Attachments Energy Rating Council
AERC

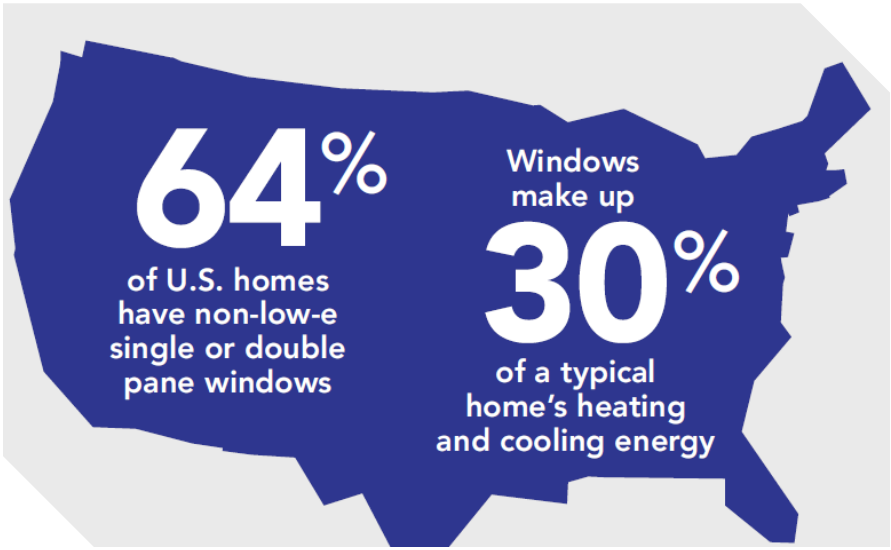
Enhancing Window Performance with Energy-Efficient Attachments

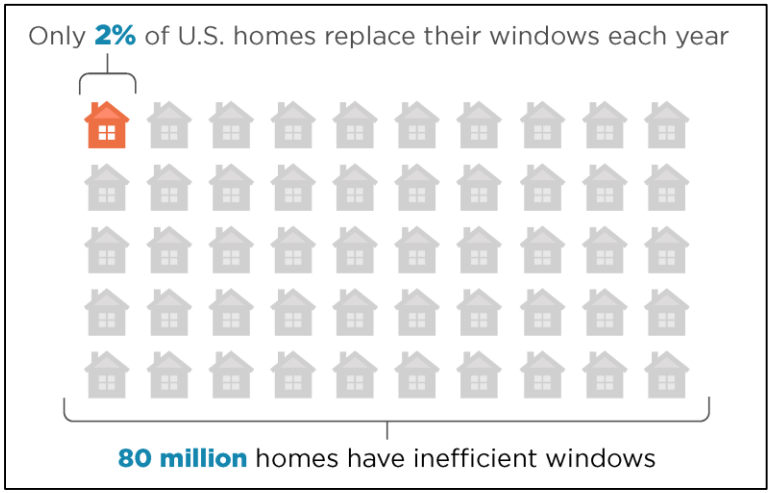
Agenda

- Introduction to Window Attachments
- Market Information
- Energy Savings Potential
- Attachments Energy Rating Council
- Low-E Storm Window Pilots
- Automated Shading Pilot

Introduction to Window Attachments

The Problem

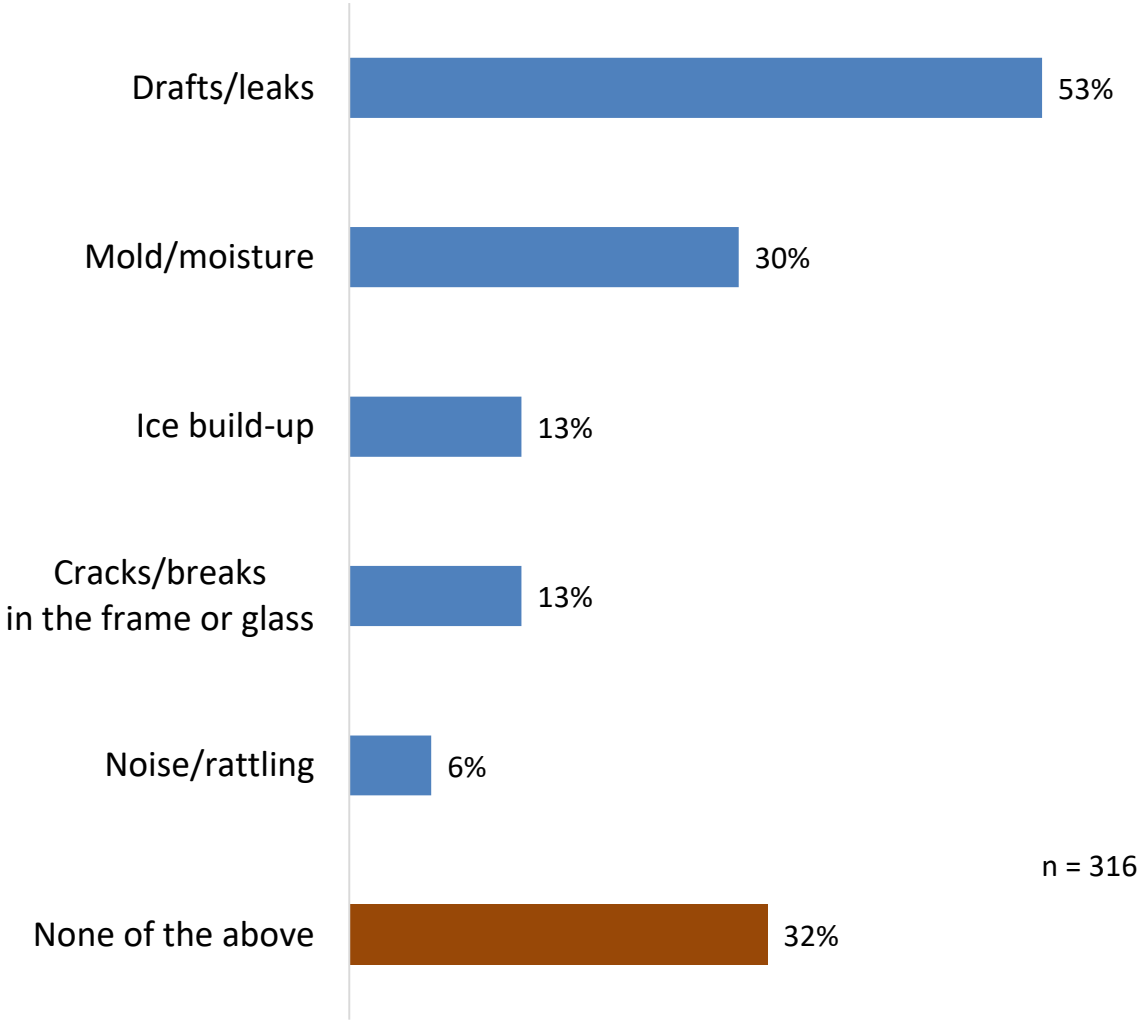

64%
of U.S. homes have non-low-e single or double pane windows
Windows make up
30%
of a typical home's heating and cooling energy


Only 2% of U.S. homes replace their windows each year
80 million homes have inefficient windows


Windows make up 34% of a commercial building's heating and cooling energy

Window Concerns

68% of respondents had a concern with their existing windows**, with 31%** having more than one concern.



Q10. What, if any, of the following concerns do you have with the windows in your home?

Efficiency Vermont. Low-E Storm Windows Market Characterization Study. November 2016.

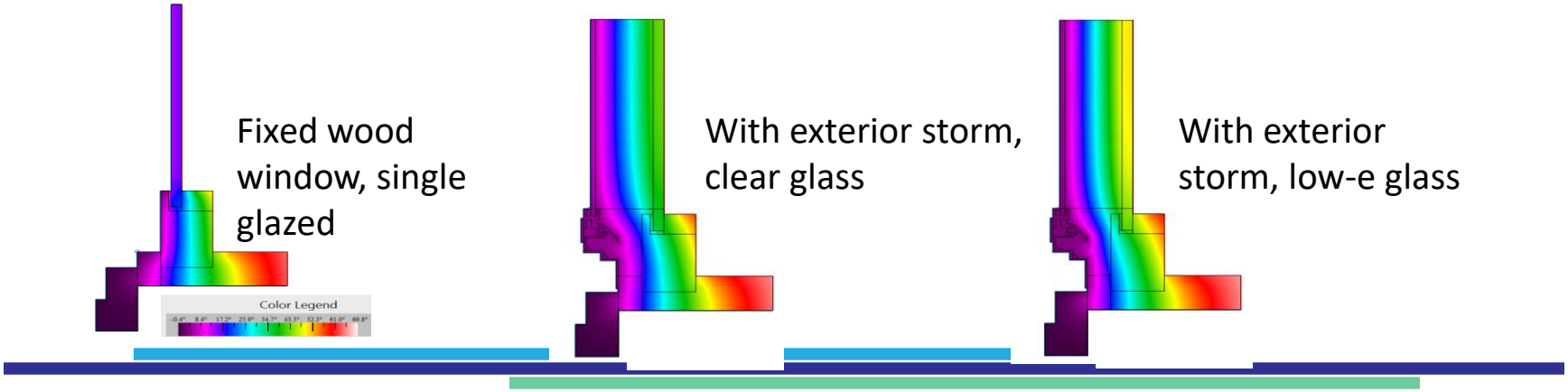
Low-E Storm Windows

- **Technology Description:**
  - Window pane added to interior or exterior of existing window
  - Low-emissivity (low-e) coating minimize infrared energy that can pass through
  - Reduces air infiltration
- **Target Market:**
  - Buildings with single or non-low-e double pane windows
  - Ideal for retrofit projects
- **Cost:**
  - $60-$180
- **Lifetime:**
  - 10-20 years
- **NEBs:**
  - Occupant comfort, improved health, noise reduction, security

Low-E Storm Windows: Concept

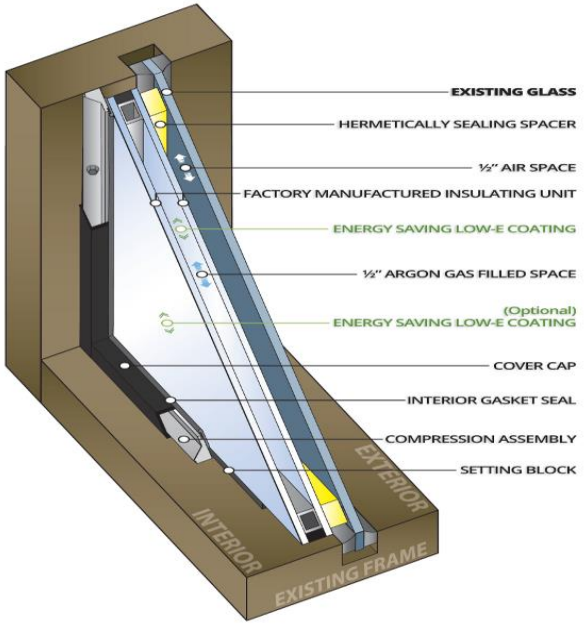
Low-e storm windows are a cost-effective **insulating** and air **sealing** measure for existing windows:

- Air Sealing of Prime Window
  - Case studies show 10% reduction in overall home air leakage
- Creation of "Dead Air Space"
  - Reduce conduction and convective losses across prime window
- Reflection of Radiant Heat: Low-E Glass
  - 35% increased performance over clear glass



