2024 Q3 Emerging Technology Quarterly Newsletter

WHAT'S NEW:

The third quarter of 2024 brought exciting progress on several projects and kicked off several new research efforts. The second Residential Laundry Field Study is nearing completion, with the final report to be published by Q4 of this year, along with data analysis underway on commercial heat pump dryers and efficient rooftop units. A regional cold climate room heat pump study, in collaboration with the Bonneville Power Administration, Washington State University and several utilities, is now underway, and this quarter saw the start of a field study testing the integration of Luminaire Level Lighting Controls with rooftop units. Read on for more.

NEEA published the Refrigerator Policy and Test Procedures: Rationale and Benefits for a Move Towards IEC. NEEA contracted with UL Verification Services to test a selection of refrigerators and compare the performance of inverter compressor technology against conventional refrigerator compressors. Units were tested under the U.S. Department of Energy (U.S. DOE) test procedure and the international IEC 62552 test procedure, which is used in many markets including Europe and Australia. Results reveal that the IEC test procedure better recognizes energy use and provides a pathway to align U.S. testing with other major markets to recognize more efficient products.

Recent and Upcoming Product Councils:

- August 27, 2024 – Demand Flexible Line Voltage & Zonal Thermostat Scan
- September 24, 2024 – Central HPWH Trainings for Multifamily and Heat Pump Water Heater Installation Tool
- October 15, 2024 – Refrigerant Regulations and Compliance Requirements

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**, Lead Product Manager, Emerging Technology & Product Management ~

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Product Summary & Readiness Levels

	PRODUCT OR PROJECT	PROGRAM*	FUEL TYPE	SECTOR	ELECTRIC SAVINGS POTENTIAL[1]	GAS SAVINGS POTENTIAL[2]	PRODUCT PERFORMANCE[3]	MARKET/ COMMERCIAL[3]	PROGRAM READINESS[3]
Consumer Products	Ultra-High Definition TVs	RPP	Electric	Residential	57	N/A	4	5	5
	Residential Laundry Field Study	RPP	Electric, Gas	Residential	N/A	N/A	5	5	5
	Monitors and Commercial Displays	TBD	Electric	Residential, Commercial	TBD	N/A	3	5	1
	Laundry Centers & All-in-One Washer-Dryers	RPP	Electric	Residential	TBD	TBD	4	5	5
	Commercial Heat Pump Dryers	TBD	Electric	Residential	TBD	TBD	1	3	1
HVAC	Very High Efficiency Dedicated Outside Air Systems	VHE DOAS	Electric, Gas	Commercial	85	20†	4	3	2
	Efficient Rooftop Units	ERTU	Electric, Gas	Commercial	N/A	9	4	3	4
	Heat Pump Rating Representativeness	AHP	Electric, Gas	Commercial	TBD	N/A	3	5	4
	Heat Pump Advanced Features and Capabilities	AHP	Electric	Commercial	35†	N/A	3	5	4
	Room Heat Pumps	TBD	Electric	Commercial	TBD	N/A	2	3	1
	Dual Fuel Gas-Electric Heat Pump	DFHP	Electric, Gas	Commercial	TBD	TBD	3	5	1
Building Envelope	High-Performance Windows	HPW	Electric, Gas	Industrial	60	30	4	3	4
	Secondary Windows	Window Attachments	Electric, Gas	Residential, Industrial	35	23†	4	5	4
	Skinny Wall Retrofit Panels	TBD	Electric, Gas	Commercial	TBD	TBD	2	1	1
	Advanced Prefabricated Zero Carbon Homes	TBD	Electric	Commercial	TBD	TBD	2	2	1
Lighting	Luminaire Level Lighting Controls	LLLC	Electric	Commercial	75	N/A	4	4	3
	LLLC with HVAC Control	LLLC	Electric, Gas	Commercial	358	TBD	3	2	3
	Parking Lot Lighting with LLLC	TBD	Electric	Commercial	TBD	N/A	3	3	1
Water Heating	Combination Hot Water and Space Heat	N/A	Electric, Gas	Residential, Industrial	130	N/A	1-4	1-3	2
	Heat Pump Water Heaters	HPWH	Electric	Residential, Industrial	TBD	N/A	2-5	3-4	2-5
	Integrated Residential GHPWH	GHPWH	Electric, Gas	Residential	N/A	200	3	1	2
	Central Commercial Heat Pump Water Heater	HPWH	Electric	Commercial	50	N/A	3	3	3
	Advanced Commercial Gas Water Heating	TBD	Electric, Gas	Commercial	N/A	64	3	3	2
	Split System Heat Pump Water Heater	HPWH	Electric	Commercial	50	N/A	3	3	3
	Industrial Heat Pumps	N/A	Electric, Gas	Industrial	TBD	TBD	2	2	1
Motors	Commercial & Industrial Fans	Fans	Electric, Gas	Industrial	176	N/A	5	4	2
	Power Drive System Technology Assessment	N/A	Electric, Gas	Commercial	292	N/A	5	4	1
	Extended Motor Products (Pumps)	XMP	Electric	Commercial	246	N/A	5	5	5
	Heat Pump Engine Block Heaters	N/A	Electric, Gas	Commercial	TBD	TBD	1	3	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 27; **Rating Scale** 1=low 5=high
†: Preliminary estimate or technical potential from the RTF

