May 23, 2024

The Northwest Energy Efficiency Alliance (NEEA) was established in 1996 when utilities and energy efficiency stakeholders from Idaho, Montana, Oregon, and Washington came together to address the challenges of a changing utility environment by sharing the costs and benefits of transforming markets for energy efficiency. NEEA leverages the collective market power of the region and its more than 25 years of experience to create lasting market change by identifying market barriers and then strategically intervening to remove them, driving permanent change throughout the supply chain. This formalized, lasting approach is known as Market Transformation.

NEEA defines market transformation as “the strategic process of intervening in a market to create lasting change in market behavior by removing identified barriers or exploiting opportunities to accelerate the adoption of cost-effective energy efficiency as a matter of standard practice.” Key market transformation concepts include designing and deploying proven strategies for overcoming market barriers and leveraging opportunities, strategically leveraging market forces, defining market transformation outcomes, and designing methodologies and metrics to track progress.

In addition to NEEA’s proven track record of designing and deploying successful Market Transformation programs to deliver energy savings to the region, NEEA maximizes the success of these efforts by convening and collaborating across organizations. By collaborating across organizations, NEEA enables the market to move faster and more efficiently than any one organization could do alone.

As other organizations across the United States are looking to create their own market transformation programs, they frequently look to NEEA for its thought leadership and expertise in this area. On behalf of the region, NEEA consults and collaborates with partners and organizations outside the Northwest that are seeking to create market transformation programs. Working with and complementing the work of other organizations ensures efforts are not duplicated and reduces potential market confusion. NEEA leverages these relationships to influence market dynamics, procure regional data and intelligence, and deliver value to the Northwest. As a growing number of other Market Transformation entities enter the market, NEEA can draw on its national leadership position to align work and priorities and deliver value to Northwest consumers by ensuring their needs and perspectives are represented.

One example of successful collaboration is with Minnesota’s Center for Energy and Environment (CEE). Minnesota (CEE) along with its Efficient Technology Accelerator (ETA) Program is working to launch several new market transformation programs including its High-Performance Windows program. By consulting and collaborating with Minnesota CEE, NEEA was able to pool resources and maximize results via a research effort to estimate the size of the residential windows market for the Northwest and for the state of

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Minnesota. NEEA contracted with Ducker Carlisle to complete a market sizing study, which is a standard deliverable in the early phase for all NEEA Market Transformation programs. In particular, the Ducker Carlisle study sought to estimate:

- the number of residential windows sold in the Northwest and in Minnesota from the most recent year of complete sales data (2022),
- the relative share of efficient windows represented in this data, and
- the proportion of efficient windows that aligned with prescriptive or energy-equivalent pathways for ENERGY STAR version 7.0 requirements.

For this study NEEA and MNCEE recognized that working together provided a framework where both organization's efforts could benefit from economies of scale for this and for potential future opportunities. For example, NEEA may be able to share costs for future data acquisition with national manufacturers, making it easier and more cost effective for each individual organization to meet goals.

The alliance will continue its work to design and deploy innovative approaches to energy efficiency market transformation and identify areas of collaboration and opportunity that accelerate the adoption of energy-efficient products and technologies in the region. Together, the alliance and its partners are overcoming barriers to achieve a more energy-efficient Northwest.

Sincerely,
Amy Webb

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May 23, 2024

REPORT #E24-483

High-Performance Residential Window Market Share Study

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Executive Summary

The Northwest Energy Efficiency Alliance (NEEA) and the Center for Energy and Environment (CEE) are assessing opportunities for residential high-performance windows (HPW) programs with a focus on windows sold in the Northwest (Idaho, Montana, Oregon, Washington) and in Minnesota, respectively. The goal of this study was to a) estimate the number of residential windows sold in these two regions from the most recent year of complete sales data (2022), b) determine the segmentation of efficient windows (or HPW) and non-efficient windows represented in this data, and c) describe the segmentation of efficient windows that aligned with prescriptive or energy-equivalent pathways for ENERGY STAR Version 7.0 requirements. This study leveraged Ducker Carlisle's ("Ducker's") relationships with key window manufacturers (n=24) and distributors (n=106), as well as their proprietary national window sales dataset, to provide a grounded estimate of recent HPW market share essential for developing savings estimates for these programs. During interviews with these market actors, the contractor also explored if they were currently selling ENERGY STAR 6.0 windows, how manufacturers were likely to meet ENERGY STAR Version 7.0 requirements (which came into effect October 2023), and whether they thought that HPW were more likely to be installed in new construction or in retrofits and remodels.

NEEA and CEE define **high-performance windows** in alignment with the ENERGY STAR® Version 7.0 **prescriptive path** guidelines for the Northern Climate Zone; as windows with a U-Factor of 0.22 or less. The **equivalent energy performance path** is another way to meet the ENERGY STAR Version 7.0 requirements. Manufacturers can raise the solar heat gain coefficient (SHGC) to adjust the U-Factor between 0.23 to 0.26 and attain similar energy savings.

This study estimated that in 2022, there were 2.9 million windows sold in the Northwest; 54% of which went to new construction. Within the Northwest, Idaho had a higher percentage (65%) of windows sold to new construction, most likely due to significant population growth (and additional housing needs) over the past few years. About 1.0 million windows were sold in Minnesota, with 50% sold to new construction.
Only a small percentage of windows sold in 2022 would have met either the prescriptive or energy equivalent pathway for ENERGY STAR Version 7.0 requirements. In the Northwest, about 3% (or 85,000) of windows sold met these requirements overall, and only 2% met the HPW definition for this study through the prescriptive pathway. In Minnesota, about 4% (or 40,000) of windows sold met the ENERGY STAR Version 7.0 requirements through either pathway, and about 3% aligned with the HPW definition (having a U-Factor of 0.22 or less).

The study also found that the majority of manufacturers (9 out of 10) and distributors (19 out of 20) were selling ENERGY STAR Version 6.0 windows. This is important, because ENERGY STAR has become a shorthand in the industry for energy efficiency and can drive supply and demand from key market actors like manufacturers, contractors, and end-use customers. Previous Ducker research has shown that having an ENERGY STAR rating is a top five criteria for window selection among consumers and can be a project requirement for contractors.

The study explored if the market actors interviewed believed HPW were more likely to be installed in new construction or in retrofit and remodels. Window manufacturers believed the average U-Factor for new construction would be lower than retrofit and remodel applications, given the necessity of applying for permits and fulfilling code requirements. Distributors, on the other hand, noted that customers buying replacement windows looked for better energy performance and could upgrade to U-Factors lower than those likely to be installed in new construction. In previous proprietary work, Ducker found that remodel and replacement windows tended to have higher performance characteristics, aligning more with distributors interviewed in this study. States in this study had different code requirements, but none would factor heavily into meeting ENERGY STAR Version 7.0 requirements.

Manufacturers will need to figure out solutions in their manufacturing processes to meet ENERGY STAR 7.0 requirements and will likely require a few years to do so, while still providing products in a price range that

consumers can afford. Of the manufacturers who were already supplying HPW in 2022, more than 85% utilized triple glazing; others used higher performing coatings or a 4th surface Low-E coating. Manufacturers were concerned, however, about adding a fourth surface Low-E coating, as it could lead to exterior condensation. Moving forward, most manufacturers believed that triple glazing would be required to reach ENERGY STAR Version 7.0 requirements.

1 Introduction

The Northwest Energy Efficiency Alliance (NEEA) and the Center for Energy and Environment (CEE) are assessing program opportunities for residential high-performance windows (defined as having a U-Factor of 0.22 or less), with a focus on windows sold in the Northwest and in Minnesota, respectively. In 2023, they contracted with Ducker to complete market research on the windows market to inform this work, building on earlier market characterization reports that both organizations had done previously.

The key objectives of this research were to estimate:

- The number of residential window units sold in 2022 by state in the Northwest (Idaho, Montana, Oregon, Washington) and in Minnesota.
- The segmentation of shipments between efficient and non-efficient windows, where:
  - "Efficient" is defined as meeting ENERGY STAR Version 7.0 certification requirements for the Northern Climate Zone, which can include:
    - U-Factor less than or equal to 0.22 (also known as the "prescriptive requirement").
    - Equivalent energy performance trade-offs with U-Factors up to 0.26 and solar heat gain coefficients (SHGC) down to 0.17.
- The segmentation of efficient windows between prescriptive vs. equivalent energy performance pathways.

Additional questions explored during interviews included whether respondents sold ENERGY STAR 6.0 windows, how manufacturers were likely to meet ENERGY STAR Version 7.0 requirements (which came into effect October 2023), and whether these market actors thought that HPW were more likely to be installed in new construction or in retrofits and remodels.

1.1 ENERGY STAR Requirements

ENERGY STAR is a program run by the U.S. Environmental Protection Agency (EPA) that promotes energy efficiency, including through requirements for windows that vary depending on the climate region. Ducker's proprietary research for manufacturers has shown that consumers value windows that display the ENERGY STAR logo as one of the top five criteria for selecting a window. Since 2014, windows have been subject to Version 6.0 requirements to earn the designation (see Table 1). However, in October of 2023, ENERGY STAR introduced Version 7.0 (see Table 2), which has lower U-Factor and SHGC requirements than the previous version.

