

Windows Deployment and Partnership for Advanced Window Solutions (PAWS)



Pacific Northwest National Laboratory (PNNL) and Berkeley Lab
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WBS 1.9.1.04 (PNNL)

Project Summary

Objective and Outcome:

- Develop new approaches to increase market demand, reduce the price of, and accelerate the adoption of high-performance windows and window attachments.
- Accelerate the transformation of the advanced window solutions market by streamlining effort through collaborative research, program design, overall demand creation, and code advocacy.
- Raise awareness about window solutions in new and existing buildings to protect vulnerable populations from rising utility bills in the national push for electrification.

Team and Partners:

Leadership Team:

Marc LaFrance (DOE)	Katie Cort (PNNL)	Tom Culp (Birch Point)
Elaine Miller (NEEA)	Robert Hart (LBNL)	Walt Zalis (Energetics)
Rick Dunn (NEEA)	Steve Selkowitz (LBNL)	
Deepti Dutt (NEEP)	Mahabir Bhandari (ORNL)	
David Lis (NEEP)	Isaac Smith (CEE)	

Partners:

Northwest Energy Efficiency Alliance (NEEA)
Northeast Energy Efficiency Partnerships (NEEP)
MN Center for Energy and the Environment (CEE)
National Fenestration Rating Council (NFRC)
Attachments Energy Rating Council (AERC)
Environmental Protection Agency (EPA) – ENERGY STAR
LBNL, PNNL, ORNL, NREL, Energetics, and Birch Point



Stats:

Performance Period: FY22–FY23

DOE FY23 Budget: \$500k

Official Cost Share: \$0k

Milestone 1: Develop Operational and Strategic Plan

Milestone 2-4: Hold Quarterly PAWS Meeting and provide quarterly updates

1.9.1.04: Partnership for Advanced Window Solutions (PAWS)

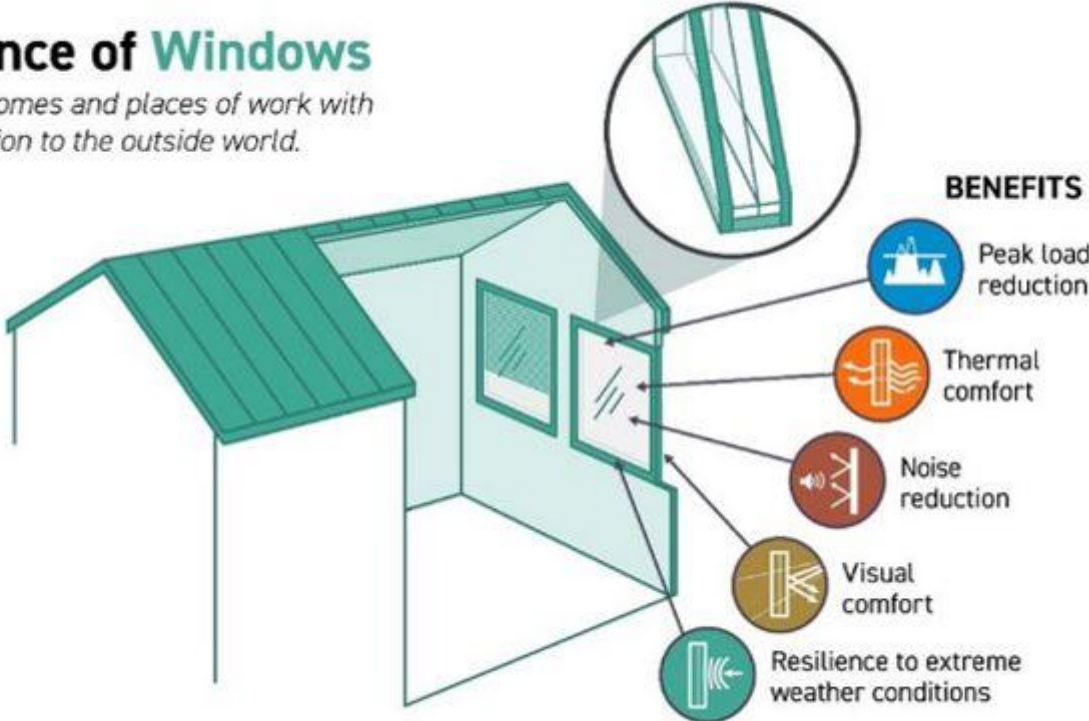
1.5.1.62: Deployment of Window Technologies

The Problem (and Opportunity)

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



Problem: Current State of Windows

48 million Single-Pane Homes* (41%)



Total windows: **1.4B stock**
29M retrofit/year
24M new construction/year
4M houses get windows/year

Floor Area: **97B SF**

139M SF window retrofit per year

284M SF new construction



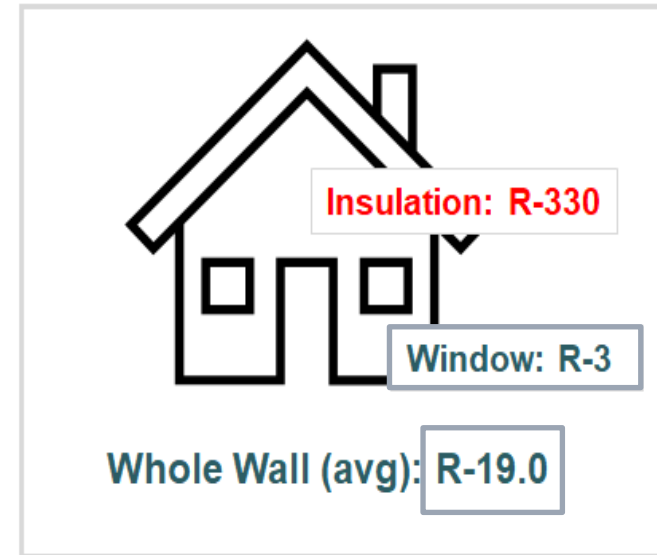
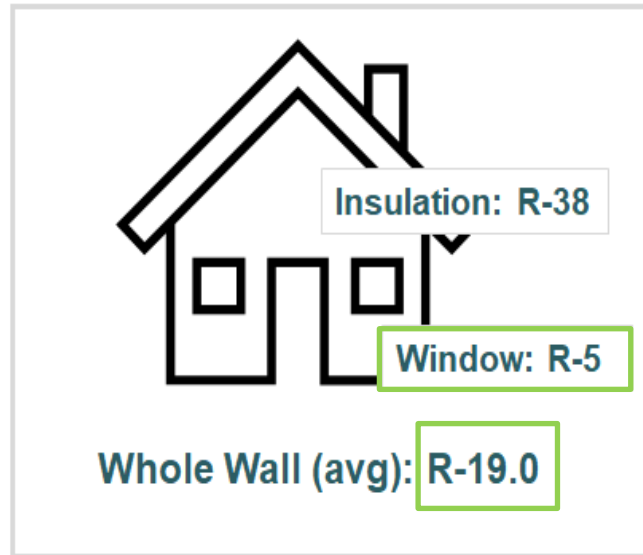
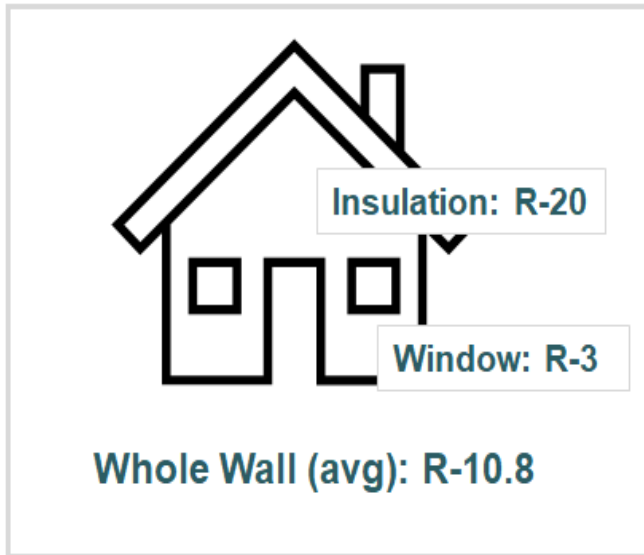
2.4 million Single-Pane Commercial Buildings (40%)

