2024 Q1 Emerging Technology Quarterly Newsletter

WHAT'S NEW:

2024 is off to a strong start for the Emerging Technology team. In addition to the progress on existing efforts, several new projects got underway including testing of commercial heat pump dryers, a commercial secondary window field study in collaboration with the California Energy Commission, participation in the development of vacuum insulated panels for easy exterior building retrofits, and the site selection of luminaire level lighting controls with integrated HVAC field test. Additionally, ENERGY STAR® and the U.S. Department of Energy (U.S. DOE) released a draft test procedure for micro heat pumps as an addition to the room air conditioner specification, which is expected to be adopted the first half of 2024. Lastly, the U.S. DOE launched a $2 million prize to advance American-made secondary glazing systems.

Recently Published Emerging Technology Reports:

- Commercial Secondary Window Field Test
- Heat Pump Water Heaters In Multifamily New Construction: Design Charette Findings

Recent Product Councils:

- Montana State University Integrated Design Lab – Ventilation Requirements for Residential Buildings in Cold Climates
- Existing Building Audits with QBAT
- Integrated Design Lab Series – University of Idaho – Bio-Based Building Materials and Rural Energy Audits

Information on upcoming Product Councils is always available at https://neea.org/get-involved/product-council.

Please reach out to Eric Olson or one of NEEA's product managers with questions or suggestions on NEEA's emerging technology work. NEEA staff would love to hear from you.

~ **Eric Olson,** Manager, Emerging Technology & Product Management ~

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Product Summary & Readiness Levels

	PRODUCT OR PROJECT	PROGRAM*	FUEL TYPE	SECTOR	ELECTRIC SAVINGS POTENTIAL[1]	GAS SAVINGS POTENTIAL[2]	PRODUCT PERFORMANCE[3]	MARKET/ COMMERCIAL[3]	PROGRAM READINESS[3]
Products	Ultra-High Definition TVs	RPP	Electric	Residential	57	N/A	4	5	5
	Residential Laundry Field Study	RPP	Gas	Residential	N/A	N/A	5	5	5
	Monitors and Commercial Displays	TBD	Electric	Residential, Commercial	TBD	N/A	3	5	1
	Laundry Centers & All-in-One Washer-Dryers	RPP	Electric	Residential	TBD	TBD	3	5	2
	Commercial Heat Pump Dryers	TBD	Gas	Commercial	TBD	TBD	1	3	1
HVAC	Very High Efficiency Dedicated Outside Air Systems	VHE DOAS	Gas	Industrial	85	20†	4	5	5
	Efficient Rooftop Units	ERTU	Gas	Industrial	N/A	9	4	3	4
	Heat Pump Rating Representativeness	AHP	Gas	Industrial	TBD	N/A	3	5	4
	Heat Pump Advanced Features and Capabilities	AHP	Electric	Industrial	35†	N/A	3	5	4
	Micro Variable Speed Heat Pump Field Study	TBD	Electric	Industrial	TBD	N/A	1	3	1
	Heat Pump Ready ENERGY STAR® Manufactured Homes	AHP	Electric	Industrial	TBD	N/A	4	5	3
	Dual Fuel Gas-Electric Heat Pump	DFHP	Gas	Industrial	TBD	TBD	5	3	1
Building	High-Performance Windows	HPW	Gas	Industrial	60	30	4	3	4
	Secondary Windows	Window Attachments	Gas	Residential	35	23†	1	5	4
	Skinny Wall Retrofit Panels	TBD	Gas	Industrial	TBD	TBD	2	1	1
Lighting	Luminaire Level Lighting Controls	LLLC	Electric	Industrial	75	N/A	4	4	3
	LLLC with HVAC Control	LLLC	Gas	Industrial	358	TBD	3	2	3
	Parking Lot Lighting with LLLC	TBD	Electric	Industrial	TBD	N/A	3	3	1
Water Heating	Combination Hot Water and Space Heat	N/A	Gas	Residential, Industrial	130	N/A	1-4	1-3	2
	Heat Pump Water Heaters in Confined Spaces	HPWH	Electric	Residential, Industrial	TBD	N/A	2-5	3-4	2-5
	Integrated Residential GHPWH	GHPWH	Gas	Residential	N/A	200	3	1	2
	Central Commercial Heat Pump Water Heater	HPWH	Electric	Industrial	50	N/A	3	3	3
	Central Commercial Thermally Driven Heat Pump	TBD	Gas	Industrial	N/A	64	3	3	2
	Split System Heat Pump Water Heater	HPWH	Electric	Industrial	50	N/A	3	3	3
	Integrated Commercial Heat Pump Water Heater	HPWH	Electric	Industrial	50	N/A	3	3	4
	Industrial Heat Pumps	N/A	Gas	Industrial	TBD	TBD	2	2	1
Motors	Commercial & Industrial Fans	Fans	Gas	Commercial, Industrial	176	N/A	5	4	2
	Power Drive System Technology Assessment	N/A	Gas	Commercial	292	N/A	5	4	1
	Extended Motor Products (Pumps)	XMP	Electric	Commercial	246	N/A	5	5	5

