



# ENERGY STAR

## Windows, Doors, and Skylights

### Draft 1 Version 7 Stakeholder Webinar

July 27, 2021

**The Webinar will begin shortly.**

**Call-in Number:** +1 (951) 384-3421

**Code:** 437-751-185

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## Welcome to the Stakeholder Meeting

- Thank you to all the stakeholders participating today
- The purpose of this webinar is to present the key elements of EPA's criteria analysis for the Draft 1 Version 7 Specification for Windows, Doors, and Skylights
- We will present each product category in its own section and pause for questions after each section
- EPA will publish these slides on the ENERGY STAR website with other documents related to this specification revision



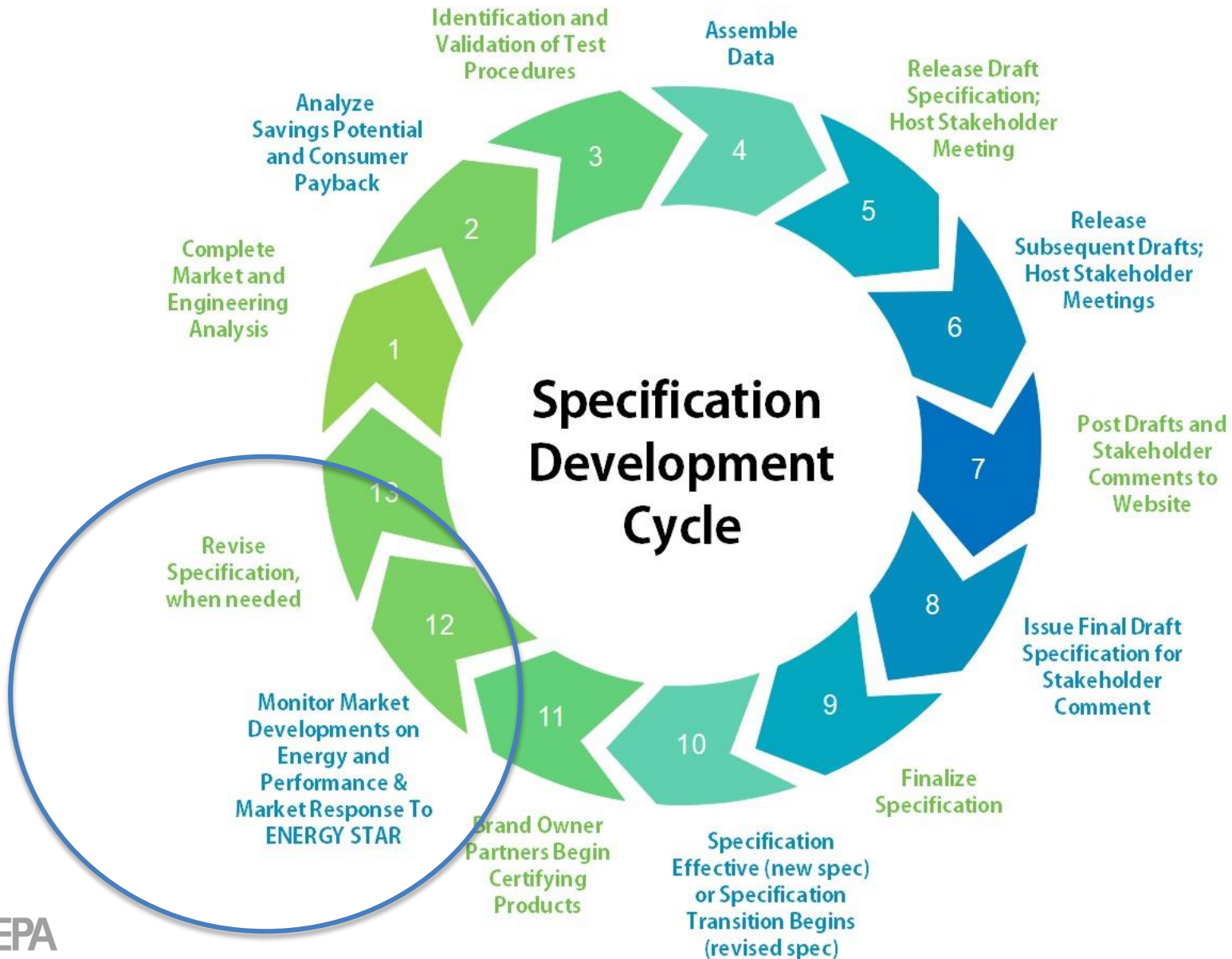
# Agenda

1. Introduction and Process Overview
2. Windows
  - a) Product Availability
  - b) Upgrade Costs
  - c) LBNL Modeling
  - d) Energy Savings and Payback
3. BREAK – 5 minutes
4. Swinging Doors
5. Patio Doors
6. Skylights
7. Climate Zones
8. Additional Topics
9. Marc Lafrance, DOE
10. Next Steps



# Draft 1 Version 7.0 Specification and Data Packages - July 2021

- [Cover Letter](#) (PDF, 211 KB)
- [ENERGY STAR Version 7.0 Residential Windows, Doors, and Skylights Draft 1 Specification](#) (PDF, 297 KB)
- [ENERGY STAR Version 7.0 Residential Windows, Doors, and Skylights Draft 1 Criteria Analysis Report](#) (PDF, 975 KB)
- [Draft 1 Data Package 1 – Product Cost Data Spreadsheet](#) (Excel, 25 KB)
- [Draft 1 Data Package 2a – Certified Product Directory Pathways Analysis – Windows](#) (Excel, 25.1 MB)
- [Draft 1 Data Package 2b – Certified Product Directory Pathways Analysis – Doors and Skylights](#) (Excel, 18.5 MB)
- [Draft 1 Data Package 3a – Savings Data Results and Assumptions](#) (Excel, 192 KB)
- [Draft 1 Data Package 3b – North and North Central Savings Data](#) (Excel, 21.2 MB)
- [Draft 1 Data Package 3c – South and South Central Savings Data](#) (Excel, 11.2 MB)
- [Draft 1 Data Package 4 – Climate Zone Adjustments and Updated Zone Map](#) (Excel, 365 KB)





# Current Market Assessment

## Market Share of Fenestration Products

– Remains relatively high

Product Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Residential Windows	81%	79%	77%	80%	83%	84%	83%	84%	85%	86%
Hinged Entry Doors	71%	73%	74%	76%	77%	79%	78%	80%	79%	80%
All Patio Doors							81%	82%	83%	84%
Skylights	70%	68%	62%	60%	62%	65%	64%	68%	68%	72%

# Current Market Assessment

## 2019 Market Share of Windows by Zone

– Remains relatively high

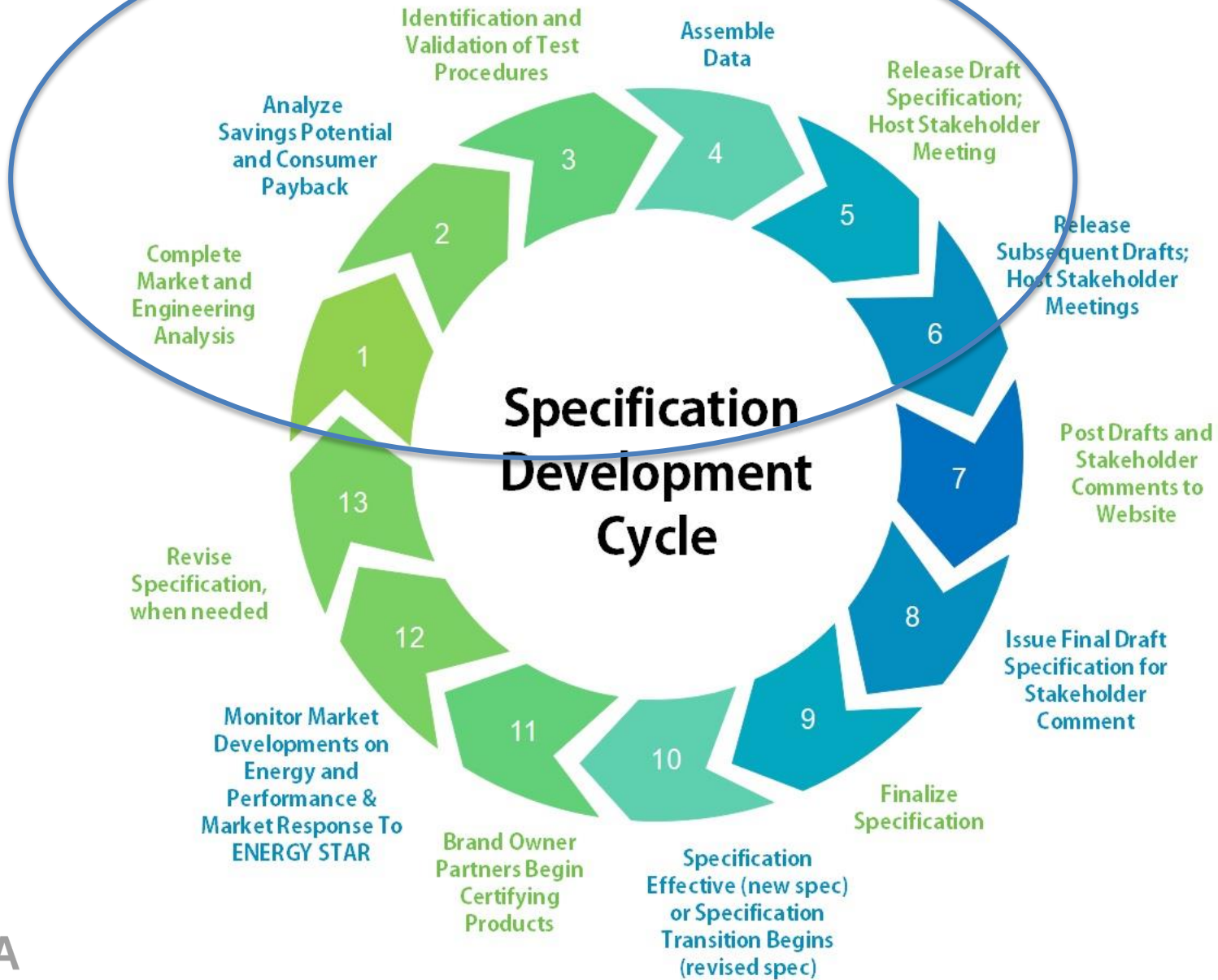
Climate Zone	All Windows Sold	ES Windows Sold	ES Market Share
Northern Zone	19,935,000	17,661,060	89%
North Central Zone	10,692,700	9,370,708	88%
South Central Zone	14,808,000	12,387,796	84%
Southern Zone	6,158,300	4,815,650	78%
Total All Zones	51,594,000	44,235,214	86%



# Current IECC State Code Status

IECC Code Revisions	States	Spec
2018 IECC code w/ amend + CA + OR	17	0.30 N Zone
2015 IECC code w/ amend	12	0.32 N Zone
2012 IECC code w/ amend	3	0.32 N Zone
2009 IECC code w/ amend	9	
None statewide or home rule	10	
<b>Total w/ DC</b>	<b>51</b>	

NOTE: 14 out of 33 Northern Zone States have adopted IECC 2018





# Window Specification Proposal

- Lower U-factor in all zones to improve insulating power
- Lower SHGC in Southern and South-Central to reduce heat gain
- Minimum SHGC in Northern to disqualify dark glass and optimize energy performance

## Version 6

Climate Zone	U-Factor	SHGC	
Northern	$\leq 0.27$	Any	Prescriptive
	$= 0.28$	$\geq 0.32$	Equivalent Energy Performance
	$= 0.29$	$\geq 0.37$	
	$= 0.30$	$\geq 0.42$	
North-Central	$\leq 0.30$	$\leq 0.40$	
South-Central	$\leq 0.30$	$\leq 0.25$	
Southern	$\leq 0.40$	$\leq 0.25$	



## Version 7

Climate Zone	U-Factor	SHGC	
Northern	$\leq 0.22$	$\geq 0.17$	Prescriptive
	$= 0.23$	$\geq 0.35$	Equivalent Energy Performance
	$= 0.24$	$\geq 0.40$	
	$= 0.25$	$\geq 0.45$	
	$= 0.26$	$\geq 0.50$	
North-Central	$\leq 0.24$	$\leq 0.40$	
South-Central	$\leq 0.28$	$\leq 0.23$	
Southern	$\leq 0.32$	$\leq 0.23$	



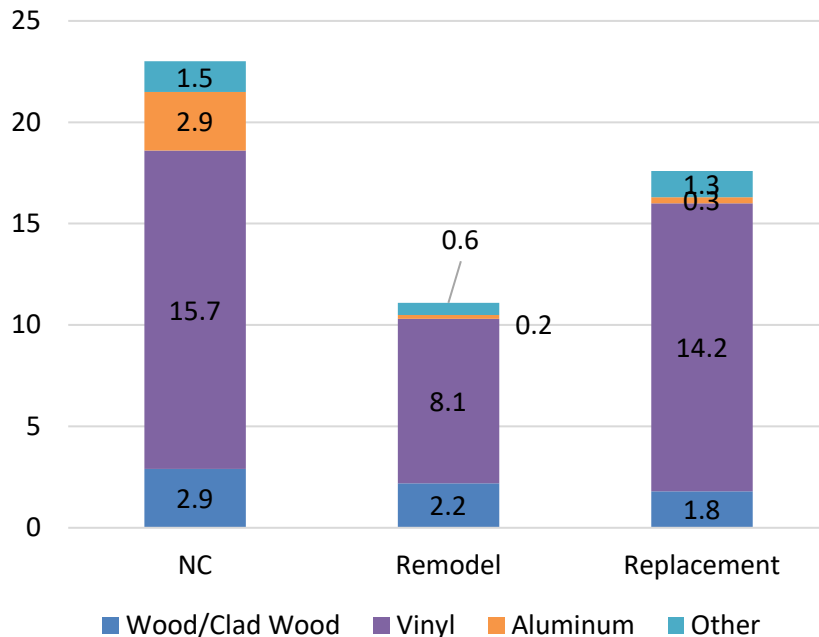
## Product Availability and Technical Feasibility

- EPA analyzed a filtered version of the NFRC Certified Product Directory (CPD) to understand what technologies are used to reach different performance ratings:
  - Gas fill
  - Spacers
  - Room-side Low-e (4<sup>th</sup> surface)
  - Low SHGC Low-e
  - Thermally improved and foam-filled frames
  - Triple Pane
- Focused on vinyl frame, vertical slider windows
- Assumed a 3'x5' window for cost research



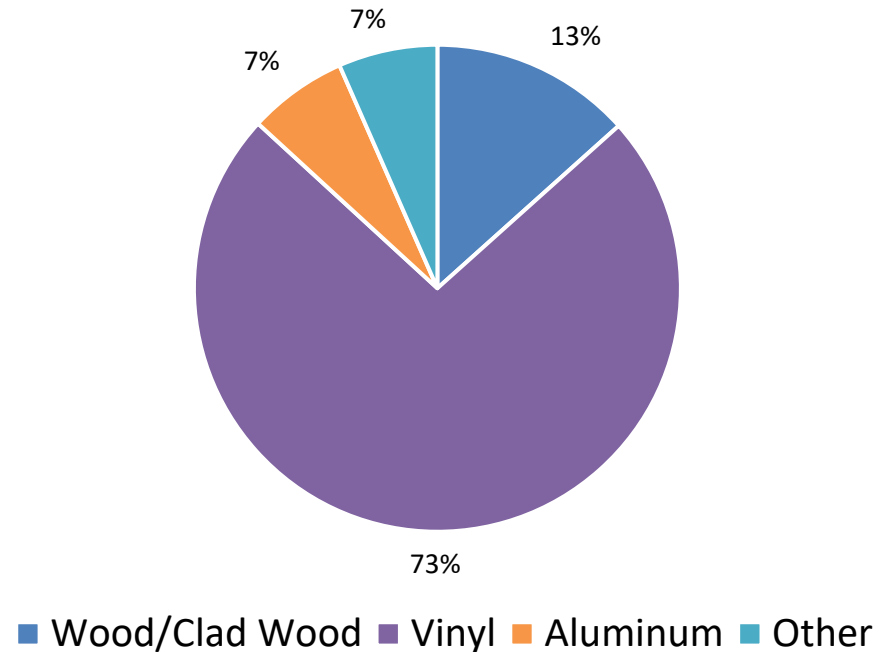
# Market Share by Frame Material and Application

**U.S. Residential Window Sales, 2019  
(Million Units)**



Vinyl represents 73% of the windows market.

