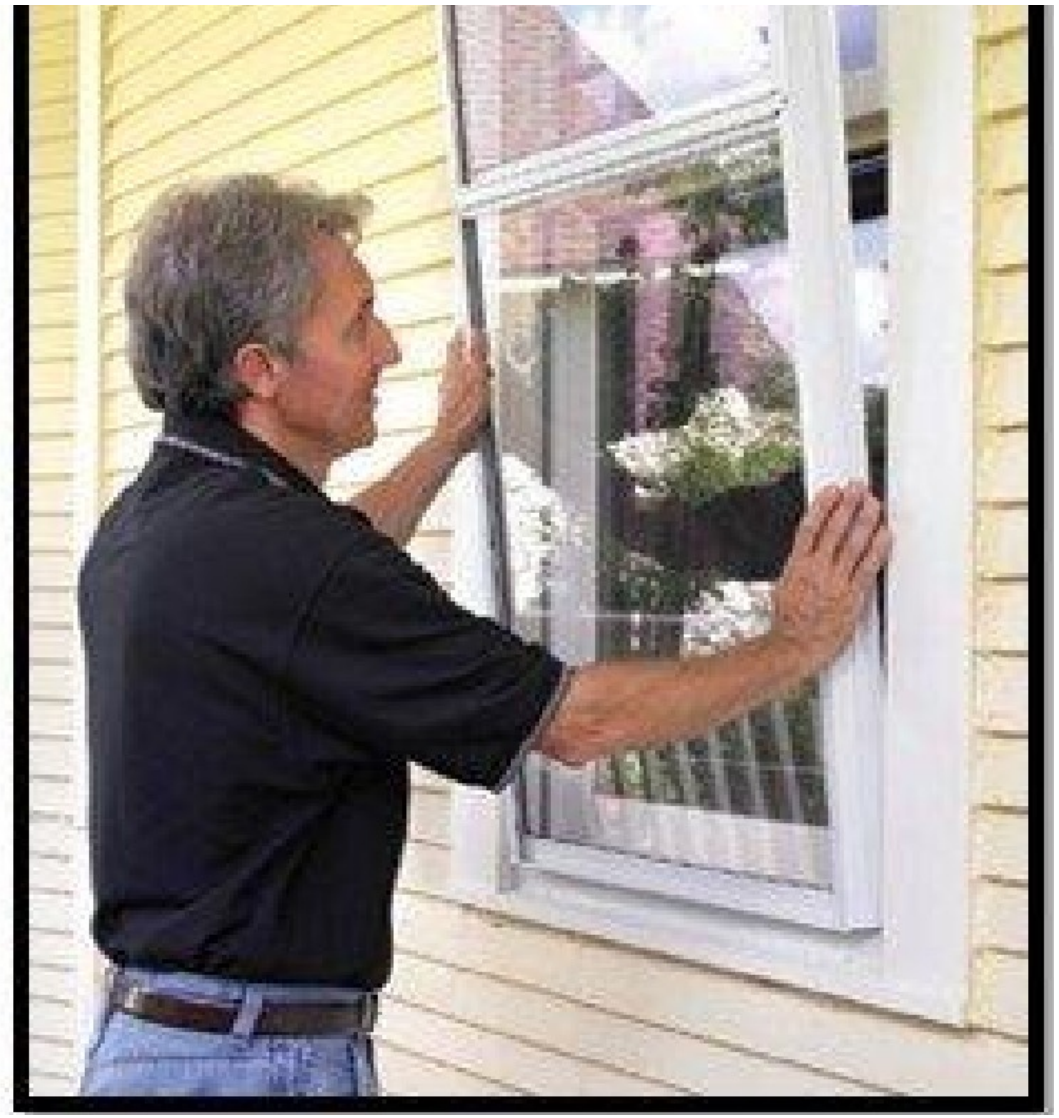
Expected Categorization of Explanatory Variables



Replacing single-pane windows with double-pane windows that have high-performance glass may be cost effective, but you could also consider installing low emissivity (low-e) storm windows. Installing interior or exterior energy-efficient storm windows that are rated by the Attachment Energy Rating Council (AERC) can produce similar savings but at about 1/3 of the cost. Storm windows can help reduce air movement into and out of existing windows, helping to improve comfort and reduce heating and cooling costs.

Low-E Storm Windows

While older storm windows were typically just clear glass, newer models are available with a low-e coating that reduces heat transmission through the storm window. Low-e storm windows are more insulating, reflecting heat back into the house into the winter, and can also help the home stay cooler during the summer, keeping the home more comfortable. Information on the energy efficiency of storm windows is available for all rated products through the AERC. You can find storm windows that have the ENERGY STAR label at energystar.gov .



Saving Windows, Saving Money:

Evaluating the Energy Performance of Window Retrofit and Replacement

A REPORT BY:

National Trust for Historic Preservation
Preservation Green Lab

FUNDED BY:

NCPTT
National Center for Preservation Technology and Training

IN PARTNERSHIP WITH:

CASCADIA
GREEN BUILDING COUNCIL

ECOTOPE
Consulting
Research
Design

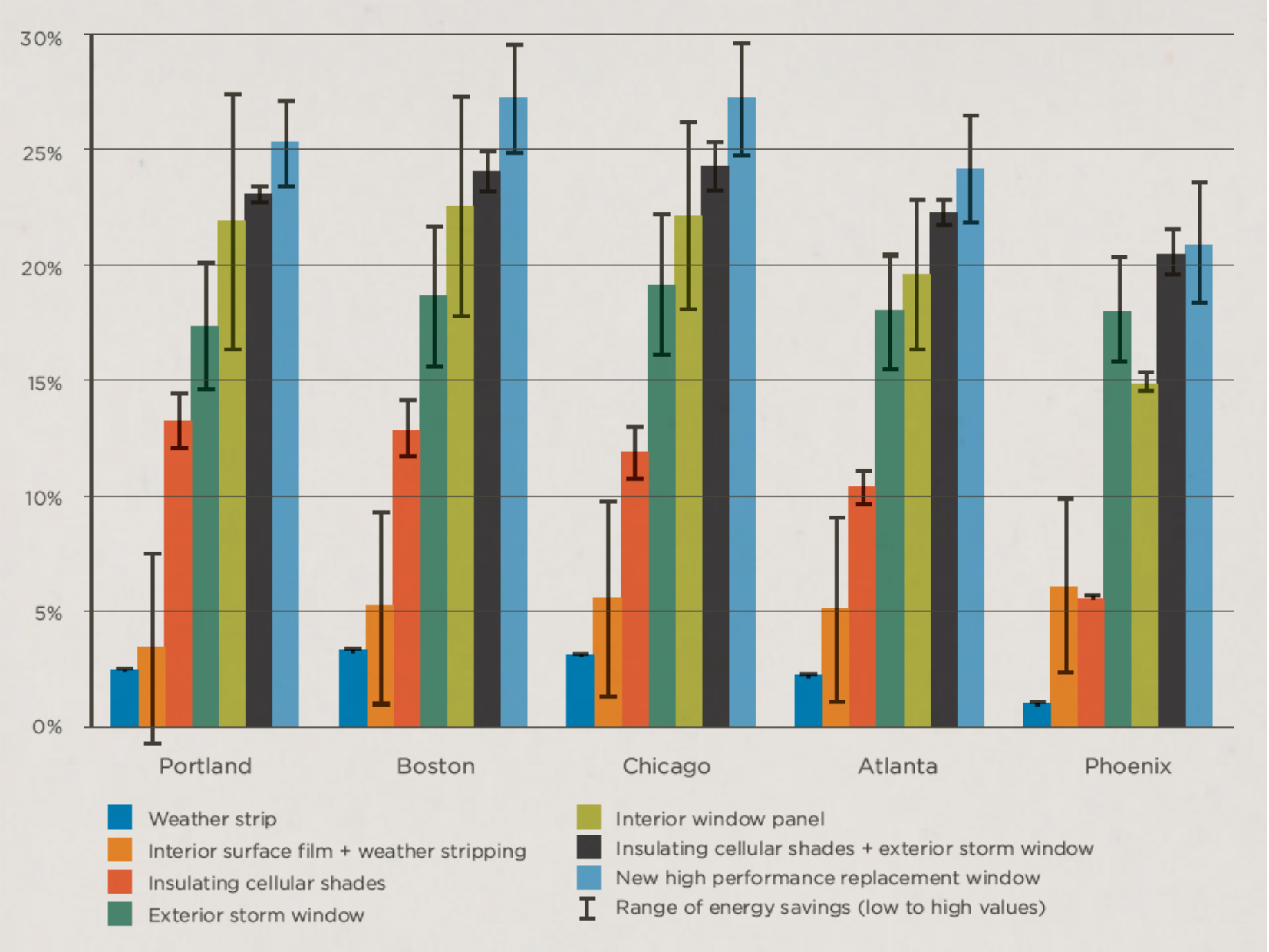
Multiple window improvement options, comparing the relative energy, carbon, and cost savings of various choices across multiple climate regions.

Results shows that a number of existing window retrofit strategies come very close to the energy performance of high-performance replacement windows at a fraction of the cost.

Annual Percent Energy Savings For Various Window Upgrade Options

Weather Strip
Interior surface Film + Weather strip
Insulating cellular shades
Exterior Storm windows
Interior Window Panel
Insulating cellular shades + exterior
High Performance Replacement window

