# Making Energy Storage Work for The Pacific Northwest

US DOE Peer Review Program 2015
Portland, OR
September 23, 2015

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*Leading Oregon to a safe, clean, sustainable energy future*

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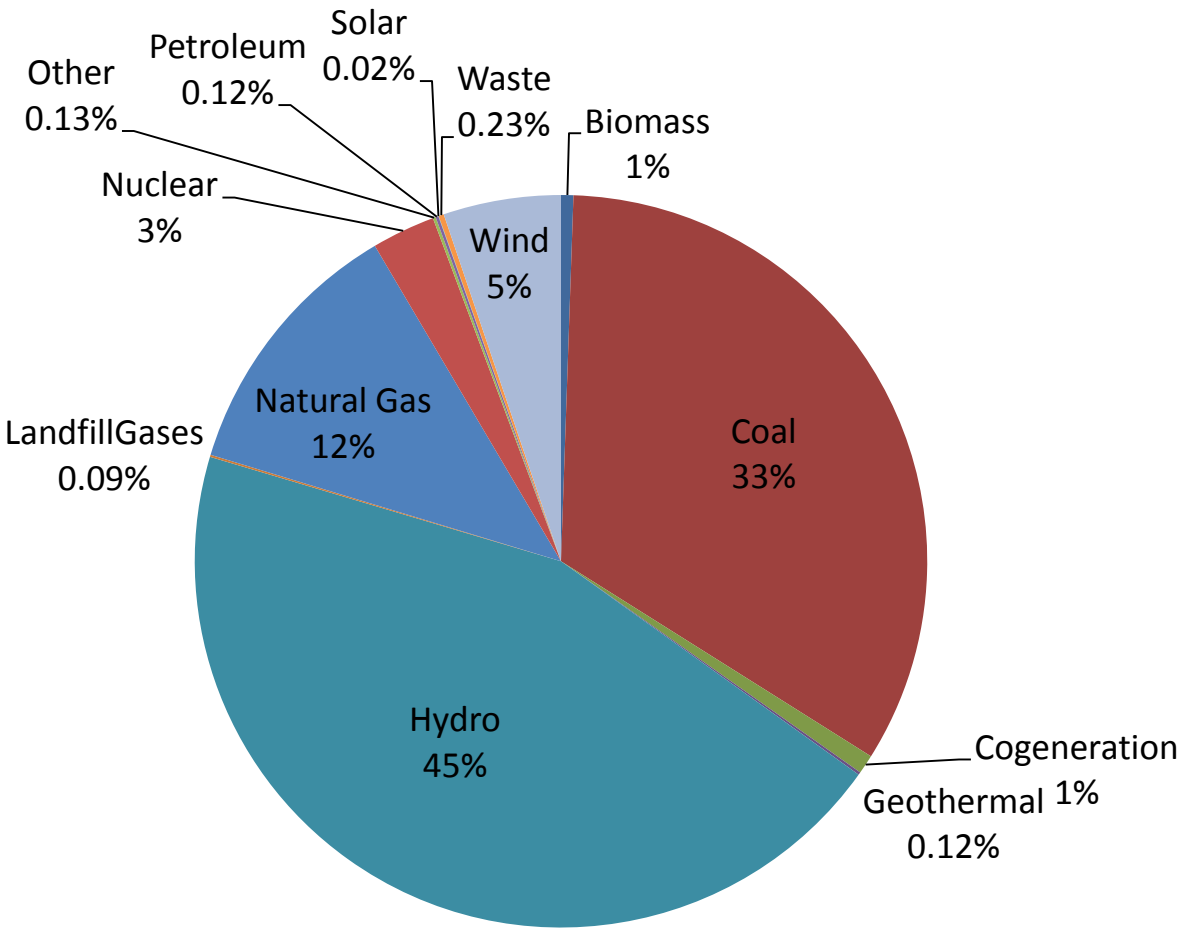
# Oregon's Electricity Portfolio