Table 1. ENERGY STAR Version 6.0 Requirements

Climate Zone	U-Factor	SHGC	Class
Northern	≤ 0.27	Any	Prescriptive
	= 0.28	≥ 0.32	Equivalent Energy Performance
	= 0.29	≥ 0.37	
	= 0.30	≥ 0.42	

Notes: Adapted from *ENERGY STAR Program Requirements for Residential Windows, Doors, and Skylights,* 2014

Table 2. ENERGY STAR Version 7.0 Requirements

Climate Zone	U-Factor	SHGC	Class
Northern	≤ 0.22	≥ 0.17	Prescriptive
	= 0.23	≥ 0.35	Equivalent Energy Performance
	= 0.24		
	= 0.25	≥ 0.40	
	= 0.26		

Notes: Adapted from *ENERGY STAR Program Requirements for Residential Windows, Doors, and Skylights,* 2023

The three primary performance metrics that ENERGY STAR window installations must meet are: U-Factor, solar heat gain coefficient (SHGC), and air leakage, although U-Factor and SHGC are the primary focus of this study. In cold Northern climates (including all states that are part of this study), the DOE (DOE/EE, 2021) recommends that buyers prioritize the lowest U-Factor (the measure of how well a window or door prevents heat from escaping or entering) that they can afford, as this will provide improved insulation and lower energy costs (see Figure 1). Windows will also have to meet SHGC factors determined by ENERGY STAR, which represent how much of the sun's heat can pass through a window. A higher SHGC results in more solar heat gain in the house.

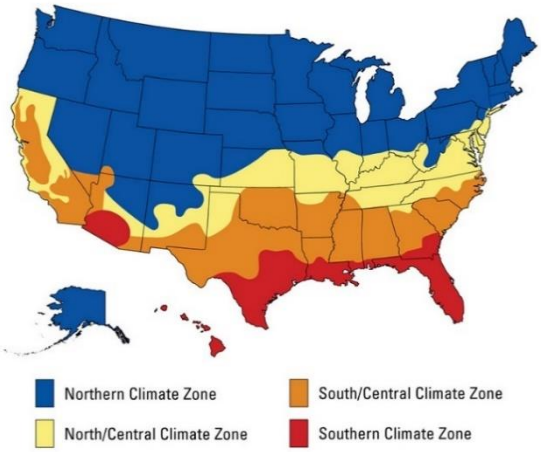

Figure 1. Climate Zone Map for ENERGY STAR Windows, Doors, and Skylights
Notes: Sourced from *ENERGY STAR Program Requirements for Residential Windows, Doors, and Skylights,* 2023

2 Research Methods

Ducker completed interviews with **24** manufacturers (sales representatives, owners, general or project managers, insights managers, and marketing directors) and **106** distributors that served the five states relevant for this study. Distributors included any company that received their windows from a manufacturer directly, selling to contractors, builders, homeowners, or retail (including big-box stores). Distributor interviews were primarily about one-off locations where respondents had the most direct knowledge, although participants were occasionally able to provide broader data for their company. Most interviews were conducted via phone, with the exception of two distributors who responded to questions via email. Only respondents who indicated they were knowledgeable about their company's window sales were included in the study.

Distributor respondents were discovered through Ducker's internal contact database, which included purchases from third-party sources, contact build-up of known distributors, and utilization of manufacturer websites listing where products are sold. Because this contact database has been built up over time, the source of each individual contact is not available. There may be, however, a slight bias towards distributors that sell one of the largest brands (e.g., Cornerstone, Andersen, MI Windows and Doors, etc.), as they tend to have better search functionality on their websites.

Manufacturer contacts were sourced from Ducker's internal database of window companies used in part for Fenestration & Glazing Industry Alliance (FGIA) and ENERGY STAR, with an additional 10 smaller manufacturers found through using multiple online search engines. Ducker also asked distributors and manufacturers for referrals of other window manufacturers selling into Minnesota and the Northwest, however, none given were separate from companies Ducker had already listed.

In addition to the primary research gathered for this engagement, Ducker reviewed previous proprietary study and work materials developed through its work with the FGIA and ENERGY STAR. These included conversations with additional manufacturers, as well as access to proprietary unit totals and splits based on performance in the Northwest region and Minnesota.

2.1 Estimate Methodology for the Number of Windows Sold in Each State

In order to estimate how many residential windows were sold in 2022 in each state, Ducker utilized its data on annual window sales from the FGIA Regions of Market Study (2023). As part of its annual work for FGIA, Ducker tracks the number of windows sold each year both in new construction and in remodel and replacement totals across eleven regions that can be found in Figure 2. The states with green outlines were the focus of this study, and they are part of three separate regions in the FGIA study: the Northwest, Mountain, and West North Central regions.

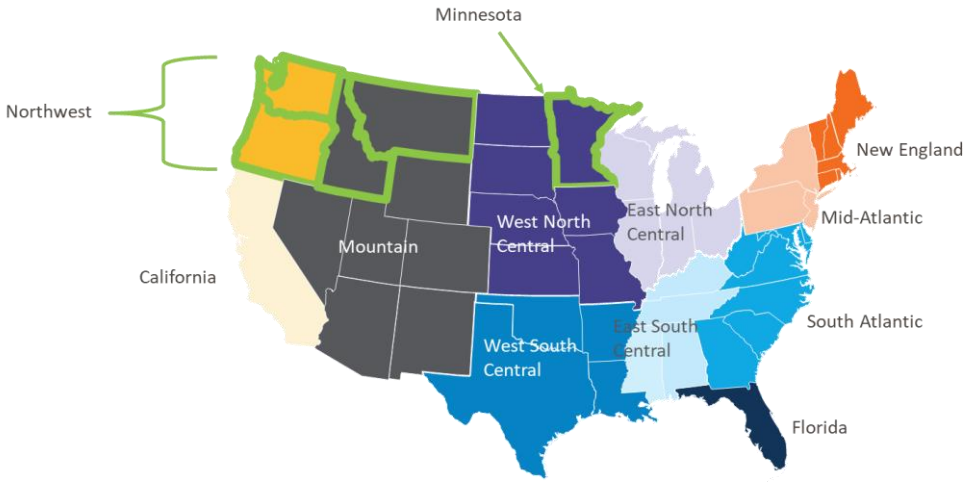

Figure 2. FGIA Regions of Market Study
Notes: Adapted from *FGIA 2021/2022 U.S. Industry Market Studies*, 2023.
States in Green Outlines are Target States

Since this data was bundled by region, Ducker needed to create individual state level estimates for new construction residential windows, as well as remodel and replacements.

To estimate new construction window sales by state, Ducker utilized national and regional window sales estimates (see Tables 5-8) and multiplied these by the percentage of windows likely to represent new constructions in each state, represented by the number of housing starts[1] reported by the US Census Bureau for each state in 2022 (see the first three columns in Tables 3 and 4 below for housing start percentages by state).

For an example of new construction window estimates for the state of Washington, look at the numbers in Table 5 to see that:

(**1,133,000** new construction windows in NW region) **X** (**71%** of housing starts were in Washington)
≈ 801,000 (new construction windows estimated in Washinton, with slight variance due to rounding)

Then, to estimate the total number of remodel and replacement windows sold per state in 2022, Ducker used population estimates for each state from the US Census Bureau (see the last two columns in Tables 3 and 4) and multiplied these by the percentage of population that the state represented of the region. These percentages were then multiplied by the regional totals from Ducker's work with FGIA (see Tables 5-8).

An example of retrofit estimates for the state of Washington can be drawn from numbers in Table 6:

(**65%** of the NW regional population lives in Washington) **X** (**1,075,000** retrofit and replacement windows sold in the NW region)
≈ 692,000 (retrofit and replacement windows sold in Washington in 2022)

Table 3. Housing Starts and Population in the Northwest

State	Housing Starts (2022)	Percent of Regional Housing Starts	Population (2022)	Percent of Regional Population
Northwest Region (FGIA)	69,354	100%	12,025,923	100%
Washington	49,033	71%	7,785,786	65%
Oregon	20,321	29%	4,240,137	35%
Mountain Region (FGIA)	198,649	100%	25,514,320	100%
Idaho	18,737	9%	1,939,033	8%
Montana	6,457	3%	1,122,867	4%

Notes: Adapted from *U.S. Census, 2023*

[1] "Housing starts" are an economic indicator collected monthly by the US Census Bureau through surveying national builders. It refers to the number of new residential units that began construction in a given month.

