Saving Windows, Saving Money. Evaluating the Energy Performance of Window Retrofit and Replacement

June 2022 Update

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Sustainable Environmental Solutions

Agenda

- Introduction to Fenestration and Windows
- What does CMHC and NRCan say about windows?
- Recent energy saving studies and recommendations
- Magnetite Acrylic Interior Window Technology
- Magnetite Energy and Sound Testing and Benefits
- RetScreen Expert Window module examples
- Net Zero - LEED & BOMA BESt, Investor Confidence
- Environmental Product Declaration
- Utility Incentives and GHG reduction funding programs
- Life cycle assessment comparison if time permits
- Questions !

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Types of Fenestrations

Fenestrations

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

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NRCan Fenestration Information

- **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:

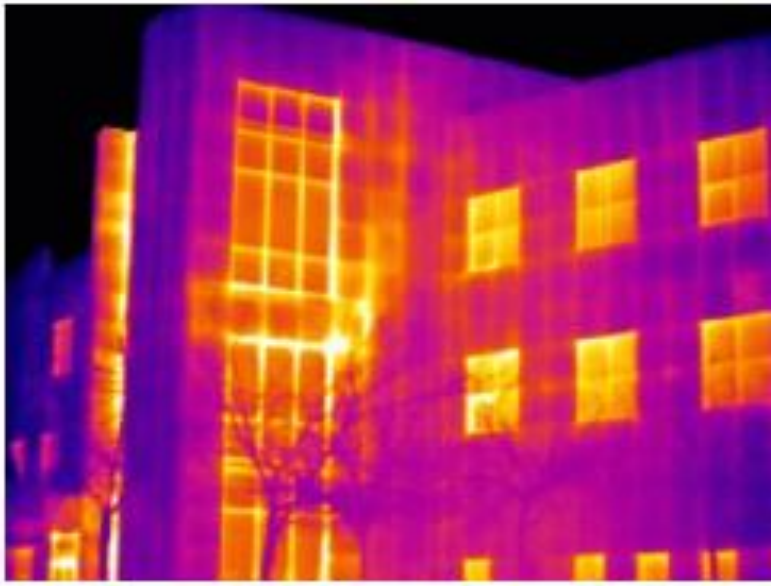
Every window assembly has places of separation whether fixed or operable. The places of connection in window assemblies and to the building envelope deteriorate over time. Constant air exchange occurs.

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



Toronto City Core Building

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.

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 Windows?

CANADA MORTGAGE AND HOUSING CORPORATION

Business / Government / Housing Organizations

Add Storm Windows to Single-Glazed Units

The Measure

Installing storm windows (or a second layer of glazing) to interior or exterior of existing window.

Application

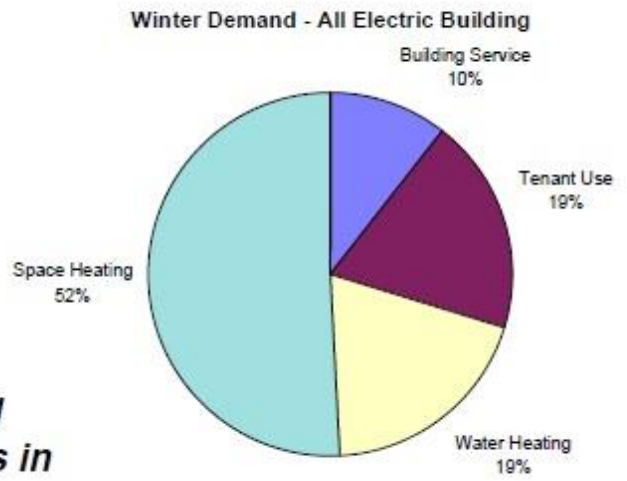
Buildings where complete window replacement cannot be justified.

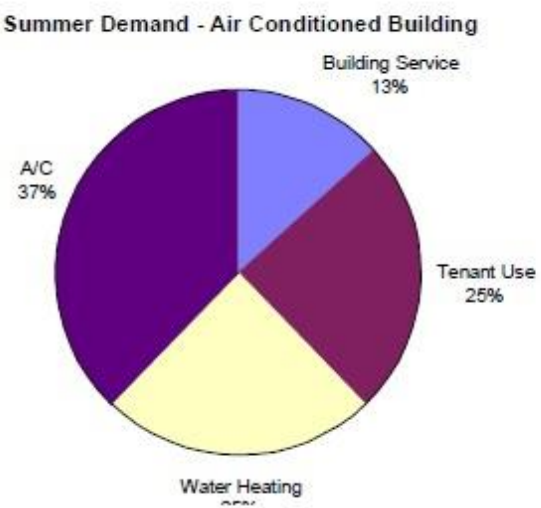
Benefits

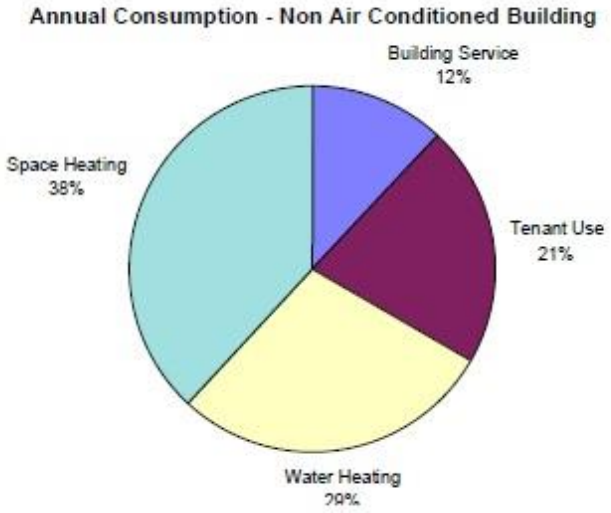
- Improved condensation resistance.
- Increased resident comfort.
- Reduced heating costs.
- Reduced moisture damage.
- Improved overall serviceability of windows.
- Increased resident satisfaction with windows.

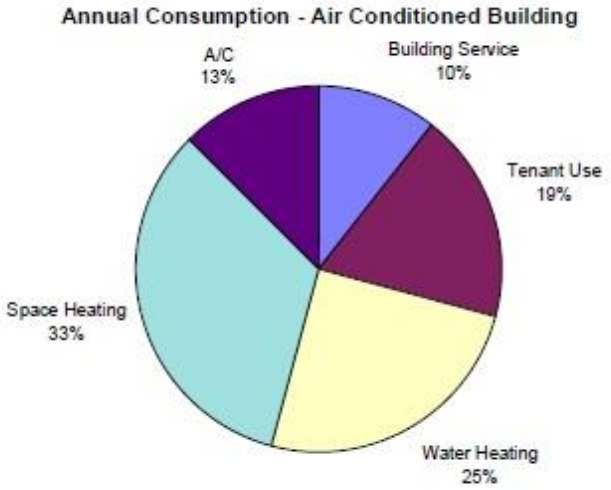
What does CMHC say about Energy in Multi Res?

Typical Energy Consumptions and Electrical Demands in Multi-Residential Buildings









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What does NRCan say about Windows?

Natural Resources Canada | Ressources naturelles Canada

Improving Window Energy Efficiency

Why Should I Worry About My Windows?

Windows can account for up to 25 percent of total house heat loss. This fact sheet describes affordable and effective options to improve the energy efficiency of the windows in your house.

"My heating bills are out of this world. What's the problem?"

— Heat loss through and around your windows is costing you more money than you might think.

"I can't sit beside some of the windows in my home because of their cold surfaces and drafts."

— Cold air entering your house through cracks and crevices around windows can make for an uncomfortable living environment.

"Condensation and frost on my windows are creating mould and rotting the frames."

— Excessive condensation can be a sign that a window needs some work.

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Energy Consumption Trends of Multi-Unit Residential Buildings in the City of Toronto – TAF - University of Toronto
by: Clarissa Binkley, Marianne Touchie, Kim Pressnail