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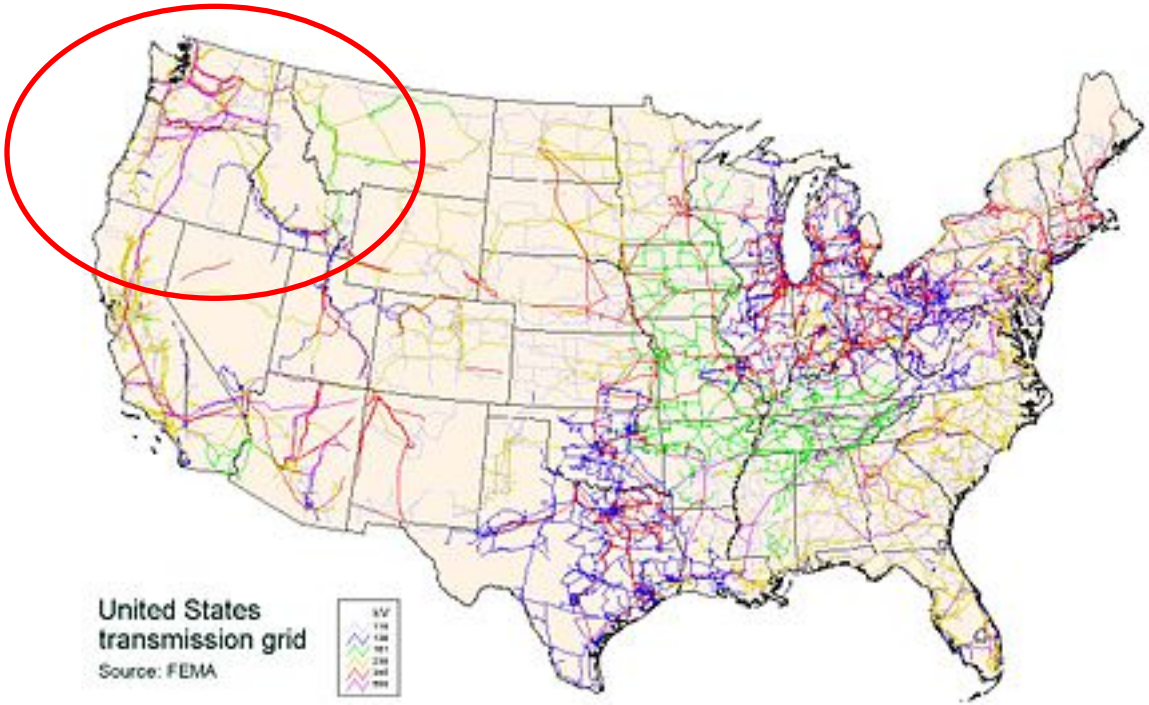
# The Pacific Northwest Electric Grid

- The Pacific Northwest transmission grid is more radial, with fewer meshes, than in the Midwest and East
- Some geographic regions are at higher risk for outages
- No RTO or ISO in the Northwest

