Demand Response Opportunities in Washington

NGA Webinar

Carl Linvill and Richard Sedano

April 5, 2017
Presentation Agenda

I. The Seventh Plan: Northwest Needs

II. The Northwest is Different

III. Northwest is Upping its DR Game

IV. DR Ideas

V. Beyond Pilots
Seventh Plan: Northwest Needs

– Peak capacity needs in critical water and weather conditions is a concern
  • DR should be able to deliver at least 600 MW by 2021 (Power Plan Action Plan assertion)

 – Increasing use of the hydro system for intra-hour balancing is affecting availability of hydro to meet peak capacity needs

 – Retiring coal plants introduce potential capacity needs
More Needs

– Need in different places (or entities) and when those needs will arise is beyond the scope of the Power Plan – Tailored DR to place
– In addition to winter capacity needs, system flexibility needs are growing and DR that can offer system flexibility will have value as well
– Didn’t see in the Power Plan but RE curtailment and hydro spilling is an area where DR (DR that acts like storage) may help
Summary Needs

- Winter peak
- Intra-hour balancing
- Capacity (retirements)
- Location specific
- System flexibility
- Curtailment mitigation
- OTHERS?

For Every Need ... There is a CAPABILITY
The Northwest is Different

• Needs are as described
• Duck curve, not so much
• Summer peaks, not so much
• Market programs, what market?
• Best practice DR from CA and the Southwest is not generally applicable
  – Interesting to consider: what effect will market development have?
Northwest is Upping Its DR Game

- Smart Grid Demonstration Projects
- Washington Storage Pilots
- Spotlight:
  - Northwest Energy Aggregated DR
  - PGE multi-family water heater program
Northwest is Upping Its DR Game

KEY

1 = PGE | 2 = Bonneville Power Administration | 3 = Peninsula Light Co. | 4 = Seattle City Light/University of Washington
5 = City of Ellensburg | 6 = Battelle | 7 = Benton PUD | 8 = Milton Freewater | 9 = Avista | 10 = Flathead Electric
11 = Northwestern Energy | 12 = Idaho Falls Power | 13 = Lower Valley Energy
## Smart Grid Asset Systems

<table>
<thead>
<tr>
<th>Asset System Investments:</th>
</tr>
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<tbody>
<tr>
<td>• Subprojects: ~$77M</td>
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<td>• Electricity Infrastructure Operations Center (Battelle): ~$11M</td>
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### Response Ranges:

- **Total Load Reduction**: -50 MW
- **Total Load Increase**: +7 MW
- **Efficiency Impact**: -10 MW

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<thead>
<tr>
<th>CVR</th>
<th>Building &amp; Comm. DR</th>
<th>In-home displays</th>
<th>Program T stats</th>
<th>Dist Generation</th>
<th>Storage</th>
<th>Photovoltaics</th>
<th>Wind</th>
<th>Residential DR</th>
<th>PHEV</th>
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X – Benton PUD and Idaho Falls Storage assets eliminated due to bankruptcy of vendor.
X – City of Ellensburg small wind farm dismantled due to safety issues.
What is the Pilot?

- BPA, as balancing authority, is obliged to balance its system
  - 4,300(+) MW intermittent wind generation
  - Increasingly less capacity and flexibility of its hydroelectric resources
- EN’s Pilot provides BPA 35 MW of Fast Firm INC balancing reserve
  - “Fast” < 10-minute Response From Notification
  - “Firm” 24/7 obligation to perform; no “opt-out” in real time
  - “INC” Load Reduction (same net effect as a generation increase)
- BPA compensates EN with performance-based capacity fee
  - Incentives to participants from EN.
  - No event or energy-based compensation; capacity fee only
  - Limits on call frequency, number, and duration
- Timeline – February 2015 through Jan 2016
- Diverse load-response assets
Results

• 85 Events; 94% success; 98% availability
• Awarded national award for innovation and excellence in DR programs by Peak Load Management Alliance (PLMA)
• Strongly demonstrated:
  • Effective use of a demand response based resource as an in-hour balancing reserve for BPA.
  • High performance of an all-public-power aggregated demand resource team.
PGE water heater demand response pilot