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

Ultra-High Definition (UHD) TVs

Project Status: The ENERGY STAR® Qualified Products List (QPL) continues to grow, with 116 TVs representing at least two major brands. Energy use data from multiple manufacturers' TV testing has been received and is informing negotiations on appropriate on-mode energy levels through the industry Voluntary Agreement.

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

Project Objectives:

- Update U.S. DOE TV test procedure and International Electrotechnical Commission (IEC) test clip to:
  1) adequately address existing features such as Automatic Brightness Control (ABC) and Motion Detection Dimming (MDD); and
  2) incorporate emerging technologies such as UHD, true and upscaled high dynamic range (HDR), increasing panel brightness and stand-by power.

- Update ENERGY STAR specification to address issues with ABC/MDD, address new energy-consuming features such as UHD, and to account for the U.S. DOE test procedure and IEC test clip updates.
- Use data from TV manufacturers' TV testing to review current television energy use, which will help to define efficiency standards for potential incentives in 2025.

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Product	4	Comm/Market	5	Program	5

Residential Laundry Field Study

Project Status: The field monitoring phase of the study is complete and data analysis is in final stages. Preliminary results have been used to inform comments on the ENERGY STAR Dryer Discussion Guide and Federal Trade Commission (FTC) Notice of Proposed Rulemaking (NOPR) on mandatory Energy Label changes. Due to the prioritization of responding to ENERGY STAR, the first results report is expected in Q4 2024.

Product Description: Residential appliances for washing and drying clothes.

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

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Product	5	Comm/Market	5	Program	5

Monitor and Commercial Display Testing

Project Status: The test procedure modification for monitors and commercial displays are complete. Testing is beginning on commercial displays to assess level setting. The potential for energy savings exploration continues.

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

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

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

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Product	3	Comm/Market	5	Program	1

Laundry Centers and Washer-Dryer Combo Testing

Project Status: Three brands are currently in the market with all-in-one combination laundry units featuring heat pump dryer technology. Consumer adoption of all-in-one units continues to be strong in the first half of 2024, indicating customers' acceptance of a single piece of equipment that runs a complete wash-and-dry cycle of a load of laundry. Formal outreach to manufacturers for input on a test procedure begins in Q3 2024. The process is expected to continue into 2025.

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	4	Comm/Market	5	Program	5

Commercial Heat Pump Dryers

Project Status: Testing is complete. The final analysis is in progress and is expected in Q4 2024.

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

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

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

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Product	1	Comm/Market	3	Program	1

Efficient Rooftop Units (RTUs)

Project Status: Monitoring the units installed in Portland, OR is ongoing, and the final report is expected by the close of Q3 2024.

