Capturing Advanced Demand Response Benefits at Scale

ACEEE Hot Water Forum

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Portland General Electric

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843,000 customers, 52 cities served

Service territory population 1.7 million, 43% of state's population

4,000-square-mile service area
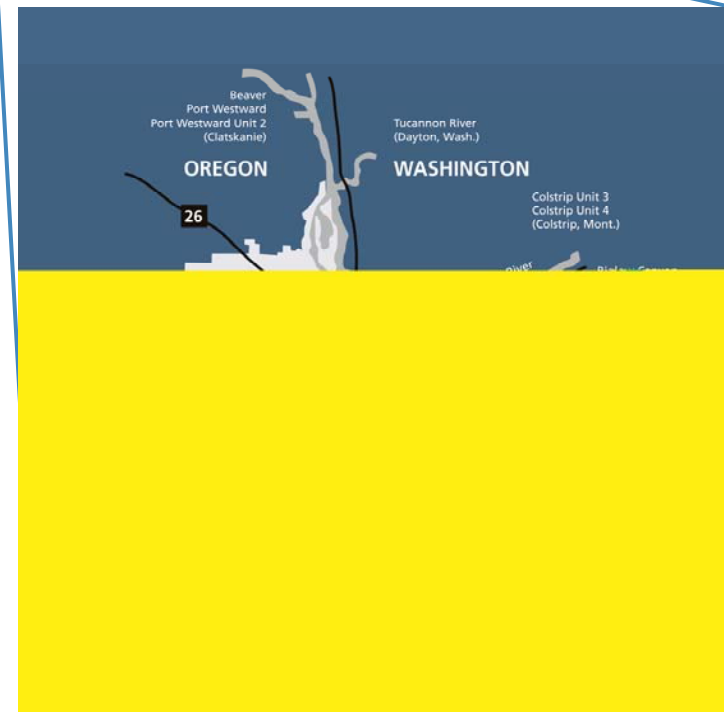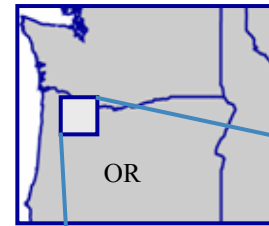
2,600 employees

Summer peak load of 3,950 MW (2009)

Winter peak load of 4,073 MW (1998)

Number #1 in US by NREL in Renewable energy sales and customers

First multi-MW Li-Ion battery-inverter system placed in operation by a utility

21% of owned generation nameplate capacity is wind generation; 36% is renewable.

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A New, Better Way to Reach Water Heaters

Under Cover

ANSI/CEA-2045 socket on tank

Like USB, Customer plugs the comm device into socket on tank

ANSI/CEA-2045 "plug" on communication device

Example of early communication device from e-Radio

This E-Radio device hears control commands broadcast on FM radio and returns water heater status via Wi-Fi if enabled by Customer.
This option can work in 99+% of US, (including rural areas) today

Wi-Fi Expansion Card

This is the "AC" form factor, there is also a much smaller "DC" device for use in thermostats

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How do Get Installation at < $75 per Water Heater?

AND

- Support for all of today's communication option
  - ZigBee®, Wi-Fi™, HomePlug®, proprietary AMI, mobile carriers, TWACS®, Cannon/Cooper/Eaton, Z-Wave®, pager, FMRDS, licensed VHF, etc.

- Support for any standard and/or proprietary command protocol
  - e.g: SEP 2, OpenADR, BACnet™

- Future proof for:
  - New communication protocols
  - Embedded Security flaws

- Answer

  A standardized-communication interface called ANSI/CEA-2045

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Why Should You Support this Standard

- **Less cost** and simple means **more customers** will try it

- Electronic "smart" control in water heater **maintains hot water**

- **Economic control on all water heaters** >40 gals; including heat pumps

- 45 million electric water heaters create the **economic** potential to:

  1. Avoid 20,000 MW of load on-peak

  2. 20 therms/tank/yr (90 million million Btu/yr) in resource energy

  3. Avoid 5 million tons of CO_2 emissions

     Last two from 24*7 use of water heater as flexible load

     20 Utilities already working, already with this standard

Great but, We have a Chicken or Egg First

- Cost at water heater/benefit for electric industry, then customers

- What about a legislated requirement?

- PGE collaboration so far with utilities, efficiency advocates & others

- Exploring whether there is support for legislation
        So far so good

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Solution: Shed Load by Day, Set Duty Cycle for Night

Execute Shed Cmd 6:00 to 21:00

Run time 88 min, use 6.6 kWh. "Smart" hot heater algorithm maintains customer's hot water supply

Run time 141 min, use 10.6 kWh. Algorithm maintains hot water supply, despite long shower at 11pm

Execute 15% Duty Cycle 21:00 to 5:55

On mins-> 3   3 5 4   5 5 8 14 11 8 7   12   3   6 12 26 6   40   7 7 2 6 17 6 6 6   5   3   7 6

Duty cycle a powerful command→ an even spread of load over 9 hours with a single command to all water heaters

Last "on" time before shed; tank fully heated

This actual data from tank reporting use every minute on a heavy day of hot water use