Q3 2023 AGENDA

Regional Emerging Technologies Advisory Committee

DATE: September 21, 2023
TIME: 9:00 a.m. – 12:20 p.m.
WEBINAR: MS Teams – See link in calendar invite or register here
AUDIO: Web audio or telephone *971-323-0535, code 442 677 024#*

MEETING OBJECTIVES:

- Participants receive an update on EPRI's work including industrial heat pump technology and testing, developments in end use load flexibility, and an overview of the CalFUSE.
- NEEA will present an update on residential heat pumps including Micro Heat Pumps and the Heat Pump Rating Representative Project

AGENDA

Time	Topic	Lead	Packet Page #
9:00 a.m. (30 min)	**Welcome & Announcements** • Introductions and agenda review	Eric Olson, Mark Rehley, NEEA All	Agenda pp. 1-2
9:30 a.m. (120 min)	**EPRI Emerging Technology Update** • Introduction to EPRI • Update on EPRI's work on industrial heat pumps and industrial activities • Developments in end use load flexibility • Overview of CalFUSE **Outcome:** Committee is updated on various EPRI projects and opportunities for collaboration	Ammi Amarnath, EPRI	Memo p. 3
11:30 a.m (15 min)	**Announcements** • Regional conferences and Product Council Updates • Key announcements and highlights from ET newsletter	Eric Olson, Mark Rehley, NEEA All	

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11:45 a.m. **(30 min)**	**Heat Pump Update** • Update on Micro Heat Pump field study • Update on residential heat pump work including rating representativeness and adanced features and capabilities • **Outcome:** Committee is updated on NEEA's residential heat pump work	Christopher Dymond, NEEA	Memo p. 4
12:15 p.m. **(5 min)**	**Wrap-Up**	Eric Olson, NEEA	Memo pp. 5-31

Memorandum – *Agenda Item (Tier 1)*

September 21, 2023

TO: Regional Emerging Technology Advisory Committee (RETAC)

FROM: Eric Olson, Manager, Emerging Technology & Product Management

SUBJECT: EPRI Emerging Technology Updates

Our Ask of You:

Come prepared with questions about EPRI's work on industrial heat pumps and other industrial work and developments in end use load flex.

Brief Overview/ Context:

Ammi Amarnath, Principal Technical Executive at EPRI, will present on their work in the industrial sector, industrial heat pumps, and developments in end use load flex, including an overview of CalFUSE. Committee members will have the opportunity to inquire about research objectives, results, and opportunities for collaboration.

Please contact Eric Olson if you have questions about **EPRI's** research.

Memorandum – *Agenda Item (Tier 1)*

September 21, 2023

TO: Regional Emerging Technology Advisory Committee (RETAC)

FROM: Christopher Dymond, Sr. Product Manager

SUBJECT: NEEA Residential HVAC Project Updates

Our Ask of You:
Please come prepared to share details on any residential HVAC field studies you are running or recently completed. Also, please bring your questions regarding Micro Heat Pumps and advanced features and capabilities of residential units, such as cold climate capable, low load efficiency, and connected commissioning.

Brief Overview/ Context:
NEEA recently completed a small-scale micro heat pump field study of three different window heat pump designs to understand the customer experience installing and operating the units and their satisfaction with them. In July, NEEA's contractor, C+C, shared the results at a Product Council meeting. Two ongoing variable speed heat pump projects continue to make good progress. VSHP Advanced Features and Capabilities, which identifies opportunities to improve the performance of air source variable speed heat pumps, and the Heat Pump Rating Representativeness Project, a co-funded project designed to analyze how the products perform in real-world conditions and then tested in the lab to both AHRI 210/240 and CSA SPE07:2023 test procedures to see how well the test procedures simulate the actual performance of the heat pumps.

Please contact Christopher Dymond if you have questions about NEEA's residential HVAC research.

2023 Q3 Emerging Technology Quarterly Newsletter

WHAT'S NEW:

The third quarter of 2023 demonstrated the interest in heat pump technology throughout the region.