Range of energy savings
High and low values

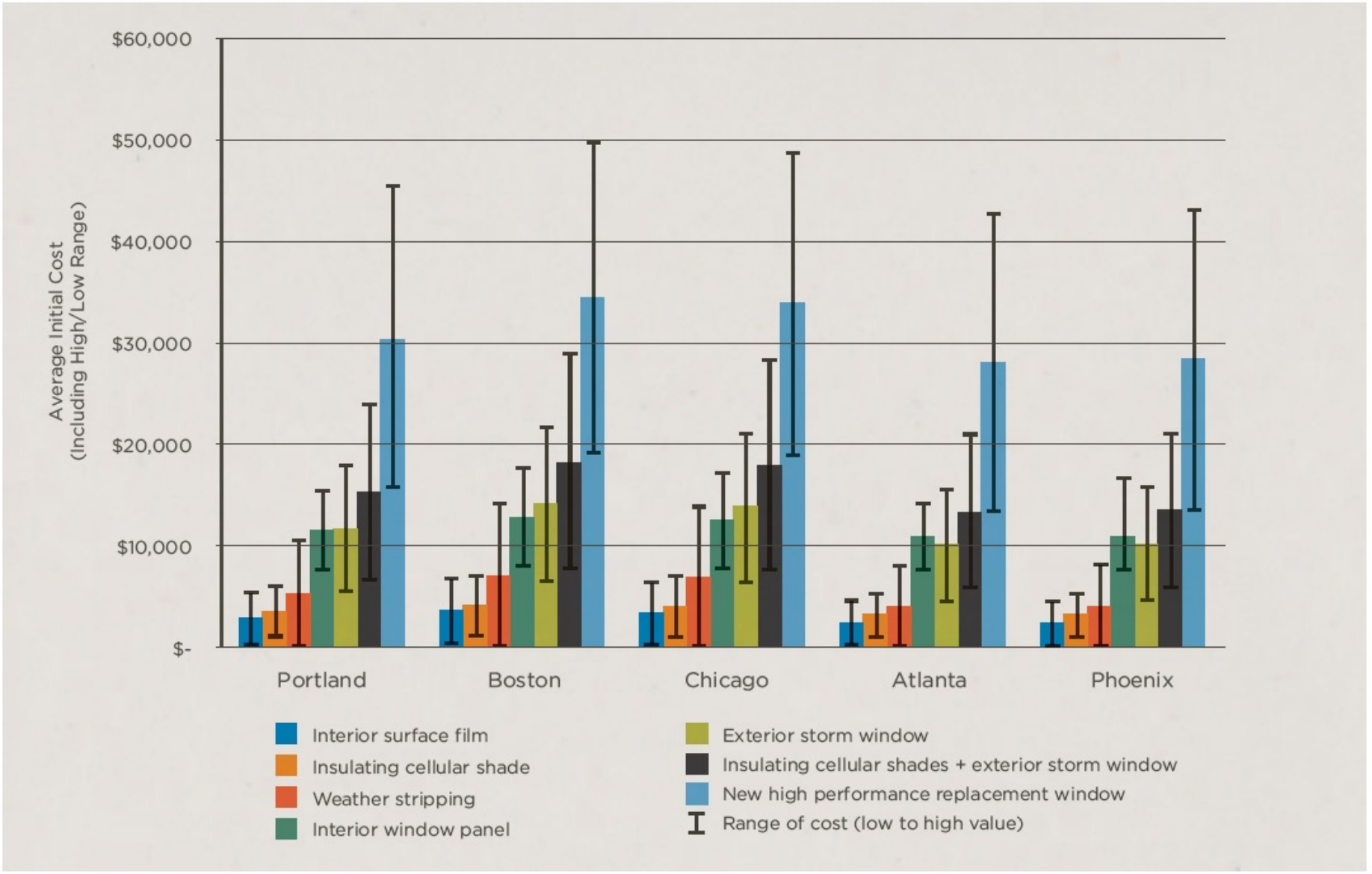


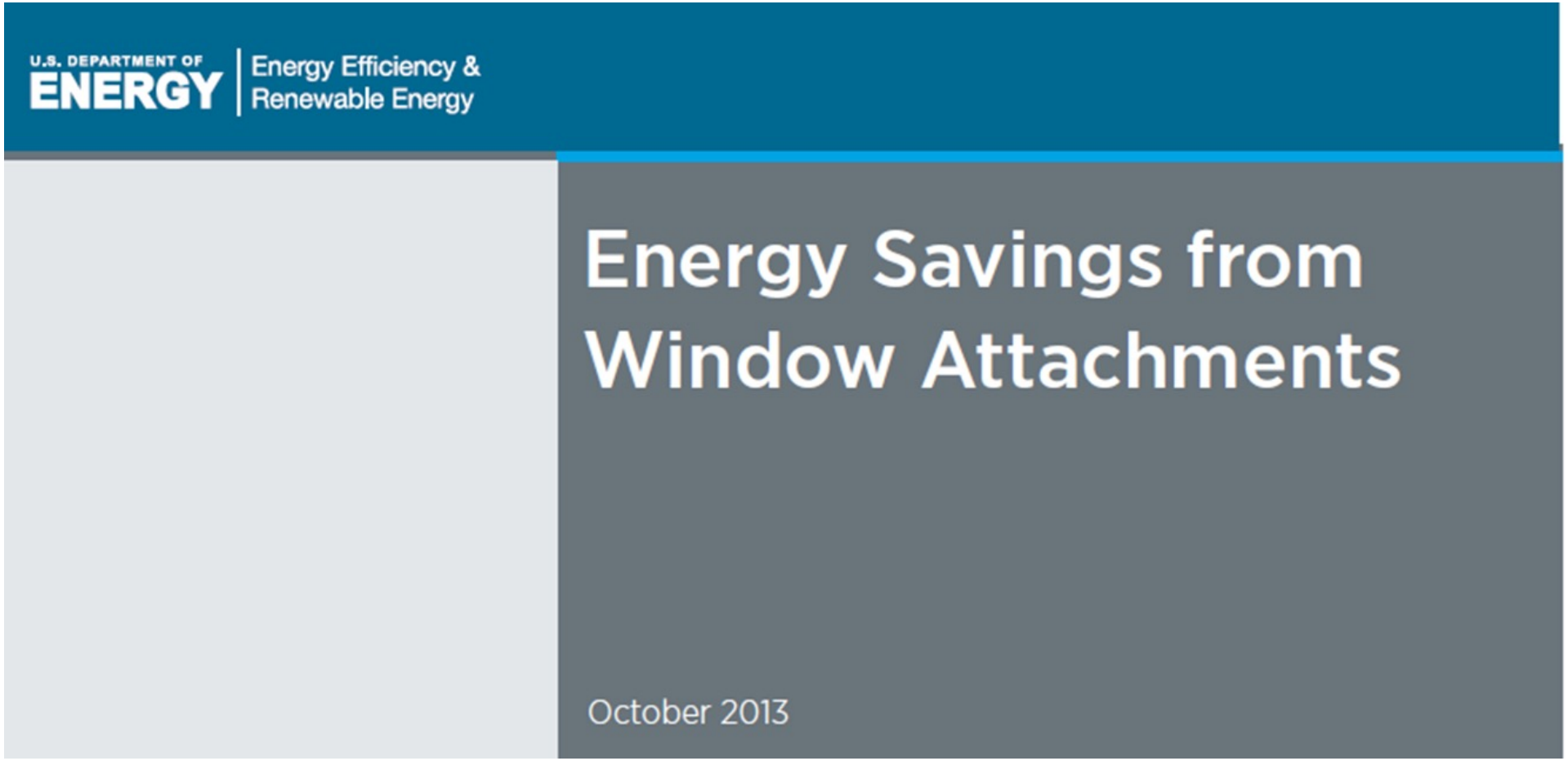
Note: Percentage savings are not intended to predict actual savings. Instead, the results are meant to be used to evaluate the relative performance of measures where other more cost-effective energy saving strategies have been implemented first.

Weather Strip
Interior surface Film + Weather strip
Insulating cellular shades
Exterior Storm windows
Interior Window panel
Insulating cellular shades + exterior
High Performance Replacement window

Range of costs
High and low values

Figure 7: Average Initial Costs of Window Options For All Cities





DOE Study - A more comprehensive study of many options and many ways windows would be operated in many different climate zones..

DOE Study - A more comprehensive study of many options and many ways windows would be operated in many different climate zones..

- Total annual energy use for houses with each shading device in several configurations and climates.
- 16,848 energy simulation runs were carried out for 12 climate zones,
- Four house types, three baseline windows, 11 window attachment categories
- Four attachment qualities and varying number of deployment positions.
- One option for fixed, three options for cellular shades, roller screens, solar screens, and drop-arm awnings
- Eight options for horizontal and vertical louvered blinds.

North Climate Zone Energy Savings Results for Comparison to Canada

Summary of energy saving for each Technology shows that the many light blue dots for interior Window panels are above the axis showing a wide range of energy savings.

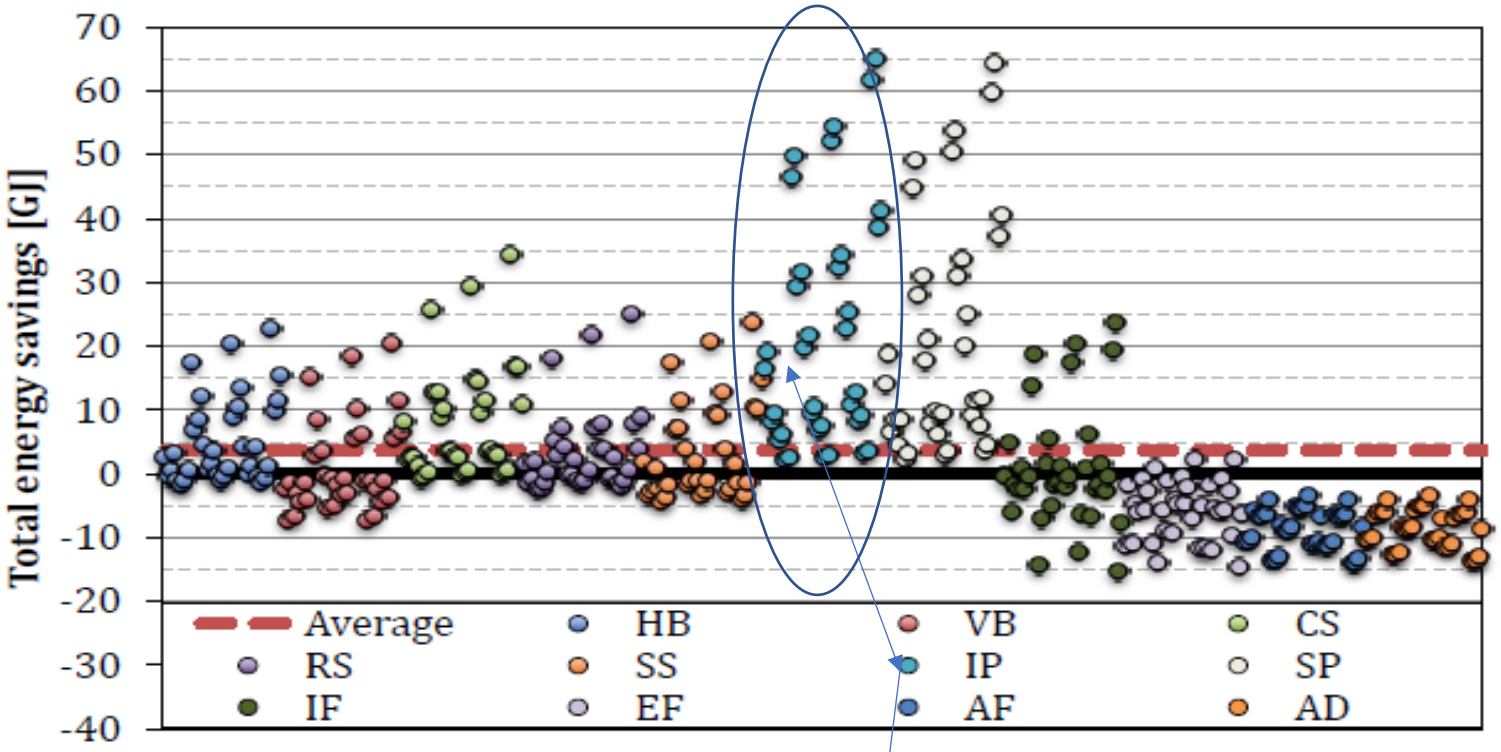


Figure 15. North Climate Zone. Average Savings: 3.72 GJ

HB	Horizontal Louvered Blind	IP	Interior Window Panel
VB	Vertical Louvered Blind	SP	Storm Panel
CS	Cellular Shade	IF	Interior Applied Film
RS	Roller Shade	EF	Exterior Applied Film
SS	Solar Screen	AF	Fixed Awning
		AD	Drop-arm Awning

DOE Study - A more comprehensive study of many options and many ways windows would be operated in many different climate zones..

Using the results in the cold cities like those in Minnesota and Washington DC to Canadian weather the Interior window panels provide greater savings than the other options and cost less than new windows.

6.3 Energy Savings Tables

The following tables show energy savings compared to the baseline case without any attachment installed. The values displayed are for the following house type: slab, gas heating, and electric A/C. See Appendix A for results for all 12 cities.

Table 21. Single Glazing -Total Energy Savings [GJ] Compared to an Un-Shaded Baseline for All Attachment Types in a House with Slab, Gas Heating, and Electric A/C, for Four Attachment Qualities (A, B, C, D).

Attachment Type	Minn				Washington.DC				Phoenix			
	A	B	C	D	A	B	C	D	A	B	C	D
Horizontal Blind	22.8	9.8	11.5	15.4	16.4	12.0	11.2	8.0	14.8	6.3	7.5	10.1
Vertical Blind	20.5	5.5	11.4	6.4	16.3	12.3	11.1	11.8	12.7	2.6	7.4	3.0
Cellular Shade	34.3	16.9	16.7	10.9	18.5	13.1	11.5	6.5	22.9	11.4	11.3	7.6
Roller Shade	25.0	7.7	4.0	8.9	18.0	11.7	8.8	4.4	16.1	4.9	2.9	5.9
Solar Screen	23.8	10.4	10.1	14.6	17.0	13.6	12.8	10.1	15.6	6.2	6.3	9.6
Interior Window Panel	61.7	65.0	38.6	41.3	24.6	17.8	12.6	10.5	38.6	39.6	23.6	24.8
Storm Window	59.8	64.4	37.1	40.5	25.7	18.5	13.9	11.6	37.4	39.4	22.8	24.4
Interior Applied Film	19.3	23.6	-15.4	-7.9	18.2	9.9	7.9	4.2	12.7	15.1	-9.1	-4.2
Exterior Applied Film	-9.7	2.2	-14.6	-6.3	12.2	5.1	8.5	4.5	-4.2	3.2	-8.8	-3.3
Fixed Awning	-14.1	-14.1	-13.4	-8.2	9.5	9.5	9.2	6.4	-8.3	-8.3	-7.9	-4.5
Droparm Awning	-13.6	-13.6	-13.1	-8.5	8.2	8.2	8.1	6.7	-9.6	-9.6	-9.2	-6.0

Using the results in the cold cities like those in Minnesota and Washington DC to Canadian weather the Interior window panels provide greater savings than the other options and cost less than new windows.

