

# PAWS Utility Playbook

## Overview

The Partnership for Advanced Window Solutions (PAWS) has assembled this playbook for utilities and other stakeholders interested in developing and implementing high-performance window programs. Window programs have been historically challenging for utilities to incorporate into their portfolios due to cost-effectiveness challenges, and as a result these products are often left out of energy efficiency program planning discussions. With recent advancements in window technologies, momentum towards electrification, and a need to improve building envelope performance, there is an exciting opportunity to begin building window programs that are cost-effective and popular among utility customers. This playbook serves as a guide to facilitate discussions with interested utilities, provide program design examples and answer questions about high performance window savings, benefits, and cost effectiveness. While this playbook focuses on strategy for primary window programs, the PAWS team is working alongside the Storm Window and Insulating Panel Campaign (SWIP) to develop an additional utility playbook focused on window attachments. If you are interested in launching a window program or have any questions about this document, please reach out to the PAWS team at [info@PAWS.energy](mailto:info@PAWS.energy)

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# High Performance Windows

## The Window of Opportunity for Utilities

As the U.S. prioritizes net zero energy buildings, addresses carbon emissions and confronts the challenges of decarbonizing the grid, there is a pressing need to dramatically increase the availability and use of highly efficient window products. Utilities are uniquely positioned to take advantage of this market shift and create window programs that meet the needs of their customers.

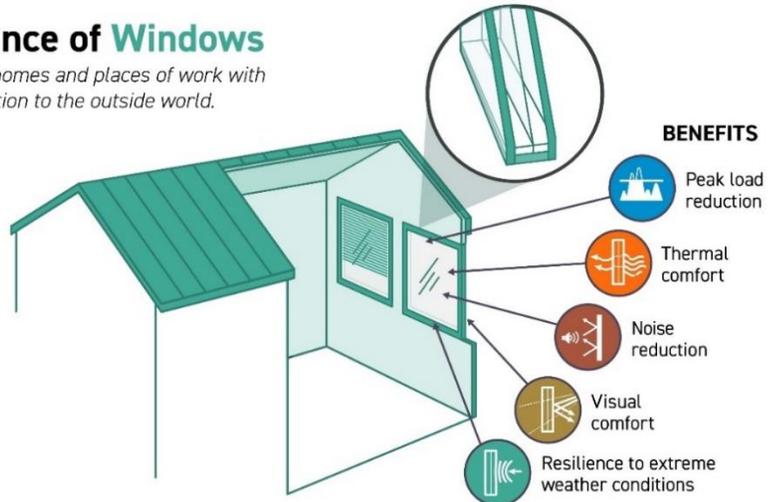
- ◆ Windows and window attachments produce peak energy savings in both the heating and cooling season. As the need to reduce peak loads in the summer and winter increases, windows will play a crucial role in reducing peak demand.

### The Importance of Windows

*Windows provide our homes and places of work with light, view, and connection to the outside world.*

**ENERGY USE**

- 25%** of heating and cooling energy use
- 10%** of total building energy use
- 8%** of envelope area, but
- 45%** of envelope heat transfer