2015 RECS and 2018 CBECS data

* Many homes in cold climates have clear storm windows

Current State of Window Solutions

Current Strategy: New Homes		Current Strategy: Existing Homes	
IECC 2021	R-60 Ceilings	~2% of windows replaced each year	
	R-20 Walls	~2 million storm windows sold (~30% low-e)	
	R-3.3 Windows	~200 million shades/blinds shipped (4% insulating shades)	



windows

without R-5 windows

What problem is PAWS trying to solve?

- A lot of innovation, investment and attention from many parts of the market
- Some have received DOE help over the years, yet some are moving on their own momentum
- But the market is very fragmented with lots of misinformation....
- This is the space that PAWS is intended to fill
- PAWS is a collaborative serving as a platform and connection point between multiple players
- Goal is to align, provide leverage and aggregation, be a trusted source of information, drive costs down and accelerate market demand for high performance window solutions



Alignment with BTO Core Values

Envelope EE First



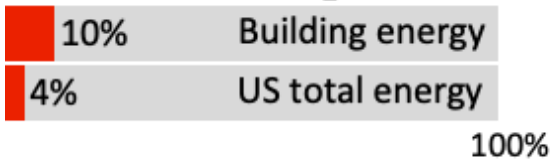
- ✓ Impactful: Carbon savings on day one with commercially available products and wide reach (new and existing)
- ✓ Grid/HP-Friendly: Reduces peak loads and facilitates renewable/clean power
- ✓ Cost-Effective: Provide long-term, persistent energy savings, benefits, and increase building value
- ✓ Resilient: Shelter-in-place protection against extreme climatic events
- ✓ Occupant Benefits: Added comfort, improved health and acoustics

Grid — HP

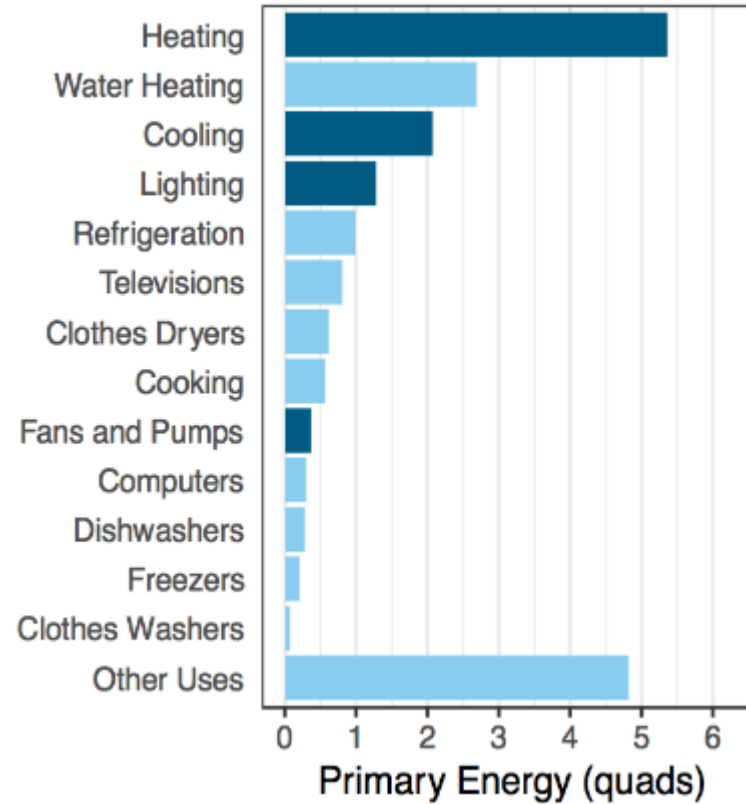


Impact

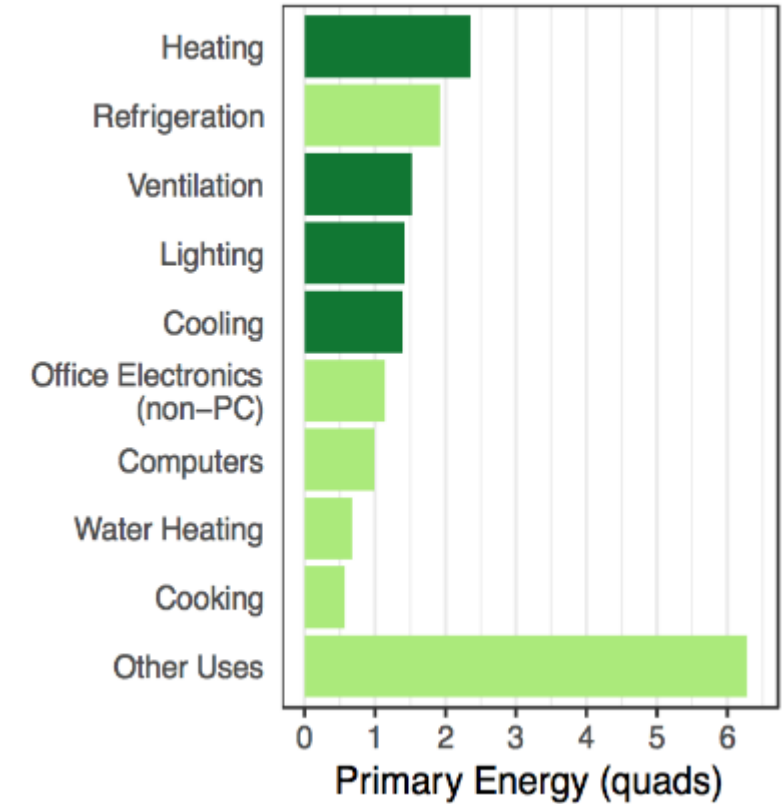
\$45 Billion per year
400 MMT CO₂



Residential



Commercial



Comfort, View, Daylight
Fresh-air, Egress, Energy

Impacts ~50% of loads

Approach: Addressing Barriers to Adoption of Advanced Window Solutions (ET and RBI)