Table 4. Housing Starts and Population in Minnesota

State	Housing Starts	Percent of Regional Housing Starts	Population	Percent of Regional Population
West North Central (FGIA)	98,309	100%	21,689,816	100%
Minnesota	31,096	32%	5,717,184	26%

Notes: Adapted from *U.S. Census, 2023*

Table 5. Northwest New Construction Windows

Region/ State	Housing Starts (2022)	Percent of Regional Housing Starts	Sales of New Construction Windows
Northwest Region (FGIA)	69,354	-	1,133,000
Washington	49,033	71%	801,000
Oregon	20,321	29%	332,000
Mountain Region (FGIA)	198,649	-	3,433,000
Idaho	18,737	9%	306,000
Montana	6,457	3%	106,000

Notes: Adapted from *U.S. Census, 2023* and Ducker analysis

Table 6. Northwest Repair & Replacement Windows

Region/ State	Population (2022)	Percent Regional of Population	Sales of Repair & Replacement Windows
Northwest Region (FGIA)	**12,025,923**	-	**1,075,000**
Washington	7,785,786	65%	692,000
Oregon	4,240,137	35%	383,000
Mountain Region (FGIA)	**25,514,320**	-	**2,175,000**
Idaho	1,939,033	8%	163,000
Montana	1,122,867	4%	98,000

Notes: Adapted from *U.S. Census, 2023* and Ducker analysis

Table 7. Minnesota New Construction Windows

Region/ State	Housing Starts (2022)	Percent of Regional Housing Starts	Sales of New Construction Windows
West North Central (FGIA)	98,309	-	1,590,000
Minnesota	31,096	32%	508,000

Notes: Adapted from *U.S. Census, 2023* and Ducker analysis

Table 8. Minnesota Repair & Replacement Windows

Region/ State	Population	Percent of Regional Population	Sales of Repair & Replacement Windows
West North Central (FGIA)	21,689,816	-	1,975,000
Minnesota	5,717,184	26%	513,000

Notes: Adapted from *U.S. Census, 2023* and Ducker analysis

Figures were checked against the manufacturers' number of windows sold in both the Northwest and Minnesota, as well as splits between new construction and remodel/replacement from this engagement. In the Northwest, manufacturers reported 52% of windows going towards new construction versus 54% through Ducker's modeling efforts. In Minnesota, 49% of windows sold by manufacturers went towards new construction, as opposed to 50% in Ducker's modeling efforts. Given minimal differences in those percentages, no adjustments were made to the number of windows in either new construction or remodeling estimates.

2.2 U-Factor and Percentage of Windows that Met ENERGY STAR Version 7.0 Methodology

Ducker asked manufacturers two questions to understand the usage of various U-Factor groupings and adherence to ENERGY STAR Version 7.0 requirements, estimating:

1. What percentage of their windows were sold within the Northwest and/or Minnesota (separately) met the following U-Factors:
    a. 0.20 or less
    b. 0.21 or 0.22
    c. 0.23 – 0.26
    d. > 0.26
2. If any of a manufacturer's windows with a U-Factor between 0.23 and 0.26 would meet ENERGY STAR Version 7.0 requirements through the equivalent energy performance requirements, and if so, what percentage?

Some manufacturers did not supply this data, so Ducker used three other methods to supplement its research:

1. Ducker asked distributors the same questions, as well as what brands of windows they purchased. From previous research, Ducker assumed that distributors tend to overestimate what percentage of their window sales are below a 0.22 U-Factor (or met the Equivalent Energy Performance requirements). Ducker also assumed these overestimations would be consistent between the purchase of brands. Therefore, the **difference** between the percentages for distributors carrying various brands helped dictate the estimated percentages for each. Ducker found slight differences among distributors carrying different manufacturers, but those tended to even out to existing totals. Table 9 shows an example of how this was measured.

Table 9. Northwest Distributors' U-Factors

Northwest Distributors	0.20 or less	0.21 or 0.22	0.23 - 0.26	> 0.26
Overall (n=84)	**5%**	**4%**	**33%**	**56%**
Selling Andersen (n=17)	1%	4%	20%	68%
Not selling Andersen (n=67)	6%	4%	36%	53%

Given the feedback from distributors shown in Table 9, Andersen should have a lower share for 0.20 or less, 0.23-0.26, and > 0.26 than existing market splits. In this case, Ducker estimated ~0.2% for 0.20 or less (as opposed to 1% market average), 1% (similar to market average) for 0.21 or 0.22, 7% for 0.23 - 0.26 (as opposed to 13% market average), with the balance going to >0.26.

2. Ducker also checked to see within National Fenestration Rating Council (NFRC) database to see if manufacturers had products that fall into the various U-Factor and SHGC categories. Andersen did have products that fit each category, but had they not, Ducker would have removed percentages from any category they did not have representation in the NFRC database. So, if Andersen did not have a window that was 0.20 or less in U-factor, Ducker would have divided that U-Factor percentage (in this case 0.2%) among the remaining categories.

3. Additionally, Ducker did review NFRC listings of respondents they spoke to, and in the case of six respondents, followed-up to get clarity and additional review of those percentages. In the case of three respondents, Ducker was unable to get a hold of that respondent, and so manually adjusted weightings following the methods outlined above in (2).

Ducker weighted responses based on how many windows were sold in 2022 in the locations of the study (Northwest and Minnesota), using primary feedback from this engagement, as well as supplemental internal estimates of each of the top 50 manufacturers. When primary feedback was not available from this direct effort, Ducker referenced previous work to get national and regional totals of manufacturers from a base year and growing them based on either investor reports (JELD-WEN, Cornerstone) or market growth, and dividing that number by percentage totals outlined in section 2.1.

A hypothetical example can be found below:

> Manufacturer X sold 1,000 windows in 2020 within the West North Central Region. The market in the West North Central grew by 10% by 2022. 29% of that region's windows can be found in Minnesota.
>
> 1000 * 1.1 * 29% = 319 windows sold in Minnesota in 2022.
>
> Individual estimates were adjusted slightly to match the top-down totals found in Table 13.

References to ENERGY STAR 7.0 requirements and U-Factors are not always data points that manufacturers have at hand, but respondents estimated these numbers to the best of their abilities. About 70% thought they were confident in the splits that they provided, with the largest gaps in knowledge occurring in the percentage of windows that would meet ENERGY STAR Version 7.0 requirements through equivalent energy performance. Were this study to be done again in 2024, respondents would likely be more familiar with those figures, as they will be the new normal for ENERGY STAR.

Distributors were less likely to have confidence in what percentage of their windows met ENERGY STAR 7.0 requirements. While only 4 out of 106 refused to answer, their responses were not entirely consistent with what manufacturers stated (or with various NFRC listings). As shown above, distributor responses were used to supplement where there was no direct input from manufacturers.

3 Manufacturer Respondent Demographics

3.1 Number of Manufacturer Responses by State

Ducker interviewed 24 manufacturers as part of this report (see Figure 3). Most companies interviewed serviced multiple states, including 29% of respondents that serviced all 5 states. Outside of those servicing all 5 states, the most common overlap between manufacturer sales territories was between Idaho and Oregon.

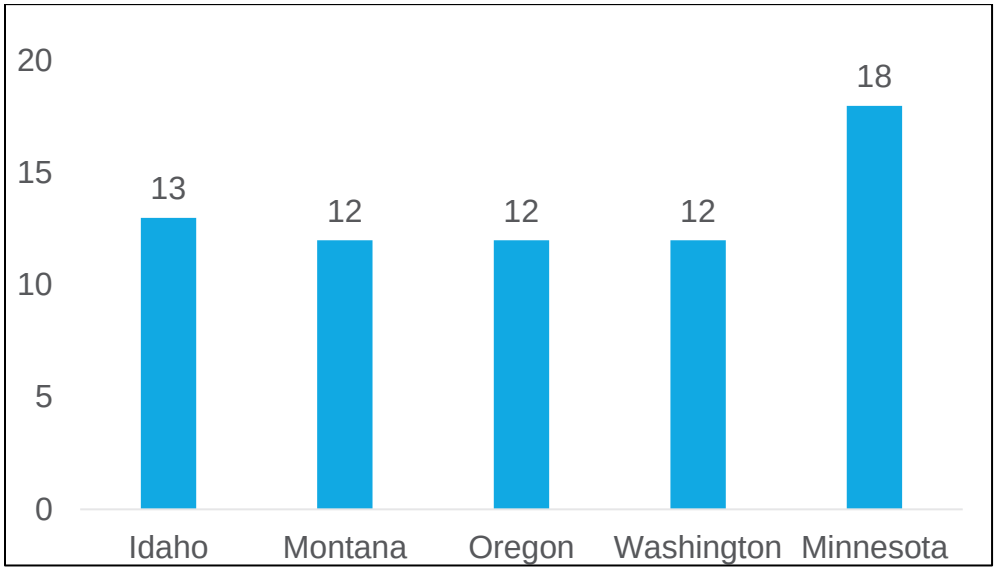

Figure 3. Number of Manufacturer Responses by State (n=24)
Notes: Adapted from the Survey question: Q2. Do you sell residential windows into any of the following states?

3.2 Range of Average Residential Windows Sold 2022

Ducker interviewed manufacturers who sold both small and large numbers of windows in 'an average' year (see Figure 4). Annual sales estimates from manufacturers ranged from under 5,000 up to 5 million windows, with over half selling over 50,000 windows.