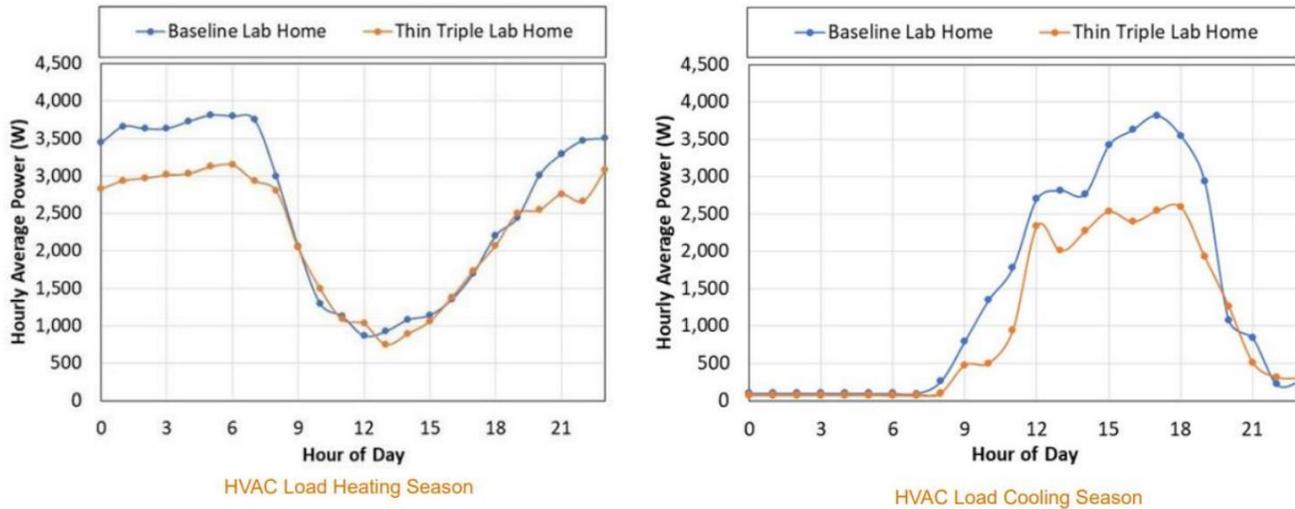
- ◆ Improving the performance of building envelopes can reduce the size and cost of HVAC equipment upgrades. This will become increasingly important as more cities implement electrification goals and consumers prioritize decarbonization.
- ◆ Customers want better windows. Throughout our utility interactions we continue to hear that windows are one of the top products that customers ask about incentives for. Due to recent technology advancements, utilities may finally be in a good position to incentivize these products and give consumers what they're asking for. A window incentive can serve as a gateway to increase customer engagement in utility programs all together.
- ◆ Numerous specifications exist that can make it easier for utilities to integrate the highest performing window products into their programs. These include ENERGY STAR most efficient primary windows, the new ENERGY STAR version 7 specification for primary windows, ENERGY STAR storm windows, automated shade energy ratings and other window attachment ratings.

For these reasons, utilities are in a superior position to affect change in the window market. As savings from lighting diminish, and HVAC upgrades are prioritized, windows will become a crucial measure in the new age of energy efficiency programs.

## Windows produce peak energy savings

A 2021 PNNL study found that thin triple-pane windows can achieve **17% peak heating savings and 33% peak cooling savings** when compared to a baseline in PNNL’s lab homes<sup>1</sup>.

**Figure 1: PNNL Lab homes testing load shapes during heating and cooling seasons**



**High performance windows are one of the best technologies for reducing peak load.** In the summer, these products with lower SHGC and/or with effective shading, can minimize solar heat gain which reduces cooling costs and system peaks. In the winter, a better insulated building envelope prevents heat from leaking out of the building, reducing peak heating load. This will be particularly important for buildings with electric heat. As the lowest performing component of a building’s envelope, windows should be prioritized when addressing winter peak load reduction. Higher performance windows also improve thermal comfort, in some cases allowing lower thermostat set points which will save additional energy.

## Consumers love windows

As many residential home energy auditors attest, windows have historically been one of the first things customers consider upgrading when assessing their home energy performance. Why? Windows offer numerous benefits beyond energy savings, including comfort, visibility, health (condensation) and noise reduction. Windows are also known to increase the resale value of homes at a higher scale than other energy efficiency improvements, significantly improving the ROI for homeowners. With envelope insulation becoming increasingly important as we move towards electrification, windows are finally on the menu for energy efficiency rebates. Not only will this satisfy customers eagerness to upgrade their windows, it will also serve as a gateway to engage customers in more comprehensive home energy retrofits.

<sup>1</sup> This study assumed a baseline home with double-pane clear glass aluminum-framed windows, the PNNL lab homes are located in Richland, Washington. *Evaluation of Thin Triple- Pane Windows in the PNNL Lab Homes*. Hunt W.E., S.I. Rosenberg, and K.A. Cort. 2021.