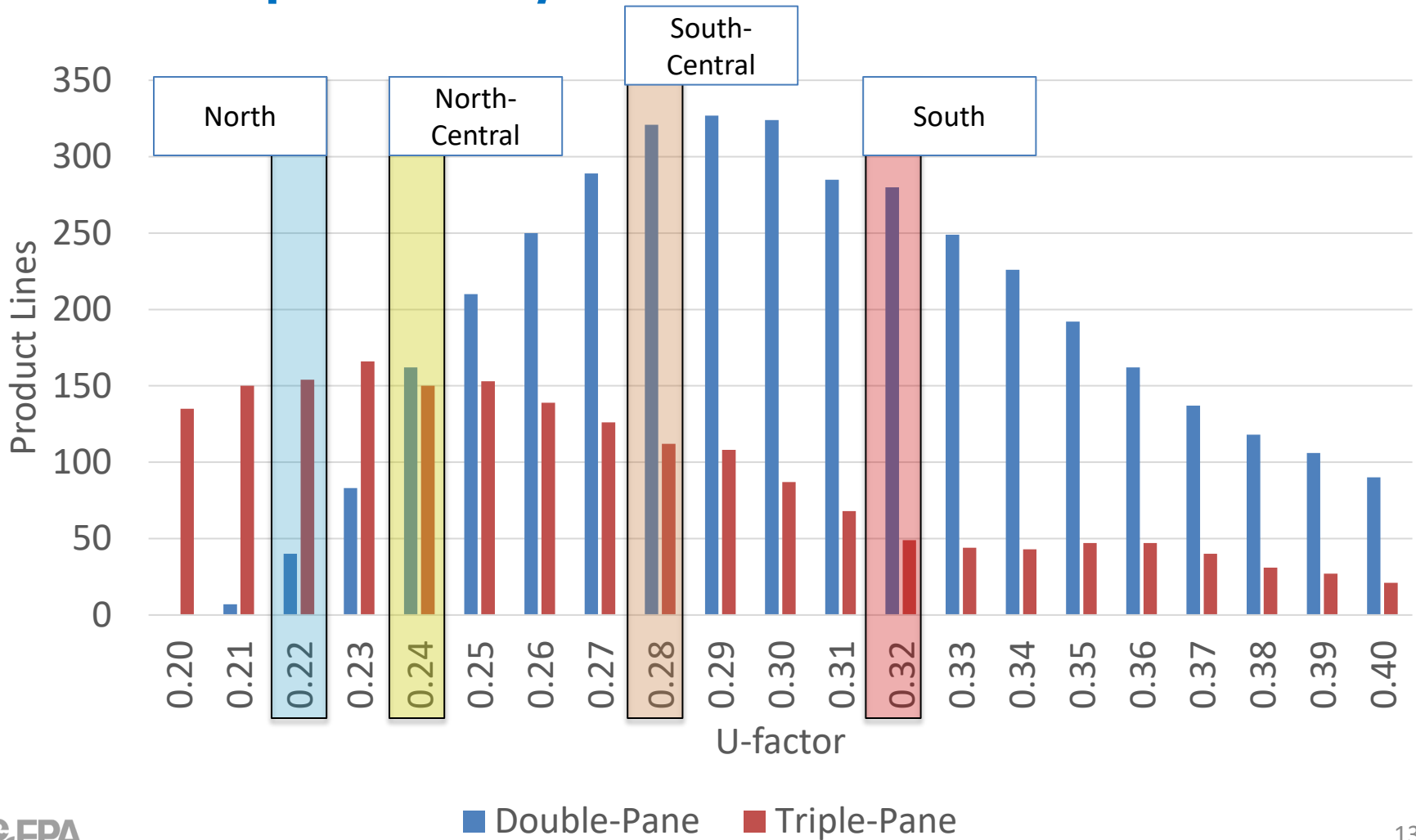
**U.S. Window Sales, 2019  
(% of Total Sales)**



Source: FGIA Study of the U.S. Market for Windows, Doors and Skylights

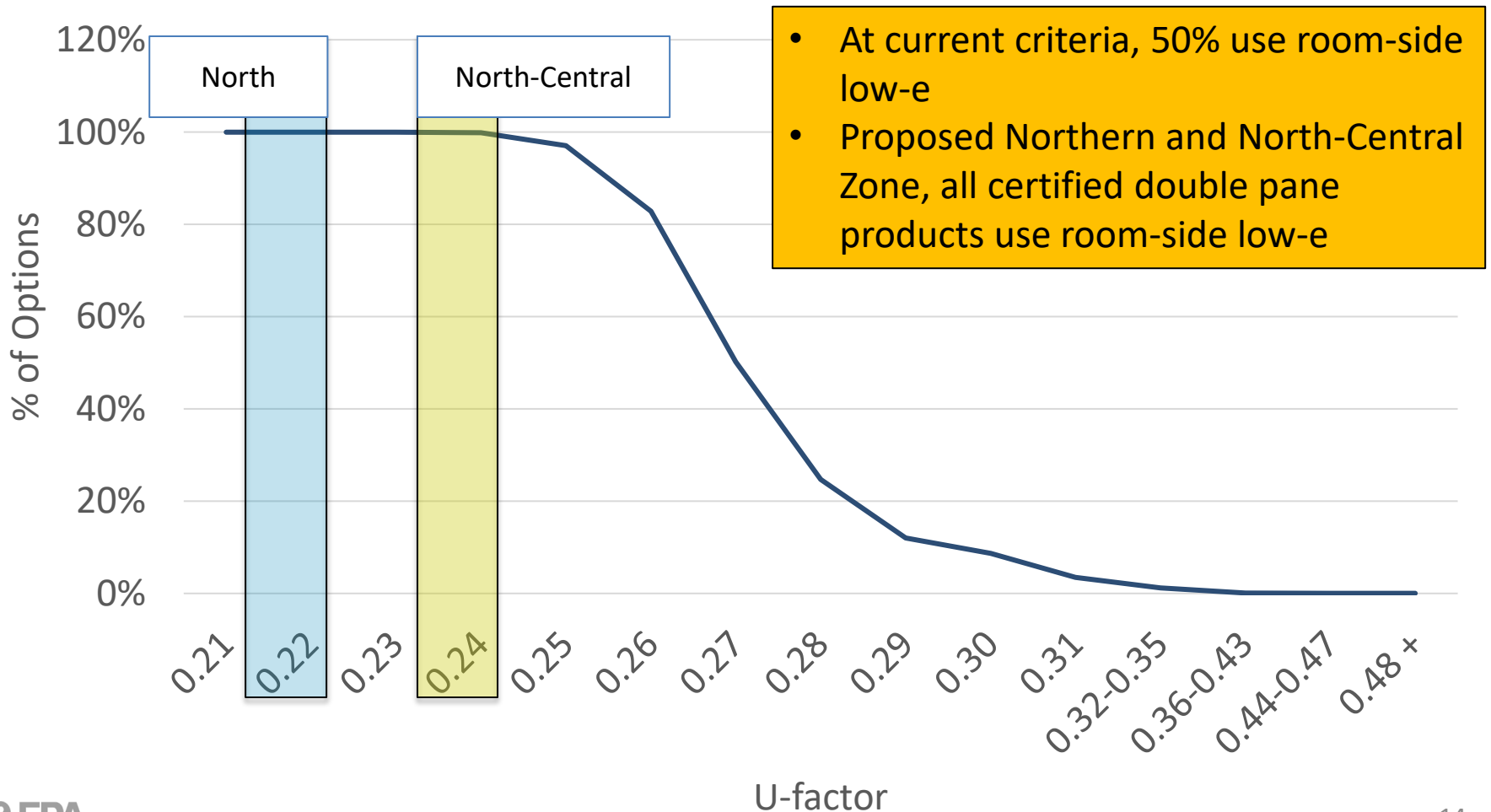


## V7 Proposal - Vinyl Vertical Slider Product Lines





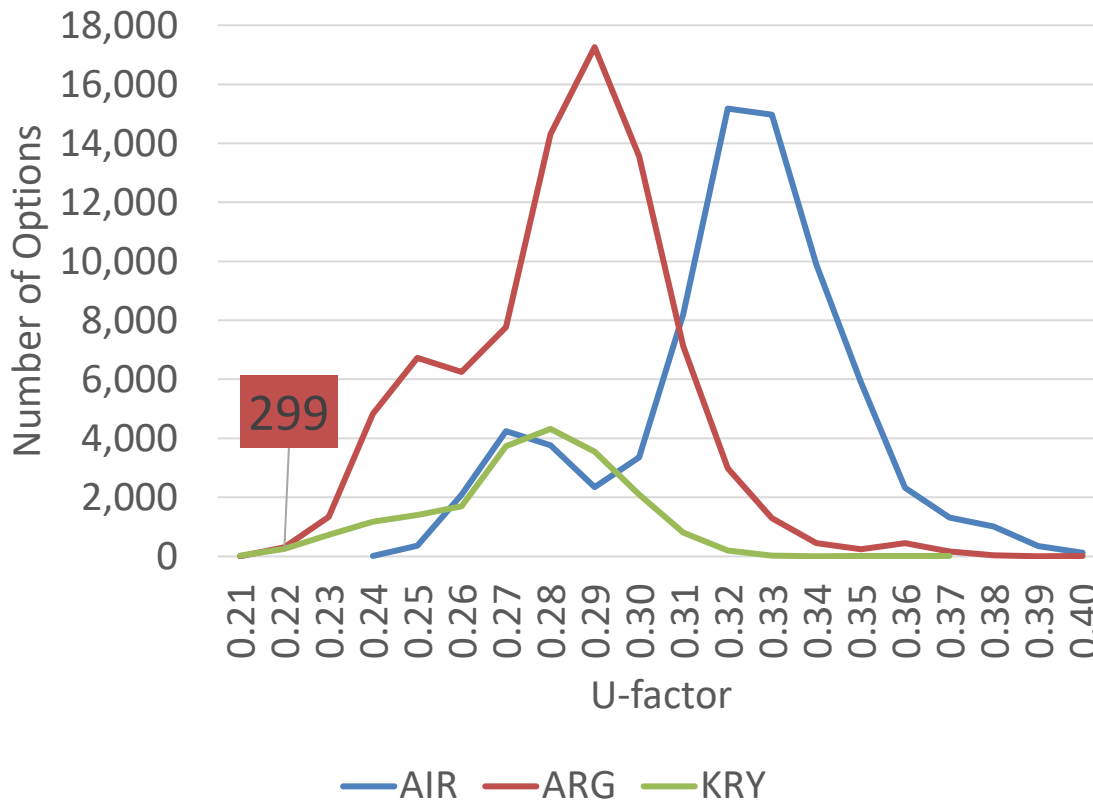
## Percent of Double-Pane Vinyl, Vertical Sliders with Room-side Low-e



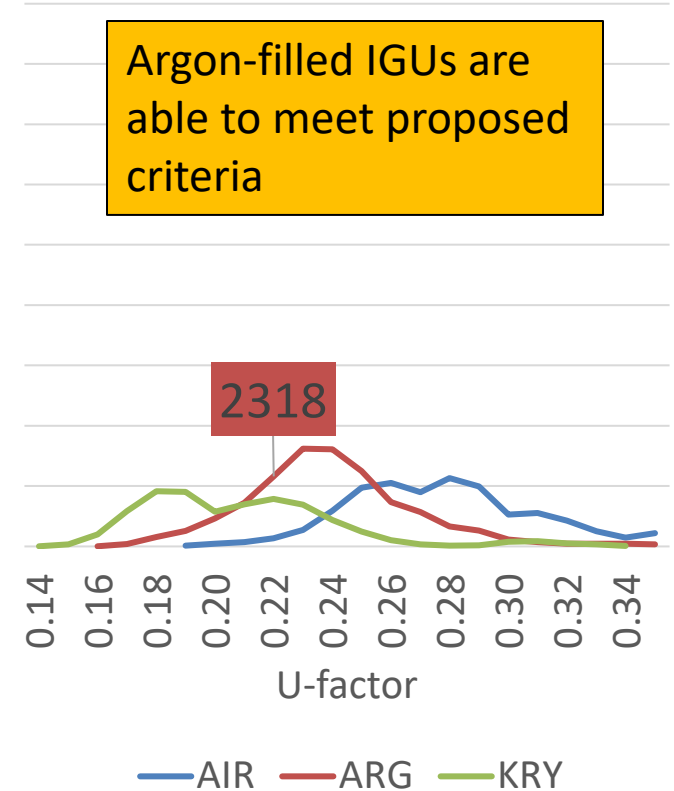


# Distributions of Product Options by Gas Fill Type

## Double Pane



## Triple Pane



Argon-filled IGUs are able to meet proposed criteria

## Visual Transmittance with Triple Silver Coatings

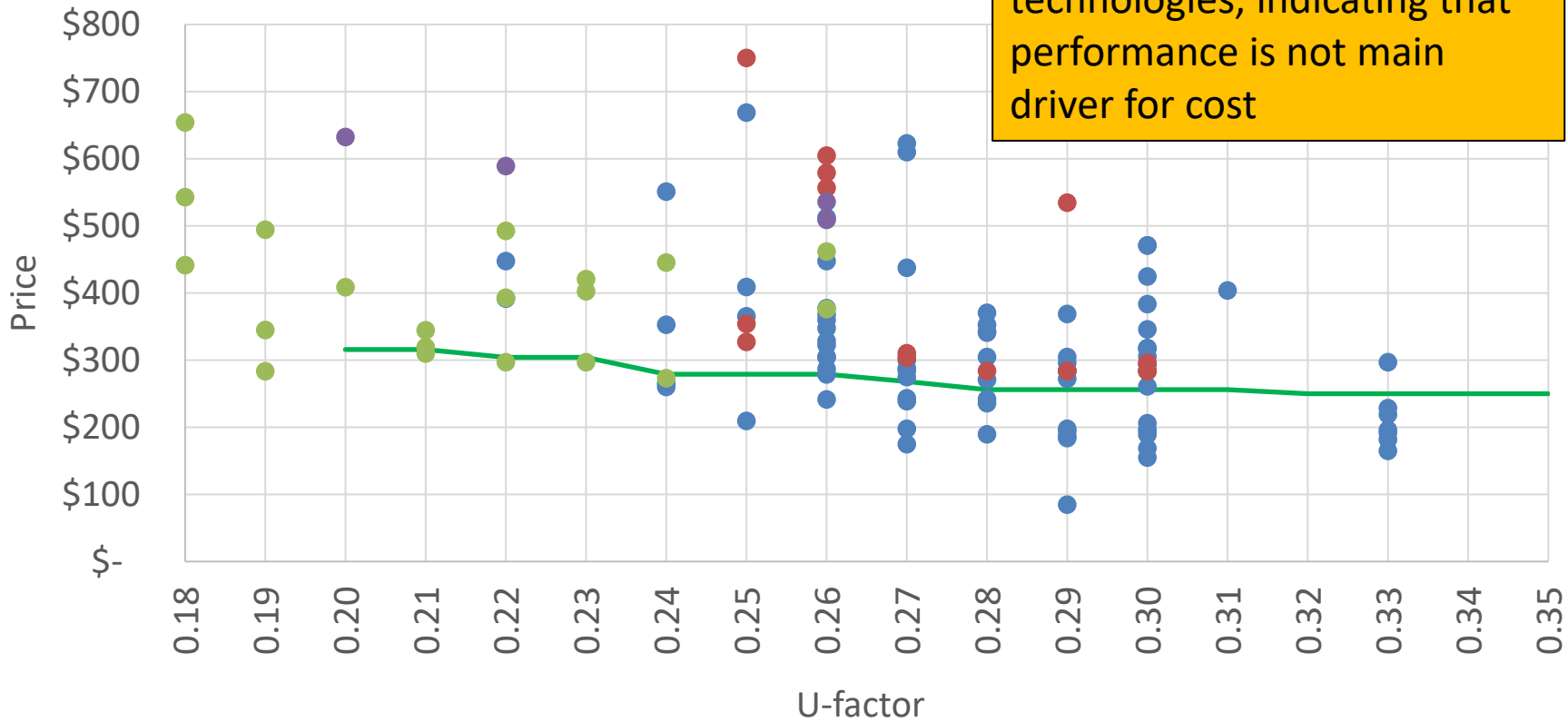
Triple-silver low-e coatings are used to reach SHGCs 0.25 and below. Analysis shows VT is typically higher than 0.40 above SHGC of 0.17.