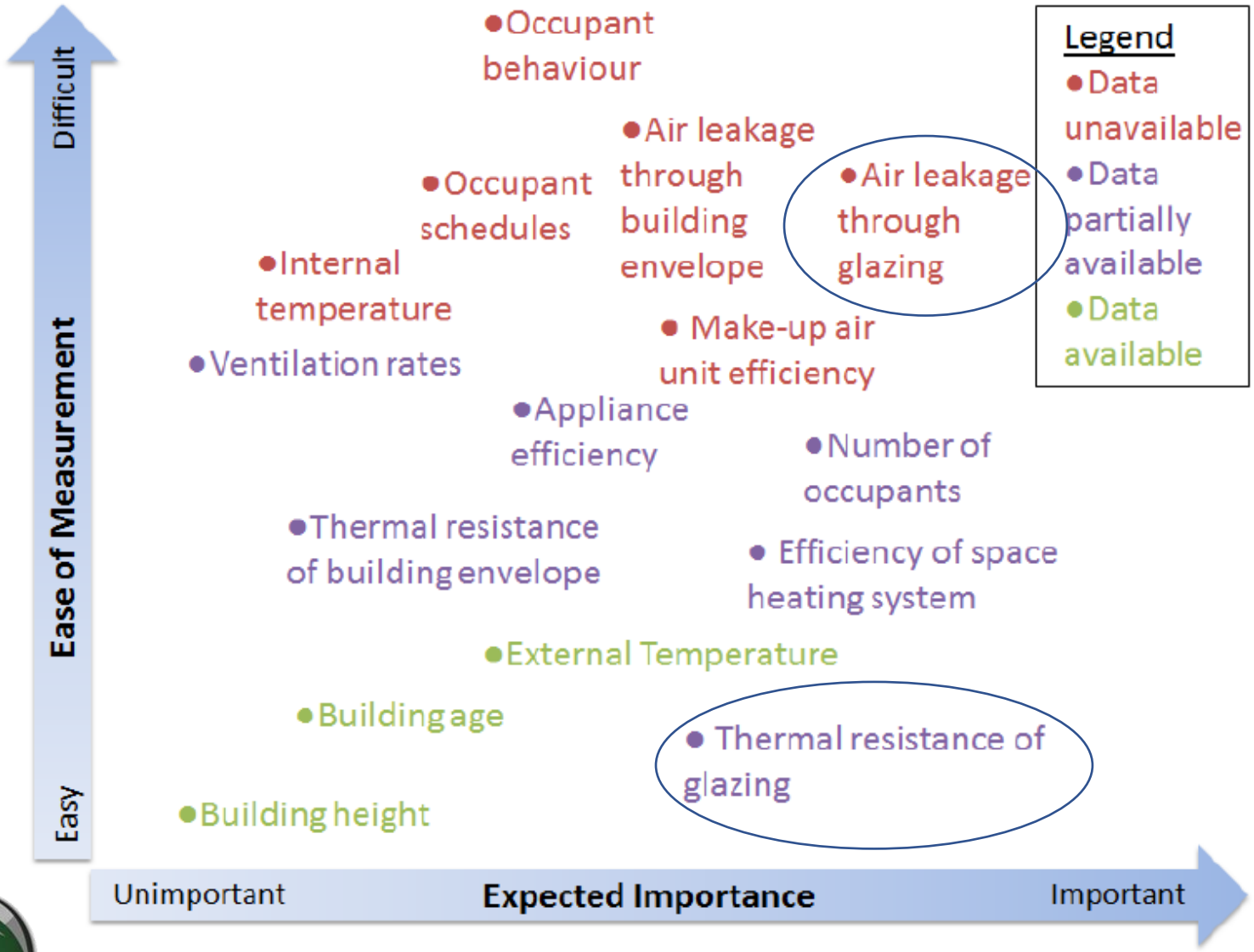
The findings of this report related to fenestration indicate that:

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



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Recent Study on the Window Solutions

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.*

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Options and Ratings used in NPHS Simulation Model

1 Baseline: Double hung single pane window – U value = 0.77 SHGC 0.74

Air leakage range at 50 psi = 646 tight to 1360 leaky

2 Weather-strip, Seal and Repair Existing Window –

A: Metal interlocking gasketed professionally installed weather-stripping – U value 0.77 SHGC 0.74

B: Owner installed rubber or felt gaskets“ U value 1.05 SHGC 0.74

Air leakage range at 50 psi = 156 tight to 812 leaky

3 Exterior Storm Window:

A: Low-E double pane operable exterior storm - U value 0.21 SHGC 0.27

B: Single-Clear Operable exterior Storm U value 0.55 SHGC 0.31

Air leakage range at 50 psi = 307 tight to 1027 leaky

4 Interior Storm Window:

A: Low-E single pane fixed interior storm - U value 0.36 SHGC 0.39

B: Single-Clear Operable Internal Storm - U value 0.48 SHGC 0.60

Air leakage range at 50 psi = 203 tight to 456 leaky

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Options and Ratings used in NPHS Simulation Model

1

5 Insulating Cellular Shades [1], night-time/daytime values

A: With Side Tracks + Existing Single Clear Glazing U value 0.26/0.77 SHGC 0.74

B: Without Side Tracks + Existing Single Clear Glazing - U value 0.58/1.05 SHGC 0.74

Air leakage range at 50 psi = 156 tight to 1360 leaky

6 Insulating Cellular Shades with Exterior Storm, night-time/daytime values.

A: With Side Tracks + Double Low-e Exterior Storm - U value 0.12/0.21 SHGC 0.27

B: Without Side Tracks + Single Clear Exterior Storm - U value 0.22/0.55 SHGC 0.31

Air leakage range at 50 psi = 156 tight to 1360 leaky

7 ***Interior Surface Film + Weather-Stripping - U value 0.55 SHGC 0.47***

Air leakage range at 50 psi = 156 tight to 812 leaky

8 New High Performance Window

A: Double Glazed Double Hung Fiber-glass Window - U value 0.24 SHGC 0.39

B: Double Glazed Double Hung Fiber-glass Window - U value 0.35 SHGC 0.24

Air leakage range at 50 psi = 38 tight to 44 leaky

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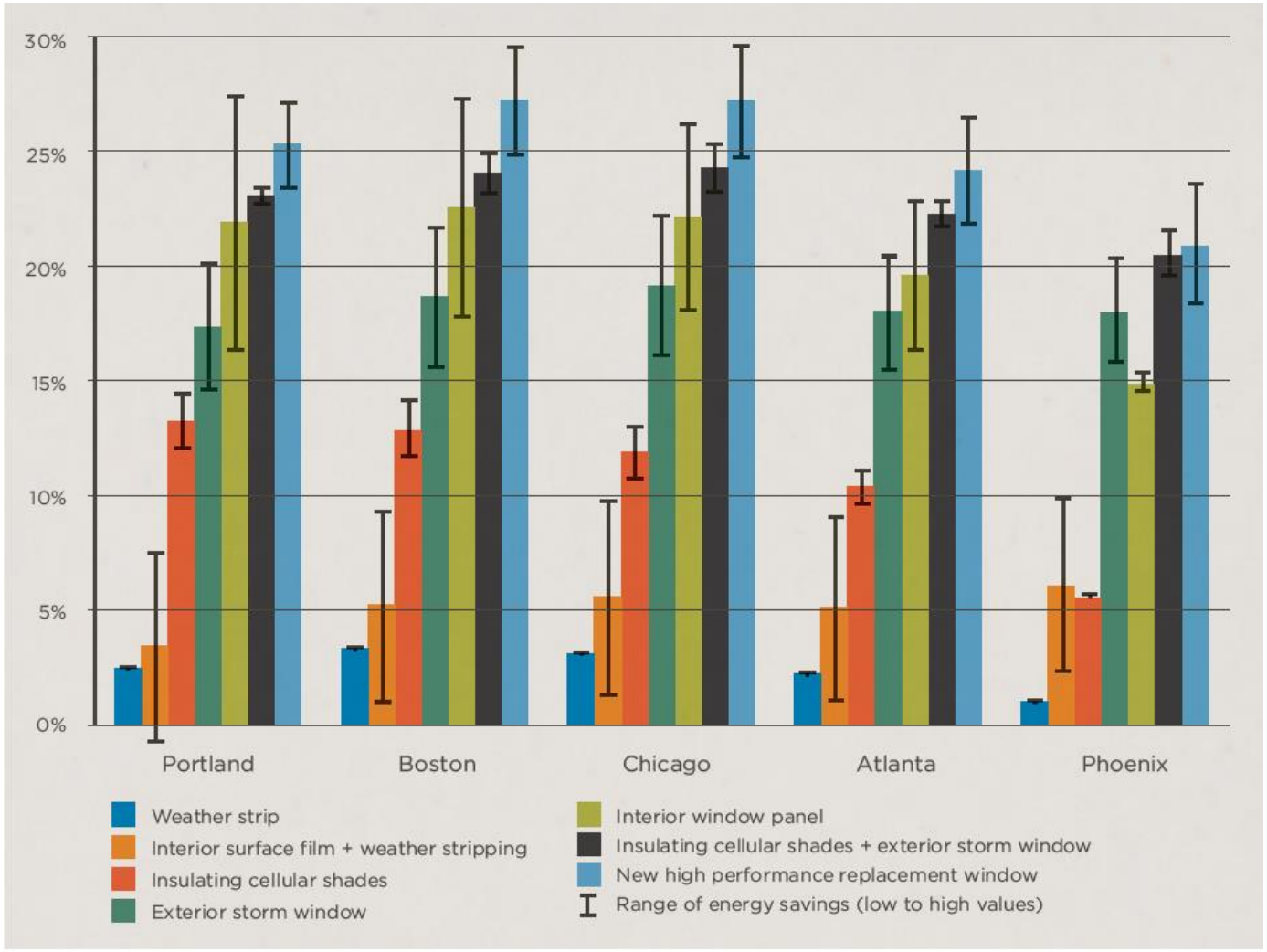
Annual Percent Energy Savings For Various Window Upgrade Options



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.