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

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

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

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Product	4	Comm/Market	3	Program	4

Heat Pump Rating Representativeness

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

Product Description: Variable Speed heat pumps and air conditioners.

Project Description: NEEA is working collaboratively with Northeast Energy Efficiency Partnerships (NEEP); 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

Room Heat Pump Field Study

Project Status: This project is complete. On July 24, 2024, the Environmental Protection Agency (EPA) and U.S. DOE released the final version of the ENERGY STAR room heat pump test procedure as part of the room air conditioner specification.

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

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

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Product	2	Comm/Market	3	Program	1

Low Load Efficient Heat Pump Investigation (Advanced Features & Capabilities)

Project Status: Testing is underway for Phase 3 (lab testing to understand and validate how heat pumps work under part load conditions), and Phase 4 (physical teardown workshop) is planned for September 2024. Phases 1 and 2 are complete; findings were presented at the April 2, 2024, Product Council.

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

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

- Phase 1 of the project will review existing publicly available data.
- Phase 2 will conduct a virtual teardown of equipment to compare a dozen different heat pumps based on technical service manuals.
- Phase 3 will consist of lab testing several variable speed heat pumps to validate and understand how heat pumps operate under part load conditions.
- Phase 4 will perform a physical teardown of subcomponents to provide insight on component differences, the manufacturing costs, and components that enable low load efficiency.

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Product	3	Comm/Market	5	Program	4

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

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

Product Description: Hardware and software to 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.

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Product Readiness Levels:

Product	3	Comm/Market	3	Program	1

Dual Fuel Heat Pumps

Project Status: AHRI released a revised version of AHRI 210/240, "Performance Rating of Unitary Air-conditioning and Air-Source Heat Pump Equipment," that includes several significant changes, including a new metric for dual-fuel systems, a new metric to help delineate heat pumps with good low-temperature performance and a controls verification procedure.

NEEA continues to work on modeling multiple dual-fuel configurations for three types of homes with multiple Northwest climate zones and demand response impacts. GTI Energy will lab test traditional dual-fuel units in the second half of 2024 and test a simultaneous dual-fuel system from iFLOW. The market landscape of dual-fuel units and controllers is complete, and NEEA continues to work with manufacturers to understand their respective differentiated value propositions and explore new equipment configurations.

Product Description: A forced air gas furnace or hydronic 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.

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Product	3	Comm/Market	5	Program	1

Dual Fuel Heat Pump Field Study

Project Status: The project is underway. Site identification is underway to recruit 10 demonstration participant sites to install the systems by the end of 2024. The system includes a variable speed cold climate air source heat pump, a natural gas condensing tankless water heater, a hydronic furnace, heat pump evaporator coils and a smart controller.

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

Project Objectives: Understand the efficiency and ability of residential dual-fuel systems to provide value through energy savings and grid flexibility by pairing highly efficient gas water and space heating with an electric heat pump and using a smart controller to increase fuel flexibility and dynamically control the system.

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Product Readiness Levels:

Product	3	Comm/Market	5	Program	1

Cold Climate Room Heat Pump Field Testing

Project Status: This project is underway. Washington State University is refining the scope of work and developing an implementation plan. NEEA is coordinating with multiple utilities in the territory to identify suitable test sites.

Product Description: A small heat pump designed to condition a single room and is plugged into a standard 15A 120V AC outlet. 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. Cold climate-capable room heat pumps can actively defrost and provide 100% capacity down to 17°F.

Project Objectives:

- Conduct lab testing to characterize full range of equipment operation.
- Conduct field testing to gather real-world operational data (runtime, consumer acceptance, etc.).

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Product	2	Comm/Market	3	Program	1

Primary High-Performance Windows

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

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

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

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

Project Objectives:

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

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Product	4	Comm/Market	3	Program	4

Secondary Windows Field Study

Project Status: GTI Energy continues to conduct a technology assessment and market characterization. GTI Energy submitted the Final Test Plan to the California Energy Commission in Q2 2024, and Lawrence Berkeley National Laboratory (LBNL) is preparing for testing in its Quantitative Infrared Thermography Chamber for multiple manufacturers of different types of secondary windows, including vacuum insulated glass construction, silica aerogel, and single pane options.

