Shell Energy North America

Hydro Battery Concept Update

JT Steenkamp P. Eng.
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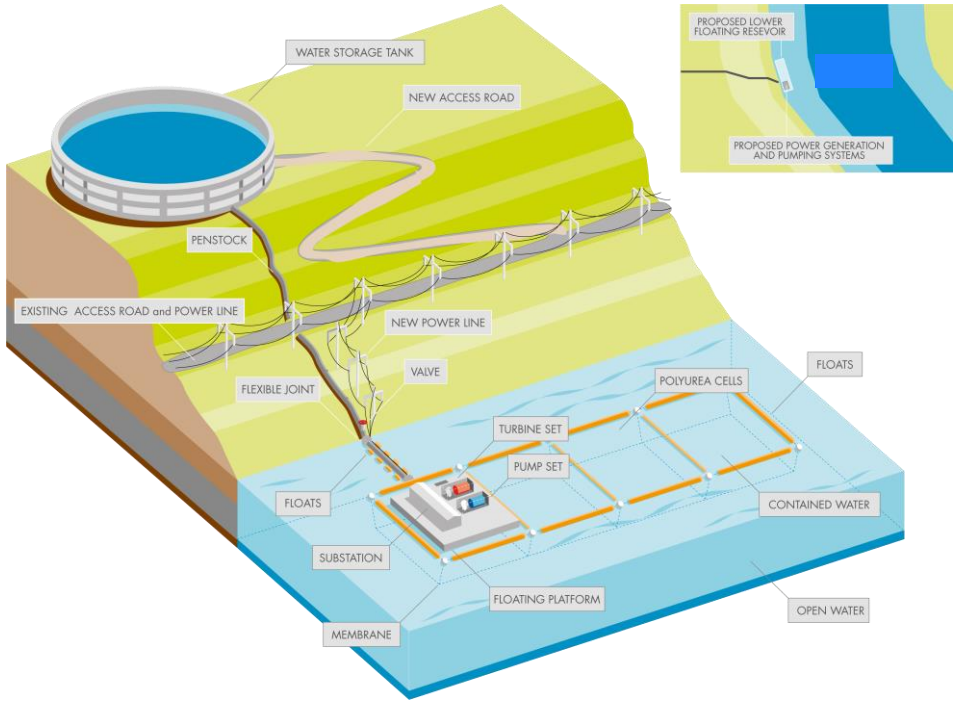
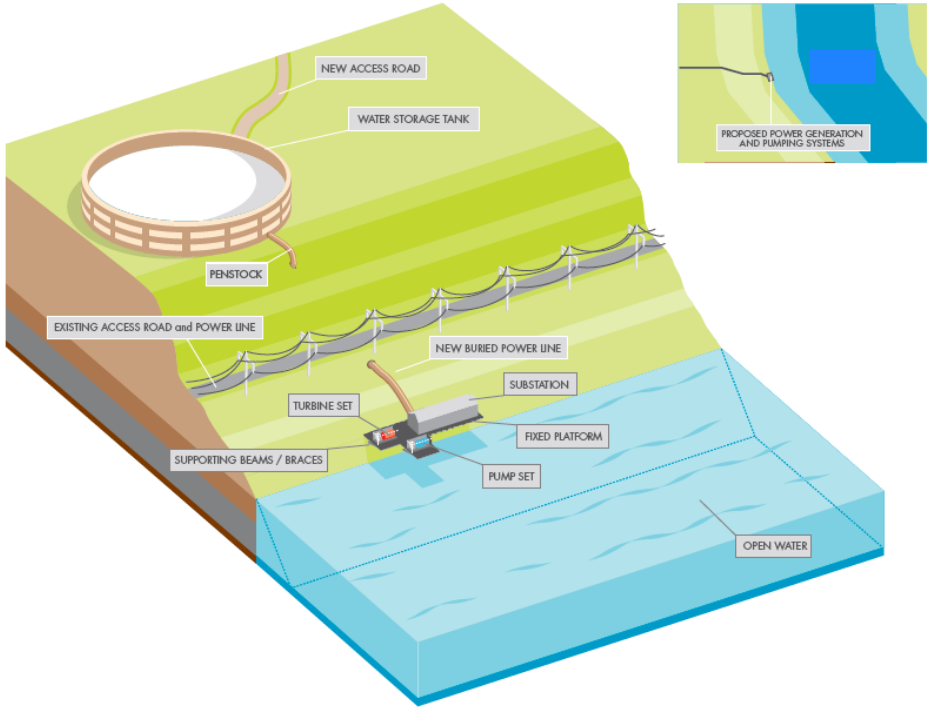
Background

