Distributed Energy Resources in the Pacific Northwest

Ken Nichols
Principal – EQL Energy

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ken@eqlenergy.com
503-438-8223
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.
Priority shall be given: first, to conservation; second, to renewable resources; third, to generating resources utilizing waste heat or generating resources of high fuel conversion efficiency; and fourth, to all other resources.

"Electric power" means electric peaking capacity, or electric energy, or both.

"system cost" means an estimate of all direct costs of a measure or resource over its effective life, including, if applicable, the cost of distribution and transmission to the consumer and, among other factors, waste disposal costs, end-of-cycle costs, and fuel costs (including projected increases), and such quantifiable environmental costs and benefits.

https://www.nw council.org/reports/poweract/
Steps Toward the Future

Is Elon Musk 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
- Technology (trade allies and vendors) and Customers
  Utility Roadmaps: pilot>demo>scale

Legislative actions that work

- Value of solar DER >>> DRP
- Distribution Resources Planning (CA AB327, WA 2045)
- Rate Strategies (reflect Utility costs, customer preference)
- Combined Heat and Power (WA E2SHB 1095, OR SB 844)
- Support (Mandate) Standards (OpenADR, IEEE1547)
- Demand Response follows Energy Efficiency (NPCC 7th Plan)
# Capacity and Energy

<table>
<thead>
<tr>
<th>Capacity (dispatchable)</th>
<th>Energy (variable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity DSM (aka Demand Response)</td>
<td>Energy DSM (aka 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>
PNW Needs Flexible Capacity (MW)
DER Drivers in PNWER

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.
- $0.038/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 > 25,000 jobs

Reliability
- 90% of outages is on distribution system. (200GW of backup power in US)
- PNW requirement for flexible capacity

Reduced rates
- Avoid 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)
>5,000 Solar Jobs in PNW
>25,000 Energy Efficiency Jobs in PNW

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

July 14, 2015
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

35,000 37,500 40,000 42,500 45,000 47,500 50,000 52,500 55,000 57,500 60,000
DER for two 69kVA Substations

September Peak Load Reduction

- Solar
- PF Correction
- BMS 1 (3Hour)
- 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
<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>
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<tr>
<td>Command to Low Speed</td>
<td>4</td>
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<td>Command VFD to 50% cfm</td>
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<td>Convert to Variable Flow Loop</td>
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<td>Curtail Radiant System</td>
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<td>Disable Fan Coil Unit Fans</td>
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<td>Install VFD on Lab Exhaust Fans</td>
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<td>Shut Off DW Booster Pumps</td>
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<td>Shut Off Heat Pumps</td>
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<td>Temperature Setback</td>
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<td>Tune VFD Controls</td>
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<td>Totals</td>
<td>949</td>
<td>1281</td>
<td>1145</td>
<td>1836</td>
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</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

- Locational Value: Avoided Costs and Benefits
- Net Locational Value by Substation

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Evolution of DRP Optimal Location Benefits Analysis

- What are the immediate benefit categories that can reasonably be evaluated?
- What are the next logical set (incl. data and tools needed) for system-wide DRPs?
PNW: Conservation and Demand Response Lowest Cost, Lowest Risk

Source: Northwest Power and Conservation Council, Mar. 2015

US 2013 DR > 28,000 MW
Energy Efficiency Net Benefit
~$1 Billion for BPA

Annual Value of Bonneville’s 2001-2011 Energy Efficiency Investments Over Their Expected Measure Life

- Annual Cost of EE Program
- Revenue from Selling EE Savings @ Mid-C Market or Avoided Cost of Purchasing EE Savings @ Mid-C

Cost/Revenues ($mil present value in year 2014)

Fiscal Year

July 14, 2015
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)</th>
<th>2013 PNW (MW)</th>
<th>2022 PNW Market Potential</th>
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</thead>
<tbody>
<tr>
<td>Solar (Helena better than Jacksonville FL)</td>
<td>25,000</td>
<td>188</td>
<td>2,300</td>
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<tr>
<td>Combined Heat and Power (CHP)</td>
<td>9,000</td>
<td>15</td>
<td>1,000</td>
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<tr>
<td>Demand Response – Renewable Integration</td>
<td>2,600</td>
<td>0</td>
<td>305</td>
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<tr>
<td>Demand Response – Peak Reduction</td>
<td>4,700</td>
<td>420</td>
<td>1,000</td>
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<tr>
<td>Energy Storage</td>
<td>1,800</td>
<td>5</td>
<td>55</td>
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<tr>
<td>Dispatchable Backup Generators</td>
<td>100</td>
<td>800</td>
<td></td>
</tr>
<tr>
<td>Energy Efficiency (amounts not included)</td>
<td>100</td>
<td>800</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