Secondary Glazing Systems

- **Technology Description:**
  - Window IGU added to interior of existing window
  - Low-emissivity (low-e) coating minimize infrared energy that can pass through
  - Reduces air infiltration
- **Target Market:**
  - Multi-family/commercial high-rise buildings with single or non-low-e double pane windows
  - Ideal for retrofit projects
- **Cost:**
  - $35 - $50/sq. ft. including installation
  - Depends on size, location, and existing conditions
- **Lifetime:**
  - 20+ years
- **NEBs:**
  - Occupant comfort, noise reduction, improved health, greater productivity



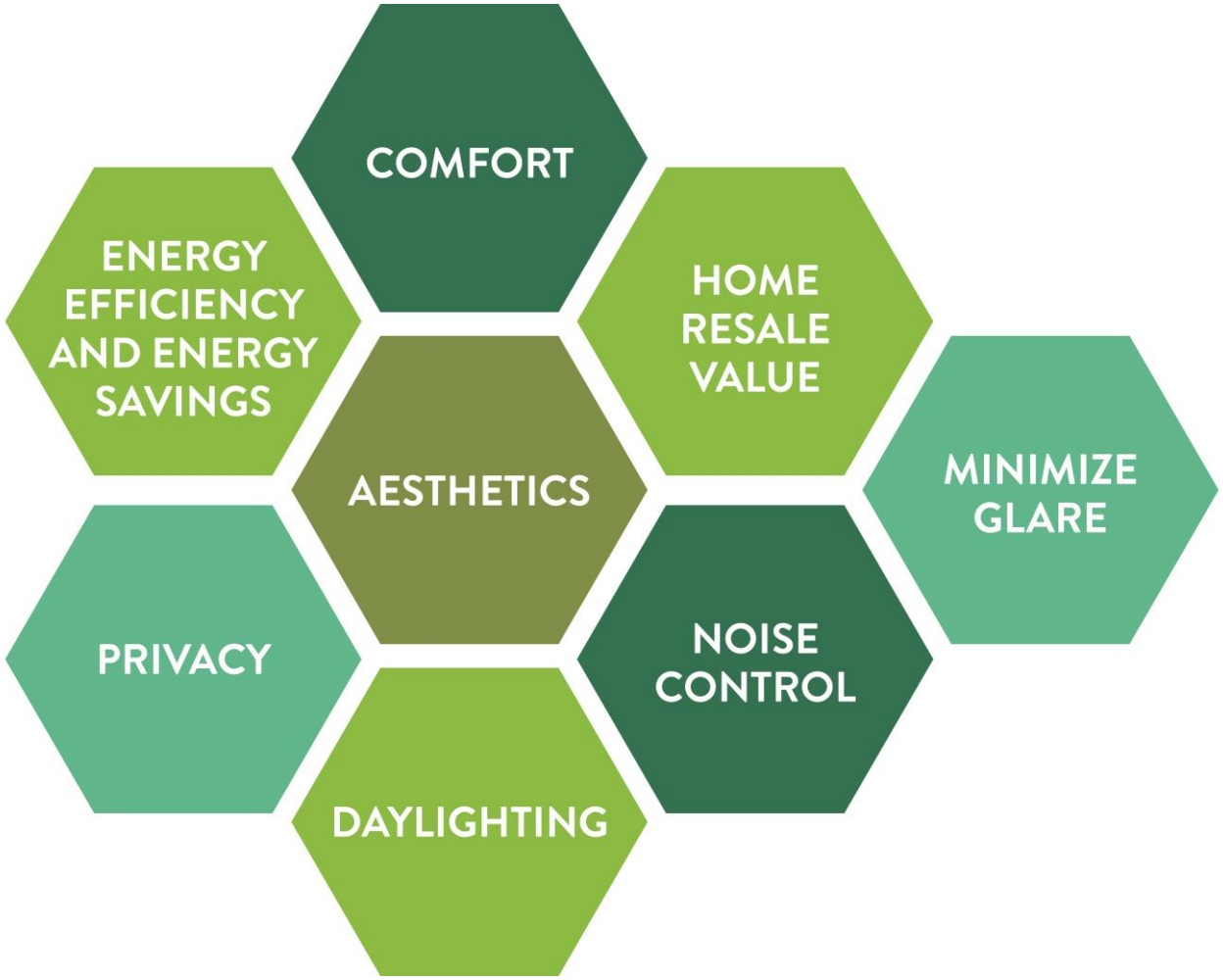
Cellular Shades

- **Technology Description:**
  - Honeycomb or cellular structure
  - Can be automated
- **Target Market:**
  - Good option for new construction and retrofit
  - Provides heating and cooling benefits
- **Cost:**
  - $35-$200
- **Lifetime:**
  - 8-10 years
- **NEBs:**
  - Occupant comfort, glare reduction, property value, privacy

Roller Shades

- **Technology Description:**
  - Exterior or interior
  - Can be automated
- **Target Market:**
  - Good option for new construction and retrofit
  - Provides cooling benefits
- **Cost:**
  - $40-$200
- **Lifetime:**
  - 6-10 years
- **NEBs:**
  - Occupant comfort, glare reduction, privacy, daylighting

Window Attachments Value



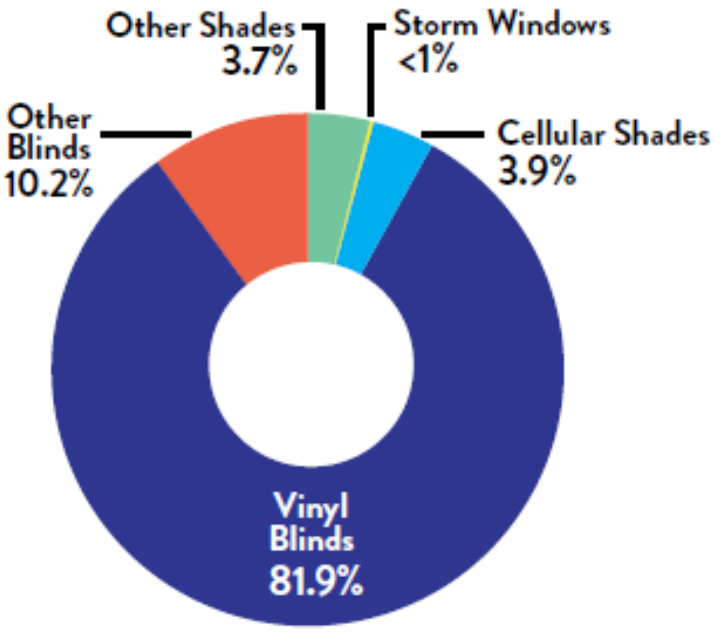
Window Attachment Efficiency Landscape

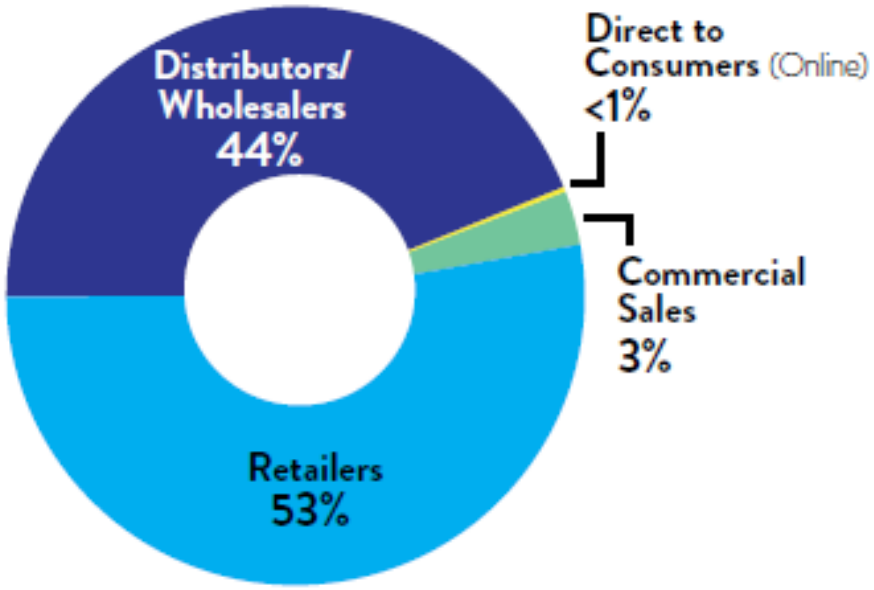
- **DOE/EPA**
  - Attachment Energy Rating Council (AERC)
  - Emerging Technologies windows research
  - Building America research, testing, and technical assistance
  - ENERGY STAR® program for storm windows
- **Utilities**
  - Consortium for Energy Efficiency
  - BPA and NEEA
  - Silicon Valley Power (with assistance from the American Public Power Association)
  - Efficiency Vermont
  - Focus on Energy Wisconsin

Window Attachments Market Information

Market Size and Share

- Annually 150-225 million residential interior units shipped

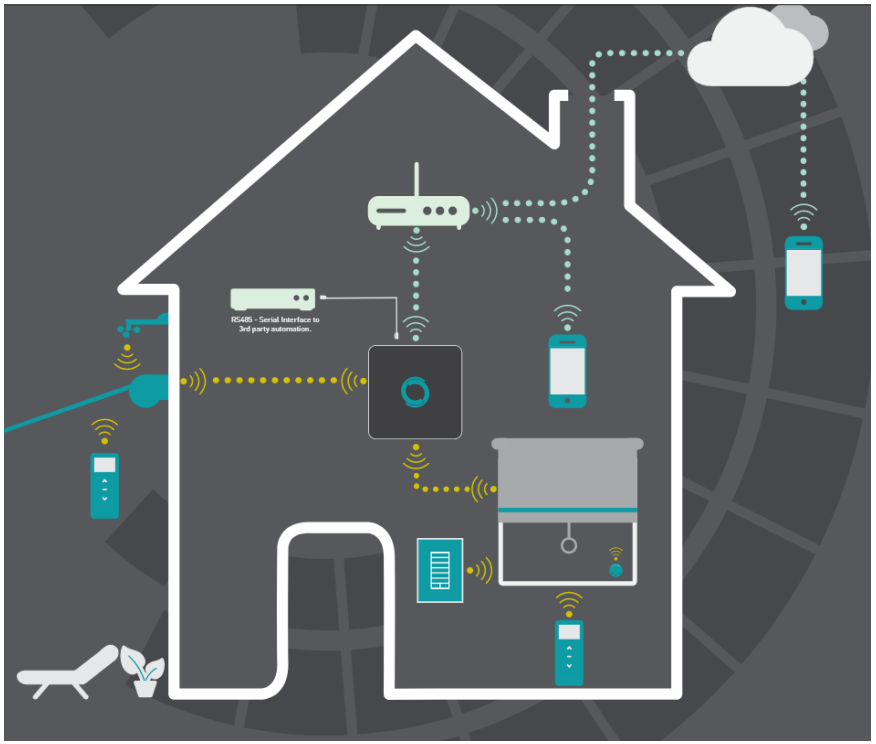


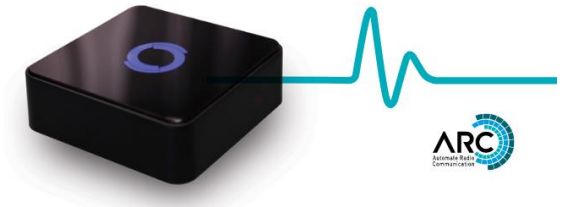


Low-E Storm Windows Multi-Family Pricing

- Product cost: $7-$12/sq. ft.
- Installation cost: $3-$8/sq. ft.
- Pricing will depend on window package and architectural requirements
- Ordering:
  - Typically ship initial test unit
  - Depending on size of order 4-6 weeks
- Building owner/manager responsible for installation
  - Typically installed by general contractor