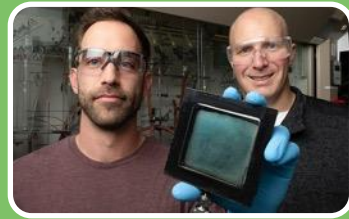
Addressing technical and market barriers requires a range of RD&D efforts

- **Thin Triple Example**
 - LBNL led development, manufacturer engagement, proof of concept, and modeling
 - PNNL led builder outreach, market assessments and field validation studies



Berkley Lab (LBNL)

- Full range of window performance and optical properties testing
- Energy simulation modeling lead for windows and attachments



National Renewable Energy Laboratory (NREL)

- Durability testing of emerging fenestration concepts and standards
- Lead aggregate modeling with ResStock Analysis Tool



Oak Ridge National Laboratory (ORNL)

- Moisture control and air infiltration research
- Wall assembly integration and window wall intersections



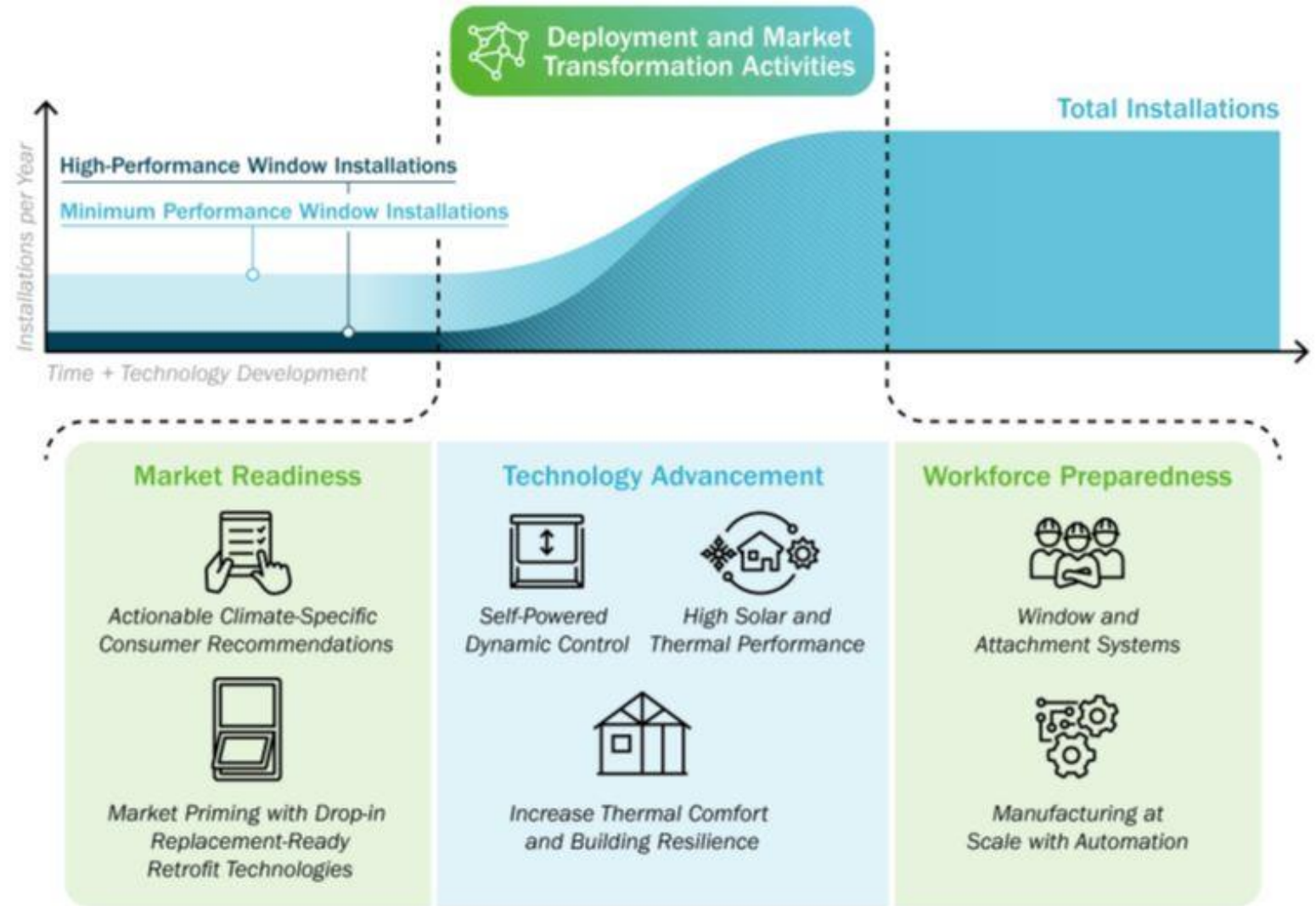
Pacific Northwest National Laboratory (PNNL)

- Lab Homes and occupied field site performance testing
- Market assessments and targeted technology campaigns