Legalistic / 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 (NPCC 7th Plan)
Ken Nichols, Principal,  EQL Energy
503 438 8223
ken@eqlenergy.com
www.eqlenergy.com

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
Extra Slides
What does your utility see as its biggest growth opportunity over the next five years?

- Distributed energy resources: 31%
- The customer relationship: 23%
- Transmission: 14%
- Distribution: 9%
- Centralized generation: 8%
- Other: 7%
- Consolidation: 5%
- Internet of Things: 4%

July 14, 2015
Powerful Macro Trends Drive Home Standby Penetration Opportunity

Aging Grid driving Power Interruptions
- 30–50% of T&D network in the U.S. is 40–50 years old
- Undergrounding the grid would cost up to $4.0 trillion

North American Penetration Opportunity
- ~20% CAGR for home standby generators from 2002-2012
- Generac has ~70% share

Aging Population fits Demographic
- 75-80% of buyers age 50 and older
- 45-50% of homes valued under $300k
- 85-90% retro-fit application

Every 1% of increased penetration equals ~ $2 billion of market opportunity

(2) At $1mm/mile.
(3) Source: Company warranty registration data
(4) Source: Management estimates
Utility Distribution of the Future
PNW Needs Capacity (MW)

Source: Northwest Power and Conservation Council, Mar. 2015
PNW projection for roof-top solar (GWh)

- Average Annual Growth Rate 2015-2035 ~ 5%
- Generation: ~ 230 MWa
- Roughly ~ 1.2% of load

Source: Northwest Power and Conservation Council, Nov. 2014
Net Metering & Value of Solar

Net Metering and VOS under review in most states

- Avoided Costs
  1. Energy Costs
  2. System Generation Capacity Additions
  3. Reduced Transmission line losses (System Losses)
  4. Avoided Transmission and Distribution
  5. Ancillary Services and Grid Support
  6. Avoided Natural Gas Pipeline Costs
  7. Avoided Renewable Costs (RPS states)
  8. Environmental
  10. Financial: Market Price Response
  11. Security: Reliability and Resiliency (Risk)
  12. Social: Economic Development
  13. "Behind-the-Meter Production During Billing Month
  14. (Valuing the benefit of load reduction from net metering)"
  15. Utility: Integration Costs
  16. Utility: Interconnection Costs
  17. Utility: Administration Costs
  18. "Rate Impacts: Net Metering Credits
  19. (Covers the difference between the retail rate credit for excess generation and the avoided cost rate)"
  20. Rate Impacts: Lost Utility Revenue
  21. Incentive Costs (i.e. utility rebates (NV)
  22. Tax credits (State and Federal)
  23. Location Value
## Estimated Value of Solar in Idaho

<table>
<thead>
<tr>
<th>Component</th>
<th>1 MW DC, yearly</th>
<th>Per MWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>$43,000 to $48,500</td>
<td>$32 to $35</td>
</tr>
<tr>
<td>Line loss</td>
<td>$3,200 to $3,600</td>
<td>$2 to $3</td>
</tr>
<tr>
<td>Wheeling</td>
<td>$0 to $6,900</td>
<td>$0 to $5</td>
</tr>
<tr>
<td>Peak capacity</td>
<td>$0 to $28,100</td>
<td>$5 to $21</td>
</tr>
<tr>
<td>Renewable portfolio standard</td>
<td>$0 to $6,800</td>
<td>$0 to $5</td>
</tr>
<tr>
<td>Hedge</td>
<td>$0 to $2,700</td>
<td>$0 to $2</td>
</tr>
<tr>
<td>Integration</td>
<td>($1,400) to $0</td>
<td>($1) to $0</td>
</tr>
<tr>
<td>Transmission capacity</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Distribution system</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Externalities</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Voltage control</td>
<td>-</td>
<td>-</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$44,900 to $96,700</strong></td>
<td><strong>$38 to $71</strong></td>
</tr>
</tbody>
</table>
**British Columbia**
- Solar: not now, DR target T&D

