

# 2023 Q4 *Emerging Technology Quarterly Newsletter*

## WHAT'S NEW:

As we prepare for the upcoming year, the Product Summary and Readiness Level table with additional electric and gas savings details has been updated. The alliance is well-positioned with ongoing and new projects in 2024, including dual fuel residential HVAC systems; work on the integration of hydronic systems with the very high efficiency DOAS HVAC system design process; improving our understanding of central heat pump water heaters in new construction and retrofits; and understanding the performance of heat pump dryers now available in laundry centers and all-in-one washer-dryers. Read on for a complete overview of our upcoming work.

### Recent Product Councils:

[How Will All These Smart Appliances Talk to the Smart Grid](#)

[Central Heat Pump Water Heaters – Stories from the Field](#)

[Mysa – Smart Thermostats for Electric Heating and Cooling](#)

[Low-Cost High-Temperature Thermal Storage for Load Shifting in Residential Applications](#)

[Heat Pump Ready Manufactured Homes and Federal Tax Credits](#)

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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PUBLISH DATE: DECEMBER 7, 2023

# Product Summary & Readiness Levels

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

**\*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 29; **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. Department of Energy (U.S. DOE) test procedure required for all TVs in September 2023. The list currently includes 59 TVs, representing at least one major manufacturer. Energy use data from multiple manufacturers' TV testing is expected to be available in Q1 2024.

**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.

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Product	4	Comm/Market	5	Program	5
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### *Residential Laundry Field Study*

**Project Status:** The field monitoring phase of the study is complete; the data analysis has begun and will continue into Q1 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 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
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### *Monitor and Commercial Display Testing*

**Project Status:** This project is currently 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, and 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;
- 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 energy test standard.

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Product	3	Comm/Market	5	Program	1
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### *Laundry Centers and Washer-Dryer Combo Testing*

**Project Status:** This project is scoped and contracting is underway.

**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
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*Very High Efficiency Dedicated Outside Air Systems (DOAS) Optimization*

**Project Status:** Monitoring the Sartori School in Renton is complete, and the final report is under review. Monitoring at Harder Mechanical Contractors, Inc. in Portland with energy recovery ventilation (ERV) and variable refrigerant flow (VRF) heating/cooling systems is complete with the final report expected in Q1 2024. 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 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 very high efficiency DOAS design principles with multiple HVAC designs, including forced air and chilled beam designs, against conventional equipment. Results will 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	5	Program	5
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## ***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%, which is 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 Better Bricks 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.

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Product	4	Comm/Market	4	Program	3
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## ***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%. This 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
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## 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. NEEA and Natural Resources Canada (NRCAN) are conducting repeated tests of two units to evaluate the repeatability of the CSA SPE07 (formerly EXP07) test procedure. The University of Nebraska is under contract for data analysis, and the preliminary test results are available from the [August 15, 2023 Product Council](#). The initial analysis was shared during the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Unitary Small Equipment Test Procedure Committee meetings in support of adding a controls verification procedure to the test procedure.

**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 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
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### *Heat Pump Advanced Features and Capabilities (Improvements)*

**Project Status:** Work plans are complete. A Product Council on [August 1, 2023](#) presented 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 Advanced Heat Pump (AHP) Program if successful.

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Product	3	Comm/Market	5	Program	4
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## *Micro Variable Speed Heat Pump (VSHP) Field Study*

**Project Status:** Phase 1 research concluded in Q1 2023; Phase 2 (field deployment) ended in May 2023, with results shared at the [July 18, 2023 Product Council](#). The study uncovered valuable feedback on the installation, use and comfort of the units tested. Another outcome of this work is coordination with three original equipment manufacturers (OEMs) on developing a test procedure and rating to enable the Consortium for Energy Efficiency (CEE) to define tax credit criteria for micro heat pumps. A future lab testing project is under development in collaboration with CalNEXT and possible field pilots with CEE.

**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.

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Product	1	Comm/Market	3	Program	1
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### *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 is 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. The results from this project were shared at the [December 5, 2023 Product Council meeting](#).

**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 specification.

- 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
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### *Low Load Efficient Heat Pump Teardown*

**Project Status:** Initial investigation underway.

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

**Project Objectives:** Research the underlying technologies that result in some heat pumps having 50+% 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
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## *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 make HVAC grid flexible and controllable.

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

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Product	3	Comm/Market	3	Program	1
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## *Dual Fuel Gas-Electric Heat Pump*

**Project Status:** NEEA is leading a work group of industry stakeholders to understand potential energy measurement considerations and approaches. The team is reviewing the currently available literature and policies. Efforts also continue to harmonize a CSA performance metric for dual fuel with AHRI 210/240.

**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 region.

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Product	4	Comm/Market	3	Program	1
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### 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) continues. 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. Based on positive experience and favorable ROI with early installations, Habitat has contributed to an [HPW case study](#) and presented its energy rater at the BuildRight 2023 conference.