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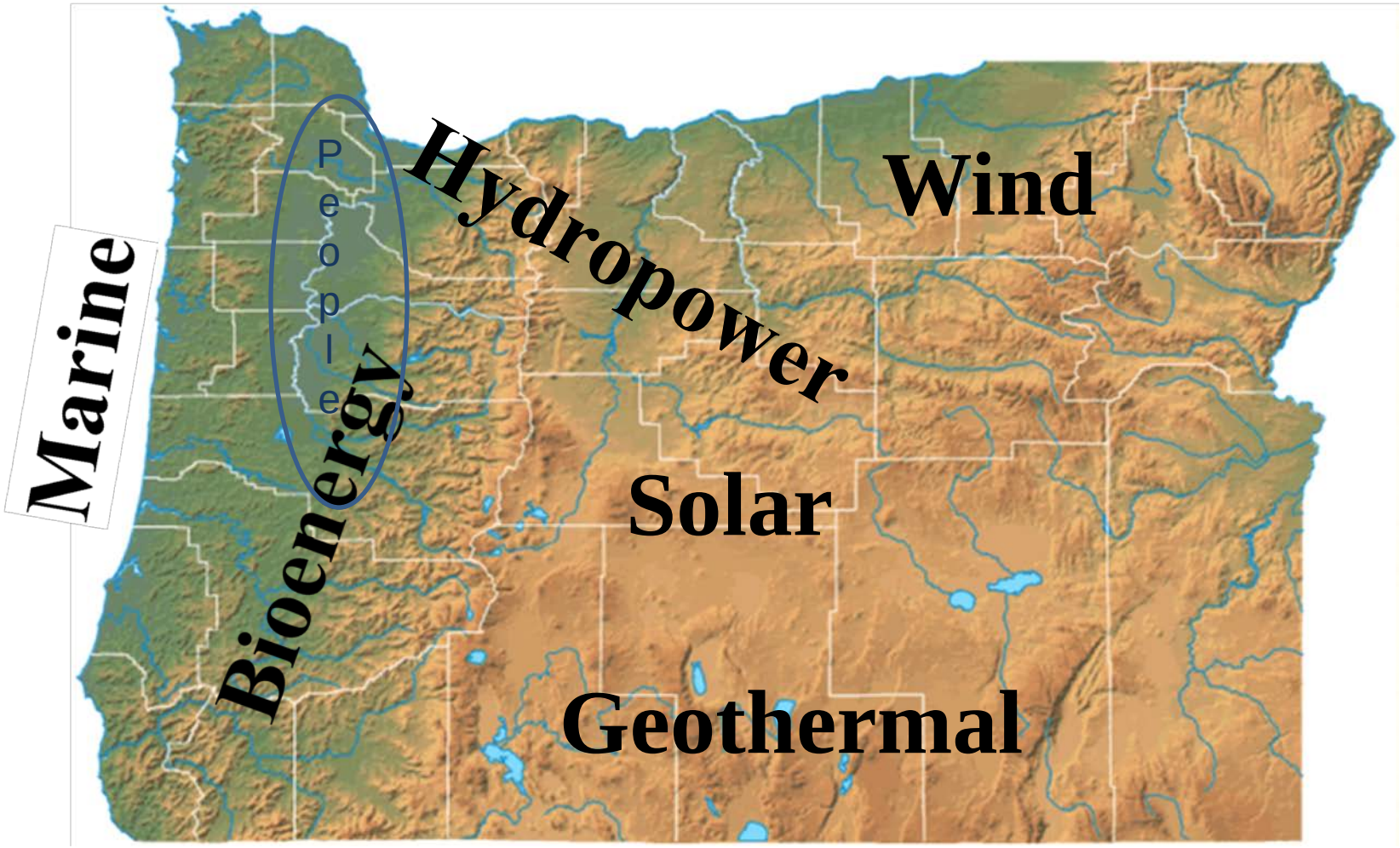
# Characterizing Renewable Energy - Resource Location

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# Oregon's Energy System Challenges

Higher RPS will bring more VER

Solar is growing, utilities see stress on T&D system – UM 1716 Investigation into Resource Value


Climate change could mean the region becomes summer peaking, also more variation in hydro resource

New loads entering the region: data centers

Exploring methods to increase flexibility: EIM, BA coord.

*"managing variability and uncertainty"*

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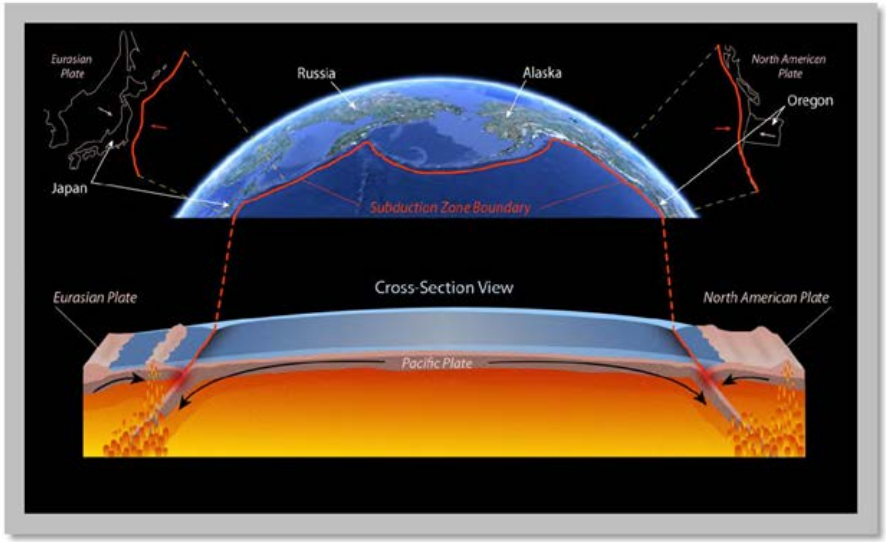
# “The Big One”

## Cascadia Subduction Zone Event

- Oregon is mirror-image of Japan in Ring of Fire
- ~15% chance of occurring in next 50 years
- Magnitude 8-9 earthquake expected 300 years; last recorded event 1700 AD
- 1 to 6 ***months*** without power, Valley and Coast