***Program Acronyms Defined:** Retail Product Portfolio (RPP); Ductless Heat Pumps (DHP); Advanced Heat Pumps, formerly Variable Speed Heat Pumps (AHP); Very High Efficiency Dedicated Outdoor Air Systems (VHE DOAS); Luminaire Level Lighting Controls (LLLC); Heat Pump Water Heater (HPWH); Efficient Gas Water Heaters (EGHW); Extended Motor Products (XMP); High-Performance Windows (HPW); Gas Heat Pump Water Heaters (GHPWH); Dual Fuel HVAC (DFHP)

1: Technical achievable **electric savings potential** in the region aMW

2: Technical achievable **gas savings potential** in the region in MM Therms

3: **Readiness Level Definitions** provided on page 27; **Rating Scale** 1=low 5=high

†: Preliminary estimate or technical potential from the RTF

Fuel Type Symbols: Electric Gas **Sector Symbols:** Residential Commercial Industrial

Ultra-High Definition (UHD) TVs

Project Status: ENERGY STAR v9 became the official U.S. DOE test procedure required for all TVs in September 2023. The list currently includes 74 TVs, representing at least two major brands. Energy use data from multiple manufacturers' TV testing has been received and is informing negotiations on appropriate on-mode energy levels through the industry Voluntary Agreement.

Product Description: 4K UHD TVs with various forms of advanced display technologies.

Project Objectives:

- Update U.S. DOE TV test procedure and International Electrotechnical Commission (IEC) test clip to:
  1) Adequately address existing features such as Automatic Brightness Control (ABC) and Motion Detection Dimming (MDD) to prevent gaming of test results by manufacturers; and
  2) Incorporate emerging technologies such as UHD, true and upscaled high dynamic range (HDR), increasing panel brightness and stand-by power.
- Update ENERGY STAR specification to address issues with ABC/MDD, address new energy-consuming features such as UHD, and to account for the U.S. DOE test procedure and IEC test clip updates.
- Use data from TV manufacturers' TV testing to review current television energy use, which will help to define efficiency standards for potential incentives in 2025.

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Product	4	Comm/Market	5	Program	5

Residential Laundry Field Study

Project Status: The field monitoring phase of the study is complete; the data analysis has begun, and results will be available in Q2 2024.

Product Description: Residential appliances for washing and drying clothes.

Project Objectives: Conduct research to leverage NEEA's Residential Building Stock Assessment (RBSA) households by selecting a statistically representative sample of households and studying their laundry use patterns and equipment energy use. This study collects data on water usage, load sizes, textile mix, washer and dryer cycles selected, how efficiently washers remove water from the load, and how efficiently dryers dry clothes. These insights will allow updates to energy savings opportunities, inform current ENERGY STAR specification development, inform future U.S. DOE rulemakings, and facilitate collaboration with other partners to replicate the study in their territories.

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Product	5	Comm/Market	5	Program	5

Monitor and Commercial Display Testing

Project Status: The test procedure modification for monitors is complete, and testing to adapt the procedure to commercial displays is in the planning phase.

Product Description: High-definition and UHD monitors and commercial displays with various advanced display technologies.

Project Objectives:
The current monitor and display policy approach has several gaps. Most displays and monitors are similar in design and construction to TVs. For TVs, the U.S. DOE has adopted ANSI/CTA-2037D, developed by NEEA, which better represents true energy use than the current industry standard. This project has three objectives:

- Replace the current industry standard with the NEEA-developed test procedure adapted to monitors and displays;
- Achieve adoption by ENERGY STAR of the NEEA-developed test procedure and methodology for monitors and displays, with buy-in by industry stakeholders including major manufacturers and energy-efficiency advocates; and
- Succeed in having the new test procedure inform an update to the U.S. DOE federal standard.

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Product	3	Comm/Market	5	Program	1

Laundry Centers and Washer-Dryer Combo Testing

Project Status: This project is expected to begin in Q2 2024. A second brand has launched an all-in-one washer-dryer, and consumer adoption of combo all-in-one units featuring heat-pump dryer technology is rapidly accelerating.

Product Description: Laundry centers are residential clothes washers and electric or gas clothes dryers that clean and dry clothes in separate, stacked drums. A combination all-in-one washer-dryer is a residential clothes washer and electric or gas clothes dryer that cleans and dries the clothes in a single tumble-type drum.

