DOE’s Building America
Low-E Storm Window Adoption Program

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• Consortium for Energy Efficiency (CEE)
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Problem and Opportunity

Problem

• Windows account for large percent of home’s heating and cooling loads
• 19 billion ft\(^2\) of existing windows, \~40\% with single pane glass
• \~47 million homes with single glazing, another \~46 million with double pane clear
• However, many homeowners are either unwilling or unable to justify upfront cost and longer payback of full window replacement

Opportunity

• **Low-E Storm Windows** offer affordable way to **insulate** and **air seal** existing windows
• Applicable to existing homes and buildings
• Meets savings-to-investment ratio payback threshold for most weatherization programs
• Easy installation

Original single pane window (light color = heat loss)
Market Transformation Progress

- Validate benefits, fill in data gaps
- Identify avenues for market transformation
- Begin developing networks and strategies
- Tailor building models to reach core customers

1. Lab Homes
2. Model Analysis
3. Market Assessment
4. Outreach
5. DOE Rating Support

**Product:** Low-E Storm Window Research and Deployment of Research Results

**Distribution Network:** Key Sources for Research

- Market Analysis (Penn study)
- CEE Outreach and Networking

**Sales Force:** Stakeholders w/Bus. Interest to Promote Research

- E-Star Home Performance
- BA Teams/Installers
- Attachment Manufacturers
- Consortiums/Associations

**Core Customers of Research and Deployment:**

- Weatherization Programs
- Utilities
- Distributors/Retailers
- Government Agencies (HUD)

**End Customers of Research and Deployment:**

- Homeowners
- Multi-family owners
- Small commercial
## Overview of Technology

Data ranges today—PNNL research to fill gaps

<table>
<thead>
<tr>
<th></th>
<th>Single-Pane Window</th>
<th>Double-Pane Replacement window</th>
<th>Clear Storm Window</th>
<th>Preliminary Low-E Storm Window Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Range of window</td>
<td>--</td>
<td>$200 - $500</td>
<td>$70 - $125</td>
<td>$80 – $150</td>
</tr>
<tr>
<td>Installation cost</td>
<td>--</td>
<td>$100 - $500 per window</td>
<td>$2 (DIY) to $60 per window</td>
<td>$2 (DIY) to $60 per window</td>
</tr>
<tr>
<td>SIR compared to single pane</td>
<td>--</td>
<td>&lt; 1 (not qualified for WX programs)</td>
<td>&lt;1 to 1.2 (usually not qualified)</td>
<td>1.4 - 2.2 in PA Higher in colder climates. Well qualified.</td>
</tr>
<tr>
<td>Average HVAC Energy Cost Savings compared to single pane</td>
<td>11 – 35%</td>
<td>5 – 20%</td>
<td>12 – 33%</td>
<td></td>
</tr>
<tr>
<td>U-factor (Btu/hr ft^2 F)</td>
<td>0.84</td>
<td>0.30 – 0.35</td>
<td>0.50</td>
<td>0.36</td>
</tr>
<tr>
<td>SHGC</td>
<td>0.63</td>
<td>0.25 – 0.30</td>
<td>0.56</td>
<td>0.48</td>
</tr>
<tr>
<td>Air leakage (cfm/ft2)</td>
<td>1 – 4</td>
<td>0.1 – 0.3</td>
<td>0.3</td>
<td>0.1 - 0.3</td>
</tr>
</tbody>
</table>
Preliminary Heating Season (2 weeks)

- Average of 10.3% whole-house energy savings (± 2.3 % with 95% confidence).
- HVAC savings were 14.7 % ± 3.7%. As the study progresses, more data will give this number more significance.

Preliminary Cooling Season

- Ongoing
• Using conservative assumptions, low-E storm windows were found to always be cost-effective (i.e., savings-to-Investment Ratio, SIR, greater than 1) when installed over single-pane windows and double-pane (clear) metal-framed windows in climate zones 3–8.

• SIR ranged from 1.2 to 3.2 across the different locations analyzed.

• SIR will be higher in areas with higher heating fuel costs (including electrical resistance or propane heating), and with leakier primary windows.
• Low-E storm windows were also found to be cost-effective when installed over double-pane (clear) wood or vinyl framed windows in climate zones 6–8, and in eastern parts of zone 5 where higher heating fuel costs exist.

• SIR ranged from 1.1 to 1.9 across the different locations analyzed.
Market Assessment: Key Findings

Market Transformation Pathways Identified

**Sales Force:** Stakeholders w/Business Interest to Promote Research

- Window Attachment Manufacturers
- Installers/Home Performance Contractors
- Energy-Efficiency Consortia/Associations
- BA Teams/BB Teams/CBI Teams
- Federal Energy Management Program (FEMP)

**Core Customers of Research and Deployment:**

- Weatherization Programs
- Utilities
- Distributors/Retailers
- Federal Agencies Managing Residential Stock
- Standards and Rating Organization (e.g., Energy Star)

**End Customers of Research and Deployment:**

- Private Homeowners/Occupants (Not Low-Income)
- Multifamily owners
- Low-Income Homes and Public Housing
- Federally Owned Residential Stock
- Applicable Commercial (Small Buildings, Lodging, Nursing Homes, Dormitories)

**Stakeholders**

- Energy Efficiency 
  - Federally Owned Residential Stock

**Federal Energy Management Program (FEMP)**

**Federally Owned Residential Stock**

- Low-Income Homes and Public Housing
- Federally Owned Residential Stock

**Applicable Commercial (Small Buildings, Lodging, Nursing Homes, Dormitories)**

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## Market Assessment

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Strategy/Pathway to Overcoming Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identity Crisis</td>
<td>CEE, Weatherization programs, Utilities, Codes and rating organizations</td>
</tr>
<tr>
<td>Stigma</td>
<td>Utilities, CEE, WAP, and Federal agencies</td>
</tr>
<tr>
<td>Not recognized by rating systems</td>
<td>Codes and rating organizations: NFRC, Building America’s CSI team, ENERGY STAR (EPA/DOE), Home Energy Score (DOE)</td>
</tr>
<tr>
<td>Do-it-yourself (or not)</td>
<td>Weatherization programs, Home Performance with ENERGY STAR, Federal Energy Management Program (FEMP)</td>
</tr>
<tr>
<td>Potential code and building rating barriers</td>
<td>Building America’s Codes and Standards Innovation (CSI) Team</td>
</tr>
<tr>
<td>Industry structure</td>
<td>No specific strategy identified</td>
</tr>
</tbody>
</table>
Most storm windows currently sold are clear glass. Transformation: 90% of storm windows sold are low-e.
References:


Preliminary Lab Home Results – Final Results forthcoming winter, 2014.