Source: Dan Bihn, et. al, Portland State University

*“building energy resilience”*

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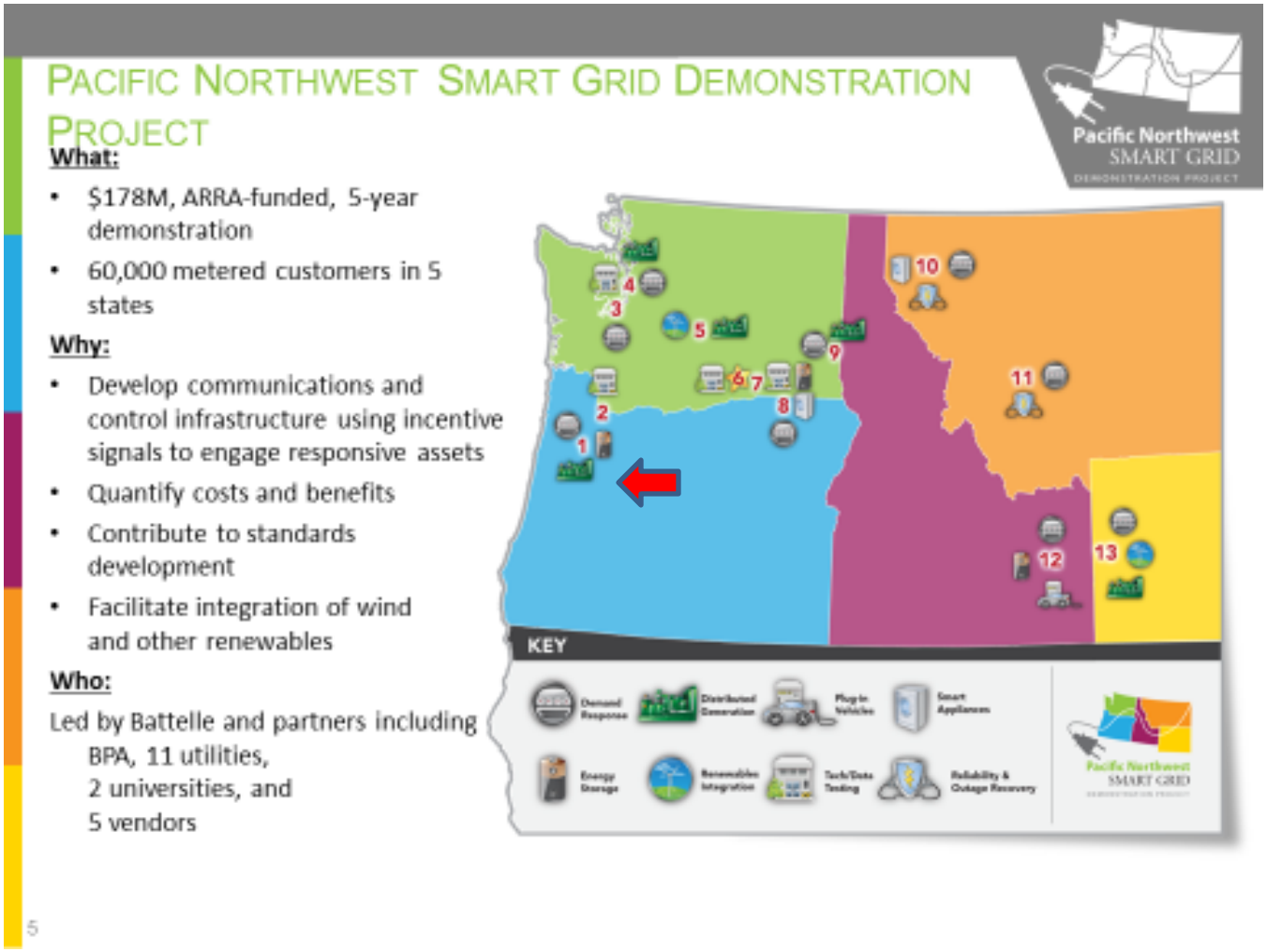
# Energy Storage Developments

## BPA's Technology Innovation Program

http://www.bpa.gov/Doing%20Business/TechnologyInnovation/Pages/default.aspx

- RECENT AND CURRENT PROJECTS: Utilities engaged in R&D using batteries in distribution substations
- Demonstrating different chemistry, modular packaging and communications standards
- Evaluating energy storage and demand response as complimentary programs

# PNW Smart Grid Demonstration



# PGE – Salem Smart Power Project

- 5 MW, 1.25 MWh Li-ion battery bank deployed in the distribution system
- 8,000 sq. ft. facility that opened in March 2013, can operate in a microgrid
- Operates on a feeder with 100 kW solar and dispatchable diesel generators
- $25 million facility built in collaboration with Eaton Corporation and EnerDel, Inc., and received DOE matching funds as part of the PNW Smart Grid Demonstration

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# Energy Storage Policy Development in Oregon

- In Oregon we want to “have our cake”, but it must be a layer cake!