Even when added to double glazing windows the interior panels and exterior storms still provide energy savings.

DOE Study - A more comprehensive study of many options and many ways windows would be operated in many different climate zones..

Table 22. Double Clear Glazing -Total Energy Savings [GJ] Compared to an Un-Shaded Baseline for All Attachment Types in a House with Slab, Gas Heating, and Electric A/C, for Four Attachment Qualities (A, B, C, D).

Attachment Type	Minn				Washington.DC				Phoenix			
	A	B	C	D	A	B	C	D	A	B	C	D
Horizontal Blind	4.3	0.1	1.3	4.1	10.2	7.4	6.5	3.4	3.3	0.4	1.3	2.9
Vertical Blind	-1.2	-7.3	-1.2	-6.7	10.0	8.0	6.2	7.5	-1.1	-5.4	-0.4	-5.1
Cellular Shade	11.4	3.4	3.8	3.2	11.8	7.6	6.3	2.9	8.3	2.9	3.0	2.3
Roller Shade	3.8	-0.9	-0.5	2.6	11.8	7.5	5.4	1.8	2.6	-0.2	0.1	1.7
Solar Screen	3.7	-3.0	-2.3	1.6	11.2	9.4	8.9	6.6	2.9	-2.0	-1.3	1.5
Interior Window Panel	22.6	25.5	10.9	12.6	15.1	10.0	6.3	4.8	15.3	16.4	7.3	8.0
Storm Window	20.0	24.9	9.0	11.4	16.4	10.2	8.1	6.0	13.8	16.2	6.4	7.6
Interior Applied Film	0.9	6.1	-6.9	-2.3	11.3	4.6	5.7	2.0	1.7	4.4	-3.2	-0.9
Exterior Applied Film	-11.7	-1.9	-12.0	-5.5	10.0	4.0	8.0	4.8	-5.9	0.1	-6.5	-2.5
Fixed Awning	-11.4	-11.4	-10.8	-6.3	8.7	8.7	8.5	5.8	-6.3	-6.3	-5.9	-3.0
Droparm Awning	-11.5	-11.5	-11.0	-7.0	7.8	7.8	7.8	6.4	-7.6	-7.6	-7.3	-4.4
No Shade	92.1	92.1	92.1	92.1	47.4	47.4	47.4	47.4	56.7	56.7	56.7	56.7

Using the results in the cold cities like those in Minnesota and Washington DC to Canadian weather the Interior window panels provide greater savings than the other options and cost less than new windows.

Even when added to double glazing windows the interior panels and exterior storms still provide energy savings.

DOE Study - A more comprehensive study of many options and many ways windows would be operated in many different climate zones..

4.5.6 Interior Window Panels

Interior (indoor-mounted) window panels are always fully deployed. They are considered to be tightly attached to the baseline window with no gaps around the edges. Gap of 1 in. between the prime glass and the interior window panel is considered for all qualities.

Table 12. Interior Window Panel Definition of Range of Qualities

Quality	Emissivity (Ext/Int) [-]	Reflectance [-]	Transmittance [-]	Conductivity k, [W/m·K]	#Panes	Deployed
A	0.05 / 0.1	0.6	0.2	0.15	2	Full
B	0.07/0.15	0.2	0.6	1.0	2	Full
C	0.84	0.3	0.6	1.0	1	Full
D	0.9	0.1	0.7	1.0	1	Full

BETTERBRICKS
Powerful Energy Ideas. Delivered by NEEA.

SECONDARY WINDOWS: HIGH-PERFORMANCE WINDOWS AT A FRACTION OF THE COST

Secondary windows—also known as low-e storm windows, insulating panels, or secondary glazing systems—are a cost-effective, high-performance alternative to full window replacement for commercial buildings with old, inefficient windows.

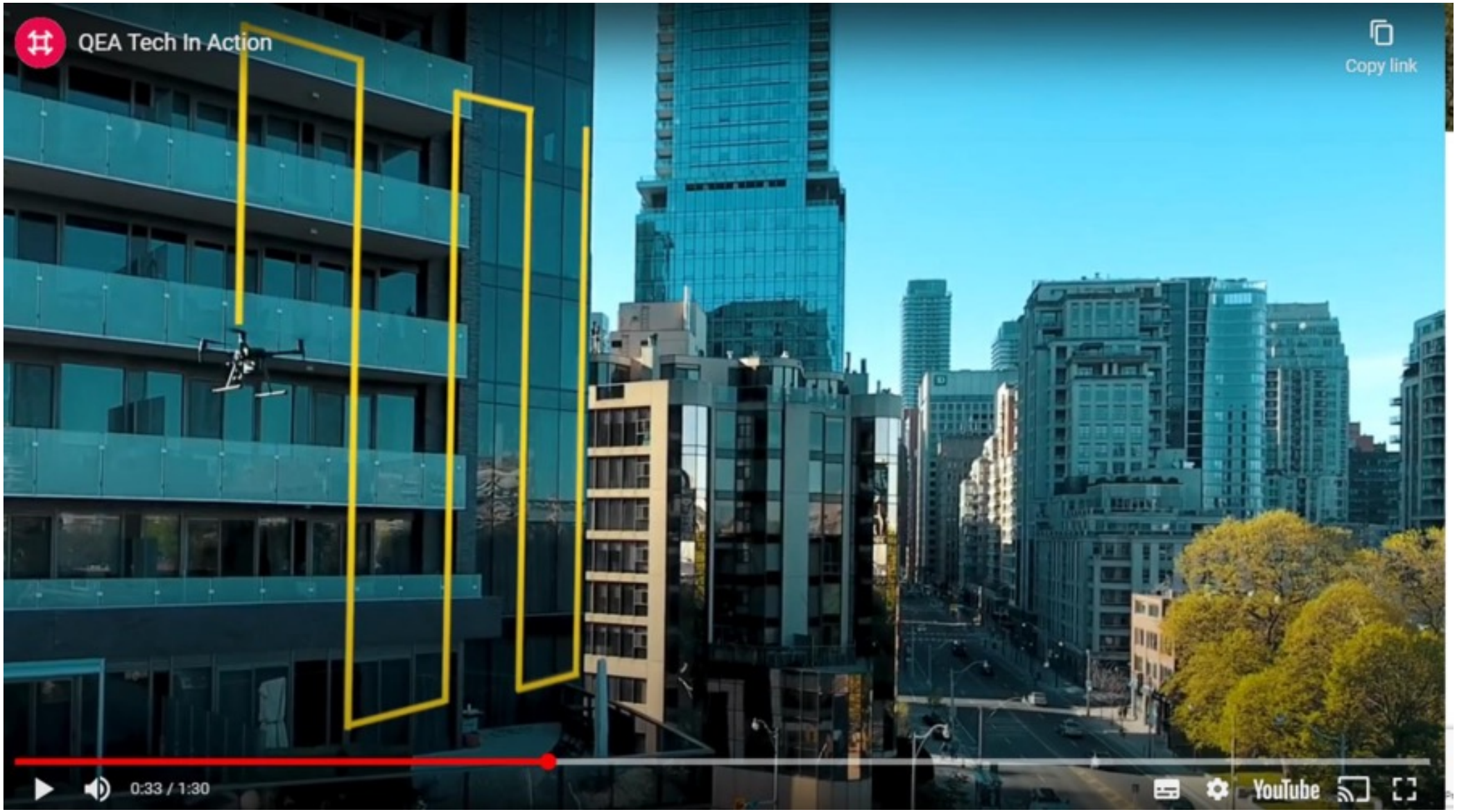
Secondary windows simply attach to the interior or exterior of an existing (i.e., primary) window for quick installation, resulting in improved occupant comfort, health and wellness, while reducing heating and cooling energy use by up to 20 percent. Further, secondary windows can achieve about the same performance as replacing windows with new high-performance models, but for as little as half the cost (depending on the product and application).

BETTERBRICKS
Powerful Energy Ideas. Delivered by NEEA.

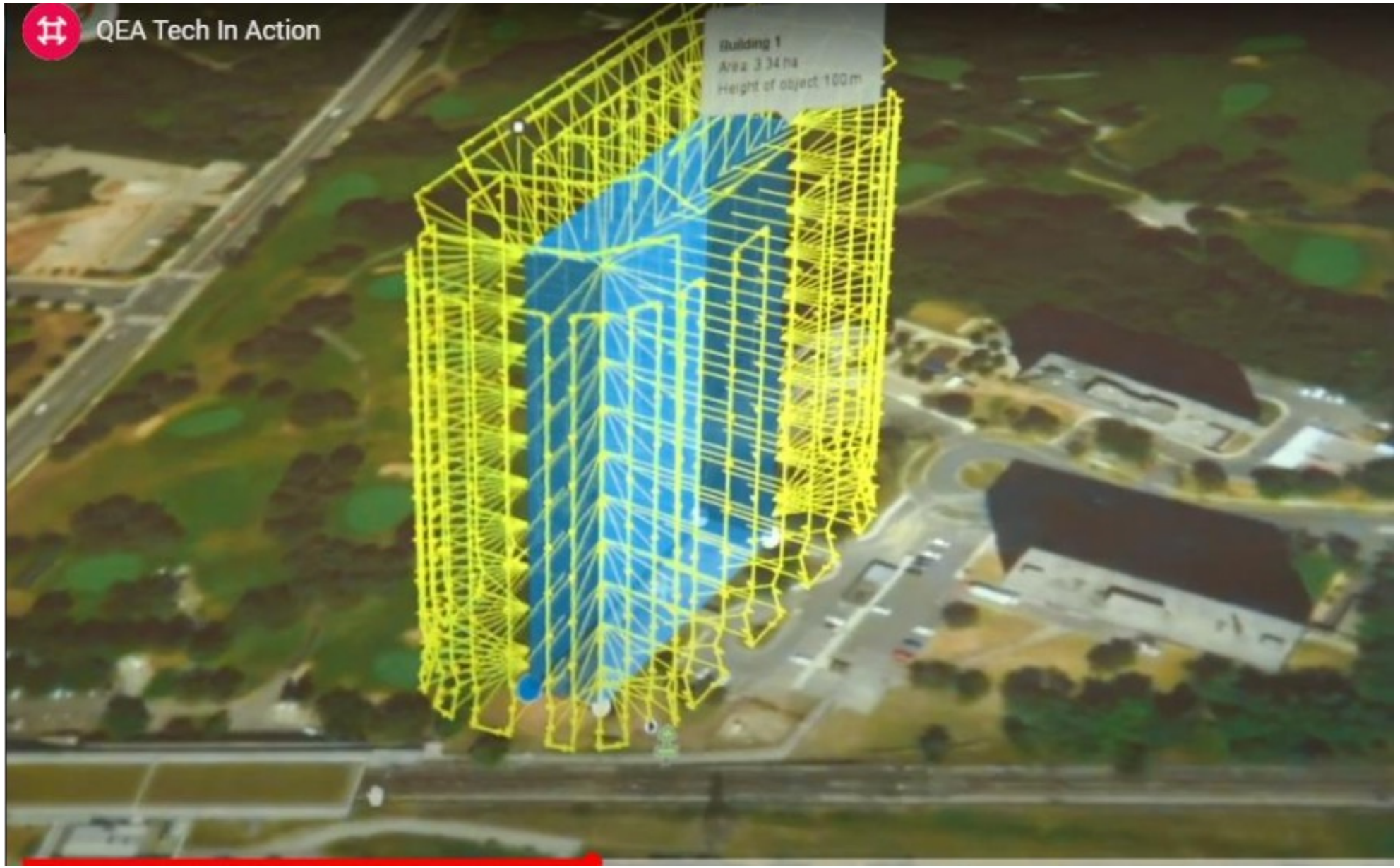
SECONDARY WINDOWS: HIGH-PERFORMANCE WINDOWS AT A FRACTION OF THE COST

With little to no occupant disruption, secondary windows can be installed during or after normal operating hours in as little as 20 minutes per window. If installation takes place inside, secondary windows eliminate the need for intrusive scaffolding or large equipment during installation. If on the exterior the window cleaning scaffolding can be used to install the exterior panels. Fully customizable, secondary window products make it easy to match the existing window aesthetic and retain the building's current or desired look.