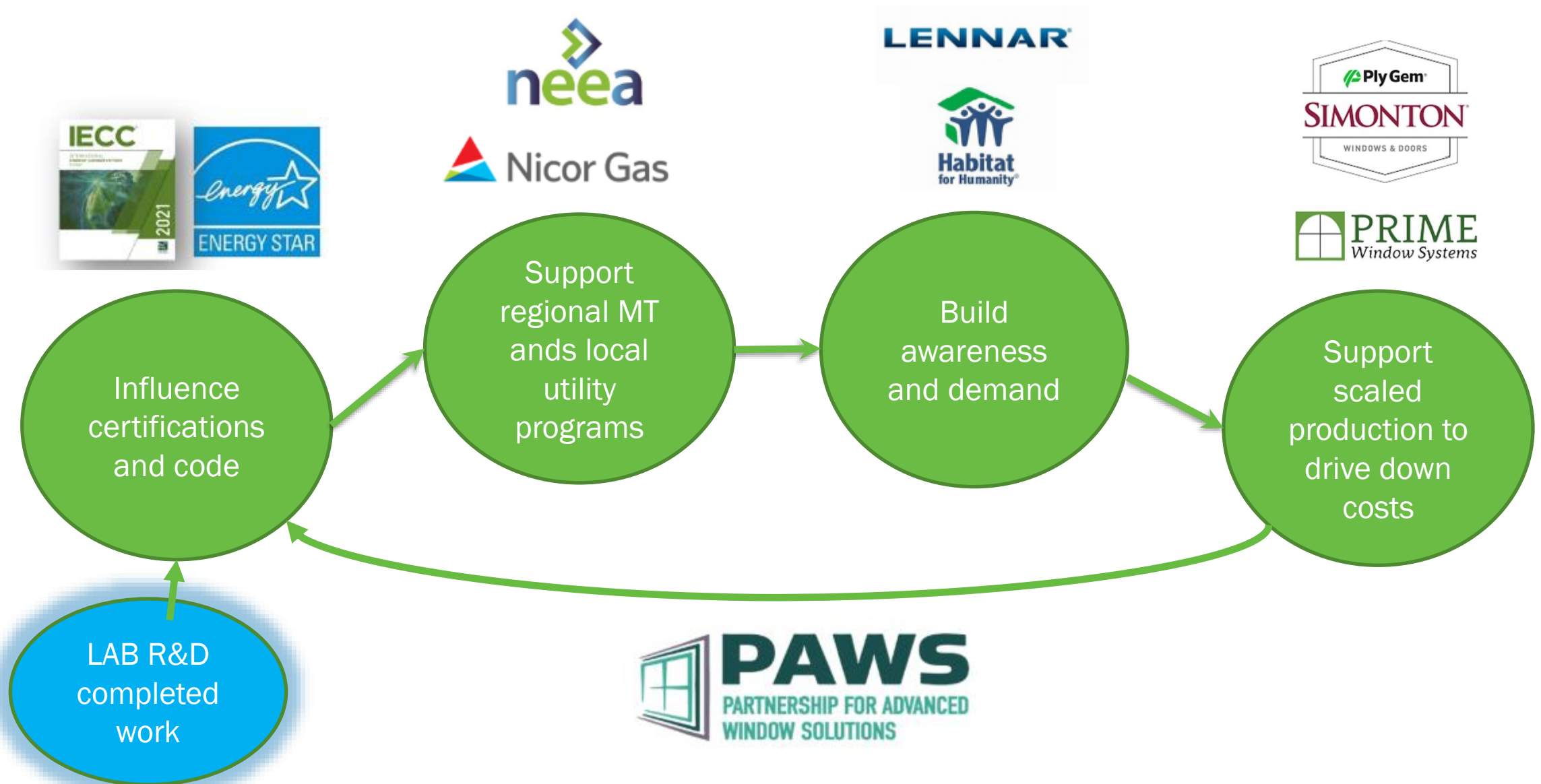
Approach: Purposeful Collaboration to Accelerate Deployment



PAWS aims to accelerate the transformation of the advanced window solutions market by helping bridge the gap between development and deployment efforts leveraging regional and industry partnerships.



Approach: An Example



Approach: Workgroups Address Key Barriers to Tech Scaling of Advanced Window Solutions

- Ratings, Codes, & Certification
 - Energy Star Version 7
 - IECC 2024
- Utility Program Collaboration
 - Midwest (Nicor)
 - Northeast (NYSERDA)
- Stakeholder Campaigns & Initiatives
 - Secondary Glazing Campaigns
 - Builder Pilots
- Communication and Outreach
 - Efficient Windows Collaborative
 - Website Development



Clean Energy Ministerial 2022

Approach

Codes, Standards and Certifications Workgroup

Provides advocacy for advanced window and attachment solutions



Advocates for high performance primary and window attachment ratings, codes, and certifications.

- ENERGY STAR Version 7
- Higher window performance requirements in IECC 2024
- High-R Prerequisite for Zero Energy Ready Homes

Utility Workgroup

Provides technical assistance for TRMs and incentive program design



Cross-collaboration across utility regions (NEEA, MN CEE, NEEP) including engagement with multiple manufacturers and production home builders

Outreach and information dissemination -- 24 utilities participated in stakeholder meetings

Approach

Stakeholder Campaigns and Initiatives Workgroup



Amplifies messaging of DOE's targeted technology campaigns and MT efforts

Evaluating prize and incentive strategies for strategic tech scaling needs

Advocates for advanced window solutions in EE programs and initiatives, including electrification and zero energy, and retrofit programs.

Communications and Outreach Workgroup



Leads engagement with key organizations who that can amplify messaging

Develops window education resources

Identifies key information needed by partners/stakeholders and communicate value/info in plain language (builders, utilities, contractors)

Leads NFRC Efficient Windows Collaborative (EWC) marketing on benefits of high-performance windows