The micro heat pump field study concluded and was presented at a Product Council. Participants were pleased with the units' performance, and the technology looks promising for efficient air conditioning and heating. Work is also proceeding on residential dual fuel efforts, testing laundry centers and all-in-one washer-dryers with heat pump dryers, and central gas heat pump water heater (HPWH) research and product testing are also in progress. Scoping work for industrial heat pumps has also begun.

NEEA also completed a Modulating Gas Valve for Commercial Dryer Study investigating the energy savings potential of retrofitting existing commercial gas clothes dryers with modulating gas valves. The region has more than 50,000 commercial dryers and the report revealed potential savings of more than 200 therms per dryer.

Be sure to check out our new projects around monitors, commercial displays, exterior luminaire level lighting controls and our other updates.

Recent Product Councils:

- Heat Pump Rating Representativeness Preliminary Results
- Harvest Thermal Space and Water Heating
- Variable Speed Heat Pump Advanced Features and Capabilities Update
- Micro Heat Pump Field Study Results
- Displacing Central AC with ASHPs for Dual Fuel Energy & Cost Savings

Upcoming Product Councils are 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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Questions about this report may be addressed to:
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PUBLISH DATE: SEPTEMBER 15, 2023

Product Summary & Readiness Levels

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

* **Program Acronyms Defined:** Retail Product Portfolio (RPP); Ductless Heat Pumps (DHP); Variable Speed Heat Pumps (VSHP); Very High Efficiency Dedicated Outdoor Air Systems (VHE DOAS); Residential New Construction (RNC); Luminaire Level Lighting Controls (LLLC); Heat Pump Water Heater (HPWH); Efficient Gas Water Heaters (EGWH); Extended Motor Products (XMP); High-Performance Windows (HPW)

** Technical **electric savings potential** for the region in aMW

* **Readiness Level Definitions** provided on page 29; **Rating Scale** 1=low 5=high

Fuel Type Symbols: Electric Gas

Sector Symbols: Residential Commercial Industrial

Paired Washer-Dryer Testing

Project Status: The final Version 2.0 NEEA Dryer Test Procedure and Summary of Changes and Rationale Analysis are available on neea.org. The Qualified Products List (QPL) has now been updated to reflect the updated test procedure.

Product Description: Residential appliances for washing and drying clothes.

Project Objectives: Measure the total energy required to wash and dry the same "real-world" load of laundry in matched washers and dryers, including compact washers with heat pump dryers, and front- and top-load washers with electric and natural gas heated dryers. This testing leveraged previous NEEA work on both clothes washers and dryers. The testing also sought to inform NEEA staff whether the previously established "real-world" load should be revised with an industry standard ANSI/AHAM HLD-1-2010 textile load, with 100% cotton textiles, to increase industry acceptance and to better ensure reproducibility.

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Product	5	Comm/Market	5	Program	5

Ultra-High Definition (UHD) TVs

Project Status: ENERGY STAR® v9 went into effect in October 2022 and currently has over 45 TVs on the list, including TVs from at least one major manufacturer. At the Consumer Electronics Show 2023 in early January 2023, industry stakeholders announced continued work toward a voluntary agreement to report TV energy usage per the test procedure. Lastly, in May 2023, the United States Department of Energy (U.S. DOE) issued a final rule to adopt ANSI/CTA-2037D as the required test procedure for TVs. This rule is voluntary until September 2023 after which it will become the official U.S. DOE test procedure required for all TVs.

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 2024. The data will be available in October 2023.

Product Manager: Chris Wolgamott
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Product	4	Comm/Market	5	Program	5

Residential Laundry Field Study

Project Status: Monitoring equipment is installed at the first four sites, and metering is complete on groups 1–3. Data analysis is underway for groups 1–3. Data collection on washer and dryer energy use will occur for about four weeks, with the participants journaling their washer and dryer cycles for at least one week.

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 future U.S. DOE rulemakings, and facilitate collaboration with other partners to replicate the study in their territories.