## Deep energy retrofits

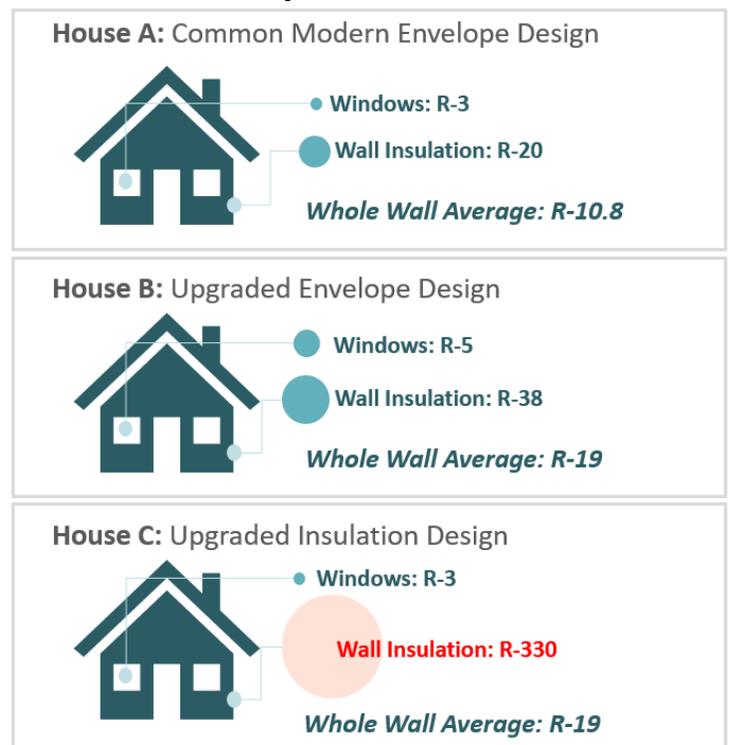
Within buildings, energy use is typically split between HVAC, lighting, and hot water; however, HVAC is the largest consumer in virtually all building types and climates. HVAC energy use is primarily driven by the thermal properties of the building envelope, where windows are historically the poorest performing element. **Replacing HVAC systems without upgrading or replacing windows requires larger, more expensive HVAC equipment, transmission, and storage to power these systems.**

This presents a unique opportunity for deep energy retrofit programs. When window measures are combined with HVAC and insulation upgrades, customers are able to reduce the size and cost of their replacement HVAC equipment because of their improved envelope performance. This will greatly improve payback and cost-effectiveness and produces a much more energy efficient and comfortable home when compared to a home whose owners pursue these upgrades separately.

## Windows cannot be left behind

As illustrated in figure 2, windows are a crucial puzzle piece as we advance the efficiency of buildings. Home A has window and insulation specifications of a typical new home, which produces a whole wall average R-value of R-10.8. Home B has an upgraded envelope design utilizing high performance R-5 windows, which achieves a whole wall R-value of R-19. Home C demonstrates what happens if windows are left behind. If we continue to *only* upgrade insulation, in an attempt to achieve a higher performing envelope equivalent to that achieved in home B, builders would have to provide wall insulation with a thermal performance of R-330. Of course, R-330 insulation is not realistic and demonstrates the need to bring windows along as we improve the efficiency of our building envelopes.

**Figure 2: Three new home design scenarios exhibiting the impact of window efficiency on whole wall thermal performance.**



## Energy savings

Window savings are heavily dependent on region. For example, cooling savings will be much more favorable in regions with hot summers where high performance window products and attachments can reduce peak cooling load by minimizing heat gain through windows. Additionally, climates with extremely cold winters will produce more favorable heating savings because high performance windows reduce heating loads by improving the insulation of a building’s envelope.

Savings in the following table were calculated for a high-performance primary window, defined by ENERGY STAR Version 7 criteria, over a code baseline for individual regions<sup>2</sup>. It’s important to note that these values can vary heavily depending on adjustments to SHGC for certain regions. To determine the optimal performance window criteria for your region, utilize the PAWS windows savings calculator or reach out to the PAWS team for more detailed savings numbers for your region by emailing [info@PAWS.energy](mailto:info@PAWS.energy)

**Table 1: Modeled gas and electric savings per window from the application of high-R windows across cities 7 climate zones when compared to a local code baseline.**

