Enhancing Window Performance with Energy-Efficient Attachments
• 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

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

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

- Drafts/leaks: 53%
- Mold/moisture: 30%
- Ice build-up: 13%
- Cracks/breaks in the frame or glass: 13%
- Noise/rattling: 6%
- None of the above: 32%

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

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 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
• **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

- Comfort
- Home Resale Value
- Minimize Glare
- Aesthetics
- Privacy
- Energy Efficiency and Energy Savings
- Daylighting
- Noise Control
• **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
• 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

Somfy myLink™

The myLink™ gate opens and closes your shades automatically. You can control them from anywhere in the world. With the myLink app, you can control your shades from anywhere in the world.

Channel Control

The myLink™ gate features up to 16 channels so you can control up to 16 individual or group of motorized solutions with one myLink™. The myLink™ has an ideal channel control and allows you to mix and match motorized solutions with ease. It’s scalable so you can always use multiple myLink™ together if additional channels are needed.

Sunlight Control

The myLink™ gate features an automatic sunlight control to create your perfect living environment. It adjusts blinds and shades automatically to ensure you enjoy each and every day. This feature is perfect for the sunny day and for the hot or cold climate.

The myLink™ gate can be used with almost any standard motor and compatible with most brands of blinds and shades.
Energy Savings Potential of Window Attachments
• 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
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

<table>
<thead>
<tr>
<th>Prototype</th>
<th>HVAC Energy Use (kWh/yr) Based on Cellular Shade Performance Level</th>
<th>Percent Savings Compared to No Shades</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Shades</td>
<td>Double Cell</td>
</tr>
<tr>
<td>Prototype # 1 (U=0.32)</td>
<td>15,957</td>
<td>14,648</td>
</tr>
<tr>
<td>Prototype #2 (U=0.68)</td>
<td>19,371</td>
<td>16,514</td>
</tr>
<tr>
<td>Prototype #3 (U=0.68)</td>
<td>8,999</td>
<td>7,184</td>
</tr>
</tbody>
</table>

• 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


Attachments Energy Rating Council
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
<table>
<thead>
<tr>
<th>Technology (experiment)</th>
<th>Baseline and Experiment Description</th>
<th>Energy Savings (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Efficiency Cellular Shades: Static Operation – always down</strong></td>
<td>Control: Vinyl blinds Use: Closed for duration</td>
<td>Cooling: 13.3 ±2.8%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heating: 10.5 ±3.0%</td>
</tr>
<tr>
<td><strong>High Efficiency Cellular Shades: Optimum Operation Comparison</strong></td>
<td>Control: Vinyl blinds Use: Hunter Douglas energy-saving schedule</td>
<td>Cooling: 10.4 ±6.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heating: 16.6 ±5.3%</td>
</tr>
<tr>
<td><strong>High Efficiency Cellular Shades: Optimum Operation</strong></td>
<td>Control: No blinds (double pane window) Use: Hunter Douglas energy-saving schedule</td>
<td>Cooling: 14.8 ±2.1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heating: 14.4 ±2.0%</td>
</tr>
</tbody>
</table>

All cellular shade products provided by Hunter Douglas.

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

## Cellular Shades – PNNL Lab Homes
### Cooling Season Results

### Cooling Test Protocol – Dynamic Control of Cellular Shades Lab Homes Testing

<table>
<thead>
<tr>
<th>Static Use compared to blinds with typical use</th>
<th>Duration</th>
<th>HVAC Savings % (+/- 95% confidence)</th>
<th>Average W-hr/day Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 days</td>
<td>13.3%</td>
<td>2,650</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Typical Use compared to blinds with typical use</th>
<th>Duration</th>
<th>HVAC Savings % (+/- 95% confidence)</th>
<th>Average W-hr/day Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 days</td>
<td>5.8%</td>
<td>1,487</td>
<td></td>
</tr>
</tbody>
</table>

