Goldendale Energy Storage Project

Supporting a carbon free future through proven, affordable grid-scale storage
Pumped storage is the only proven, cost-effective storage technology at scale

- **Pumped storage** is the only **proven, cost-effective** storage at **scale**
- Consists of pumping or generating by moving energy in the form of water through a powerhouse between an upper and lower reservoir
- **Pumped storage is prolific** in the **US** – there are **39 pumped storage plants** in operation with a total installed capacity of about **22,000 MW**; however, **over 2 decades since last built in US**
- **Globally**, there is nearly **131,000 MW** of pumped storage capacity currently in operation; **currently building all over world but US**
- **Batteries** still very expensive, uncertainty viability in replacing thermal plants, don’t last nearly as long and come with mining/toxic waste issues
National Grid: one of the world’s largest investor-owned energy utilities

- Own/operate the electricity transmission network in England and Wales (i.e. System Operator or “SO”)
- Operate, but do not own, the Scottish networks
- Own/operate the gas National Transmission System in UK
- Own/operate transmission facilities across upstate New York, Massachusetts, New Hampshire, Rhode Island and Vermont
- Own/operate electricity distribution networks in upstate New York, Massachusetts and Rhode Island
- Own/operate gas distribution networks across the northeastern US, located in upstate New York, New York City, Long Island, Massachusetts and Rhode Island.
Rye Development – Overview

Rye Development is the leading Developer of New Hydro in the US

- FFP New Hydro LLC ("FFP NH") is institutionally owned and funded, by US Renewables Group, Crestline Investors, and Ascent Holdings
- Rye Development, LLC ("Rye") is the manager of FFP NH
- 24 projects – $2.5-billion in development
Goldendale Energy Storage Project

- 1200MW “closed loop” pumped storage facility
  - 2,360 feet of head (719 m)
  - 3 x 400MW pump-turbine/generator units
  - 25,506 MWh energy storage

- **Leasing water from KPUD.** Water rights secured by KPUD for the specific purpose of a pumped storage facility by Washington law
  - 9000 AF initial fill
  - 300 AF annual water use

- Achievable in-service date 2028

- Interconnection Feasibility Study performed by Bonneville Power Administration at 500-kV John Day Substation; cost $11M

- HDR Opinion of Probable Construction Cost $2B
Project Characteristics

- 10% Engineering Definition
- Three 400-MW reversible pump-turbines = 1,200 MW
- Energy storage =12 hours = 14,400 MWh @ rated capacity
- Two modes of operation
  - Generating
  - Pumping
  - Time to change mode: minutes
Pumped storage **strategically located in grid for renewable integration and replacement capacity**

- Viable/constructible “**closed-loop**” project interconnecting into existing **high-voltage transmission** that leverages major import/export path to California
- Proven storage solution **strategically located in grid** to support regional **decarbonization** goals affordably and reliably
- Project support **continued history** of beneficial regional bulk power exchanges between California and the Pacific Northwest
- **Hundreds of millions of annually potential cost-saving/revenue based on E3 economic modeling** (in addition to staggering economic development/jobs)

**Map Diagram**
- California Oregon Transmission Project (COTP)
- Pacific AC Intertie (PACI)
- Pacific DC Interties (PDCI)

**1200-MW Goldendale Energy Storage Project**

**7900MW total transfer capacity vis-à-vis AC-DC Interties**
Regional Regulatory/Market Situation

The PNW system will need 8 GWs of new effective capacity by 2030, 20 GWs by 2045 per E3 Resource Adequacy study.

http://www.publicgeneratingpool.com/e3-carbon-study/

Proposed Washington State 100% out of coal by 2025
Significant PNW capacity needs

- Significant capacity deficits for PGE beginning in 2025
2019 PGE IRP draft “Preferred Portfolio”

Mixed Full Clean Portfolios includes:
- Diverse portfolio of wind resource additions in 2023
- Additional wind in 2025
- Storage (4 hour duration and longer) to meet remaining capacity needs
Significant PNW capacity needs

- Early/accelerated coal plant retirement
With **no new thermal resources** available the only resource large enough to meet the capacity need is **pumped storage** hydro. *PSE 2017 IRP*
CA 100% modeling selects mostly solar and storage to meet decarbonization goals

- 100%+ RPS achieved by 2050 in both scenarios
- E3’s RESOLVE utilizes a Planning Reserve Margin constraint but does not examine resource adequacy in detail

### High Biogas Scenario

- **Solar and storage build driven by decarbonization targets**

### High Electrification Scenario

- 6-hr duration

**Installed renewable resources as of 3/4/2019**

<table>
<thead>
<tr>
<th>Resource</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>11,799</td>
</tr>
</tbody>
</table>
With transmission/market access to CA, Goldendale can extract value of cheap mid-day solar oversupply from the market.
Curtailment over time - CAISO
Economic Benefits

- Project construction will create 1,000’s of good-paying construction jobs

- Project Operation: 30 family wage operator positions, 40 additional local jobs indirectly created

- *Millions of dollars in annual property taxes to the county for an area that has long been the focus of commercial/industrial redevelopment*
Economic Benefits

- Klickitat County Assessor annual tax district estimates
  - County general: $2,601,249
  - County road: $3,221,685
  - Goldendale school district: $3,000,000
  - EMS: $1,000,000
  - Klickitat County Hospital: $1,230,566
  - Fire 7: $1,692,540
  - Library: $727,160
  - Rec. District 1: $540,000
Development Schedule

- **2019**: Licensing Studies / Draft License Application
- **2020/2021**: FERC EA or EIS
- **2022-2024**: Final Design / Equipment Procurement
- **2028**: COD

**Timeline:**
- **2020**: License Application
- **2022**: FERC License
- **2024-2028**: Construction
Thank You

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Appendices
Pumped storage is a cheaper storage technology than Li-ion batteries

When evaluating large-scale energy storage options, the two most mature technologies demonstrate favorable options to cost effectively integrate renewable energy on grid. With the long, reliable project life of pumped storage, investments today will offer greater savings for future generations.
Li-Ion Battery vs Pumped Storage

Dr. Klaus Krüger | 2018-06-27
Comparison of Raw Material Costs during the Assumed Lifetime of 100 Years (13.4 GWh)

Assumptions for the comparison:

• the battery cells need to be replaced 4 times within 100 years (every 20 years)
• the runners and the motor-generator sets have to be replaced 2 times (every 40 years)

➔ The running raw material costs (excluding initial raw materials) of BSS is about 357 times more cost intensive over 100 years.

➔ Overall, over 100 years, the raw material requirements of BSS are approximately 18 times more cost intensive than PSP.
The CO₂ footprint regarding the PSP includes not only the raw materials but also the emissions during construction.

For the BSS the CO₂ footprint contributions for the air-conditioned transport, storage and installation of the battery cells have been considered.

⇒ The CO₂ footprint of the BSS is about twice the footprint of the PSP.