**Washington**
- DRP Proposed (HB 2045)
- Avista - Distribution Automation (DA)

**Oregon**
- DER Study in PGE IRP
- Dispatchable Standby Generation (DSG)

**Colorado**
- Wind more pressing concern
- Xcel Energy VVO & DMS Investment

**Utah**
- Growth potential: QF and utility solar

**California**
- Distribution Resources Planning
- 12,000 MW DER Target
- Push for DER other than PV (storage)

**Arizona**
- IOU Rooftop Solar Pilot
- APS VVO, DMS, & DA

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EIA Average Residential Rate
- $0.076/kWh

NREL Solar Irradiance
- $0.153/kWh

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MW PV

July 14, 2015
Distribution Resources Planning Purposes

(1)

- Identify **optimal locations** for Distributed Energy Resources
- Evaluate **locational benefits** of DERs based on:
  - Reductions versus increases in local generation **capacity** needs
  - **Avoided costs** versus increased investment for distribution infrastructure, safety benefits, reliability benefits
  - Any other **savings or costs** that DERs may provide to the grid or to ratepayers
- **Integrated Capacity Analysis**
- Propose or identify **standard tariffs, contracts, or other mechanisms for deployment** of cost-effective DERs that satisfy distribution planning objectives
DRP Process: “More Than Smart (MTS)”
Working Group

Purpose:

- **Provide an open, voluntary stakeholder forum** to discuss core issues

Objectives:

- Define common parameters for the development of distribution planning scenarios
- Identify and define the integrated engineering-economic analysis required to conduct distribution planning in the context of AB 327 requirements
- Identify the considerations to meet customers’ needs and California’s policy objectives.
- Define the scope and parameters of an operational/DER market information exchange
- Define distribution services associated with identified DER values, including performance requirements
DER Wholesale Value Components (1/2)

Objective is to define a list of **mutually exclusive and collectively exhaustive (MECE)** value categories

<table>
<thead>
<tr>
<th>Value Component</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>WECC Bulk Power System Benefits</td>
<td>Regional BPS benefits not reflected in System Energy Price or LMP</td>
</tr>
<tr>
<td>CA System Energy Price (NEM 2.0)</td>
<td>Estimate of CA marginal wholesale system-wide value of energy</td>
</tr>
<tr>
<td>Wholesale Energy</td>
<td>Reduced quantity of energy produced based on net load</td>
</tr>
<tr>
<td>Resource Adequacy (NEM 2.0 modified)</td>
<td>Reduction in capacity required to meet Local RA and/or System RA reflecting changes in net load and/or local generation</td>
</tr>
<tr>
<td>Flexible Capacity</td>
<td>Reduced need for resources for system balancing</td>
</tr>
<tr>
<td>Wholesale Ancillary Services (NEM 2.0)</td>
<td>Reduced system operational requirements for electricity grid reliability including all existing and future CAISO ancillary services</td>
</tr>
<tr>
<td>RPS Generation &amp; Interconnection Costs (NEM 2.0)</td>
<td>Reduced RPS energy prices, integration costs, quantities of energy &amp; capacity</td>
</tr>
<tr>
<td>Transmission Capacity</td>
<td>Reduced need for system &amp; local area transmission capacity</td>
</tr>
<tr>
<td>Generation/DER Deliverability</td>
<td>Increased ability for generation and DER to deliver energy and other services into the wholesale market</td>
</tr>
<tr>
<td>Transmission Congestion + Losses (NEM 2.0 modified)</td>
<td>Avoided locational transmission losses and congestion as determined by the difference between system marginal price and LMP nodal prices</td>
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<tr>
<td>Wholesale Market Charges</td>
<td>LSE specific reduced wholesale market &amp; transmission access charges</td>
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## DER Distribution Value Components (2/2)