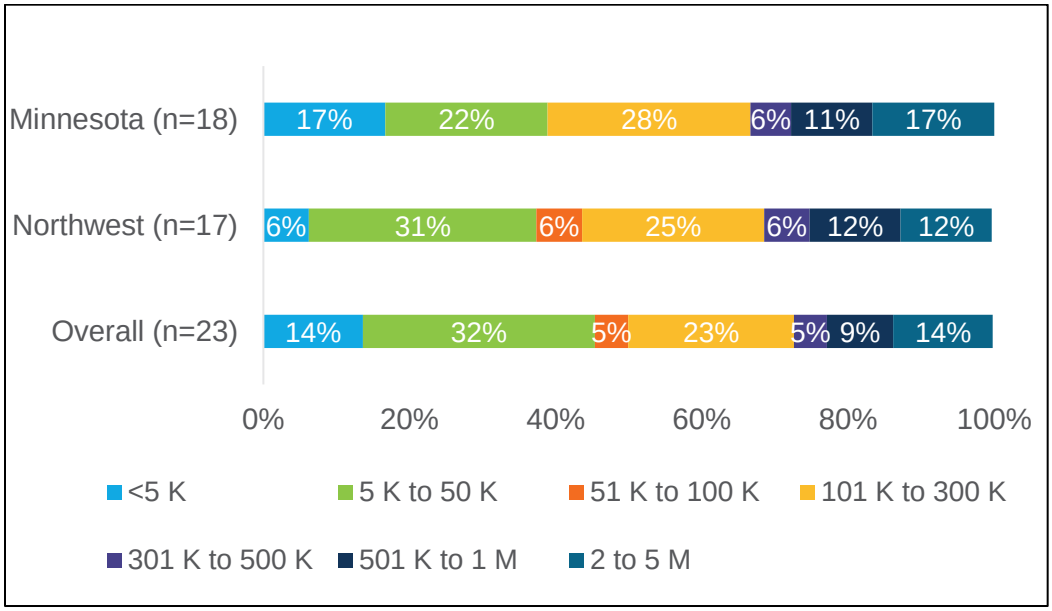

Figure 4. Range of Total Average Residential Windows Sold by Manufacturers in 2022 (n=23)

Notes: Adapted from the Survey question: Q3. How many total residential windows does your company sell on average per year?

3.3 Manufacturers Selling ENERGY STAR Version 6.0 Windows Currently

Most manufacturers (88%) sold windows that were ENERGY STAR Version 6.0 certified, with the primary reasons for doing so being consumer demand and business reputation (see Table 10). Ducker's proprietary research for manufacturers has shown that consumers value windows that display the ENERGY STAR logo as one of the top five criteria for selecting a window, and consumers are often less likely to investigate differences within energy ratings, so long as a window has that ENERGY STAR logo. Additionally, certain projects use ENERGY STAR as a shorthand for proving that windows are energy efficient.

- *"A lot of people are willing to pay for ENERGY STAR windows. People want higher efficiency ones, and may be willing to pay 20-30% extra."* – Window manufacturer
  "We want to be known as a company with energy-efficient windows. The best way to show that is to be ENERGY STAR certified." – Window manufacturer

Table 10. Percentage of Manufacturers Selling ENERGY STAR (Version 6.0) in 2022

State	Yes	No
Overall (n=24)	**88%**	**13%**
Northwest (n=18)	89%	11%
Minnesota (n=18)	89%	11%

Notes: Adapted from the Survey question: Q5. Do you sell ENERGY STAR Windows (Version 6.0)?

Those that did not have the certification often met the ratings but were smaller manufacturers with a single location serving an individual Metropolitan Statistical Area (MSA). These manufacturers did not see the value in ENERGY STAR certification, as they often have a more direct relationship with the end customer and can educate about the differences in ratings without paying for the ENERGY STAR logo.

- *"We're too small of a company to pay for the ENERGY STAR logo, even though our windows meet those requirements. When you're only selling a couple thousand windows a year, it doesn't make sense for us to pay for that."* –Window manufacturer
- *"We are known for very energy-efficient windows. We have windows that meet ENERGY STAR requirements, without specifically striving to achieve ENERGY STAR requirements. Some projects require ENERGY STAR products, so we need to have the ENERGY STAR label for our windows. Since our windows are so energy efficient -- beyond the requirements of ENERGY STAR -- stating we have ENERGY STAR windows has no marketing benefit to us whatsoever. If we were doing less windows, we wouldn't bother with getting the logo."* – Window manufacturer

Additionally, manufacturers commented that there is little difference in the percentages of certification in the Northwest and Minnesota vs. other parts of the country, as almost all manufacturers sell ENERGY STAR windows as part of their offerings.

4 Distributor Respondent Demographics

4.1 Number of Distributor Responses by State

Ducker interviewed 106 distributors as part of this report. Contacts primarily served one local location; however, in some cases within the Northwest, a regional manager spoke for multiple states (see Figure 5).

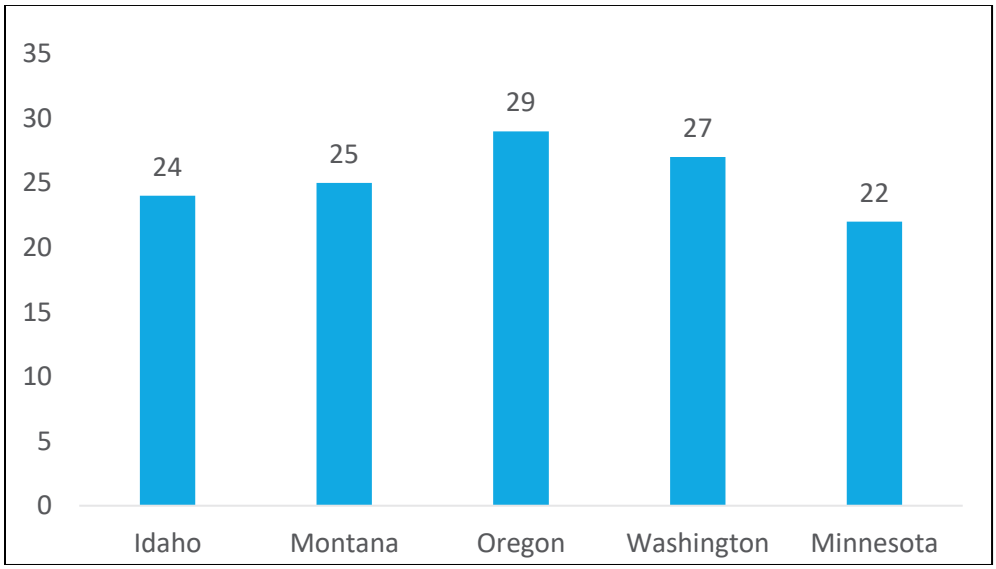

Figure 5. Number of Responses by Distributor (n=106)
Notes: Adapted from the Survey question: Q2. Do you sell residential windows into any of the following states?

4.2 Distributors Selling ENERGY STAR Version 6.0 Windows in 2022

The vast number of distributors were offering ENERGY STAR windows, as all the primary manufacturers that sell through distribution (e.g., Cornerstone, JELD-WEN, MI Windows, etc.) had offerings that met the requirements of Version 6.0 (see Table 11). Of the three distributors that did not offer ENERGY STAR windows, two shared that they sold less than 1,000 windows a year and that selling windows was not a core part of their business. The other respondent sold high-performance, triple-pane windows, but did not believe the manufacturer had received ENERGY STAR certification. There was little differentiation among distributors by location in the percentage offering ENERGY STAR windows today.

Table 11. Percentage of Distributors Selling ENERGY STAR (Version 6.0) Windows in 2022

State or Region	Yes	No
Overall (n=106)	**97%**	**3%**
Northwest (n=84)	98%	2%
Minnesota (n=22)	96%	4%

Notes: Adapted from the Survey question: Q5. Do you sell ENERGY STAR Windows (Version 6.0)?

5 Number of Windows Sold by State

Population is a good indicator of construction activity. Typically, as the population grows, so does the need for housing. Higher population growth areas, like Idaho, have a higher percentage of windows used for new construction. When comparing states, typically the larger the population, the higher the number of replacement windows sold in a given year. Washington is the largest state by population and also had the most window sales (both for new construction and replacement).

The Northwest region has experienced faster population growth than the national average, whereas Minnesota's population growth rate is more in line with the national average. Idaho and Montana were both within the top 10 fastest-growing states by population in 2022, with Washington also exhibiting higher-than-average growth (see Table 12).

Table 12. Population Growth

State or Region	2022 Population	One Year Population Growth (2022 from 2021)	Five-Year Population Growth (2022 from 2017)
National	333,287,557	0.38%	2.51%
Minnesota	5,717,184	0.10%	2.66%
Northwest	15,087,823	0.53%	5.15%
Washington	7,785,786	0.58%	4.82%
Oregon	4,240,137	-0.38%	2.24%
Idaho	1,939,033	1.82%	12.75%
Montana	1,122,867	1.50%	6.55%

Notes: Data is adapted from the Census Bureau.

Nationally, about half of residential windows (47%) were used in new construction (see Table 13). The Northwest outpaced national population growth by 2.64% over the past five years, leading to faster growth in housing construction and a higher percentage of windows going to new construction (54%).

