Emily Zachery
Dan Lauf
D&R International
Agenda

• Proposed Draft 1 Window Criteria
• Proposed Draft 1 Door Criteria
• Proposed Draft 1 Skylight Criteria
• Comment Period
Agenda

• Proposed Draft 1 Window Criteria
• Proposed Draft 1 Door Criteria
• Proposed Draft 1 Skylight Criteria
• Stakeholder Meeting
V6.0 Draft 1 Criteria

- Overview
- Technological Feasibility & Product Availability
- Cost-Effectiveness
- Aggregate National Energy Savings Potential
- Possible Considerations for V7.0
## Proposed Criteria

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>U-Factor</th>
<th>SHGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>≤ 0.27</td>
<td>Any</td>
</tr>
<tr>
<td>Trade-Off</td>
<td>= 0.28</td>
<td>≥ 0.32</td>
</tr>
<tr>
<td>North-Central</td>
<td>≤ 0.29</td>
<td>≤ 0.40</td>
</tr>
<tr>
<td>South-Central</td>
<td>≤ 0.31</td>
<td>≤ 0.25</td>
</tr>
<tr>
<td>Southern</td>
<td>≤ 0.40</td>
<td>≤ 0.25</td>
</tr>
</tbody>
</table>

## Current Criteria

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>U-Factor</th>
<th>SHGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>≤ 0.30</td>
<td>Any</td>
</tr>
<tr>
<td>Trade-Offs</td>
<td>= 0.31</td>
<td>≥ 0.35</td>
</tr>
<tr>
<td></td>
<td>= 0.32</td>
<td>≥ 0.40</td>
</tr>
<tr>
<td>North-Central</td>
<td>≤ 0.32</td>
<td>≤ 0.40</td>
</tr>
<tr>
<td>South-Central</td>
<td>≤ 0.35</td>
<td>≤ 0.30</td>
</tr>
<tr>
<td>Southern</td>
<td>≤ 0.60</td>
<td>≤ 0.27</td>
</tr>
</tbody>
</table>
V6.0 Draft 1 Criteria

• Overview

• Technological Feasibility & Product Availability

• Cost-Effectiveness

• Aggregate National Energy Savings Potential

• Possible Considerations for V7.0
Technological Feasibility & Product Availability

• NFRC CPD Data Analysis
• Products Available for Sale Methodology
• Availability of Low U-Factor Windows
• Glazing Level and Gas Fill
• Glass Type
• Frame Materials
• Exploration of Select Alternate Proposals
NFRC CPD Data Analysis

Number of Panes

- Single
- Double
- Triple
- Quad

Low-E Surface 4

Gas Fill

- Air
- Argon
- Krypton
- Xenon

Spacer

- Traditional AL
- AL Combination
- Warm-Edge

U-Factor

= Average

= Median
NFRC CPD Data Analysis

- Vinyl
  - Insulated Vinyl
  - Reinforced Vinyl
- Wood
- AL-Clad Wood
- Wood Composite
- Vinyl-Clad Wood
- Cellular PVC
- Fiberglass
- Aluminum
  - Thermally Improved AL

= Average
= Median

U-Factor
Products Available for Sale Methodology

Random Sample of CPD U-Factors
CPD versus PA Analysis

![Chart showing U-Factor distribution for Products Available for Sale, CPD Top 20 Manufacturers, and CPD All Products.](chart_image)
Availability of Low U-Factor Windows (CPD)
Availability of Low U-Factor Windows (PA)
Glazing Level (CPD)
Glazing Level and Gas Fill (CPD)
Glazing Level and Gas Fill (PA)
Glass Type: Surface 4 (CPD)
Glass Type: Whole-Product VT for Low SHGC (CPD)
Glass Type: COG VT for Low SHGC (CPD)
Frame Materials (CPD)
Frame Materials (PA)
Exploration of Select Alternate Proposals

- Allow any SHGC in North-Central
  - ES would not meet code
- Establish minimum SHGC in Northern Zone