### Optimal and Integrated Control Strategies (in common area rooms) Compared to Blinds operated in Typical Use

<table>
<thead>
<tr>
<th>Optimal Control – HD “Green Mode” Schedule compared to blinds with typical use</th>
<th>Duration</th>
<th>HVAC Savings % (+/- 95% confidence)</th>
<th>Average W-hr/day Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 days</td>
<td>15.1%</td>
<td>3,287</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Typical Use with Occupancy Override 9AM-5PM compared to blinds with typical use</th>
<th>Duration</th>
<th>HVAC Savings % (+/- 95% confidence)</th>
<th>Average W-hr/day Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 days</td>
<td>15.2%</td>
<td>3,814</td>
<td></td>
</tr>
</tbody>
</table>

## Cellular Shades – PNNL Lab Homes

### Cooling Season DR Results

<table>
<thead>
<tr>
<th>Integrated Control and Demand Response</th>
<th>Duration</th>
<th>HVAC Savings % (± 95% confidence)</th>
<th>Average W-hr/day Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cellular shades</strong> pulled down during 4-hr peak and 4°F thermostat increase versus <em>vinyl blinds</em>, typical use, no thermostat set-back</td>
<td>15 days</td>
<td>15.7%</td>
<td>4,060</td>
</tr>
<tr>
<td><strong>Cellular shades</strong> pulled down during 4-hr peak and 4°F thermostat increase versus <em>vinyl blinds</em>, typical use, 4°F thermostat increase</td>
<td>8 days</td>
<td>16.6%</td>
<td>2,998</td>
</tr>
</tbody>
</table>

*Cellular shades* pulled down during 4-hr peak and 4°F thermostat increase versus *vinyl blinds*, typical use, no thermostat set-back

*Cellular shades* pulled down during 4-hr peak and 4°F thermostat increase versus *vinyl blinds*, typical use, 4°F thermostat increase

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## Static Thermal Performance

<table>
<thead>
<tr>
<th>Static use: Double-cell cellular shades always pulled down on all windows versus no shades</th>
<th>Duration</th>
<th>HVAC Savings % (+/- 95% confidence)</th>
<th>Average W-hr/day Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 days</td>
<td>2.3%</td>
<td>1,970</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Static use: Double-cell cellular shades always pulled down on all windows versus vinyl blinds, always down</th>
<th>Duration</th>
<th>HVAC Savings % (+/- 95% confidence)</th>
<th>Average W-hr/day Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 days</td>
<td>9.3%</td>
<td>7,011</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Typical use: Double-cell cellular shades bedrooms closed, living/dining open versus vinyl blinds, typical use</th>
<th>Duration</th>
<th>HVAC Savings % (+/- 95% confidence)</th>
<th>Average W-hr/day Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 days</td>
<td>2%</td>
<td>1,505</td>
<td></td>
</tr>
</tbody>
</table>

Cellular Shades - Lab Homes 2017-2018 Heating Season Results

- **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)

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

Low-E Storm Window Study Results
## PNNL Lab Homes – Low-E Storm Windows Energy Savings

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

Triple-cell Hunter Douglas cellular shade used for study.
• Modern Clear Glass Storm Window vs. Low-E comparison

<table>
<thead>
<tr>
<th>Wood Double Hung, Double Glazed</th>
<th>U-Factor</th>
<th>SHGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>0.51</td>
<td>0.57</td>
</tr>
<tr>
<td>Clear, Exterior</td>
<td>0.34</td>
<td>0.49</td>
</tr>
<tr>
<td>Clear, Interior</td>
<td>0.32</td>
<td>0.51</td>
</tr>
<tr>
<td>Low-E, Exterior</td>
<td>0.28</td>
<td>0.42</td>
</tr>
<tr>
<td>Low-E, Interior</td>
<td>0.26</td>
<td>0.47</td>
</tr>
</tbody>
</table>

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

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

- Solar Control Low-E Storm Windows need to be evaluated on a case-by-case basis.
- Low-E Storm Windows Recommended