Drone Thermography for Comprehensive Building Envelope Conditions



Drone Thermography for Comprehensive Building Envelope Conditions



Inovues new Glass Options for both exterior or Interior applications

Inovues new Glass Options Specifications

Inovues new Glass Options Specifications

Technical Data*	Before	After
System	Curtainwall	Curtainwall + Inovues Glazing Shield™ GS100LF
Glass	1/4" Clear	5/16" Laminate w/Low-E + 5/8" Air Space + 1/4" Clear
U-Value (Total)	1.07	.38
R-Value (CoG)	.98	3.33
SHGC	.75	.35
CRF	26	58
VLT	80	64
STC	31	38

* Varies between the different glass performance options. U-Value (Winter): Total Rate of heat transfer; R-Value (Center of Glass): Resistance to heat flow; SHGC: Solar Heat Gain Coefficient; CRF: Condensation Resistance; VLT: Visible Light Transmittance; STC: Sound Transmission Class.

Acrylic Interior Panels by Magnetite Canada.

Magnetite storm window insulating panels are a unique interior mounted acrylic window panel that attaches and seals magnetically around the entire perimeter of a window.

Our technology is endorsed by **Natural Resources Canada** and **CMHC**.

Magnetite is a patented system that has been installed in residential and commercial properties for the last 35 years in Canada, the US and Australia.

CSA (Canadian Standards Association) tested as the only window product to allow 0 air infiltration.

SUSTAINABLE ENVIRONMENTAL solutions

Magnetite CANADA

The Technology

The technology provides all the benefits of double and triple glazing without replacing the existing window. This allows us to provide a cost-effective solution for noise reduction, thermal comfort and energy efficiency in the home or office.

Frame or Channel

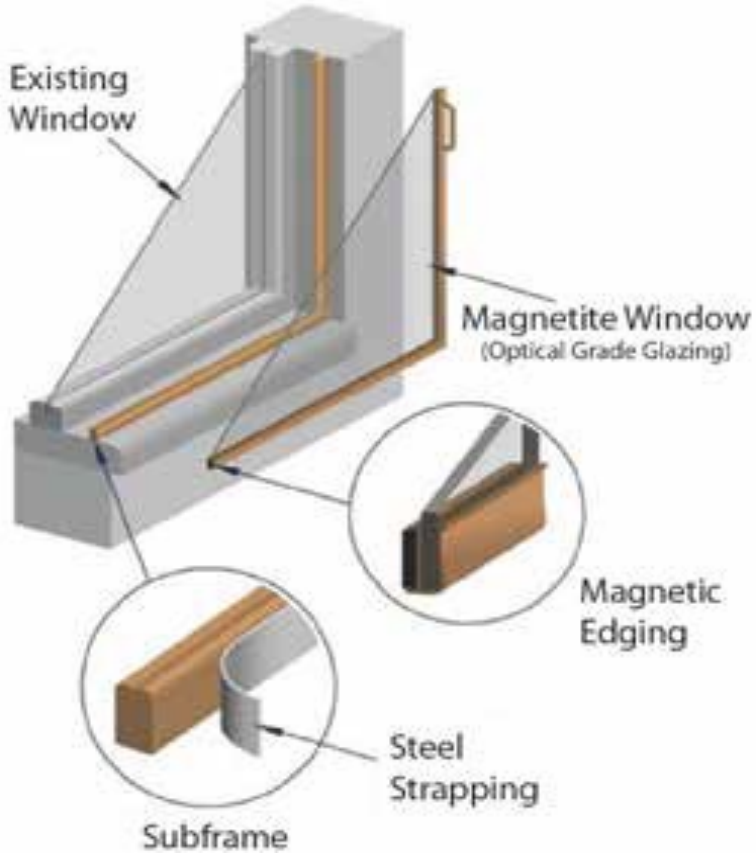
Framed with 1 1/2” PVC closed cell foam Galvanized steel banding

Magnetic Extrusion

Flexible and durable vinyl that will create a seamless finish

100% Virgin Acrylic

Optical grade, will not yellow or craze.



See sample at Booth 826

SUSTAINABLE ENVIRONMENTAL solutions

Magnetite CANADA

Magnetite Air leakage Reduction Test Results

Test	Requirements	Test Results	Rating
Air Leakage Resistance (Clause: 5.3.2) **Test Date:** June 20, 2014	**Maximum Allowable Air Leakage:** 1.5 L/s m^2 @ 75 Pa Canadian Air Infiltration / Exfiltration Levels (R-Class): A2 Level: < 1.5 L/s m^2 A3 Level: < 0.5 L/s m^2 Fixed Level: < 0.2 L/s m^2	**Specimen Configuration: With Acrylic Pane Off** Infiltration Q = 0.19 L/s m^2 Exfiltration Q = 0.42 L/s m^2 Average Q = 0.30 L/s m^2 @ 75 Pa Unit Area = 1.84 m^2	**Meets Gateway:** HS-R **Canadian Level:** A3
Air Leakage Resistance (Clause: 5.3.2) **Test Date:** June 20, 2014	**Maximum Allowable Air Leakage:** 1.5 L/s m^2 @ 75 Pa Canadian Air Infiltration / Exfiltration Levels (R-Class): A2 Level: < 1.5 L/s m^2 A3 Level: < 0.5 L/s m^2 Fixed Level: < 0.2 L/s m^2	**Specimen Configuration: With Acrylic Panel On** Infiltration Q = 0.01 L/s m^2 Exfiltration Q = 0.00 L/s m^2 Average Q = 0.01 L/s m^2 @ 75 Pa Unit Area = 1.84 m^2	**Meets Gateway:** HS-R **Canadian Level:** A3

Magnetite Video on Air leakage Reduction

EASYTO R-E Window Film
can help reduce*

95%

of the solar heat energy gain
through the glass windows.

blocks 98% IR*, 99% UV
without loss of visible light

SUSTAINABLE ENVIRONMENTAL
solutions

Best and smart ways to bring view & sunlight into your home & office

COMFORT & ENERGY SAVING

EASYTO R-E Window Films reduce up to 95% of the total sun's heat through windows by reflecting it away from your home. This means a cooler, more comfortable environment for you and your family, all while helping you to save money with lower air conditioning bills.

PROTECTION FROM UV DAMAGE AND FADING

Even indoors, your family and belongings are subjected to the damaging effects of ultraviolet (UV) rays. EASYTO R-E Window Films are designed to reduce the effects of solar heat and visible light on your furnishings while blocking up to 99% of the sun's harmful rays, the single most significant cause of fading.

REDUCE GLARE

These films significantly reduce glare to help you work, relax and entertain without added eye strain and discomfort from excessive light. Year-round insulation and savings.

TRULY BLOCK INFRARED (IR)

EASYTO R-E Window Films are the only R-E film that can block up to 98% of Infrared (IR) range measure start from 750nm* by our innovative discovery of LSPR effect. It is truly designed to retain indoor heat during the winter and keep interior cooler during the summer, saving on heating and cooling energy costs low all year-round. These films also help increase insulation performance, like upgrading a single-pane to a triple-pane window and a double-pane to a multiple-pane window. Therefore, increasing the glass insulation value is very important. Fully controllable thermal comfort and energy-saving, lower carbon footprint are the future for all of us to live better.

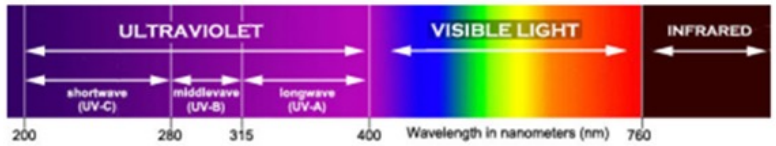
EASYTO R-E film is a different approach than Low E coating and it solved the fundamental problem. R-E film's unique Localized Surface Plasma Resonance (LSPR) effect absorbs solar radiants, converts them into physical heat and carries them away by air. It blocks harmful UV & IR radiant waves but allows visible light to pass through. It makes glass insulated with a higher R-value which can reduce heat loss from the indoors and reduce solar heat gain via glass windows. EASYTO R-E window film provides excellent insulation, comfort, and huge energy savings of 45-60%. The energy cost saving will payback the retrofit itself in a short period. Contact out project consultant for details.

EASYTO LIVE BETTER

PRODUCT SPECIFICATION

Product	Thickness (mil)	Transmittance VTL	Total Solar Energy ReductionTSER	Shading Coefficient	UV Block	IR Block (700-1000nm)
Clear	2	70%	95%	0.30	99%	98%
Tint	2	50%	95%	0.30	99%	98%
Transition	2	65-15%	95%	0.30	99%	98%

*All performance data gathered using a LAMBDA 1050+ UV/Vis/NIR Spectrophotometer with films applied to 3mm (1/8") glass plates. All values represented are with film applied on 3mm (1/8") glass. Visible light and solar energy data are reported using EN 410 methodology & IR reduction data are reported at full IR wavelength range start from 750nm. Product performance tolerances for visible light, solar energy, UV reduction and IR reduction values are +/- 3%.



**RECOMMENDED SHELF LIFE - 5 years from the date of purchase. Product thickness values are nominal and for guidance only. Further information can be found at www.easyto.ca. For any additional information contact info@easyto.ca.

SUSTAINABLE ENVIRONMENTAL solutions

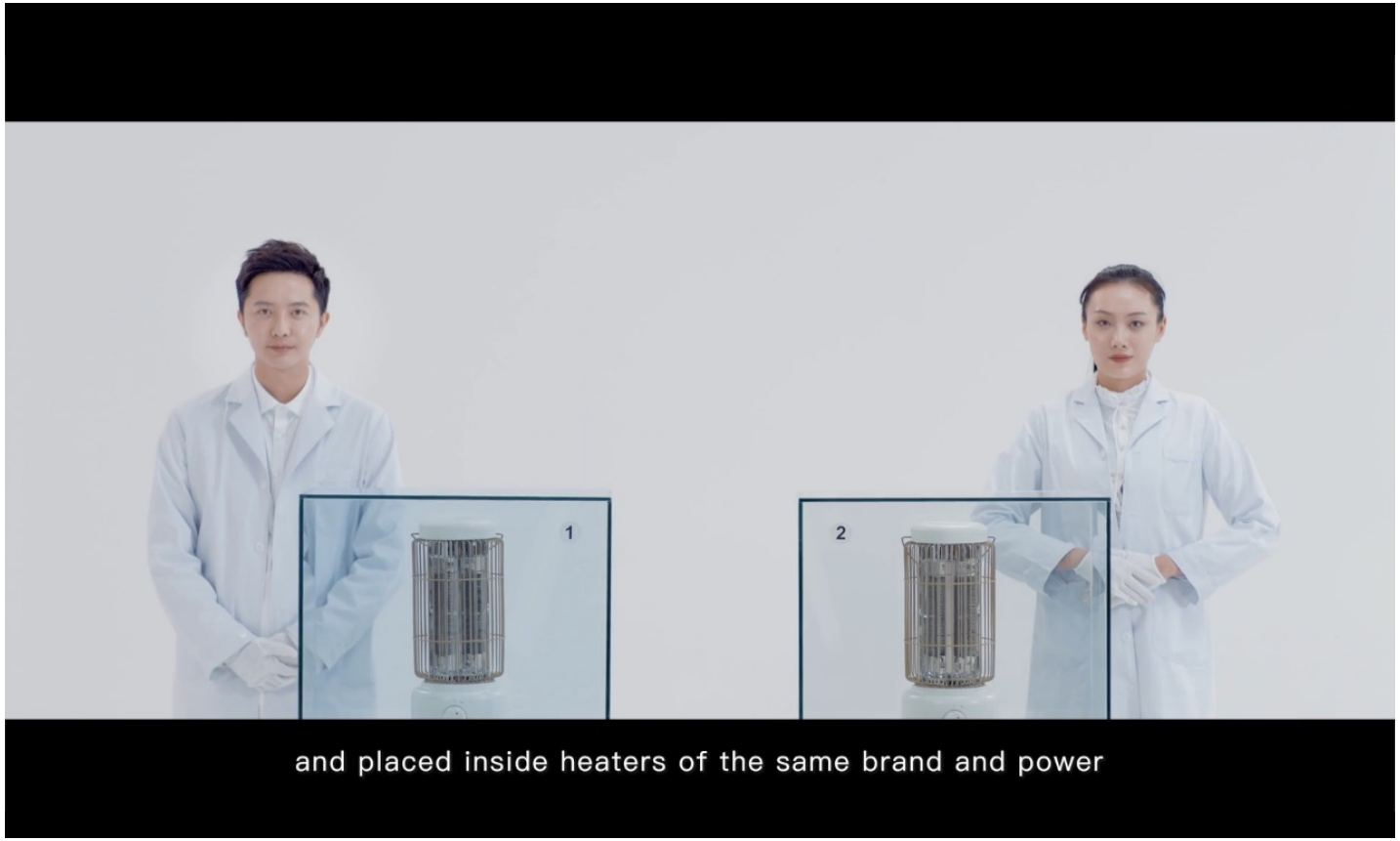
R-E film's unique Localized Surface Plasma Resonance (LSPR) effect absorbs solar radiants, converts them into physical heat and carries them away by air. It blocks harmful UV & IR radiant waves but allows visible light to pass through. It makes glass insulated with a higher R-value which can reduce heat loss from the indoors and reduce solar heat gain via glass windows.