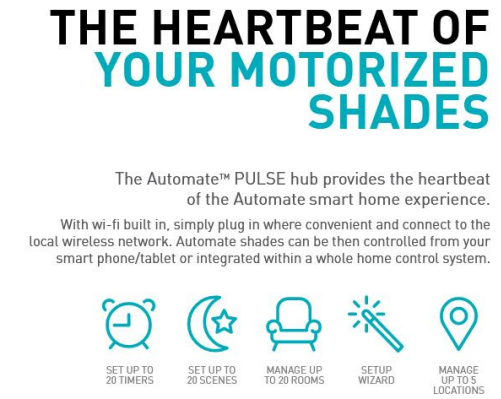
Automated Shading Systems





Motorization and Automation

- Many manufacturers/retailers offer motorization on almost all window attachment types
  - Operated with remote control
- More limited number offer automation
  - Lutron
  - Rollease Acmeda
  - Somfy
  - Hunter Douglas
  - Mechoshade
  - Draper



WORKS WITH amazon alexa

IFTTT

works with the Google Assistant

logitech

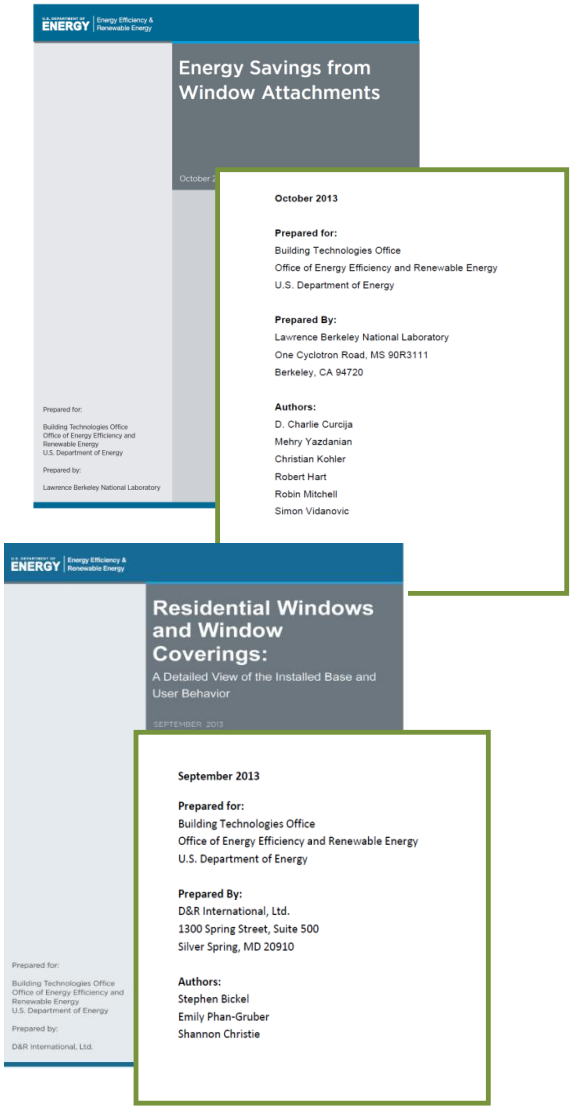
Control4

works with nest

Energy Savings Potential of Window Attachments

LBNL Energy Modeling

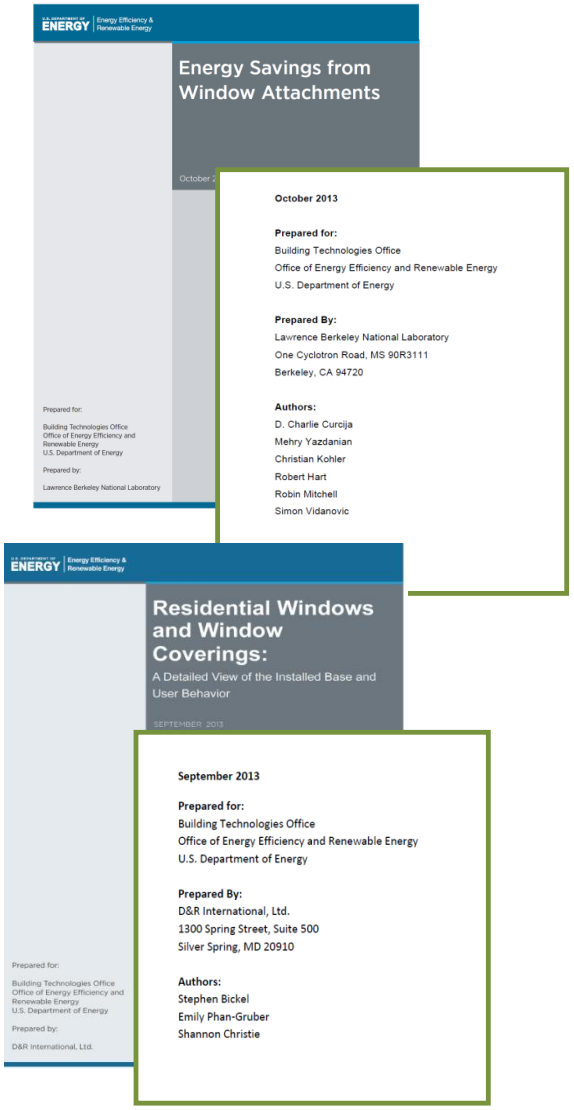
- Comprehensive energy-modeling study that examined 11 residential window attachments
  - Baseline with 4 types of houses with 3 types of windows in 12 climate zones
  - Operation assumptions based on empirical study
- For most attachments examined, energy savings significant
  - Results depend on type of attachment, season, climate, and operation
- *In heating-dominated climates,* ***low-e storm panels and cellular shades*** *are the most effective at reducing HVAC energy use*



User Operation Study

Major Findings:

- People rarely move or adjust their window coverings throughout the day.
- People tend to keep their window coverings closed in areas where they would like privacy and more open in common areas.
- There is some variation in the position of the window coverings that appears to be based on climate/weather (e.g., warmer climates kept more window coverings closed in the summer months).



Cellular Shade Modeling and Field Results

Modeled Annual Energy Savings Estimates

Washington, DC – Climate Zone 4A

	HVAC Energy Use (kWh/yr) Based on Cellular Shade Performance Level			Percent Savings Compared to No Shades	
Prototype	**No Shades**	**Double Cell**	**Triple Cell**	**% Savings of Double-Cell Shades**	**% Savings of Triple-Cell Shades**
Prototype # 1 (U=0.32)	15,957	14,648	14,486	8%	9%
Prototype #2 (U=0.68)	19,371	16,514	16,461	15%	15%
Prototype #3 (U=0.68)	8,999	7,184	7,119	20%	21%

- Cellular Shade operation assumptions:
  - Summer: Shades are down (April to September)
  - Winter: Shades are up during the day and down at night (October to March)

- **Prototypes (WWR 15%)**
  - #1 – 2400 sq ft and 0.32 U-Factor
  - #2 – 2400 sq ft and 0.68 U-Factor
  - #3 – 15000 sq ft and 0.68 U-Factor

Metzger et al. Modeling Cellular Shades in EnergyPlus. December 2017. Pacific Northwest National Laboratory. PNNL-27187.

PNNL Energy Modeling

Lab Homes Characteristics

- Specified to represent existing manufactured and stick-built housing
- 3 BR/2BA, ~1500 ft^2, double-wide
- All-electric with 13 SEER/7.7 HSPF heat pump central HVAC + alternate Cadet fan wall heaters throughout
- R-22 floors, R-11 walls & R-22 ceiling
  with composition roof
- 13% window area
  - All double-pane and aluminum framed clear glass windows

PNNL Lab Homes Cellular Shades Impact on Energy Savings (2015-2016)

Technology (experiment)	Baseline and Experiment Description	Energy Savings (%)
High Efficiency Cellular Shades: Static Operation – always down	Control: Vinyl blinds Use: Closed for duration	**Cooling: 13.3 ±2.8%** **Heating: 10.5 ±3.0%**
High Efficiency Cellular Shades: Optimum Operation Comparison	Control: Vinyl blinds Use: Hunter Douglas energy-saving schedule	**Cooling: 10.4 ±6.5%** **Heating: 16.6 ±5.3%**
High Efficiency Cellular Shades: Optimum Operation	Control: No blinds (double pane window) Use: Hunter Douglas energy-saving schedule	**Cooling: 14.8 ±2.1%** **Heating: 14.4 ±2.0%**

All cellular shade products provided by Hunter Douglas.

*Petersen et al. Evaluation of Cellular Shades in the PNNL Lab Homes. November 2016. PNNL. PNNL-24857, Rev2.

PNNL Lab Home Energy Consumption Comparison

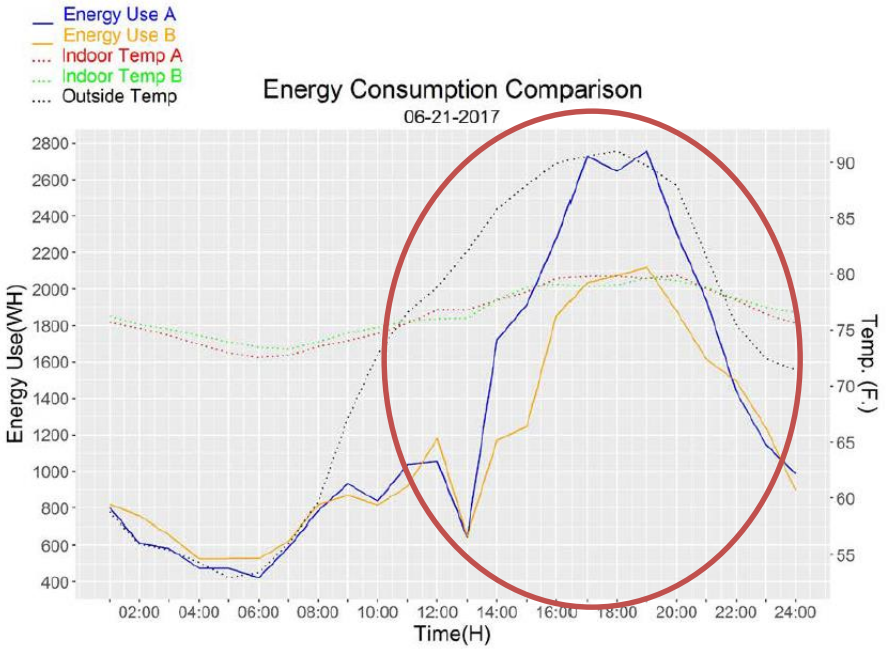


Figure 4.3. Whole-House Cooling Use (solid lines) on a Summer Day with Cellular Shades Closed in the Experimental Home (Lab Home B) and No Shades on the Baseline Home (Lab Home A) Shows Peak Flattening Effect

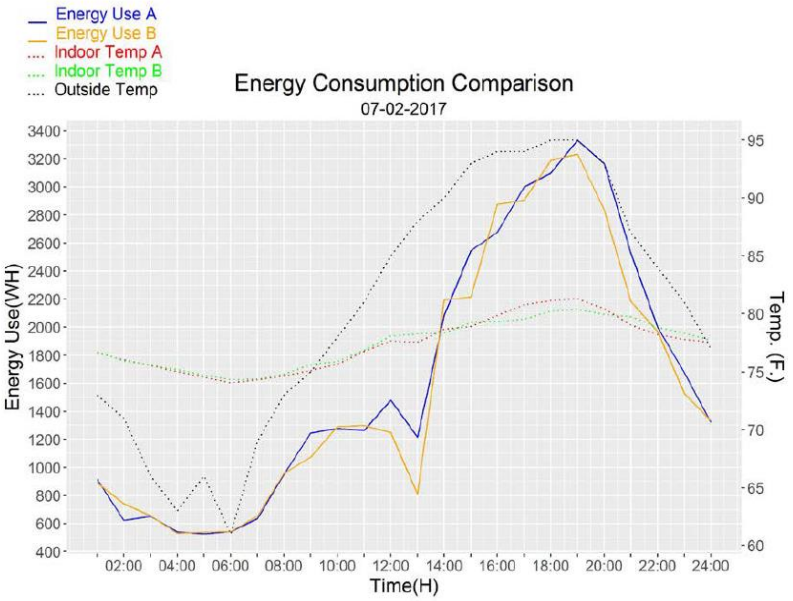


Figure 4.5. Whole-House Cooling Use (solid lines) on a Summer Day with Cellular Shades with Typical Use Settings in the Experimental Home (Lab Home B – yellow line) and Vinyl Blinds with a Typical Use Setting in the Baseline Home (Lab Home A – blue line)

Shades closed in summer

Shades open in summer

Cort et al. Testing the Performance and Dynamic Control of Energy-Efficient Cellular Shades in the PNNL Lab Homes. August 2018. Pacific Northwest National Laboratory. PNNL-27663.