Product Manager: Eric Olson
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Product	5	Comm/Market	5	Program	5

Monitor and Commercial Display Testing

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

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

Project Objectives: The current monitor and display policy approach has several efficiency gaps. Most displays and monitors are similar in design and construction to TVs, and the U.S. DOE has adopted ANSI/CTA-2045D, developed by NEEA, that better represents true energy use. This project has three objectives:

- Replace the current industry standard with the NEEA-developed test procedure.
- 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.
- Succeed in having the new test procedure inform an update to the U.S. DOE federal energy test standard.

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Product	3	Comm/Market	5	Program	1

Laundry Centers and Washer-Dryer Combo Testing

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

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.
- Identify relevant regional program opportunities for laundry centers and single-drum washer-dryers.

Product Manager: Eric Olson
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Product	4	Comm/Market	5	Program	5

Very High Efficiency Dedicated Outside Air Systems (DOAS) Optimization

Project Status: Monitoring the Sartori School in Renton is complete; the final report is expected by Q4 2023. 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 by Q4 2023. SERA Architects in Portland, OR, with ERV and VRF heat pumps, is being monitored through Q4 2023.

Product Description: A system-based approach for commercial HVAC systems that uses 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 very high efficiency DOAS design principles with multiple HVAC designs, including forced air and chilled beam designs, against conventional equipment. Results inform improved modeling of very high efficiency DOAS design principles in various building types and equipment selection.

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Product	4	Comm/Market	4	Program	3

Very High Efficiency Dedicated Outside Air Systems (DOAS) in Multifamily Applications

Project Status: The project is complete. The code minimum balanced system reduced HVAC energy by 14% on average, while the very high efficiency DOAS balanced ventilation system reduced HVAC energy by 41%, an additional 27% reduction over the code minimum balanced system. The research concludes that very high efficiency DOAS principles are applicable for multifamily buildings and that best practices for components, configurations and controls can be developed. The full report is available on the BetterBricks website.

Product Description: A system-based approach for commercial HVAC systems that uses high efficiency HRV or 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 DOAS design principles in a multifamily application with highly efficient DOAS and HRV equipment in an application with electric resistance in the dwelling units. The research seeks to understand the potential energy opportunity when usage of in-unit electric resistant heaters is reduced. Monitoring data will also support DOAS modeling improvements.

Product Manager: Chris Wolgamott
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Product	4	Comm/Market	4	Program	3

Efficient Rooftop Units (RTUs)

Project Status: The units' installation in Portland, OR is complete, and monitoring is underway.

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 Objective: 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.

Product Manager: Chris Wolgamott
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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 began in May 2023 at UL Solutions' facility and is approximately 50% complete. Units are tested with AHRI 210/240 M1 and CSA SPE07:2023 test procedures, and NEEA and Natural Resources Canada (NRCan) are conducting repeated tests of two units to evaluate the repeatability of the SPE07 test procedure. NEEA is also contracting with the University of Nebraska to begin data analysis. The preliminary test results are available from the August 15, 2023 Product Council. The U.S. DOE is also considering an adapted load-based test method as a controls procedure verification as part of an AHRI 210/240 update.

Product Description: Heat pumps that can vary their speed to meet heating and cooling demands, enabling the heat pump to operate across a wider ambient temperature range and to have superior performance under low load conditions.

Project Description: NEEA is working collaboratively with Northeast Energy Efficiency Partnerships (NEEP); the Air-Conditioning, Heating, and Refrigeration Institute (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 (formerly EXP07) 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.

Product Manager: Christopher Dymond
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Product	4	Comm/Market	5	Program	4

Heat Pump Advanced Features and Capabilities (Improvements)

Project Status: Work plans are in their final drafts for finalization in early Q4 2023. A Product Council was held on August 1, 2023, presenting data on three improvements NEEA is pursuing: low load efficiency (LLE), cold climate capability, and connected commissioning.

Product Description: 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 Variable Speed Heat Pump (VSHP) program if successful.