SHGC	Visual Transmittance				
	0–0.194	0.195–0.294	0.295–0.394	0.395–0.499	0.500+
< 0.175	80	3,980	4,265		
0.175–0.194	4		119	693	
0.195–0.224	28	36	1,676	22,393	3,309
0.225–0.254	14	18	2	2,752	2,410
0.255–0.284		67	26	1,401	578
0.285–0.314		851	207	4,858	1,899
0.315–0.344		413	1,643	1,556	798
0.345–0.374			222	224	757
0.375–0.404					105



# Consumer Price Research

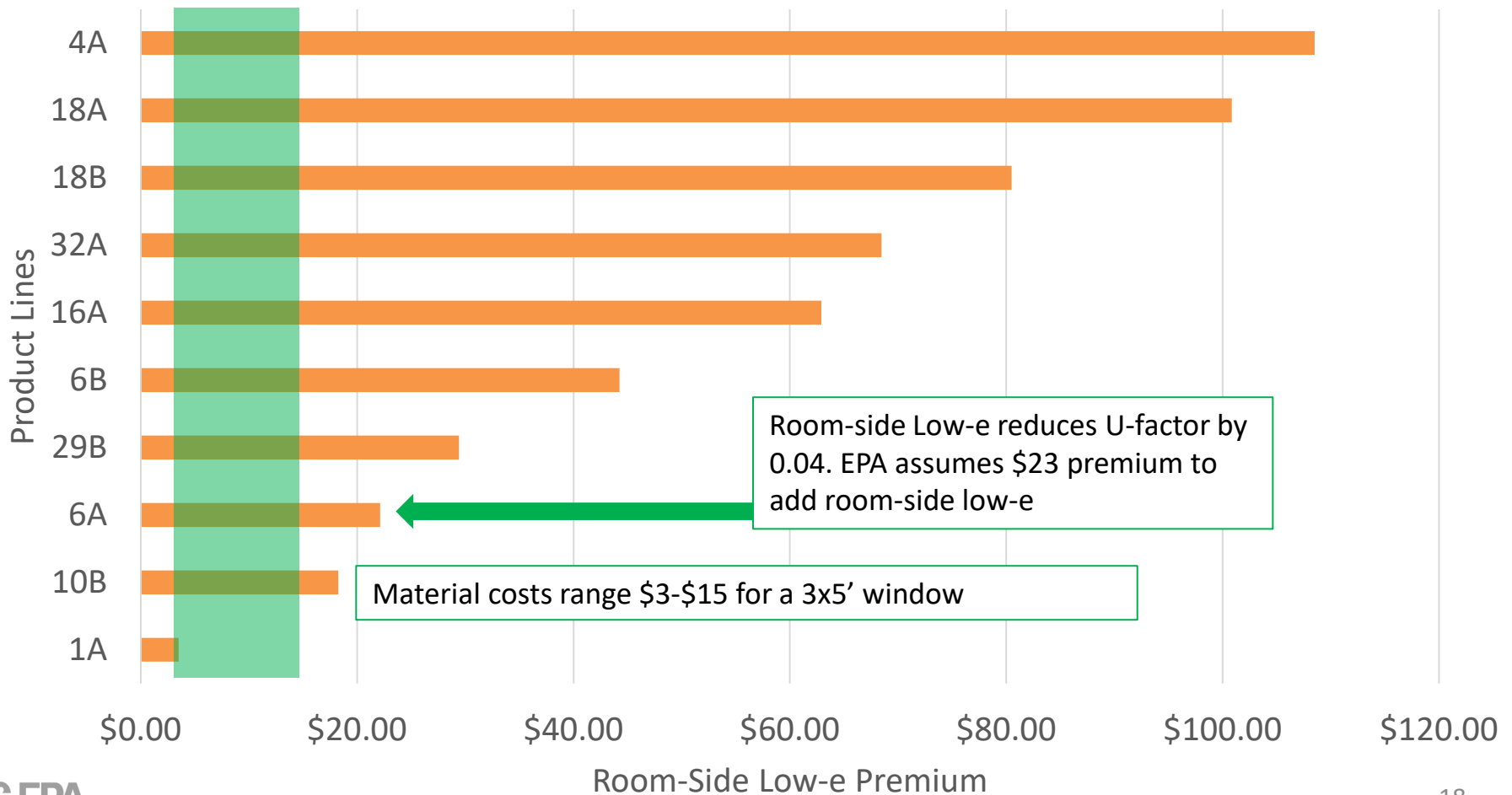
Prices vary widely by performance levels and technologies, indicating that performance is not main driver for cost



- Vinyl Double-Pane
- Wood Double-Pane
- Vinyl Triple-Pane
- Wood Triple-Pane
- Cost Model

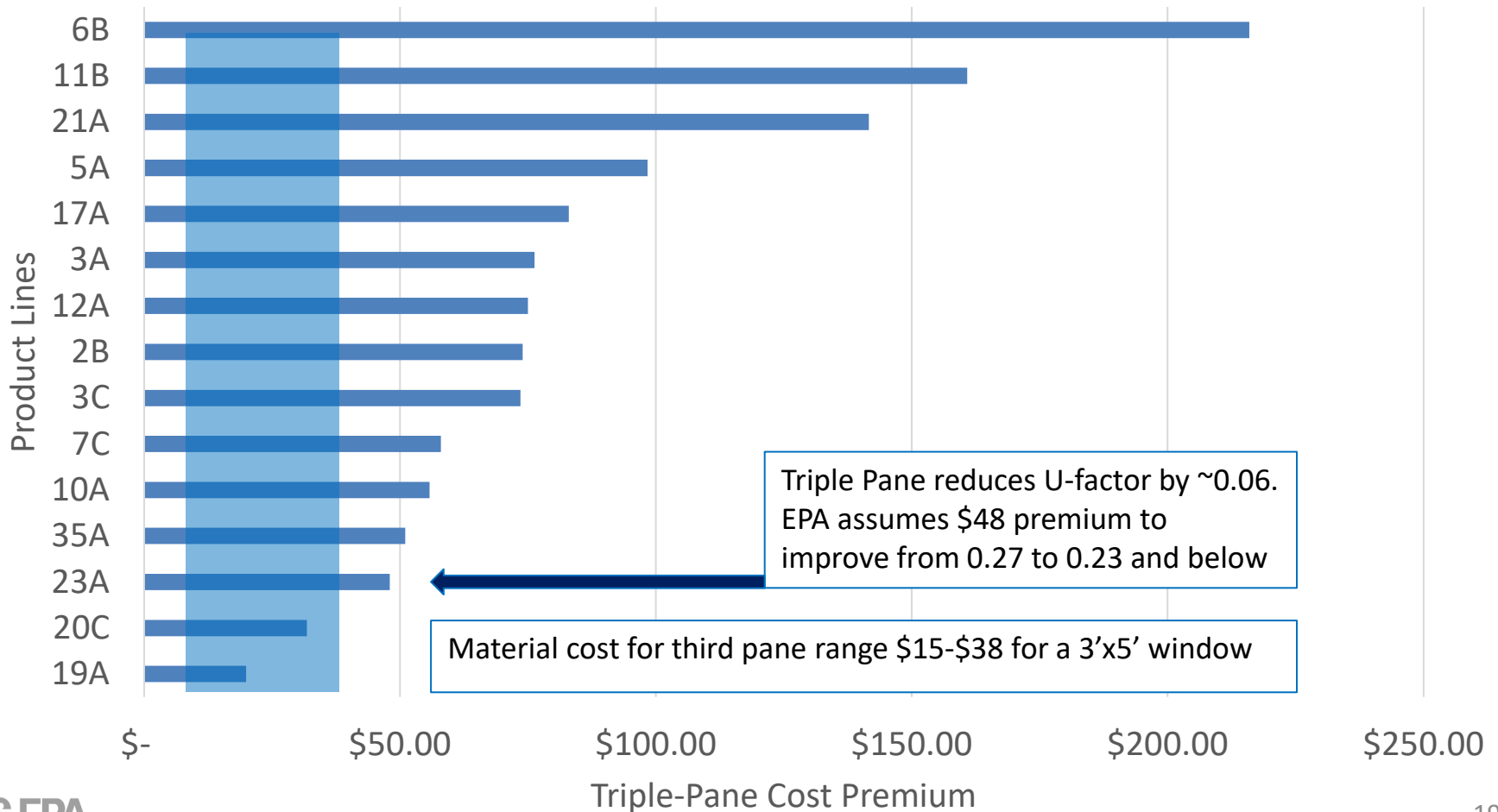


# Room-side Low-e Upgrade Costs





# Triple Pane Upgrade Cost



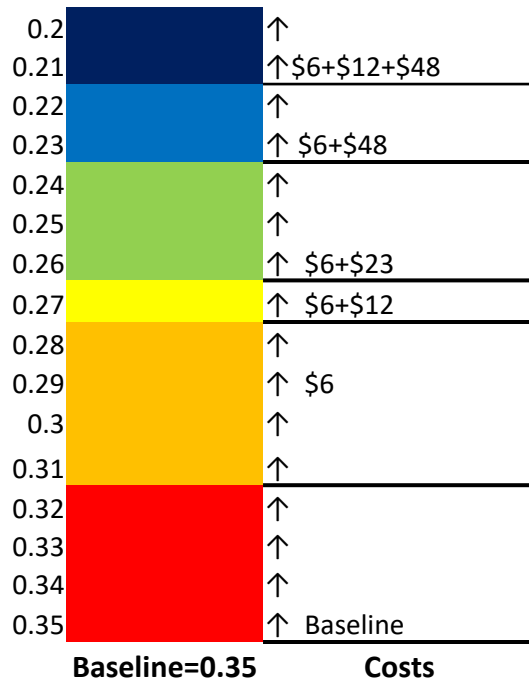
## Consumer Cost Premium Assumptions

U-Factor	Most Common Technical Pathways	Incremental Consumer ('Retail') Cost Over the Market Baseline	
		SHGC > 0.25	SHGC ≤ 0.25
<b>0.32–0.35</b>	1 Low-e coating, air-filled IGU and basic frames	Market Baseline	\$7.50
<b>0.28–0.31</b>	1 Low-e coating with argon-filled IGU	\$6	\$13.50
<b>0.27</b>	1 Low-e coating with argon-filled IGU and improved frames and spacers	\$18	\$25.50
<b>0.24–0.26</b>	2 Low-e coatings (room-side low-e) with argon-filled IGU	\$29	\$36.50
<b>0.22–0.23</b>	Triple-pane with 2 low-e coatings and argon-filled IGU	\$54	\$61.50
<b>0.21 and Below</b>	Triple-pane with room-side low-e, argon-filled IGU, non-metal spacers, and improved and/or foamed frames	\$66	\$73.50

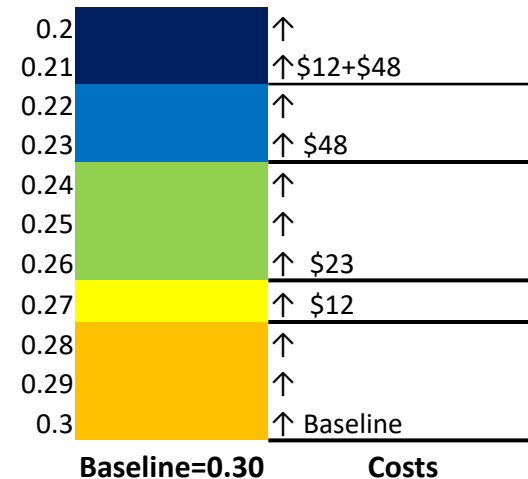


# Improvements from Baseline Products

**Market Baseline**



**Northern Zone Code Baseline**



Baseline for new construction in areas that have adopted the latest code (Northern Zone)  
**Vinyl frame, Argon-filled IGU, double-silver low-e**

Replacement window baseline represents the worst-performing replacement window offered by most brands (All Zones)

**Vinyl frame, air-filled IGU, double-silver low-e**



## Questions about Windows Technology and Cost Model





# Window Energy Analysis

**Anothai Thanachareonkit, Christian Kohler**  
**Lawrence Berkeley National Laboratory**

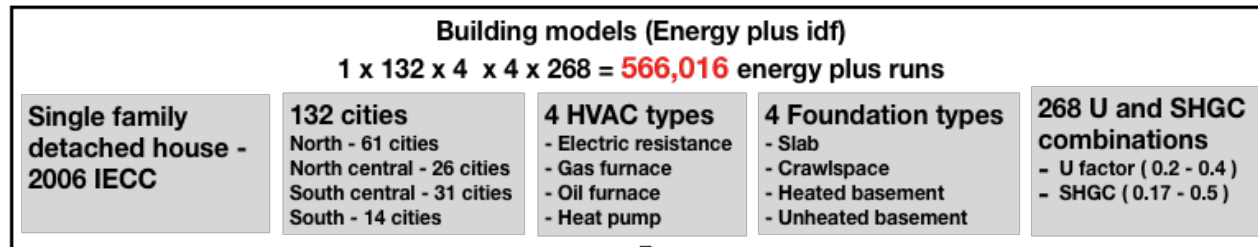




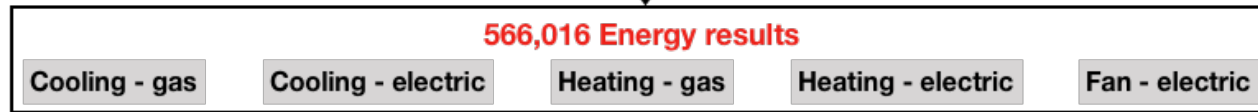
## Overview of LBNL work

- Energy simulation to determine savings for different window performance levels
  - DOE/PNNL Residential Prototype simulation model
    - 4 different heating systems (gas furnace, heat pump etc.)
    - 4 different foundations (crawlspcace, unheated basement etc.)
  - 132 cities across the US
  - 268 combinations of U and SHGC
- Evaluated HVAC site energy savings (heating, cooling, fan), cost savings, carbon impact
- Upgraded from DOE2 to EnergyPlus
- Trend:
  - Lowest U-value provides most energy savings everywhere
  - Highest SHGC provides most energy savings in Northern Zone