Cellular Shades – PNNL Lab Homes Cooling Season Results

Cooling Test Protocol – Dynamic Control of Cellular Shades Lab Homes Testing	Duration	HVAC Savings % (+/- 95% confidence)	Average W-hr/day Savings
Static Use **compared to blinds with typical use**	6 days	13.3%	2,650
Typical Use **compared to blinds with typical use**	8 days	5.8%	1,487
Optimal and Integrated Control Strategies (in common area rooms) Compared to Blinds operated in Typical Use			
Optimal Control – HD "Green Mode" **Schedule compared to blinds with typical use**	6 days	15.1%	3,287
Typical Use with Occupancy Override 9AM-5PM **compared to blinds with typical use**	11 days	15.2%	3,814

Cort et al. Testing the Performance and Dynamic Control of Energy-Efficient Cellular Shades in the PNNL Lab Homes. August 2018. Pacific Northwest National Laboratory. PNNL-27663.

Cellular Shades – PNNL Lab Homes Cooling Season DR Results

Integrated Control and Demand Response	Duration	HVAC Savings % (+/- 95% confidence)	Average W-hr/day Savings
Cellular shades **pulled down during 4-hr peak and 4°F thermostat increase versus *vinyl blinds*, typical use, no thermostat set-back**	15 days	15.7%	4,060
Cellular shades **pulled down during 4-hr peak and 4°F thermostat increase versus *vinyl blinds*, typical use, 4°F thermostat increase**	8 days	16.6%	2,998

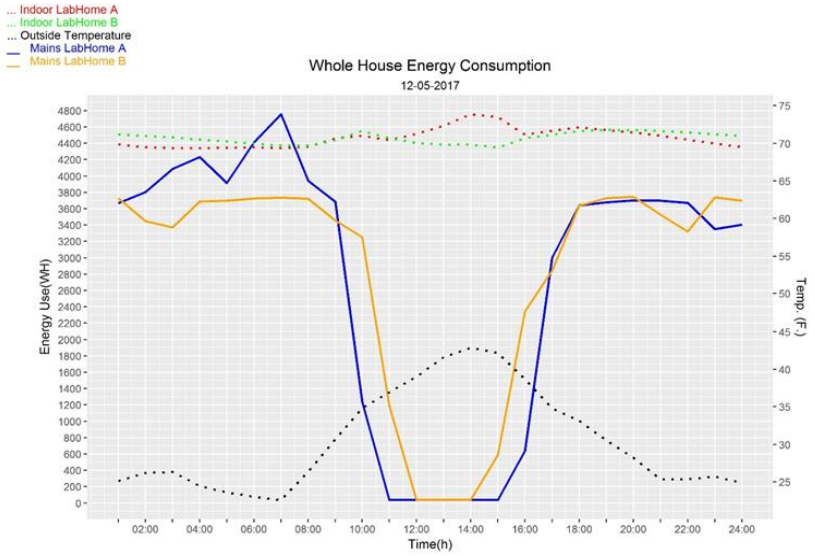
Cort et al. Testing the Performance and Dynamic Control of Energy-Efficient Cellular Shades in the PNNL Lab Homes. August 2018. Pacific Northwest National Laboratory. PNNL-27663.

Cellular Shades – PNNL Lab Homes Heating Season Results

Static Thermal Performance	Duration	HVAC Savings % (+/- 95% confidence)	Average W-hr/day Savings
Static use: Double-cell *cellular shades* always pulled down on all windows versus *no shades*	9 days	2.3%	1,970
Static use: Double-cell *cellular shades* always pulled down on all windows versus *vinyl blinds*, always down	6 days	9.3%	7,011
Typical use: Double-cell *cellular shades* bedrooms closed, living/dining open versus *vinyl blinds*, typical use	4 days	2%	1,505

Cort et al. Testing the Performance and Dynamic Control of Energy-Efficient Cellular Shades in the PNNL Lab Homes. August 2018. Pacific Northwest National Laboratory. PNNL-27663.

Cellular Shades - Lab Homes 2017-2018 Heating Season Results



- **Scenario:** Cellular shades up during day and closed at night
- **Results:** HVAC savings were 8% compared to the home with blinds operated typically.

- **Scenario**: Cellular shades covering all windows in Lab Home B and no shades covering Lab Home A
- **Results:** Negligible average savings when shades down all the time (although ~4% savings recorded on very cloudy days)

Cort et al. Testing the Performance and Dynamic Control of Energy-Efficient Cellular Shades in the PNNL Lab Homes. August 2018. Pacific Northwest National Laboratory. PNNL-27663.

Low-E Storm Window Study Results

PNNL Lab Homes – Low-E Storm Windows Energy Savings

Low-E Storm Windows	Baseline and Experiment Description	Energy Savings (%)
Exterior 2014 (Larson Manufacturing)	Metal-frame, double-pane clear glass windows (no window coverings)	Average Annual Savings: **10.1 ±1.4%** Simple Payback = 5-7 yrs
Interior 2015 (Quanta Technologies)	Covering ~75% of window area over double-pane metal-frame clear glass windows	Average Annual Savings: **7.8 ±1.5%**

Knox JR and SH Widder. Evaluation of Low-E Storm Windows in the PNNL Lab Homes. PNNL. May 2014.
Petersen et al. Evaluation of Interior Low-E Storm Windows in the PNNL Lab Homes. PNNL. Oct 2015.
Triple-cell Hunter Douglas cellular shade used for study.

Low-E Storm Windows

- Modern Clear Glass Storm Window vs. Low-E comparison

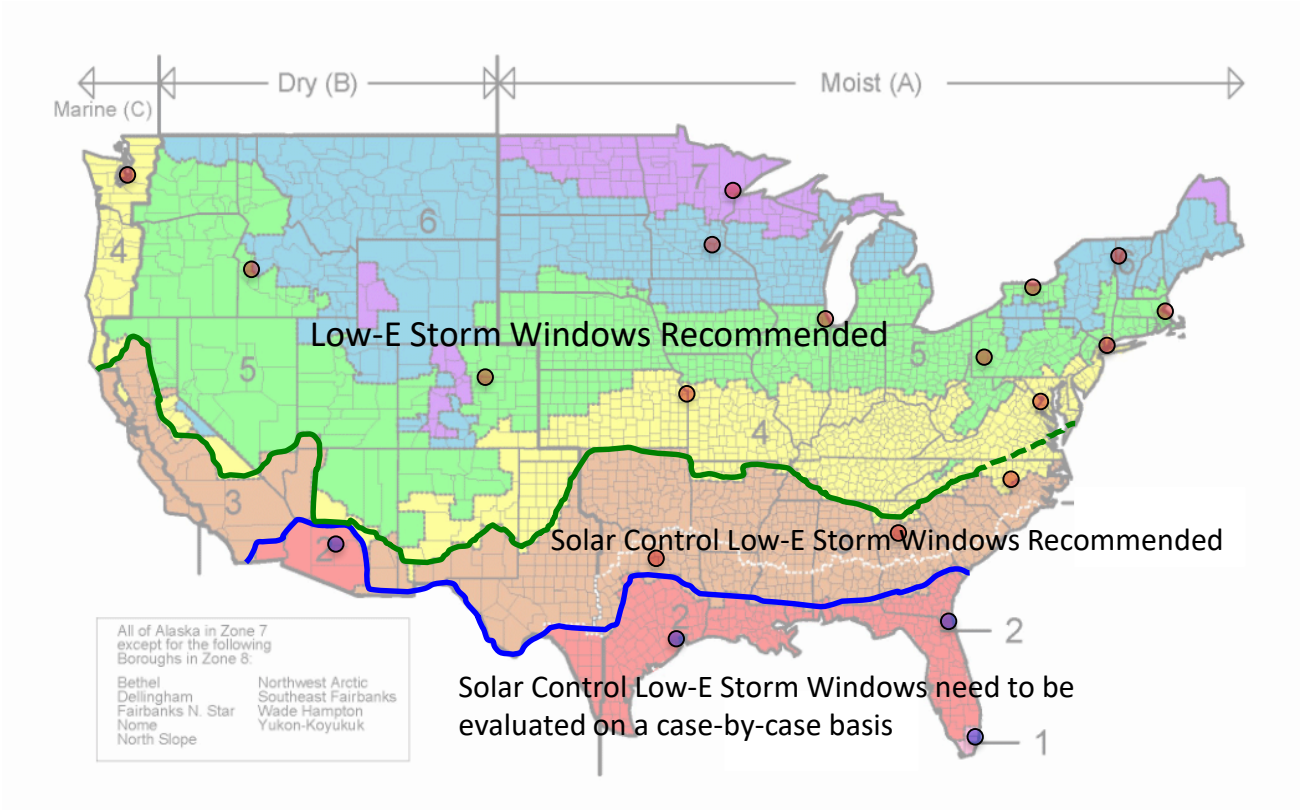
Wood Double Hung, Double Glazed	U-Factor	SHGC
Baseline	0.51	0.57
Clear, Exterior	0.34	0.49
Clear, Interior	0.32	0.51
Low-E, Exterior	0.28	0.42
Low-E, Interior	0.26	0.47

- Older clear glass storm windows will not provide the same performance and air leakage benefit as modern storm windows

Culp et al. Thermal and Optical Properties of Low-E Storm Windows and Panels. Pacific Northwest National Laboratory. July 2015.

Climate Zone Modeling

Over single-pane windows or double-pane metal-framed windows:



Culp et al. 2014 and 2015. PNNL-22864 rev2 and PNNL-24826

- Cost effective in climate zones 3-8
- Savings to Investment Ratio = 1.2 – 3.2

Modeled Energy Savings

Smaller, Older Home (1-story, 1700 sq ft)

Baseline Window: Wood frame, single pane	% Source Energy Savings	Energy Cost Savings	Simple Payback
With exterior low-e storm	25.1%	$418.21	6
With interior low-e storm	27.2%	$450.14	5.6

Culp et al. 2014. PNNL-22864 rev2.