<table>
<thead>
<tr>
<th>U-Factor ≤ 0.27</th>
<th>Double- and Triple-Pane</th>
<th>Double-Pane Only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>SHGC ≥ 0.32</td>
<td>4,562</td>
<td>0.77%</td>
</tr>
<tr>
<td>SHGC ≥ 0.40</td>
<td>933</td>
<td>0.16%</td>
</tr>
</tbody>
</table>

("Products Available for Sale" database contained no windows meeting these criteria)
V6.0 Draft 1 Criteria

• Overview
• Technological Feasibility & Product Availability
• Cost-Effectiveness
• Aggregate National Energy Savings Potential
• Possible Considerations for V7.0
Cost-Effectiveness

- Incremental Product Costs
- Household Energy Savings
- Payback
Incremental Product Costs

- Calculated two sets of incremental product costs
  - Cost increase from V5.0 to V6.0 (to evaluate manufacturer cost)
  - Cost increase from IECC 2009 to V6.0 (to calculate payback for consumer)

<table>
<thead>
<tr>
<th>Zone</th>
<th>U-Factor</th>
<th>SHGC</th>
<th>V5 to V6</th>
<th>IECC ’09 to V5</th>
<th>IECC ’09 to V6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>0.27</td>
<td>Any</td>
<td>$34.00</td>
<td>+ $20</td>
<td>$54.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$173.00 (incl. trips)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North-Central</td>
<td>0.29</td>
<td>0.35</td>
<td>$28.00</td>
<td>+ $20</td>
<td>$48.00</td>
</tr>
<tr>
<td>South-Central</td>
<td>0.31</td>
<td>0.25</td>
<td>$21.00</td>
<td>+ $20</td>
<td>$41.00</td>
</tr>
<tr>
<td>Southern</td>
<td>0.40</td>
<td>0.25</td>
<td>$13.00</td>
<td>+ $20</td>
<td>$33.00</td>
</tr>
</tbody>
</table>
Household Energy Savings

- Same methodology and assumptions as previous criteria revision
- Modeled two baselines
  - Single-pane clear
  - Double-pane clear
- Calculate marginal savings of V6.0 over both baselines
- Double-clear used to determine payback
Payback

- Average window lifetime 20-30 years
- Payback for Los Angeles Excluded
  - Extremely low baseline energy usage
- Median simple payback 11 years
- Mean simple payback 13 years

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Mean Payback Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>14 years</td>
</tr>
<tr>
<td>North-Central</td>
<td>16 years</td>
</tr>
<tr>
<td>South-Central</td>
<td>15 years</td>
</tr>
<tr>
<td>Southern</td>
<td>6 years</td>
</tr>
</tbody>
</table>
V6.0 Draft 1 Criteria

• Overview
• Technological Feasibility & Product Availability
• Cost-Effectiveness
• Aggregate National Energy Savings Potential
• Possible Considerations for V7.0
Aggregate National Energy Savings over V5

2.21 tBtu
Total First Year Savings

- Southern: 45%
- North-Central: 21%
- South-Central: 10%
- Northern: 24%

V6.0 Draft 1 Criteria

- Overview
- Technological Feasibility & Product Availability
- Cost-Effectiveness
- Aggregate National Energy Savings Potential
- Possible Considerations for V7.0
Possible Considerations for Version 7.0

- Program Elements Considered during Version 6.0 Criteria Revision
- Program Elements Unchanged during Version 6.0 Criteria Revision
- Future Codes
- Most Efficient Program
- Emerging Technologies
Agenda

• Proposed Draft 1 Window Criteria
• Proposed Draft 1 Door Criteria
• Proposed Draft 1 Skylight Criteria
• Comment Period
V6.0 Draft 1 Criteria