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

Culp et al. 2014 and 2015. PNNL-22864 rev2 and PNNL-24826
## Modeled Energy Savings

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

<table>
<thead>
<tr>
<th>Baseline Window: Wood frame, single pane</th>
<th>% Source Energy Savings</th>
<th>Energy Cost Savings</th>
<th>Simple Payback</th>
</tr>
</thead>
<tbody>
<tr>
<td>With exterior low-e storm</td>
<td>25.1%</td>
<td>$418.21</td>
<td>6</td>
</tr>
<tr>
<td>With interior low-e storm</td>
<td>27.2%</td>
<td>$450.14</td>
<td>5.6</td>
</tr>
</tbody>
</table>

Storm Window Multi-Family Case Studies
Storm Window Multi-Family Modeling
### Multi-Family Modeling

**Source:** *Birch Point Consulting, 2012*

<table>
<thead>
<tr>
<th>City</th>
<th>25% Window-to-Wall Ratio</th>
<th>50% Window-to-Wall Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mbtu Savings</td>
<td>kWh Savings</td>
</tr>
<tr>
<td>New York</td>
<td>212</td>
<td>8,530</td>
</tr>
<tr>
<td>Chicago</td>
<td>275</td>
<td>9,717</td>
</tr>
<tr>
<td>Atlanta</td>
<td>97</td>
<td>9,077</td>
</tr>
</tbody>
</table>

- **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)

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

<table>
<thead>
<tr>
<th>Heating</th>
<th>October 2011 to April 2012 A</th>
<th>October 2012 to April 2013 B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Degree-Days, HDD</td>
<td>3,938</td>
<td>4,693</td>
</tr>
<tr>
<td>Heating Gas Use C, therms</td>
<td>22,167</td>
<td>21,692</td>
</tr>
<tr>
<td>Normalized Gas Use, therms/HDD</td>
<td>5.63</td>
<td>4.62</td>
</tr>
<tr>
<td>Heating Savings Over Base</td>
<td></td>
<td>18%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heating</th>
<th>November 2011 to March 2012 A</th>
<th>November 2012 to March 2013 B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Degree-Days, HDD</td>
<td>3,309</td>
<td>4,058</td>
</tr>
<tr>
<td>Heating Gas Use C, therms</td>
<td>18,808</td>
<td>18,023</td>
</tr>
<tr>
<td>Normalized Gas Use, therms/HDD</td>
<td>5.68</td>
<td>4.44</td>
</tr>
<tr>
<td>Heating Savings Over Base</td>
<td></td>
<td>22%</td>
</tr>
</tbody>
</table>

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.

### Table 2. Cooling Electricity Use Estimates

<table>
<thead>
<tr>
<th>Cooling Month</th>
<th>Apartment Average Electric Use(^{A}), kWh</th>
<th>Estimated Cooling Electric Use, kWh</th>
<th>CDD(^{B}) Normalized, kWh/CDD</th>
<th>Post- to Pre-Retrofit Savings(^{C})</th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>322</td>
<td>151</td>
<td>1.33</td>
<td>18.0%</td>
</tr>
<tr>
<td>June</td>
<td>474</td>
<td>278</td>
<td>2.45</td>
<td>-3.8%</td>
</tr>
<tr>
<td>July</td>
<td>752</td>
<td>557</td>
<td>4.90</td>
<td>6.7%</td>
</tr>
<tr>
<td>August</td>
<td>721</td>
<td>526</td>
<td>4.63</td>
<td>36.3%</td>
</tr>
<tr>
<td><strong>Month Average Total</strong></td>
<td><strong>2,269</strong></td>
<td><strong>1,512</strong></td>
<td><strong>1.34</strong></td>
<td><strong>9.3%</strong></td>
</tr>
</tbody>
</table>

\(^{A}\) Only non-zero meter values (occupied apartments) included.

