State Policies - Distributed Energy Resources

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Distribution utilities will no longer just supply electric energy to customers, but will plan for, coordinate, and manage the flow of electric energy to, from, and between customers.
Is Solar City/Tesla the utility of the future?

- Utility business models in transition
  Large Supply-Side Capex >>>> Grid Modernization, Reliability, IT
- “Every feeder is a snowflake”
- DER value: Location, Location, Location
  Battle: Utility Integration Cost vs. DER Value
- Push: Technology Vendors, Policy, and Customers
  Pull: Utilities Roadmaps>Pilots>Demos>Scale

Legislative actions that work

- Value of solar DER >>> DRP
- Energy Efficiency >>>> Capacity Efficiency (demand response)
- Distribution Resources Planning (CA AB327, WA 2045)
- Rate and NEM Strategies (reflect Utility fixed costs)
- Everyone loves Evs?
- Combined Heat and Power (WA E2SHB 1095, OR SB 844)
- Support (Mandate) Standards (OpenADR, IEEE1547)
- Clean Power Plan 111(d) – uncertainty for state governments
# Distributed Energy below 69kV

<table>
<thead>
<tr>
<th>Dispatchable</th>
<th>Non-Dispatchable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated Demand Response</td>
<td>Energy Efficiency</td>
</tr>
<tr>
<td>Energy Storage (Customer, Utility)</td>
<td>Solar</td>
</tr>
<tr>
<td>Dispatched Generation</td>
<td>Wind</td>
</tr>
<tr>
<td>Electric Vehicle Charging</td>
<td></td>
</tr>
<tr>
<td>Combined Heat &amp; Power</td>
<td></td>
</tr>
<tr>
<td>Smart Inverter services (e.g., VAR Support)</td>
<td></td>
</tr>
</tbody>
</table>
DER Drivers

Cost declines in solar, storage, and smart grid
- 40% decline since 2011, Panels $1.31/Watt to $.50/Watt (peaker is $1.2/Watt not including fuel)
- Import tariffs on Chinese solar will slow the steep decline, but decline will continue.
- $.038/kWh 20 year solar PPA for NV Energy
- Tesla’s gigafactory to reduce Li-ion battery cost
- Smart building management systems, thermostats, water heaters, motor load, VFDs

Customer Expectations
- Lower costs, reliability, and environmental concern

Economic Development
- PNW: Solar Jobs > 6,000. Energy Efficiency > 15,000 jobs

Reliability
- 90% of outages is on distribution system. (200GW of backup power in US)
- Hurricanes, Earthquakes, and Animals oh my

Environmental Costs/Policy

Reduce rates
- Avoided costs for Transmission, Distribution, Generation, etc.
- 1990s Puget Sound Reliability: voltage support, targeted EE
Customers are looking for reliability, self-generation, and environmental stewardship.

- Customer desire for self-reliance increasing
  - **E&Y**: 33% of the multi-national firms are expected to meet a greater share of their energy needs through self-generation over the next five years

- **Navigant**: nearly 75% of surveyed residential customers have “concerns about the impact electricity costs have on their monthly budgets, and 63% are interested in managing energy used in their homes”

- **Best Buy**: 36% of residential customers desire to “financially and physically protect the home” (Home Safeguarding persona)
174,000 Solar Jobs in US

http://pre.thesolarfoundation.org/solarstates#wy

August 2, 2015
Solar creates 860 jobs per lifetime MWh

U.S. Job Creation by Energy Source

SOURCE: (FIG. 6) THE SOLAR FOUNDATION; (FIG. 7) RENEWABLE AND APPROPRIATE ENERGY LAB
Renewable Portfolio Standard

States with Renewable Portfolio Standards (mandatory) or Goals (voluntary), January 2012
Campus DER for 69kVA Substations

December Peak Load Reduction

- BMS 1 (3 Hour)
- BMS 1 (6 Hour)
- BMS 1 (12 Hour)
- VO 1
- VO 2
- BMS 2 (3 Hour)
- BMS 2 (6 Hour)
- BMS 2 (12 Hour)
- Residential Heat
- VO 3
- Backup Generators
- Substation Load

KVA vs Hour

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

August 2, 2015
DER for two 69kVA Substations

September Peak Load Reduction

- Solar
- PF Correction
- BMS 1 (3 Hour)
- BMS 1 (6 Hour)
- BMS 1 (12 Hour)
- VO 1
- VO 2
- BMS 2 (3 Hour)
- BMS 2 (6 Hour)
- BMS 2 (12 Hour)
- VO 3
- Backup Generators
- Substation Load

