Updated: January 7, 2019

2019 Q1

Emerging Technology Quarterly Report

IN THE SPOTLIGHT:

What's New

Happy New Year! 2019 should be an exciting year for emerging technologies as we focus more on Heating, Ventilation, and Air Conditioning (HVAC) and water heating and less on lighting. This transition will take a few years, and it comes with much trepidation because lighting has generated so much energy efficiency for our region. I'm reminded of a quote by Bob Marley, "In this bright future you cannot forget your past." In the near term, lighting will remain the biggest driver of energy savings, and lighting continues to evolve rapidly, even to the point where lighting controls could expand to control HVAC and other building systems. Lighting baselines are changing, but it is important to know that even with baseline changes there is a bright future and significant savings for the region in controls and HVAC. To help accelerate the readiness of a variety of water heating and HVAC systems, the Regional Emerging Technology Advisory Committee (RETAC) and NEEA staff decided in our Quarter 4 meeting to focus on research gaps for these products. As RETAC implements its operations plan for 2019, look for updates and more data on viability and readiness levels as these products move toward program implementation and their bright future as the drivers of energy savings.

Here's to the beginning of a great year.

~ Mark Rehley, Sr. Manager ~

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Readiness Levels*

AT A GLANCE

Ratings based on 1=low & 5=high

Residential

	PRODUCT PERFORMANCE*	MARKET/ COMMERCIAL*	PROGRAM*
Combo Electric Hot Water & Space Heat - CO2 (Carbon Dioxide)	1	1	1
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Advanced Research Projects Agency - Energy (ARPA-e)	1	1	1
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Extended Motor Products	3	2	3
Inverter Driven Packaged Terminal Heat Pump	1	3	1
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Switch Reluctance Motors	4	3	3
Thin, Lightweight Triple Pane Window	1	3	2
Window Attachments	3	3	3

***PRODUCT PERFORMANCE READINESS:** Measurement of energy savings viability, fitness for use, and the Regional Technical Forum measure status if applicable

***MARKET/COMMERCIAL READINESS:** Measurement of supply chain maturity, product availability, presence of market failures, and lack of market maturity

***PROGRAM READINESS:** Measurement of cost effectiveness, program delivery and interventions, and a risk assessment of technical, market, program and regulatory risk

Residential

EMERGING TECHNOLOGY PROJECTS

Combo Electric Hot Water and Space Heat - CO2 (Carbon Dioxide)

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

- Eco-Runo: Uses CO2 (Carbon Dioxide) as a refrigerant and a hydronic loop between inside and outside modules.
- Chiltrix: Uses 410a as a refrigerant in an intergrated systems. The heat pump is based on Mitsubishi's variable speed compressor.

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

Project Status:

- Eco-Runo: NEEA staff share in the pain of the untimely loss of Ken Eklund, a senior researcher at Washington State Energy Extension Program and the project manager for the Eco-Runo field test. Karen Janowitz has recently taken on the management of this project. As of June 2018, eight Sanden 2.25-ton Eco Runo heat pump systems have been installed in recruited existing homes, and we are in the data collection phase. Two more Electric Forced Air Furnace (EFAF) sites are needed, so please contact Christopher Dymond (503-688-5454, cdymond@neea.org) if you are interested in partnering on this project.
- Chiltrix: NEEA staff are planning a lab test and possible field test starting in Q2, 2019.

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Product	1	Comm/Market	1	Program	1

Residential

EMERGING TECHNOLOGY PROJECTS

Ductless Heat Pump (DHP) Product Innovations and Channel Developments

Product Description: HVAC split systems, including ductless split systems, utilize variable speed (inverter-driven) compressors and fans.

Project Objective: NEEA staff, Pacific Northwest National Lab (PNNL), Bonneville Power Administration (BPA) and Silicon Valley Power (SVP) are working on a project to identify 2-4 low cost standards of practice and/or technology solutions to maximize the annual performance of a DHP (mini-split) when installed in a home with a pre-existing heating system (electric zonal and electric forced air furnaces).