Product Manager: Christopher Dymond
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Product	3	Comm/Market	5	Program	4

Micro Variable Speed Heat Pump (VSHP) Field Study

Project Status: Phase 1 research concluded in mid-Q1 2023. Phase 2 (field deployment), which included eight weeks of customer experience, began in April 2023 and finished at the end of May 2023. Results were shared at the July 18, 2023 Product Council. The study uncovered valuable feedback on the installation, use and comfort of the units tested. In general, findings showed that customers were satisfied with the units' performance.

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.

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.

Product Manager: Christopher Dymond
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Product	1	Comm/Market	3	Program	1

Heat Pump Ready ENERGY STAR Manufactured Homes

Project Status: 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 has been delayed until July 2025. An analysis of the Inflation Reduction Tax Act identified elements of the specification that would benefit the Northwest Energy-Efficient Manufactured Housing Program™ (NEEM) and the unique way ENERGY STAR homes are certified in the Northwest. A report is expected to be published by NEEM by Q4 2023.

NEEA also provided formal comments to U.S. DOE's Zero Energy Ready Program Requirements, encouraging the U.S. DOE to include the NEEM continuous improvement process as a requirement to help ensure quality and persistent energy savings.

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.

- 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.

Product Manager: Christopher Dymond
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Product	4	Comm/Market	5	Program	3

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

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

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

Project Objective: 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-Electric Heat Pump

Project Status: Finalized a market assessment report for dual fuel technologies. The market landscape report presents the current state-of-the-art residential forced-air hybrid systems commercially available in the North American market. Efforts are also underway to harmonize a CSA performance metric for dual fuel with AHRI 210/240. The metric is expected to provide the market with a method to understand the performance of dual fuel systems. For details on the report, please get in touch with Noe Contreras.

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

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

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

Primary High-Performance Windows (HPWs)

Project Status: Collaborative efforts continue through the U.S. DOE-funded Partnership for Advanced Window Solutions (PAWS). NEEA is exerting national influence on window markets to benefit the alliance's Northwest stakeholders.

NEEA's collaboration with Habitat for Humanity (Bend, OR) is underway. To achieve net-zero performance, Habitat for Humanity will install HPWs in 12 townhome units as part of its 27th Street Townhome project in 2023. NEEA's collaboration with a national builder started in Q4 2022 and continues throughout 2023. As part of this effort, installs thin triple pane windows are being installed in a 100-home development built in the region over the course of two to three years. HPWs are a path to code credits for this builder. Construction has begun, and windows have been installed in approximately two dozen homes. Interviews with the builder and window installers indicate no incremental labor is required, and installation was no different than for double pane windows. The builder has begun promoting the energy and non-energy benefits of HPWs in marketing materials installed in the model home.

Work continues for evaluating benefit/cost ratios for single- and multifamily markets.

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.

Product Manager: Rick Dunn
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Product	4	Comm/Market	3	Program	4

Secondary Windows

Project Status: Installation of commercial secondary windows at all six pilot sites is complete: 915 Broadway (Vancouver, WA); Romney Hall (Bozeman, MT); Crane Aerospace & Electronics (Seattle, WA); SBH Legal (Portland, OR); Creekside Business Park (Beaverton, OR) and Big Sky Economic Development (Billings, MT). Post-installation metering will continue at specific sites until mid-2023. A comprehensive technical report is being drafted and is expected in late-2023.

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 that is 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.

Product Manager: Rick Dunn
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Product	4	Comm/Market	5	Program	4

Luminaire Level Lighting Controls (LLLC)

Project Status: Next Generation Lighting Systems (NGLS) and NEEA continue to collect data from the NEEA office install. In 2023 NGLS hopes to conduct additional studies on the LLLC system, which has not been possible with limited site use due to COVID-19. NGLS continues to look for additional whole-floor space sites in 2023.

Product Description: Advanced lighting control systems, either with wireless sensors or with luminaire integrated lighting controls to provide occupancy-sensor and light-level control plus energy metering.