\(^{B}\) CDD = Cooling Degree Days, 65°F base.

\(^{C}\) Savings based on normalized energy use.

Commercial Secondary Glazing System Case Study
• 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
• Results:
  – East-facing offices: savings between 36% and 39%
  – North-facing offices: savings between 9% and 60%
  – Savings show effects for perimeter offices

<table>
<thead>
<tr>
<th>Test Office/Orientation</th>
<th>Heating Energy A, kWh</th>
<th>Cooling Energy B, kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>December - February</td>
<td>July 27 - September</td>
</tr>
<tr>
<td>East, Original Glazing, Film</td>
<td>372</td>
<td>341</td>
</tr>
<tr>
<td>East, Low-e Retrofit Panels</td>
<td>226</td>
<td>217</td>
</tr>
<tr>
<td><strong>East Office Energy Savings</strong></td>
<td><strong>39%</strong></td>
<td><strong>36%</strong></td>
</tr>
<tr>
<td>North, Original Glazing, Film</td>
<td>863</td>
<td>222</td>
</tr>
<tr>
<td>North, Low-e Retrofit Panels</td>
<td>343</td>
<td>202</td>
</tr>
<tr>
<td><strong>North Office Energy Savings</strong></td>
<td><strong>60%</strong></td>
<td><strong>9%</strong></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Inside Glass Surface Temperature Profile</th>
<th>East Facing</th>
<th>North Facing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low-e Retrofit Panel</td>
<td>Original Single Pane/Film</td>
</tr>
<tr>
<td>Winter day, Maximum during day</td>
<td>70 - 76°F</td>
<td>75 - 85°F</td>
</tr>
<tr>
<td>Winter day, Minimum during day</td>
<td>57 - 58°F</td>
<td>33 - 40°F</td>
</tr>
<tr>
<td>Summer day, Maximum during day</td>
<td>84°F</td>
<td>104 - 109°F</td>
</tr>
<tr>
<td>Summer day, Minimum during day</td>
<td>72 - 73°F</td>
<td>74 - 75°F</td>
</tr>
</tbody>
</table>

Commercial Shading Case Studies
New York City –
Goldman Sachs Building

- 40,000 ft²/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-$900,000/year

Source: Demonstration of Energy Efficient Retrofits for Lighting and Daylighting in New York City Office Buildings
• 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
Attachments Energy Rating Council
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

**PHASE 1**
- 2018
- Blinds
- Cellular Shades
- Roller Shades
- Storm Windows
- Solar Screens
- Pleated Shades

**PHASE 2**
- Late 2018
- Awnings
- Window Quilts
- Roller Shutters

**PHASE 3**
- 2019
- Drapes
- Interior Shutters
- Roman Shades
AERC Technical Ratings

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

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

5/6/2020
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.

3. Discover Your Energy Savings

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

- **COOL CLIMATE RATING**
  - 96/110
  - NO IMPROVEMENT: 96
  - MAX IMPROVEMENT: 110
  - STORM WINDOW MAX: 110

- **WARM CLIMATE RATING**
  - 48/55
  - NO IMPROVEMENT: 48
  - MAX IMPROVEMENT: 55
  - STORM WINDOW MAX: 55

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

AERC DISCLAIMER: THE AERC 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.

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.
<table>
<thead>
<tr>
<th>EP value</th>
<th>Signifies: The window attachment installed over baseline window</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0</td>
<td>Use more energy on an annual basis than if it had no attachment at all</td>
</tr>
<tr>
<td>0</td>
<td>No net impact on the energy performance of the home on an annual basis</td>
</tr>
<tr>
<td>&gt;0 and 100</td>
<td>Improves the net annual energy performance of the home</td>
</tr>
<tr>
<td>100</td>
<td>Performance is equivalent to a net zero energy window</td>
</tr>
<tr>
<td>&gt;100</td>
<td>Net annual energy producer compared to a net zero energy window</td>
</tr>
</tbody>
</table>
AERC Product Certification is now open!
Look for the Label
Your resource for energy efficient window products

Energy Rated. Added Comfort.
Did you know that window attachments—such as blinds, shades and shutters—can help you save energy? Not only that, energy efficient window attachments make it easier for you to control the temperature of your home for added comfort.