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

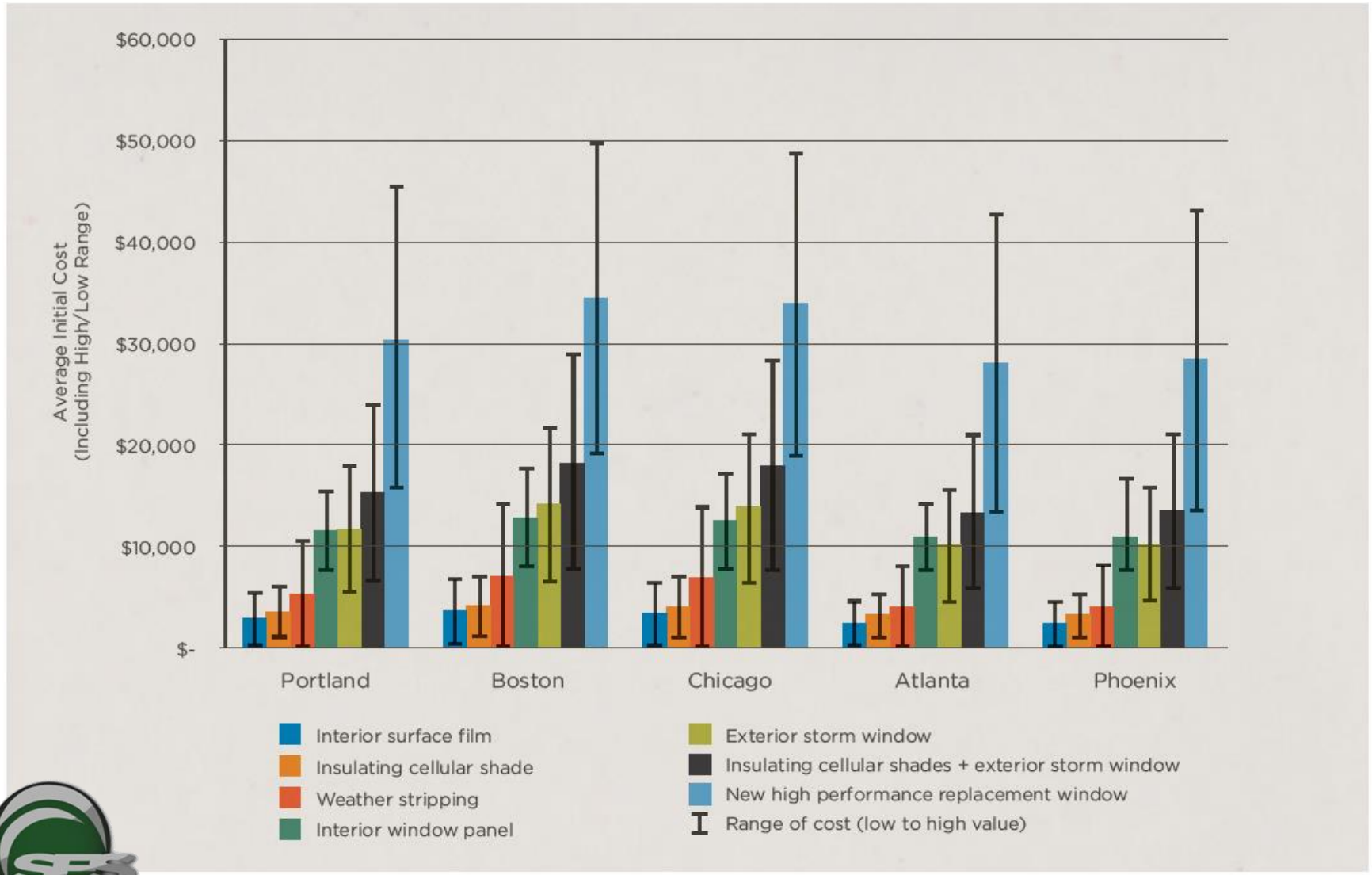

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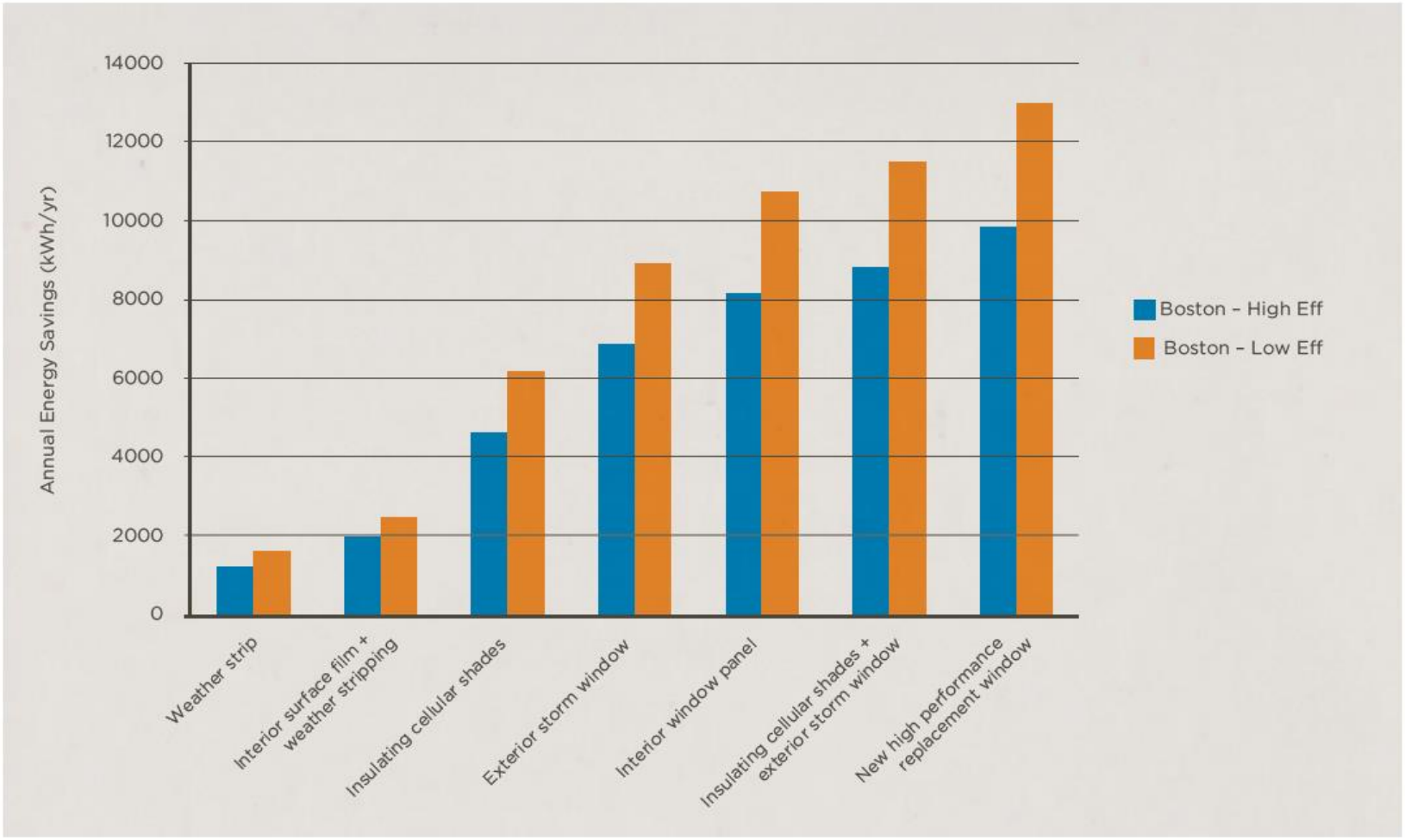
Figure 12: Average Energy Savings (kWh/yr) over baseline for low and high efficiency HVAC



This graph charts the average kWh savings per year that the baseline home is expected to realize with various window improvement measures. The blue bars represent energy savings when the home is assumed to have a high efficiency heating system; the red bars represent savings for the home with a low efficiency heating system. These results show that the savings from upgrading windows is diminished if a home's heating system has already been upgraded. While this graph shows simulation results for Boston, the influence of equipment efficiency on the window savings applies to the other cities studied in proportion to their heating load.

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Recommendations and Conclusion

Upgrading windows (specifically older, single-pane models) with high performance enhancements can result in substantial energy savings across a variety of climate zones.

Selecting options that retain and retrofit existing windows are the most cost effective way to achieve these energy savings and to lower a home's carbon footprint.

Due to the cost and complexity of upgrading windows, however, these options are not likely to be the first intervention that homeowners undertake.

For many older homes, non-window-related interventions—including air sealing, adding insulation, and upgrading heating and cooling systems—offer easier and lower cost solutions to reducing energy bills.

This study is for single family homes but many of the benefits are applicable to larger buildings but some options like external storm windows would not be applicable.