EASYTO R-E window film provides excellent insulation, comfort, and huge energy savings of 45-60%. The energy cost saving will payback the retrofit itself in a short period.

Both the IESO and Enbridge will be offering custom incentives as the IESO wants to lower peak demand from HVAC and Enbridge want to retain customers with electric options for the HVAC loads that use natural gas.

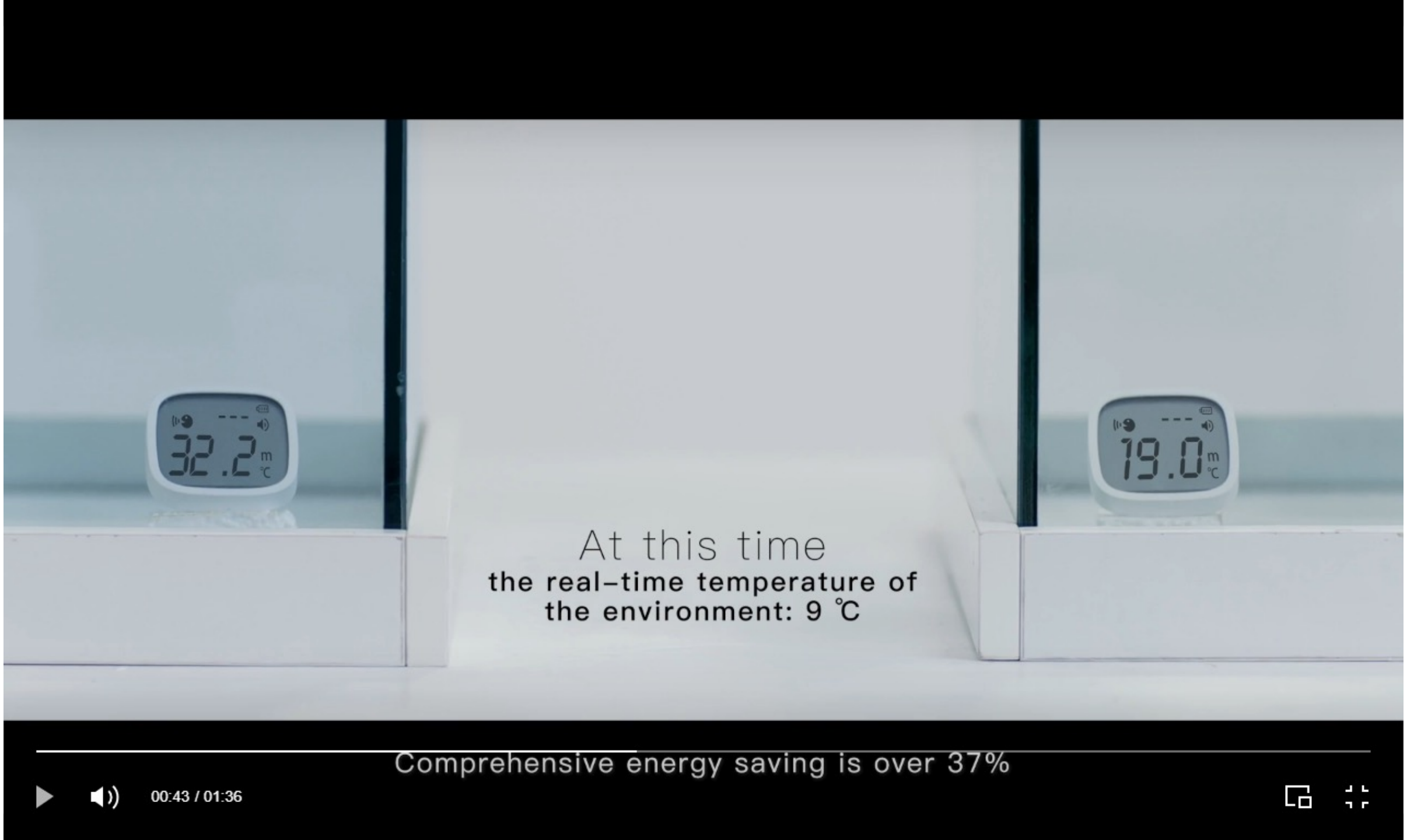
SUSTAINABLE ENVIRONMENTAL solutions

Test of Easy coating with same heaters but Box #1 is coated.



SUSTAINABLE ENVIRONMENTAL solutions


1
2
TURN OFF AT 40 C
40.0
40.0
we turn off the heaters at the same time
00:30 / 01:36


32.2
19.0
At this time
the real-time temperature of
the environment: 9 ℃
Comprehensive energy saving is over 37%
00:43 / 01:36

Combining the installation of secondary windows with other upgrades is a smart approach to maximizing energy savings and reducing project costs.

It is best to sequence upgrades such that the quality and condition of the building's envelope is the first consideration. This allows improved window performance (and related air leakage control) to reduce a building's HVAC load, which may present an opportunity to downsize the building's heating and cooling equipment upgrade or replacement.

In addition to the windows there are the walls and the roof that can also be improved. These will be presented by Jiri Skopek. After Dr Philip Ju can discuss how we do the new energy model as we switch to electric HVAC options.

Insulation

Jiri Skopek, Architect

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Building Envelope Improvements for Decarbonization Objectives

How much Insulation?

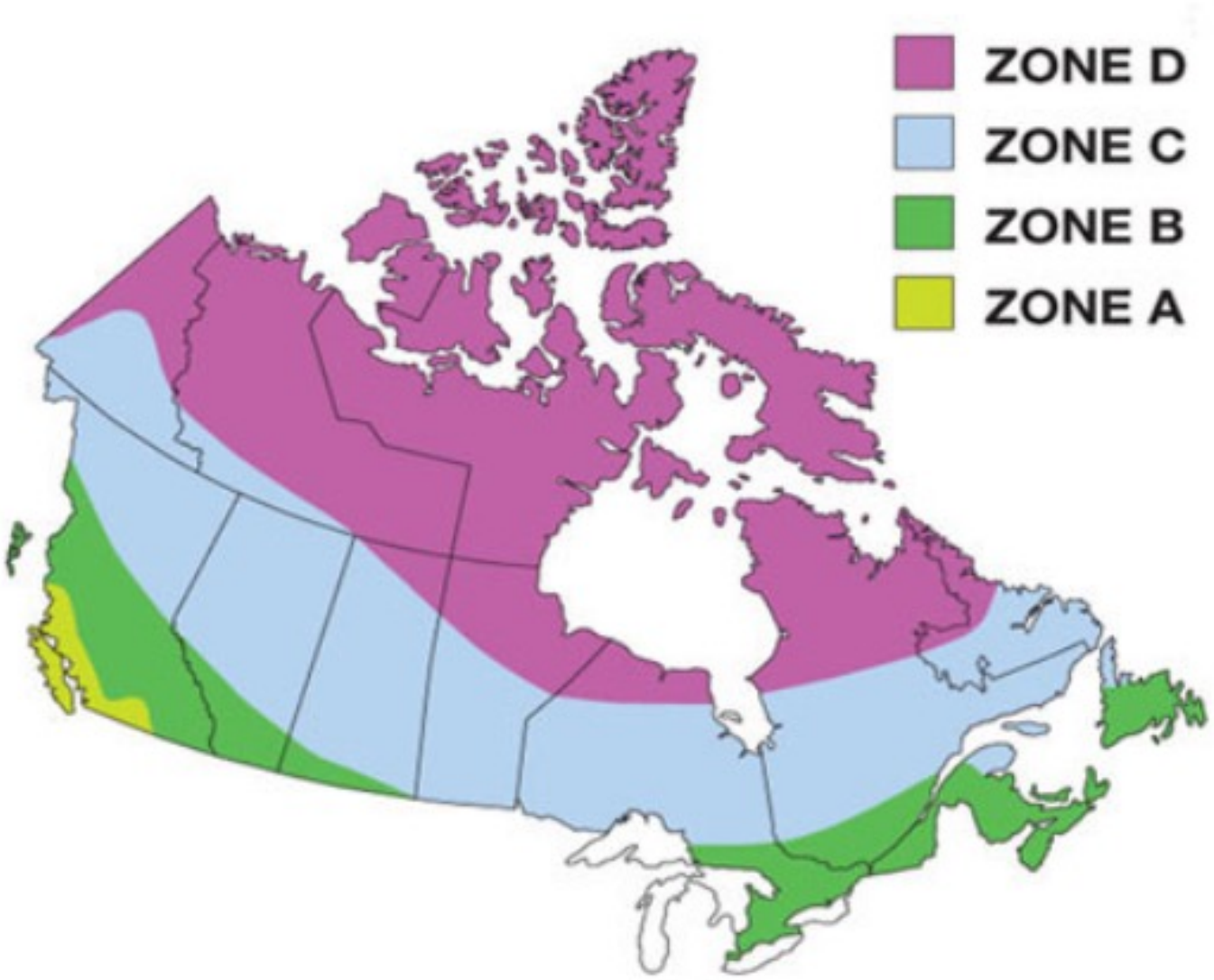


Table 3.1.1.3.A (IP)
ZONE 2 - Compliance Packages for Space Heating Equipment with AFUE ≥ 92%
Forming Part of Sentence 3.1.1.3.(1)