Project Update: Phase 1 is complete (identifying all use cases and currently available products). Phase 2 (multi-zone building simulation to estimate performance) was completed. Phase 3 (testing PNNL lab homes) is underway. Lab data will be collected in both winter and summer conditions. Final results are due in the fall of 2019.

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Product	2	Comm/Market	3	Program	3

Smart Thermostats

Product Description: Residential thermostats that control various heating and cooling equipment, utilize weather and occupancy data to better manage the systems, and engage homeowners to more closely manage energy use and comfort.

Project Objective: To develop a method to estimate energy savings for Smart Thermostats based on performance metrics. This will enable Northwest utilities to quickly screen new products for inclusion in Qualified Products Lists (QPLs) and estimate energy savings.

Project Status: This project has been adopted by the Consumer Products Strategy Steering team. An updated Research Strategy has been developed and approved, and funding is being lined up for 2019 implementation.

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Product	3	Comm/Market	5	Program	4

Residential

EMERGING TECHNOLOGY PROJECTS

Ultra-High Definition (UHD) TVs

Product Description: 4K Ultra high definition (UHD) TVs with various forms of advanced display technologies.

Project Objectives:

- Support new revision of ENERGY STAR specification and federal test procedure for standard dynamic range (SDR) TVs to address eco feature persistence
- Collaborate on development of new IEC (International Electrotechnical Commission) test clip to address UHD and HDR (high dynamic range)

Project update: Stakeholder committee agreed on a development plan for revised SDR and HDR IEC test clips. The SDR and HDR clips have been acquired, assembled and tested. Draft clip test results were presented to stakeholder committee in December 2018. The PT100 committee released a schedule for work on draft test clips and a revised test procedure with work to continue into the summer of 2019 with IEC approval in October 2019.

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Product	3	Comm/Market	5	Program	5

Commercial

EMERGING TECHNOLOGY PROJECTS

Luminaire Level Lighting Controls (LLLC)

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

Project Update: The Next Generation Lighting Systems (NGLS) competition in 2017 and 2018 selected connected lighting for testing its installation, commissioning and energy performance in a real world test location. Installations for retrofit kits (Competition Two) took place in January 2018, and the installed systems will join the Competition One systems in the Living Lab at Parson's School of Design in New York City. NEEA staff have participated as observers and judges. In the Fall of 2018 NGLS turned over the completed systems from both competition one and two over to the school for continued observation and verification of energy savings. Competition Three is now in the planning phase and is scheduled to be installed before Q2 of 2019. Also, in Q2/3 of 2019, NGLS Outdoor competition will be launched. This will look at connected street/parking lot lighting. This will start down the research path of connected cities (IoT).

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Product	2	Comm/Market	3	Program	3

Luminaire Level Lighting Controls (LLLC) with HVAC Control

Product Description: Luminaire level lighting controls with additional sensors and supports for HVAC control

Project Update: NEEA staff has been working with the University of Oregon Integrated Design Lab (IDL) and has found two sites for a LLLC + HVAC pilot in the Portland area. Staff are currently working on a scope of work to define costs and research parameters. Late Q1 or early Q2, 2019 is the target to have agreements in place and start the pilot. NEEA staff will be monitoring a couple of pilots that include LLLC and HVAC done by Seventhwave, out of the Mid-West.

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Product	2	Comm/Market	3	Program	3

Commercial

EMERGING TECHNOLOGY PROJECTS

Very High Efficiency Dedicated Outside Air Supply (VHE DOAS)

Product Description: Replacing packaged rooftop units with a combination dedicated outdoor air system, heat recovery ventilator, and high efficiency heat pump. Key distinguishing feature is the separation of ventilation from heating and cooling via Dedicated Outside Air System (DOAS) with high efficiency heat recovery ventilation (HRV) system.