Project Objectives:
Laundry centers and combination all-in-one washer-dryers with heat pump dryers are now available in the market. This research aims to:

- Test equipment to understand actual performance and energy consumption compared to U.S. DOE and ENERGY STAR estimates;
- Develop possible U.S. DOE test procedure updates for laundry centers and combination washer-dryers and potential implications for standard washer and dryer tests;
- Craft laundry center and single-drum washer-dryer ENERGY STAR program recommendations; and
- Identify relevant regional program opportunities for laundry centers and single-drum washer-dryers.

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Product	3	Comm/Market	5	Program	4

Commercial Heat Pump Dryers

Project Status: Equipment testing will begin in Q2 2024 with one commercially available heat pump dryer and matched washer, one electric resistance and one gas commercial dryer.

Product Description: Commercial clothes dryers using electric heat pump technology in place of, or in addition to, electric resistance elements to dry textiles. Commercial heat pump dryers may be utilized in vended applications or as on-premises laundry.

Project Objectives:
Commercial heat pump dryers are now available in the market. This research seeks to:

- Quantify the energy use of heat pump dryers compared to similar capacity (50 lb. ± 10 lbs.) electric resistance and gas commercial dryers;
- Develop a regional model of energy use and savings estimates looking at three locations in NEEA's territory and comparing them to a U.S. national average calculation;
- Understand the cycle time differences between conventional and commercial heat pump dryers by testing a variety of textiles, including Association of Home Appliance Manufacturers (AHAM) 100% cotton textiles, hotel linens and hotel towels;
- Quantify potential impacts in capital costs, operational and labor costs in using heat pump dryers versus conventional commercial dryers; and
- Utilize learning to inform future ENERGY STAR and U.S. DOE test procedure developments or rulemakings.

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Product	1	Comm/Market	3	Program	1

Very High Efficiency Dedicated Outside Air Systems (DOAS) Optimization

Project Status: Monitoring the Sartori School in Renton is complete, and the final report is complete and available by request. Monitoring at Harder Mechanical Contractors, Inc. in Portland, OR, with energy recovery ventilation (ERV) and variable refrigerant flow (VRF) heating/cooling systems is complete, with the final report expected in Q2 2024. SERA Architects in Portland, OR, with ERV and VRF heat pumps, is being monitored through Q4 2024.

Product Description: A system-based approach for commercial HVAC systems that use high efficiency heat recovery ventilation (HRV) or energy recovery ventilation (ERV) that features 82% or greater sensible effectiveness; a high-performance heating and cooling system that meets ENERGY STAR performance standards; ventilation fully separated from heating and cooling; and right-sized heating and cooling equipment.

Project Objectives: Test and validate HVAC systems utilizing DOAS design principles with multiple HVAC designs, including forced air and chilled beam designs, against conventional equipment. Results inform improved modeling of DOAS design principles in various building types and equipment selection.

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Product	4	Comm/Market	5	Program	5

Efficient Rooftop Units (RTUs)

Project Status: The units' installation in Portland, OR, is complete, and monitoring is underway. A final report is anticipated by Q3 2024.

Product Description: Packaged, weatherized, commercial natural gas indirect air heating systems that may or may not include ventilation, air conditioning or both. Efficient RTUs are mounted externally to a building and capture heat from the products of combustion (flue gases) to achieve a minimum thermal efficiency or annual fuel utilization efficiency (AFUE) of 90%. Also includes non-condensing products that use modulating gas valves.

Project Objectives: Evaluate the performance of efficient RTU products through field trials in multiple climates. The first test site in Winifred, MT, evaluated an AAON unit over a nine-month period that concluded in June 2022. The Montana State University (MSU) Integrated Design Lab managed this project.

The second site, in Portland, OR, is testing units from two manufacturers — a high-efficiency Daikin unit and a standard-efficiency Trane model. The units will be tested over nine months. Results will inform plans to promote and accelerate the adoption of efficient RTU products.

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Product	4	Comm/Market	3	Program	4

Heat Pump Rating Representativeness

Project Status: Field testing of the six heat pumps concluded in February 2023; lab testing with both AHRI 210/240 M1 and CSA SPE07:2023 test procedures was completed in late December 2023. The University of Nebraska is under contract for data analysis and coordinating with the prime contractor (DNV) on a final report. Preliminary test results are available from the August 15, 2023 Product Council. The results of this project were presented during the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Unitary Small Equipment Test Procedure Committee meetings and helped redefine future federal test procedures. A published report of findings will be presented at the 2024 Herrick Conference (Purdue University) in July 2024.