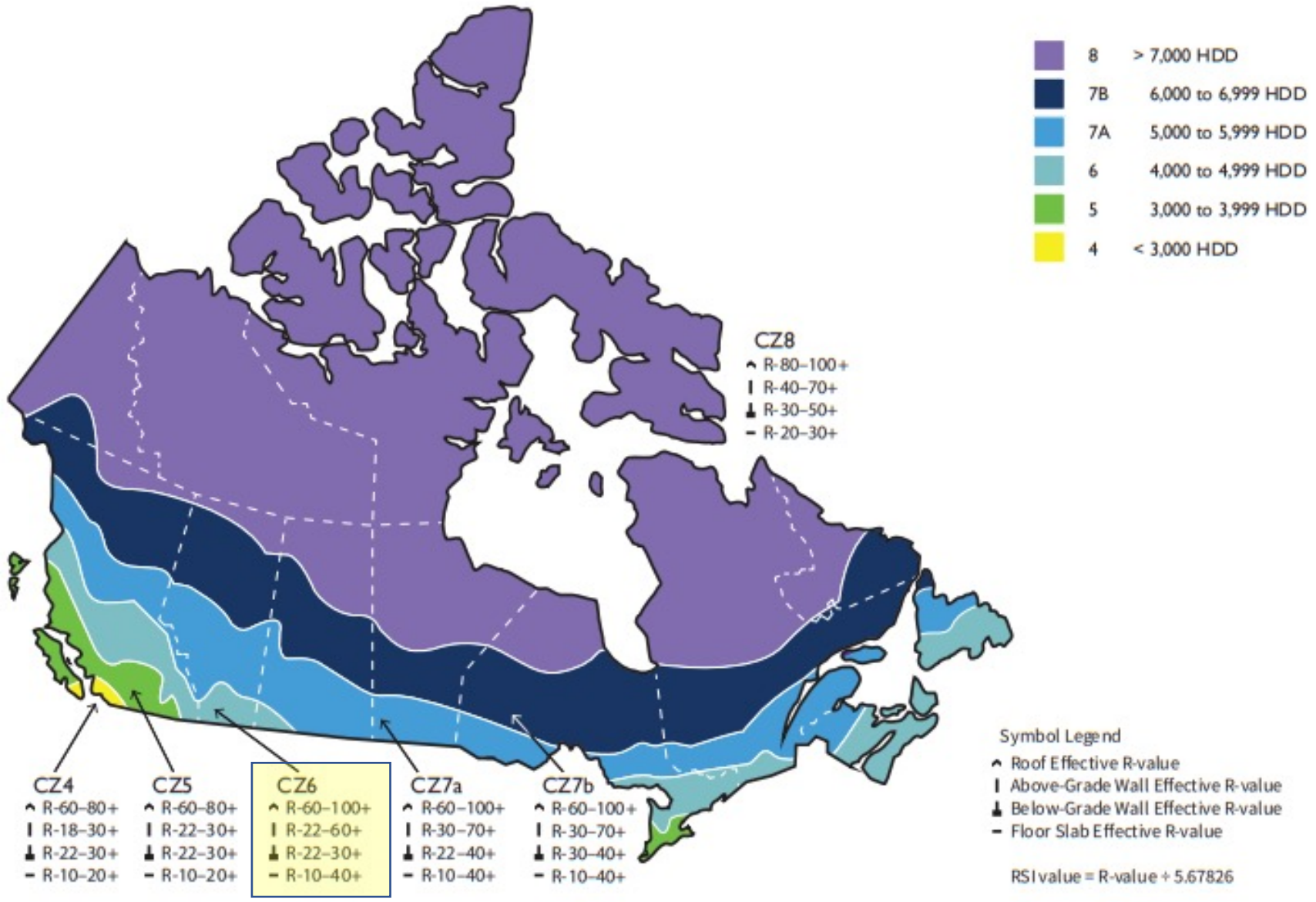
Component	Thermal Values	Compliance Package					
		A1	A2	A3	A4	A5	A6
Ceiling with Attic Space	Min. Nominal R[1]	60	50	60 + HH	60	60	50
Ceiling without Attic Space	Min. Nominal R[1]	31	31	31	31	31	31
Exposed Floor	Min. Nominal R[1]	31	35	31	31	31	35
Walls Above Grade	Min. Nominal R[1]	19 + 5 ci	19 + 10 ci	22 + 5 ci	22 + 7.5 ci	19 + 10 ci	22 + 7.5 ci
Basement Walls	Min. Nominal R[1]	20 ci	20 ci	20 ci	20 ci	20 ci	20 ci
Below Grade Slab Entire Surface > 600 mm (24") Below Grade	Min. Nominal R[1]	—	—	5	—	10	7.5
Heated Slab or Slab ≤ 600 mm (24") Below Grade	Min. Nominal R[1]	10	10	10	10	10	10
Edge of Below Grade Slab ≤ 600 mm (24") Below Grade	Min. Nominal R[1]	10	10	10	10	10	10
Windows and Sliding Glass Doors	Max. U[5]	0.21	0.28	0.28	0.21	0.25	0.25
Skylights	Max. U[5]	0.49	0.49	0.49	0.49	0.49	0.49
Space Heating Equipment	Min. AFUE	96%	96%	98%	96%	94%	92%
HRV	Min. SRE	81%	70%	65%	65%	65%	75%
Domestic Water Heater	Min. EF	0.70	0.80	0.80	0.67	0.67	0.70
Column 1	2	3	4	5	6	7	8

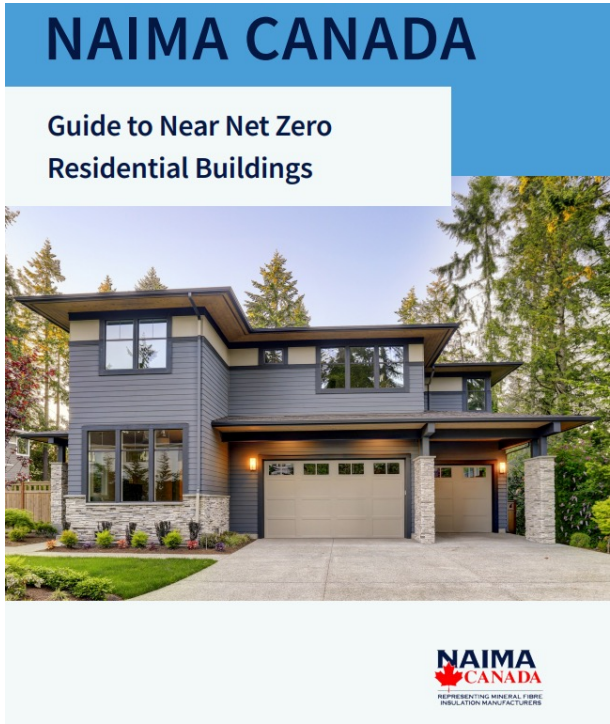
Table Source: OBC

ZONE	A	B	C	D
Walls	R-30 to R-35	R-33 to R-40	R-35 to R-45	R-45
Basement walls	R-30 to R-35	R-33 to R-40	R-35 to R-45	R-45
Roof or Ceiling	R-45 to R-50	R-55 to R-60	R-55 to R-60	R-60
Floor (over unheated spaces)	R-35 to R-40	R-40 to R-45	R-50 to R-55	R-55

How much Insulation?

Recommended Effective R-values to Reach Near Net Zero - BC and Across Canada





Insulation Opportunity- ICF Report

Residential Buildings

Considerable savings potential for existing homes.

Energy savings can range from 10 to 45 percent in existing homes that are air sealed and have insulation added in the ceiling and floors

Commercial Buildings

Significant energy savings for commercial buildings.

Energy savings from 5 percent nationally in schools, office buildings, apartments and stand-alone retail buildings that have roof insulation and HVAC pipe insulation upgrades

Industrial Facilities

Exceptionally short payback periods.

Pipe and mechanical insulation improvements would save more than $126 billion in energy costs for industrial facilities with one-year payback.

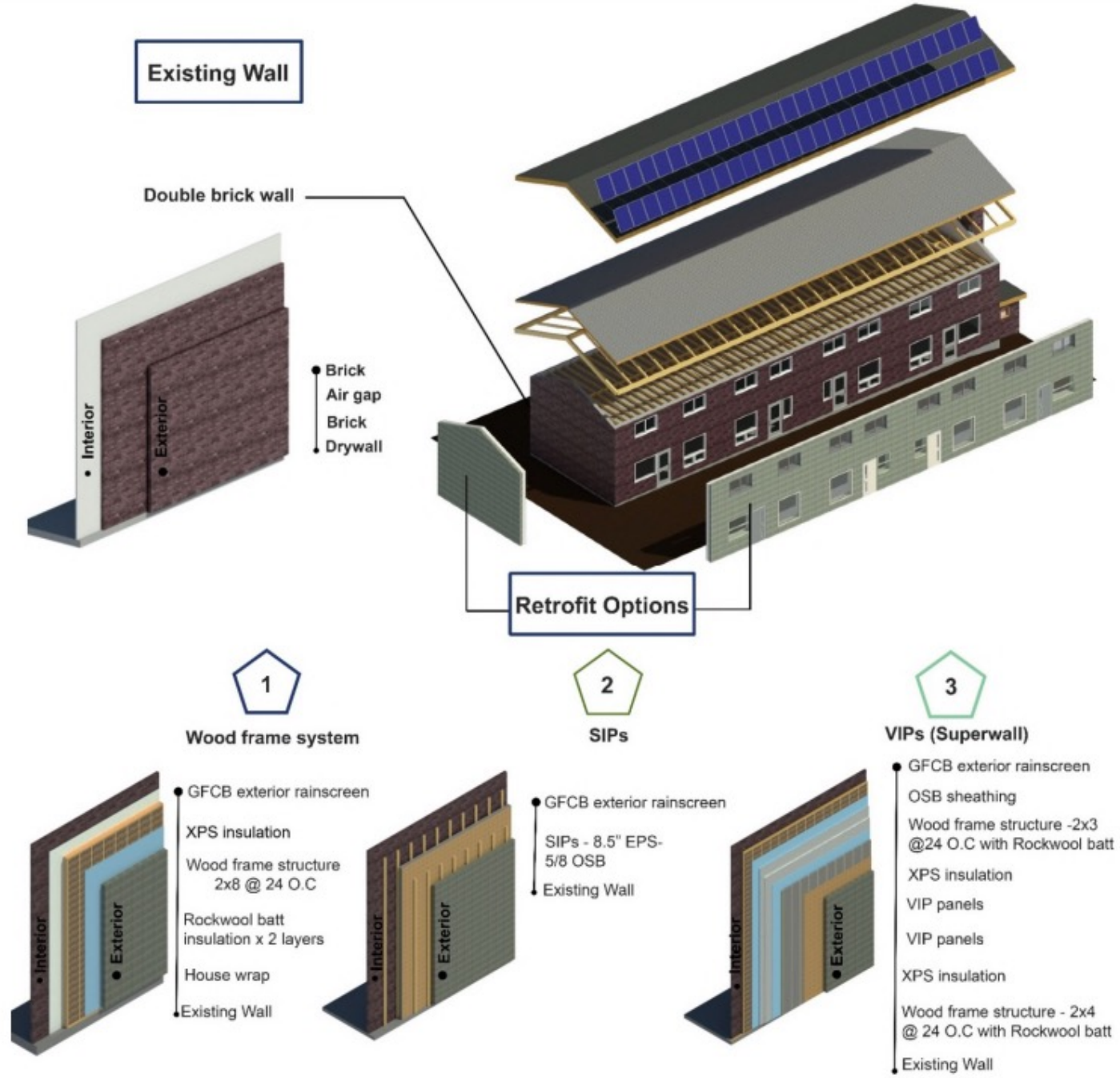
Do it the old way

External Retrofit

- A Dutch system of factory built, panelized, deep energy retrofits
- 5000 units completed
- 10,000 units underway
- 110,000 units planned