Storm Window Multi-Family Case Studies

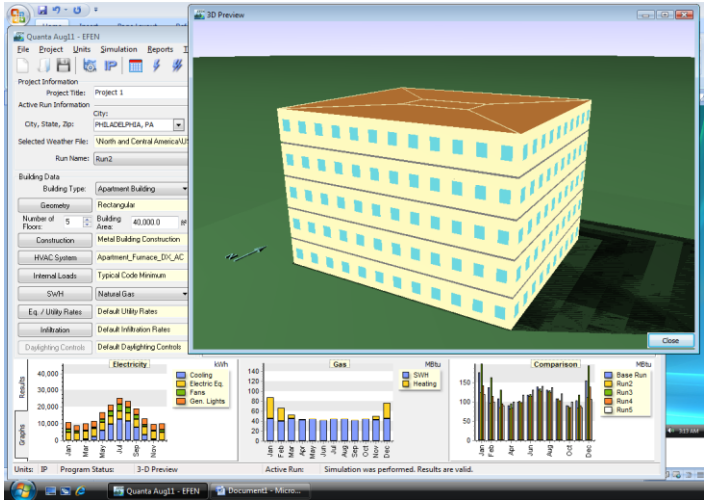
Storm Window Multi-Family Modeling

Multi-Family Modeling

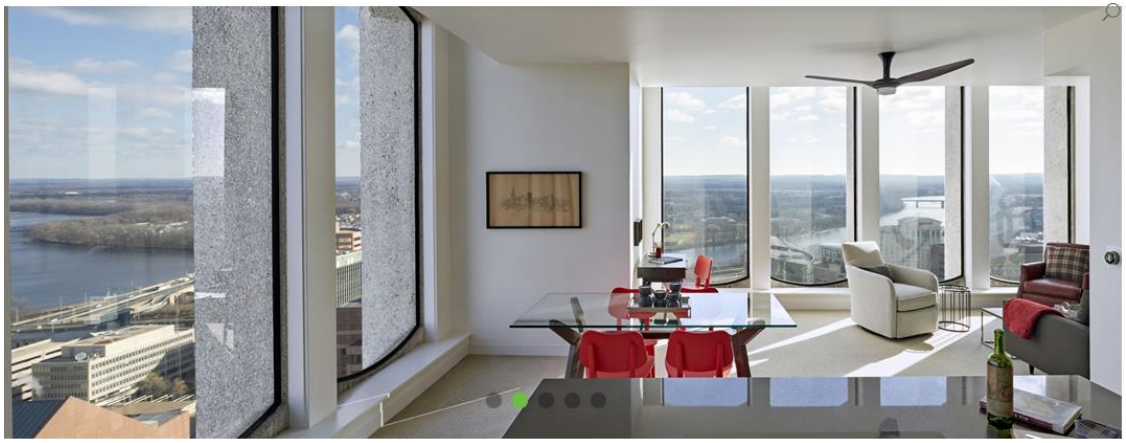
Source: *Birch Point Consulting, 2012..*

	25% Window-to-Wall Ratio				50% Window-to-Wall Ratio			
City	Mbtu Savings	kWh Savings	$ Savings	% Savings	Mbtu Savings	kWh Savings	$ Savings	% Savings
New York	**212**	**8,530**	**$3,967.80**	**22.1%**	**387**	**14,967**	**$7,137.39**	**25.6%**
Chicago	275	9,717	$3,406.20	26.5%	529	18,291	$6,512.15	32.5%
Atlanta	97	9,077	$2,497.39	19.4%	183	16,100	$4,607.54	23.0%

- Model details:
  - 5 story apartment, default construction (e.g. R13 walls, R19 roof)
  - 40,000 ft2 building area; 1.17 aspect ratio (96.6 x 82.8 ft), long side on north/south
  - Single glazing, aluminum window: U 1.14, SHGC 0.76, Air leakage 0.55 (assumes 50%-50% split between operable at 1.0 and fixed at 0.1)
  - With QuantaPanel - interior: U 0.36, SHGC 0.51, Air leakage 0.03

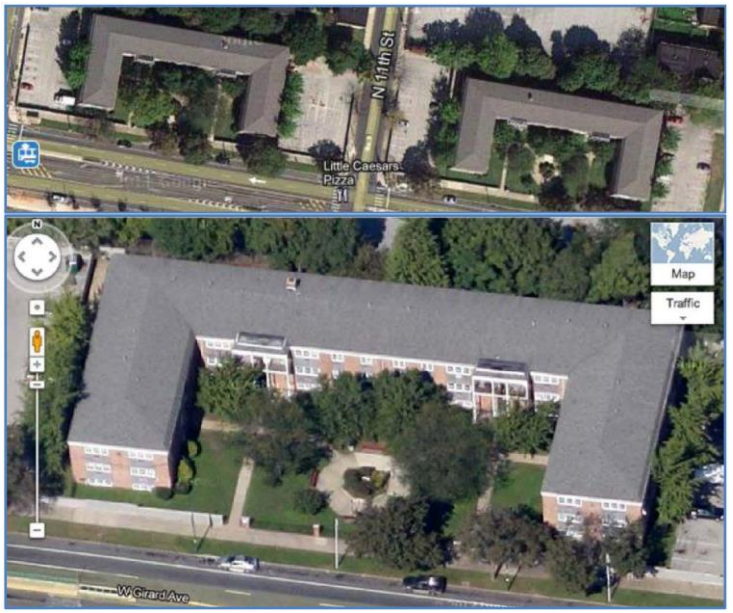


Multi-Family Case Study



Storm Windows
Multi-Family Field Study

- Replaced existing clear glass storm windows with Low-E storm windows in a 101 multi-family unit building in Philadelphia
- Goal to improve air leakage and reduce energy consumption (including supplemental heaters)



Source: *Performance Comparison of a Low-E Storm Window in a Philadelphia Multifamily Apartment Building.* Home Innovation Research Labs, November 2013.

Storm Windows Multi-Family Field Study

- Retrofit assessment techniques:
  - Blower door tests in 15 units
  - Infiltration leakage before and after installation
  - Utility bill comparison before and after installation for winter months

Multi-Family Savings Results

Table 1. Energy Use Comparison Based on Monthly Utility Billing

Heating	October 2011 to April 2012 [A]	October 2012 to April 2013 [B]
Heating Degree-Days, HDD	3,938	4,693
Heating Gas Use [C], therms	22,167	21,692
Normalized Gas Use, therms/HDD	5.63	4.62
Heating Savings Over Base		18%
Heating	**November 2011 to March 2012 [A]**	**November 2012 to March 2013 [B]**
Heating Degree-Days, HDD	3,309	4,058
Heating Gas Use [C], therms	18,808	18,023
Normalized Gas Use, therms/HDD	5.68	4.44
Heating Savings Over Base		22%

[A] Pre-window retrofit
[B] Post-window retrofit.
[C] Heating Gas Use estimated by subtracting estimated hot water gas use in non-heating swing months.

Source: *Performance Comparison of a Low-E Storm Window in a Philadelphia Multifamily Apartment Building.* Home Innovation Research Labs, November 2013.

Multi-Family Savings Results

Table 2. Cooling Electricity Use Estimates

Cooling Month	Apartment Average Electric Use[A], kWh		Estimated Cooling Electric Use, kWh		CDD[B] Normalized, kWh/CDD		Post- to Pre-Retrofit Savings[C]
	2012	2013	2012	2013	2012	2013	
May	322	245	151	124	1.33	1.09	18.0%
June	474	424	278	289	2.45	2.54	-3.8%
July	752	673	557	519	4.90	4.57	6.7%
August	721	482	526	335	4.63	2.95	36.3%
Month Average Total	2,269	1,824	1,512	1,267	1.34	1.21	9.3%

[A] Only non-zero meter values (occupied apartments) included.
[B] CDD = Cooling Degree Days, 65°F base.
[C] Savings based on normalized energy use.

Source: *Performance Comparison of a Low-E Storm Window in a Philadelphia Multifamily Apartment Building.* Home Innovation Research Labs, November 2013.

Commercial Secondary Glazing System Case Study

Philadelphia Office Retrofit

- 12-story office building in Philadelphia
  - Building constructed in 1971
  - Existing technology: Single pane windows with window film
  - Upgrade: commercial SGS panels (RENOVATE system)
    - Converted windows to triple pane Low-E window system
    - Solar control low-e glass and argon fill

Philadelphia Office Retrofit

- Results:
  - East-facing offices: savings between 36% and 39%
  - North-facing offices: savings between 9% and 60%
  - Savings show effects for perimeter offices

Test Office/Orientation	Heating Energy[A], kWh	Cooling Energy[B], kWh
	December - February	July 27 - September[C]
East, Original Glazing, Film	372	341
East, Low-e Retrofit Panels	226	217
East Office Energy Savings	**39%**	**36%**
North, Original Glazing, Film	863	222
North, Low-e Retrofit Panels	343	202
North Office Energy Savings	**60%**	**9%**

Source: *Performance Comparison of a Low-e Retrofit Window in a Philadelphia Office Building.* Home Innovation Research Labs, October 2013.

Philadelphia Office Retrofit

- Results:
  - Smaller temperature swings on glazing surface after retrofit
  - Minimum temperatures 15-20°F greater after retrofit

Table 3. Diurnal Glazing Surface Temperature Range for Selected Periods

Inside Glass Surface Temperature Profile	East Facing		North Facing	
	Low-e Retrofit Panel	Original Single Pane/Film	Low-e Retrofit Panel	Original Single Pane/Film
Winter day, Maximum during day	70 - 76°F	75 - 85°F	65°F	52 - 53°F
Winter day, Minimum during day	57 - 58°F	33 - 40°F	61 - 62°F	34 - 37°F
Summer day, Maximum during day	84°F	104 - 109°F	73 - 74°F	83 - 84°F
Summer day, Minimum during day	72 - 73°F	74 - 75°F	71°F	72°F

Source: *Performance Comparison of a Low-e Retrofit Window in a Philadelphia Office Building.* Home Innovation Research Labs, October 2013.