Project Objective: The NGLS program's prior competitions in 2017 and 2018 selected connected lighting for testing installation, commissioning and energy performance in a real-world test location. In 2021, NGLS added a new project studying the installation, color tuning, energy monitoring and occupancy/daylighting performance of the system, with the possibility of future studies.

Product Manager: Chris Wolgamott
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Product	4	Comm/Market	4	Program	3

Luminaire Level Lighting Controls with HVAC Control

Project Status: This project remains on hold; however, as many businesses' employees start to return to the office, NEEA has identified multiple sites that are interested in being part of this project. The project team is currently working with building owners to get an agreement in place; once that occurs, the team will proceed to fund a study on one or more sites.

Product Description: LLLC with additional sensors and supports for HVAC control.

Project Objectives: Determine whether additional energy savings are possible from more granulated sensors in every general lighting fixture. Analyze different HVAC control strategies in terms of how the controls look at the information being collected by the lighting sensors.

Product Manager: Chris Wolgamott
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Product	3	Comm/Market	2	Program	3

Parking Lot Lighting with LLLC

Project Status: NEEA is conducting a market survey including existing demand response systems, currently available parking lot luminaire technology and conducting industry interviews. A complete market analysis report is expected by Q4 2023.

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: Space heating data collected; data collection for domestic hot water (DHW)-only performance is underway.
- Vicot Solar Technology Co., Ltd gas heat pump 20 kW (68kBTU/h): The unit has arrived at the lab for testing; communicating with the manufacturer to review the system. Performance report is expected in Q4 2023.

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.

Product Manager: Noe Contreras
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Product	1-4	Comm/Market	1-3	Program	2

Heat Pump Water Heaters (HPWHs) in Confined Spaces

Project Status: "The Amazing Shrinking Room" report and Product Council presentation recording highlighting findings is available on neea.org. Additional work funded by Pacific Gas & Electric with other products and intervention strategies continues, and results will be shared with the Product Council. Work continues with manufacturers to include findings in their installation instructions and manuals. NEEA has hosted several hands-on trainings at the lab for installers. Manufacturers are changing installation guidelines and manuals to reflect project findings.

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.

Product Manager: Geoff Wickes
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Product	2-5	Comm/Market	3-4	Program	2-5

Integrated Residential Gas Heat Pump Water Heaters

Project Status: Shakedown lab testing is underway; UEF testing will start after tuning. The report is expected in Q4 2023.

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.

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Product	3	Comm/Market	1	Program	2

Split-System Heat Pump Water Heaters (Electric)

Project Status: Commercial multifamily HPWHs from Nyle, Mitsubishi, and WaterDrop, which uses an ECO2 engine, have been added to the Commercial Multifamily Heat Pump Water Heater Qualified Products List.

Product Description: Split-system HPWHs separate the heat pump from the water tank. These products offer a heat pump alternative for locations where the integral product doesn't physically fit. While only one split-system product has been available to date, more manufacturers are entering the market. 2023 shows promise for four more manufacturers to start offering split-system HPWHs.

Project Objective: Lab and field test commercially available split-system water heaters to confirm performance and compliance with NEEA's Advanced Water Heating Specification.

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Product	3	Comm/Market	3	Program	3

Integrated Commercial Heat Pump Water Heaters (Electric)

Project Status: NEEA is working closely with A. O. Smith and Ecotope on multiple installations to fine-tune performance and suggest product and installation manual improvements. The A. O. Smith CHP 120, a 120-gallon commercial HPWH, shows promise and is expected to be listed on NEEA's Commercial HPWH Qualified Products List by Q4 2023. Learnings from monitoring equipment reinforced the need to consider water heaters as a system solution rather than an individual component. Due to mixing valve and room volume issues, the unit uses more electric resistance heating than anticipated. Additional monitoring equipment is installed, and NEEA is working with the manufacturers, market actors and building owners to rectify the challenges. Field work findings reinforce the value of having "skid" or "kit" water heating systems that are fully designed and configured at the manufacturing facility to reduce installation variability.