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

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

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

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Product	4	Comm/Market	5	Program	4

Skinny Wall Retrofit Panels

Project Status: This project is underway, and the feasibility study is now expected in Q4 2024.

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

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

Project Objectives:

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

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Product	2	Comm/Market	1	Program	1

Advanced Prefabricated Zero Carbon Homes

Project Status: This project is now underway. Due to a change in the project schedule, the next major update is due in Q4 2024.

Product Description: Prefabricated net-zero homes that meet California Title 24 Building Efficiency Standards with efficient HVAC, heat pump water heating, photovoltaic (PV) energy generation and energy storage.

Project Description: A co-funded project with GTI Energy and the CEC project EPC-23-018 to develop advanced, highly efficient manufactured homes that can achieve zero carbon operation with on-site photovoltaic power generation and battery energy storage. Homes will meet the California 2022 Title 24 Building Energy Efficiency Standards and will use HPWHs and air source heat pumps.

Project Objectives:

- Design, build and commission energy-efficient, all-electric manufactured homes with integrated PV and battery energy storage.
- Perform field validation of zero carbon operation.
- Perform techno-economic analysis using as-built advanced home costs within this project as well as scaled future costs assuming broad adoption of energy efficiency and demand response technologies.

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Product	2	Comm/Market	2	Program	1

Luminaire Level Lighting Controls with HVAC Control

Project Status: Installation started in mid-August 2024. The project should begin data collection by the close of Q3 2024 and conclude by Q3 2025.

Product Description: Luminaire Level Lighting Controls (LLLC) integrated with basic HVAC systems (rooftop units with only thermostats) simplifying the equipment necessary to control thermostats.

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

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Product	4	Comm/Market	4	Program	3

Parking Lot Lighting with LLLC

Product Status: The contractor is conducting a market survey, including existing demand response systems and currently available parking lot luminaire technology, and is conducting industry interviews. The market analysis report is complete; Phase 3 is underway and should be completed by the end of Q2 2025.

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: Multifamily site testing is complete. Early results illustrated a net efficiency of 136%, a 54% gas consumption savings for hot water-only mode, and 55% for combined space heating and water heating mode. Single-family hydronic and forced-air heating sites are complete. Early results showed 110% to 130% efficiencies, saving the home 18% to 25% in operating costs.
- Vicot Solar Technology Co., Ltd gas heat pump 20 kW (68kBTU/h): The team has learned the functionality and capabilities of the system. Early COP_{gas} ranges between 1.15 and 1.41 in air to water testing. Under an application combined with a hydronic air handler, the COP_{gas} ranges between 1.04 and 1.22. There is room for improvement with an optimized air handler.

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

Integrated Residential Gas Heat Pump Water Heaters

Project Status: GTI Energy confirmed prior findings that indicated heat losses in the process limit the system's performance. The manufacturer is actively working on solutions and redesigning certain areas to enhance the heat pumping process. GTI Energy is optimistic about achieving a COP of 1.1 to 1.2 with these improvements. Meanwhile, NEEA is conducting a market research project to understand what motivates consumers to choose higher efficiency storage water heaters.

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

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

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

Integrated Commercial Heat Pump Water Heaters (Electric)

Project Status: NEEA continues to work closely with A. O. Smith, other manufacturers, and Ecotope on multiple installations to fine-tune performance and suggest improvements to manuals for product and installation. NEEA is working to understand better these products' market potential in commercial applications. The Advanced Water Heating Specification (AWHS) was updated to Version 8.1 in July 2024 and includes commercial integrated water heaters in the Commercial section. Cadeo completed a study of the market size for commercial water heaters in the Northwest and found that more than 60% of commercial hot water usage could be met with a light commercial HPWH 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	1	Program	2

Central Commercial Heat Pump Water Heaters (Electric)

Project Status: Case studies and design tools are now available on BetterBricks.com, and additional content will be added as it is developed.