Product Description: Variable speed heat pumps and air conditioners.

Project Description: NEEA is working collaboratively with Northeast Energy Efficiency Partnerships (NEEP); AHRI; BC Hydro; NRCan; New York State Energy Research and Development Authority (NYSERDA); Southern California Edison; Xcel Energy; and U.S. DOE to determine the representativeness of different heat pump test procedures. The study will observe heat pump performance in a controlled field installation and compare those observations with corresponding laboratory test results. NEEA will investigate the heat pump test procedures prevalent in North America (CSA SPE07 and U.S. DOE Appendix M1) and identify which method more accurately represents energy use. Additionally, key conditions and sequences (e.g., defrost, variation of compressor speed at part load) affecting instantaneous power demand and overall energy use will be investigated.

Project Objectives:

- Identify how well U.S. DOE Appendix M1 represents field performance.
- Identify how well CSA SPE07 represents field performance.
- Identify essential pieces of information that must be captured by any heat pump test procedure to accurately represent heat pump performance (e.g., any controls sequences that are particularly impactful to performance).
- Determine critical performance indicators that could effectively be used to differentiate efficient equipment in a Qualified Products List (QPL) in advance of wide availability of modified test procedures.

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Product	3	Comm/Market	5	Program	4

Heat Pump Advanced Features and Capabilities (Improvements)

Project Status: On August 1, 2023, a Product Council presented data on three improvements NEEA is pursuing: low load efficiency, cold climate capability, and connected commissioning. Initial work plans were completed in Q2 2023, and updated versions will be completed in Q2 2024.

Product Description: Variable speed heat pumps.

NEEA contracted with Cadeo Group to assist with defining specifications, energy saving estimates, and identification methods for four improvements to heat pump technologies: low load efficiency, cold climate capability, minimizing auxiliary heat, and connected commissioning. Current AHRI metrics do not cover these features and capabilities. Other heat pump improvements with the potential to increase performance, including auto demand response, adaptive defrost and low-energy crankcase heaters, will be investigated in the future.

Project Objectives: Conduct a literature review and gap analysis and develop work plans that address knowledge and technology gaps. These features and capabilities will become part of NEEA's Advanced Heat Pump program if successful.

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Product	3	Comm/Market	5	Program	4

Micro Variable Speed Heat Pump (VSHP) Field Study

Project Status: In December 2023, the Environmental Protection Agency (EPA) and U.S. DOE announced an ENERGY STAR test procedure draft for room heat pumps as part of the room air conditioner specification, with comments due in January 2024. NEEA submitted remarks and continues collaborating with CalNEXT and CalMTA on supplemental field and lab testing. A final specification is anticipated in the first half of 2024.

Product Description: A small heat pump designed to condition a single room. The heat pump may be installed in a window, like a window air conditioner, or portable so it can easily be moved from room to room. It is plugged into a standard 15A 120V AC outlet.

Project Objectives: Conduct consumer research and field test micro heat pumps. This project consists of a small sample (16 total units) placed in a selected sample of homes. The principal research goal is to understand the customer experience and develop an assessment of the product's market readiness. The secondary goal is to gather information to guide estimates of energy savings potential and to determine the units' effectiveness at displacing energy used by the pre-existing heating system.

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Product	1	Comm/Market	3	Program	1

Heat Pump Ready ENERGY STAR Manufactured Homes

Project Status: Project completed. The results from this project were shared at the Product Council meeting on December 5, 2023. Related ongoing work continues to influence the U.S. DOE's and EPA's criteria of DOE Zero Energy Ready Home (ZERH) manufactured homes and ENERGY STAR, respectively. NEEA seeks to use the approach developed by this project so that homes can ship from a factory participating in the Northwest Energy-Efficient Manufactured Housing Program™ (NEEM). Due to uncertainty regarding enforcement responsibilities between the U.S. DOE and the U.S. Department of Housing and Urban Development (HUD), the compliance date is delayed until July 2025. An analysis of the Inflation Reduction Tax Act identified elements of the specification that would benefit NEEM and the unique way ENERGY STAR homes are certified in the Northwest.

Product Description: Manufactured homes that can be shipped as "Heat Pump Ready" to comply with the new ENERGY STAR Manufactured Home specification.

Project Objectives: The updated ENERGY STAR Manufactured Home specification went into effect May 31, 2023, and requires that such homes be equipped with a heat pump. The revised NEEM specification for a Heat Pump Ready ENERGY STAR manufactured home will enable factories to sell homes prepped for a heat pump installation in the field. It also enables installation tracking to ensure the homes meet the ENERGY STAR spec.