• Overview
• Technological Feasibility
• Cost-Effectiveness
## Proposed Criteria

<table>
<thead>
<tr>
<th>Glazing Level</th>
<th>U-Factor</th>
<th>SHGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opaque</td>
<td>≤ 0.17</td>
<td>No Rating</td>
</tr>
<tr>
<td>≤ ½-Lite</td>
<td>≤ 0.23</td>
<td>≤ 0.25</td>
</tr>
<tr>
<td>&gt; ½-Lite</td>
<td>≤ 0.30</td>
<td>≤ 0.25</td>
</tr>
</tbody>
</table>

## Current Criteria

<table>
<thead>
<tr>
<th>Glazing Level</th>
<th>U-Factor</th>
<th>SHGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opaque</td>
<td>≤ 0.21</td>
<td>No Rating</td>
</tr>
<tr>
<td>≤ ½-Lite</td>
<td>≤ 0.27</td>
<td>≤ 0.30</td>
</tr>
<tr>
<td>&gt; ½-Lite</td>
<td>≤ 0.32</td>
<td>≤ 0.30</td>
</tr>
</tbody>
</table>
Technological Feasibility

Door Core Material

- Wood Solid: U-Factor = 5,934
- Extruded Polystyrene: U-Factor = 414
- Polyurethane: U-Factor = 293,313
- Expanded Polystyrene: U-Factor = 27,090

Legend:
- □ = Average
- ▲ = Median
Technological Feasibility

Door Skin Material

- Wood: 2,511
- Steel: 13,158
- Galvanized Steel: 200,284
- Fiberglass: 103,404
- Aluminum: 4,109

U-Factor

= Average
\(\triangle\) = Median
Technological Feasibility

<table>
<thead>
<tr>
<th>Glazing Level</th>
<th>Percent Qualifying</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opaque</td>
<td>77%</td>
</tr>
<tr>
<td>≤ ½-Lite</td>
<td>77%</td>
</tr>
<tr>
<td>&gt; ½-Lite</td>
<td>67%</td>
</tr>
</tbody>
</table>
Technological Feasibility

83% of Full-Lite Doors have SHGC ≤ 0.25
V6.0 Draft 1 Criteria

- Overview
- Technological Feasibility
- Cost-Effectiveness
Cost-Effectiveness

- Incremental Product Costs
- Household Energy Savings
- Payback
Incremental Product Costs

- Initial incremental product costs only included switching from V5.0 ES to V6.0
- For cost-effectiveness, IECC 2009 makes more sense as a baseline
- Requesting data accordingly in report
- Data shows spec change not cost-prohibitive for manufacturers

<table>
<thead>
<tr>
<th>Glazing Level</th>
<th>U-Factor</th>
<th>SHGC</th>
<th>V5.0 to V6.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opaque</td>
<td>≤ 0.17</td>
<td>No Rating</td>
<td>None</td>
</tr>
<tr>
<td>≤ ½-Lite</td>
<td>≤ 0.23</td>
<td>≤ 0.25</td>
<td>$13.00</td>
</tr>
<tr>
<td>&gt; ½-Lite</td>
<td>≤ 0.30</td>
<td>≤ 0.25</td>
<td>$30.00</td>
</tr>
</tbody>
</table>
Household Energy Savings

• Opaque Doors
  – V6.0 spec matches performance of best-selling products
  – No delta in spec = no energy savings
  – Also no marginal cost

• Less than/Equal to Half-Lite Doors
  – Zero to $2 per year

• Greater than Half-Lite Doors
  – Marginal savings (RESFEN rounds to zero)
Payback

- Opaque Doors
  - N/A (No energy savings; No marginal cost)
- Less than/Equal to Half-Lite Doors
  - Average of 22 years
- Greater than Half-Lite Doors
  - N/A (Marginal savings)
  - Requesting incremental cost from IECC 2009
Agenda

- Proposed Draft 1 Window Criteria
- Proposed Draft 1 Door Criteria
- Proposed Draft 1 Skylight Criteria
- Comment Period
V6.0 Draft 1 Criteria