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Recommendations and Conclusion

In an LCHP study, windows made up 10.9% of total material carbon emissions. Windows are commonly an important feature of reducing operational emissions (i.e., energy retrofits that improve the air tightness of the home by the use of 'better' windows). Unfortunately, windows, particularly thick ones like triple-pane windows, tend to have high material carbon associated with their manufacturing. For this reason, it is important that the material carbon emissions be considered alongside the operational emission considerations so that overall reductions in greenhouse gas emissions are assured. In an area with a high emission grid, reducing operational emissions through improved energy efficiency by replacing leaky windows might lead to significant overall emissions reductions. Whereas triple pane windows may not be worth it in a place with a low emission grid (i.e., the material carbon emissions associated with the manufacturing of the triple-pane windows may be higher than the emissions reductions from highly energy efficient triple-pane windows). This topic would also benefit from more research.

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U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Energy Savings from Window Attachments

October 2013

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

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Another US study with comprehensive modeling of many scenarios

- 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.

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North Climate Zone Energy savings Results for Comparison to Canada

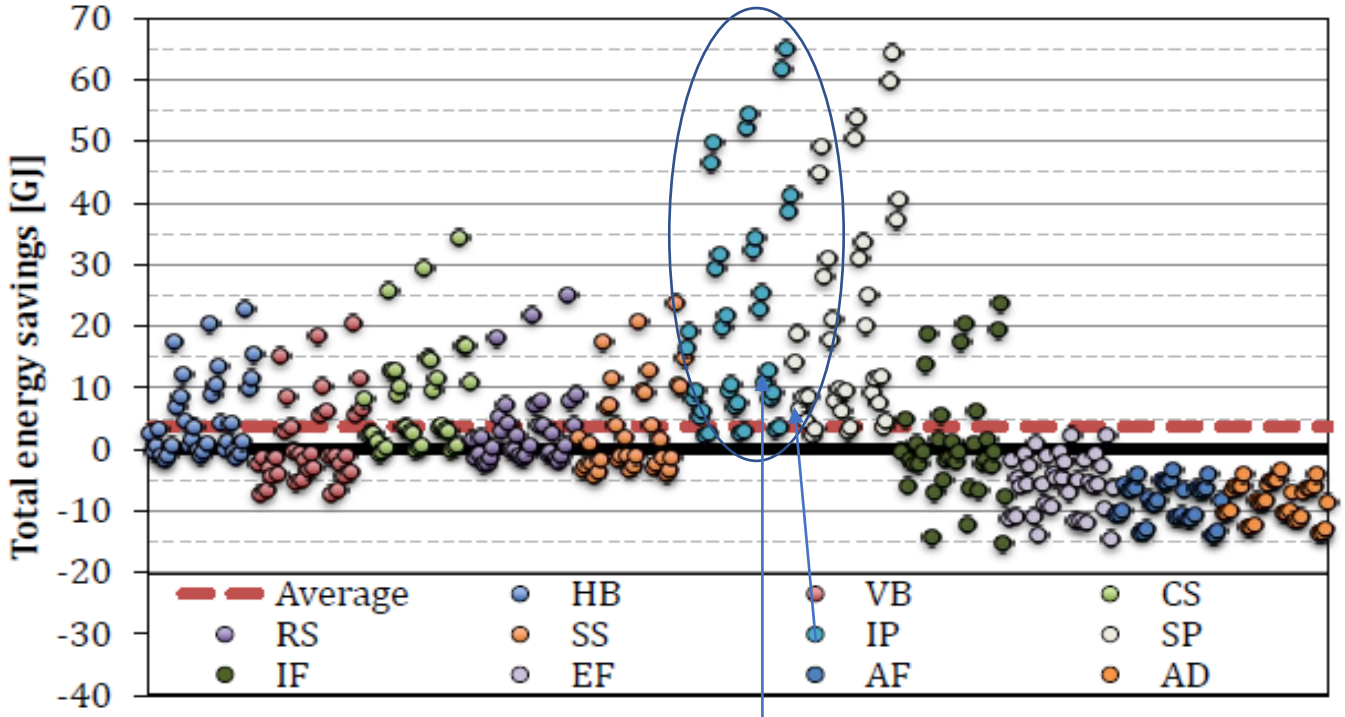

Figure 15. North Climate Zone. Average Savings: 3.72 GJ

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

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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

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

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Table 14. U-factor / SHGC for Attachment and Double Clear Glazing System Combinations

Product	Emissivity		Transmittance		Reflectance		Angle	U-factor (Btu/h-ft2-F)		SHGC	
	High	Low	High	Low	High	Low		Low	High	Low	High
Baseline window								0.49		0.59	
Horizontal blind	0.9	0.1	0.05	0	0.9	0.1	0	0.45	0.46	0.55	0.58
							45	0.43	0.45	0.33	0.51
							90	0.36	0.42	0.12	0.46
Vertical blind	0.9	0.1	0.05	0	0.9	0.1	0	0.46	0.46	0.59	0.59
							45	0.44	0.46	0.38	0.52
							90	0.36	0.42	0.12	0.46
Roller Shades	0.9	0.1	0.5	0	0.8	0.05	N/A	0.29	0.46	0.14	0.54
Cellular Shades	0.9	0.1	0.5	0	0.8	0.1	N/A	0.20	0.43	0.15	0.48
Interior Applied Film	0.9	0.02	0.6	0.2	0.6	0.1	N/A	0.39	0.49	0.23	0.51
Storm Windows	0.9	0.05	0.7	0.2	0.6	0.1	N/A	0.20	0.37	0.19	0.46
Interior Window Panel	0.9	0.05	0.7	0.2	0.6	0.1	N/A	0.20	0.37	0.24	0.51
Exterior Applied Film	0.9	0.02	0.6	0.2	0.6	0.1	N/A	0.48	0.49	0.18	0.46
Exterior Solar Screens	0.9	0.1	0.5	0.1	0.8	0.05	N/A	0.32	0.40	0.10	0.34

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Interior panels were amongst the highest performers for energy savings

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

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Annual Percent Energy Savings For Various Window Upgrade Options

Exterior (outdoor-mounted) attachments are generally more effective in saving cooling energy, but not always the highest overall energy savings due to a potential increase (penalty) in heating energy.

In north and largely central climate zones, heating energy use is higher than cooling energy, so a combination of insulating properties and balanced solar control saves the most energy.

Insulating interior window panels, exterior storm panels and cellular shades are most effective in these localities.

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What is Magnetite?

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.

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The Technology

Our 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

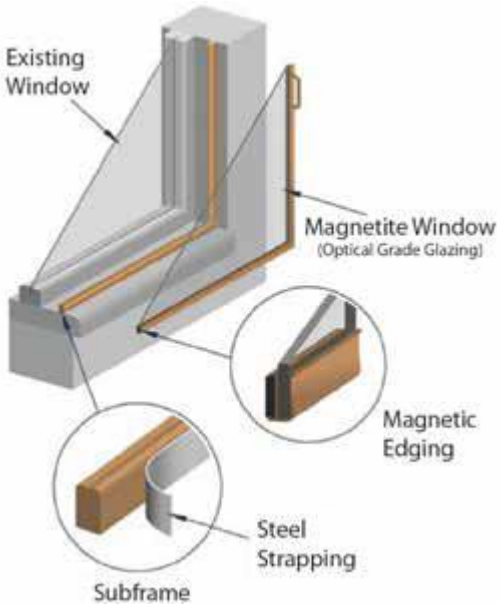
Framed with 1 1/2” PVC closed cell foam Galvanized steel banding

Magnetic Extrusion

Flexible and durable vinyl that will create a seamless finish

100% Virgin Acrylic

Optical grade, will not yellow or craze.



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Benefits & Advantages

- Significant savings on heating and cooling costs and lowers benchmark
- Completely eliminate drafts and air leaks
- Eliminates condensation that can cause early thermal and sill replacement
- 6 times more energy efficient than glass reducing carbon footprint
- Reduces outside noise pollution by up to 25 decibels
- Stops 96% of harmful UV light
- Optical grade 3mm 100% virgin acrylic panel
- 18 times stronger than glass and does not shatter
- Aesthetically appealing with no visible reduction in transparency
- Panel will not craze or yellow
- Typically 25% of the cost of complete window replacement
- May qualify for energy utility incentives or tax credits
- No messy construction and nothing for the landfill
- More comfortable environment means less vacancy

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Energy and Benefits of Acrylic in Other applications

A key aspect when choosing Plexiglas as a greenhouse roof is energy savings, a significant benefit why the acrylic sheet is favoured by growers in extremely cold areas. Nonetheless, many growers in warmer, sunny climates enjoy the consistent light transmission due to its non-yellowing characteristics. However, "the most important reasons for growers to choose Plexiglas / Acrylite is the combination of high and consistent light transmission, multi-layer diffusion and energy savings", Nicholas said.

Still, the double layer acrylic sheet will save the grower up to 60% energy over single layer glass; while providing cooling capacities in the summer months.

Examples include Rosa Flora in Ontario Canada recently built a 2,7 hectare cut flower operations utilizing Acrylite Alltop acrylic for the significant energy savings, especially in these cold winter months", Nicholas said.

Many solariums in Condos are so hot making them unbearable to sit in during the summer weather. Magnetite has been installed in some solariums to keep the heat out and allow the unit air conditioning to make in comfortable to enjoy the solarium space.