- Shell is developing a standard design catalogue for fast-deploying small modular pumped storage configurations
- Using O&G methodologies
- And with support from DOE HydroNEXT program





Key Participants

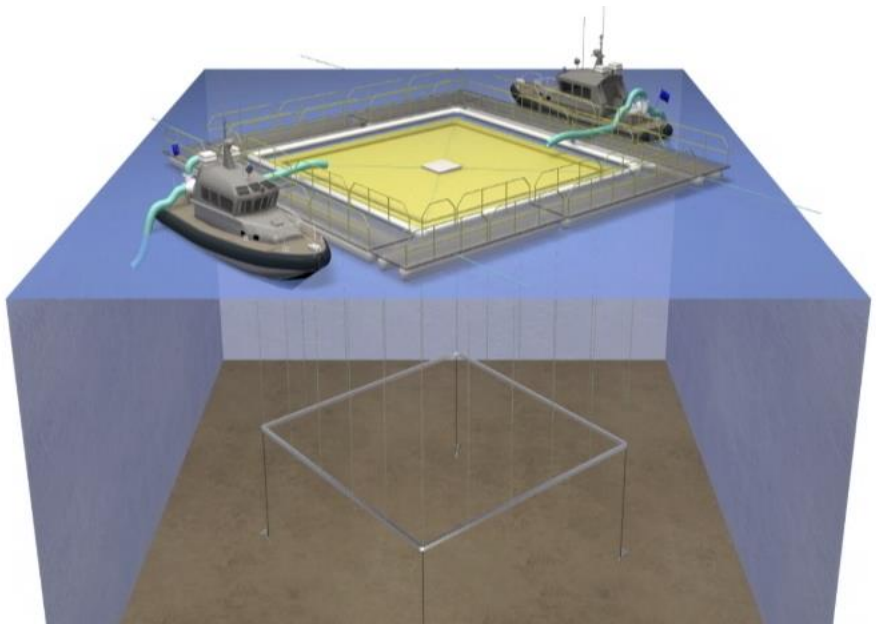
- Shell – Principle investigator; in-house design focused on terrestrial elements of catalog.

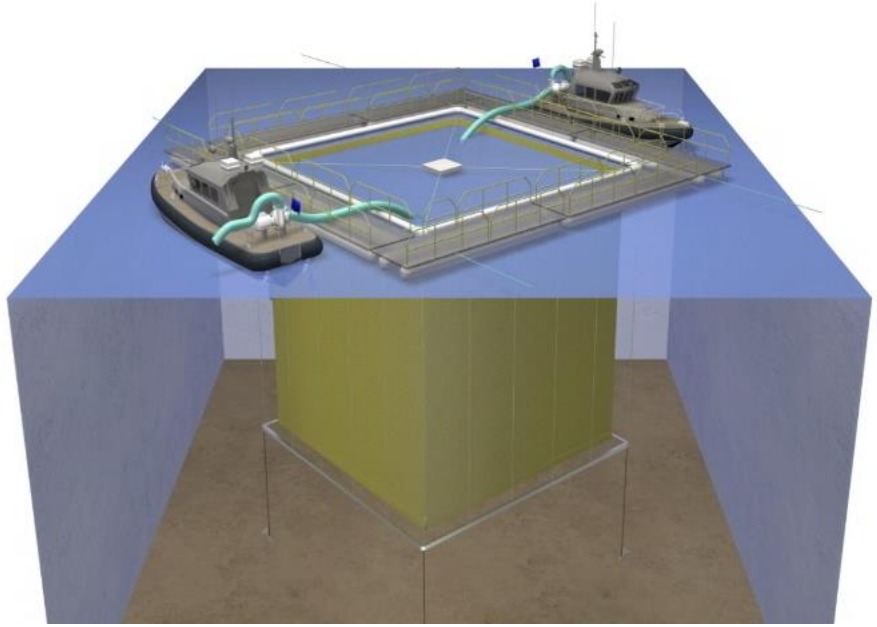
  Shell would also like to thank:

  - ORNL – Design of floating reservoir system for catalogue, Bo Hadjerioua
  - PNNL – Market value analysis, Patrick Balducci
  - Western Washington University – Lifecycle Energy Intensity Benchmarking, Charlie Barnhart

Highlights to date

- Floating reservoir concept "so crazy it just might work…"

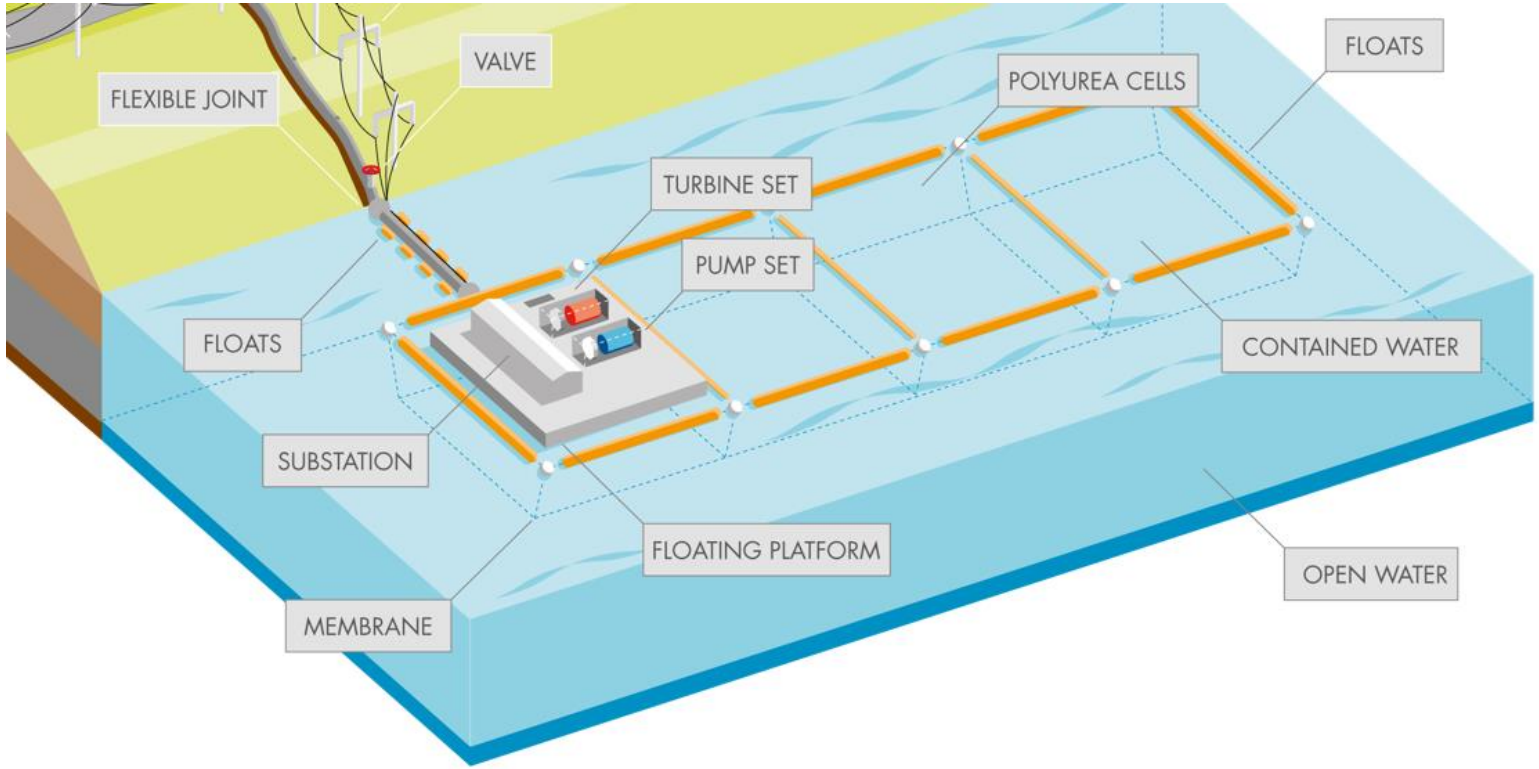




Boats shown are for testing scenarios only

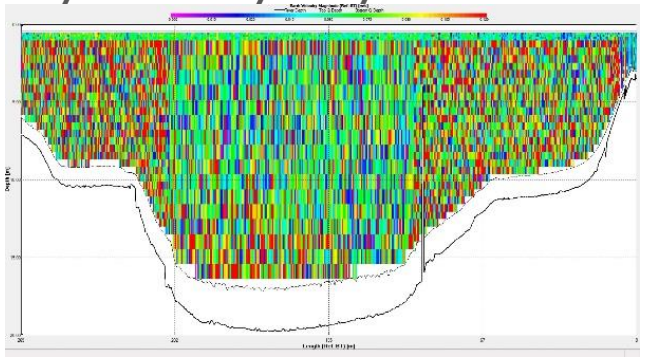
Highlights to date

