NW Energy Coalition
Webinar
Flexible Demand
July 1st, 2020
Using Zoom in today’s webinar

- Unmute only when it is your turn to speak
- Raise hand or view the list of participants
- Ask questions in the chat
NW Energy Coalition Webinar

Flexible Demand

- Conrad Eustis, REASCEND
- Jeff Harris and Geoff Wickes, Northwest Energy Efficiency Alliance (NEEA)
- Tony Koch, Bonneville Power Administration (BPA)
- Moderated by Fred Heutte, NW Energy Coalition
ANSI/CTA-2045 as the Enabler of Flexible Load

i.e.

Making the Communication link Cost Effective

Conrad Eustis
NWEC Webinar

July 1, 2020
Are you Hungry for the arrival of **Sustainable** energy?

• We’ll need a lot of storage to shift solar and wind energy to periods like windless nights

**BUT**

• Shifting load to times when renewable energy is available is both cheaper and lower impact than making and installing storage

• Shifting load is critical to lower costs, but how do we make this easy for customers?
CTA-2045 Vision in 2005 & History

• In the age of modern Internet, the demand response focus has been on the “home gateway”; this does not address cost effective access to devices themselves
• Need standardized communication access (like USB) on all major devices
• Specification work 2008 to 2012 (EPRI & SGIP)
• Prototypes and define device response 2012 to 2015
• NW Demonstration 2016 to 2018
• Washington State HB 1444 signed June 2019
What is CTA-2045?

- A communication port standard like USB
- Like USB, the appliance port enables flexibility and prevents obsolescence
- Customer “plugs in” communication device
  - Sent by utility or aggregator
- Communication device can support any type of communication link: e.g. Wi-Fi, 4G LTE, utility AMI network, HomePlug, ZigBee, etc., or any FUTURE communication protocol
- CTA-2045 supports any standard DR control language: e.g. OpenADR, SEP, BACNet, etc.
- OEM devices can “speak” one standard language, and the aggregator a different one
- Enables common customer experience across all products! (This is critical for high adoption.)

DR = demand response
Standard Customer Experience

• The E-Radio device above “hears” control commands broadcast on FM radio; water heater data returned by Wi-Fi if enabled by Customer.

• The FM option can work in 99+% of US, (including rural areas) today
NW Regional CTA-2045 Demonstration
BPA funds and leads project with two IOUs and six PUDs
www.BPA.gov/goto/smartwaterheaterreport

Objectives:
- Quantify 24x7 load shifts; including “on-peak”
- At least 2 events per day...every day
  - ~600 DR events in 220 days
  - ~300 customers
  - Test both resistance & HP WHs
- Measure customer satisfaction
- Conservatively quantify benefits
  - Benefits will increase over time
- Create a CTA-2045 market transformation plan [thank you NEEA!]
- Determine cost effectiveness
- Create stakeholder awareness of CTA-2045 benefits

Results:
- B/C of 2.6 compared to peaking plant with all costs included
- In OR & WA 301 MW and $230 million in net savings
- Conservative present value, if extrapolated to US, $4.3 billion
- Customer satisfaction: 80% very satisfied; low lifestyle impact because of CTA-2045
- Willingness to enroll in future program: 73% very likely; 21% somewhat likely
  - Benefits estimated based on 26% enrollment over 15 years
Everybody Wins

• Utilities get:
  • A direct way to interact with customers
  • Means to fulfill customers’ wishes for greener resources
  • A least cost resource

• Customers get:
  • Economic benefit of a least cost resource
  • A simple way to lower their carbon footprint

• Environment gets:
  • More use of sustainable energy
  • Reduced consumption of materials
Electric WH Storage Potential (w/o fuel switch)

- 50 million electric water heaters in US
- \(~1 \text{ kWh flexible load, twice daily}\)
- Implies potential of **50 GWh of storage** (i.e. ten times EIA 2021 forecast of installed storage)
- Marginal cost, at-scale:
  - $10 for additional OEM cost per tank
  - $20 for communication module
  - Equivalent battery cost at LESS than $15/kWh!
    - Economic bonus: No in/out losses, or degradation of storage quantity over the product life.
CTA-2045 & OpenADR

- OpenADR is a demand response language
  - Works securely over internet, server to server
  - Not designed for electronics in appliances
  - So manufacturers instead:
    - support OpenADR in the “Cloud”
    - use proprietary commands to reach the home appliance using the customer’s Wi-Fi network

- CTA-2045 is the physical interface for communication (ears and voice)
  - So it has the ability to “hear and speak” any language

- CTA-2045 can support OpenADR, but the reverse is not true
Other Disadvantages of OpenADR
aka connecting to the manufacturer’s cloud

1. Legal and IT cost
2. Only available in premium products
3. The Wi-Fi headache
4. Different customer experience with each OEM
5. Marketing thru OEM disintermediation
6. Limits on access to appliance data
7. Stranded products (e.g. GE Geospring water heater)
8. Limits innovation by entrepreneurs
9. Does not support future communication methods

Credit: Kennet Kjell Johansson Hultman
Ideally, federal government would follow Washington’s lead, but....... 