Table 13. Total Number of Windows Sold in 2022

State	New Construction	Remodel & Replacement	Total Windows	Total Windows Rounded to Millions
National	27,200,000	30,200,000	57,400,000	57.4 million
Minnesota	508,000	513,000	1,021,000	1 million
Northwest	1,545,000	1,336,000	2,881,000	2.9 million
Washington	801,000	692,000	1,493,000	
Oregon	332,000	383,000	715,000	
Idaho	306,000	163,000	469,000	
Montana	106,000	98,000	204,000	

Notes: Data comes from a combination of FGIA/ Ducker work, Census data, and minor adjustments from primary research

6 Segmentation of Window Shipments

6.1 Percentage of Windows Sold that Met ENERGY STAR Version 7.0

Less than 5% of windows sold in 2022 met ENERGY STAR Version 7.0 requirements, with 70 to 75% of those units met through the prescriptive method (see Figure 6). A small portion of windows (1% of both Northwest and Minnesota) met ENERGY STAR Version 7.0 requirements through Equivalent Energy Performance.

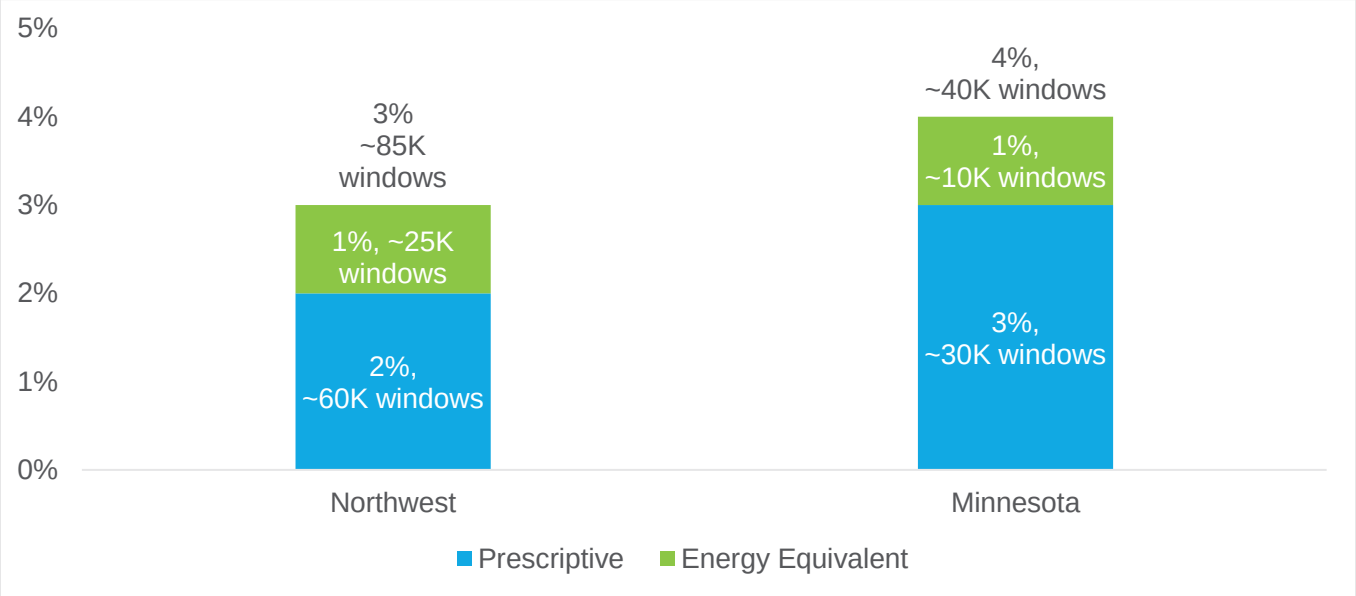

Figure 6. Percentage of Windows that Met ENERGY STAR Version 7.0 Requirements through Prescriptive or Energy Equivalent Pathways

Notes: Adapted from primary research questions: 6b. As you may be aware, ENERGY STAR rules are changing late this October. What percentage of your 2022 window sales would meet the northern climate requirements for v7 today? And Q8. What percent of your 0.23 – 0.26 residential windows would meet ENERGY STAR Version 7.0 certification criteria with Energy Performance trade-offs for the Northern climate zone?, as well as checked against NFRC listings and existing Ducker knowledge/ data

Manufacturers typically tracked U-Factor figures by region and so did not have data to show differences between the various Northwest states, but believed if there was a difference in percentage of windows sold in 2022 that met the ENERGY STAR Version 7.0 requirements within the Northwest states, that Washington may have had a slightly higher percentage than Idaho or Montana due to higher home values and incomes (willingness to pay by homeowners).

6.2 U-Factor Segmentation

Most residential windows in both markets had U-Factors higher than 0.26 (see Tables 14 and 15). Those that were selling windows 0.22 or below were typically doing so through triple glazing. Larger manufacturers have an even lower share of windows below 0.26; those that were meeting 0.22 or below today were typically more niche, local manufacturers with high-end offerings.

Table 14. Northwest Window Units by U-Factor

Category	Thousands of Windows, 2022	Percentage of Windows
0.20 or less	22	1%
0.21 or 0.22	36	1%
0.23 – 0.26	363	13%
> 0.26	2460	85%

Notes: Adapted from primary research question: Q7. What percent of your residential windows within these states fall into the following U-Factor ranges? As well as checked against NFRC listings and existing Ducker knowledge/ data.

Table 15. Minnesota Window Units by U-Factor

Category	Thousands of Windows, 2022	Percentage of Windows
0.20 or less	10	1%
0.21 or 0.22	20	2%
0.23 - 0.26	153	15%
> 0.26	837	82%

Notes: Adapted from primary research question: Q7. What percent of your residential windows within these states fall into the following U-Factor ranges? as well as checked against NFRC listings and existing Ducker knowledge/ data.

6.3 New Construction vs. Replacement Perceptions

About half of window manufacturers interviewed believed that the average U-Factor for new construction windows tended to be lower than that of remodel and replacement windows (see Figure 7). However, fewer distributors (between 13% and 32%) agreed with this statement.

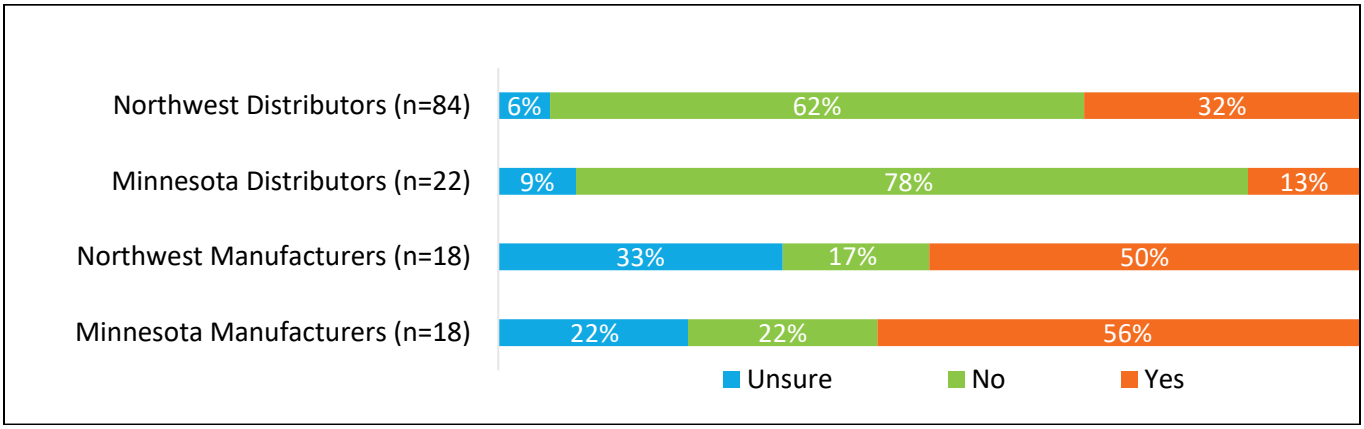

Figure 7. Is U-Factor for windows sold for new construction lower than that for retrofit and replacement windows?
Notes: Adapted from primary research question: 7b. Is the average U-Factor for windows sold for new construction lower than that for R&R? A "no" response could indicate that either they were likely to have the same U-Factor or that new construction windows were likely to have higher U-Factors.

In past work, Ducker has noted that replacement windows had a lower U-Factor as they were typically installed to improve energy performance in the home. New construction applications, however, tended to have lower-performing windows, possibly due to home builders being motivated to keep costs down.

Within the states under study, each uses a version of the International Energy Conservation Code (IECC) (see Figure 8) IECC recognizes several climatic regions that impact code. In general, higher numbered regions require lower U-Factor windows. There are differences in U-Factor requirements based on the year of the code adopted by the state, but not enough to cause window purchasers to require using windows that are part of ENERGY STAR Version 7.0 performance. See Table 16 for current U-Factor code requirements for windows in states relevant to this study.