<table>
<thead>
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<th>Value Component</th>
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<td><strong>Distribution</strong></td>
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<tr>
<td>Subtransmission, Substation &amp; Feeder Capacity (NEM 2.0 modified)</td>
<td>Reduced need for local distribution system upgrades</td>
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<tr>
<td>Distribution Losses (NEM 2.0)</td>
<td>Value of energy due to losses between wholesale transaction and distribution points of delivery</td>
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<tr>
<td>Distribution Steady-State Voltage</td>
<td>Improved steady-state (generally &gt;60 sec) voltage, voltage limit violation relief, reduced voltage variability, compensating reactive power</td>
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<tr>
<td>Distribution Power Quality</td>
<td>Improved transient voltage and power quality, including momentary outages, voltage sags, surges, and harmonic compensation. <em>May also extend the life of distribution equipment</em></td>
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<tr>
<td>Distribution Reliability + Resiliency+ Security</td>
<td>Reduced frequency and duration of outages &amp; ability to withstand and recover from external natural, physical and cyber threats</td>
</tr>
<tr>
<td>Distribution Safety</td>
<td>Improved public safety and reduced potential for property damage</td>
</tr>
<tr>
<td>Customer &amp; Societal</td>
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<tr>
<td>Customer Choice</td>
<td>Customer &amp; societal value from robust market for customer alternatives</td>
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<tr>
<td>CO2 Emissions (NEM 2.0 modified)</td>
<td>Reductions in federal and/or state carbon dioxide emissions (CO2) based on cap-and-trade allowance revenue or cost savings or compliance costs</td>
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<td>Criteria Pollutants</td>
<td>Reduction in local emissions in specific census tracts utilizing tools like CalEnviroScreen. Reduction in health costs associated with GHG emissions</td>
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<td>Energy Security</td>
<td>Reduced risks derived from greater supply diversity and less lumpiness</td>
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<td>Water Use</td>
<td>Synergies between DER and water management (electric-water nexus)</td>
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<tr>
<td>Land Use</td>
<td>Environmental benefits &amp; avoided property value decreases from DER deployment instead of large generation projects</td>
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<tr>
<td>Economic Impact</td>
<td>State and/or local net economic impact (e.g., jobs, investment, GDP, tax income)</td>
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Locational Value: Assessment of DER by Adding Avoided Costs and Benefits

Note: Analysis excludes some avoided costs/benefits that do not have a locational dimension. Therefore, analysis is not intended to estimate full stack of avoided costs and benefits associated with DER.

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<tr>
<th>Value</th>
<th>Integration Cost</th>
<th>Net Locational Value</th>
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<table>
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<td>Integration Costs</td>
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<td>Total Benefits</td>
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<td>Net Avoided Costs</td>
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</tbody>
</table>

Locational Value: Adding Avoided Costs and Benefits

Illustrative

- Local Emissions
- Power Quality
- Resiliency
- Reliability
- Dist Capacity
- Transmission Capacity
- Generation Capacity
- Energy

July 14, 2015
WIEB/SPSC Report: Essential Recommendations

1. **Develop long term distribution planning roadmaps**
   - Use Open Stakeholder process for roadmap
   - Include if and when formal DRPs are necessary for which locations
   - Include risk assessments of technologies and reliability of resources

2. **Do not re-invent what has already been achieved**
   - Use existing DRP costing methodology, as applicable
   - Follow SIWG technological requirements and IEEE 1547 standard
   - Use existing integration and communication standards for interoperability

3. **Address cost allocation early**
   - Focus on “least regrets” solutions
   - Enhance market equitability (“fairness”) over time (not just the last DER)
   - Provide pricing and investment stability
   - Minimize technological obsolescence
Addressing EV Load Growth

Electric vehicles per 1,000 registered vehicles

- Less than 1
- 1 to 2
- 2 to 3
- More than 3

EQL ENERGY
EV Cars in Urban Markets

7,896 Electric Vehicles registered in Washington
As of January 1, 2014

Source: Washington State Department of Transportation
EV Registrations in Oregon by County