Climate Zone (model city)	Window Assumptions				Electric Savings <b>kWh/window</b>	Gas Savings <b>therms/window</b>
	Baseline		Performance			
	U-value	SHGC	U-value	SHGC		
<b>1 (Miami, FL)</b>	0.35*	0.25	0.32	0.23	<b>6.25</b>	<b>0.03</b>
<b>2 (Phoenix, AZ)</b>	0.35*	0.25	0.32	0.23	<b>7.96</b>	<b>0.09</b>
<b>3 (Charleston, SC)</b>	0.35*	0.30	0.28	0.23	<b>17.07</b>	<b>0.21</b>
<b>4 (Philadelphia, PA)</b>	0.32	0.40	0.24	0.40	<b>8.94</b>	<b>1.26</b>
<b>5 (Salt Lake City, UT)</b>	0.32	0.30	0.22	0.30	<b>1.45</b>	<b>2.3</b>
<b>6 (Minneapolis, MN)</b>	0.32	0.30	0.22	0.30	<b>2.60</b>	<b>2.98</b>
<b>7 (Anchorage, AK)</b>	0.30	0.30	0.22	0.30	<b>2.09</b>	<b>3.36</b>

\*Cities with code minimum U-values for windows above 0.35 were modeled using a default U-value of 0.35 for the baseline.

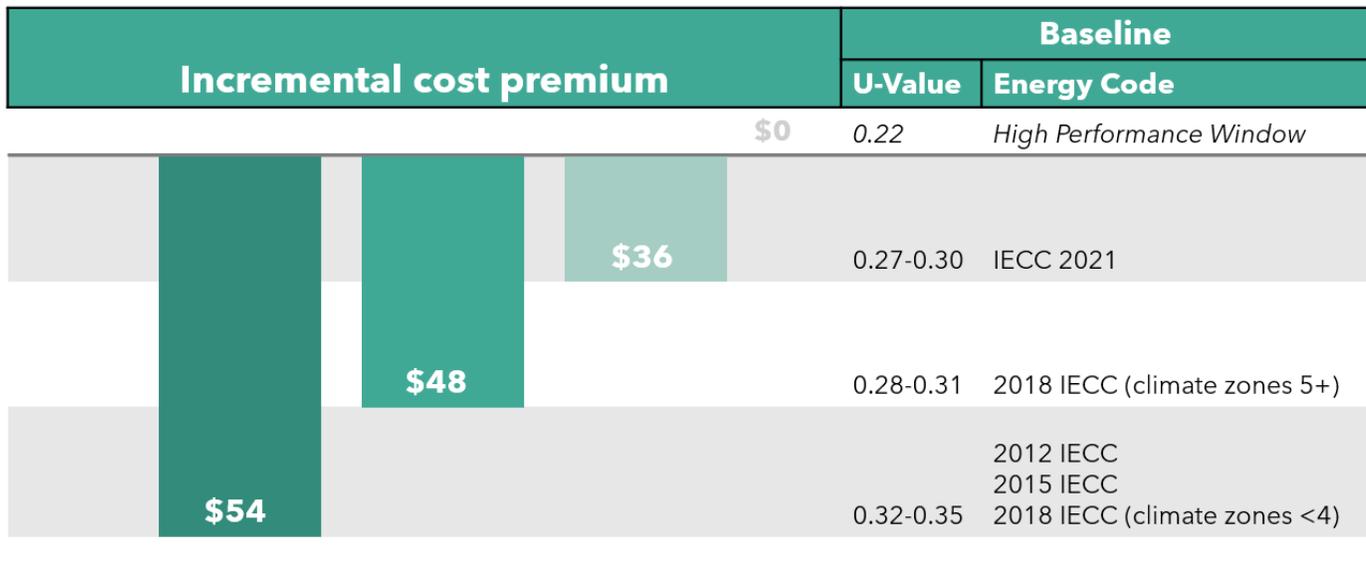
Note: Savings were calculated for 132 cities across 8 climate zones utilizing modeling data compiled for the ENERGY STAR Version 7 Specification for Windows and Skylights. The baseline for each city was determined based on the current adopted energy code, or a default baseline of U-0.35 and 0.30 SHGC. These savings values are for a 3’x5’ window.

<sup>2</sup> The high-performance window modeled had specifications matching the ENERGY STAR Version 7 criteria for each respective region. The baseline window used for each city matched the minimum energy code window for that jurisdiction.

## Incremental cost

The incremental cost for a high-performance window<sup>3</sup> depends on the code baseline in your region, but this typically comes out to \$54 per window assuming a baseline of a U-0.32 window. Costs for alternative baselines are illustrated in the figure below.

**Figure 3: Incremental Cost Premium for High Performance Windows Across Three Baselines**



Source: ENERGY STAR Version 7 Product Cost Data Package

A goal of the PAWS group is to bring down this incremental cost through engagement with manufacturers, increased product demand and updated specifications.