**Energy plus ( v 8.9)**

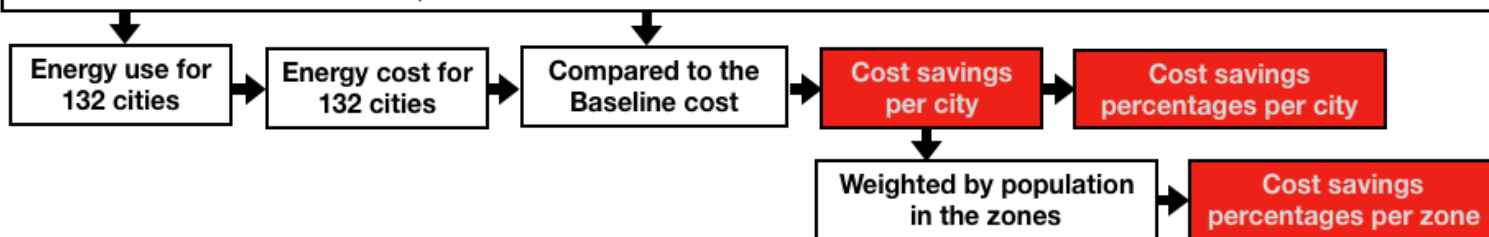


**Weighted the energy results based on 4 HVAC types per 10 Census divisions**  
 (sources : RECS micro data)

**For example :**  
 In New York city, located in Middle Atlantic division, 23% of all houses use electric resistance, **76%** use gas furnace, 0.0001% use oil furnace or heat pump.

**Weighted the energy results based on 4 Foundation types per 10 Census divisions**  
 (sources : Census micro data and RECS micro data)

**For example :**  
 In New York city, located in Middle Atlantic division, **57%** of all houses have unheated basement foundation, 33% have heated basement, 6% have slab and 4% have crawlspace.

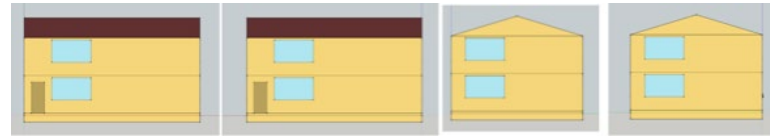
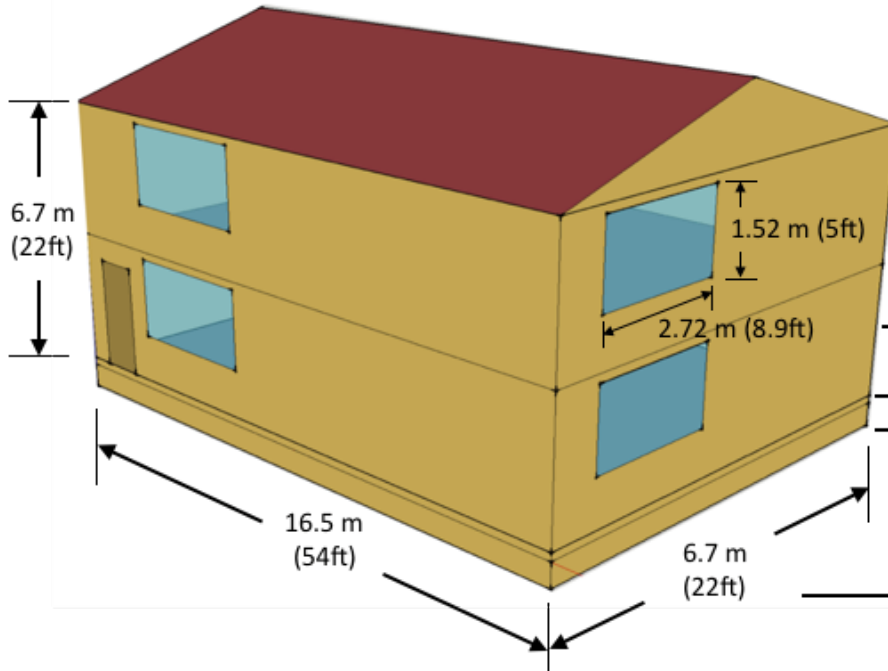




# Modeled Energy Analysis

- Used 2006 DOE/PNNL residential prototype– not new and not too old
- Weighted average for foundation and HVAC system
- Assumed 15% floor to window surface area
- Used most recent weather data – TMY3 (class I or II)
- Analyzed standard home in 132 cities across the US
- Analyzed 268 window U-factor and SHGC combinations for each standard home in each city
- Assumed market baseline of  $U = 0.35$  (and a Northern Zone code baseline of  $U = 0.30$ )
- Massive computing power needed (~560,000 annual energy simulations)



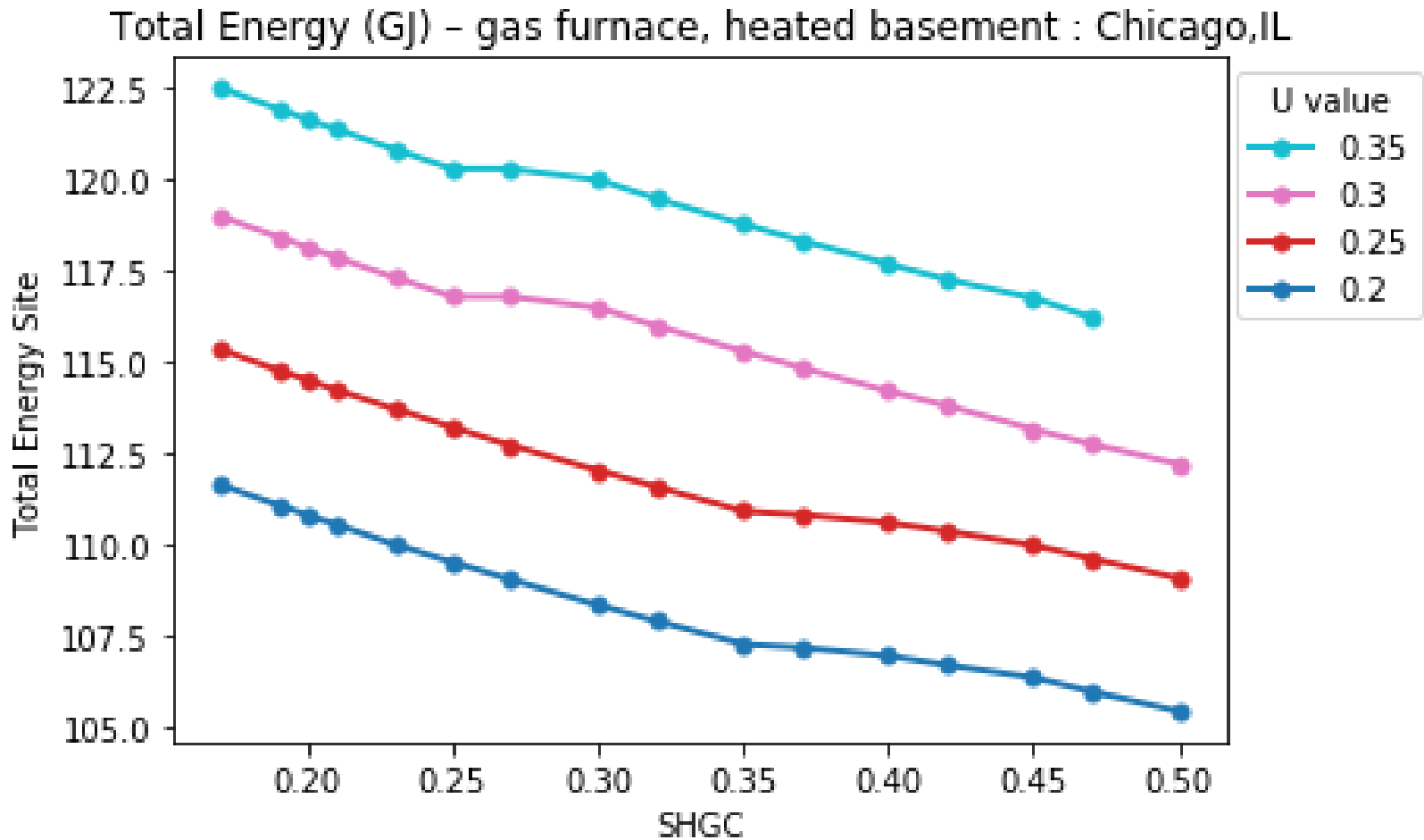


- Gross exterior wall area = 240 sq.m (2,483 sq.ft)
- Area below roof/ceilings = 110.5 sq.m (1,189 sq.ft)
- **Total floor area = 221 sq.m (2,378 sq.ft)**
- Area above unconditioned space = 110.5 sq.m (1,189 sq.ft)
- Perimeter length = 46.3 m (152 sq.ft)
- Conditioned basement, where applicable = 110.5 sq.m (1,189 sq.ft)

Parameter	Assumption
Window area used - and number of 3'x5' windows that represents	33.075 sq.m (356 sq.ft) # of windows = $8 \frac{11}{16}$ Window size = 2.72m x 1.52m (8.9ft x 5ft) $\frac{11}{16}$ Equates to 23.8 windows of 3' x 5' dimensions per house
Shading assumed	2 west windows with shading overhangs
Window area (relative to conditioned floor area)	15% equally distributed to the four cardinal directions (or as required to evaluate glazing-specific code changes)
Door area	3.9 sq.m (42 sq.ft)
Internal gains	91537.71 kJ/day
Foundation system	Slab, Heated Basement, Unheated Basement, Crawl Space
Heating system	Natural gas furnace, heat pump, electric furnace.
Cooling system	Central electric air conditioning
Water heating	Same as fuel used for space heating, or as required to evaluate domestic hot water-specific code changes
Heating Setpoint	22.2°C (71.9°F)
Cooling Setpoint	23.9°C (75°F)



## Total Energy trends for Chicago



## Window Comfort

Uncomfortable area due to cold window surface temperatures



Single pane

**ENERGY STAR**  
U-factor 0.30

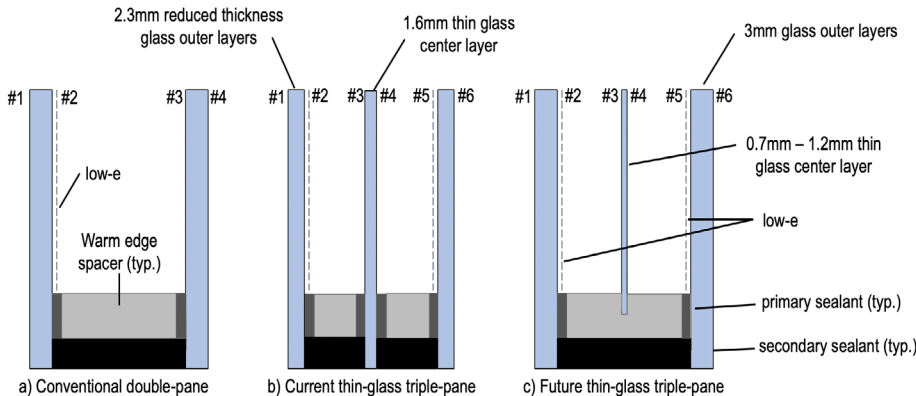
**Triple pane**  
U-factor 0.20

Outside temperature -10F, darker blue is less comfort

Winter comfort driven by glass surface temperature

- Lower U -> Higher T

# Future Trends and Opportunities



## Partnership for Advanced Window Solutions (PAWS)

PAWS aims to aggregate market demand, reduce product cost, quantify benefits, and accelerate the adoption of advanced windows and window attachments.

- Utility and Program Collaborations
- Ratings, Codes and Certifications
- Resources, Tools
- Incentives, Rebates and Tax Credits
- Targeted Campaigns and Initiatives

## High performance technology solutions

- **1-1/4" triple-pane IGUs:** high-performance without Krypton
- **Thin-glass triple-pane and VIG:** High performance in frames designed for double glazing



Berkeley Lab is committed to helping manufacturers redesign their products in order to reduce the carbon impacts due to window energy consumption



## Thank You

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**[windows.lbl.gov](http://windows.lbl.gov)**





## Northern Zone Energy Savings (GJ over Market Baseline)

U-Factor	SHGC															
	0.17	0.19	0.20	0.21	0.23	0.25	0.27	0.30	0.32	0.35	0.37	0.40	0.42	0.45	0.47	0.50
0.02	8.1	8.7	8.9	9.2	9.8	10.3	10.8	11.5	11.9	12.5	12.6	12.8	13.1	13.4	13.8	14.3
0.21	7.3	7.9	8.2	8.5	9.0	9.5	10.0	10.7	11.2	11.8	11.9	12.1	12.3	12.7	13.1	13.6
0.22	6.6	7.2	7.5	7.8	8.3	8.8	9.3	10.0	10.5	11.1	11.2	11.4	11.6	12.0	12.4	12.9
0.23	5.9	6.5	6.7	7.0	7.6	8.1	8.6	9.3	9.7	10.4	10.5	10.7	10.9	11.3	11.7	12.2
0.24	5.2	5.7	6.0	6.3	6.9	7.4	7.9	8.6	9.0	9.7	9.8	10.0	10.2	10.6	11.0	11.5
0.25	4.4	5.0	5.3	5.6	6.1	6.7	7.2	7.9	8.3	9.0	9.1	9.3	9.5	9.9	10.2	10.8
0.26	3.7	4.3	4.6	4.9	5.4	5.9	6.3	6.9	7.4	8.1	8.3	8.6	8.8	9.2	9.6	10.2
0.27	3.0	3.6	3.9	4.2	4.7	5.2	5.5	6.0	6.5	7.2	7.4	7.9	8.2	8.6	9.0	9.5
0.28	2.3	2.9	3.2	3.4	4.0	4.5	4.7	5.1	5.6	6.3	6.6	7.2	7.5	8.0	8.4	8.9
0.29	1.5	2.2	2.5	2.7	3.3	3.8	3.9	4.3	4.7	5.5	5.9	6.5	6.8	N/A	7.8	N/A
0.30	0.8	1.5	1.7	2.0	2.6	3.1	3.1	3.4	3.9	4.7	5.1	5.8	6.2	6.8	7.2	7.8
0.31	0.1	0.8	1.1	1.3	1.9	2.5	2.4	2.7	3.2	4.0	4.4	5.1	5.5	N/A	6.5	N/A
0.32	-0.5	0.1	0.4	0.7	1.2	1.8	1.7	2.0	2.6	3.3	3.7	4.4	4.8	N/A	5.9	N/A
0.33	-1.2	-0.6	-0.3	0.0	0.5	1.1	1.1	1.4	1.9	2.6	3.1	3.7	4.1	N/A	5.2	N/A
0.34	-1.9	-1.3	-1.0	-0.7	-0.1	0.4	0.4	0.7	1.2	1.9	2.4	3.0	3.5	N/A	4.5	N/A
0.35	-2.6	-2.0	-1.7	-1.4	-0.8	-0.3	-0.3	0.0	0.5	1.2	1.7	2.4	2.8	N/A	3.8	N/A



