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Commercial Window Attachments: Secondary Window Market Characterization

Prepared For NEEA:

Lauren Bates, Sr. Project Manager
Market Research & Evaluation

Prepared by:

Ingo Bensch, Principal Consultant
Ross Donaldson, Senior Analyst
Lyndsey Shimazu, Analyst

Evergreen Economics, Inc.
1500 SW First Avenue,
Suite 1000
Portland, OR 97201

Northwest Energy Efficiency Alliance
PHONE
503-688-5400
EMAIL
info@neea.org



1 Executive Summary

The Northwest Energy Efficiency Alliance (NEEA) engaged Evergreen Economics to conduct a characterization study of the market for secondary windows. This research informs NEEA's development of a program intended to transform the market so that secondary windows become established as the standard product and practice for addressing low-performing windows in existing commercial buildings.

Commercial secondary windows are retrofit products that enhance the performance of an existing window without a full replacement or reglazing. They can be added to existing windows with poor energy performance to mitigate air infiltration, energy loss, or unwanted solar gain, while also offering non-energy benefits to building occupants, thereby offering a lower cost alternative to window replacement. Secondary windows are appropriate for windows with single panes and, in some cases, those without low-emissivity coatings that were introduced in 1979 and became commonplace after 1990.

In contrast to other window attachments like window film, coverings, and shading devices, secondary windows add additional layers of glazing (and framing) to the interior or exterior of the existing window. They are historically related to storm windows used in residential buildings, but are designed and custom-produced for commercial applications. They can be constructed to offer add-ons such as multiple panes, low-emissivity coating, or gas-filled cavities to further enhance their performance and energy savings.

Study Objectives

The study builds on prior information gathered by NEEA and was guided by the following research objectives:

- Determine whether the market differentiates between low-emissivity storm windows and secondary glazing systems;
- Understand how secondary windows are offered by market actors;
- Understand market actors' perceptions of secondary windows;
- Learn market actors' understanding of the possible installation scenarios for secondary windows;
- Understand market actors' perceptions of the best applications for secondary windows;
- Document existing supply chain(s) for secondary windows;
- Confirm barriers and opportunities for secondary windows in the Northwest commercial market;
- Describe current commercial secondary window installations in the Northwest; and

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Executive Summary

The University of Oregon completed a major renovation of Straub Hall in 2014 that included modernization of the building’s original single-pane windows. The university selected Chosen Windows’ SLIP attachments to preserve the historical appearance and window operability while improving thermal comfort and efficiency. Chosen Windows’ presence on the project team and laboratory testing by the university facilitated selection of window attachments over replacement.

Project Timeline



Quick Facts

Building Facts:

- **Location:** Eugene, OR
- **Size of Building:** 58,000 square feet
- **Age:** Built in 1928 - 91 years old
- **Occupancy:** Classrooms, lecture halls, faculty offices
- **Ownership:** University of Oregon
- **HVAC system:** Hydronic Radiant Heating and Chilled Water Cooling (updated during renovation to match the university-wide hydronic radiant heating system)

Window Facts:

- **Number of Windows Upgraded:** 250 (100% of windows)
- **Size of Windows:** 3 ft wide x 5 ft tall
- **Window Frames:** Wood
- **Previous Window Type:** Single-pane and double-hung
- **Condition of Original Windows:** Excellent
- **Cost of Window Attachment Project:** \$500,000
- **Cost of Entire Renovation Project:** \$44 million

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Project Background

Originally constructed in 1928, the University of Oregon's Straub Hall building first operated as a dormitory and later as the central location for the school's Psychology and Linguistics departments. With four stories of classrooms and lecture halls, Straub Hall is a prominent historical landmark on the university's Northeast Central campus.

Project Impetus

The University of Oregon began to discuss the major renovation of Straub Hall in 2011. This renovation was necessary to meet the educational needs of students and faculty: creating modern learning spaces (including the first two-story lecture hall) and expanding the building space. The university aimed to preserve the historic appearance of Straub Hall, particularly in the case of the building exterior, which included approximately 250 windows.



Original windows

The original windows in Straub Hall were single-pane, double-hung windows. The window panes themselves were in an excellent condition and had wooden frames, which were also in a good condition. However, many of the windows in Straub Hall had become inoperable over time. As a result, many building occupants were unable to open their windows.

Additionally, the original windows were not weather-stripped, so many spaces in Straub Hall were drafty, particularly in the winter. Before the 2014 renovation, occupants stated that although sections of the building had felt warm (due to fireplaces within the building), sections of the building near the windows felt chilly.

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Decision Making

While the windows themselves were only a small part of the larger project, many individuals were involved in the decision-making process, including:



- **University of Oregon** officials, who were the main financial decision makers and hired Chosen Windows for the renovation project. The university wanted to preserve the historical appearance of the building.
- **Rowell Brokaw**, the project architects.
- **Chosen Windows**, a windows restoration and repairs company, which suggested different window options based on the goals of the project.
- The University of Oregon **Energy Studies in Buildings laboratory**, which was able to empirically test multiple window scenarios to determine the most energy efficient option.