• Despite a majority of citizens that agree on the need to act on climate change, partisan stances at federal and state level prevent coherent policy e.g.: 
  • Whether to take action on climate change 
  • National carbon tax policy 
  • Net metering only changed when reliability crisis arises 
  • Legal disputes between state and FERC on subsidy for nuke plants 
  • Region-by-region variations in retail markets, operations, & planning 

• Standards to simplify control and communication too technical; causes inaction by policy makers 

• It’s time to lead by example and implement flexible load devices at scale.
Now is the time to lead

• For 120 years, the customer role was simply to consume electricity.

• In the next era, customers have an important role that most want to support\(^1\), i.e. accelerating the arrival of renewable generation.

• With flexible loads they can shift load to desirable times, but they need the simple process that CTA-2045 creates for them

• However, like recycling, this is an education process that will take a couple decades. Start Now!

\(^1\) 62% of demonstration participants cited ability to serve them with more renewable energy as reason to participate in a future program.
Questions

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Capturing the Full Value of Grid-Enabled Water Heaters

Jeff Harris
Chief Market Transformation Officer, NEEA

July 1st, 2020

CLASSIFICATION LEVEL: PUBLIC
Vision: What does a transformed market look like?

- All electric water heaters over 40 gallons shipped to the Pacific Northwest have an open-source communication interface (CTA-2045)
- Variable output energy from renewables is fully used and useful to the grid
- ENERGY STAR and the DOE recognize and promote ANSI/CTA-2045
- Utilities integrate DR and flexible load capabilities into planning and operations
- Aggregators successfully leverage capabilities of CTA 2045 connected loads into energy markets
**Benefits of a Transformed Grid-Enabled WH Market**

**Aggregated Benefits of Market Transformation**

- **Installed Smart WHs in 1000s**
- **Enrolled Customers**
- **Resource MWs (Hi Part 75%)**
- **Resource MWs (Lo Part 23%)**

Source: CTA 2045 Water Heater Demonstration Report; BPA Technology Innovation Report 336; Nov. 2018
Value Proposition for Grid-enabled Water Heaters

Utilities
- Increase renewables & reliability
- Choice of communication modes
- Avoid vendor lock-in
- Lower power rates

Grid
- Integrate renewables more easily
- Increase low-cost storage resources
- Support microgrid solutions to grid congestion

Customers
- Save money & make a difference
- More scheduling & control
- Optimize for time of use rates
- Choice of manufacturers

Manufacturers (OEMs)
- Standard solution for mass market
- Enhanced customer experience
- Connection to customer
- Enables smaller OEMs

Aggregators
- Choice of communication modes
- Standard solutions for mass market
- Enables local gateway control
- Solutions for small loads

Smart Cities & States, Low Income Opportunity
- Meet carbon goals
- Resiliency, Self-sufficiency
- Decarbonization
Need for intervention and support: It's All About Scale

• Large scale installations (60,000 = 25 MW) required for utility operational value

• High levels of customer participation (>85%) required to get to scale in time to impact NW grid

• OEMs need scale to lower cost/unit

• Scale needed to allow for load diversity during real-time interaction with device to capture full value of flexible loads
Opportunities

• ~200,000 eWH and HPWHs sold each year

• HPWHs already have sophisticated controls; multiple operating modes and connectivity

• Customers have increased interest in “smart” appliances and desire to “do the right thing” for climate change;

• Washington State leading the way in standards, Oregon and California following suit

• ENERGY STAR is considering connectivity as a requirement

• National interest in low-cost energy storage; potential extra-regional partners
Barriers

• Lack of grid to manufacturer value exchange
• Added cost to provide communication and control
• Lack of end customer value proposition or perceptions
  - Lack awareness about water heaters in general
  - Privacy and security
  - Performance concerns
• OEM’s worry about customer experience
• Minimal and variable demand side value to the northwest grid
• Competing communication standards
• Contractors need education and awareness
• Connectivity can be sketchy if not standard
Three Components for Success…