- Identify how well U.S. DOE Appendix M1 represents field performance.
- Conduct HVAC contractor interviews to ensure product acceptance.
- Develop a mechanical and electrical specification; document process changes to achieve ENERGY STAR specification levels.
- Develop a database to enable tracking of products that meet the ENERGY STAR specification.

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Product	4	Comm/Market	5	Program	3

Low Load Efficient Heat Pump Investigation

Project Status: The initial investigation findings will be presented at the April 2, 2024, Product Council. The initial findings confirmed that:

1) The product differentiation metric (coefficient of performance (COP) at minimum output at 47°F) provides a good representation of part load efficiency, and
2) No singular technology element is responsible for better part load efficiency. The improved efficiency is not driven by specific hardware choices but rather by how the control algorithms modulate and take advantage of the compressor and fan efficiencies under part load conditions.

Product Description: Variable speed heat pumps that are highly efficient when running under low loads.

Project Objectives: The core objectives are to determine the incremental cost and reasons why some variable speed heat pumps exhibit significantly better part load (low load conditions) operating performance.

- Phase 1 of the project will review existing publicly available data.
- Phase 2 will conduct a virtual teardown of equipment to compare a dozen different heat pumps based on technical service manuals.
- Phase 3 will perform a physical teardown of subcomponents to evaluate the manufacturing costs and components that enable low load efficiency.

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Product	3	Comm/Market	5	Program	4

Air-Conditioning, Heating, and Refrigeration Institute (AHRI) 1380 HVAC Connectivity Standard

Project Status: This project is currently in its planning phase.

Product Description: Hardware and software to enable grid flexible and controllable HVAC systems.

Project Objectives: Support efforts to harmonize connectivity standards among several standards, including heat pumps, ENERGY STAR, OpenADR and others.

Product Managers:
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Product	3	Comm/Market	3	Program	1

Dual Fuel Gas Heat Pump

Project Status: NEEA continues to lead a workgroup of industry stakeholders to understand potential energy measurement considerations and approaches to dual fuel systems. Efforts continue to harmonize a CSA Group performance metric for dual fuel systems with AHRI 210/240. NEEA planning activities include collecting technical and market data to evaluate opportunities further.

Product Description: A forced air gas furnace combined with an electric air source heat pump (ASHP) with integrated controls.

Project Objectives: Understand energy and cost savings from ASHPs as a centrally ducted air-conditioning replacement across various representative applications in the Northwest.

Product Manager: Noe Contreras
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Product	4	Comm/Market	3	Program	1

Primary High-Performance Windows

Project Status: To support the proliferation of high-performance windows in the Northwest, the alliance continued facilitating the national Partnership for Advanced Window Solutions (PAWS) Collaborative. PAWS promotes cost-effective, high-performance window solutions for the nation's new and existing building stock.

The installation in 12 Grand Ronde, OR, residential duplexes is complete. The Confederated Tribes of Grand Ronde selected high-performance windows as part of the net-zero design for this project. Insights gained from the installation include comparable weight and installation to conventional double-glazed windows, improved energy performance by 40%, minimization of air leakage, and enhanced thermal, visual and acoustic comfort, among others. A complete overview of the project is available at betterbuiltnw.com.

NEEA's collaboration with a national builder started in Q4 2022 and has extended into 2024. High-performance windows are a path to code credits for this builder. Windows have been installed in approximately three dozen homes; interviews with the builder and window installers indicate no incremental labor is required, and installation has proven no different than for double pane windows.

Product Description: Primary window using three panes of glass (or film or rigid plastic), two of standard thickness and a center thin pane of glass (or film). The overall thickness and weight are similar to standard double pane windows.

Project Objectives:

- Identify manufacturing technical needs for production of thin triple pane windows.
- Provide technical assistance on production processes (adapting double glazed equipment or new lines).
- Research motivating factors for increasing production of thin triple pane windows.
- Identify barriers in the supply chain.
- Investigate enhancements in thin triple pane window technology.

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Product	4	Comm/Market	3	Program	4

Secondary Windows

Project Status: The final report is available on neea.org. The average annualized energy savings across the six sites was 6.7%, with the three highest performing sites averaging 10.6%.

Product Description: Retrofit products comprised of one or more panes of material such as glass, polymer or acrylic, with or without Low-E coatings, which are mounted in a frame attached either to the interior or exterior of existing windows without replacing the primary glass or frame.

Project Objectives: Increase familiarity with product costs (for both materials and installation in the Northwest), product energy savings, market opportunity in the Northwest, installer capability and market drivers, especially value proposition for owners and owner representatives.

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Product	4	Comm/Market	5	Program	4

Secondary Windows Field Study

Project Status: This project is now underway.