August 2, 2015
## BMS Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Winter KVA Shed Level 1</th>
<th>Winter KVA Shed Level 2</th>
<th>Summer KVA Shed Level 1</th>
<th>Summer KVA Shed Level 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command to Low Speed</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Command VFD to 50% cfm</td>
<td>0</td>
<td>12</td>
<td>0</td>
<td>12</td>
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<tr>
<td>Convert to Variable Flow Loop</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Curtail Radiant System</td>
<td>8</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Disable Fan Coil Unit Fans</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Install VFD on Lab Exhaust Fans</td>
<td>83</td>
<td>0</td>
<td>83</td>
<td>0</td>
</tr>
<tr>
<td>Lock-Out Elevators</td>
<td>0</td>
<td>120</td>
<td>0</td>
<td>120</td>
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<tr>
<td>Lock-Out EV Chargers</td>
<td>50</td>
<td>0</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>Pre-Cool Ice Rink</td>
<td>0</td>
<td>500</td>
<td>0</td>
<td>500</td>
</tr>
<tr>
<td>Reduce dP Setpoint</td>
<td>19</td>
<td>0</td>
<td>9</td>
<td>0</td>
</tr>
</tbody>
</table>

### Reduce Duct Static

#### Pressure Set Point

<p>| | | | | |</p>
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<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Reduce Velocity Pressure</td>
<td>9</td>
<td>0</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Remove Bypass Flow Control to dP</td>
<td>11</td>
<td>0</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Shut Off AHU</td>
<td>11</td>
<td>117</td>
<td>11</td>
<td>117</td>
</tr>
<tr>
<td>Shut Off Chiller</td>
<td>0</td>
<td>66</td>
<td>0</td>
<td>949</td>
</tr>
<tr>
<td>Shut Off DW Booster Pumps</td>
<td>71</td>
<td>0</td>
<td>71</td>
<td>0</td>
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<tr>
<td>Shut Off Electric Boiler</td>
<td>40</td>
<td>0</td>
<td>40</td>
<td>0</td>
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<tr>
<td>Shut Off Heat Pumps</td>
<td>0</td>
<td>108</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Shut Off Heat Recovery</td>
<td>0</td>
<td>146</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Shut Off HR Chiller</td>
<td>0</td>
<td>191</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Shut Off Lights</td>
<td>220</td>
<td>0</td>
<td>220</td>
<td>0</td>
</tr>
<tr>
<td>Shut Off Pump</td>
<td>12</td>
<td>21</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>Temperature Setback</td>
<td>68</td>
<td>0</td>
<td>274</td>
<td>117</td>
</tr>
<tr>
<td>Tune VFD Controls</td>
<td>22</td>
<td>0</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>Totals</td>
<td>949</td>
<td>1281</td>
<td>1145</td>
<td>1836</td>
</tr>
</tbody>
</table>
NPV of Substation Capacity DSM

<table>
<thead>
<tr>
<th>Component</th>
<th>Value ($ MM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Capacity Cost</td>
<td>3</td>
</tr>
<tr>
<td>System Loss Savings</td>
<td>0.6</td>
</tr>
<tr>
<td>Feeder Deferral</td>
<td>0.9</td>
</tr>
<tr>
<td>Ancillary Services</td>
<td>-</td>
</tr>
<tr>
<td>Shoulder Month Savings</td>
<td>1.7</td>
</tr>
<tr>
<td>BMS EE Savings</td>
<td>0.3</td>
</tr>
<tr>
<td>Substation Deferral</td>
<td>3.4</td>
</tr>
<tr>
<td>Environmental Value</td>
<td>-</td>
</tr>
<tr>
<td>Total Value</td>
<td>10</td>
</tr>
<tr>
<td>Cost</td>
<td>7</td>
</tr>
<tr>
<td>Net Benefit</td>
<td>3</td>
</tr>
</tbody>
</table>
Distribution Resource Planning (DRP)

- Purpose is for distribution planning to include DER energy capacity, “smart” capabilities, energy efficiency, and market incentives during long-term distribution planning.

- These factors would then be balanced against the avoided costs of “traditional” distribution planning.

Identify DPA & Substations → Perform Planning Analyses → Calculate Locational Net Value → Rank Substations by Locational Net Value.

August 2, 2015
SCE Available Capacity by Line Section
States should mandate DRP whenever utilities are

- proposing new infrastructure investment to meet load growth (Gen, Trans, Dist)
- DER kW forecasted to exceed 40% of Feeder Daily Minimum Load

Visibility & Initial Locational Benefits

2015-1H 2016

Walk

2016-2019

Jog

2020+

Run

System-wide DRPs incl. Locational Societal Benefits

System-wide DRP including LTPP & TPP locational benefits

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PNW: Conservation and Demand Response Lowest Cost, Lowest Risk

Source: Northwest Power and Conservation Council, Mar. 2015

US 2013 DR > 28,000 MW
Everyone likes EVs

<table>
<thead>
<tr>
<th></th>
<th>EE</th>
<th>PV</th>
<th>EV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer Cost</strong></td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td><strong>Integration Cost</strong></td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td><strong>Utility Revenue</strong></td>
<td>↓</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td><strong>Ratepayer</strong></td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
</tr>
</tbody>
</table>
Utility Rates should reflect Cost Type

2015 EPRI “Capacity and Energy in the Integrated Grid
Utility Rates should reflect Cost Type

2015 EPRI "Capacity and Energy in the Integrated Grid"
Decoupled Utility return from revenue
States Blowing Utility Model Up

Net Metering

www.dsireusa.org / July 2013

43 states + Washington DC & 4 territories have adopted a net metering policy

Note: Numbers indicate individual system capacity limit in kilowatts. Some limits vary by customer type, technology and/or application. Other limits might also apply.