- Equipment
- Customer Participation
- Utility Engagement and Operation → Value
Current/Planned interventions - Equipment:

In process:

- Washington Standards 2021-2022
- State of Oregon Standards – 2022?
- California Title 24; Title 20
- OpenADR ↔ CTA 2045
- ENERGY STAR specifications

Still needed:

- “Comm-ready” installations: Module installed at factory or in-field
Current/Planned interventions – Customer Engagement

Still needed:

- High-participation customer recruitment program; e.g. PGE Testbed “opt-out” model
- Targeted consumer messaging on benefits of participation: e.g. GHG reduction, increased use of renewables; energy independence
Current/Planned interventions - Utility:

In process

- Utility DER integration into operation
- EIM / DAM
- NW Resource Adequacy Valuation

Still needed:

- Utility operational process that capture full value of flexible behind the meter thermal storage
- Utility planning process that recognizes distributed thermal storage as controllable asset to avoid other resources dispatch/local T&D upgrades
- Regulatory models that support “opt-out” customer models
Call to Action / Next Steps

• Align standards for e-WHs & HPWHs across the NW states;
• Regionally coordinated program to turn “dark assets” into “comm-ready” flexible load assets – ready to “light up” by utility.
• Consumer friendly “opt-out” engagement models with high participation rates.
Benefits of a Transformed Grid-Enabled WH Market

Aggregated Benefits of Market Transformation

Source: CTA 2045 Water Heater Demonstration Report; BPA Technology Innovation Report 336; Nov. 2018
Jeff Harris
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Making Electricity Demand Manageable in the Northwest

*The CTA-2045 Standard and Flexible Demand*

*July 1, 2020  9:30 - 11:00am Pacific*

*Presented by the NW Energy Coalition*

*Tony Koch*

Bonneville Power Administration
Intent of ANSI / CTA-2045

Created with intent to be used on any demand response friendly appliance

EPRI tested (in addition to water heaters):
- Pool pump, PTAC, thermostat,
- EV charger

PNW regional deep-dive effort started with water heaters

….and now, we turn to HVAC
Mitsubishi HVAC Heat Pump via CTA-2045

BPA explored a hand full of sites with “friend & family” in 2020
  • Wall mounted duct-less units
  • Central blower, whole house ducted systems
  • Re-used left over water heater communication modules
    (after firmware flash from eRadio)

Performed successful “Shed” commands which had the direct effect of 3 F thermostat set-point change via 2045

Thermostat set point delta is selectable by DR dispatch user

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New opportunity being explored by BPA/PNNL/PGE in 2020-21
  • Participants are PGE customers at large
  • Wall mounted and central blower applications
Mitsubishi HVAC: Ductless

Wall or ceiling mounted: Ductless

Red circle shows the Mitsubishi proprietary adapter

Blue circle shows hand held control, which is the thermostat

- No issues for port availability
- But, overall, not very cost effective, need adapter and module at each indoor head
Mitsubishi HVAC: Central Ducted Blower

Central Ducted Blower

Red circle shows the Mitsubishi proprietary adapter

Blue circle shows the thermostat, can be wireless or wired

- Significant issues for port availability
- Port commonly used for wireless stat application
- Very cost effective, one adapter and module for the entire house
Mitsubishi HVAC Collaboration

BPA, PNNL, and eRadio are actively engaged with Mitsubishi product development team in Atlanta.

Have communicated issues discovered in the early field testing.

Mitsubishi is interested in the feedback and is beginning to be responsive to our requests.

Currently, to the best of our knowledge, there are no other HVAC heat pump manufacturers that offer a CTA-2045 port.
OpenADR and CTA-2045

These are not interchangeable standards

They can be complimentary

• **OpenADR** was designed for server to server communication via internet
  - Intended for utility / DR entity dispatch to DR aggregator and/or C&I customers
  - No physical port requirement, assumes robust and secure IT hardware and internet

• **CTA-2045** was designed for use on residential / small commercial appliances
  - Physical port and command set embedded in the appliance
  - Modular comm, back haul communications to the DR entity chosen by the utility

Two examples of OpenADR being misapplied

**AHRI 1380 (2019)** - Demand response through variable capacity HVAC systems in residential and small commercial application

**ENERGY STAR** Connected Water Heater Specification, Draft v3.3 (not yet finalized)

• Both of these specs allow CTA-2045 or OpenADR, or both
• That is not a cost effective or practical solution
Thank You

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Questions?