<sup>3</sup> High-performance window is defined as an ENERGY STAR Version 7 window in the northern climate with a U-value of 0.22 and an SHGC greater than or equal to 0.25.

## How PAWS Can Support You

In an effort to increase the presence of utility window programs, PAWS can provide additional support for interested utilities in the following areas:

**TRM Support:** We recognize the importance of integrating these measures into state TRM's and can provide support for advocating for the addition of window and window attachment related TRM measures by providing savings analysis, whitepapers or other support.

**Region Specific Savings Analysis:** Utilizing ENERGY STAR V7 modeling data, the PAWS group can provide tailored savings analysis including optimal U-value and SHGC targets for your region along with suggested rebate structures.

**Program Design:** PAWS can support in the design and early implementation of window programs and pilots. Utilizing the expertise within the PAWS leadership team and PAWS utility members with successful programs, we can help design a program that fits your region's needs.

**Manufacturer Engagement:** PAWS has developed relationships with several manufacturers and can facilitate connections for interested utilities.

**Online Resources:** As we move forward, resources like this one will be uploaded to the [PAWS website](#). Resources specific to window attachments can also be found on [AERC's utility page](#).

**Let us know!** Our goal is to assist utilities in overcoming the barriers that exist to implementing window programs. Reach out to set up a call to discuss any of these topics or let us know where else you can use support and we will continue to work to develop supporting resources for you.

## Utility Program Strategies

This section focuses on program strategies for high performance window replacements. However, window attachments (low-e storm windows and insulated shades) are also a great window solution. The PAWS team is working alongside the Storm Window and Insulating Panel Campaign (SWIP) to develop an additional utility playbook focused on these products. For more information, reach out to [info@PAWS.energy](mailto:info@PAWS.energy).

### Single Family

Single family programs are the most common utility rebate offering for windows. Many homeowners are already purchasing windows for the benefits they offer beyond energy savings (comfort, noise reduction etc.), and a utility rebate can help motivate homeowners to choose a more energy efficient option. This also creates a great opportunity for utilities to engage with their residential customers. Windows tend to be the first thing homeowners ask about when they think about comfort and home energy, so a high-performance window or window attachment (e.g., low-e storm windows, insulated shades, etc.) offering can serve as a gateway to additional utility program participation.

### Downstream – Direct to Consumer

A downstream high performance window program is the most common and has shown the most success. This approach allows customers and/or contractors to apply for a rebate directly, and it provides a great opportunity for utilities to engage with customers. Savings could be calculated using the data referenced in

the measure savings section, or a high-performance window measure could be incorporated into a technical reference manual (TRM). If you'd like support for getting a window measure added to your states TRM or calculating savings from window, let the PAWS team know (info@PAWS.energy).

Program Design	
<b>Program Type</b>	Downstream/Direct to Consumer
<b>Target Sector</b>	Single Family
<b>Suggested Rebate Structure</b>	Prescriptive, Tiered Rebate Tier 1: ≤ U 0.27, \$25 per window Tier 2: ≤ U 0.22, \$50 per window
<b>Key Program Activities</b>	<ul style="list-style-type: none"> <li>• Design online application for customers and/or contractors</li> <li>• Simple per window rebate amount               <ul style="list-style-type: none"> <li>• Easier for customer compared to \$/sq. ft.</li> </ul> </li> <li>• Launch Consumer Awareness Campaign</li> </ul>

### Upstream/Midstream

This is a less common approach given the different distribution and sales channels for window products. This can still be effective with the correct manufacturer, distributor, and/or retailer relationships. Engagement with these entities is key to the success of a midstream program. Be sure to understand their business model and sales approach and engage with them to determine the best approach for a midstream or upstream incentive before launching the program.

Program Design	
<b>Program Type</b>	Upstream/Midstream
<b>Target Sector</b>	Single Family
<b>Suggested Rebate Structure</b>	Varies
<b>Key Program Activities</b>	<ul style="list-style-type: none"> <li>• Engage with upstream market actors in your region and discuss approaches that will work for them</li> <li>• Provide incentives for distributors or retailers to stock and promote high performance window products</li> <li>• Provide incentives to reduce the cost of high-performance window products at distributor or manufacturer level</li> </ul>

### Multifamily

Multifamily programs offer a large energy savings opportunity but require increased engagement with building owners and/or property management. Window programs pair well with multifamily programs that

may already be in place, for example a multifamily direct install or energy audit program. The programs create an opportunity to engage with building owners on future building and energy investments. Windows should be included in this discussion, and in many cases building owners are already considering window upgrades as part of capital improvement plans. A multifamily utility rebate program can ensure that these opportunities are not missed and will encourage building owners to purchase high performance windows.