EnergieSprong

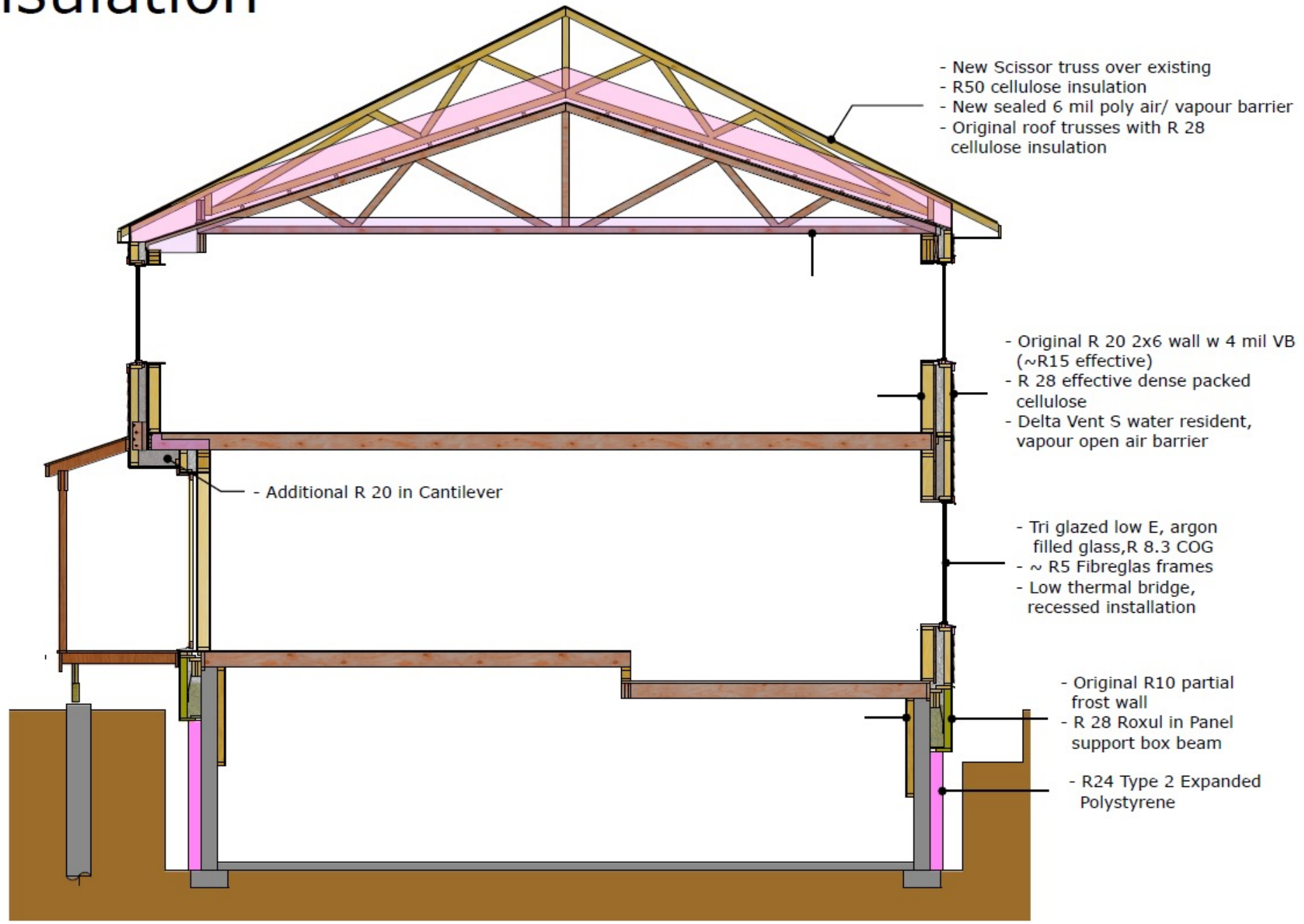
External Retrofit Energiesprong



External Retrofit

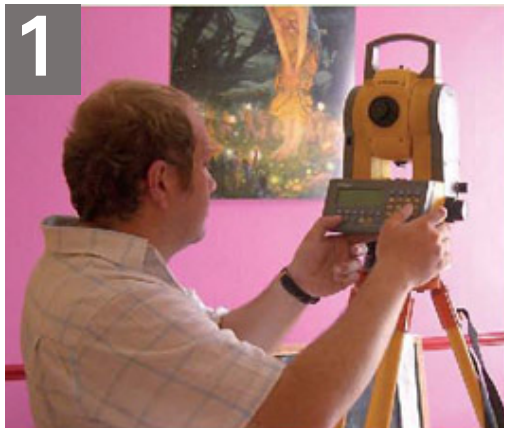
Energiesprong

Insulation



Interior Retrofit – WHISCERS Whole House In-Situ Carbon and Energy Reduction Solution

Whiscers™



United House – UK: System for the application of internal insulation with minimum effort, low mess and minimal impact on the user, fast and economical. **Three-part process**.

- building geometry data of the affected walls is metered by a **laser measuring** device.
- geometry data is then transmitted to a computer-based CAD/CAM system and further to **CNC**-aided manufacturing machine to cut fitting items from large composite panels.
- These are installed locally on the object and ensure a **clean and fast assembly** without affecting the residents

Original System: Internal insulation composite panel- diffusion-proof rigid foam board, which is glued onto a 12.5 mm plasterboard

Interior Retrofit - WHISCERS

Interior Retrofit - WHISCERS

Fixing and Joint Levelling

DEVELOPMENT OF INTERNAL INSULATION COMPOSITE PANEL

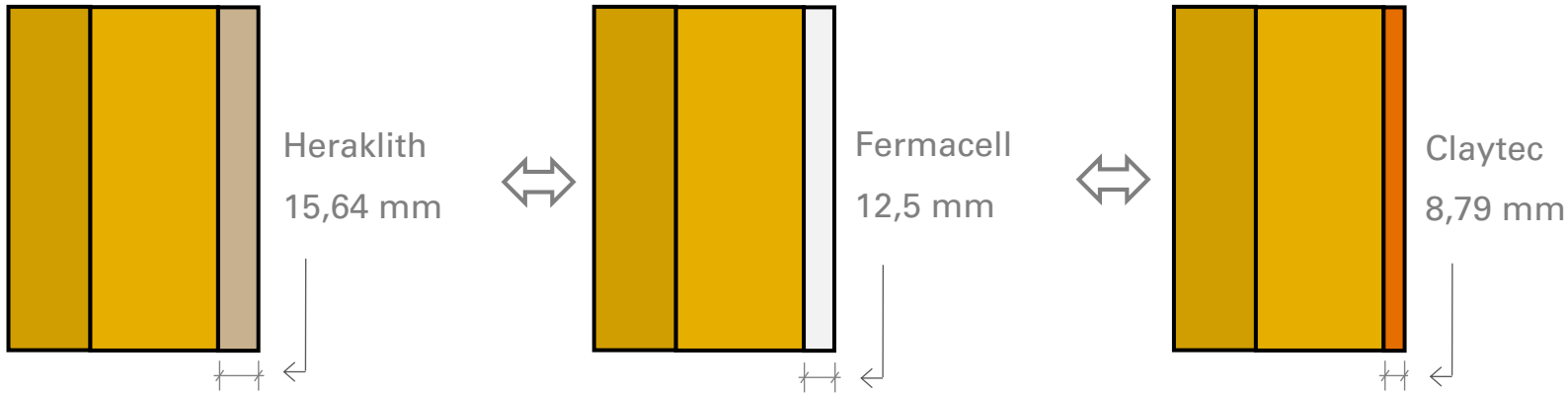
Specific Heat Capacity (ÖN EN ISO 13786): Inner Shell

Material for room side completion	Thermal conductivity λ [W/(m·K)]	Heat capacity c [J/(kg·K)]	Density ρ [kg/m³]	Specific heat capacity W (1mm) [J/(m²·K)]	Thermal effusivity b [W $\sqrt{s}/(m^2 \cdot K)$]	Conductibilityoftemperature a [m²/s]
Woodwool Board (Heraklith M)	0.08	1,470	688	1,011	284	7.91E-08
GypsumFibre Board (Fermacell GL)®	0.32	1,100	1,150	1,265	636	2.53E-07
Clay plaster (Claytec)	0.91	1,000	1,800	1,800	1,280	5.06E-07

Heraklith M (8 mm): χ_1 = 8,091 (detailed method: 8,053) J/(m²K)

Fermacell Greenline (12.5 mm): χ_1 = 15,813 (detailed method: 15,602) J/(m²K)

Clay plaster Claytec (3 mm): χ_1 = 5,400J/(m²K) (detailed method: 5,393) J/(m²K)

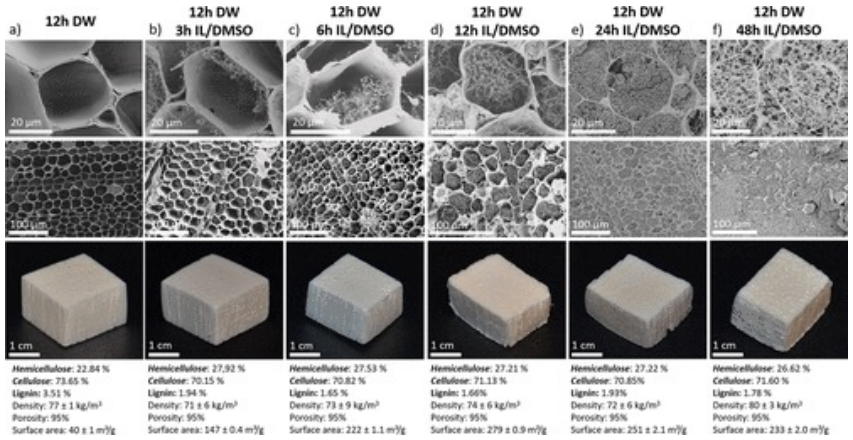


Future of Insulation

Many common insulating materials *reduce* operational carbon, but *increase* other environmental hazards

- Extruded polystyrene-global warming potential of 1,430 tons of CO_2
- Spray foam insulation might have a GWP of 700 to 1,000

Biobased aerogel



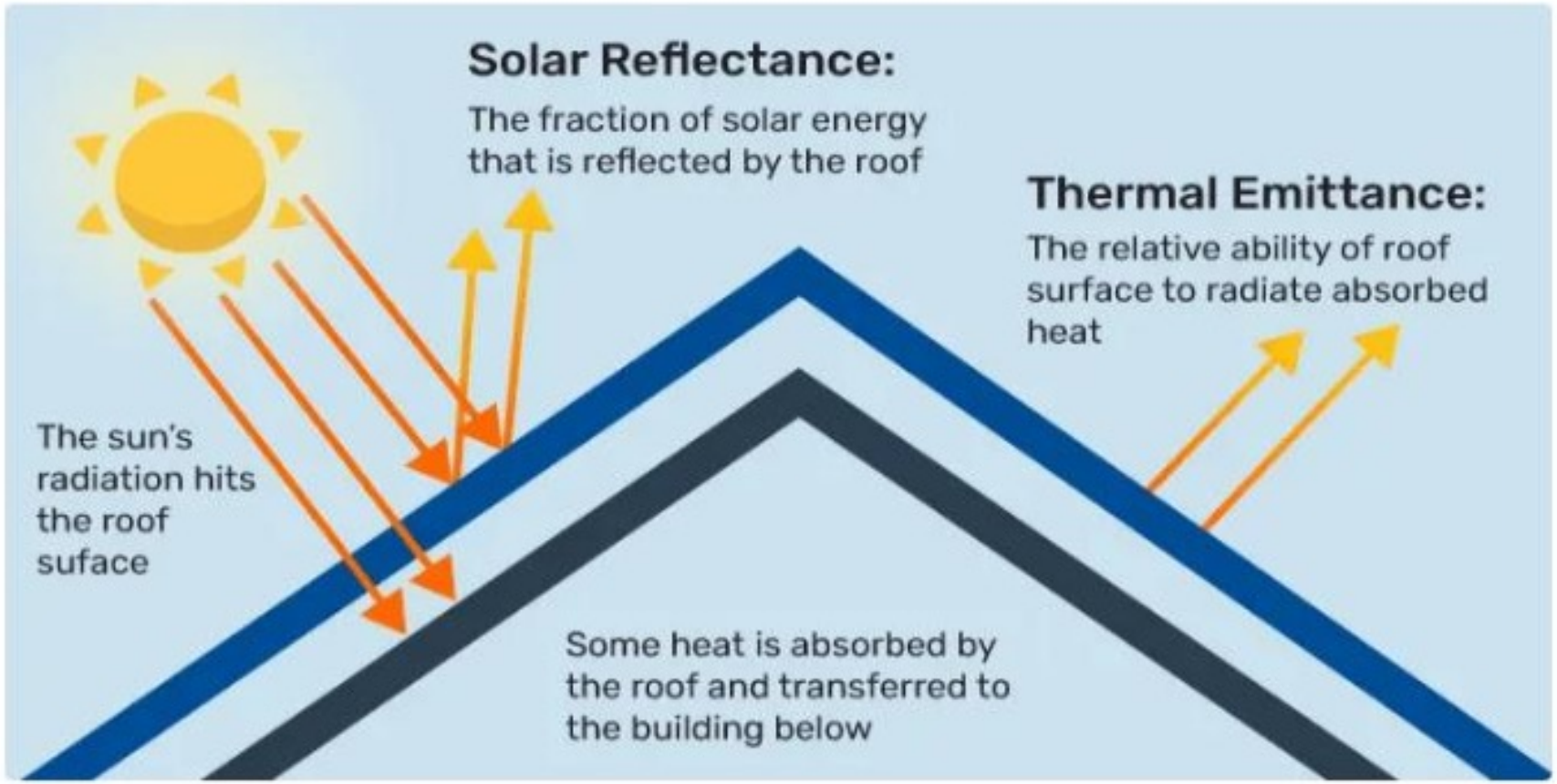
Hollow silica nanospheres as thermal insulation

Granulated popcorn

Fly ash

- Cut Your Home Energy Bills by Opting for an Energy-Efficient Roof

What Is Energy-Efficient Roofing?