Project Objectives:

- Demonstration of feasibility and savings potential in different building types and climates.
- Improved energy modeling and modeling tools for DOAS/HRV systems

Project Update:

Nine pilot projects have been installed in the region. Six pilot projects are complete with five draft technical reports prepared and four draft case studies complete. One additional project has completed data collection and is in the analysis stage with a report expected in early 2019. Two other projects have equipment installed and are collecting data through Q2, 2019. Currently, NEEA staff and contractors have been unable to find three additional projects (strip retail, big box retail and primary school) to fill data gaps. Two additional office buildings without conversions are being monitored to help refine the heat pump performance baselines.

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Product	5	Comm/Market	4	Program	4

Industrial/Agricultural

EMERGING TECHNOLOGY PROJECTS

Compressed Air Saving Unit

Product description: Variable control air nozzle for compressed air open blowing applications.

Project Objectives: Savings value for Regional Technical Forum (RTF) to review.

Project update: A contract is in place to field test a variable control air nozzle. Four of ten sites have been identified and started for evaluation (Pre and Post intervention) to validate savings. The summary of findings will be completed by end of Q2, 2019.

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Product	2	Comm/Market	3	Program	3

Pump System Assessment Certification

Product description: Certification program for key processes, important steps and proven methodologies to manage and conduct any type of pumping systems audit, available through Pump Systems Matters.

Project Objectives: Identify ways that a Pumps System Assessment Professional (PSAP) can support energy savings.

Project update: The Hydraulic Institute (HI) has a sufficient number of professionals through the certification to get the exam ANSI 17024 accredited. With certification available, Utilities and municipalities should consider requesting that pump assessments are completed by Hydraulic Institute certified practitioners.

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Product	2	Comm/Market	3	Program	3

Cross-Sector

EMERGING TECHNOLOGY PROJECTS

Advanced Research Projects Agency-Energy (ARPA-e)

Approximately every three years, ARPA-E issues OPEN Funding Opportunity Announcements (FOAs) as a means to address the full range of energy-related technologies and fund those potentially disruptive technology concepts not currently supported through an ARPA-E focused FOA. ARPA-E selects individuals and organizations with experience in the energy sector to review and rate applications for funding. NEEA staff was invited by ARPA-E to review 20+ initial OPEN funding proposals including LED lighting, window attachments, and HVAC. Later this year NEEA staff will review the second round of full proposals. The proposals give NEEA staff visibility into a range of pre-commercialized technologies that might impact future energy efficient products for our region. As of Q4 of 2018 ARPA-e is still in the review phase of the OPEN FOA and should be moving to the next round before the end of Q1, 2019.

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Product	1	Comm/Market	1	Program	1

Advanced Research Projects Agency-Advanced Sensors (ARPA-e) - NEW -

Product Description: Advanced occupancy and other sensors that support adaptive management of Heating, Ventilation and Air Conditioning.

Project Description: The ARPA-e funding for the advanced occupancy sensors and Carbon Dioxide (CO2) sensors is starting to see the first products making their way past concept. Three of the awarded products will be on display at ASHRAE in January.

- **Zheng O'Neill/Kristen Cetin, U of Alabama/Iowa State** - Commercial and Residential Building Occupancy Presence and Counting Sensor Technologies: Supports HVAC, especially demand controlled ventilation without the need for CO2 sensors.
- **Jeff Rhodes, Purdue University -** Innovative CO2 Sensor Development for Commercial Buildings**:** Holds the potential to solve the calibration longevity issues with current sensors.
- **Zheng O'Neill/Kristen Cetin, U of Alabama/Iowa State -** Development of Guidelines/Standards for Occupancy Sensor Testing: ASHRAE's Role

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Product	2	Comm/Market	2	Program	2

Cross-Sector

EMERGING TECHNOLOGY PROJECTS

Extended Motor Products (XMP)

Product Description: Integrated motor systems with optimized performance to a system curve. Includes motor, controller, and fan / pump / compressor combinations

Fan Product Description: Fan, motor and integrated controls

Fan Project Objectives: Develop standardized specification, testing method and label to make fan selection reflect performance and energy use.