Program Design	
<b>Program Type</b>	Downstream and/or Upstream
<b>Target Sector</b>	Multifamily
<b>Suggested Rebate Structure</b>	Leverage existing programs Prescriptive
<b>Key Program Activities</b>	<ul style="list-style-type: none"> <li>• Provide technical assistance to building owners</li> <li>• Leverage MF audits or direct install programs to evaluate window upgrade options</li> <li>• Work with manufacturers to facilitate bulk purchases of windows for multifamily projects</li> <li>• Offer incentives for high performance products</li> </ul>

### New Construction

New construction is the perfect time to invest in high performance windows. Adding high performance window rebates to a new construction program can send an important signal to builders, manufacturers, and homeowners that high performance windows are a long-term investment that should be prioritized.

Program Design	
<b>Program Type</b>	Downstream
<b>Target Sector</b>	New Construction
<b>Suggested Rebate Structure</b>	Prescriptive, Tiered Rebate
<b>Key Program Activities</b>	<ul style="list-style-type: none"> <li>• Utilize current new construction program framework for modeled savings</li> <li>• Create builder resources that illustrate the impact of high-performance window products, rebate opportunities and customer benefits</li> <li>• Offer bonus or prescriptive rebate for high performance products</li> </ul>

### Utility Program Examples

The following are examples of successful and well-established window rebate programs from across the country. If you would like to connect these utility program managers for more details, PAWS can help connect you.

Energy Trust of Oregon - Window Incentive Program		<a href="#">Learn More &gt;&gt;</a>
<b>Program Type</b>	Downstream	
<b>Target Sector</b>	Single Family	
<b>Rebate Structure*</b>	Prescriptive, Tiered Rebate Three tiers ranging from U-0.30 to U-0.24 \$1.75 to \$6 per sq. ft. (equivalent to \$26 - \$90 per window)	
<b>Key Program Activities</b>	<ul style="list-style-type: none"> <li>• Online education, window resources, and application</li> <li>• Find a trade ally feature to connect homeowners to contractors</li> <li>• 15 years of window program experience</li> </ul>	

*\*Rebate structure for this program is expected to change January 1, 2023*

Consumers Energy - Window and Insulation Rebate program in Michigan		<a href="#">Learn More &gt;&gt;</a>
<b>Program Type</b>	Downstream	
<b>Target Sector</b>	Single Family	
<b>Rebate Structure</b>	Prescriptive Rebate U < 0.28 (ENERGY STAR V6) \$15 per window	
<b>Key Program Activities</b>	<ul style="list-style-type: none"> <li>• Online application, resources, and connection to federal tax credits</li> <li>• Find a trade ally feature to connect homeowners to contractors</li> <li>• Encourage window and insulation upgrades, though not required               <ul style="list-style-type: none"> <li>• Majority of program participation is from window rebates</li> </ul> </li> <li>• Total rebate amount calculator</li> </ul>	

<b>Eversource - Energize Connecticut</b>		<a href="#">Learn More &gt;&gt;</a>
<b>Program Type</b>	Downstream	
<b>Target Sector</b>	Multifamily, Retrofit	
<b>Rebate Structure</b>	<p>Program incentives based on energy savings</p> <p>Cover 100% of incremental cost for triple-pane windows</p> <p>Review <a href="#">case study</a> for details</p>	
<b>Key Program Activities</b>	<ul style="list-style-type: none"> <li>• Holistic approach, evaluate building for all energy savings opportunities (e.g. lighting, HVAC, hot water, windows...)</li> <li>• Work with property managers and/or building owners on capital improvement plans</li> <li>• Facilitate bulk purchase of triple-pane windows with local manufacturer (reduces upfront cost)</li> <li>• Cover 100% of incremental cost between new double pane and new triple pane windows</li> <li>• Completed over 14,000 window installs and offered over \$2 million in window incentives from 2015 to 2017</li> </ul>	