It’s the right time

- 800MW capacity shortfall by 2020
- Integrated Resource Plan calls for 77MW by 2021
- Water heating second largest opportunity after thermostats among residential customers
- Learn from pilot and build a recipe for water heater DR growth
- PGE water heater DR opportunity: 25-50MW
NW Upping Its Game

• Do you have others you think are important?
DR Ideas

• Overview
• Procurement/Pricing
• Big End Uses
  – Water Heating examples
• Market Linkage opportunities
Procurement/Pricing

• Ontario Procurement
• CA Distribution non-wires
• OG&E TOU Pricing
• Detroit Edison EV Pricing
• Water pumping pricing opportunity
• Load building procurement
IESO DR Pilot (Ontario)

• Procure 100 MW price responsive DERs
  – No more than 50 MW with BMG

• Needs
  – Capacity and energy
  – 5 minute and hourly balancing
  – Day ahead or 4 hours ahead curtailment

• RFP process
CPUC DRP Incentive Compensation for IOU T&D Deferral

- Decision issued December 2016
- Purpose: promote DER portfolios that defer or obviate IOU Distribution investment
- Each IOU to nominate distribution investment deferral projects
- CPUC to select deferral projects to put out to bid
OG&E TOU Pricing Program

• TOU pricing with In-home displays, programmable communicating thermostats and web portals
• 20% of customers
• 170 MW of DR
• PCT enhances response
DTE EV Charging

- $2,500 for home charging incentive
- 5000 customers
- TOU and Flat Rate options

Source: DTE

<table>
<thead>
<tr>
<th>Time of Use Plan</th>
<th>Time</th>
<th>Cost per kWh</th>
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<tbody>
<tr>
<td>On-Peak</td>
<td>9 - 11 p.m. Monday-Friday</td>
<td>$0.18195</td>
</tr>
<tr>
<td>Off-Peak</td>
<td>11 p.m. - 9 a.m. Monday-Friday and all</td>
<td>$0.07695</td>
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<tr>
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<td>day Saturday and Sunday</td>
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<tr>
<td>Standard</td>
<td>Not applicable</td>
<td>$0.11915 (first 17 kWh/day)</td>
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<td>$0.1326 (over 17 kWh/day)</td>
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DTE Lessons

• 75% of charging is off peak for TOU customers, 40% off peak for Flat Rate
• Customers with vehicles capable of delayed charging prefer TOU
• EV customers also charge at work, so doesn’t capture all charging
• Charger incentive caused EV purchases that would not have otherwise occurred
Water Pumping Potential

• Most water systems maintain significant storage capacity.
• Rate design changes can encourage fewer hours of more intensive pumping.
Load Building Procurement

• Very low cost energy can induce economic development if adequate volume certainty
• RE induced low cost energy should induce complementary load building
• Priority rights to very low cost (zero or negative) energy has value
• Auction 5 year call option for very low cost energy, guarantee minimum amount
Big End Uses: Energy Storage Capabilities

- Air Conditioning
- Water Pumping
- Electric Vehicles
- Water Heating
These are Big End Uses
~19% of Total Electricity Consumption
Water Heaters

• Examples:
  – Single and Multi-family opportunities
  – Great River Electric Cooperative

• Magnitude of the opportunity
Single-Family: Mostly Convertible to Heat Pump
Multi-Family: Overwhelmingly Electric Resistance – and Will Stay that Way

Fewer Options

– **Gas:** No gas piping and venting

– **Solar:** Cold water only plumbing

– **HPWH:** Space limitations; indoor installs
Why Multi-Family

• Access and Crew Efficiency
• Communications and Controls
• Renters with few money-saving options
Emerging Technology: Multi-Family Shared Heat Pump

Source: Ken Eklund, WSU Energy Program
Community Storage

- First “Community Storage” housing development
  - All homes have grid-interactive water heaters
- Also includes:
  - EV charging stations in the garage
  - LED lighting upgrades
  - Air source heat pump upgrade
- Cell modems installed in water heater initially
  - Evaluate other communications as the project moves forward
    - Lora 900 MHz System
Grid interactive water heating

- 85 gallon water heaters
- Adjusts temperature in response to:
  - Market energy price
  - Availability of renewable energy
- Able to provide ancillary services
  - 4 second response rate
- Assures comfort is never compromised
Is Net Zero possible?