Certified Product Search
The AERC Product Search allows you to find energy-efficient window attachments tailored to your specific needs. Select the type of product you’re looking for from icons at the top of the search. Then, narrow your search using various filters.

Window Attachments
You may not know the term, but chances are you use window attachments every day in your home or at the office. Click here to learn more about the different kinds of window attachments and how they can benefit you.

What Can WINDOW ATTACHMENTS DO FOR ME?
A window attachment of your choice—such as blinds, shades or storm windows—can help your home save energy.

DID YOU KNOW?
Window attachments also allow you to control the amount of light and sunlight that enter your home, which can help regulate temperature and make your living space more comfortable.

ENERGY RATED. ADD COMFORT.
When choosing window attachments, look for the AERC Energy Improvement logo and label for increased energy savings and added comfort.
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

<table>
<thead>
<tr>
<th></th>
<th>Efficiency Vermont</th>
<th>Focus on Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>All of Vermont (5 store locations)</td>
<td>Milwaukee (28 store locations)</td>
</tr>
<tr>
<td><strong>Timeline</strong></td>
<td>Aug. 17 – Oct. 12, 2015</td>
<td>Sep. 15 – Nov. 15, 2017</td>
</tr>
<tr>
<td><strong>Manufacturer Partners</strong></td>
<td>Larson Manufacturing</td>
<td>Larson Manufacturing and Quanta Panel (multi-family)</td>
</tr>
<tr>
<td><strong>Retail Partners</strong></td>
<td><img src="logo.png" alt="The Home Depot" />, Lowe's, Menards</td>
<td></td>
</tr>
<tr>
<td><strong>Markdown</strong></td>
<td>Full product markdown of Low-E storm window incremental cost to clear glass (20-35%)</td>
<td>25% customer discount</td>
</tr>
</tbody>
</table>
Pilot Marketing

Branding and messaging of product benefits

In-store displays

Utility communications

Digital marketing and social media ads

BENEFITS OF LOW-E STORM WINDOWS

MODERN DESIGN
A visually appealing addition to your home with an easy, ready-to-use design.

NO BRAINER ECONOMICS
The elimination of wasted energy pays for itself many times over.

SUPERIOR COMFORT
Regain comfort everywhere in your home, all year long.
## Low-E Storm Window Utility Pilot Results

<table>
<thead>
<tr>
<th>Pilot (year)</th>
<th>Overall storm window sales increase</th>
<th>Low-E sales increase</th>
<th>Low-E market share</th>
</tr>
</thead>
</table>
| Efficiency Vermont (2015) | 37% | 337% | 2014 – 22%  
                             |          |          | 2015 – 70% |
| Focus on Energy (2017) | 9.6% | 125% | 2016 – 30%  
                             |          |          | 2017 – 62% |
Focus on Energy
Comparison City Results

- Madison Control Area: 29% (2016), 37% (2017)
- Milwaukee Pilot Area: 30% (2016), 62% (2017)
• 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
Thank You!
Product Pricing: Low (Stock) – High (Custom) Price Points

- Storm Windows: $129
- Blinds: $181
- Roller Shades: $90
- Cellular Shades: $70

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

<table>
<thead>
<tr>
<th>Product Category</th>
<th>Average Price Manual</th>
<th>Average Price Motorized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellular Shades</td>
<td>$140</td>
<td>$280</td>
</tr>
<tr>
<td>Roller Shades</td>
<td>$145</td>
<td>$290</td>
</tr>
<tr>
<td>Blinds</td>
<td>$125</td>
<td>$280</td>
</tr>
</tbody>
</table>

- 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.*