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Recent RetScreen Expert Window Measure Reports

Building envelope

Description	Building envelope
Note	

Building envelope

		Base case	Proposed case
Building north	°	20	20
Schedule		Schedule	Schedule
Incremental initial costs	$		

		Base case North	Base case East	Base case South	Base case West	Proposed case North	Proposed case East	Proposed case South	Proposed case West
Walls									
Windows									
Area	ft²	0	120	224	30	0	120	224	30
U-value	(W/m²)/°C	2.58	2.58	2.58	2.58	1.67	1.67	1.67	1.67
Solar heat gain coefficient		0.76	0.76	0.76	0.76	0.69	0.69	0.69	0.69
Incremental initial costs	$					5,610			

Individual Measure of windows for CIBC Bank Branch
Only change in U value and SHGC for glazing improvement and air leakage below

SUSTAINABLE ENVIRONMENTAL solutions

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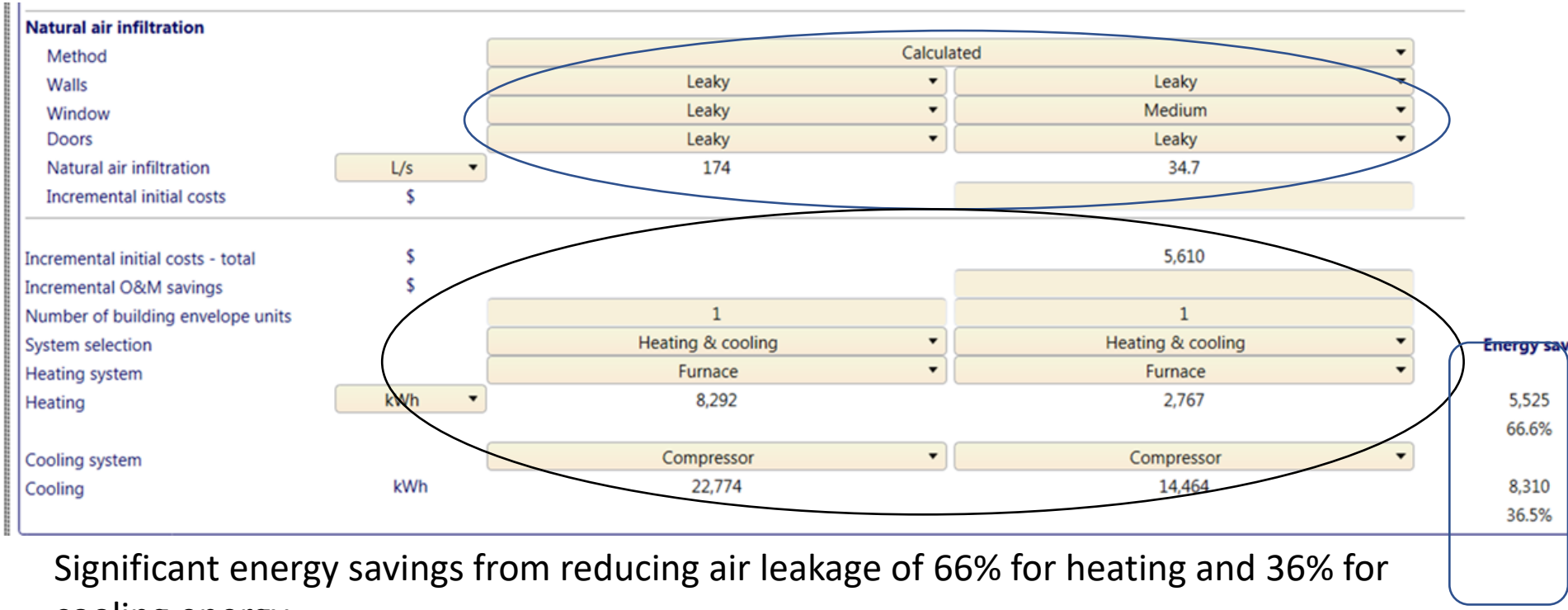
Recent RetScreen Expert Window Measure Reports

Air Leakage improvement using the Calculated method from Leaky to Medium
Lowers L/s from 174 to 34.7



Natural air infiltration				
Method		Calculated		
Walls		Leaky	Leaky	
Window		Leaky	Medium	
Doors		Leaky	Leaky	
Natural air infiltration	L/s	174	34.7	
Incremental initial costs	$			
Incremental initial costs - total	$		5,610	
Incremental O&M savings	$			
Number of building envelope units		1	1	
System selection		Heating & cooling	Heating & cooling	
Heating system		Furnace	Furnace	
Heating	kWh	8,292	2,767	5,525
				66.6%
Cooling system		Compressor	Compressor	
Cooling	kWh	22,774	14,464	8,310
				36.5%

Significant energy savings from reducing air leakage of 66% for heating and 36% for cooling energy.

Other Methods allows for input of leakage rates to see other differences in energy saving related to this improvement.

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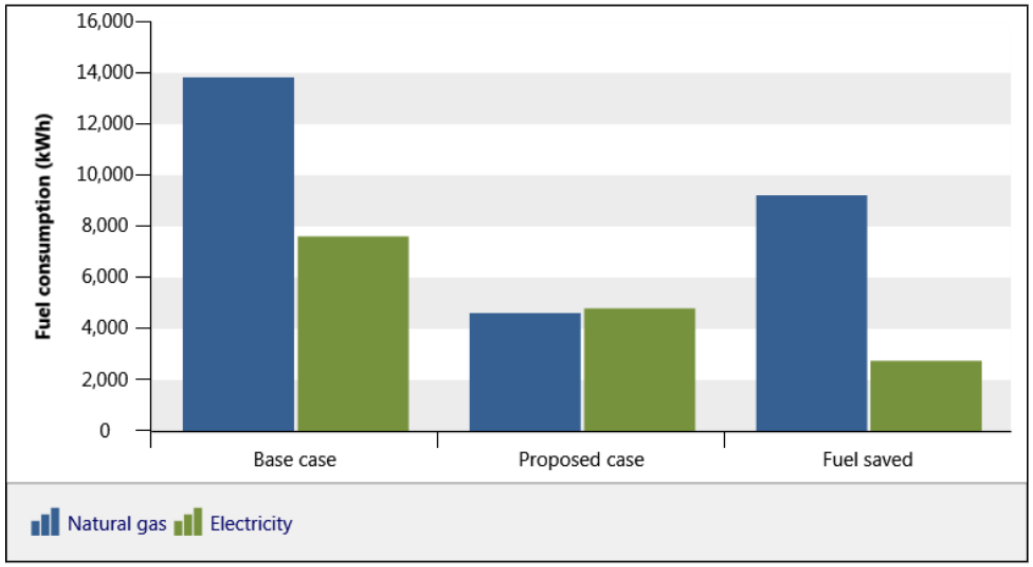
Recent RetScreen Expert Reports

Fuel summary



Fuel type	Fuel Unit	Base case Fuel consumption	Proposed case Fuel consumption	Savings Fuel saved
Natural gas	m^3	1,327	443	884
Electricity	kWh	7,591	4,821	2,770

Fuel type	Fuel Fuel rate	Base case Fuel cost	Proposed case Fuel cost	Savings Savings
Natural gas	0.38 $/$m^3$	$ 504	$ 168	$ 336
Electricity	0.18 $/kWh	$ 1,366	$ 868	$ 499
Total		$ 1,871	$ 1,036	$ 835

CIBC Bank in ESSEX

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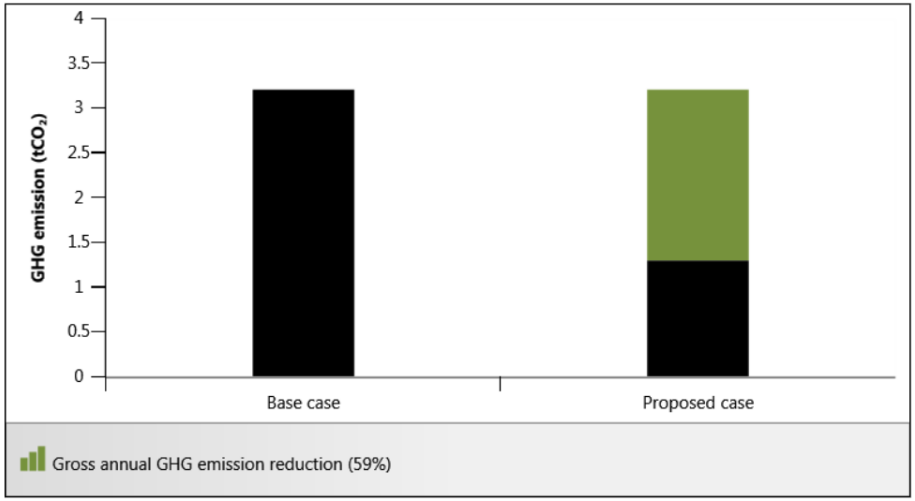
Recent RETScreen Expert Reports

GHG emission



GHG equivalence

1.9 tCO_2 is equivalent to 0.4

Cars & light trucks not used

GHG emission		
Base case	3.2	tCO_2
Proposed case	1.3	tCO_2
Gross annual GHG emission reduction	1.9	tCO_2

CIBC Bank in ESSEX

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TAF Marginal Emission Factors

Year-Round Marginal Emissions Factor: The MEF in the table is an annual marginal operating electricity emissions factor that can be easily applied to electricity conservation estimates in general. TAF has also developed appliance-specific, hourly, and projected annual emissions factors– see the appendices for details.