NEEA, in cooperation with the Bonneville Power Administration, commissioned D+R International to develop an interactive case study of the "Splash Block" to act as a tool to inform architects, mechanical engineers, building owners and plumbers. NEEA will host a Product Council on September 24, 2024 to provide a deeper dive into the Splash Block Nyle e360 installation.

The AWHS has been updated and includes commercial unitary water heaters. The latest updates for the central commercial HPWH QPL are available in the Advanced Water Heating Specification/Resources section of neea.org. NEEA is supporting the alignment and agreement of AHRI 1300 with the AWHS and is working through the details, calculations and boundary conditions.

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

Advanced Commercial Gas Water Heating

Project Status: Planning continues on a market characterization with the North American Heat Pump Collaborative to further understand the market. NEEA is working with a partner to model gas absorption heat pumps installed in commercial water heating applications. Additionally, NEEA is working with a partner to understand the opinions and applicability of gas heat pump water heating equipment in Washington. Work is ongoing to secure up to three field site demonstrations in the Northwest.

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.

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Product	3	Comm/Market	3	Program	2

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 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.

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Product	2	Comm/Market	2	Program	1

Commercial and Industrial Fans Product Research

Project Status: NEEA began assessing the applications into which Fan Energy Index (FEI)-rated fans are sold to better understand the savings associated with different fan classes.

Product Description: Stand-alone fans that are not packaged as part of an efficiency rated product.

Project Objective: The FEI describes the fan efficiency at a design point compared to a "minimally compliant" reference fan at that same operating point and is accepted as the best metric to characterize "efficient fans" at a particular operating point. This project seeks to identify which fan systems and corresponding applications can best achieve efficiency through proper selection using the FEI, proper sizing, speed control, design and other efficiency options.

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Product	5	Comm/Market	4	Program	2

Power Drive System Technology Assessment

Project Status: NEEA continues to clarify previously identified barriers that impede the widespread adoption of retrofit drives and characterizes variable torque systems as the most appropriate and cost-effective power drive systems (PDS).

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

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

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Product	5	Comm/Market	4	Program	1

Heat Pump Engine Block Heaters for Backup Generators

Project Status: This project is in the planning phase and is seeking an appropriate test site in the region.

Product Description: An air source heat pump engine block heater for 1 MW and greater backup generators.

Project Overview: Engine block heaters are a critical component for large (1 MW and greater) emergency backup generators designed to keep critical systems operating in the event of a power emergency. Backup generators (also called stand-by generators) typically use continuous-use electric resistance heaters to keep the engine warm and ready to start.

Project Objectives: This project seeks to quantify the energy savings potential of next generation heat pump engine block heaters compared to the current generation of heat pump engine block heaters, and electric resistance engine block heaters.

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Product	1	Comm/Market	3	Program	1

Flexible Load Management (Special Project)

Project Status: NEEA continues to influence AHRI by recommending CTA-2045B Level 2 for residential and commercial HPWHs. AHRI 1430 applies to 40–80-gallon electric water heaters and AHRI 1530 applies to electric commercial water heaters over 80 gallons.

Product Description: Connecting informed autonomous behind-the-meter applications.

Project Overview: NEEA has received special funding to explore connected devices capable of operating under flexible load management. These devices can be used for traditional demand response opportunities and may also enable leveraging future energy imbalance markets and potential carbon markets. To start, NEEA is focusing on open architecture connected pathways that work with the marketplace and operated in the background with limited awareness by the end customer. Initial technologies are water heating and line voltage thermostats. Future products may include inverter driven HVAC, EV charging, consumer appliances, battery storage, commercial buildings, street lighting and others.

Project Objective: Create pathways for behind-the-meter loads that can help support the integration of renewables on the grid.

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Product	5	Comm/Market	5	Program	2

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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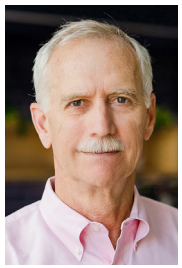

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TOGETHER We Are Transforming the Northwest

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Clark Public Utilities
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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