NEEA's collaboration with a national builder started in Q4 2022 and will extend into 2024. HPWs 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. A case study is in development, and 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. The Regional Technical Forum (RTF) has reported that currently available data is insufficient for reliably estimating savings rates, and it has developed a research proposal describing the effort needed to acquire the necessary information and data. Funding from the region will be required to conduct the prescribed research.

**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
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### 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). All post-installation metering was completed as of July 2023. A comprehensive technical report is being finalized and is expected by Q1 2024. The 915 Broadway project (also referred to as Pacific Tower) recently received a U.S. DOE [Building Envelope Campaign Retro 30 Award](#), which recognizes envelope retrofits that achieve a >30% improvement in envelope efficiency.

**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 the value proposition for owners and owner representatives.

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Product	4	Comm/Market	5	Program	4
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### *Secondary Windows Field Study*

**Project Status:** This project will start in Q1 2024.

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

- 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  $\leq 0.13$ , Solar Heat Gain Coefficient (SHGC)  $\leq 0.20$ , 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
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### ***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 will continue to look for other 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.

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Product	4	Comm/Market	4	Program	3
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### ***Luminaire Level Lighting Controls with HVAC Control***

**Project Status:** NEEA has identified multiple sites interested in participating in this project. The project team is currently working with building owners to get an agreement. Once that occurs, the team will 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.

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Product	3	Comm/Market	2	Program	3
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### *Parking Lot Lighting with LLLC*

**Project Status:** The contractor is conducting industry interviews and a market survey that includes existing demand response systems and currently available parking lot luminaire technology. A complete market analysis report is expected by Q1 2024.

**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
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### *Combination Hot Water and Space Heat (Gas)*

#### **Project Status:**

- Stone Mountain Technologies, Inc. (SMTI) 80kBTU/hr gas heat pump: the team completed domestic hot water (DHW)-only measurements and changed to “winter mode” to prepare for colder outside air temperatures that will require space heating.
- Vicot Solar Technology Co., Ltd gas heat pump 20 kW (68kBTU/h): commissioning of the controls has delayed testing.

**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
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### *Heat Pump Water Heaters (HPWHs) in Confined Spaces*

**Project Status:** [“The Amazing Shrinking Room”](#) report and [Product Council presentation recording](#) highlighting findings are available on neea.org. Additional work funded by Pacific Gas & Electric with other products and intervention strategies continues, and results are expected to be shared with the Product Council sometime in early 2024 as more work is scoped. 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.

**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
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### *Integrated Residential Gas Heat Pump Water Heaters*

**Project Status:** Lab testing revealed some minor manufacturing issues. The necessary modifications are underway, with testing to follow. Results are anticipated in Q1 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	3	Comm/Market	1	Program	2
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### *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
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### *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.

**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.

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Product	3	Comm/Market	3	Program	4
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### Central Commercial Heat Pump Water Heaters (Electric)

**Project Status:** The Ecosim tool continues to be enhanced and is expected to be available by early 2024, 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. OEMs, suppliers and engineering houses can submit a Product Assessment Datasheet for their products. Three new manufacturers are submitting their products for inclusion on the QPL. Challenges due to the backlog of work prevent more products from being added to 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, with monitoring underway; most retrofit installations are in low-income housing in urban and rural locations. Ecotope is also developing load-shifting metrics for central water heating. The October 24, 2023 Product Council [“Central Heat Pump Water Heaters: Stories from the Field,”](#) shares several installation case studies.

**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
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### Central Commercial Gas Heat Pump Water Heaters

**Project Status:** A market potential review analysis is complete and collaboration with manufacturers for a possible small field study is underway.

**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
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### 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
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## ***Commercial and Industrial Fans Product Research***

**Project Status:** NEEA is investigating ways to increase the adoption of more efficient fans by promoting visibility and information in fan selection software.

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

**Project Objectives:** 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 identify how FEI is represented in fan selection software and referenced in existing codes and standards, and then to provide recommendations for increasing awareness of FEI as a driving factor in fan selection.

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Product	5	Comm/Market	4	Program	2
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## ***Power Drive System Technology Assessment***

**Project Status:** NEEA continues to characterize the energy savings opportunity for power drive systems (PDS) in retrofit applications, 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:** ASDs, sometimes referred to as power drive systems (PDS), 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 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
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### MARKET READINESS

	Level 1: Pre-commercial	Level 2: Limited	Level 3: Niche	Level 4: Growing	Level 5: Wide
<b>Supply Chain Maturity &amp; Market Demand</b>	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
<b>Savings Reliability &amp; Fitness for Use</b>	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
<b>Cost Effectiveness Knowledge</b> <i>(technical and market potential, product cost at scale, non-energy benefits)</i>	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
<b>Market &amp; Program Knowledge</b>	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
<b>Risk Assessment</b> <i>(Market, Program, Regulatory)</i>	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



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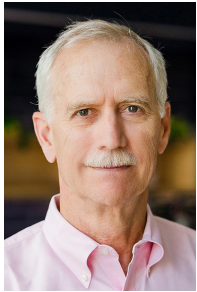
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**TOGETHER** *We Are Transforming the Northwest*