Any roofing system that reduces the energy consumption of the structure beneath can count as a form of energy-efficient roof.

The 7 Best Energy-Efficient Roofing Options

Insulation

Image source: Roof Doctor

Without even touching your roof, you can cut up to 10 percent of your energy costs with home insulation.

Cool Roof Coatings

Image source: Roofing Contractor

If you live in a hot climate and your existing roof still has plenty of life to give, a cool roof coating saves you the trouble of an outright replacement while reducing up to 30 percent of cooling costs.

These white, reflective coatings maximize the roof's ability to reflect and emit heat.

Asphalt Shingle Roofing

Image source: Owens Corning

When infused with reflective granules, asphalt shingles can boast respectable SRI ratings and even qualify for energy efficiency standards, all at an unbeatable price.

Cool roof shingles cost around $9 to $15 per square foot, making them the most affordable energy-efficient roofing material in most cases.

Metal Roofing

Image source: Metal Roofing Alliance

Metal roofing comes in many shapes (panels, tiles, shakes), substrates (steel, aluminum, copper), and colors to suit both residential and commercial buildings, but one aspect is almost certain – energy savings.

Lighter colors and vented metal roofing installation can net energy savings of up to 25 percent.

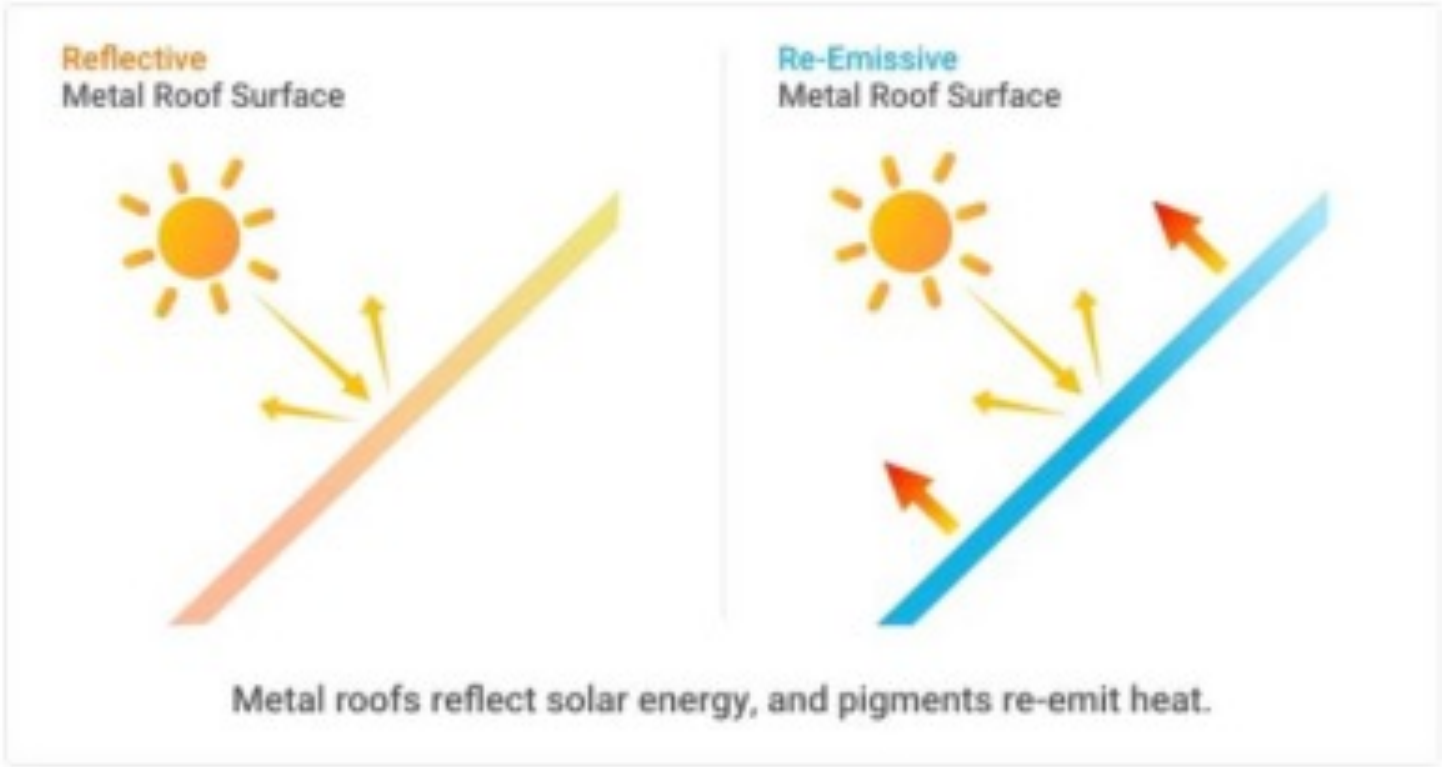
Beyond its energy-saving capabilities, metal has earned a reputation as one of the most sustainable roofing materials thanks to industry recycling efforts. Many manufacturers even include recycled material in their new metal roofing products.

Of course, a metal roof will cost more than an asphalt roof at around $4 to $30 per square foot.

However, the energy savings and enduring lifespan, 80 years in ideal cases, will recoup your costs and then some.

Image source: Metal Roofing Alliance

Metal roofing comes in many shapes (panels, tiles, shakes), substrates (steel, aluminum, copper), and colors to suit both residential and commercial buildings, but one aspect is almost certain – energy savings.



Metal roofs reflect solar energy, and pigments re-emit heat.

Lighter colors and vented metal roofing installation can net energy savings of up to 25 percent.

Tile Roofing

Image source: Dynasty Building Solutions

Tile roofing fosters energy efficiency mainly by the nature of its installation, which researchers found can lower annual air conditioning costs by as much as 20 percent in the intense Southern California heat.

SOLAR ROOFING

The only thing better than a roof that lowers energy costs generates energy itself!

Like conventional solar panels, solar tiles come equipped with photovoltaic cells that convert sunlight into electricity.

Unlike arguably unsightly solar panels, they embody the elegant profile of traditional tile or shingle roofs. Solar tiles endow you with the savings of renewable energy without compromising on style.

Perhaps unsurprisingly, solar tiles are not cheap relative to non-solar roofing materials. Tesla, the most popular solar tile provider, charges between $14.00 and $19.95 per square foot of solar tile without taking accessory equipment into account.

Despite the hefty upfront costs, solar tiles should pay for themselves within a decade through energy savings and solar incentives.

When it comes to sustainability, perhaps no other roofing material comes close to green roofing. Green roofs are essentially just soil and vegetation atop a flat roof.

This primitive combination dates back thousands of years as a roofing material. Nonetheless, modern-day sustainable urban developers gravitate towards green roofs because of how well they combat the urban heat island effect – the reason why cities clock hotter temperatures than outlying areas.

From an energy-efficiency standpoint, green roofs absorb solar radiation and provide insulation, which keeps the building more comfortable. One study found a reduction in air conditioning demand by more than 75 percent for a building with a green roof.

Beyond helping you save money, green roofs offer a long list of personal and communal benefits, including improved roof lifespan, stormwater retention, and natural beauty.

Green roof costs range between $10 to $35 per square foot. Potentially adding to lifetime costs, some green roof systems require frequent maintenance.

ENERGY MODELING FOR NEW LOADS FROM BUILDING ENVELOPE IMPROVEMENTS AND ELIMINATION OF FOSSIL FUEL EQUIPMENT FOR DECARBONIZATION.

Whether it is DOE2, EnQuest, EE4, RETScreen and other models, as shown in this presentation, deep retrofits of existing buildings for decarbonization is a complex project. The new focus is also on the embodied carbon in the materials used in the project and this also contributes to the incentive to reuse and improve the existing building envelope with the addition of new coverings to the existing structure rather than demolishing them and adding new materials that have a much greater embodied carbon.

ENERGY MODELING FOR NEW LOADS FROM BUILDING ENVELOPE IMPROVEMENTS AND ELIMINATION OF FOSSIL FUEL EQUIPMENT FOR DECARBONIZATION.

There are many HVAC load calculators that give you the loads for the building when the insulation levels are known and the weather for that zone is used. CaGBC and others have reports that show the deep retrofits are possible.

In addition to the calculators provided by the equipment manufacturers so that the project specifies their equipment , the new incentives for decarbonization requires that the GHG levels be significantly reduced. The Canada Infrastructure Bank provides lower interest rates on their loans when they are used on projects that provide deeper GHG reductions. These savings in the interest on the loans could provide the economic returns to increase the spending on the building envelope improvements that reduce the GHGs.

Zoom Webinar

Andy

Recording

Type here to search

-10°C Mostly sunny

ENG

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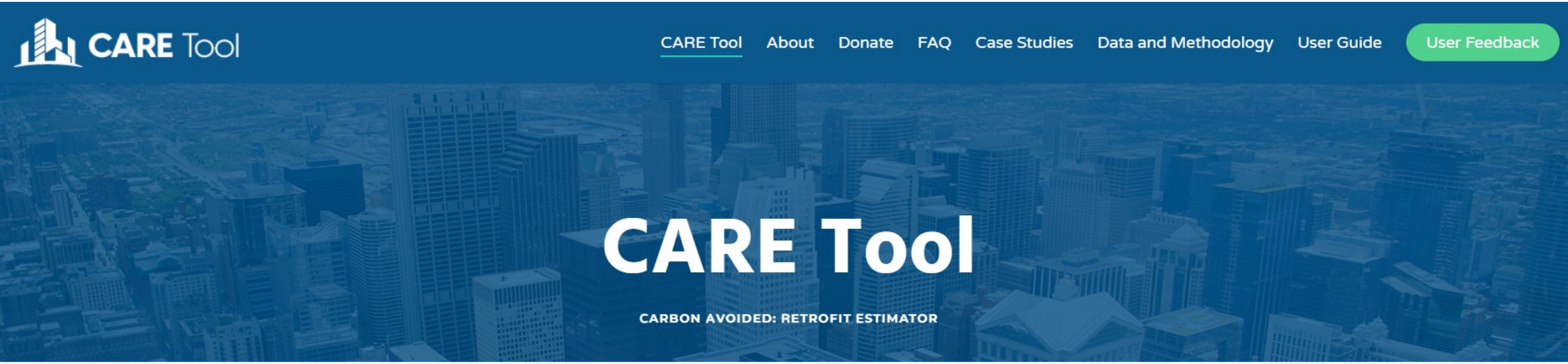
2023-02-24

Mind your Carbon



The CARE Tool allows users to compare the total carbon impacts of renovating an existing building vs. replacing it with a new one.

LEARN MORE

SUPPORT CARE TOOL

INSTRUCTIONS

Enter information in the first tab about the existing building. In the second tab enter information about renovating the existing building including any planned additions, and in the third tab enter information about the new building to replace the existing building. Click an information for more details.

Compare each option using the charts and table to the right. The results will automatically populate once enough information is entered and automatically update as inputs are adjusted.

Questions and Discussion

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Philip Ju, Ph.D. P.Eng. – philipju@gmail.com – 416-269-2464