- Floating reservoir concept "so crazy it just might work…"

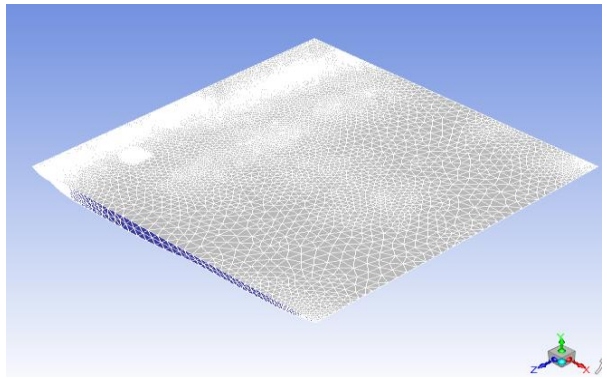


Prototype Testing Site

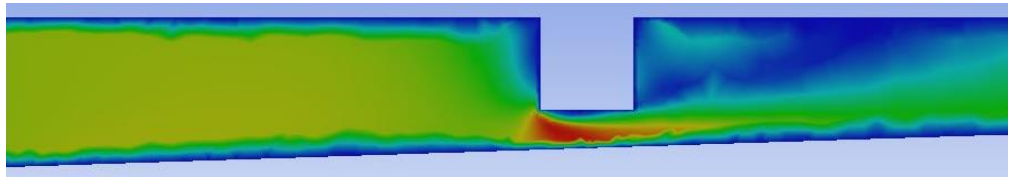
Velocity and Bathymetry Measurements



3-D Computational mesh



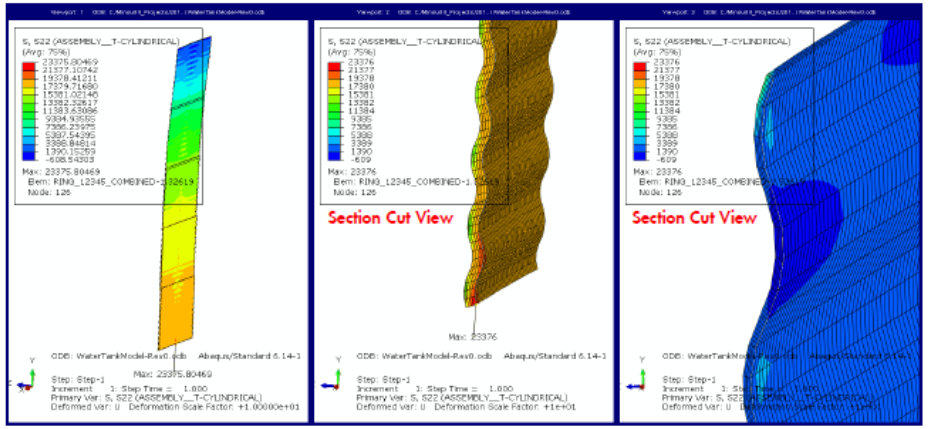
Velocity Contours Around the Floating Reservoir

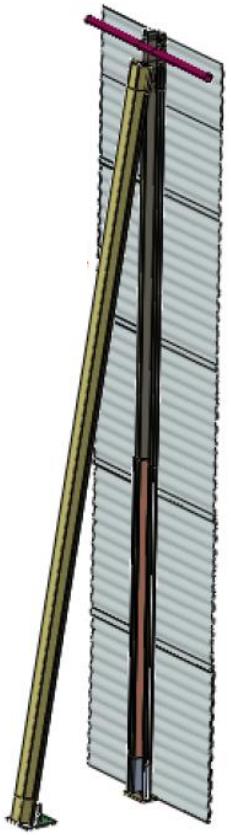


OAK RIDGE National Laboratory

Highlights to date

- World's largest corrugated steel tank?