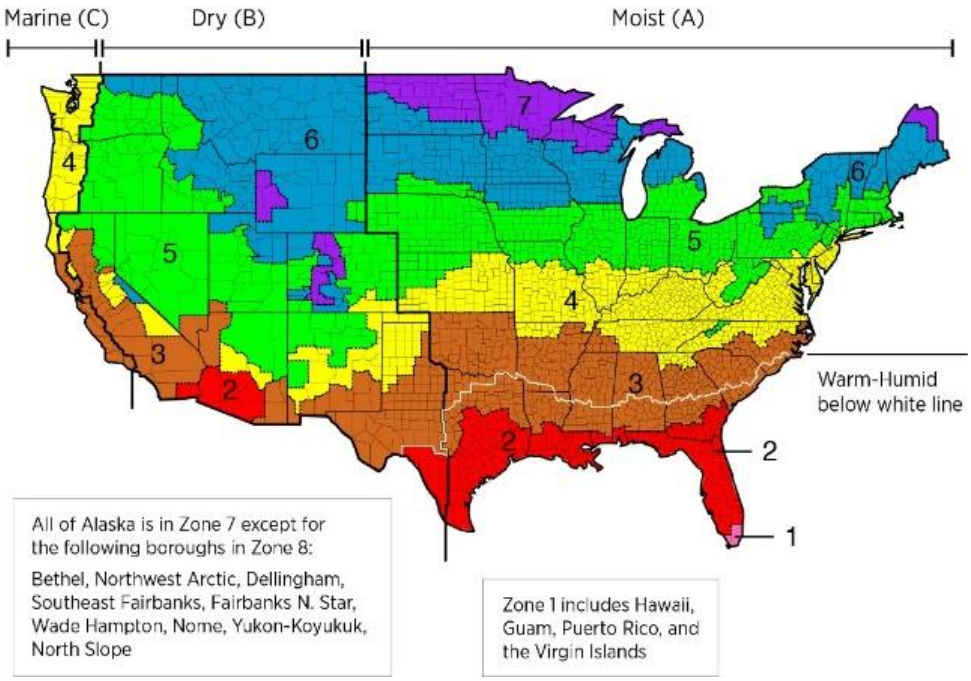

Figure 8. IECC Climate Zones
Notes: Taken from IECC Building Code

Table 16. Residential Building Code by State

State	Residential Code Efficiency Category (IECC)	U-Factor Requirement	Alternative Requirements
Minnesota	2009	0.32	None
Washington	2021	0.30	Seattle recently passed local emissions standard on December 12th, 2023, but the target was buildings > 20,000 sq. ft. that were unlikely to use residential windows
Oregon	2018	0.27	Recent update of U-Factor of 0.27 in fenestration
Idaho	2009	0.30 – 0.32	None
Montana	2009	0.32	None

Notes: Data is adapted from the Department of Energy and State Regulations.

6.4 Current Methods to Meet the ENERGY STAR 7.0 Certification Requirements

Most manufacturers attained ENERGY STAR 7.0 requirements through triple-glazing (see Figure 9). Some shared that they felt there was less room for improvement in higher performing Low-E coatings and they had concerns about using 4th surface Low-E coatings, due to high levels of condensation.

Double-pane windows with thicker glass were mentioned as an alternative by both distributors and manufacturers, and one manufacturer mentioned having foam-filled frames or alternative gasses as part of the filling.

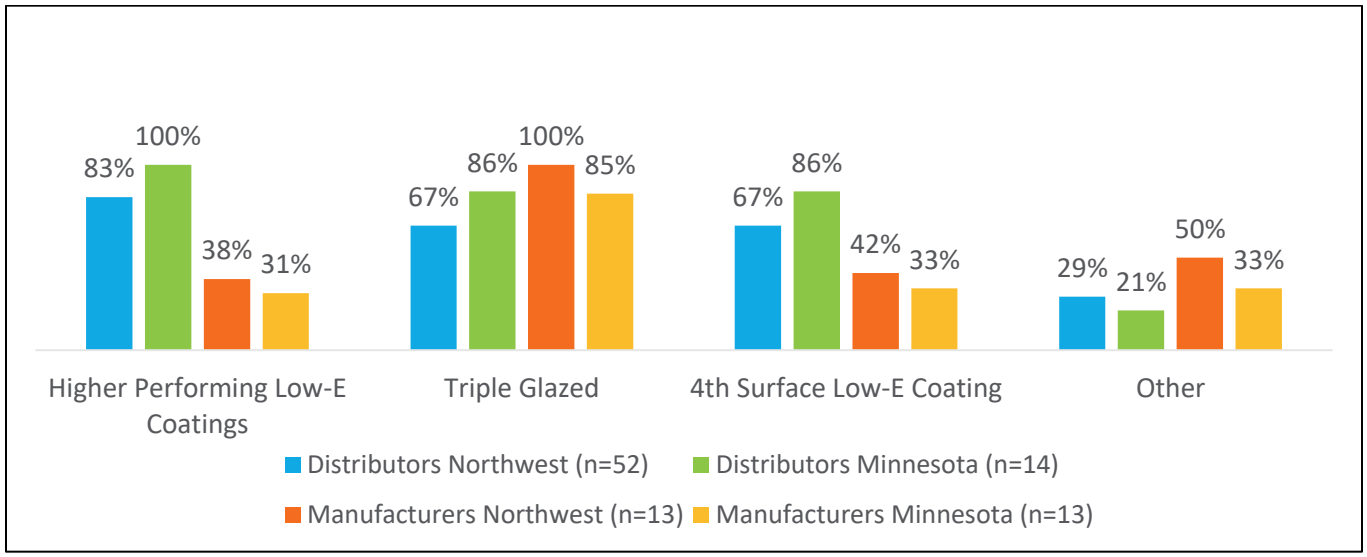

Figure 9. Methods Used on Windows Purchased/Sold to Reach ENERGY STAR Version 7.0 Requirements
Notes: Adapted from primary research questions: 9 (Distributor). In order to meet the performance requirements of ENERGY STAR 7.0 certification, does your company purchase or sell residential windows that are manufactured using the following methods? And Q9. (Manufacturer) What method(s) does your company use to meet the performance requirements of ENERGY STAR 7.0 certification?

6.5 Perceived Best Method to Meet ENERGY STAR 7.0 Requirements

When asked what the best method to meet the new ENERGY STAR 7.0 requirements might be, most manufacturers suggested triple glazing, while most distributors suggested higher-performing Low-E coatings (see Figure 10).

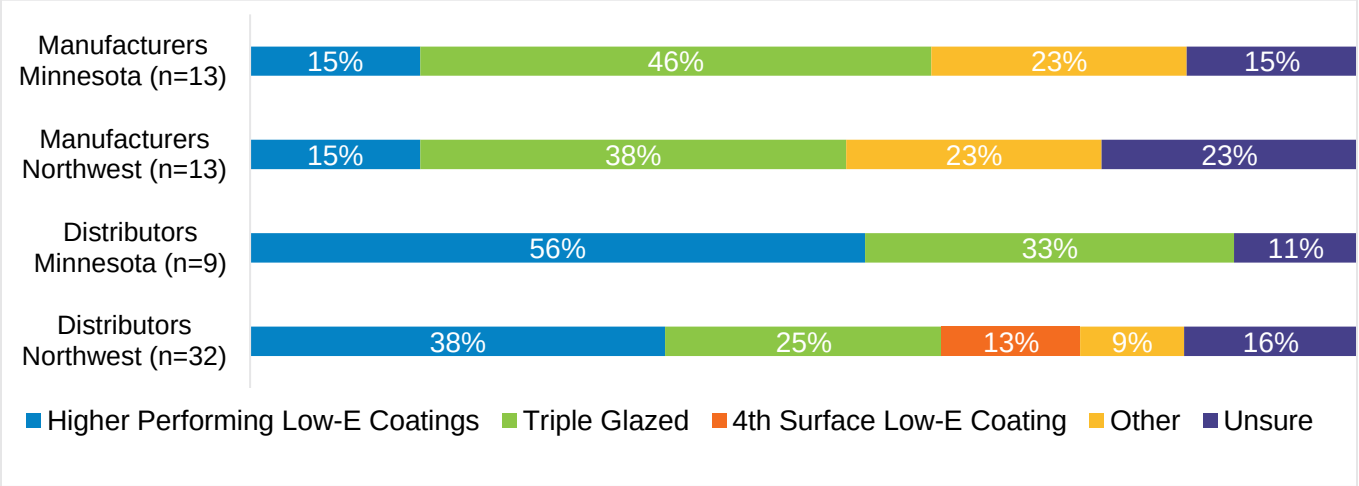

Figure 10. Perceived Best Method to Meet ENERGY STAR Version 7.0 Requirements
Notes: Adapted from primary research question, Q10. In order to meet the performance requirements of ENERGY STAR Version 7.0 certification, which method would you consider the best?

Manufacturers most commonly believed that triple glazing would be required for them to reach ENERGY STAR Version 7.0 requirements, in part because other methods such as 4th surface Low-E had not been fully developed yet.

- *"Fourth surface Low-E has the potential to be a longer-term solution because it is less expensive, but we haven't seen it work quite yet, and there are some issues with condensation and consistency. For now, you'll see a lot try to use Low-E."* –Window Manufacturer

Distributors were familiar with high-performing Low-E coatings and so were most likely to choose that as a solution. Some manufacturers support the possibility of high-performing Low-E coatings in limited applications.