- Make electric loads as efficient as possible or practical
  - VFD drives, LED lights, scroll compressors, etc.
  - Watch for waste and quick fixes that become permanent
- Convert all thermal loads to electric
  - Heat pumps
- Add renewable energy systems and storage to meet demand
Water Heating: Magnitude

• 45 million existing electric water heaters
  – ~10% of total residential electricity usage
  – ~12% of residential peak demand
  – ~70% kWh reduction possible with HPWH where applicable

Beneficial Electrification Potential:
55 million gas water heaters
Water Heating Peak Load Impacts

Before: 23 GW
After: 2.5 GW

- Mobile Home
- Multi-Family
- Single-Family
Water Heating Energy Impacts

Before | After
---|---
126 GWh | 79 GWh

- Mobile Home
- Multi-Family
- Single-Family

Million MWh/Year
Water Heating Load Shift Impacts

GWh

Energy solutions
for a changing world
Electric Water Heaters are not Distributed Uniformly by Region of the US

<table>
<thead>
<tr>
<th></th>
<th>Total US</th>
<th>Northeast</th>
<th>Midwest</th>
<th>South</th>
<th>West</th>
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<tbody>
<tr>
<td>Electric Water Heaters</td>
<td>45,435,000</td>
<td>4,558,000</td>
<td>7,532,000</td>
<td>26,921,000</td>
<td>6,424,000</td>
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Market Linkage Opportunities

• LBNL Take-aways on DR
• CAISO interface opportunities
Recommended Reading from LBNL

http://www.cpuc.ca.gov/General.aspx?id=10622
Report Highlights

• Shape: 1 GW shed, 3 GWh/day shift (TOU/CPP)
• Shift: $700 mm market, 10% DR
• Shed: Deferring Distribution Investment to become highest value of shed
• Shimmy: AS prices may limit to commercial (variable freq drives/pumps and lighting controls)
CAISO Interface Opportunities

- See extra slides
From Pilots to SCALE

- Pilot programs in the Northwest and elsewhere are showing results

- SCALING is the challenge at hand

- What have we learned about scaling from other places?
About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power sector. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

Learn more about RAP at www.raponline.org

Rich Sedano, rsedano@raponline.org
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DR Participation in CAISO Markets

• Proxy Demand Response (PDR)
  – Established 2010 per FERC Order 719
  – Curtailment Service Provider (CSP) may bid in Day-ahead Market (DAM), the Real-time 5 minute market (FMM) and Day ahead non-spinning reserve at the customer LAP.
  – Includes controlled load and price responsive DR programs
DR Participation in CAISO Markets

• Reliability Demand Response Resource (RDRR)
  – Implemented in 2012
  – Designed to integrate large resources that can be interrupted in system emergency conditions
  – Offered as an emergency reliability resource in the DAM for system emergencies and local T & D system emergencies
  – Telemetry required for > 10 MW resource
DR Participation in CAISO Markets

• Distributed Energy Resource Provider (DERP)
  – Established 2016
  – Aggregated DER capacity > 500 kW
  – Can curtail or dispatch
  – Can bid as a generator in DAM, RT balancing and Ancillary Service markets
  – DERP Aggregator (DERPA) resources must be concentrated in a single Sub LAP
DR Participation in CAISO Markets

• Energy Storage and Distributed Energy Resource (ESDER) initiative
  – Started 2015, on-going
  – Aimed at lowering barriers for transmission connected storage and distribution connected DERs
  – Non-generator resources, DR, multiple-use application storage and station power for storage resources
  – Enabling bi-directional DR
Demand Response Auction Mechanism

- DR, EV and Storage providers bid into utility solicitations
- Winning bids, selected by each utility, will be used by utilities to provide day ahead RA capacity to CAISO
- Plans to expand DRAM to include Flexible Capacity and other capabilities
Demand Response Auction Mechanism

• Piloted in 2016, RA MW delivered and dispatched, uptake below registration targets
• DRAM awardees new to CAISO markets
• Click through application process a barrier that is being improved
Incentive Compensation

- IOU’s run a competitive solicitation for local resources that defer or obviate the need for the distribution investment
- IOU selects top ranking bids
- The Procurement Review Group (third parties such as CPUC staff) review the bids and evaluate the recommended selection
- IOU is allowed to earn 4% on a portion of the cost deferred or obviated