Philadelphia Office Retrofit

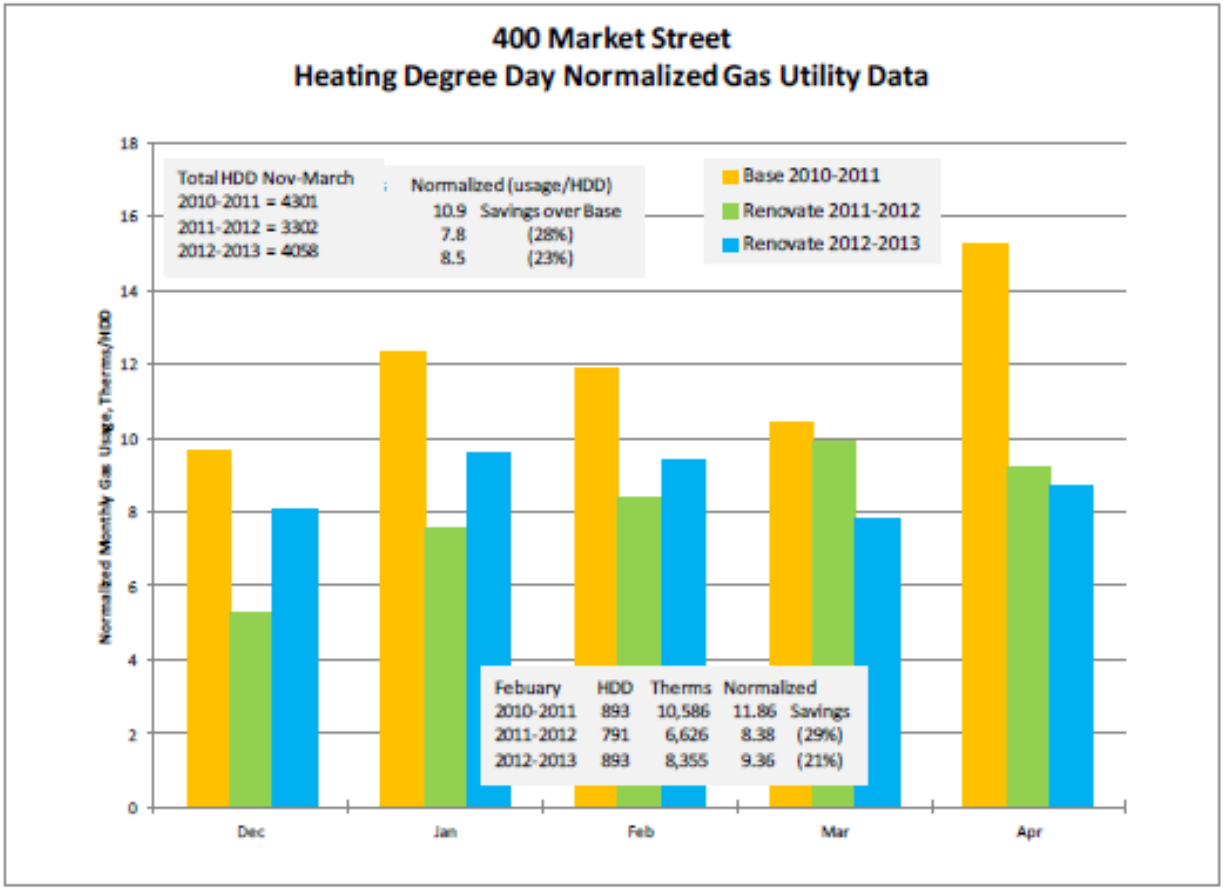


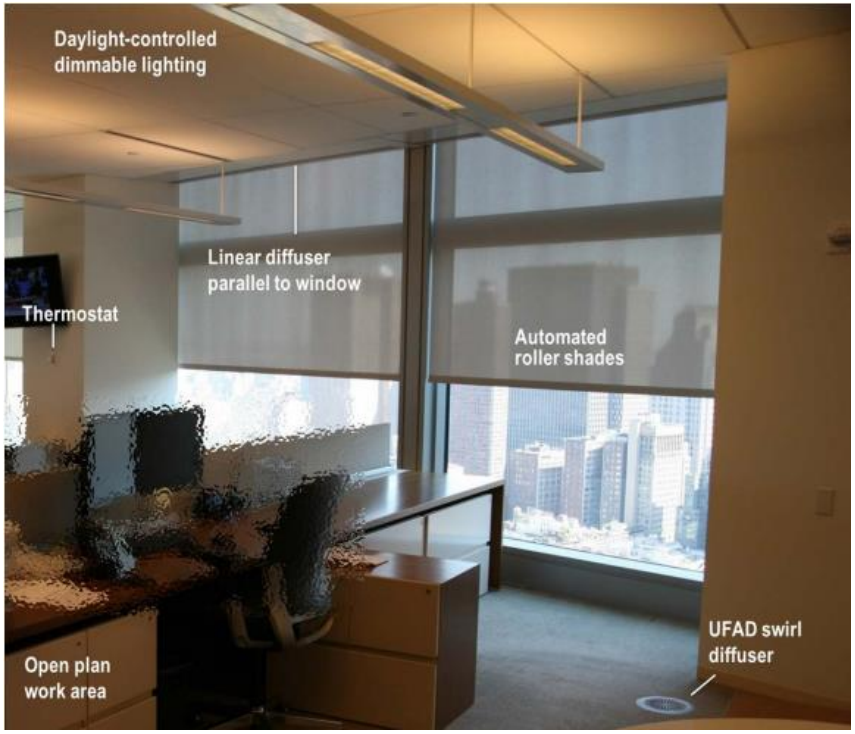
Figure 14. Normalized Heating Fuel Use

Source: *Performance Comparison of a Low-e Retrofit Window in a Philadelphia Office Building.* Home Innovation Research Labs, October 2013.

Commercial Shading Case Studies

New York City – Goldman Sachs Building

- 40,000 ft^2/floor of 43-story high-rise office building
- 1-floor retrofitted with automated shades and LED lighting and controls
- Estimated whole building energy savings from 3.6-4.5 million kWh/year and dollar savings of $730,000-$900,00/year



Source: Demonstration of Energy Efficient Retrofits for Lighting and Daylighting in New York City Office Buildings
https://aercnet.org/wp-content/uploads/2018/10/LBNL_Demonstration-of-Energy-Efficiency-Retrofits-in-NYC-Offices_April-2017.pdf

Melbourne, Victoria, Australia

- 12-story, 8,343 square foot high rise building
- Modeled building retrofitted with automated external venetian blinds
  - Façade replaced with argon-filled double glazed units with low-e coating
- Found energy savings of 27% in comparison to base case building with static shading

Source: Responsive Shading and Energy Efficiency in Office Buildings: an Australian Case Study
https://aercnet.org/wp-content/uploads/2018/10/Melbourne_Responsive-shading-in-office-buildings_2012.pdf

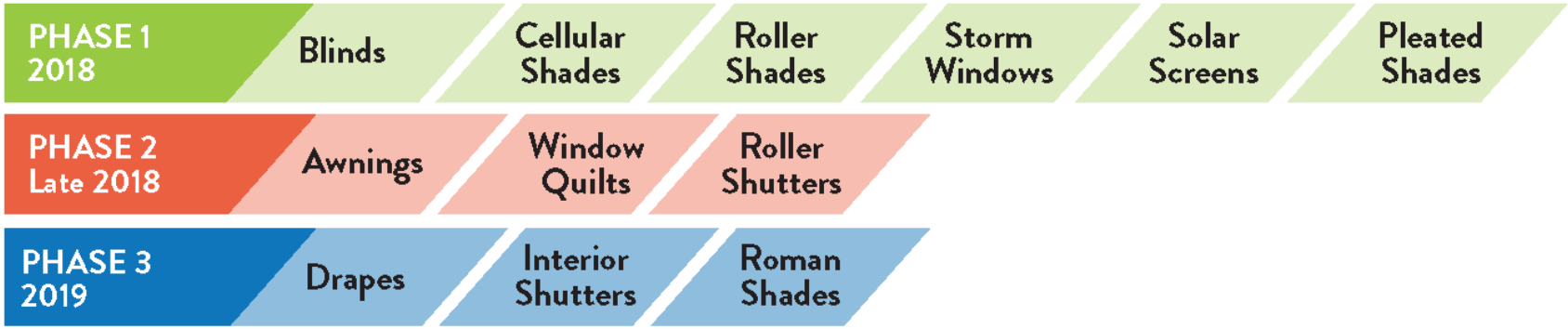
Attachments Energy Rating Council

What is the AERC?

AERC is an independent, **public interest** organization whose mission is to provide consumers with **credible, relevant, and comparable** information about **window attachments** and their **performance.**

- AERC members include
  - Public Interest Groups
  - National Labs
  - Commercial Labs
  - Product Manufacturers
  - Component Manufacturers
  - Utilities

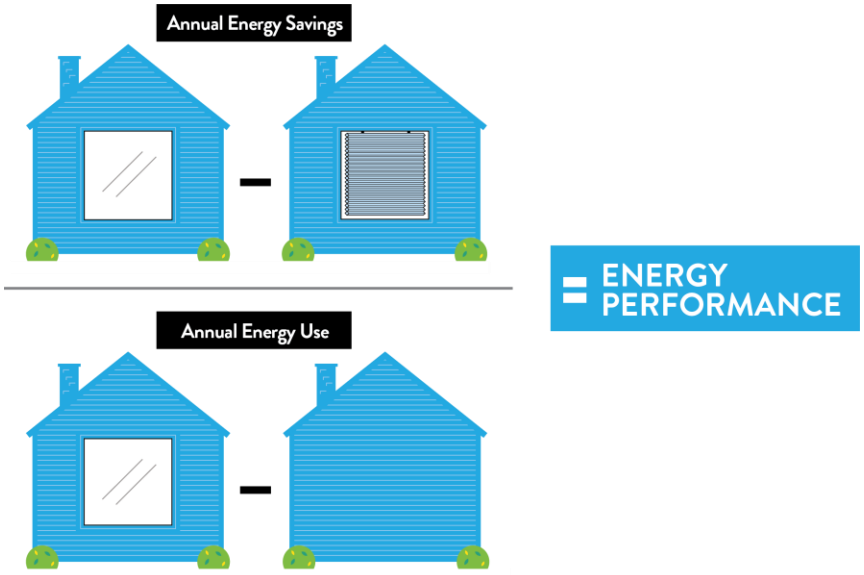
Phased Ratings Development



AERC Technical Ratings

- U-Factor
- Solar Heat Gain Coefficient
- Visual Transmittance
- Air Leakage (as applicable)

- Annual Energy Performance
  - Comparative metric
    - Cold climate
    - Warm climate



Save energy and make your home more comfortable.

Window attachments products with this label–such as **blinds, shades, shutters** and **storm windows**–can help you do both.

1. Look for the AERC Energy Improvement Label

Seeing the AERC Energy Improvement label on a window attachment product means it will help you save energy and make your home more comfortable. This label also allows you compare energy improvement across different product types in order to select the best one for your home.

2. Choose Your Climate

Since window attachments can help keep your home warmer in cool climates and cooler in warm climates, this label helps you select the best product for where you live.

Cool Climate

If you tend to turn on the heat more throughout the year, be sure to look at the **COOL CLIMATE RATING**.

Warm Climate

If you tend to use your air conditioning more throughout the year, then take a look at the **WARM CLIMATE RATING.**

AERC

ENERGY IMPROVEMENT RATING

COOL CLIMATE RATING

96/110

NO IMPROVEMENT — MAX IMPROVEMENT 110

96

STORM WINDOW MAX 110

WARM CLIMATE RATING

48/55

NO IMPROVEMENT — MAX IMPROVEMENT 110

55 STORM WINDOW MAX

48

To find your state's climate zone or learn more, visit:
AERCEnergyRating.org

AERC #12345. DISCLAIMER: THE ATTACHMENTS ENERGY RATING COUNCIL RATINGS ARE BASED ON CERTAIN ASSUMED CRITERIA INCLUDING ATTACHMENT INSTALLATION OVER A DOUBLE-PANE, CLEAR GLASS WINDOW. AERC DOES NOT REPRESENT OR GUARANTEE IN ANY RESPECT THAT THE CONSUMER WILL EXPERIENCE ENERGY SAVINGS. SEE WEBSITE FOR ADDITIONAL RATING CRITERIA DETAILS.

3. Discover Your Energy Savings

The amount of energy you can save will vary based on the type of product you buy.

96/110

The large number indicates the product's **energy rating**.

The smaller number indicates the **maximum energy rating** possible for that product category (storm windows, in this case).

So, the closer the product's energy rating is to the maximum energy rating in your climate, the greater your energy savings!