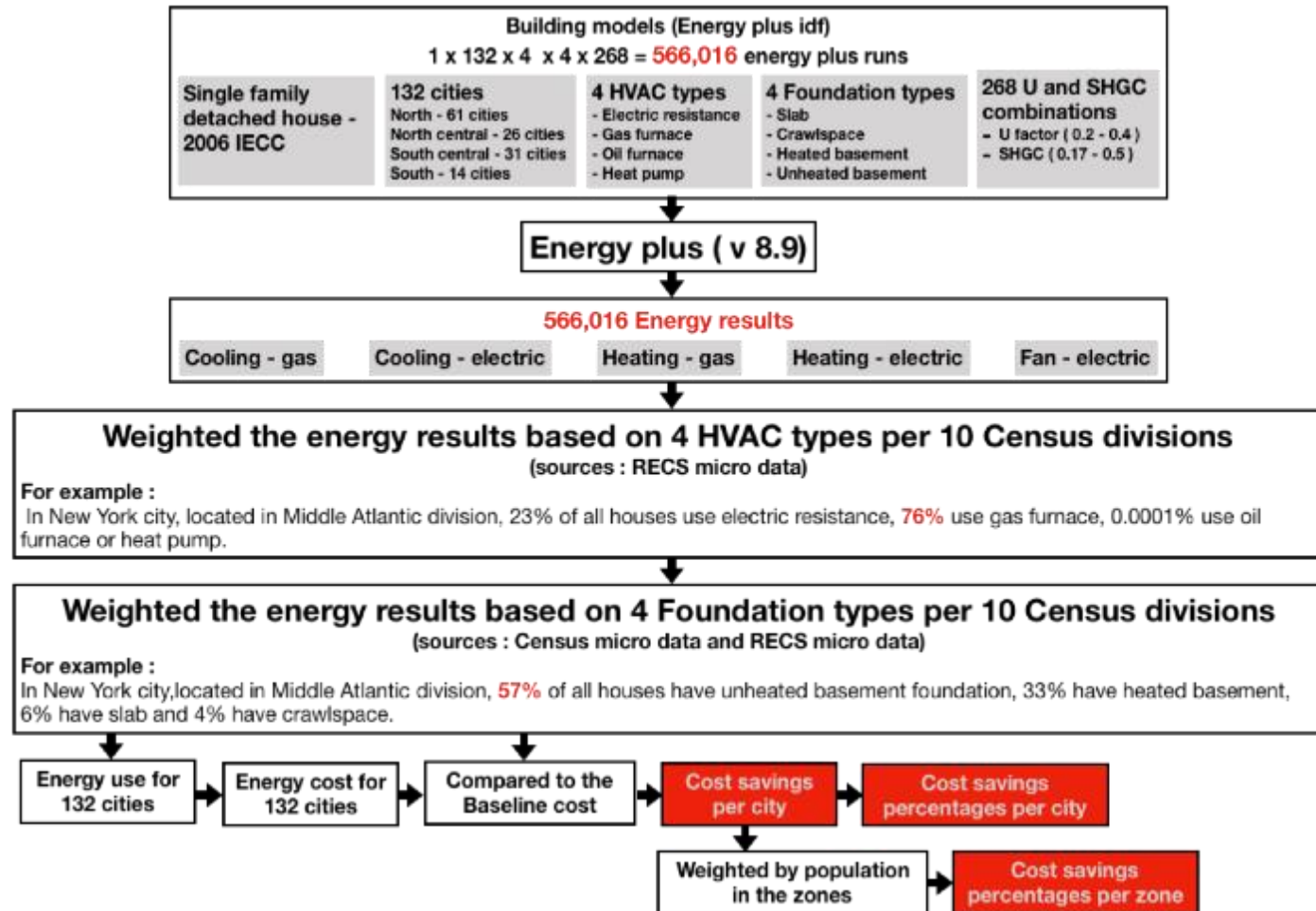
Progress and Future Work

Progress and Future Work: Energy Star v7

Provide technical support for all draft proposals

1 Million+ annual energy simulations
 Localized energy costs
 Trend analysis
 Component costs
 Weighting by population, building type, HVAC
 Industry stakeholder webinars

FY23+:
 Most Efficient
 New Homes
 Shading Products



Progress and Future Work: Ratings and Codes

Organized technical responses to:

IECC 2024

California T-24 2025

ENERGY STAR Version 7.0

Zero Energy Ready Homes

Home Energy Scores

AERC's new ratings for shade automation

FY23+:

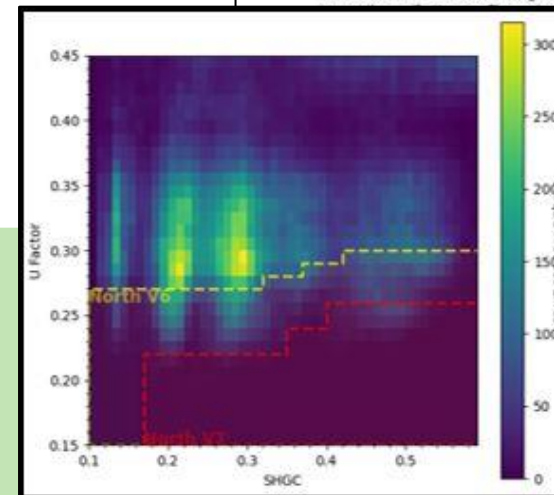
Monitoring codes/standards

Rescoping

Technical Webinars for NFRC members for Energy Star v7

•Frames: <https://www.youtube.com/watch?v=SXqoWMQjbMs>

•IGUs: https://www.youtube.com/watch?v=_6z1u2_fGx0



Progress and Future Work: Utilities

Utilities Technical Reference Manual (TRM) models

Nicor Gas, IL

Efficiency Maine

Northwest Energy Efficiency Alliance

Minnesota (windows and cellular shades)

FY23+:

Secondary windows

Additional programs

Stakeholder directed

State of Minnesota
 Technical Reference Manual
 for
 Energy Conservation
 Improvement Programs

VERSION 4.0
 FINAL
 JANUARY 31, 2023

Effective:
 January 1, 2024 – December 31, 2024



HIGH PERFORMANCE WINDOW INCENTIVE CALCULATOR

INPUTS - *Select location, baseline and performance window specs, and incentive levels for your region.*

Location		Baseline Window		Performance Window		Incentive Rebate Level	
State	City	U-Factor	SHGC	U-Factor	SHGC	Gas (\$/therm)	Electric (\$/kWh)
MN	Minneapolis-St.Paul.Intl.AP.726580	0.32	0.3	0.22	0.3	\$4.00	\$0.20

OUTPUTS

Gas Savings (therms)			Proposed Incentive (per window)	Electric Savings (kWh)			Proposed Incentive (per window)
percent	per window	per home		percent	per window	per home	
4%	2.98	71	\$11.91	1%	2.60	62	\$0.52

Minnesota CEE Utility Incentive Calculator
 (Extending Energy Star Analysis)


Progress and Future Work: Efficient Windows Collaborative

Making an impact with consumers

- 5,000 unique visitors per month
- 50+ partner manufacturers
- 1,000+ listed window options
- Updated educational content “Why Windows Matter”
- Initial Window Selection Tool (WST) redesign

FY23+: Creating more value

- Refine selection tool usability through focus groups
- Update backend energy calculations
- Consumer outreach

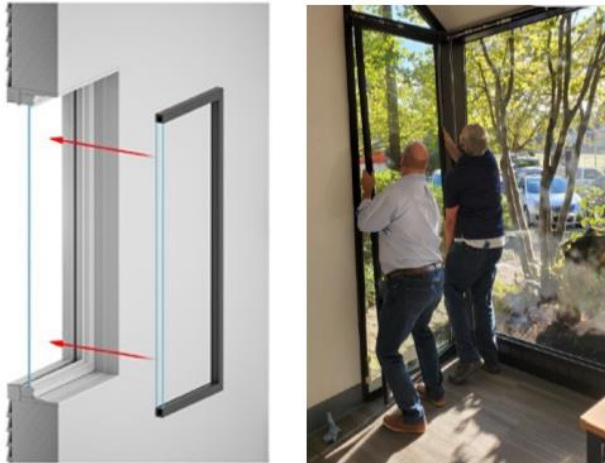


The screenshot shows the Energy Star Window Selection Tool interface for a Triple Pane Window. At the top, there is a 3D cutaway image of a window frame with three glass panes and an Energy Star logo. Below the image, the title "Triple Pane Window" is displayed. The "Description" section lists features: Triple Pane, Low-e Glass, Gas Filled, High Solar Gain, and Non-metal. The "Comfort" section shows "Slightly Warm" for Summer and "Neutral" for Winter. The "Condensation" section shows "None". The "Energy Cost" section shows \$9 for Summer, \$196 for winter, and \$205 Total.