## Northern Zone Energy Savings (GJ over Market Baseline)

U-Factor	SHGC															
	0.17	0.19	0.20	0.21	0.23	0.25	0.27	0.30	0.32	0.35	0.37	0.40	0.42	0.45	0.47	0.50
0.20	8.1	8.7	8.9	9.2	9.8	10.3	10.8	11.5	11.9	12.5	12.6	12.8	13.1	13.4	13.8	14.3
0.21	7.3	7.9	8.2	8.5	9.0	9.5	10.0	10.7	11.2	11.8	11.9	12.1	12.3	12.7	13.1	13.6
0.22	6.6	7.2	7.5	7.8	8.3	8.8	9.3	10.0	10.5	11.1	11.2	11.4	11.6	12.0	12.4	12.9
0.23	5.9	6.5	6.7	7.0	7.6	8.1	8.6	9.3	9.7	10.4	10.5	10.7	10.9	11.3	11.7	12.2
0.24	5.2	5.7	6.0	6.3	6.9	7.4	7.9	8.6	9.0	9.7	9.8	10.0	10.2	10.6	11.0	11.5
0.25	4.4	5.0	5.3	5.6	6.1	6.7	7.2	7.9	8.3	9.0	9.1	9.3	9.5	9.9	10.2	10.8
0.26	3.7	4.3	4.6	4.9	5.4	5.9	6.3	6.9	7.4	8.1	8.3	8.6	8.8	9.2	9.6	10.2
0.27	3.0	3.6	3.9	4.2	4.7	5.2	5.5	6.0	6.5	7.1	7.2	7.4	7.6	8.0	8.4	9.0
0.28	2.3	2.9	3.2	3.4	4.0	4.5	4.7	5.1	5.6	6.2	6.3	6.5	6.7	7.1	7.5	8.1
0.29	1.5	2.2	2.5	2.7	3.3	3.8	3.9	4.3	4.7	5.3	5.4	5.6	5.8	6.2	6.6	7.2
0.30	0.8	1.5	1.7	2.0	2.6	3.1	3.1	3.4	3.9	4.7	5.1	5.8	6.2	6.8	7.2	7.8
0.31	0.1	0.8	1.1	1.3	1.9	2.5	2.4	2.7	3.2	4.0	4.4	5.1	5.5	N/A	6.5	N/A
0.32	-0.5	0.1	0.4	0.7	1.2	1.8	1.7	2.0	2.6	3.3	3.7	4.4	4.8	N/A	5.9	N/A
0.33	-1.2	-0.6	-0.3	0.0	0.5	1.1	1.1	1.4	1.9	2.6	3.1	3.7	4.1	N/A	5.2	N/A
0.34	-1.9	-1.3	-1.0	-0.7	-0.1	0.4	0.4	0.7	1.2	1.9	2.4	3.0	3.5	N/A	4.5	N/A
0.35	-2.6	-2.0	-1.7	-1.4	-0.8	-0.3	-0.3	0.0	0.5	1.2	1.7	2.4	2.8	N/A	3.8	N/A

Northern Zone Equivalent Energy Performance (Trade-offs)



## Northern Zone Cost Savings (\$/yr over Market Baseline)

	SHGC															
U-Factor	0.17	0.19	0.20	0.21	0.23	0.25	0.27	0.30	0.32	0.35	0.37	0.40	0.42	0.45	0.47	0.50
0.20	\$124	\$126	\$127	\$128	\$130	\$131	\$132	\$132	\$132	\$131	\$133	\$135	\$134	\$132	\$130	\$127
0.21	\$115	\$117	\$118	\$119	\$121	\$122	\$123	\$123	\$123	\$122	\$124	\$126	\$125	\$123	\$122	\$119
0.22	\$105	\$108	\$109	\$110	\$111	\$113	\$113	\$114	\$114	\$113	\$115	\$117	\$116	\$115	\$113	\$110
0.23	\$96	\$99	\$100	\$101	\$102	\$104	\$104	\$105	\$105	\$104	\$107	\$108	\$108	\$106	\$104	\$102
0.24	\$87	\$89	\$91	\$92	\$93	\$95	\$95	\$96	\$96	\$95	\$98	\$100	\$99	\$97	\$96	\$93
0.25	\$78	\$80	\$81	\$82	\$84	\$86	\$87	\$87	\$87	\$87	\$90	\$91	\$90	\$89	\$87	\$85
0.26	\$68	\$71	\$72	\$73	\$75	\$77	\$78	\$79	\$80	\$80	\$81	\$82	\$82	\$80	\$79	\$77
0.27	\$59	\$62	\$63	\$64	\$66	\$68	\$69	\$71	\$72	\$72	\$73	\$74	\$73	\$72	\$71	\$68
0.28	\$50	\$53	\$54	\$55	\$57	\$59	\$60	\$62	\$63	\$64	\$65	\$65	\$65	\$64	\$63	\$60
0.29	\$41	\$44	\$45	\$46	\$48	\$50	\$51	\$53	\$54	\$55	\$56	\$56	\$56	N/A	\$54	N/A
0.30	\$32	\$35	\$36	\$37	\$39	\$41	\$42	\$43	\$45	\$46	\$47	\$48	\$47	\$46	\$45	\$42
0.31	\$23	\$26	\$27	\$29	\$31	\$32	\$34	\$35	\$36	\$38	\$39	\$39	\$39	N/A	\$37	N/A
0.32	\$14	\$17	\$19	\$20	\$22	\$24	\$25	\$26	\$27	\$29	\$30	\$31	\$31	N/A	\$29	N/A
0.33	\$5	\$8	\$10	\$11	\$13	\$15	\$16	\$17	\$19	\$21	\$22	\$22	\$22	N/A	\$20	N/A
0.34	-\$4	-\$1	\$1	\$2	\$4	\$6	\$8	\$9	\$10	\$12	\$13	\$14	\$14	N/A	\$12	N/A
0.35	-\$12	-\$9	-\$8	-\$7	-\$4	-\$2	-\$1	\$0	\$2	\$4	\$5	\$5	\$6	N/A	\$4	N/A



# Northern Zone Payback (Years)

U-Factor	SHGC															
	0.17	0.19	0.20	0.21	0.23	0.25	0.27	0.30	0.32	0.35	0.37	0.40	0.42	0.45	0.47	0.50
0.20	14.1	13.8	13.7	13.6	13.5	13.4	11.9	11.9	11.9	12.0	11.8	11.7	11.7	11.9	12.1	12.3
0.21	15.2	14.9	14.8	14.7	14.5	14.4	12.8	12.8	12.8	12.9	12.6	12.5	12.6	12.7	12.9	13.2
0.22	13.9	13.6	13.4	13.3	13.1	13.0	11.3	11.3	11.3	11.4	11.1	11.0	11.0	11.2	11.4	11.7
0.23	15.2	14.8	14.7	14.5	14.3	14.1	12.3	12.2	12.2	12.3	12.0	11.9	11.9	12.1	12.3	12.6
0.24	10.0	9.7	9.6	9.5	9.3	9.2	7.2	7.2	7.2	7.2	7.0	6.9	7.0	7.1	7.2	7.4
0.25	11.2	10.8	10.7	10.5	10.3	10.2	8.0	7.9	7.9	7.9	7.7	7.6	7.6	7.8	7.9	8.1
0.26	12.7	12.2	12.0	11.8	11.5	11.3	8.9	8.7	8.7	8.6	8.5	8.4	8.4	8.6	8.7	9.0
0.27	10.2	9.8	9.6	9.4	9.2	9.0	6.2	6.0	6.0	5.9	5.9	5.8	5.9	6.0	6.0	6.3
0.28	6.4	6.1	5.9	5.8	5.6	5.5	2.4	2.3	2.3	2.2	2.2	2.2	2.2	2.2	2.3	2.4
0.29	7.8	7.3	7.1	6.9	6.6	6.4	2.8	2.7	2.6	2.6	2.6	2.5	2.5	N/A	2.6	N/A
0.30	10.0	9.2	8.9	8.6	8.1	7.8	3.4	3.3	3.2	3.1	3.0	3.0	3.0	3.1	3.2	3.4
0.31	7.7	6.9	6.5	6.3	5.8	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	0.0	N/A
0.32	12.6	10.4	9.6	9.0	8.2	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	0.0	N/A
0.33	34.0	21.5	18.4	16.3	13.6	11.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	0.0	N/A
0.34	0.0	0.0	200.4	81.5	40.1	28.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	0.0	N/A
0.35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	0.0	N/A

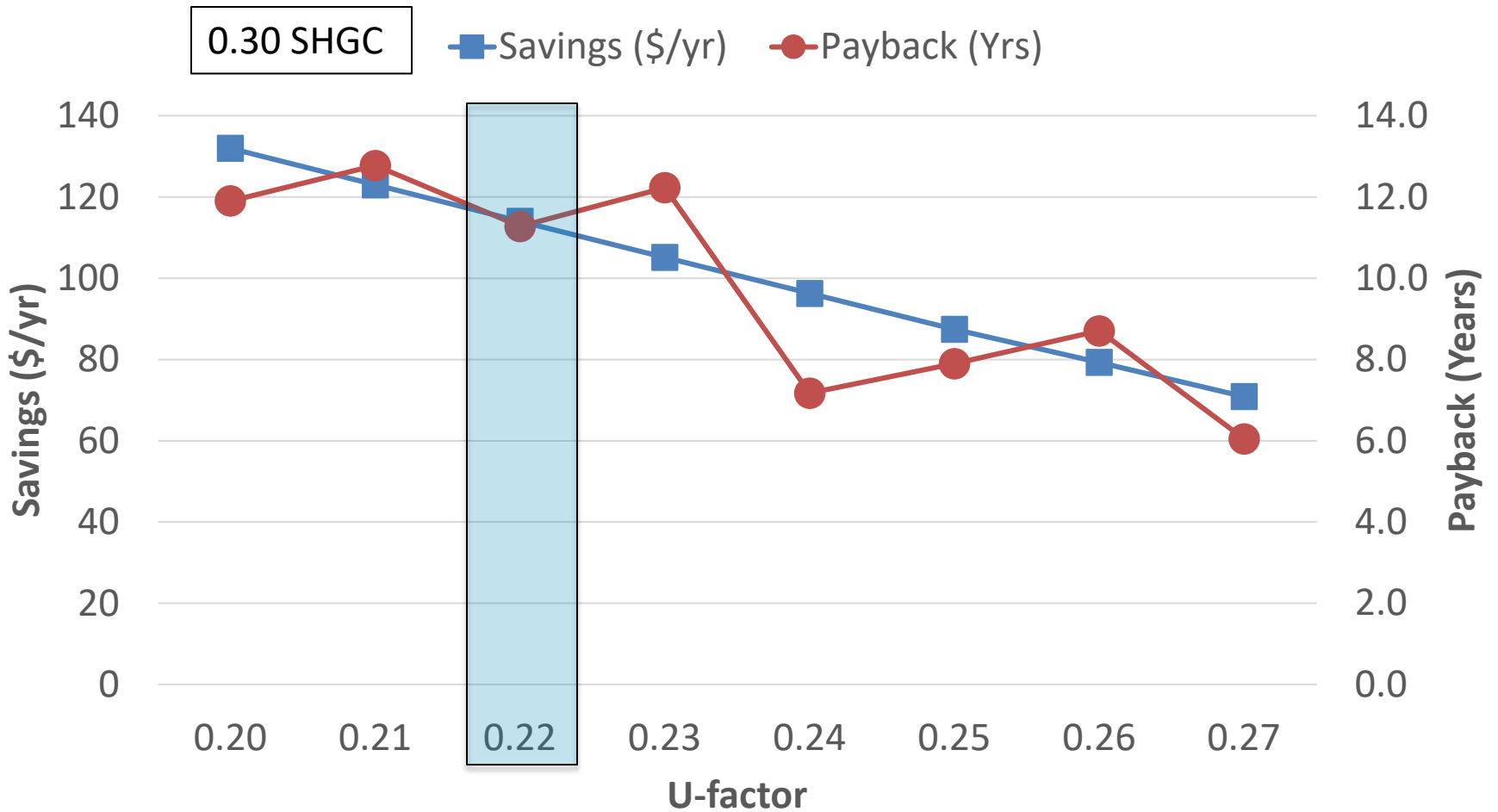


# Payback

- Payback = Annual Household Energy Savings / (Incremental Consumer Cost per Window \* 23.8 Windows)
- Windows can last 20-30 years and often have lifetime warranties
- Industry studies saying homeowners typically stay in a home 10-13 years (see CAR)
- Our goal is payback in under 13 years