While the hourly MEFs are highly variable, TAF found that when applied to numerous common load profiles (which can be found in Appendix B and C) the average MEF on an annual basis was around 159 grams of carbon dioxide equivalent per kilowatt-hour (gCO_2eq/kWh). This value can be simply applied to grid electricity conservation projects to better estimate their emissions reduction impact. Table 1 summarizes the two primary emissions factors, their use cases, and their sources.

Type	Use Case	Emissions Factor (gCO_2eq/kWh)	Year	Source
Average	Calculating emissions from electricity consumption for a baseline or inventory.	43	2015	Canada's 2017 National Inventory Report
Marginal	Calculating emissions reductions from electricity conservation, shifting or renewable generation	159	2016	2016 IESO data and TAF's methodology

Table 1: Types of Emissions Factors

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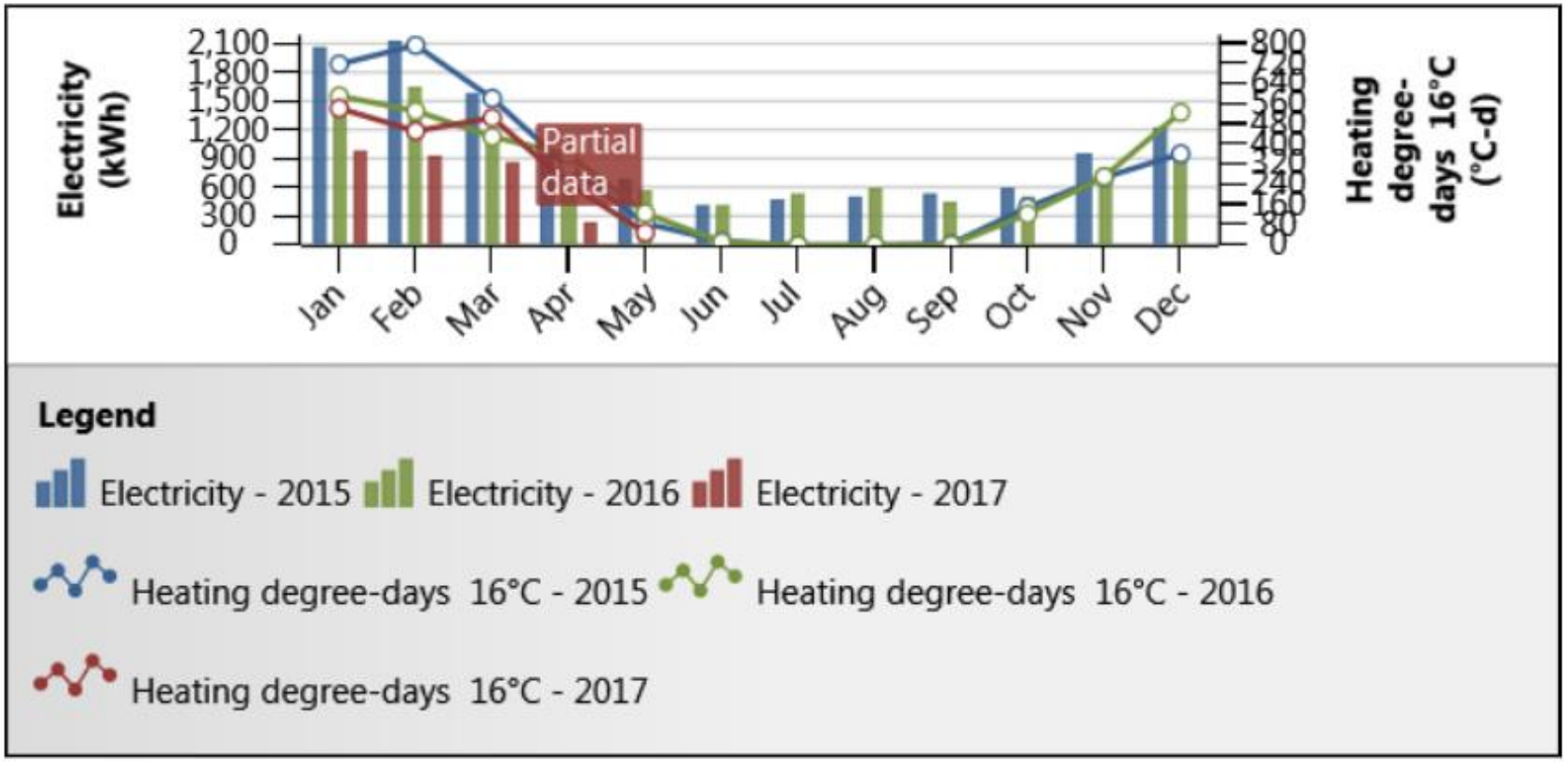
Recent RETScreen Expert Reports

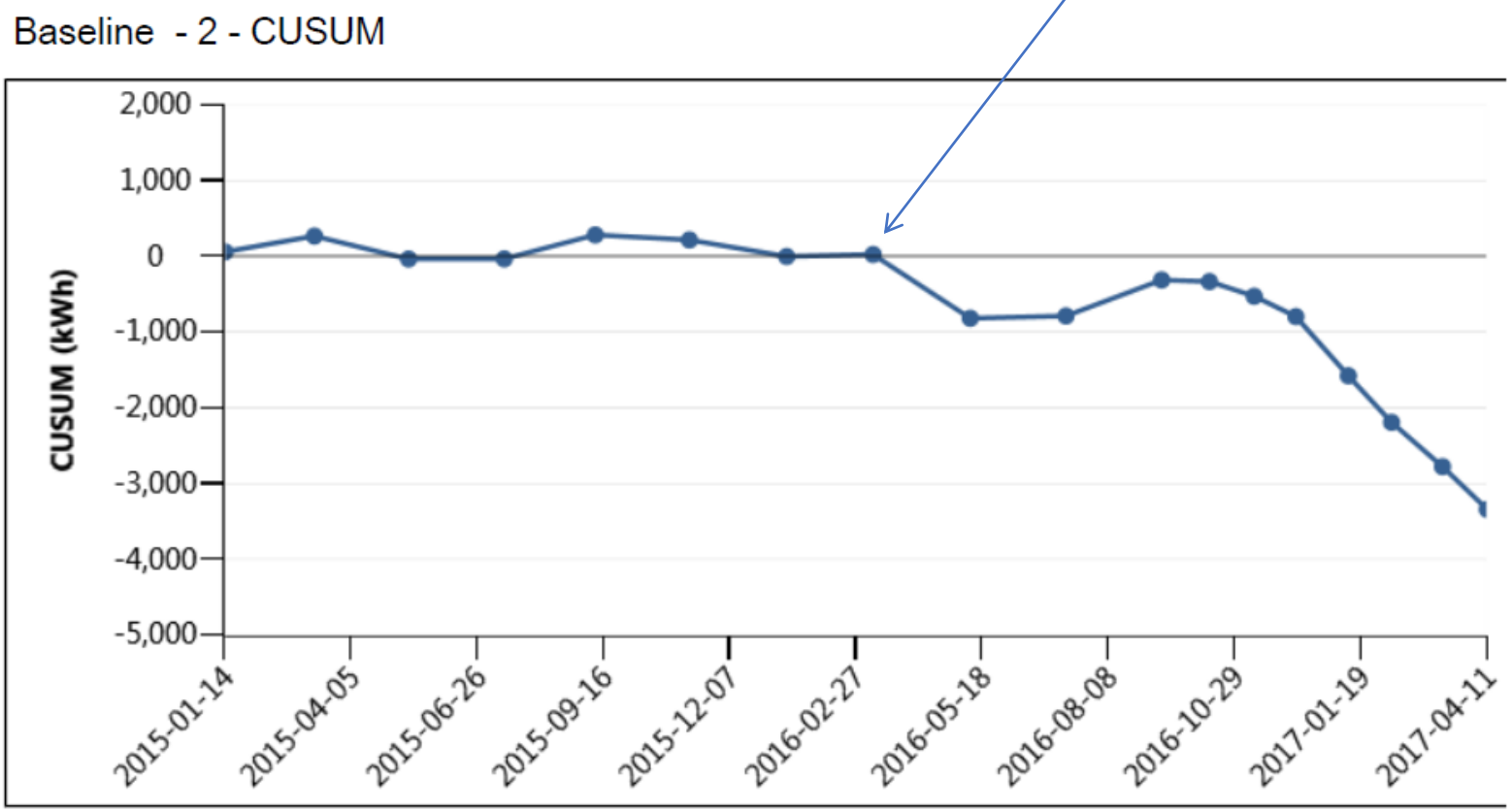
Toronto Condo Unit Performance
using electric meter readings before and after Magnetite Installation.