Category	Option	Value
Description	Triple Pane	Low-e Glass
	Gas Filled	High Solar Gain
Non-metal	Non-metal	
	Comfort	Condensation
Slightly Warm	Summer	
	Neutral	Winter
None	None	
	Energy Cost	
\$9	Summer	
	\$196	winter
\$205	Total	

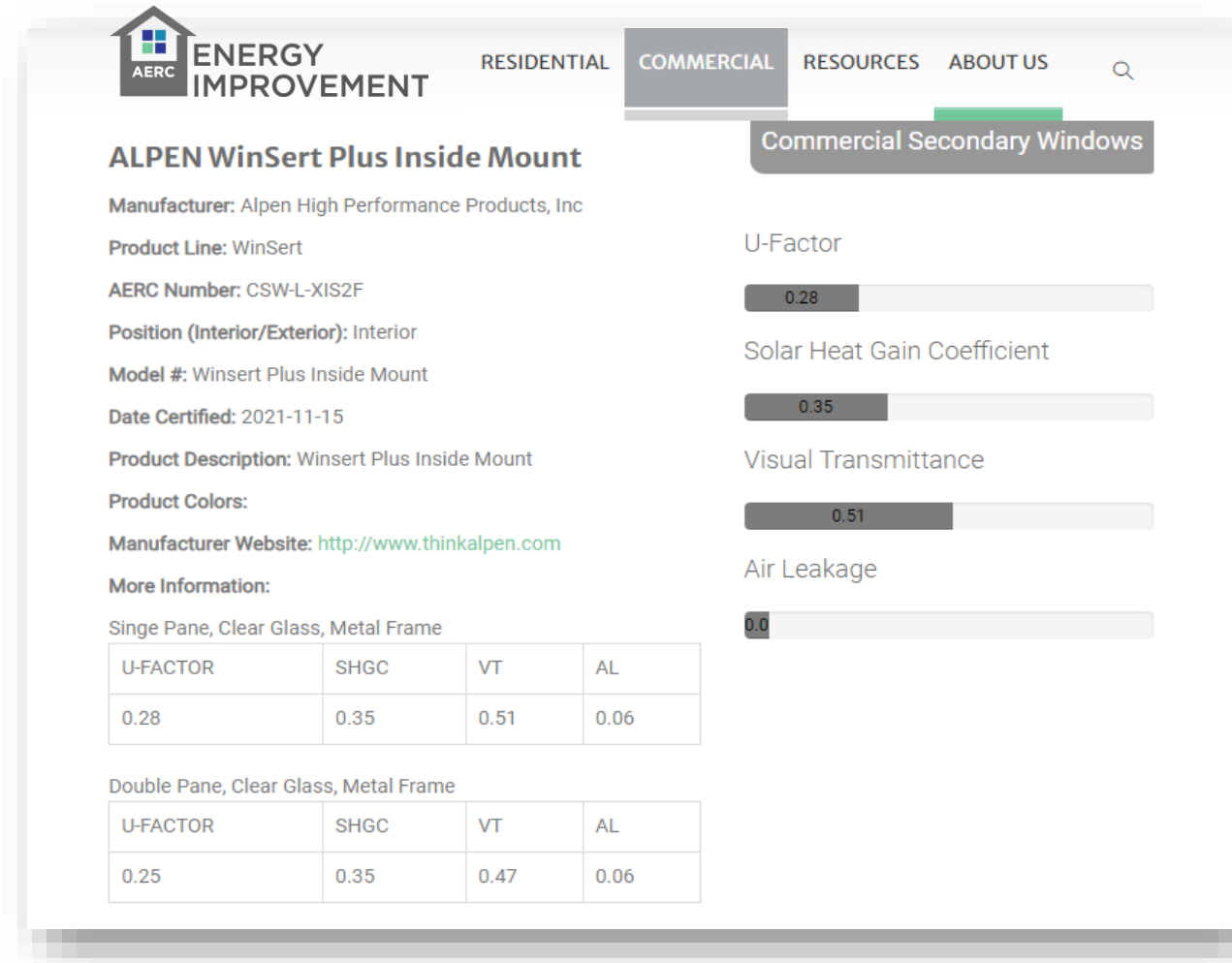
Progress and Future Work: Campaigns and Initiatives

Window Attachments



FY23 Launching Commercial Secondary Windows (CSW) PAWS Initiative

- Works with utilities, manufacturers, and related stakeholders to drive adoption of high-performance commercial secondary windows



AERC ENERGY IMPROVEMENT RESIDENTIAL **COMMERCIAL** RESOURCES ABOUT US

ALPEN WinSert Plus Inside Mount

Manufacturer: Alpen High Performance Products, Inc
Product Line: WinSert
AERC Number: CSW-L-XIS2F
Position (Interior/Exterior): Interior
Model #: Winsert Plus Inside Mount
Date Certified: 2021-11-15
Product Description: Winsert Plus Inside Mount
Product Colors:
Manufacturer Website: <http://www.thinkalpen.com>

More Information:
Single Pane, Clear Glass, Metal Frame

U-FACTOR	SHGC	VT	AL
0.28	0.35	0.51	0.06

Double Pane, Clear Glass, Metal Frame

U-FACTOR	SHGC	VT	AL
0.25	0.35	0.47	0.06

Commercial Secondary Windows

U-Factor: 0.28
Solar Heat Gain Coefficient: 0.35
Visual Transmittance: 0.51
Air Leakage: 0.0



Attachments Energy Rating Council (AERC) certification program for storm windows, commercial secondary windows.
<https://aercenergyrating.org/product-search/>