• Overview
• Technological Feasibility & Product Availability
• Cost-Effectiveness
### Proposed Criteria

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>U-Factor</th>
<th>SHGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>≤ 0.45</td>
<td>≤ 0.35</td>
</tr>
<tr>
<td>North-Central</td>
<td>≤ 0.47</td>
<td>≤ 0.30</td>
</tr>
<tr>
<td>South-Central</td>
<td>≤ 0.50</td>
<td>≤ 0.25</td>
</tr>
<tr>
<td>Southern</td>
<td>≤ 0.60</td>
<td>≤ 0.25</td>
</tr>
</tbody>
</table>

### Current Criteria

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>U-Factor</th>
<th>SHGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>≤ 0.55</td>
<td>Any</td>
</tr>
<tr>
<td>North-Central</td>
<td>≤ 0.55</td>
<td>≤ 0.40</td>
</tr>
<tr>
<td>South-Central</td>
<td>≤ 0.57</td>
<td>≤ 0.30</td>
</tr>
<tr>
<td>Southern</td>
<td>≤ 0.70</td>
<td>≤ 0.30</td>
</tr>
</tbody>
</table>
Technological Feasibility (CPD Skylights)

![Graph showing U-Factor for different glazing, glass type, frame material, and operator type combinations.]

- **Glazing**: Single, Double, Triple
- **Glass Type**: Low-E, Clear
- **Frame Material**: Aluminum, Vinyl, Other, AL Clad-Wood
- **Operator Type**: Domed, Fixed, Operable

U-Factor values range from 0.00 to 1.00, with 4,662 being the average U-Factor value for all products.
Technological Feasibility (CPD TDDs)
CPD versus PA Analysis

% of Total Products

U-Factor
CPD
Products Available for Sale

≤0.44  ≤0.45  ≤0.46  ≤0.47  ≤0.50  ≤0.60
Technological Feasibility Analysis (CPD)

- Number of Products
- SHGC
- U-Factor

SHGC Categories:
- ≥ 0.60
- 0.51-0.59
- 0.46-0.50
- 0.41-0.45
- 0.36-0.40
- 0.31-0.35
- 0.26-0.30
- 0.21-0.25
- ≤ 0.20
Product Availability Analysis

Number of Products vs. U-Factor

SHGC
- 0.51-0.59
- 0.46-0.50
- 0.41-0.45
- 0.36-0.40
- 0.31-0.35
- 0.26-0.30
- 0.21-0.25
- ≤0.2
V6.0 Draft 1 Criteria

- Overview
- Technological Feasibility & Product Availability
- Cost-Effectiveness
Cost-Effectiveness

• Incremental Product Costs
  – Not enough skylight data received to publish
  – Too few TDDs to calculate

<table>
<thead>
<tr>
<th>Zone</th>
<th>U-Factor</th>
<th>SHGC</th>
<th>V5.0 to V6.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>≤ 0.45</td>
<td>≤ 0.35</td>
<td>$0-20</td>
</tr>
<tr>
<td>North-Central</td>
<td>≤ 0.47</td>
<td>≤ 0.30</td>
<td>$0-20</td>
</tr>
<tr>
<td>South-Central</td>
<td>≤ 0.50</td>
<td>≤ 0.25</td>
<td>$20-$40</td>
</tr>
<tr>
<td>Southern</td>
<td>≤ 0.60</td>
<td>≤ 0.25</td>
<td>$20-$40</td>
</tr>
</tbody>
</table>

• Household Energy Savings
  – Zero to $4 per year

• Average Payback of 29 years
Agenda

- Proposed Draft 1 Window Criteria
- Proposed Draft 1 Door Criteria
- Proposed Draft 1 Skylight Criteria
- Comment Period
Comment Period

• Send to windows@energystar.gov

• Mark as “Confidential” any files not to be posted

• All other comments will be posted to http://www.energystar.gov/index.cfm?c=revisions.residential_windows_spec

• Comments due Friday, Sept. 28