Monthly bar graph



Recent RetScreen Expert Reports

Electric Heat Condo Unit Performance after 2016 installation



Results of Air Leakage and Condensation Exova 2014 CSA Tests

5.0 CONCLUSIONS

Based on the results shown in Tables 1 & 3, the "Window Insulators System" when used in conjuction with the conventional vinyl horizontal single-sliding window configuration as desribed, significantly increased the condensation resistance performance. The summaized comparative condensation resistance performance results are shown below:

Specimen Description	Performance Criteria	Rating
Single Slider Unit with Window Insulators System	I-Value	65
Single Slider Unit without Window Insulators System	I-Value	47

Based on the results shown in Table 1, the "Window Insulators System" when used in conjuction with the conventional vinyl horizontal single-sliding window configuration as desribed, decreased the air leakage rate of the window unit. The summaized comparative air leakage performance results are shown below:

Specimen Description	Average Leakage Rate @ 75Pa
Single Slider Unit without Window Insulators System	0.30 L/s m^2
Single Slider Unit with Window Insulators System	0.01 L/s m^2

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Results of Single Magnetite Thermal Exova 2014 CSA Tests

Based on the results shown in Tables 1 & 2, the "Window Insulators System" when used in conjuction with the conventional fixed window configuration as desribed, significantly reduced the thermal conductivity. The summaized comparative thermal performance results are shown below in Table 3:

Table 3 – Summarized Thermal Performance Results

Configuration Number	Specimen Description	SI Units		British Units			
1	3 mm Clear / 12.7 mm Argon / 3 mm Clear	2.47	W/m²-K	0.44	BTU/h.ft^2.°F	2.27	°F. ft^2.h/BTU
3	3 mm Clear / 12.7 mm Argon / 3 mm Clear + Window Insulators Systems	1.62	W/m²-K	0.29	BTU/h.ft^2.°F	3.45	°F. ft^2.h/BTU
2	3 mm Clear / 12.7 mm Argon / 3 mm LoE 180 [3]	1.55	W/m²-K	0.27	BTU/h.ft^2.°F	3.70	°F. ft^2.h/BTU
4	3 mm Clear / 12.7 mm Argon / 3 mm LoE 180 [3] + Window Insulators Systems	1.12	W/m²-K	0.20	BTU/h.ft^2.°F	5.00	°F. ft^2.h/BTU

* SI units were the primary units of measure / calculation. Conversion: 1 BTU/h.ft^2.°F = 5.678 W/m^2.K

Summary of Recent Exova CSA Test of Double Magnetite

Based on the results shown in Tables 1 & 2, the "Magnetite Acrylic Panel System" when used in conjuction with the conventional fixed window configuration as desribed, significantly reduced the thermal conductivity. The summaized comparative thermal performance results are shown below in Table 3:

Table 3 – Summarized Thermal Performance Results

Configuration Number	Specimen Description	U- Value			
		Without Magnetite System		With Magnetite System	
		SI Units (W/m^2-K)	British Units ($°F.\ ft^2.h/BTU$)	SI Units (W/m^2-K)	British Units ($°F.\ ft^2.h/BTU$)
1	3 mm Clear / 16.2 mm Air / 3 mm Clear	2.88	0.51	1.28	0.23
2	3 mm Clear / 16.2 mm Argon / 3 mm Clear	2.76	0.49	1.25	0.22
3	3 mm Clear / 16.2 mm Air / 3 mm LoE180	2.05	0.361	1.03	0.182
4	3 mm Clear / 16.2 mm Argon / 3 mm LoE180	1.83	0.322	0.961	0.169

* SI units were the primary units of measure / calculation. Conversion: 1 $BTU/h.ft^2.°F = 5.678\ W/m^2.K$

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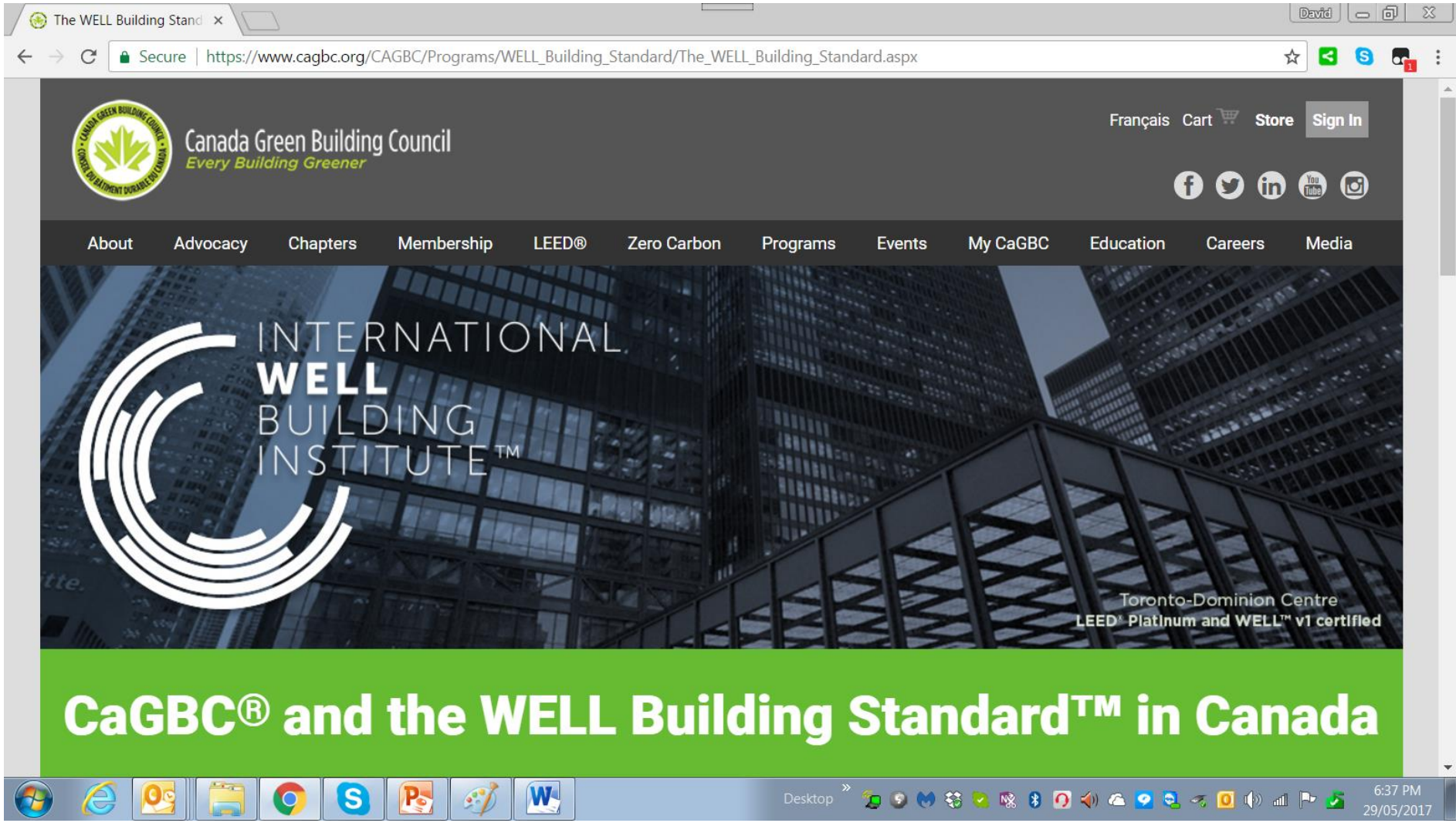
Magnetite for Sound Reduction and WELL Rating



Airborne Sound Transmission Loss Measurements of Magnetite Window Systems

Magnetite Canada

A1-009464.1

19 September 2016

National Research Council Canada
Conseil national de recherches Canada

Canada

Sound Reduction Test in NRC Lab. For both single and double pane windows with and without Magnetite

This report presents the description, the measured and the calculated one-third octave band transmission loss and the single-number rating, Sound Transmission Class (STC), in accordance with ASTM E413 of the filler wall, the single pane wood window, the single pane wood window with the Magnetite framing system, the double pane aluminum window, and the double pane aluminum window with the Magnetite framing system. The measurement procedures are described in Appendix A.

The test results show that the Magnetite Framing System improved the STC values of both the single pane wood window and the double pane aluminum window by 16 point when it was installed with an air space of 100 mm (4") between the glass pane and the Magnetite Framing System.

SUSTAINABLE ENVIRONMENTAL solutions

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Sound Reduction Test in NRC Lab. For both single and double pane windows with and without Magnetite

Figure 5. 1496 mm high x 1196 mm wide Magnetite Framing System was installed 100 mm away from the 1457 mm high x 1178 mm wide double pane aluminum window.