Progress: Communication and Outreach Website

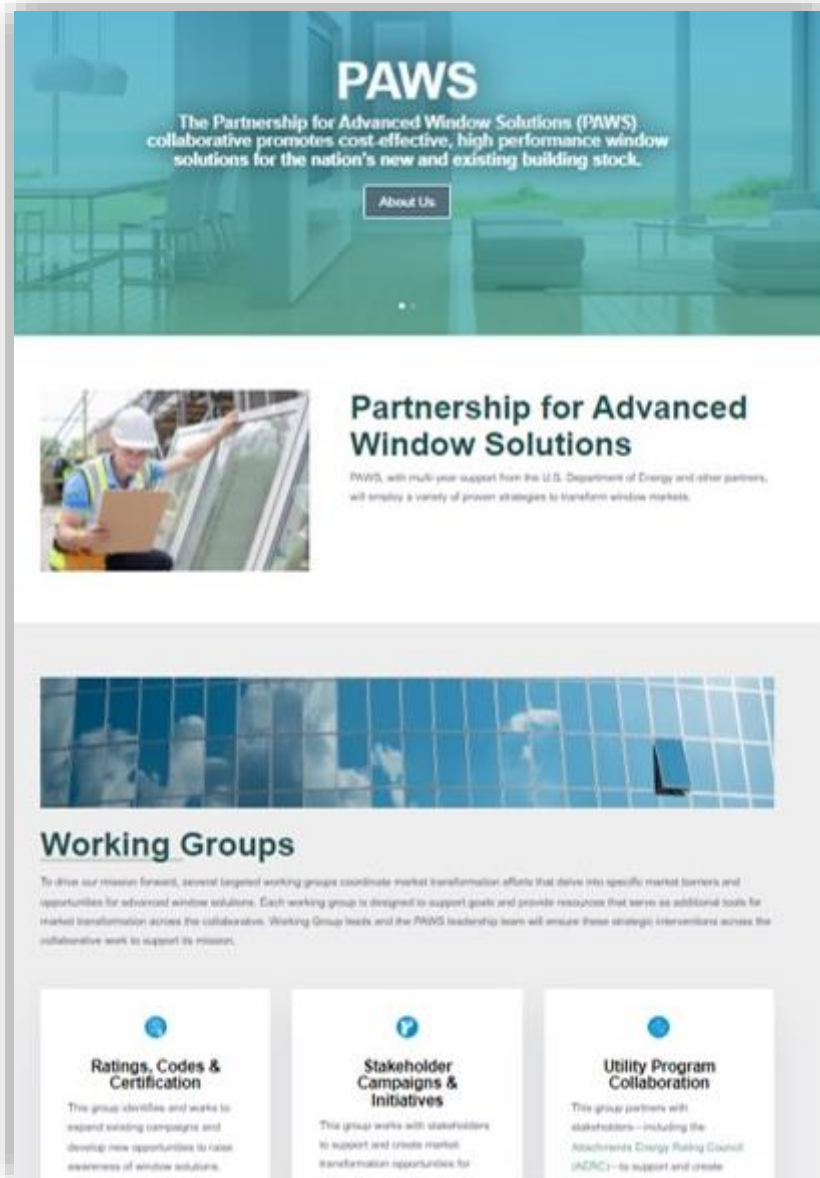


PAWS

The Partnership for Advanced Window Solutions (PAWS) collaborative promotes cost-effective, high performance window solutions for the nation's new and existing building stock.


[About Us](#)

Progress: Communications and Outreach Website




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Partnership for Advanced Window Solutions

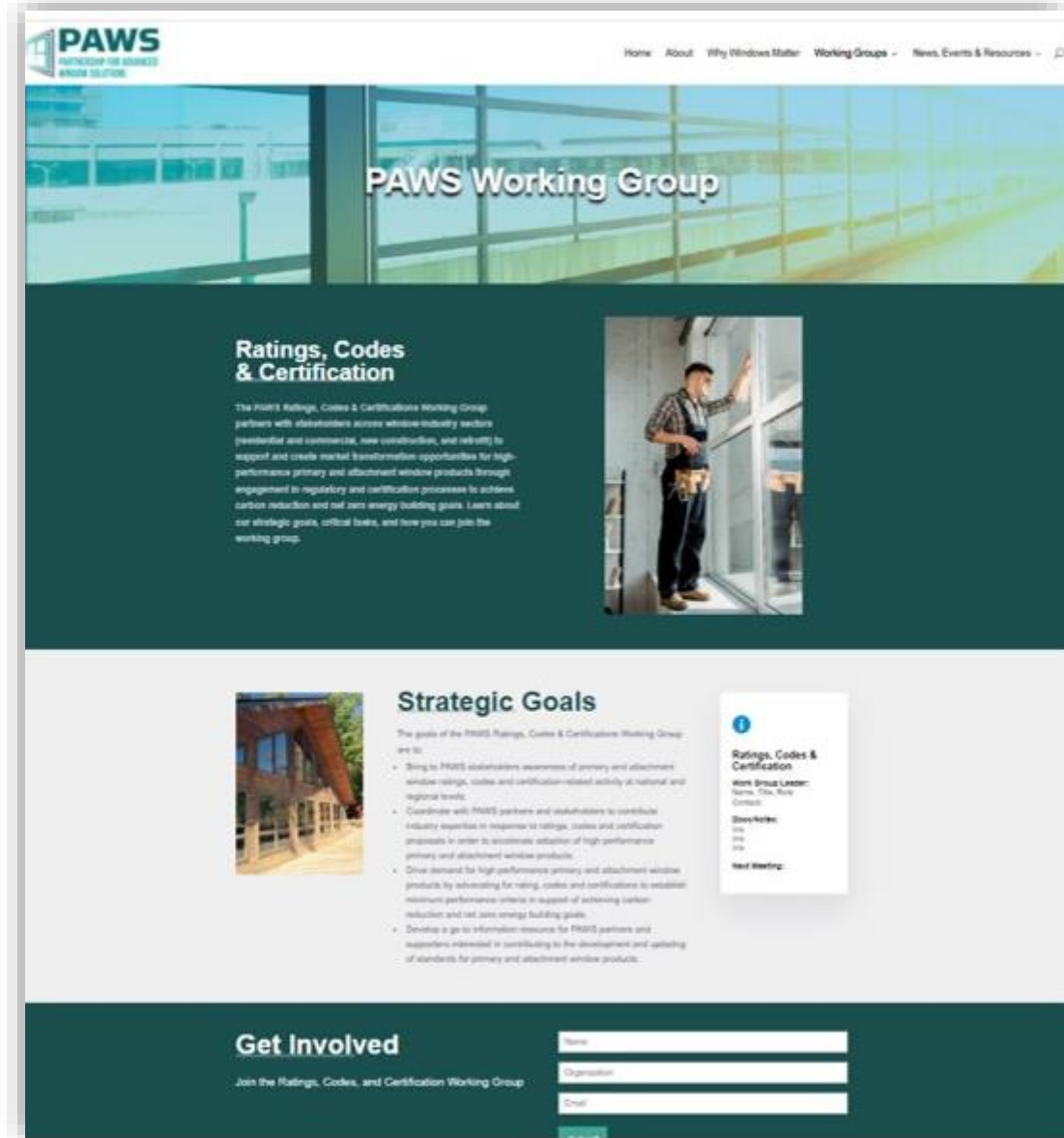
PAWS, with multi-year support from the U.S. Department of Energy and other partners, will employ a variety of proven strategies to transform window markets.