Manufacturer's Role: Chosen Windows

The University of Oregon selected Chosen Windows to lead the window installation. Because Chosen Windows had the capability of installing the windows in addition to manufacturing the windows, the University of Oregon was able to contractually hand over all of the responsibility for the windows to Chosen, rather than splitting the responsibility between a manufacturer and a glazing subcontractor.

As a result, Chosen Windows was on-site for all steps of the decision-making process: fixing the existing wooden frames, installing the new windows with SLIP attachments added to them in the building, and updating anything related to the sash weights.



Chosen Windows restoring Straub Hall window sashes in shop

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The project team debated over multiple approaches to the building's windows during the first year (2011-2012) of renovation planning:

Option 1: Complete Window Replacements	Option 2: Adding Film to Existing Windows	Option 3: SLIP Window Attachments
<p>The proposed window replacements would be double-pane, divided light windows that would have created a similar appearance to the original windows when installed. However, university officials disregarded this option. While the new windows were similar to the original windows, they felt that the replacements were not similar <i>enough</i> to the original design.</p>	<p>As both the frames and panes were in an excellent condition, the second option was to replace the glazing on the current windows with an insulated film. However, while this would maintain the original appearance of the windows, this method was projected to be both more expensive than other options and more time-consuming.</p>	<p>The SLIP attachments were cheaper than replacements, maintained the look of the original windows, and allowed the windows to remain operable. However, the attachments would add weight to the windows, which could potentially interfere with the weight system that operated the windows.</p>

The University of Oregon hired the on-campus Energy Studies in Buildings laboratory to test the effectiveness of the following scenarios: the original windows, windows with one layer of insulated film, insulated glass conversions, and Chosen Windows's SLIP attachments. Analyses from the UO energy lab confirmed the following:

1. Even one layer of insulated film provided significantly better insulation than the original windows.
2. The insulated glass conversion option and the SLIP attachments provided nearly identical levels of insulation.



UO Energy Lab testing windows in Straub Hall

The full energy report can be found at <https://windowslip.com/commercial/> by clicking on the energy testing tab. This report allowed the team to move forward with the cheaper SLIP attachment option.

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Installation and Quality Assurance

Installation was a three-step process:

- 1. Before Installation:** Chosen Windows removed the existing window sashes and took them back to their Portland shop. Because the windows renovation was part of a larger renovation, it was easier for Chosen to take the window sashes back to their shop rather than work around the other subcontractors on the renovation. At the shop, the original window sashes were stripped down, and the SLIP attachments were installed.
- 2. On-Site:** Chosen Windows then transported the window sashes back to Eugene. In addition, the window frames were restored on site. However, one of the flaws of window attachments in older buildings is that they add weight to the existing windows. The original windows had operated on a weight system, which used the windows' original weights to allow occupants to open the windows. The original weight system had to be rebalanced to accommodate the additional weight of the window attachments before the new windows could be installed.
- 3. Installation:** After re-balancing the weight system and coordinating with other subcontractors on the project (e.g., the insulation subcontractor), Chosen Windows installed the new windows. Each window took approximately 2 to 4 hours to install (also accounting for the time it took to rebalance the weights), and the installation generally went very smoothly. However, Chosen Windows stated that a few window attachments had to be removed and reinstalled, as other subcontractors would occasionally accidentally scratch the windows.

The architects on the project performed quality assurance checks, which included a visual inspection of the windows and a spray test, which involves spraying the glass with a controlled stream of water to make sure that there were no leaks on the inside. The re-installed windows passed both tests.



An example of a window re-installation

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Outcomes

Since the completion of the building renovation in 2014, the feedback on the windows retrofit (and the larger renovation) has been universally positive. According to Chosen Windows, University of Oregon administrators have since asked Chosen Windows to come back and install SLIP window attachments in other department buildings (Gerlinger Hall and the Volcanology Building).

While the architect hadn't heard of window attachments before the University of Oregon project and hasn't worked with secondary window attachments since the project, he said that he would work with window attachments again if they were applicable to any of his new projects. He believed that secondary window attachments would work best in historical buildings (where the original windows needed to be preserved) with windows that had wooden or steel frames.



Window with SLIP attachment added

Conclusions & Implications

Interviews conducted for this case study suggest that there may be potential for secondary window attachments in the following scenarios:

- Windows with historic or sentimental value
- Windows that need to be operated
- Windows with wooden or steel frames

Thus, while window attachments may not be the appropriate solution for every building, the emphasis on the historical preservation of Straub Hall in combination with the excellent quality of the pre-existing windows and wooden frames, made Chosen Windows' SLIP attachments an effective solution for this specific project.