*In some cases, you may see **"Not applicable for energy savings"** listed instead of a rating number. This means that the product is not recommended for energy improvement in that particular climate.*

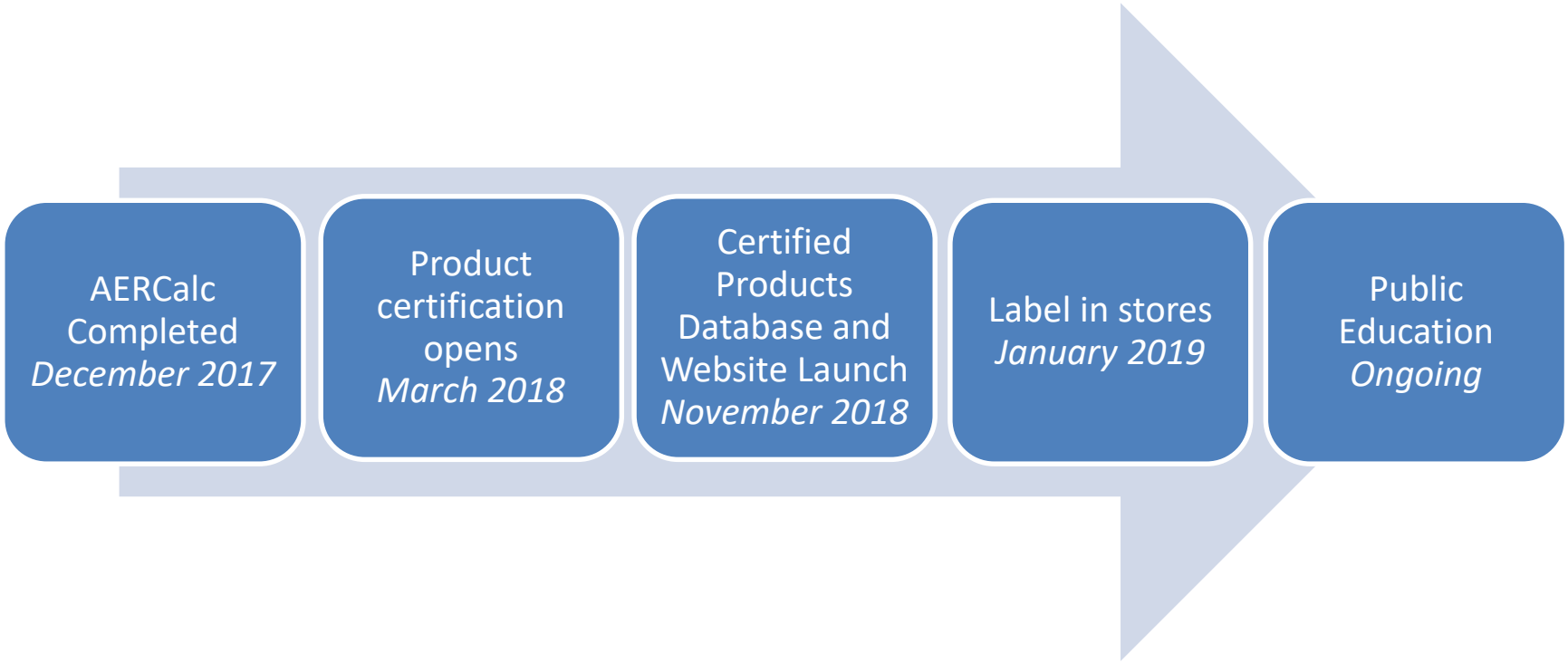
ENERGY RATED. ADDED COMFORT.

Want to learn more? Visit **www.AERCEnergyRating.org**

Energy Performance

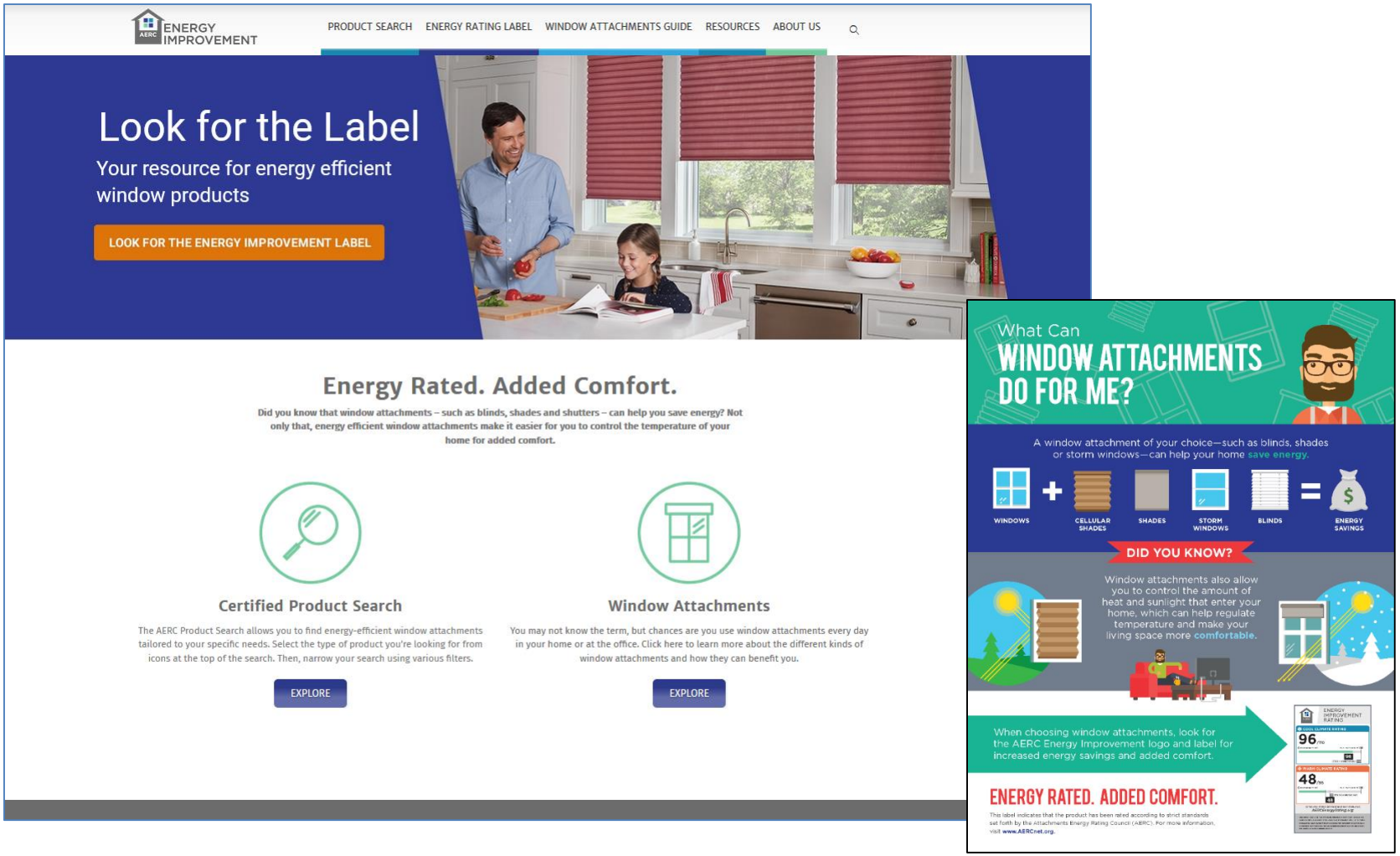
EP value	Signifies: The window attachment installed over baseline window
<0	**Use more energy** on an annual basis than if it had no attachment at all
0	**No net impact on the energy performance** of the home on an annual basis
>0 and 100	**Improves the net annual energy performance** of the home
100	**Performance is equivalent to a net zero energy window**
>100	**Net annual energy producer compared to a net zero energy window**

Timeline



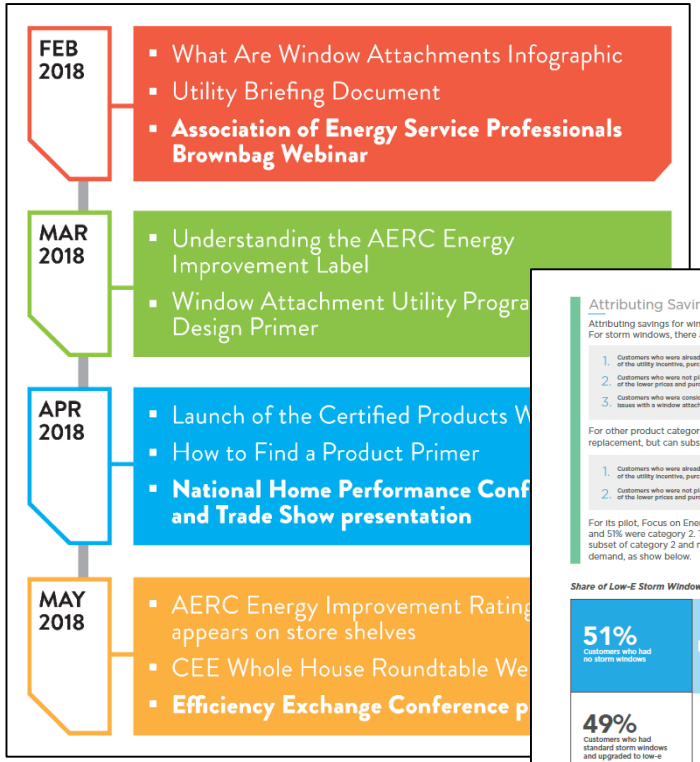
AERC Product Certification is now open!

AERC Certified Products Website

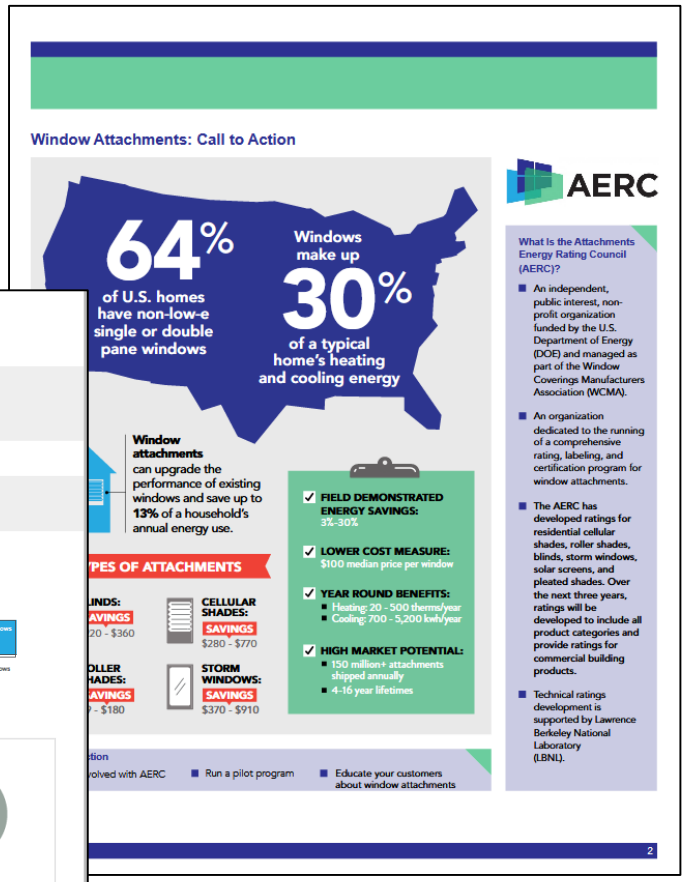


Resources

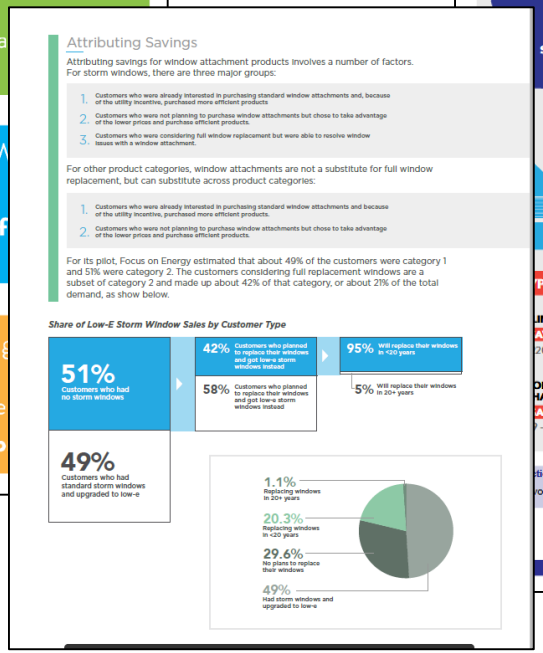
Utility Monthly E-Blast



Utility Briefing Document



Utility Program Design Primer



Get involved!