Working Groups

To drive our mission forward, several targeted working groups coordinate market transformation efforts that delve into specific market barriers and opportunities for advanced window solutions. Each working group is designed to support goals and provide resources that serve as additional tools for market transformation across the collaborative. Working Group leads and the PAWS leadership team will ensure these strategic interventions across the collaborative work to support its mission.

- Ratings, Codes & Certification**
This group identifies and works to expand existing campaigns and develop new opportunities to raise awareness of window solutions.
- Stakeholder Campaigns & Initiatives**
This group works with stakeholders to support and create market transformation opportunities for...
- Utility Program Collaboration**
This group partners with stakeholders—including the Attachment Energy Rating Council (AERC)—to support and create...




PAWS
PARTNERSHIP FOR ADVANCED WINDOW SOLUTIONS

Home About Why Windows Matter Working Groups News, Events & Resources

PAWS Working Group

Ratings, Codes & Certification


The PAWS Ratings, Codes & Certification Working Group partners with stakeholders across window industry sectors (residential and commercial, new construction, and retrofit) to support and create market transformation opportunities for high-performance primary and attachment window products through engagement in regulatory and certification processes to achieve carbon reduction and net zero energy building goals. Learn about our strategic goals, critical tasks, and how you can join the working group.



Strategic Goals

The goals of the PAWS Ratings, Codes & Certification Working Group are to:

- Bring to PAWS stakeholders awareness of primary and attachment window ratings, codes and certification-related activity at national and regional levels.
- Coordinate with PAWS partners and stakeholders to contribute industry expertise in response to ratings, codes and certification proposals in order to accelerate adoption of high-performance primary and attachment window products.
- Drive demand for high-performance primary and attachment window products by advocating for rating, codes and certifications to establish maximum performance criteria in support of achieving carbon reduction and net zero energy building goals.
- Develop a go-to information resource for PAWS partners and supporters interested in contributing to the development and updating of standards for primary and attachment window products.



Get Involved

Join the Ratings, Codes, and Certification Working Group.

Name

Organization

Email

[Join Us](#)

Ratings, Codes & Certification

Work Group Leader:
Name, Title, Role
Contact:

Steer-Committee:
Title
Role
Email

Next Meeting:

Progress: Communications and Outreach

Sparking engagements and unifying market leaders

- ACEEE Summer Study
- Virginia Energy Efficiency Council (VAEEC)
- Seattle Building Envelope Council (SeaBEC)
- Advanced Building Construction (ABC) Initiative Coffee Chat
- Better Buildings Low Carbon Pilot Peer Exchange
- Commercial Secondary Window Summit
- SWIP Storm Window Summit
- Architectural West Magazine article
- Getting To Zero Forum
- Crown article
- NFRC Annual Meeting
- Better Building Summit
- Climate Wire article
- National Glass Association Annual Technical Meeting
- FGIA Annual Meeting
- WDMA Annual Meeting
- New Energy & Fuel article
- US Glass Magazine article (Q2 2022)

PNNL hosts regional utility workshop featuring RBI supported programs



Energy Secretary Jennifer Granholm holds a thin triple pane window at Berkeley Lab

Future Work Summary



- Collaborate with EPA to **prepare the market** for E* 7.0
- Grow PAWS membership to enable **additional partners**
- **Continue to grow regional MT and utility programs** and amplify impact with manufacturer and supply chain engagement
- **Demonstrating a viable business case for high-performance windows specified within an electrification focused remodel**
- Develop commercial buildings initiatives, including commercial codes & standards and secondary glazing initiatives
- Conduct communication & outreach - educate middle market about benefits and how to position advanced window solutions
- **Develop DEI initiatives** for groups like Habitat and secondary windows when replacement not practical

Thank You

PNNL

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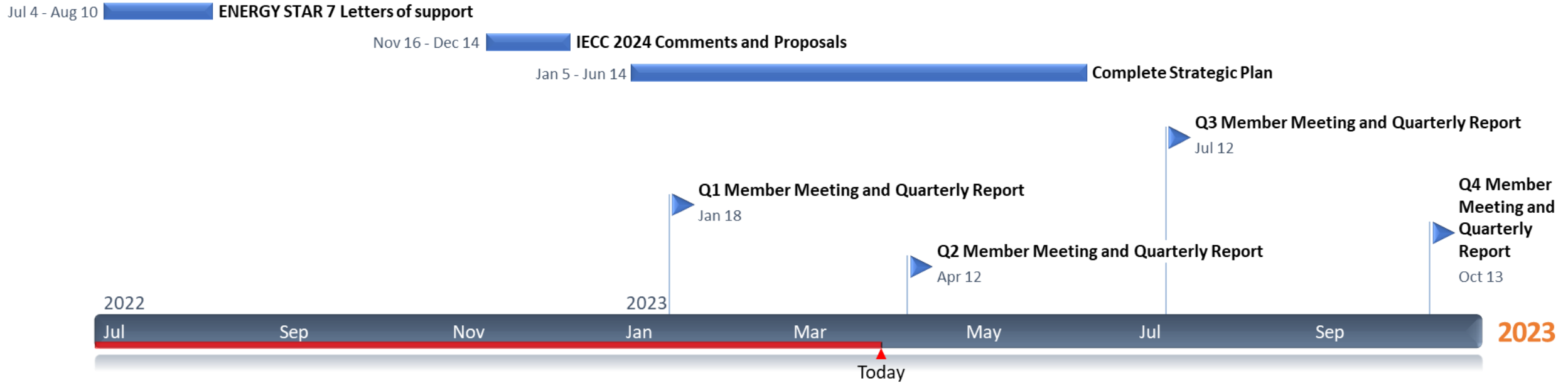
LBNL

rghart@lbl.gov

WBS 1.5.1.62

REFERENCE SLIDES

Project Execution



Performance Period: FY22 – FY23
DOE budget FY23: \$450k+\$200k
Cost Share FY23: \$0

Team



Katherine Cort
PNNL



Rick Dunn
NEEA



Elaine Miller
NEEA



Stephen Selkowitz
Affiliate LBNL



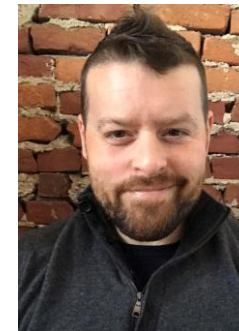
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Robert Hart
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Isaac Smith
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Energetics

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Sam Rosenberg, PNNL
Christian Valoria, PNNL
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