- *"Believe it or not, we're really close at reaching the requirements with just higher-performing Low-E coatings because our vinyl frame has better performance. For our wood products though we'd need to go an alternative route."* –Window Manufacturer

Conclusions

As of 2022, a very small number of windows (4% in Minnesota and 3% in the Northwest) were likely to meet ENERGY STAR Version 7.0 requirements, with an even smaller figure (3% and 2%, respectively) able to meet the prescriptive path requirement (having a U-Factor of 0.22 or below).

Manufacturers do have motivations to figure out how to meet Version 7.0 requirements. ENERGY STAR has developed a strong reputation among both contractors, and consumers, and there will be a market for higher-end performance. Additionally, if one of the largest nine manufacturers that represent 70% of sales nationally were to figure out a manufacturing method that meets Version 7.0 requirements at a reasonable cost, they would have a significant competitive advantage. Rebates or incentive programs (in addition to existing ENERGY

STAR tax credit[2] for most efficiency home improvement) could help speed up this process; without them (or an explicit regulation targeting windows) the existing 15% price difference[3] between double and triple pane windows will likely be too much of a barrier to widespread adoption.

While manufacturers most commonly believed that triple glazing would be required for them to reach ENERGY STAR Version 7.0 requirements in the short term, it will likely take a shift towards 4th surface Low-E (or a method that hasn't been developed yet) for significant adoption. Triple glazing has been around since the 1990s without widespread usage, and 4th surface Low-E would provide the performance needed at a lower cost if manufacturers can figure out a solution to issues with exterior condensation or fix the perception unique to 4th surface Low-E that this is a problem.

[2] https://www.energystar.gov/about/federal_tax_credits/windows_skylights
[3] Price difference estimate from Ducker research for various window manufacturers

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Appendix A: Average Percentage of Windows with Frames of Specific Materials

Nationally Vinyl windows represent 75% of window sales, and similar percentages were found by respondents for this project, with the exception of distributors in Minnesota (see Figure 11). The distributors in Minnesota have a higher percentage of wood and fiberglass windows than would be expected in the overall market due to a higher amount of Anderson and Marvin sales (some of the only manufacturers that sell fiberglass), and a higher focus on remodels. Distributors in MN for this survey sold 74% of windows for the purpose of remodel/replacement as opposed to 50% statewide.

While not a core focus of this study, Ducker reviewed this data as an indicator that respondents were representative of the overall market and were knowledgeable about windows.

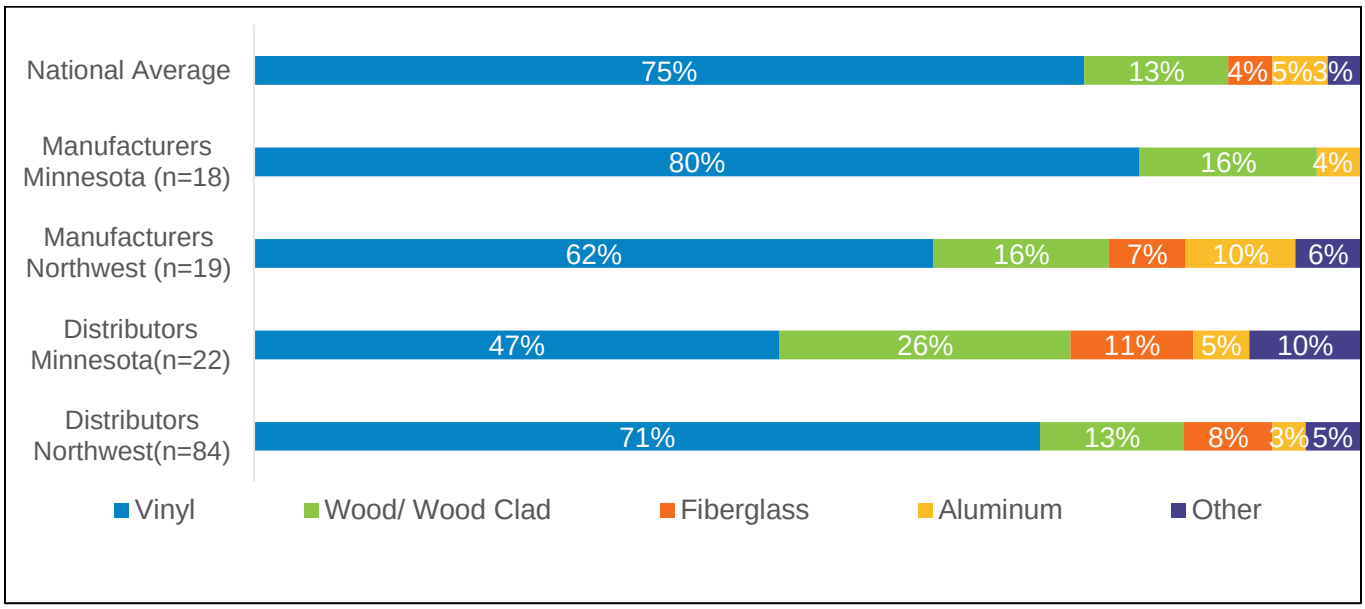

Figure 11. Average Percentage of Windows with Frames of a Specific Material
Notes: Adapted from primary research question Q11. Which materials make up the frames in the residential windows you sell? What percentage of the windows are each material?

Most distributors (about 60%) were unwilling to provide window sales data in revenue, but aggregated sales data is provided in Figure 12 below. Ducker did not use this segmentation for weighted averages in responses, opting instead for window sales in units, since many people did not respond to these survey prompts.

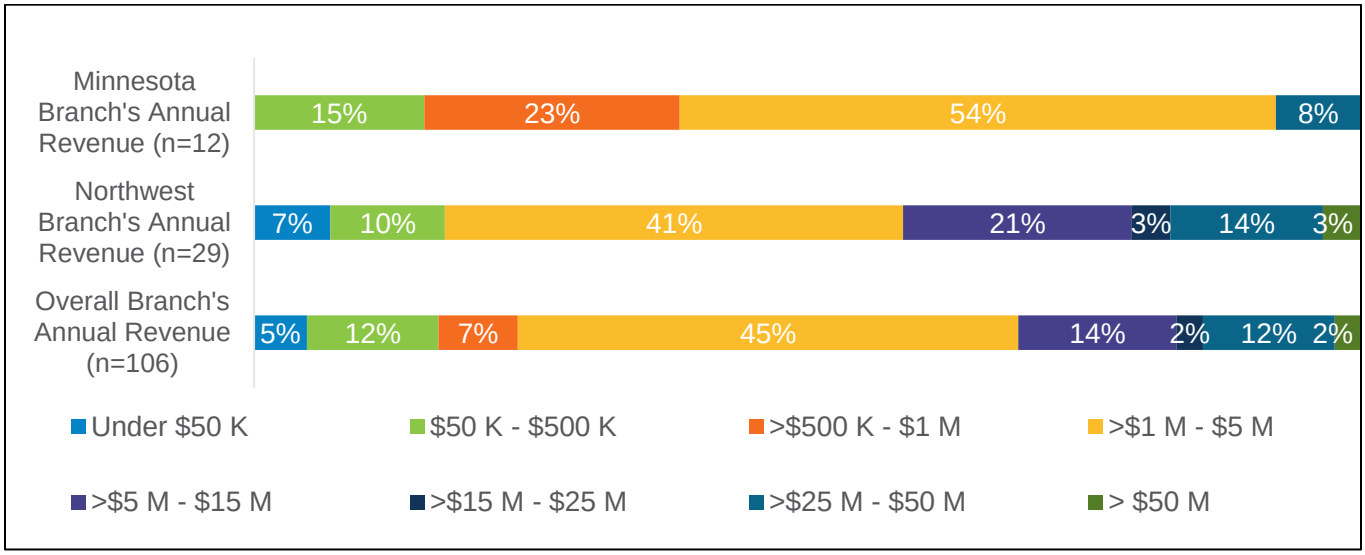

Figure 12. Annual Revenue of Distributor's Residential Window Sales in 2022

Notes: Adapted from primary research question Q12. What was the company's annual revenue for residential window sales in 2022?

Appendix B: Manufacturer Survey Questions

[Screeners]

1. Does your company **manufacture** residential windows?
    - Yes
    - No **[TERMINATE if selected]**

2. Do you sell residential windows into any of the following states: **[input 2-letter state code] [TERMINATE if ID, MT, OR, WA, or MN NOT Selected]** *Multi-Select.*

[End Screeners]

Next, we'll be asking about the number of windows you sold and percentages within 2022.

3. How many total residential windows does your company sell on average per year? *Single Select*
    - <5 K
    - 5 K to 50 K
    - 51 K to 100 K
    - 101 K to 300 K
    - 301 K to 500 K
    - 501 K to 1 M
    - 2 to 5 M
    - 6 to 10 M
    - >10 M
    - Prefer not to answer.

4. How many residential windows did you sell in these states in 2022? How does this vary by new construction vs. remodeling & replacement (R&R)? *(Numerical value, Fill out what you can)*

State	New Construction Windows	R&R Windows	Total
ID			
MT			
OR			
WA			
MN			
Total			

Green = Northwest
Pink = MN

5. Do you sell Energy Star Windows?
    - Yes
    - No
    - Unsure

6. [If Yes]

a. What percent of your Window sales in 2022 do you estimate meet Energy Star v6 criteria today?