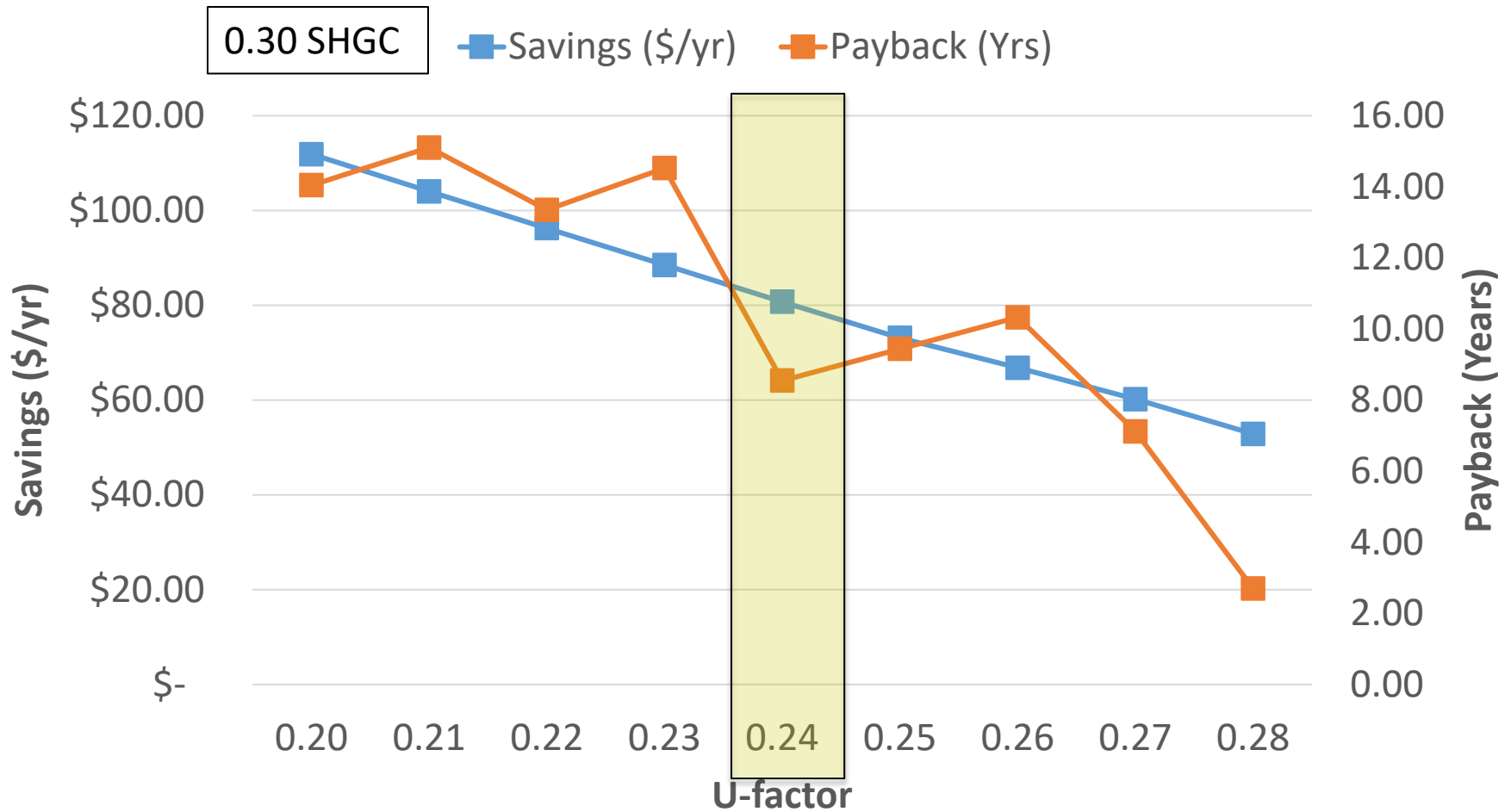


# Northern Zone Savings and Payback (Market Baseline)



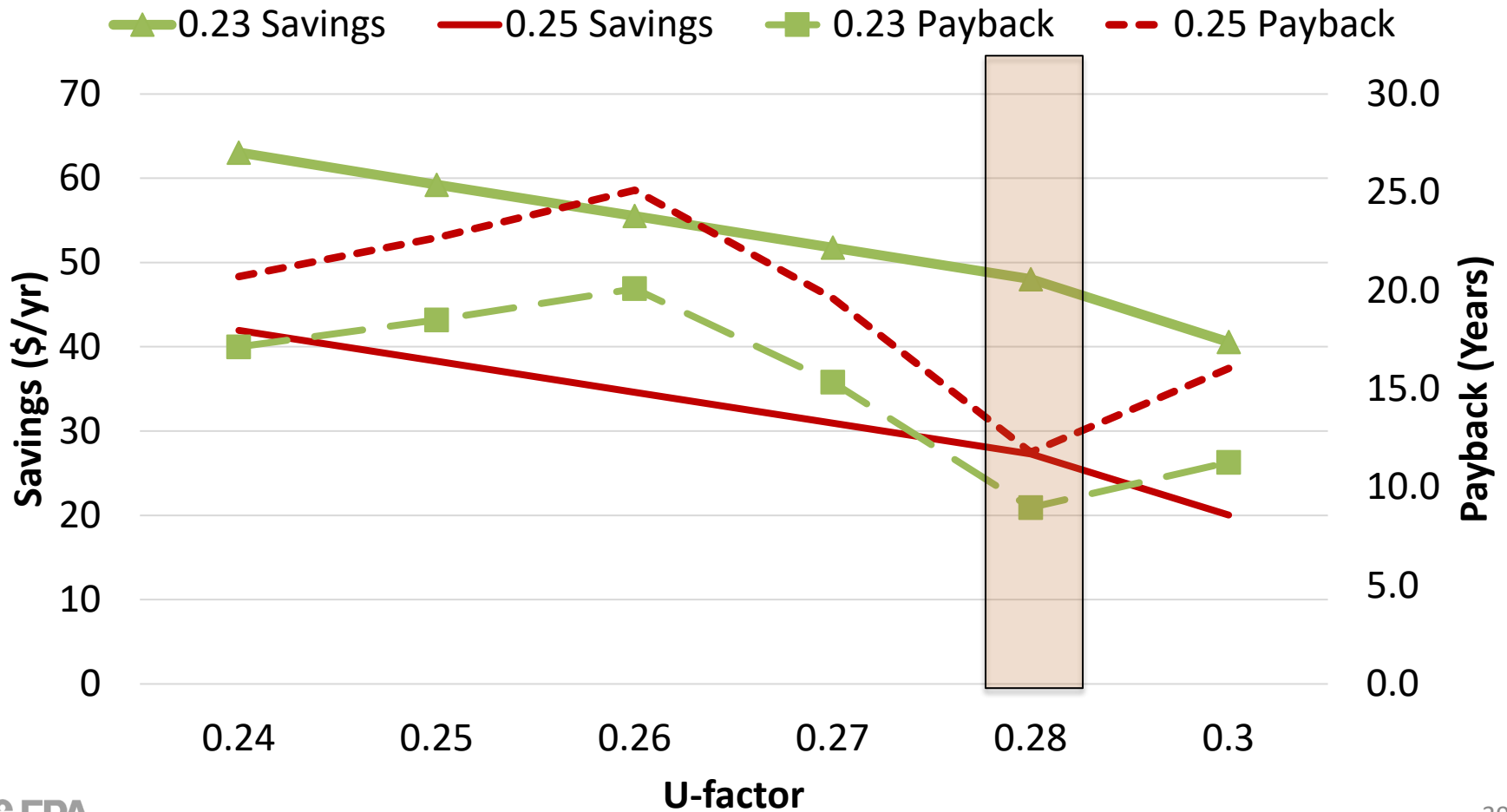


# North-Central Zone Savings and Payback



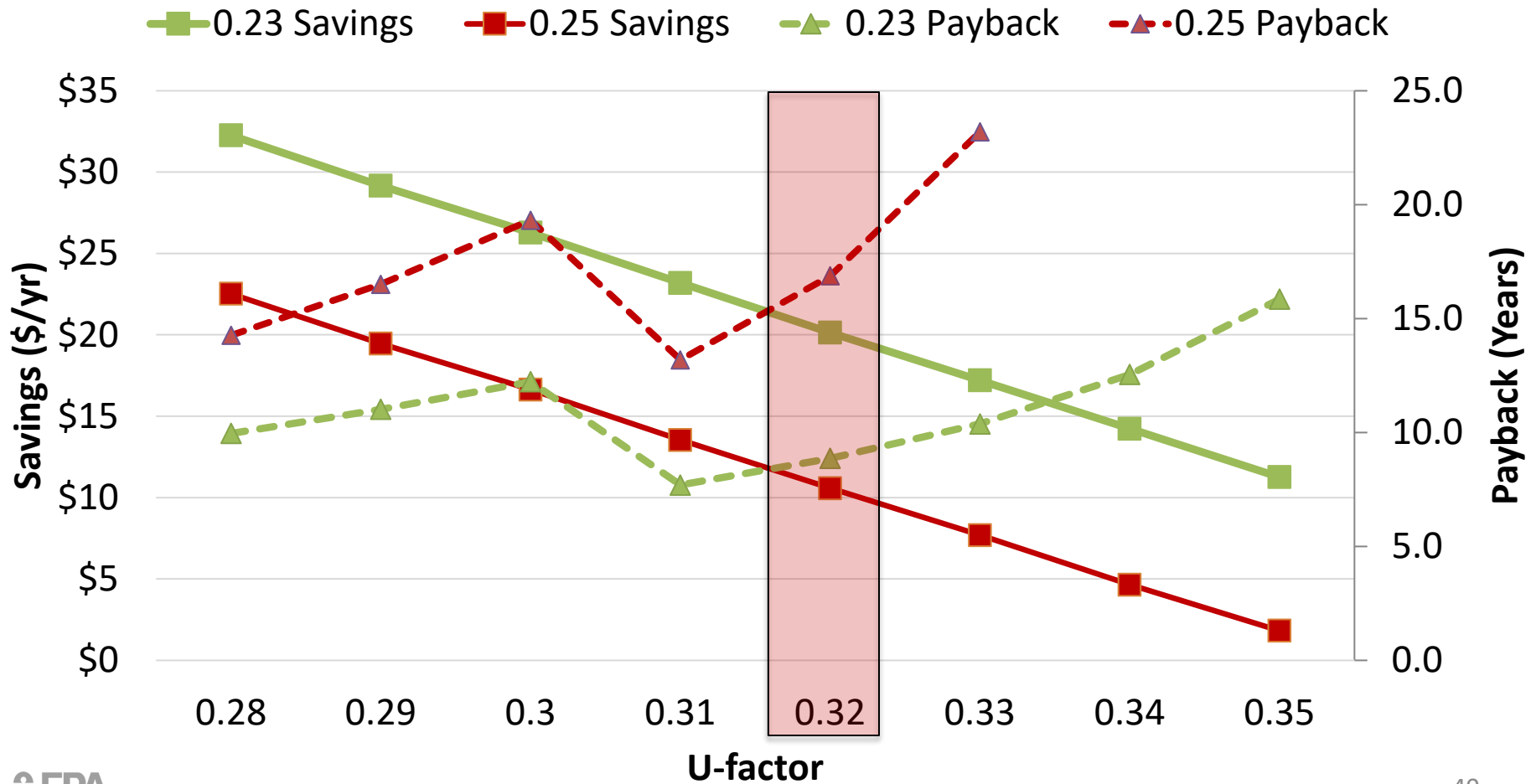


## South-Central Savings and Payback





## Southern Savings and Payback





## Northern Zone Tradeoffs

Energy Star Zone	U-factor	SHGC (model)	Savings (\$/yr) Market base	Payback (Yrs) Market baseline	Payback (Yrs) Code baseline
<b>Northern Tradeoffs</b>	0.22	0.30	\$113.99	11.3	16.2
	0.23	0.35	\$104.18	12.3	18.8
	0.24	0.40	\$99.71	6.9	9.7
	0.25	0.45	\$88.56	7.8	12.1
	0.26	0.50	\$76.69	9.0	16.4



# ENERGY STAR Zone Savings Summary

- Market Baseline: 0.35 U-factor, 0.30 or 0.23 SHGC
- Code Baseline in Northern Zone: 0.30 U-factor, 0.30 SHGC

Energy Star Zone	U-factor	SHGC (model)	Savings (\$/yr) Market	Standard Payback (Yrs) Market	Savings (\$/yr) Code	Standard Payback (Yrs) Code
Northern	0.22	0.30	\$113.35	11.3	\$70.26	16.2
North/Central	0.24	0.30	\$80.75	8.5		
South/Central	0.28	0.23	\$35.85	9.0		
Southern	0.32	0.23	\$20.14	8.9		



# Potential National Energy Savings

Climate Zone	Unit Energy Savings (MMBtu)	2019 Shipments	Total Energy Savings (TBtu)
<b>Northern Replacement/Remodel</b>	0.40	11,084,395	4.420
<b>Northern New Construction</b>	0.26	6,576,665	1.726
<b>North/Central</b>	0.26	9,370,708	2.451
<b>South/Central</b>	0.08	12,387,796	0.946
<b>Southern</b>	0.03	4,815,650	0.132
<b>National Total</b>		<b>44,235,214</b>	<b>9.675</b>



## Who Can Meet the Proposed Criteria?

Product Lines	All Certified Products	V6 Northern Zone	Proposed Northern Zone	% Meeting Proposal
All Operators and Frames	2,342	2,165	1,502	64%
All Vertical Sliders	542	474	268	49%
Vinyl Vertical Sliders	398	348	226	57%
Wood Vertical Sliders	103	94	35	34%

Manufacturers	All Certified Products	V6 Northern Zone	Proposed Northern Zone	% Meeting Proposal
All Operators and Frames	166	163	138	83%
All Vertical Sliders	144	132	96	67%
Vinyl Vertical Sliders	131	119	89	68%
Wood Vertical Sliders	26	25	13	50%



## Questions about Windows Analysis and Proposal





**Break Time!**

**We'll start again at 2:53**



# Sliding Patio Door Specification Proposal

- Reduce U-factor to improve insulating power
- Reduce SHGC in Southern US to reduce heat gain

## Version 6

Glazing Level	U-Factor	SHGC	
Opaque	≤ 0.17	No Rating	
≤ ½-Lite	≤ 0.25	≤ 0.25	
> ½-Lite	≤ 0.30	Northern North-Central	≤ 0.40
		Southern South-Central	≤ 0.25



## Version 7

Climate Zone	U-Factor	SHGC	
Northern	≤ 0.22	≥ 0.17	Prescriptive
	= 0.23	≥ 0.35	Equivalent Energy Performance
	= 0.24	≥ 0.40	
	= 0.25	≥ 0.45	
	= 0.26	≥ 0.50	
North-Central	≤ 0.24	≤ 0.40	
South-Central	≤ 0.28	≤ 0.23	
Southern	≤ 0.32	≤ 0.23	

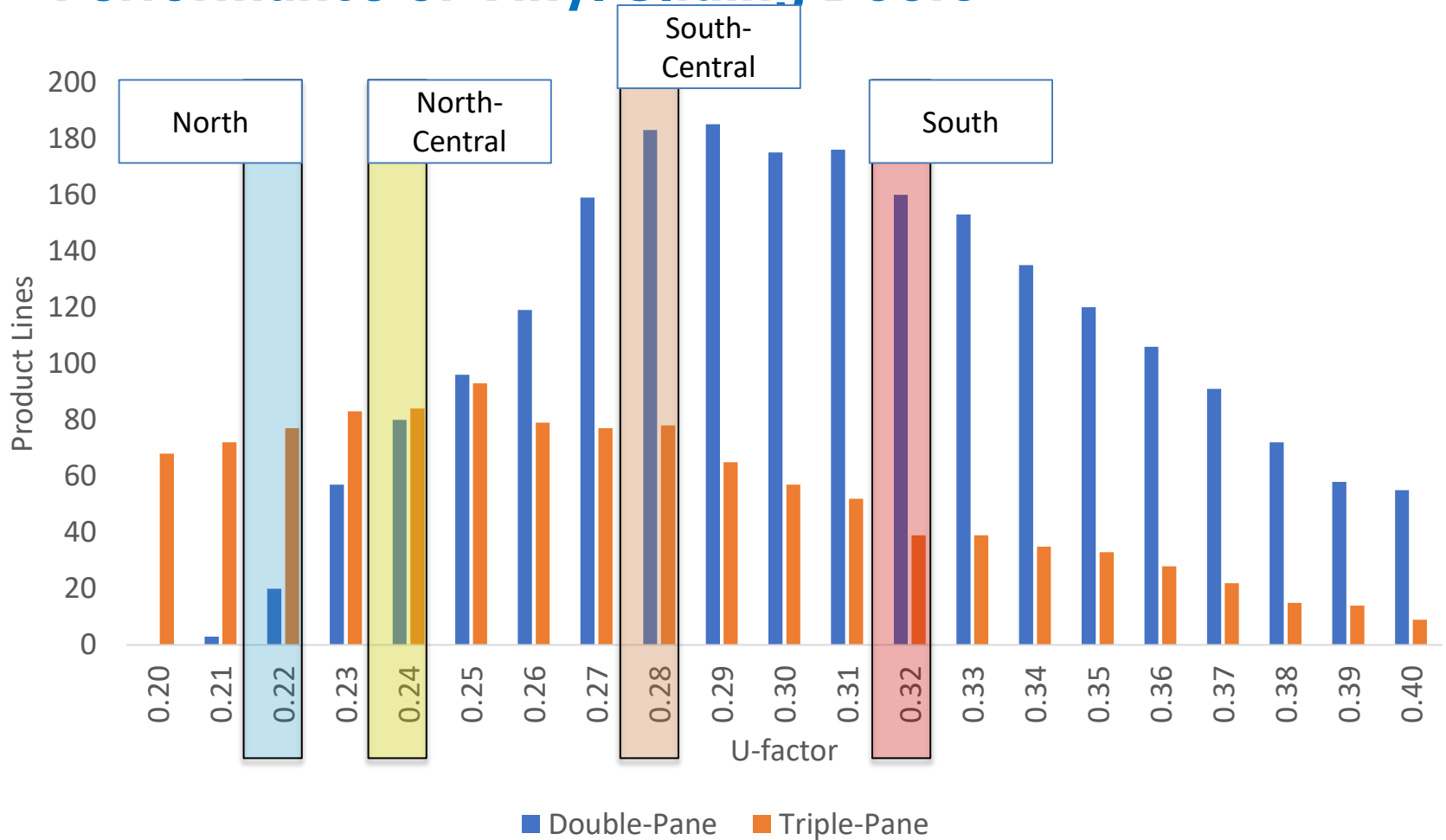
## Full-Lite Patio Door Specification

- EPA asked for stakeholder feedback on applying the window criteria to full-lite sliding patio doors in the Discussion Guide
- Patio doors consist of a large area lite with a frame and are more similar to windows than swinging doors in performance and components
- Consumers prefer to match patio door and window glass to provide a consistent look across the wall façade
- Major patio door lines on the market were confirmed to offer the same high-performance glass packages as the window lines offered by the same manufacturers
- Feedback from stakeholders and analysis of the U-factor performance of distribution of full-lite sliding patio doors indicate a proposal to align sliding patio doors with windows is reasonable