- Engage with AERC
  - Sign-up for our newsletters
  - Consider becoming a member
  - Participate on utility working group
- AERC can:
  - Provide additional technical details and analysis
    - Check out our Resources page
  - Provide introduction to manufacturers
  - Help facilitate pilot projects or field studies

Visit our website:
www.aercnet.org

Low-E Storm Window Pilots

Pilot Design and Partners

	Efficiency Vermont	Focus on Energy
Location	All of Vermont (5 store locations)	Milwaukee (28 store locations)
Timeline	Aug. 17 – Oct. 12, 2015	Sep. 15 – Nov. 15, 2017
Manufacturer Partners	Larson Manufacturing	Larson Manufacturing and Quanta Panel (multi-family)
Retail Partners	The Home Depot, Lowe's	The Home Depot, Menards (Dedicated to Service & Quality℠)
Markdown	Full product markdown of Low-E storm window incremental cost to clear glass (20-35%)	25% customer discount

Pilot Marketing

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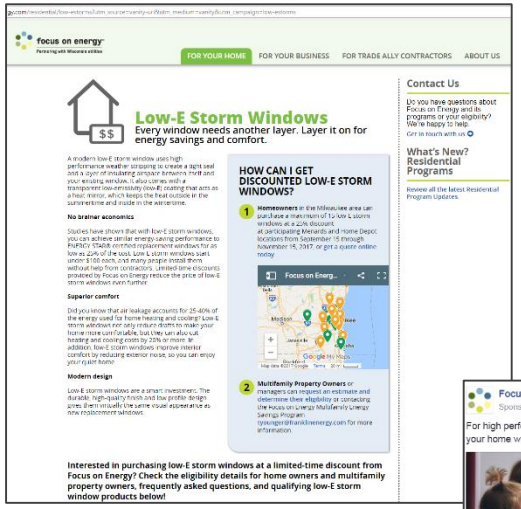
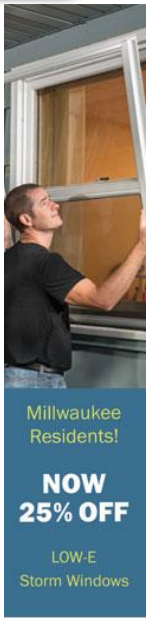
- Branding and messaging of product benefits
- In-store displays
- Utility communications
- Digital marketing and social media ads





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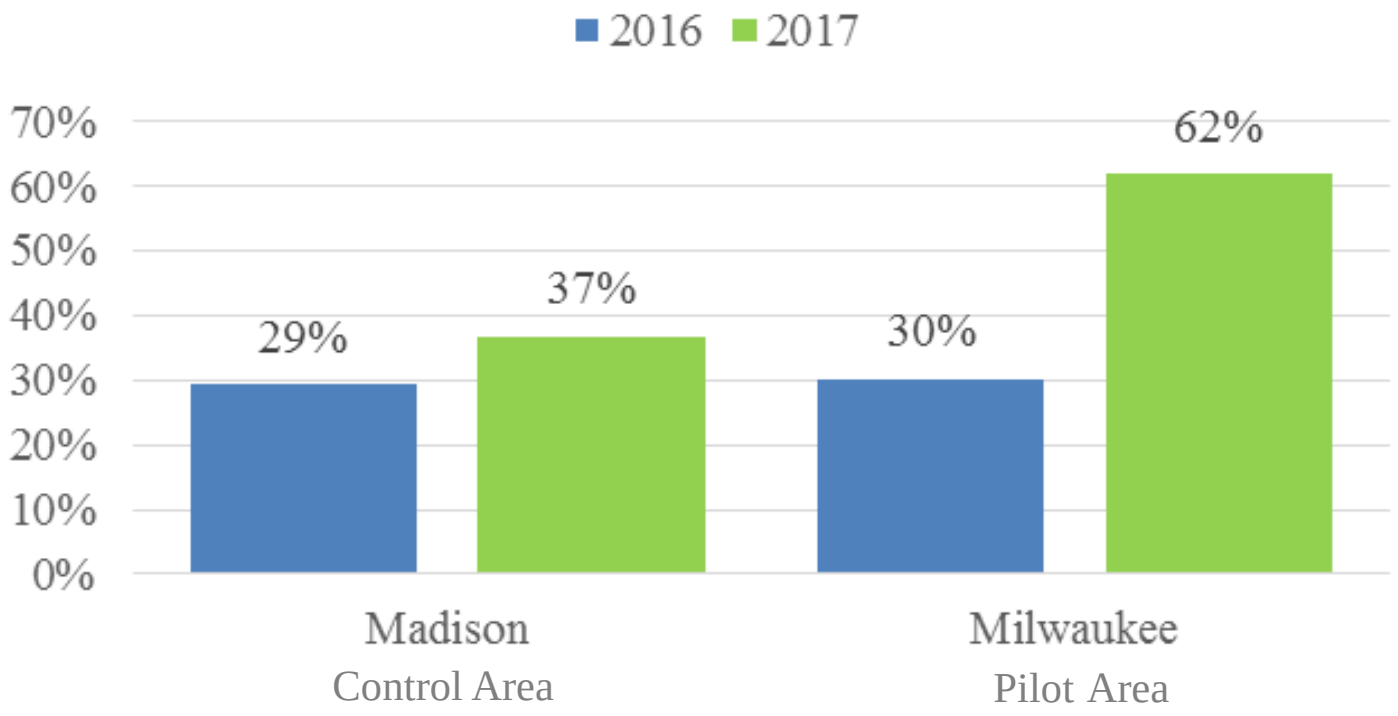
Low-E Storm Window Utility Pilot Results

Pilot (year)	Overall storm window sales increase	Low-E sales increase	Low-E market share
Efficiency Vermont (2015)	37%	337%	2014 – 22% **2015 – 70%**
focus on energy Partnering with Wisconsin utilities (2017)	9.6%	125%	2016 – 30% **2017 – 62%**

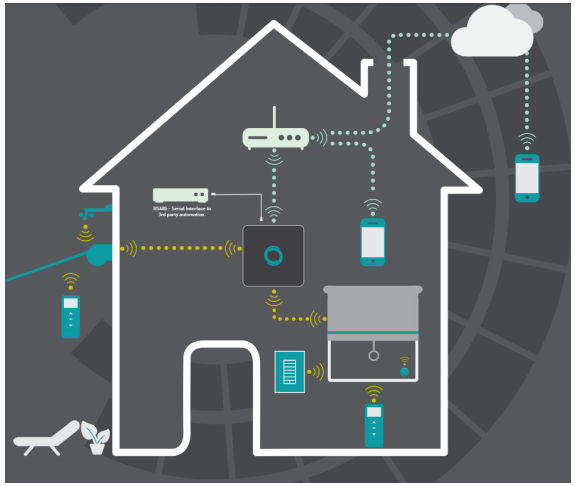
Focus on Energy Comparison City Results



Storm Windows

- ENERGY STAR Storm Window program just launched earlier in September
- Will be included in Wisconsin TRM published in January
- On list for development for Minnesota TRM process currently underway
- Approved by NW RTF as single-family weatherization measure

Pilot/Program Concepts



Pilot Concepts Overview

Commercial

- C&I New Construction or Public Sector
  - Encourage inclusion of automated shades with lighting and HVAC downsizing
- Facility assessments
  - Automated shades
  - Secondary glazing systems
- Target management companies with mid-century buildings for SGS installation and maintenance staff training program
- Test DR capabilities

Residential/Multi-Family

- Nest Seasonal Savings or Total Connected Savings with automated shades
- Low-e storm windows for income eligible programs (single and multi-family)
- Cellular shades for affordable housing new construction
- Public housing retrofits

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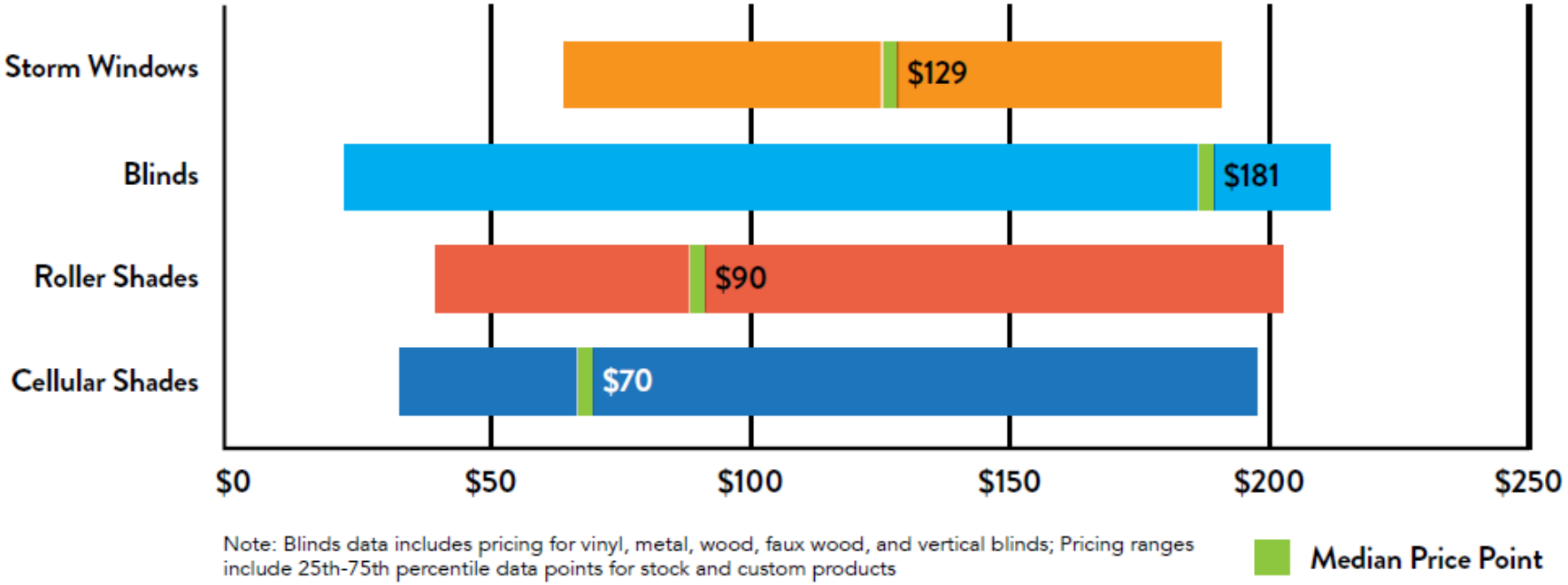
Thank You!

Residential Market Pricing

Product Pricing: Low (Stock) – High (Custom) Price Points



Note: Blinds data includes pricing for vinyl, metal, wood, faux wood, and vertical blinds; Pricing ranges include 25th-75th percentile data points for stock and custom products

Residential Motorization and Automation Pricing

Product Category	Average Price Manual	Average Price Motorized
Cellular Shades	$140	$280
Roller Shades	$145	$290
Blinds	$125	$280

- Average price of hub: $153
- Average price of remote: $45

*Pricing information based on information provided by manufacturers and through internet research conducted by D+R International in October 2018.