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

Product Manager: Geoff Wickes
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Product	3	Comm/Market	3	Program	4

Central Commercial Heat Pump Water Heaters (Electric)

Project Status: The Ecosim tool continues to be enhanced and is expected to be available in 2023, in addition to the Ecosizer tool. New, more transparent versions will be available for utilities, manufacturers, and plumbing and building engineers-. The latest updates for the central commercial HPWH QPL are available on the Advanced Water Heating Specification/Resources section of neea.org.

OEMs are migrating to unique SKU model numbers that incorporate all components of the central HPWH system, including the heat pump (heat engine), storage, control valves, recirculation pumps, control logic, and demand response capabilities on a skid or pre-engineered and designed system. The SKU includes a system warranty, manual and factory-trained commissioning agent. Entities such as OEMs, suppliers, and engineering houses can submit a Product Assessment Datasheet for their products. Three new manufacturers are currently going through the process of submitting their products for inclusion on the QPL.

NEEA is participating with the Association for Energy Affordability (AEA) on an Electric Program Investment Charge (EPIC) grant. AEA has completed two of the five installations, which are being monitored; most retrofit installations are in low-income housing in urban and rural locations. Ecotope is also developing load shifting metrics for central water heating.

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 Objectives: 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	3

Central Commercial Gas Heat Pump Water Heaters

Project Status: Target market identification and savings potential validation are currently underway. Nine manufacturers now have products available in 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.

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Product	3	Comm/Market	3	Program	3

Industrial Heat Pumps

Project Status: NEEA is exploring 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

Commercial and Industrial Fans Product Research

Project Status: Investigating opportunities for energy savings with technology improvements in the fan and fan system. Additional work is ongoing to explore other opportunities with the qualification of approved calculators that could be made publicly available and easily accessible.

Product Description: Stand-alone fans that are not embedded into packaged units.

Project Objective: The Fan Energy Index (FEI) describes the fan efficiency at a design point compared to a "minimally compliant" reference fan at that same operating point. FEI is the best metric to characterize "efficient fans" at a particular operating point. Proper sizing of the fan for design conditions leads to more efficient operations; however, FEI is rarely used by designers and specifiers in their fan selection, and the total cost of ownership is not a considered metric. This project seeks to understand the barriers to using FEI as a design consideration.

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Product	5	Comm/Market	4	Program	2

Commercial Adjustable Speed Drive (ASD) Market Penetration Study

Project Status: NEEA contracted with Johnson Consulting Group (JCG) to better understand the market penetration of, and path to decision making for, commercial adjustable speed drives in the Northwest. JCG conducted 40 subject matter expert (SME) interviews across the commercial pump and ASD markets. Interviewees included SMEs, manufacturers/manufacturers' representatives, specifying/design engineers, systems integrators/contractors and distributors. The final report is expected to be published in Q4 2023.

Product Description: ASDs, sometimes referred to as power drive systems (PDS), combine an electric motor and variable speed controls to provide feedback to the equipment.

Project Objective: This project includes three research objectives:

- Assess the proportion of commercial pumps and fans paired with ASDs across the alliance's four-state region.
- Assess the distribution, by horsepower and by application (retrofit, naturally occurring replacement, new construction), of commercial fans and pumps paired with commercial ASDs across the alliance's four-state region.
- Explore and document the decision-making process, including triggers for consideration of drive/device pairing, steps typically taken and influential factors throughout the process.

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Product	5	Comm/Market	4	Program	1

MARKET & COMMERCIAL 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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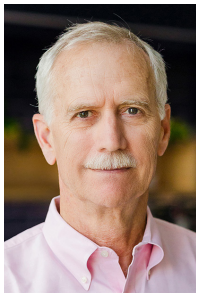

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TOGETHER We Are Transforming the Northwest

AVISTA · Bonneville Power Administration · Cascade Natural Gas Corporation · 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 · Tacoma Power Tacoma Public Utilities