- Develop analytics, modeling and policies that value the multiple layers of system benefits[1]
  - What value streams are analyzed, and which are not?
  - Does the analysis address a specific power system need against an alternative?
  - Is the analysis based on market-price valuation? If so, does it account for the market price effects of the added unit?
  - Is there a power system dispatch model used? If so, does the model use sub-hourly dispatches and have good input data?
  - Are environmental costs and benefits addressed?
  - Does the valuation look at a range of futures, with some evaluation of the sensitivity to assumptions?

1. Excerpted from K. Dragoon, “Energy Storage Opportunities and Challenges”, April 2014

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# Oregon and US DOE Energy Storage Demonstration Pilot

- One year of preparatory work: Oregon energy storage workshop; comment opportunity; targeted outreach to stakeholders in energy storage; solicitation team formed
- Demo objectives: demonstrate integration and operation of energy storage system with electric utility operations; multiple applications or “use cases” in one project; resiliency/reliability and integration of renewable energy

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# Oregon RFGA Open Now

| Application | Description | ESS location | Example Value Demonstrations |
|---|---|---|---|
| **T&D Upgrade Deferral/ Management of Peak Demand** | Defer the installation or upgrade of power lines and transformers | Utility system, transmission or distribution, or C&I facility | $/kW of peak load reduction; site specific benefits such as cost deferred and for how long the deferral will be adequate |
| **Service Reliability/ Resiliency** | Backup power on the utility side of the meter or at commercial & industrial facilities | Utility distribution system, microgrid or C&I facility, | Response to grid disturbances; and emergency preparedness, Control and visibility to owner. Critical load being served. |
| **Power Quality/ Voltage support** | Utilize the power conversion systems of ESS for dynamic, bi-directional VAR support | Utility system, transmission or distribution | Total cost of ownership; operating cost |
| **Grid Regulation** | Transmission system area regulation, faster response than conventional generators | Utility system, transmission or distribution | Total cost of ownership; operating cost; Cost savings compared to peaker plant or next best alternative. |
| **Renewable energy firming, ramp control, energy shift** | Smooth output of solar and wind generators, assisting in meeting interconnection standards | Utility system, transmission or distribution | $/kWh of reduced curtailments; availability; capacity factor |

- Up to $295,000 grant through US DOE OE, ODOE, Sandia Natl. Lab and Oregon BEST
- 500 kW/kWh min. size
- Utility partner or letter of support
- Five high-interest applications
- Online within 18 months
- Min. one year of operational data
- Responses due by Oct. 16 2015

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# Energy Storage Legislation: HB 2193

- Mandate for energy storage projects by two largest IOUs by 2020
- Utilities have been engaged in refining the bill; passed both houses
- Modest in size: 5 MWh total project size (minimum) and no more than 1% of the utility's peak load (maximum)
- Initial activity is a working group, composed of OPUC staff, utilities, energy storage advocates, and ratepayer advocates
  - Develop criteria for the proposals from utilities
  - Define values of energy storage
  - Describe electrical system operational challenges and how energy storage is a suitable solution with costs that are proportional to customer benefits
- First proposals due from utilities by Jan. 2019

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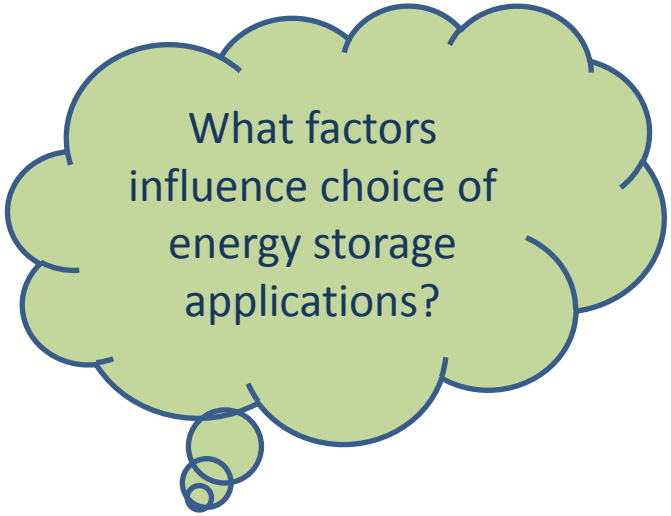
# Solicitation Q & A

Time period for submitting questions closed Monday Sept. 21 4:00 pm PT.