This map generally does not address statutory changes until administrative rules have been adopted to implement such changes.
Clean Power Plan and DER

Legend

Emission Rate Reduction Targets (lbs/MWh)
- 0.0 - 411.5
- 411.5 - 687.3
- 687.3 - 963.2
- 963.2 - 1239.4
- 1239.0 - 1514.9

Further information on the Clean Power Plan and DER can be found in the text blocks.
Natural Gas prices putting pressure on DSM
~$1 Billion for BPA
Oregon: Department of Energy sought comments to assist with development of storage demonstration RFP.

California:
- AB 327 – DRP Mandates
  - Storage 1.2GW 2020
  - DER – 12,00 MW 2020
  - In state Renewables CA ISO allow 3rd parities to sell DR to ISO

Arizona:
- Utilities allowed to invest in:
  - Solar Rooftop
  - Storage
- SRP – demand charge for Solar

Hawaii: HECO considering three battery storage projects from RFP soliciting projects of 60 MW to 200 MW

Washington:
- DRP- HB 2045
- Department of Energy awarded $15 million to three utilities for storage demonstration projects

U.S.: DOE announced a $2.5 billion solicitation (with additional funding up to $4 billion) in loan guarantees toward renewable energy and energy efficiency projects including energy storage.

New York: Reform the Energy Vision

PJM: Seeing consistent deployments for ancillary services; developing new capacity performance requirements for resources including storage.

ERCOT: Undertaking comprehensive redesign of ancillary service market to allow participation in the market and appropriately value fast acting resources such as storage within 3 years; Oncor sponsored study showing value of utility-controlled distributed energy storage in Texas.

March 12, 2015

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Focus on Peak Demand Reduction

Average prices low, peak prices high
## DER will be 23% of western power by 2022

<table>
<thead>
<tr>
<th>DER</th>
<th>2022 WECC (MW)¹</th>
<th>2013 PNW (MW)</th>
<th>2022 PNW Market Potential², ³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar (Helena better than Jacksonville FL)</td>
<td>25,000</td>
<td>188</td>
<td>2,300</td>
</tr>
<tr>
<td>Combined Heat and Power (CHP)</td>
<td>9,000</td>
<td>15</td>
<td>1,000</td>
</tr>
<tr>
<td>Demand Response – Renewable Integration</td>
<td>2,600</td>
<td>0</td>
<td>305</td>
</tr>
<tr>
<td>Demand Response – Peak Reduction</td>
<td>4,700</td>
<td>420</td>
<td>1,000</td>
</tr>
<tr>
<td>Energy Storage</td>
<td>1,800</td>
<td>5</td>
<td>55</td>
</tr>
<tr>
<td>Dispatchable Backup Generators</td>
<td></td>
<td>100</td>
<td>800</td>
</tr>
<tr>
<td>Energy Efficiency (amounts not included)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>43,400</strong></td>
<td><strong>713</strong></td>
<td><strong>14,660</strong></td>
</tr>
</tbody>
</table>

¹. Source: EQL Energy for Western Interstate Energy Board May 2015,
². Summary of 2013 TEPPC high DG case, 2013 LBNL
Stakeholders

- Distribution Utility
- Utility Shareholders
- Regulators
- Ratepayers
- DER owners
- Economic Development
  - (politicians/business associations)
- Solar industry (175,000 employed)
- Cleantech Companies
- Third party DER, Retail energy providers
- Utility Distribution Equipment Vendors
- Concerned Citizens
Summary

Legislative / Regulatory actions

• Support Utility Transition in business models
• Value of solar DER >>> DRP
• Distribution Resources Planning (CA AB327, WA 2045)
• Utility Roadmaps - pilot>demo>scale
• Combined Heat and Power (WA E2SHB 1095, OR SB 844)
• Support (Mandate) Standards - OpenADR, IEEE1547
• Obtain Demand Response as we have Energy Efficiency
• Everyone Loves EVs, make sure it benefits ALL ratepayers
Link to Western Interstate Energy Board paper:
Emerging Changes in Electric Distribution Systems in Western States and Provinces

http://westernenergyboard.org/2015/05/final-report-released-by-eql