



Black text: facilitator notes
Red: technologies discussed
Green: comments submitted on GoToWebinar during discussion

Workshop: The Role of ET in Supporting Decarb in Building Systems
Breakout Session: Commercial Technologies (Electric and Gas)

Objective: We will discuss electric and gas emerging technologies and how ETP can support these technologies today and 15-20 years out.

Outcome: Identify technology gaps that ETP can support/advance.

Technology Prioritization:

- HVAC
- Water heating
- Battery energy storage

Discussion Questions

- What is known about this technology’s performance? Has it proven high-efficiency performance in at least one application or are more assessments desirable (e.g., study, testing, pilot, demonstrations)?
- Are the market barriers unique to this emerging technology solution well understood? Are market barrier studies and market characterizations warranted?
- Are program intervention strategies in place that would reduce the market barriers, with no regulatory barriers? Is more support needed to identify or modify program intervention strategies?

Facilitator Summary

Most of the discussion centered on technologies that would add flexibility to the system load, for example, technologies that would add storage (phase change) to RTUs and offer enhanced demand flexibility. This highlighted also the need to include this flexibility enhancement capability in cost-effectiveness analyses.

Discussion Notes and Comments Submitted – These are unedited draft notes.

Advanced water heating initiative (west coast) 4 working groups.

- 1) Launch 120V heat pump water heater— avoid 240V need.



- a. There are 2 manufacturers ready, and they would like to pilot in CA w/IOUs
 - b. Developing pilot now-looking for participants-q1 2021;
NBI: Central HPWH Pilot ready for March, 2021, seeking utility and PA partners
- 2) 240V water heaters—90% is gas today—want elec resistance first-3x EE
 - 3) JA13 control techs
 - 4) Central water heating group—packaged design—ECOSizer—tool.
 - a. Product early 2021. Thermal storage (ice in past), for heating and cooling.

[Advanced Water Heating Initiative](#)
[Heat Pump Water Heaters into the Mainstream](#)

HP integration w/E Storage—HI conductivity phase change materials-transition temp close to RTUs sat temp. Developed new tech that integrates phase change w/commercially available rooftop units – hybrid cooling-w/compression and stored E to meet peak cooling—downsize compressor, permanent kW and kWh, and system can be flex resource—peak shaving/shift storage.

- Tech readiness: 1-2 yrs before commercially available—wrapping up proof of concept in lab now. Will have performance characteristics results by Summer 2021. Now minimize footprint w/storage material added to RTU—to ensure it is adopted by consumers. Also weight to enable deployment as drop-in replacement for existing RTUs.
 - Leverage existing RTUs and retrofit w/phase change hi conductivity and hi transition temp. Use existing components. Phase change is used as Storage material as evaporator for RTU. Can use in hybrid—while compressor running can also use tRaeno increase cooling to max. Downsize the compressor—eg from 4Ton go to 3Ton compressor + storage to meet peak for limited hours/yr.
 - Multi, variable speeds possible. Cost is main issue with variable speed compression—which would be part of final design
 - With variable speed, it would have more flexible capability-cost is main issue. Working w/retrofit and OEMs for new units. Working w/TES and OEM to see if can get sliding approach to costs and benefits—optimum size of unit, footprint, weight and capabilities in storage for best economics. Can be climate appropriate too.
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- **If people are interested in supporting this issue of making sure technologies are evaluated for IOU programs correctly in terms of cost-effectiveness, Cal TF is working on the concept of valuing new measure types consistently and correctly, also understanding where policy barriers may exist.**



- [Link for details on Hybrid technology developed by NREL](#)
- How common is conversion of existing gas storage water heater to Heat Pump Water Heater? [Please see this fact sheet from U. of . Washington](#)

Other technologies mentioned

- **Hybrid HVAC** w/West cooling==PCM and heating/cooling—lab testing. Demo at UCD in March 2021.
 - LBNL: We're also currently working on a hybrid HVAC project at Lawrence Berkeley Lab in collaboration with Western Cooling Efficiency Center that integrates heat pump and hot thermal storage (with PCM) to shift heating loads. We've made component and system models, are currently doing performance characterization testing of components in the lab, and plan to begin our demonstration of the integrated system at UC Davis starting in March 2021.
- At EE Conf in Europe—**storage in cube** introduced. German company.
 - Last year at an Energy Efficiency conference in Europe a company introduced thermal storage in a steel cube. This seemed so simple - and there are no rare earths needed for this technology! I'm by no means a technology expert, but this concept seemed intriguing because of its simplicity. I don't know whether this technology is evaluated in California, but I'm pasting the [link of the German company and their pilot here](#).
- **E recovery wheels for HVAC**—w/increased ventilation for Covid may be useful.
 - How about heat or energy recovery wheels for HVAC? This technology existed for long time now but appears to have not penetrated the market? This technology might be more relevant with increased ventilation rates from COVID-19.
- **Interior window inserts w/selective properties/film** technology
- **Preventive maintenance of HVAC** – can save 20%.
 - We would suggest the need for preventative maintenance of cooling equipment, both refrigeration (especially) and AC. Such things as heat transfer coil cleaning, filter replacement can save ~20% of the energy now being used to run those energy hogs.
 - A study on my previous comment: [Optimization Monitoring Maintenance of Cooling Technology.pdf](#)
 - [First patent link](#); [second patent link](#)
 - We ran a calculation for the unneeded power plant emissions from refrigeration and AC, both residential and commercial/institutional, from clogged condenser coils and other related maintenance-type issues. We used 2017 GDP for CA and the world as calculation proxy to extrapolate from the 500 million metric ton global emissions figure