Climate Zone	U-Factor[1]	SHGC[2]	
Northern*	≤ 0.27	Any	Prescriptive
	= 0.28	≥ 0.32	Equivalent Energy Performance
	= 0.29	≥ 0.37	
	= 0.30	≥ 0.42	

For the Northwest____ %

- Unsure

For MN: ___%

- Unsure

b. As you may be aware, Energy Star rules are changing late this October. What percentage would meet the northern climate requirements for v7 today?

The ENERGY STAR 7.0 criteria are as follows:

Version 7.0

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

The Northwest and MN are all included as part of the Northern Climate Zone.

For the Northwest____ %

- Unsure

For MN: ___%

- Unsure

c. Is that much different than your national figures for Energy Star v7 requirements? Why or why not? *(Open End)*

7. As you know, there is a range of U-factors that can qualify a window for an ENERGY STAR rating. When you think about residential windows you've sold in the NW and MN in the last year, what percentage **are… 0.20 or less? 0.21 or 0.22? Between 0.23 and 0.26? Over 0.26?**

For Northwest:

U-Factor Range	Percentage of Windows

0.20 or less	_____%
0.21 - 0.22	_____%
0.23 - 0.26	_____%
> 0.26	_____%
TOTAL	**100%**

a. Is the average U-factor for windows sold for new construction lower than for R&R?

- Yes
- No
- Unsure

For Minnesota:

U-Factor Range	Percentage of Windows
0.20 or less	_____%
0.21 - 0.22	_____%
0.23 - 0.26	_____%
> 0.26	_____%
TOTAL	**100%**

a. Is the average U-factor for windows sold for new construction lower than for R&R?

- Yes
- No
- Unsure

[If percentage given is >0 for "0.23 - 0.26" in Q7] So, some of your residential windows fell in the U-factor range of 0.23 to 0.26 this year. If you look at the ENERGY STAR 7 specification, you'll see that some of these windows might still meet the ES7 specification if they have higher solar heat gain coefficients. [Show table.] See? With a U-factor between 0.23 and 0.24, you could meet ES7 by having a solar heat gain coefficient of 0.35 or greater. For a U-factor between 0.25 and 0.26, you could meet ES7 by having a solar heat gain coefficient of 0.40 or greater.

So, about what percent of your .23 - .26 residential windows would meet ENERGY STAR 7.0 certification criteria with Energy Performance trade-offs for the Northern climate zone?

For Northwest: _____%

- I don't know.

For Minnesota: _____%

- I don't know.

8. What would you consider the primary reasons for meeting the new Energy Star requirements? *(Open End)*

[PROGRAMMING NOTE: For Q6B, they would need to either have something >0%]

9. **[If they have windows that meet Energy Star 7.0 Certifications]** What method(s) does your company use to meet the performance requirements of Energy Star 7.0 certification? *Select all that apply.*
   - Higher Performing Low-E Coatings (e.g., Solarbari, ClimaGuard, etc.)
   - Triple Glazing
   - 4th Surface Low-E Coating
   - Other, Specify: _____

a. Why?
   Comment: _____ (Open End)
b. Of the ones you utilize, please rank which ones you find most effective.

10. What would you consider the best method to meet the performance requirements of Energy Star 7.0 certification? *Single select.*
    - ○ Higher Performing Low-E Coatings (e.g., Solarbari, ClimaGuard, etc.)
    - ○ Triple Glazing
    - ○ 4th Surface Low-E Coating
    - ○ Other, Specify: _____

    a. Why?
       Comment: _____ (Open End)

11. Which materials do you use for the frames in your residential windows? What percentage of the windows are each material?

Material	Percentage
○ Aluminum	_____%
○ Vinyl	_____%
○ Fiberglass	_____%
○ Wood/ Wood Clad	_____%
○ Other, Specify: _____	_____%

Appendix C: Distributor Survey Questions

[Screeners]

1. Does your company **distribute** residential windows?
   - Yes
   - No **[TERMINATE if selected]**

2. Do you sell residential windows into any of the following states: **[input 2-letter state code] [TERMINATE if ID, MT, OR, WA, or MN NOT Selected]** *Multi-Select.*

[End Screeners]

Next, we'll be asking about the number of windows you sold and percentages within 2022.

3. In order, which brands do you purchase the most residential windows from? (*Open End)* ***[PROGRAMMING NOTE, PLEASE PROVIDE 10 BOXES)***

4. How many residential windows do you sell in these states in 2022? How does this vary by new construction vs. remodel & replacement (R&R)? *(Numerical value, Fill out what you can)*

State	New Construction Windows	Remodel & Replacement Windows	Total
ID			
MT			
OR			
WA			
MN			
Total			

5. Do you sell Energy Star Windows?
   - Yes
   - No
   - Unsure

6. [If Yes]
   a. What percent of your Window sales in 2022 do you estimate meet Energy Star v6 criteria today?

Climate Zone	U-Factor[1]	SHGC[2]	
Northern*	≤ 0.27	Any	Prescriptive
	= 0.28	≥ 0.32	Equivalent Energy Performance
	= 0.29	≥ 0.37	
	= 0.30	≥ 0.42	

For the Northwest____ %

- Unsure

For MN: ___%

- Unsure

b. As you may be aware, Energy Star rules are changing late this October. What percentage would meet the northern climate requirements for v7 today?

The ENERGY STAR 7.0 criteria are as follows:

Version 7.0

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

The Northwest and MN are all included as part of the Northern Climate Zone.

For the Northwest____ %

- Unsure

For MN: ___%

- Unsure

7. What percent of your **residential windows** within these states fall into the following U-factor ranges:

U-Factor Range	Percentage of Windows
0.20 or less	_____ %
0.21 or 0.22	_____ %
0.23 - 0.26	_____ %
> 0.26	_____ %
TOTAL	**100%**

a. Please note any differences by state or region [Open-End] **[PROGRAMMING NOTE: For Q8 they would need to either have >0% for Q6B.**

b. **Is the average U-factor for windows sold for new construction lower than for R&R?**

- Yes
- No
- Unsure

8. **If percentage given is >0 for "0.23 - 0.26" in Q7]** So, some of your residential windows fell in the U-factor range of 0.23 to 0.26 this year. If you look at the ENERGY STAR 7 specification, you'll see that some of these windows might still meet the ES7 specification if they have higher solar heat gain coefficients.

[Show table.] See? With a U-factor between 0.23 and 0.24, you could meet ES7 by having a solar heat gain coefficient of 0.35 or greater. For a U-factor between 0.25 and 0.26, you could meet ES7 by having a solar heat gain coefficient of 0.40 or greater.

a. So, about what percent of your 0.23 - 0.26 residential windows would meet ENERGY STAR 7.0 certification criteria with Energy Performance trade-offs for the Northern climate zone?

9. **[If they have windows that meet Energy Star 7.0 requirements]** In order to meet the performance requirements of Energy Star 7.0 certification, does your company purchase or sell residential windows that are manufactured using the following methods? *Select all that apply.*
   - ○ Higher Performing Low-E Coatings
   - ○ Triple Glazed
   - ○ 4th Surface Low-E Coating
   - ○ Other, Specify: _____
   - ○ Unsure

   a. Why? Comment: _____ (Open End)

   b. Of the ones you utilize, please rank which ones you find most effective.

10. **[If they have no windows that meet energy star requirements]** In order to meet the performance requirements of Energy Star 7.0 certification, which method would you consider the best? *Single select.*
    - ○ Higher Performing Low-E Coatings
    - ○ Triple Glazed
    - ○ 4th Surface Low-E Coating
    - ○ Other, Specify: _____
    - ○ Unsure

    a. Why? Comment: _____ (Open End)

11. Which materials make up the frames in the residential windows you sell? What percentage of the windows are each material?

Material	Percentage
○ Aluminum	_____%
○ Vinyl	_____%
○ Fiberglass	_____%
○ Wood/ Wood Clad	_____%
○ Other, Specify: _____	_____%

Demographics:

12. What was the company's annual revenue for residential window sales in 2022? *Single Select*
    - ○ Under $50,000
    - ○ $50,001 - $500,000
    - ○ $500,001 - $1,000,000
    - ○ $1,000,001 - $5,000,000
    - ○ $5,000,001 - $15,000,000

- $15,000,001 - $25,000,000
- $25,000,001 - $50,000,000
- Over $50,000,000
- Prefer not to answer.
- I do not know.

13. **[IF I DO NOT KNOW SELECTED IN Q12]** Are you part of a branch location?
    - Yes
    - No

13a. What was your branch's annual revenue for residential window sales in 2022? *Single select.*
- Under $50,000
- $50,001 - $500,000
- $500,001 - $1,000,000
- $1,000,001 - $5,000,000
- $5,000,001 - $15,000,000
- $15,000,001 - $25,000,000
- $25,000,001 - $50,000,000
- Over $50,000,000
- Prefer not to answer.
- I do not know.