Product Description: Retrofit products comprised of one or more panes of material such as glass, polymer or acrylic, with or without Low-E coatings, which are mounted in a frame attached either to the interior or exterior of existing windows without replacing the primary glass or frame.

Project Objectives: Primarily funded by the California Energy Commission (CEC), this multi-year, co-funded project, led by GTI Energy, seeks to:

- Identify manufacturing technical needs for production of thin triple pane windows.
- Advance high-performance window technologies by addressing the retrofit technical and cost challenges such as replacement cost, existing window size and weight incompatibilities, and durability;
- Demonstrate increased energy performance with a U-Factor ≤ 0.13, Solar Heat Gain Coefficient (SHGC) ≤ 0.20, Visual Transmittance (VT) > 0.42, and decreased HVAC energy consumption by at least 15% compared to current HVAC energy use with existing single pane windows;
- Reduce installation costs compared to code compliant windows; and
- Accelerate high-performance window uptake in the retrofit market through direct partnerships with manufacturers, suppliers and others.

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Product	4	Comm/Market	5	Program	4

Skinny Wall Retrofit Panels

Project Status: This project is now underway.

Product Description: Highly efficient, customizable vacuum insulated panels (VIP) with an insulation value of up to R30 targeted for residential applications.

Project Description: A co-funded project with GTI Energy and NYSERDA to develop an easy-to-install, highly efficient, and customizable wall retrofit solution for residential buildings. Key innovations include using VIPs, 3D scanning and modeling of the building enclosure, and customized design and fabrication of retrofit panels.

Project Objectives:

- Identify manufacturing technical needs for production of thin triple pane windows.
- Determine retrofit parameters affecting thermal performance, air, vapor and moisture drainage, and weather-resistive barriers;
- Evaluate panel concept with the defined design characteristics;
- Fabricate full-scale prefabricated prototype panels retrofitting a 10'x20' mock-up wall, including door, window and corner features;
- Recruit sites and develop a screening process for demonstration site(s);
- Construct and install VIPs; and
- Conduct energy performance modeling, including comparison to baseline building performance.

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Product	2	Comm/Market	1	Program	2

Luminaire Level Lighting Controls with HVAC Control

Project Status: A test site was identified. The project is expected to begin in Q2 2024 and completed by Q3 2025.

Product Description: Project is going to use the occupancy sensors in the LLLC system to help control the HVAC system. This project is working with a basic HVAC system (rooftop units with only thermostats) with the hope of simplifying the equipment needed to control the thermostats.

Project Objective: Determine whether additional energy savings are possible from more granulated sensors in every general lighting fixture. Analyze the data from using simple thermostats (as a cost-effective way to do LLLC+HVAC) and LLLC to help reduce the HVAC usage. With more than 50% of the building stock being less than 15,000 sq ft, and not having a complex Building Management System, the NEEA team wants to find a cost-effective and simple way to use the occupancy data from the LLLC system to inform the HVAC on setpoints and setbacks based on who is in the space.

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Product	3	Comm/Market	2	Program	3

Parking Lot Lighting with LLLC

Project Status: Industry interviews and a market survey that includes existing demand response systems and currently available parking lot luminaire technology are underway.The market analysis report is complete, and Phase 3 scope development and contracting are underway.

Product Description: Exterior lighting with LLLC.

Project Objective: Develop and field test a simple, cost-effective parking lot lighting LLLC technology that will reduce electric demand from parking lot lighting during times of peak electric demand.

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Product	3	Comm/Market	3	Program	1

Combination Hot Water and Space Heat (Gas)

Project Status:

- Stone Mountain Technologies, Inc. (SMTI) 80kBTU/hr gas heat pump: Project is complete and the site will be decommissioned in Q1 2024. The draft report is under development.
- Vicot Solar Technology Co., Ltd gas heat pump 20 kW (68kBTU/h): The manufacturer continues to provide support to GTI Energy to commission controls.

Product Description: An integrated appliance providing space and water heating. Production options include different refrigerants and water, air and refrigerant working fluids.

Project Objective: Demonstrate the performance and adaptability of these systems to provide space conditioning and domestic water heating systems in existing homes and small commercial applications.

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Product	1-4	Comm/Market	1-3	Program	2

Heat Pump Water Heaters (HPWHs) in Confined Spaces

Project Status: An extension of this work has been completed, and a report is available on neea.org. Multifamily applications present design and installation challenges for HPWHs in low-rise multifamily housing. To better understand the opportunity at hand, NEEA staff collaborated with Energy Trust of Oregon staff to identify solutions that overcome these challenges and increase adoption of HPWHs in multifamily applications in the Northwest.