from the Kigali Cooling knowledge brief earlier sent. The number was 17.55 million metric tons CO₂eq yearly in indirect emissions that could be cut if the coils in these units were kept clean.

- [Coilpod](#) is working on an **air-cleaning blower concept** to retard condenser coil fouling on refrigeration units which cuts the energy efficiency once the unit is deployed --- the US patent issued today. We need to partner with a refrigeration entity for a proof of concept and so forth.
- [Calseia](#) – EE/storage—not all benefits are monetized the same. \$ for various and don't align. **HP H₂O heater** that shifts load—how incent w/all C/E in there.
- NREL is working on a new technology with an OEM that **transforms traditional air conditioning (A/C) into a low-cost, behind-the-meter, flexible energy resource** with double the energy efficiency of existing systems. This eliminates weather-driven building A/C peak demand and enables new designs for zero net energy buildings.
- NREL is working on a **liquid desiccant air conditioning system** reduces typical HVAC electricity and water consumption compared to existing best-in-class solutions.



Workshop: The Role of ET in Supporting Decarb in Building Systems

Breakout Session: Residential Technologies (Electric and Gas)

Technology Prioritization:

- HVAC
- Water heating
- Cooking
- Battery energy storage

Discussion Questions (9:30 – 10:00; 30 minutes):

- What is known about this technology's performance? Has it proven high-efficiency performance in at least one application or are more assessments desirable (e.g., study, testing, pilot, demonstrations)?
- Are the market barriers unique to this emerging technology solution well understood? Are market barrier studies and market characterizations warranted?
- Are program intervention strategies in place that would reduce the market barriers, with no regulatory barriers? Is more support needed to identify or modify program intervention strategies?

Facilitator Summary

Four topics were discussed during this breakout session:

- The first topic was on 120V HPWHs. The group identified the need to pilot more of these systems in the market to show how they can be used to replace gas WHs without having to do panel upgrades. The group identified the need for ETP to help drive fuel switching by developing training modules and pathways for installers. NBI, NEEA, and EPRI are looking to collaborate on this topic.
- The second topic was on new space heating and cooling. Specifically, the new PTHP unit by Innova. The group is interested in this technology and wants to understand its impact on the future market.



- The third topic was on GWPs. EPRI is currently conducting a study on GWPs and the impacts. The group expressed interest in this study and would like to learn more about the findings to help generate additional pilots/studies and how this information could be used to inform CA policy.
- The last topic discussed was the work being done on indoor air quality. The participants noted that research is being conducted by entities such as University of Oregon, HRV, and EPRI. The group stated that this is an important topic due to the wildfires and Covid-19 impacts.

Discussion Notes and Comments Submitted – These are unedited draft notes.

NBI is in process of designing a **120V HPWH** pilot – currently looking at testing locations. 1% are HP water heaters—get installers to do this and sell them.

Gas to electric HPWHs – Advanced water heating is happening for a reason and we need to help support to overcome the market barriers. ET can help drive this by developing training modules and developing pathways for installers (example, SCE is piloting an incentive program for HPWH with Lowe’s)

MT pathways are part of HP initiative. 120V tech will help w/retrofit.

- Existing gas HPWH to electric – add-on component that can convert it – Industry is interested in knowing if converting is worth it or completely replacing the HPWH

NEEA and EPRI are conducting a pilot on **CTA 2045 controls** on new and existing HPWHs – they are currently looking for funding/support. NEEA w/Consumer Tech Assoc and EPRI looking for \$ to do tests. BPA provided funding for test harness.

- **CTA 2045 Test Harness:** The work will be the development of the test harness that will include all printed circuit boards, connectors, software test commands, testing protocol, documentation, certification of accredited labs and initial QPL. All this work will be to the CTA 2045B standard just approved by the CTA 2045 working group. BPA and NEEA have provided some funding but are still seeking additional funding. If you need additional information or would like to speak to the team reach out to Geoff Wickes, Senior Product Manager, NEEA Emerging Technology Group. 503.329.0523 gw Wickes AT neea.org
- [NYSERDA Announces First of Its Kind Partnership with ASHRAE](#)



There is a new **HP PTAC** that is expected on the market in the next year: **Innova**. HP is slim—feasibility study last year and coming out next year – retrofit nicely into buildings. MF or low rise, commercial segments, hotels, etc. Came from Europe—EPRI testing them.