# Performance of Vinyl Sliding Doors





## Questions about Sliding Doors Analysis and Proposal



# Swinging Door Specification Proposal

- Reduce U-factor for  $\leq 1/2$ -Lite and  $>1/2$  Lite categories
- Reduce SHGC for  $>1/2$ -Lite in Southern and South-Central Zones

## Version 6

Glazing Level	U-Factor	SHGC	
Opaque	$\leq 0.17$	No Rating	
$\leq 1/2$ -Lite	$\leq 0.25$	$\leq 0.25$	
$> 1/2$ -Lite	$\leq 0.30$	Northern North-Central	$\leq 0.40$
		Southern South-Central	$\leq 0.25$



## Version 7

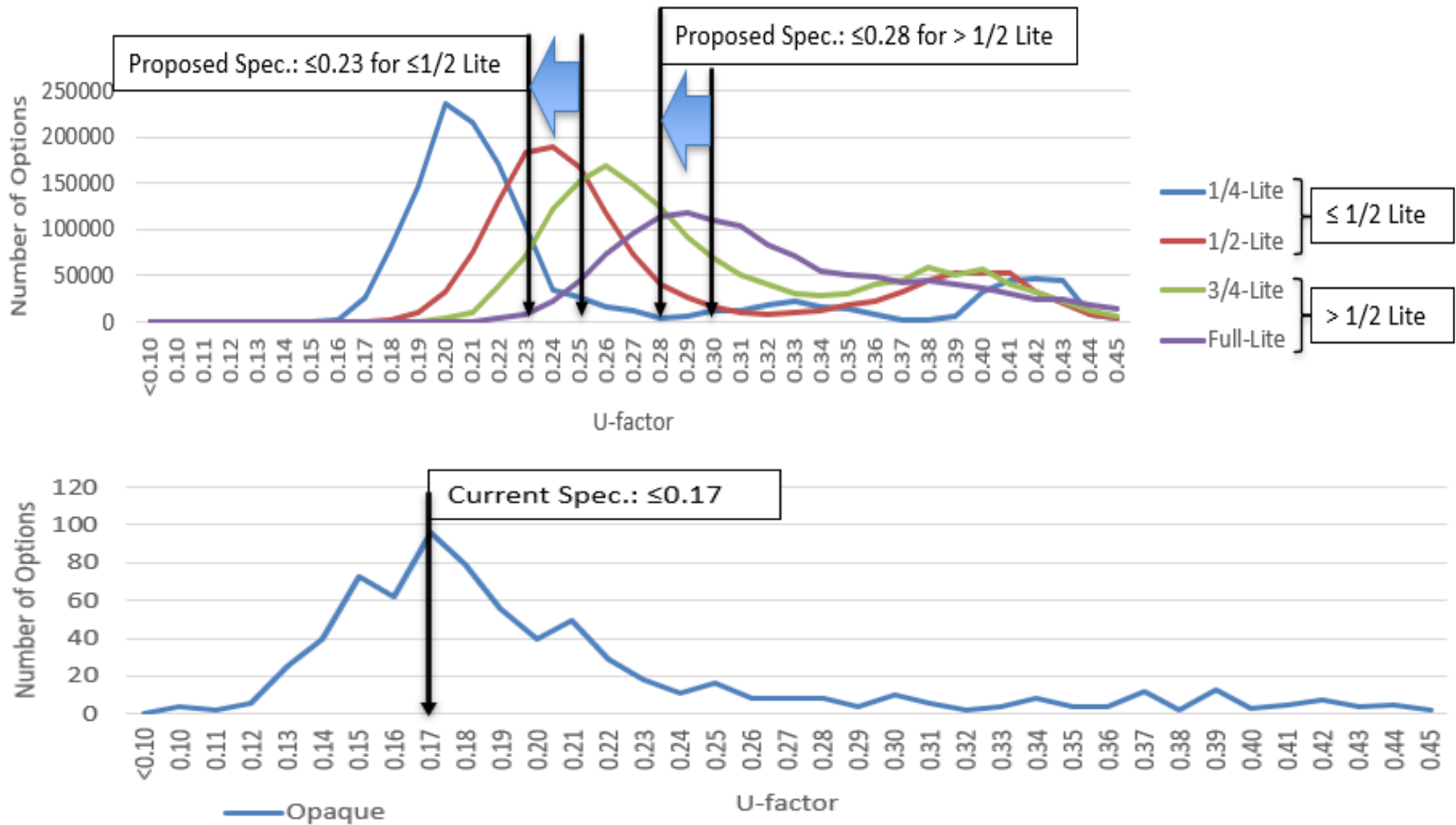
Glazing Level	U-Factor	SHGC	
Opaque	$\leq 0.17$	No Rating	
$\leq 1/2$ -Lite	$\leq 0.23$	$\leq 0.23$	
$> 1/2$ -Lite	$\leq 0.28$	Northern North-Central	$\leq 0.40$
		Southern South-Central	$\leq 0.23$

# Swinging Door Specification



- EPA asked for stakeholder feedback on possibly sunsetting the swinging door in the Discussion Guide
  - Doors account for a small fraction of household energy consumption (a small percentage of wall surface area)
  - Doors with lites are complex and varied and national labs did not model energy savings for doors
- Analysis of the U-factor performance distribution by lite category showed many certified options are available at lower U-factors than the current criteria for each glazing category – so EPA proposes to improve the criteria by an incremental amount for swinging doors with lites
- The opaque doors performance distribution did not show as much opportunity to advance - so EPA proposes that the criteria not change for opaque doors

# Swinging Door Performance





## Doors Household Savings (2 doors)

≤ ½ Lite

Climate Zone	U-Factor	SHGC	Energy Savings (GJ)	Savings (\$/year)
Northern	0.23	0.17	0.59	\$7.54
North-Central	0.23	0.17	0.46	\$6.51
South-Central	0.23	0.17	0.26	\$3.17
Southern	0.23	0.17	0.15	\$2.55

> ½ Lite

Climate Zone	U-Factor	SHGC	Energy Savings (GJ)	Savings (\$/year)
Northern	0.28	0.30	0.60	\$7.28
North-Central	0.28	0.30	0.46	\$6.22
South-Central	0.28	0.23	0.24	\$3.97
Southern	0.28	0.23	0.16	\$3.58



## Doors National Savings

Door Type	Unit Energy Savings (MMBtu)	2019 Shipments	Total Energy Savings (TBtu)
> ½ Lite	0.19	3,398,611	0.64
< ½ Lite	0.19	2,729,966	0.52
National Total (2019 Shipments)			1.16
National Total (50% Shipments)			0.58

## Questions about Swinging Door Analysis and Proposal





# Skylight Specification Proposal

- Reduce U-factor to improve insulating power
- Simply specification to 2 sets of criteria
- Reduce SHGC in Southern U.S. to reduce heat gain

## Version 6

Climate Zone	U-Factor	SHGC
Northern	$\leq 0.50$	Any
North-Central	$\leq 0.53$	$\leq 0.35$
South-Central	$\leq 0.53$	$\leq 0.28$
Southern	$\leq 0.60$	$\leq 0.28$



## Version 7

Climate Zone	U-Factor	SHGC
Northern	$\leq 0.45$	Any
North-Central		
South-Central	$\leq 0.50$	$\leq 0.25$
Southern		

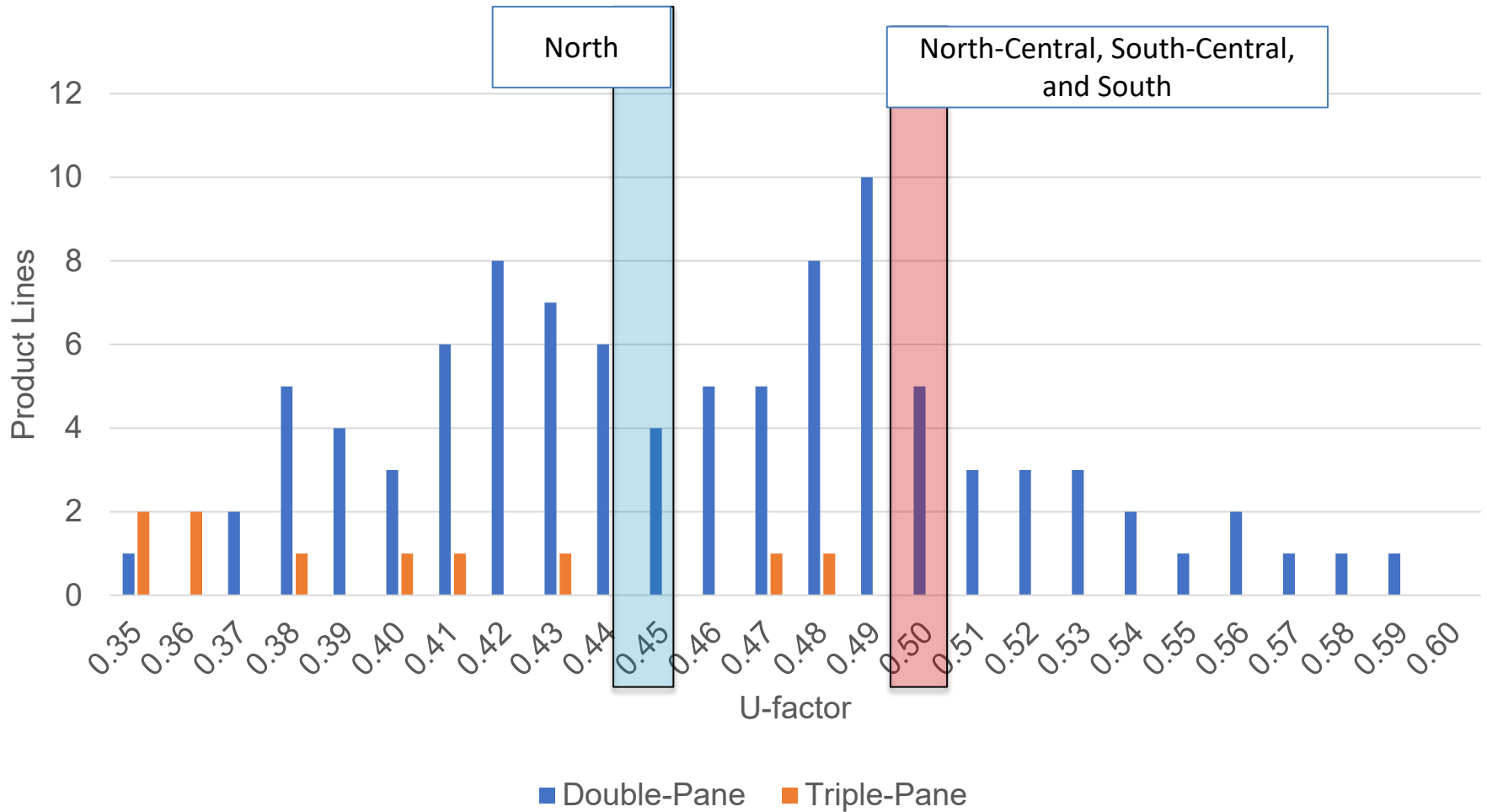
## Skylight Specification



- EPA indicated that it would consider sunsetting the ENERGY STAR criteria for skylights – not many products produced compared to other fenestration products and low energy savings
- EPA attempted to calculate an ‘adjustment factor’ to convert vertical window performance to a standard skylight angle of 20% - but the factor was not consistent
- However, analysis of the U-factor performance distribution showed many options are available at lower U-factors than the current criteria – so EPA proposes to improve the criteria for skylights and simplify the climate zones