Inquiries indicate a good level of interest and a variety of tech/applications.

Answers will be posted on ORPIN and the ODOE website on Sept. 28.

# Oregon's Energy Loan Program

Established in 1981, SELP is the oldest State managed, energy loan program in the United States.

Underwritten and financed over $600 million in energy projects.

The program provides technical expertise and has experience working with developers and underwriting renewable energy projects.

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# Thank you for your attention. Questions?

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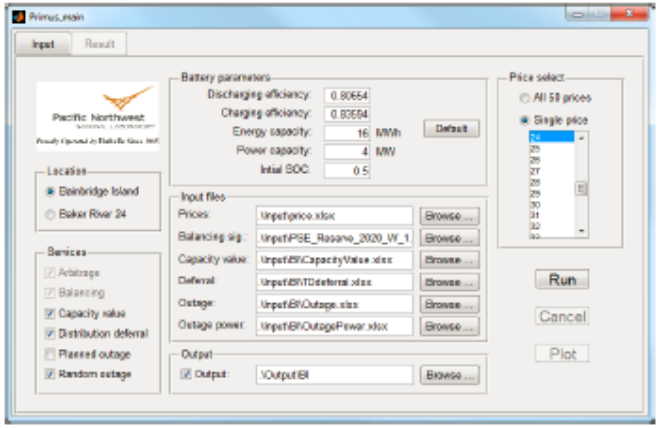
# Reference Slides – not for presentation

# PNNL Storage Analysis

## Bainbridge Island, WA

- **BPA/PSE/Primus with DOE OE**
- **The Bainbridge Challenge**
  - Substations capacity constrained
  - Reliability issues with radial transmission and distribution
- **Approach**
  - Developed analysis tool to effectively optimize value from multiple applications.




**Energy Storage System**

- 0.5MW/2MWh Primus Zn-$Br_2$
- Battery Cost $2300/kW
- Installed Cost $3,690/kW

**Analysis Results**

- $20M in benefits required
- $21M - $26M projected return by co-optimizing benefits.
- Optimal energy storage is 3 MW and 9-12 MWh

**Usage Breakdown**

- 40% Outage Mitigation
- 25% Capacity Value
- 23% Upgrade Deferral,
- 11% Balancing service
- < 1% Arbitrage

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# PGE – Salem Smart Power Project

- **Energy storage for resilience**: The lithium-ion batteries can run the micro-grid for up to 30 minutes.
- **Back-up to the back-up**: The batteries also work in concert with nearby standby generators owned by the state of Oregon, creating a high-reliability zone designed to reduce service interruptions for customers in the area. The Oregon State Data Center and Oregon Military Department are participating.
- **Integrating renewables**: Salem-based Kettle Brand, pioneer of the kettle-cooked potato chip and industry leader in sustainability, is connecting its 616-panel rooftop solar installation to the project to help test storage and bring solar energy into the grid when it's needed most.
- **Leveling out demand**: To test demand response technologies, several business customers are volunteering to let PGE cycle their heating and cooling and other systems on and off throughout the day or to shift their use to off-peak periods. Several households have volunteered to have PGE cycle their water heaters on and off briefly throughout the day to reduce demand when usage and energy costs are high.
- **Transactive Control**: PGE is performing ongoing tests of its own Smart Power® software that uses a regional efficiency and reliability pricing market, where local and regional conditions including transmission congestion, generator availability and customer reliability are considered as electricity price indicators.

# Energy Storage Developments

## BPA's Technology Innovation Program

http://www.bpa.gov/Doing%20Business/TechnologyInnovation/Pages/default.aspx

- PAST PROJECTS: Integrating RE, mostly focused on wind farms 100 MW +
- Batteries and capacitors, collocated at the wind farm
- Comparing the cost of energy storage for balancing services to cost of increased O&M costs for hydro generators

BONNEVILLE POWER ADMINISTRATION

OSU