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ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: Magnetite Canada **Test ID:** TLA-16-064

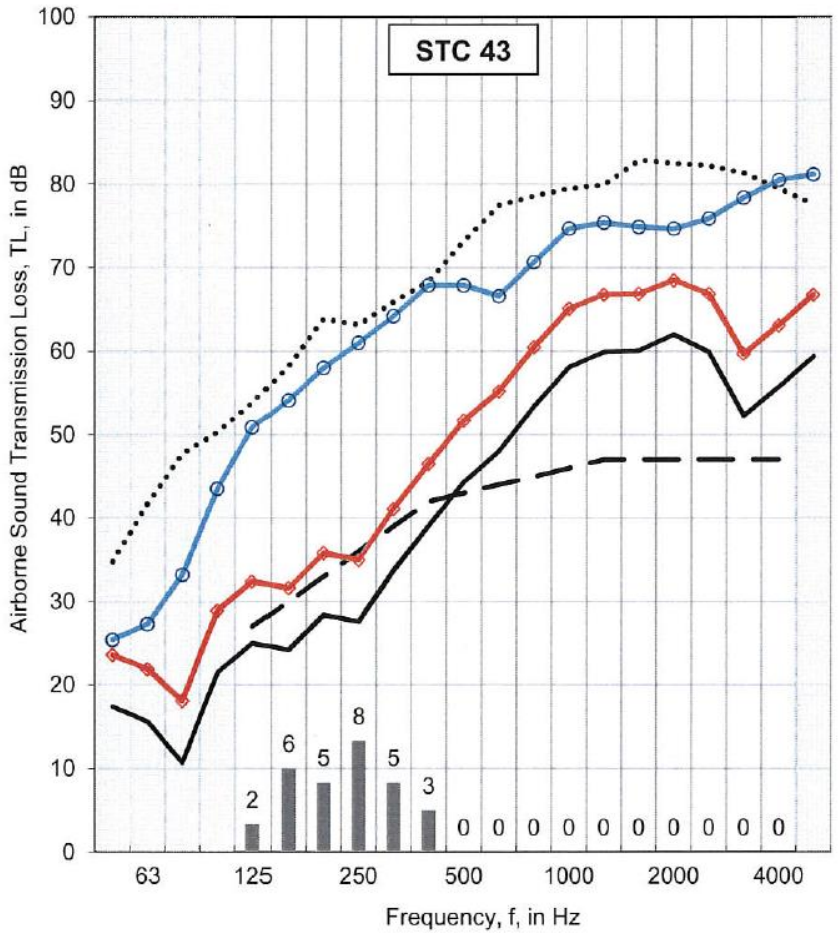
Specimen ID: A1-009464-1WM **Date of Test:** August 19, 2016

Room	Volume (m^3)	Air Temperature (°C)	Humidity (%)
Large	254.9	21.8 to 22	67.7 to 67.8
Small	140.6	21.5 to 21.5	65.4 to 65.6

Area of test specimen:	1.61 m^2
Mass of test specimen:	13.6 kg

f (Hz)	TL (dB)	
50	17	min
63	16	clc
80	11	
100	22	
125	25	
160	24	
200	28	
250	28	
315	34	
400	39	
500	44	
630	48	clc
800	53	clc
1000	58	clc
1250	60	clc
1600	60	clc
2000	62	clc
2500	60	clc
3150	52	
4000	56	
5000	59	
Sound Transmission Class (STC)	43	

Sum of Deficiencies (dB)
29
Max. Deficiency (dB)
8 dB at 250 Hz



In the graph:

The blue solid line with circle markers is the measured sound transmission loss of the filler wall. The red solid line with diamond markers is the measured sound transmission loss of the filler wall with the double pane aluminum window and the Magnetite Framing System. The black solid line is the calculated sound transmission loss of the double pane aluminum window with the Magnetite Framing System. The dashed line is the STC contour fitted to the calculated values according to ASTM E413-l0. The shaded cells in the table and areas in the graph are outside the STC contour range.

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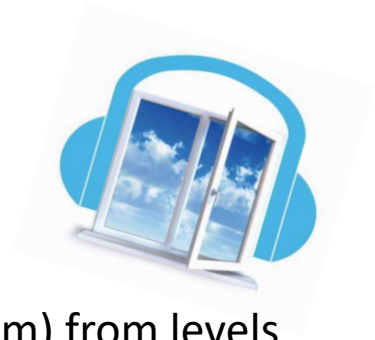
Sound Reduction Project in Australia



Magnetite installed retrofit double glazing to 363 windows (avg size 3 sqm) from levels one to nine.

Scratch resistant acrylic glazing, custom-manufactured by Mitsubishi Rayon, was imported exclusively for this project.

The air cavities created were maximised to achieve the best acoustic results.

Magnetite addressed both energy savings and acoustics required to achieve a 5 Stars NABERS energy rating as well as a 5 Star Green Star rating.

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Sound Reduction Project

Magnetite CANADA

Environmental Factors – GHG and Life Cycle Assessment

These studies evaluated only the energy savings of various test conditions and did not address impacts to the environment or to human health associated with material production, transportation, maintenance, replacement, or disposal over the anticipated life span of the retrofitted or replacement windows. Further research is needed to understand how each test condition compares based on these impacts.

Due to the wide range of material choices that exist for window retrofit/replacement measures, this type of analysis was outside the scope of these studies. However, the energy results from this analysis could provide a basis for a more comprehensive study on life cycle impacts in the future.

Given the Low Carbon and Net Zero Building objectives, in addition to the lower cost for the energy usage savings, deep retrofits that consider replacing the windows with new windows that take nearly 30 years of energy savings to payback should look at the similar energy savings from adding interior acrylic panels and the lower carbon footprint then the replacement option.

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Environmental Product Declaration- LEED and Other Programs

Declared unit

Data are referred to 1 kg of product and related packaging. The following table describes the relationship between the declared unit (1 kg) and the profile length (1 m) of each product series.

	Total [kg/m]	Al [kg/m]	Polyamide [kg/m]	Paint[19] [kg/m]	Packaging [kg/m]
Planet NEO 62	1,87	1,51	0,22	0,085	0,054
Planet NEO 72	1,98	1,34	0,49	0,092	0,058
Slide NEO 106	2,12	1,76	0,20	0,098	0,062
Sirio NEO 50	1,70	1,57	Not included	0,078	0,049

Environmental impact

Impact category	Unit	Total value (Cradle to Gate)			
		Planet NEO 62	Planet NEO 72	Slide NEO 106	Sirio NEO 50
Global Warming Potential (GWP)	[kg CO2-Equiv.]	7,78	8,08	7,78	7,78
Ozone Depletion Potential (ODP)	[mg R11-Equiv.]	0,54	0,46	0,56	0,62
Acidification Potential (AP)	[g SO2-Equiv.]	31,00	31,11	31,09	31,71
Eutrophication Potential (EP)	[g PO_4^{2-}-Equiv]	1,99	2,52	1,92	1,61

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Life Cycle Assessment – Making and adding Interior Acrylic Panels to existing single or double pane windows.

TABLE 11:Weight of PLEXIGLAS Sheet, Thicknesses : 0.118 inch Weight in lb/sq ft: 0.73
Glass Weight per Square Foot: 1/8" = 1.64 lbs. sq. ft.
Eco Calculator GWP/MJ = 11.8

All these are simple assumptions and many factors would impact the actual differences in eqCO2.

200 SF of .125 mm glass for double pane window weighs 328 lbs. or 149 kg.
Embodied energy per table is 19MJ/kg so this amount of glass has 2831 MJ.
100 SF of .118 acrylic sheet weighs 73 lbs. or 33 kg therefore it has about 3465 MJ.

Therefore the embodied energy for the glazing portion is 634 MJ more for the acrylic panels.

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Life Cycle Assessment – Making and adding Interior Acrylic Panels to existing single or double pane windows.

The framing materials also need to be compared. Comparing the 774 MJ/SF for the residential aluminum and the 322 MJ/SF for the vinyl wood windows that would be similar to the framing used for the acrylic panels the framing increase for the 100 SF of new windows would be 4530 MJ. The GWP of the aluminum framing is 7.78 kg eqCO2 per meter so the impact on the total os very dependent on the shape of each window.

Commercial non operable aluminum windows are less energy intense but the energy used in their production and installation in high rise buildings could still be more than the new windows.

Assuming a lower difference for acrylic of only 2000 MJ for 100 SF using acrylic instead of new windows in a recent windows assessment of a 33 story Condo that has over 57,000 SF of windows would save about (57000/100*2000/11.8 = 96,610) or 96 metric tonnes eqCO2.

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Energy Utility Incentives and GHG Reduction Programs

IESO has Building Envelope and HVAC Custom Solutions.

Gas Utilities have insulation incentives and this is an insulator not a new window.

ESCO's are now specifying Magnetite as an option for long term savings.

New focus on GHG is addition to energy in the Climate Action Plan.

Large emitters have Cap and Trade and are looking for any GHG reduction.

Global Corporations reporting to Carbon Disclosure Project need to reduce GHGs.

Ontario Smart Grid Forum Corporate Partners Committee working on Innovation.

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Questions?

Block Out Harmful UV Rays

Reduce Noise by 70%

Energy Efficient

Cost Savings

Going Green

Increase R Value

Seal Out Drafts & Leaks

SUSTAINABLE ENVIRONMENTAL solutions

Magnetite CANADA

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