The design charrette's objectives were to identify barriers, including those pertaining to design, installation and market adoption, to HPWHs in multifamily housing (in one-to-one applications) and to propose practical solutions to overcome these barriers. This report describes the process and identifies solutions. Participants in the charrette included architects, mechanical, electric, and plumbing engineers, plumbers, and raters.

Product Description: An electric powered air-to-water heat pump, generally with a backup electric element, used for domestic hot water.

Project Objectives: Understand the performance impacts on HPWHs of different room volumes, specifically small spaces like utility closets, and test different interventions at restoring efficiency compromised by a small enclosure.

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Product	2-5	Comm/Market	3-4	Program	2-5

Integrated Residential Gas Heat Pump Water Heaters

Project Status: The previously identified issues with manufacturing components have been corrected. The prototype is going through a shakedown with UEF testing to follow. Results are anticipated in Q2 2024.

Product Description: A HPWH using either an adsorption or absorption thermal cycle powered by natural gas.

Project Objectives: Evaluate the performance of a prototype, full-size, adsorption gas HPWH.

Product Manager: Noe Contreras
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Product	2-5	Comm/Market	3-4	Program	2-5

Integrated Commercial Heat Pump Water Heaters (Electric)

Project Status: NEEA continues to work closely with A. O. Smith and Ecotope on multiple installations to fine-tune performance and suggest manual improvements for product and installation. The A. O. Smith CHP 120, a 120 gallon commercial HPWH, shows promise and is expected to be listed on the Commercial Multifamily Heat Pump Water Heater Qualified Products List. Learnings from monitoring equipment reinforced the need to consider water heaters as a system solution rather than an individual component. Some challenges encountered with the products installed are due to the application of the solution. A new section of the Advanced Water Heating Specification (AWHS) will be dedicated to this product category. Cadeo is finishing a study of the size of the market for "unitary commercial" water heaters in the Northwest. A Product Council will be held in Q2 2024 with those findings.

Product Description: Generally sized from 80–120 gallons and similar to integrated residential HPWHs, commercial HPWH applications cover a broad range of hot water uses.

Project Objectives: Conduct a feasibility study to determine in-field COP, resistance heat utilization and success in keeping up with hot water demand.

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Product	3	Comm/Market	1	Program	2

Central Commercial Heat Pump Water Heaters (Electric)

Project Status: Case studies and design tools are now available on BetterBricks.com, and additional content will be added as it is developed. NEEA, in cooperation with the Bonneville Power Administration, have commissioned D+R International to develop an interactive case study of the "Splash Block." This learning tool will be extremely informative to architects, mechanical engineers, building owners and plumbers.

The AWHS is being revised for commercial unitary water heaters included in the Commercial section, and is expected to be published in early Q2 2024. The R-2 Occupancy (low-rise multifamily new construction) technical bulletin has been updated and is available at betterbricks.com. The latest updates for the central commercial HPWH QPL are available on the Advanced Water Heating Specification/Resources section of neea.org.

Numerous conversations with OEMs and water heating integrators are fully supportive of the systems approach for water heating in commercial and central applications. The Qualified Products List now includes a number of newly active additional models.

The Regional Technical Forum (RTF), with the help of the Bonneville Power Administration and Ecotope, is supporting development of a standard unit energy savings (UES) based on the AWHS v8.1 and the modeling tool that the Ecopath with Ecosim suite provides. Pacific Gas and Electric (PG&E) is verifying and validating a small sample of the products to ground truth the modeled savings values to help inform the RTF measure development.

Product Description: Commercial HPWHs used in multifamily buildings with central water heating and a distribution system. Several products are available and new products from major manufacturers are expected soon.

Project Objective: Test design tools and new HPWHs as efficient electric solutions for central water heating. The results should lead to an updated product specification, test method and potentially a QPL. NEEA staff are supporting a couple of projects in this area, one with the Bonneville Power Administration and one with New Buildings Institute and the California Energy Commission.

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Product	3	Comm/Market	3	Program	4

Central Commercial Gas Heat Pump Water Heaters

Project Status: Planning for a small pilot is underway. NEEA is planning a market characterization initiative to further understand the market.

Product Description: Central water heating systems utilize a thermally driven heat pump, buffer tank, indirect storage tank and other smaller components to deliver domestic hot water.

Project Objectives: Understand energy and cost savings from thermally driven heat pumps as replacements for boilers, natural gas-fired storage tanks, and tankless systems across various representative applications in the Northwest region.

Product Manager: Noe Contreras
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Product	3	Comm/Market	3	Program	3

Industrial Heat Pumps

Project Status: NEEA continues to explore the Industrial Heat Pump (IHP) opportunity with the Bonneville Power Administration and Cascade Energy. Initial work will determine the opportunity's scale and scope, manufacturers and suppliers of the technologies, barriers to adoption and possible solutions, ultimately leading to measure-based solutions and/or calculators.