- BPA provided the seed funding for the test harness - paper can be found at www.bpa.gov//goto/E3T
 - Mitsubishi QAHV CO2 HPWH Feasibility Study (2020)
 - Innova View 2.0 Feasibility Study (2020)
 - CO2 Heat Pump Water Heater
 - Multifamily Retrofit: Elizabeth James House Report (2020)
- Manufacturers also getting UL certification. For space heating and cooling

Any experience with **smart vents for residential applications**? Replace always open vent w/controlled centrally and/or with override. Central system that can control at each vent/room. Claim 30-50% savings.

- [FLAIR Puck](#) home comfort system. Past research showed that it didn't save much. Is there any info on more recent research? Amazon has lots of reviews on how it's being used and the expectations of customers.
- DOE paper – They do more harm than good if there's no variable speed central system. Better to do dampers. BCHydro did a study on dampers instead of central that gave good savings. Skeptical of smart registers. The damper is at the air handler. Properties of these new systems monitor the air flow – cannot shut off full sections – increased pressure/increased duct losses. Can't completely shut off whole sections—limits room control—just can adjust to a few degrees—to avoid taxing air handler with increased air pressure resulting in more duct losses.
 - See fixed speed w/smart dampers that did more harm than good. ([maybe this?](#))

HP refrigerants—regulations forthcoming GWP of refrigerants are a big issue. What is happening with these new systems?

- Regs for HVAC will hit CA in 2023 requiring refrigerants of GWP <750. It will require new refrigerants and products but manufacturers are still uncommitted. Some pushing natural refrigerants because of that.
- At EPRI when hp water heaters came out in 2005-6, we tested 200 around USA, but market penetration continued under 5%. Many complaints from manufacturers: pushed them but didn't do enough to promote the market. Have to AHRI in this conversation to ensure manufacturers will bring good products in the market. And Consumer Tech Assoc (CTA) have to be included in these meetings, too.



- CA policy will impact the requirements for refrigerants on HVAC systems. This will impact the types of technologies we can install.

Improving **indoor air quality** w/Covid?

- Any research on improving indoor air quality especially triggered by this pandemic because most of the residential conditioned air is recirculated.
- [NBI Recommended Resources for dealing with COVID-19](#)
- [Tactics for Minimizing COVID-19 Transmission in the Built Environment](#)

WCEC: Started project for ARB to test IAQ in department buildings and 3 different apartment bldgs. Field testing to start next year to check transfer between apartments due to levels of tightness and systems.

HRV solutions? Push those to improve IAQ? It won't decrease the load... Only way to get savings is by tightening the load.

- HRV can increase ventilation and dilution rate, but since balance system—will use electricity for fans—to get savings from outside air you have to tighten building. HRV will increase E a little but won't decrease E used for infiltration. If only goal is to add ventilation w/o significant E use—it makes sense. If want to impact E load—it won't do it on its own—if tighten space and add an HRV-then it makes sense.

University of Oregon is doing research on IAQ and biome, sterilizing bacteria in comm bldgs. HRV good way to dilute air with a tight bldg. It can get rid of contaminated air more quickly.

UL O3 bipolar ionization – as another anti nasty biome/bacterial/mold/virus air stream treatment.

EPRI: Undertaking evaluation of biological chemical effects and how to reopen safely in the workplace. There are **electrically motivated disinfectant techs** being studied. EMI interference effects, etc. Clearinghouse of info—safety in the workplace with IAQ work.

WCEC: A project for CEC measured CO2 and PM levels in classrooms. 100 had new HVACs, 65% had high levels of CO2 (pre Covid). Not getting adequate ventilation. WCEC became key for new legislation that classrooms have CO2 reading thermostats. Last



December money became available to upgrade ventilation and filters in classrooms from MERV8 to a MERV13. In CA this is critical when increasing outdoor ventilation due to PM2.5s during fire season. Covid adds to having safe classrooms, where we need more extra air, and have looked at energy cost of extra ventilation.

Other comments/technologies:

- NBI will be releasing the Building Electrification Technology Roadmap (BETR) before the end of this year.
- Product that turns water heater gas into a hp water heater.
- put hp coil into water supply line—not sure if still available. But storage tanks have 10 yr warranty—may last 15 yrs—but converting existing may not make much sense.
- Packetize tech to convert gas to electric.
- Building decarb coalition does workshops w/contractors for alternatives to panel upgrades; as go to EVs, gas cooking...etc.
- Panel upgrades may be necessary: how to improve residential whole-house electrification.