# Skylight Performance Distribution

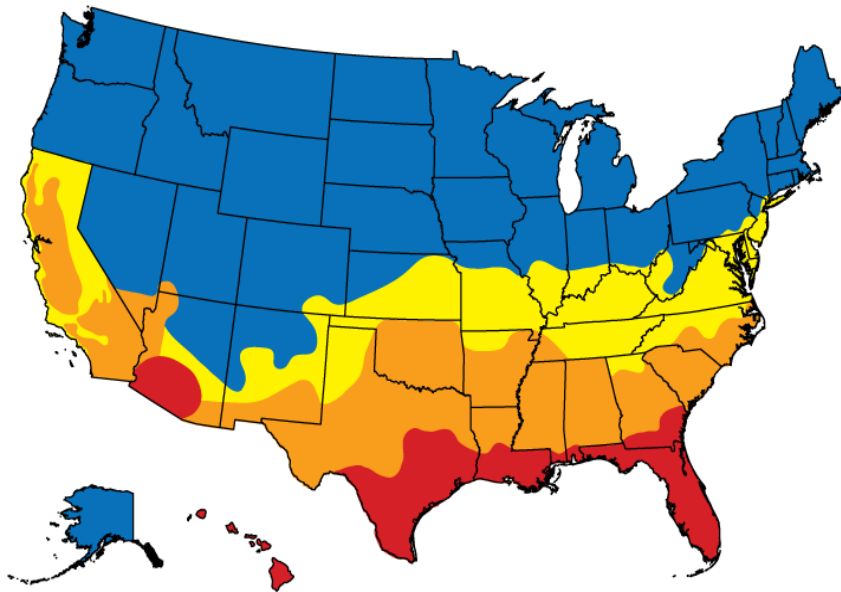


## Questions about Skylight Analysis and Proposal

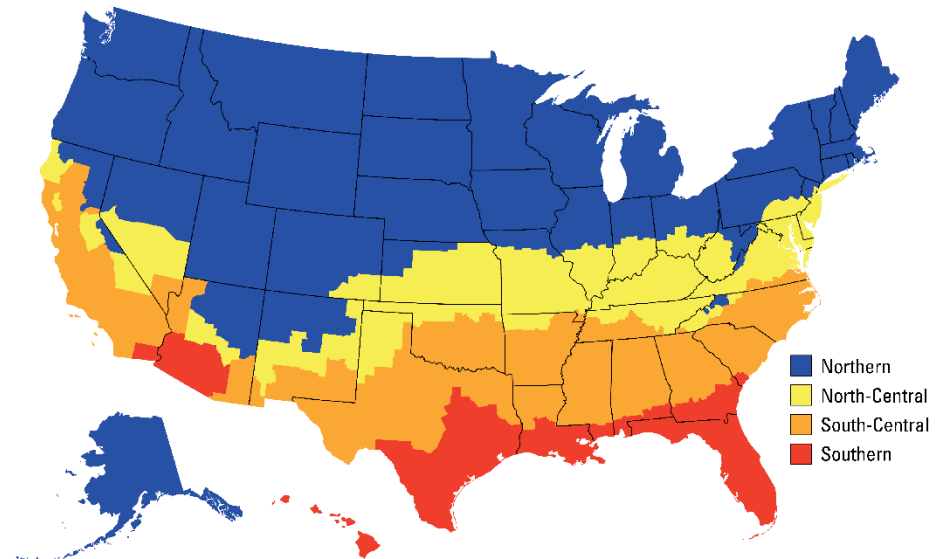


# Proposed Climate Zone Changes

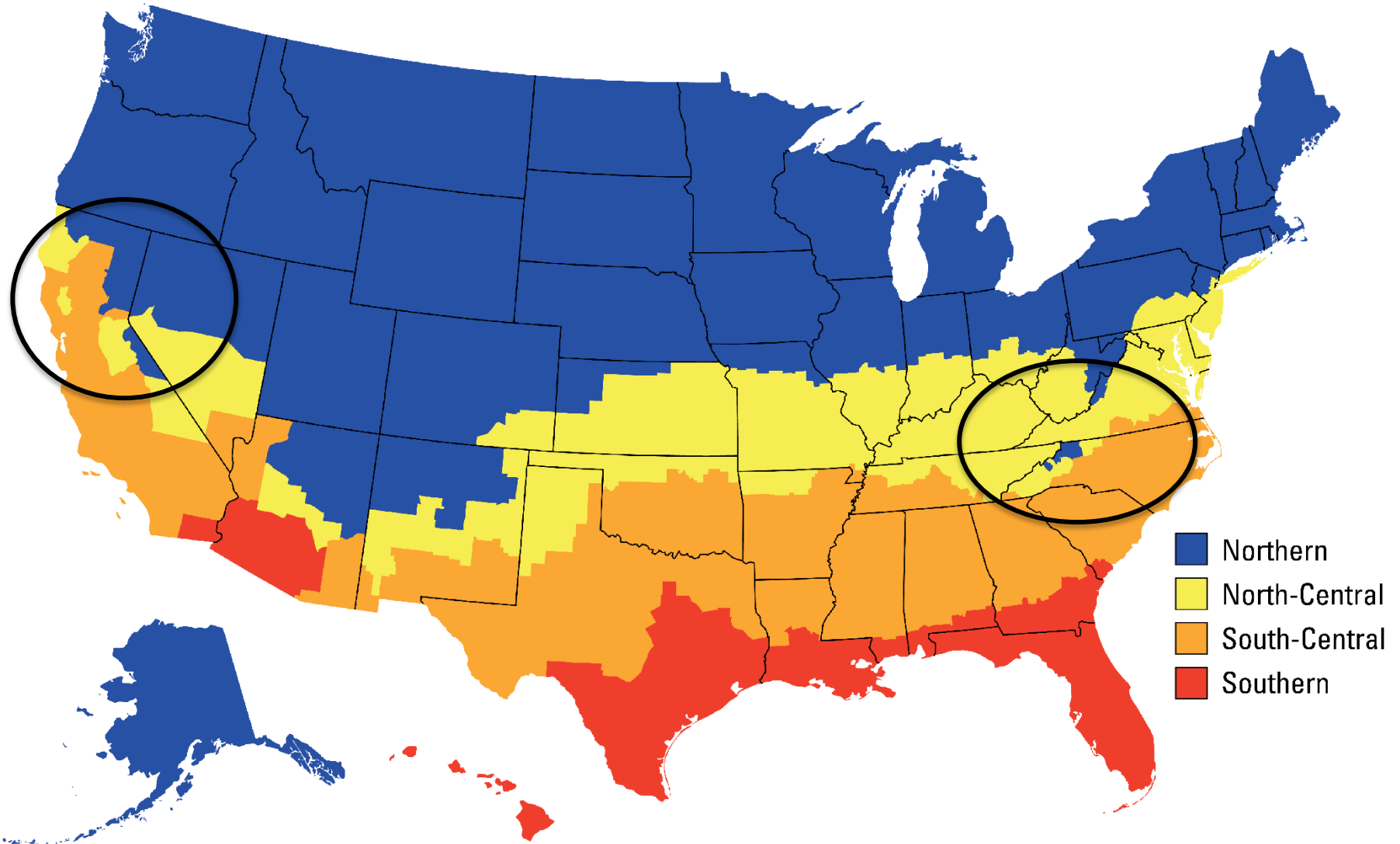
## Current Climate Zones



## Proposed Climate Zones



## Proposed Climate Zone Considerations





## Additional Issues Considered

- **Combining or Revising Climate Zones**
  - Analysis of window performance by climate zone did not indicate that we should combine zones.
  - EPA evaluated changes in IECC zones and proposed to modify ENERGY STAR zone boundaries accordingly
- **Minimum SHGC in the Northern Zone**
  - Analysis indicates lower-energy performance and lower visible transmittance (VT) for products at 0.17 and lower SHGC. New criteria proposes to set a minimum SHGC for the Northern Zone.



## Additional Issues Considered - continued

- **Dynamic Glazing and Shading**
  - Research indicated very limited ability to find and compare dynamic products in the NFRC CPD, therefore, no modifications to criteria are proposed
- **High Altitude and Impact Resistance**
  - No accommodations proposed
- **Extended Implementation Schedule**
  - Extended implementation schedule planned (over 270 days) – if possible



# Conclusion

## **New V7 criteria brings:**

- Better energy savings with reasonable payback
- Improved comfort
- Clear differentiation from baseline products
- More WDS marketing from ENERGY STAR
- Possible expansion in utility incentives

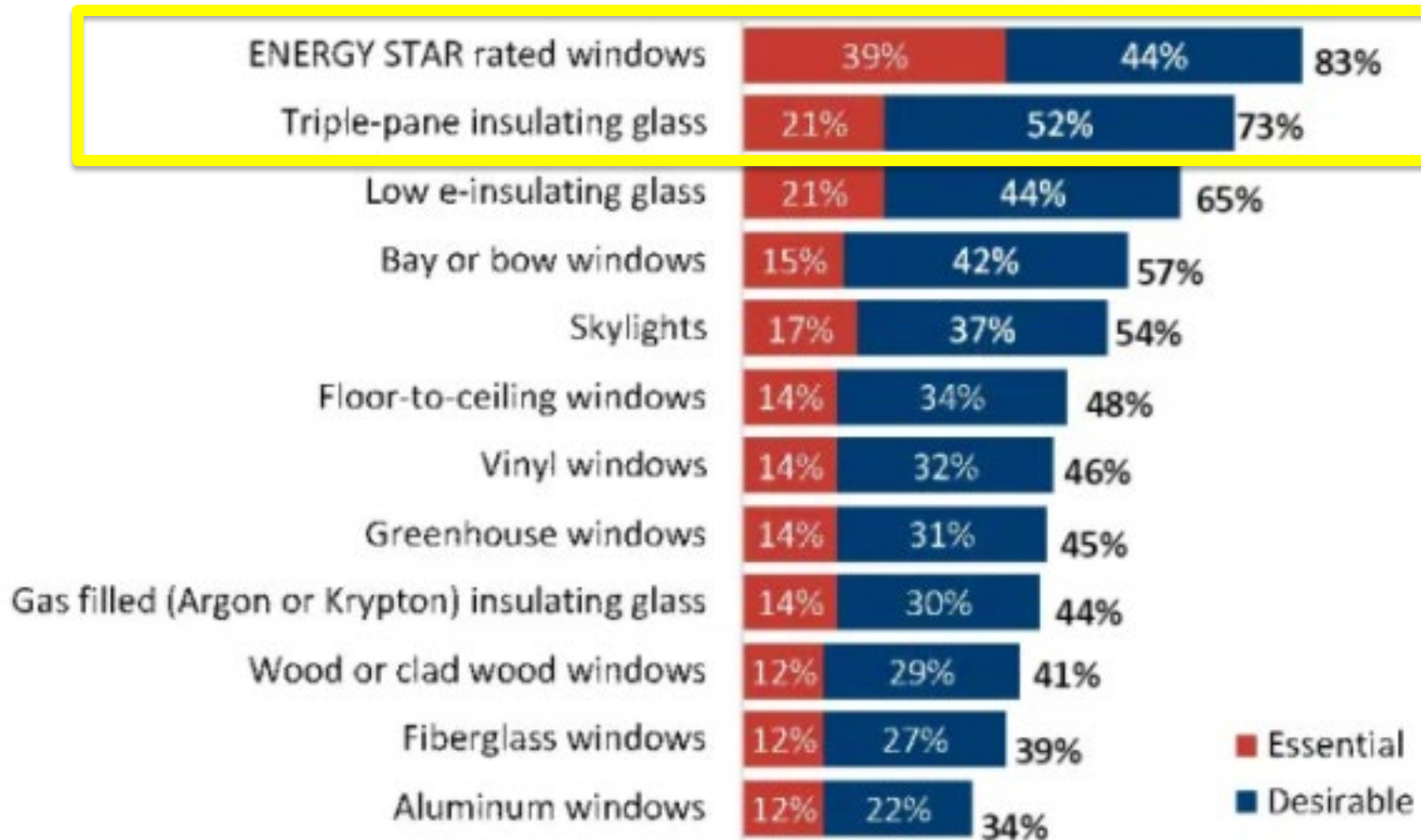
## **Based on the response from the last revision:**

- We project that partners will offer additional products that meet the V7 criteria



# NAHB Survey – *What Home Buyers Really Want*, 2021 Edition

## Window Features Rated Essential or Desirable (Share of Respondents)



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
ENERGY EFFICIENCY &  
RENEWABLE ENERGY

# US DOE's Perspectives on EPA's Window ENERGY STAR specification revision

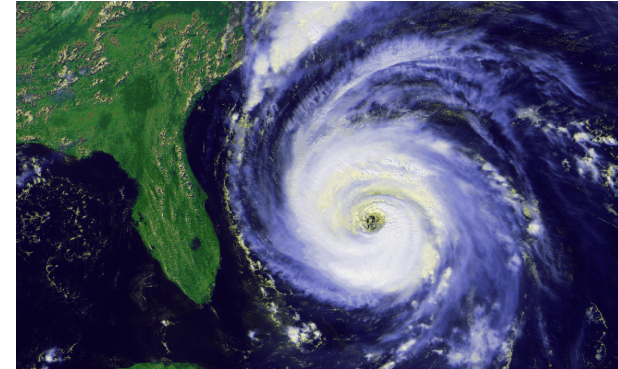
Marc LaFrance – Window R&D Manager

7/27/2021



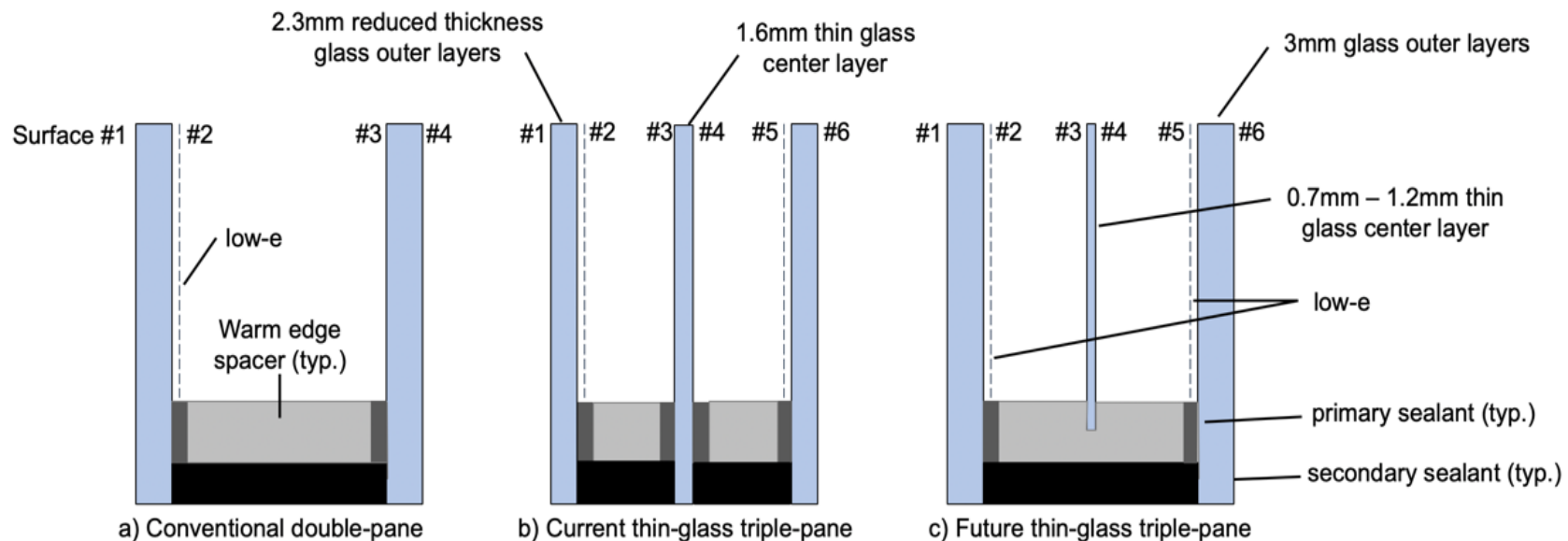
# Macro Response

- US DOE strongly supports EPA's ENERGY STAR update – path to low carbon homes
- Latest building codes, IECC 2021 for residential - windows represents 7% of the surface area of a home but 48% of the thermal losses:  
**AMERICA NEEDS BETTER WINDOWS!!!**
- High performance, more efficient ENERGY STAR windows, provide immediate carbon emission reductions upon installation



# DOE Background and Support to Industry

- DOE/LBNL extensive design and rating tools investment
- Extremely high market utilization of tools allow manufacturers to quickly and easily redesign products while minimizing cost
- DOE is supporting market transformation activity to help drive incentives, education, and other activities to help increase market demand
- Near-term goal, high volume triple pane IGU manufacturing with only two seals



# What else can DOE do to support the transition to triple pane windows?

- Very strong interest to address the market value proposition for windows
- Ensure that all the energy benefits of windows are considered when assessing the economics
  - Air leakage
  - Consumers
  - Reduced HVAC costs
  - Shorter duct runs
  - Reduced noise
  - Daylight
- Zero energy/passive house – high performance American made windows





# Next Steps for Version 7 Consideration

Next Steps	Expected Date
<b>Draft 1 Version 7.0 Comments Due</b>	August 20, 2021
<b>Draft 2 Version 7.0</b>	September–October 2021
<b>Final Draft Version 7.0</b>	November–December 2021
<b>Final Specification</b>	January 2022
<b>Specification Effective</b>	TBD



# Thank you!

## Open Q&A Session

### Contact Information:

**ENERGY STAR Windows General Mailbox (and for comments)**  
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**Doug Anderson, U.S. Environmental Protection Agency**  
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Please send comments to [windows@energystar.gov](mailto:windows@energystar.gov)