Fan Project Update: NEEA staff hired a contractor to evaluate the AMCA (Air Movement and Controls Association) Fan Efficiency Index (FEI) and cross verify that the testing method aligns with the FEI. Rough market assessment and rough savings estimates for the Pacific Northwest will be completed by end of Q1, 2019. Currently on the Regional Technical Forum (RTF) docket for Q2, 2019.

Pump Project Objectives: Validate RTF planned savings for clear water pumps and circulators.

Project update: Research has started in earnest, and there is a need for more utilities, engineering firms and pump manufacturers reps. PG&E supported with $100K cooperatively funding some of the research to vet the RTF savings numbers. Completion expected Q3, 2019.

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Product	3	Comm/Market	2	Program	3

Inverter Driven Packaged Terminal Heat Pump (IPTHP)

Product description: All-in-one packaged heat pumps that use inverter driven variable refrigerant compressors found in mini-split systems. Similar to conventional packaged terminal air conditioners (PTAC) found in many hotels but significantly quieter and more efficient.

Project Objective: Find and test relevant products to understand their performance and cost.

Project Update: No new progress ---- NEEA plans to conduct field testing of the "EcoSnap" system in 2019 (NREL received a top 100 R&D award for this product in 2017 - https://www.energy.gov/eere/ampedup/articles/new-easy-install-air-conditioning-unit-frees-window-space-snap). NREL is still resolving final details with an undisclosed HVAC manufacturer and hopes to have beta versions ready for field trials in early 2019. Other technologies have been reviewed, but nothing yet has been identified as a worthy lab.

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Product	1	Comm/Market	3	Program	1

Cross-Sector

EMERGING TECHNOLOGY PROJECTS

Split-system Heat Pump Water Heater

Product description: Split-system heat pump water heaters separate the heat pump from the water tank. These products offer a heat pump alternative for locations where the integral product doesn't fit.

Project update: NEEA staff are actively engaging manufacturers to attract more split system products to our region. One product is available on the heat pump water heater qualified products list, but more are needed to adequately support enclosed spaces. Several meetings are scheduled at the International Air-Conditioning, Heating, Refrigeration Exposition in January, 2019.

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Product	3	Comm/Market	3	Program	4

Switch Reluctance Motors

Product Description: A Switched Reluctance Motor (SRM) is a type of stepper motor, an electric motor that runs by reluctance torque. It is easier to control and has greater efficiency at part load conditions.

Project Objective: Document efficiency potential for the northwest including considerations for savings from applications where a gear box or belt are eliminated.

Project Update: Contract is in progress and results are expected by the end of Q1, 2019.

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Product	4	Comm/Market	3	Program	3

Cross-Sector

EMERGING TECHNOLOGY PROJECTS

Thin, Lightweight Triple Pane Window

Product Description: Primary window using three panes of glass, two standard thickness and a center thin pane of glass. The thickness and weight are similar to standard double pane windows.

Project Objective: Document product costs by component to demonstrate potential cost effectiveness, and document manufacturer engagement and interest.

Project Update: Contract is in place and expect documentation by the end of Q1, 2019

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Product	1	Comm/Market	3	Program	2

Window Attachments

Product Description: Products that attach to existing low performance windows to increase their energy performance; includes films, blinds, storm windows, secondary glazing systems, awnings, etc.

Project Objective: Assess the energy savings and product performance of low-e surface applied films.

Project Description: In Q2, 2019, Pacific Northwest National Lab (PNNL) will install and test in-place, on an occupied administrative building, the newest generation of hard-coat, washable Low-e Surface Applied Films (SAF). This physical testing will evaluate technical, qualitative, and product "fit for use" durational performance including visual and thermal comfort improvements. The testing will occur from 9 to 12 months through seasonal changes and temperature extremes.

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Product	3	Comm/Market	3	Program	4

Definitions

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 NW from 1 manufacturer through standard channels Niche market demand	Commercially available in NW 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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TOGETHER We Are Transforming the Northwest

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