- Clatsop: 20
- Columbia: 6
- Tillamook: 3
- Washington: 282
- Yamhill: 23
- Marion: 134
- Multnomah: 424
- Hood River: 8
- Sherman: 0
- Gilliam: 1
- Morrow: 1
- Umatilla: 7
- Union: 8
- Wallowa: 0
- Lincoln: 10
- Benton: 92
- Linn: 24
- Jefferson: 4
- Crook: 3
- Wheeler: 0
- Grant: 0
- Baker: 6
- Coos: 16
- Douglas: 20
- Lane: 123
- Deschutes: 48
- Klamath: 8
- Lake: 0
- Harney: 1
- Malheur: 1

Effective Date: 9/13/2012

July 14, 2015

www.eqlenergy.com
### Roadmaps

<table>
<thead>
<tr>
<th>MODERN GRID</th>
<th>SHORT TERM</th>
<th>MEDIUM TERM</th>
<th>LONG TERM</th>
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<tbody>
<tr>
<td></td>
<td>Implement Oahu Pilot</td>
<td>Full Smart Grid Implementation</td>
<td>Implement DA/FCI Phase 2</td>
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<tr>
<td></td>
<td></td>
<td>Implement DA/FCI Phase 1</td>
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</tr>
<tr>
<td>ADVANCED INVERTERS</td>
<td>Test/Implement Phase 1 Smart Inverter Features</td>
<td>Test/Implement Phase 3 Smart Inverter Features</td>
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<tr>
<td>DISTRIBUTED STORAGE</td>
<td>Select Utility Scale Energy Storage Projects</td>
<td>Implement DESS Pilot</td>
<td>Begin DESS/CESS Deployments</td>
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<tr>
<td></td>
<td></td>
<td>Implement CESS Pilot</td>
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<table>
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<tr>
<th>DEMAND RESPONSE</th>
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<th>R-DL Continuation &amp; Expansion</th>
<th>R-Flexible Full Program</th>
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<tr>
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<td>CIDLC Continuation &amp; Expansion</td>
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<tr>
<td></td>
<td></td>
<td>C&amp;I Flexible Full Program</td>
<td>Water Pumping Full Program</td>
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<tr>
<td></td>
<td></td>
<td>Customer Firm Generation Full Program</td>
<td>Dynamic Pricing and CPP Full Program</td>
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</table>

| ELECTRIC VEHICLES |     | Redefine TCU periods to shift load to desired periods during the day | Implement Dynamic Pricing |
|                  |     | Implement EV Load Build and Charge Strategy to Mitigate Grid Issues | Implement Smart EV Charging with AMI |
|                  |     | Install and operate up to 25 DC Fast Chargers on Oahu, Maui, and Kauai Island under Rate Schedule EVU | Investigate Pilot V2G Opportunities |
|                  |     | Enroll commercial customers under Rate Schedule EV-U to encourage the startup of EV Fast Charging facilities |         |

| NON-EXPORT DG |     | Implement 14H Appendix II-B Revisions | Track/Monitor Non-Export DG by Circuit |
|              |     | Ancillary Services Testing and Evaluation |         |

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- **NO Two-Way Communication Required**
- **Two-Way Communication Required**
**Without Planning DER integration may be utility asset heavy**

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<thead>
<tr>
<th>Item</th>
<th>Violation Trigger</th>
<th>Total</th>
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<tbody>
<tr>
<td>Installed DG (MW)</td>
<td></td>
<td>902</td>
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<tr>
<td>Regulator</td>
<td>Feeder Reverse Flow</td>
<td>$308,000</td>
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<tr>
<td>LTC</td>
<td>Substation Transformer Reverse Flow</td>
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<tr>
<td>Reconductoring</td>
<td>Exceed 50% Backbone Conductor/Cable</td>
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<tr>
<td>Substation Transformer and Switchgear</td>
<td>Exceed 50% Capacity</td>
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<tr>
<td>Distribution Transformer</td>
<td>Exceed 100% Loading, % GDML Linear Relationship to % Transformers Upgraded</td>
<td>$15,617,535</td>
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<tr>
<td>Poles and Secondary</td>
<td>Assumed 15% of Distribution Transformer Replacements need poles/secondary</td>
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<tr>
<td>Grounding Transformers</td>
<td>Exceed 33% GDML (66% in model)</td>
<td>$43,045,200</td>
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<tr>
<td><strong>Total</strong></td>
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<td><strong>$194,500,777</strong></td>
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