Product Description: Industrial heat pumps can harvest low-grade heat and turn it into useful heat for manufacturing processes or space conditioning. Current performance levels can achieve working temperatures of 212°F–570°F (100°C–300°C) for process heat.

Project Objectives: Determine the energy savings opportunity from industrial-scale thermally driven heat pumps, market potential, currently available products, barriers to adoption and potential solutions.

Product Managers:
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Product	2	Comm/Market	2	Program	1

Power Drive System Technology Assessment

Project Status: NEEA continues to characterize the energy savings opportunity for power drive systems (PDS) in retrofit applications, specifically variable-torque applications, as well as to clarify previously identified barriers that impede the widespread adoption of retrofit drives, refine the target portion of the existing motor-driven system market on which to focus, and establish a vetted product definition.

Product Description: PDS, also referred to as complete drive modules (CDMs), combine an electric motor and variable speed controls to provide feedback to the equipment.

Project Objectives: This project builds off NEEA's work developing the Power Index (PI) metric with the National Electrical Manufacturers Association (NEMA), describing the percent of power savings expected from a complete PDS. This project will continue researching how PI can be used to calculate savings when retrofitting an adjustable speed drive (ASD) to a motor-driven system, establishing minimum PI values, and understanding power quality requirements for PDS. Additionally, the research will provide a high-level market characterization and initial technical potential estimate for the region.

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Product	5	Comm/Market	4	Program	1

MARKET READINESS

	Level 1: Pre-commercial	Level 2: Limited	Level 3: Niche	Level 4: Growing	Level 5: Wide
Supply Chain Maturity & Market Demand	Not commercially available or limited, pre-commercial availability	Commercially available outside of region Requires special order Limited market awareness	Commercially available in Northwest from one manufacturer through standard channels Niche market demand	Commercially available in Northwest from at least two manufacturers Growing market demand	Commercially available from 2+ manufacturers, well developed supply chain across region Wide market demand

PRODUCT PERFORMANCE READINESS

	Level 1: Unvalidated	Level 2: Engineering Validation	Level 3: Lab Validation	Level 4: Limited Field Validation	Level 5: Confirmed
Savings Reliability & Fitness for Use	Manufacturer claims energy savings but not validated by unbiased experts	Concept validated by unbiased expert via technical review and engineering calculations	Independent lab testing of product features and energy use in typical applications with clear baseline established	Lab and small-scale field testing across broader range of applications and systems conditions	Reliable prediction of performance across the range of intended applications; fully evaluable savings via established protocols by regional or national bodies

PROGRAM READINESS

	Level 1: None	Level 2: Exploratory	Level 3: Preliminary Pilots	Level 4: Full-scale Pilots	Level 5: Ready
Cost Effectiveness Knowledge *(technical and market potential, product cost at scale, non-energy benefits)*	None or very limited	Performance readiness at 2; initial market size calculated (units per year)	Performance readiness at 3; product cost at-scale estimated	Performance readiness at 4; product costs at or trending towards at-scale levels; preliminary estimates of non-energy benefits	Performance readiness at 5; CE calculations based on solid estimates or proven values
Market & Program Knowledge	None or very limited	Preliminary research exposes barriers and/or similarities to other successfully transformed markets warranting further efforts	Market research illuminates barriers and opportunities to intervene; preliminary logic model developed; small-scale pilots	Formal market characterization underway; larger-scale pilots to test program elements and barrier removal	Formal logic model developed; market characterization and large-scale pilots prove out program design and barrier removal
Risk Assessment *(Market, Program, Regulatory)*	No risk assessment	Limited risk assessment	Preliminary risk assessment complete - major categories of risk understood	Well-developed risk assessment - no major unresolved risks	Periodic risk assessment process in place

CONTACT US: Ask questions • Request feedback • Suggest technologies

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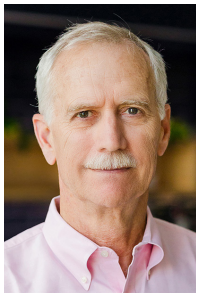

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TOGETHER We Are Transforming the Northwest

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Bonneville Power Administration
Cascade Natural Gas Corporation — A Subsidiary of MDU Resources Group, Inc.
P.U.D. Chelan County
Clark Public Utilities
EnergyTrust of Oregon
Idaho Power — An IDACORP Company
NorthWestern Energy
NW Natural
Pacific Power
Portland General Electric
PSE Puget Sound Energy
Seattle City Light
Snohomish County PUD — Public Utility District No. 1
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