Highlights to date

- World's first insulated pumped storage reservoir?

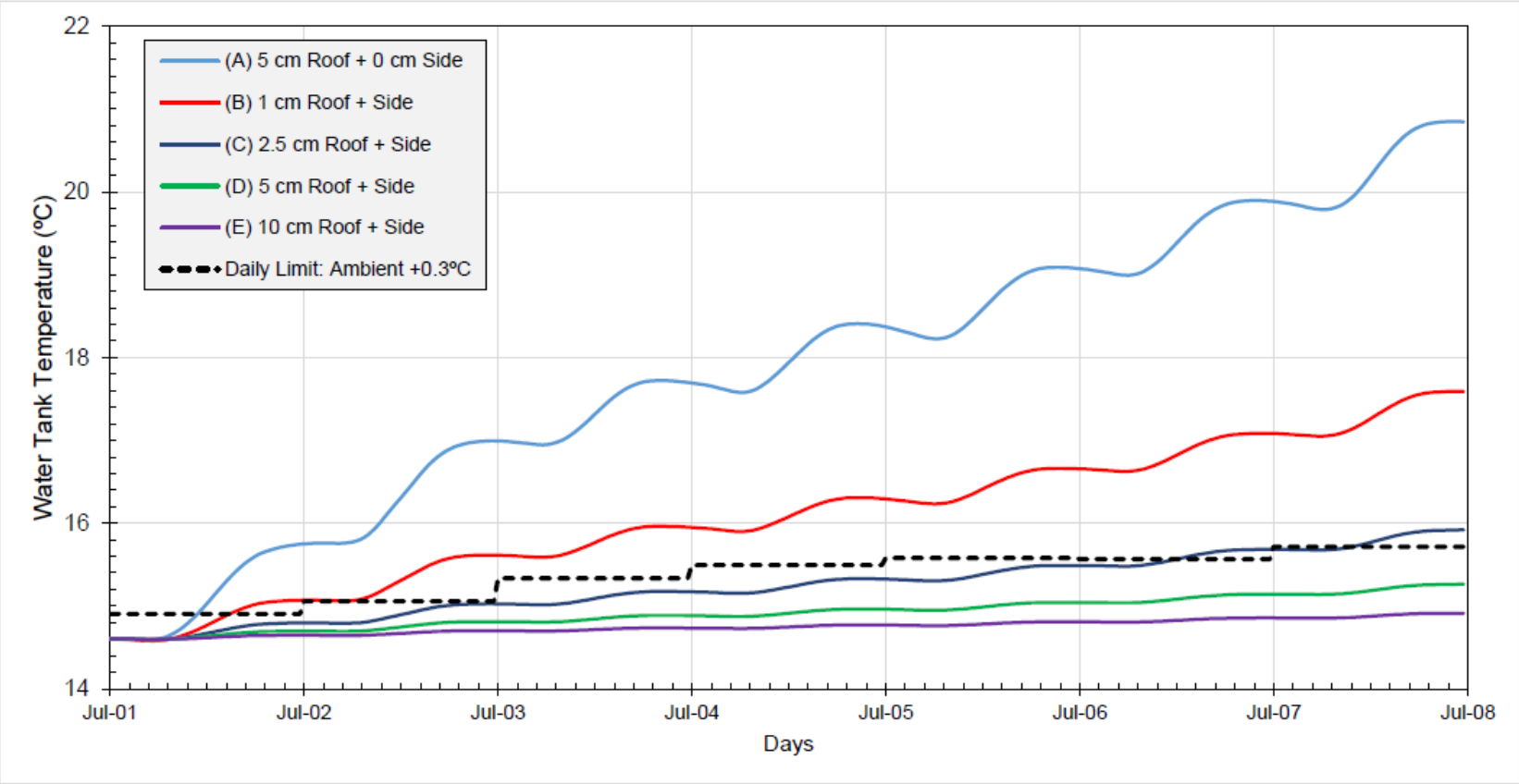


Figure 3: Predicted Storage Tank Water Temperature for Various Levels of Insulation

Highlights to date

- PNNL's Market Value Analysis results are in for PacNW using Pearl Hill reference configuration

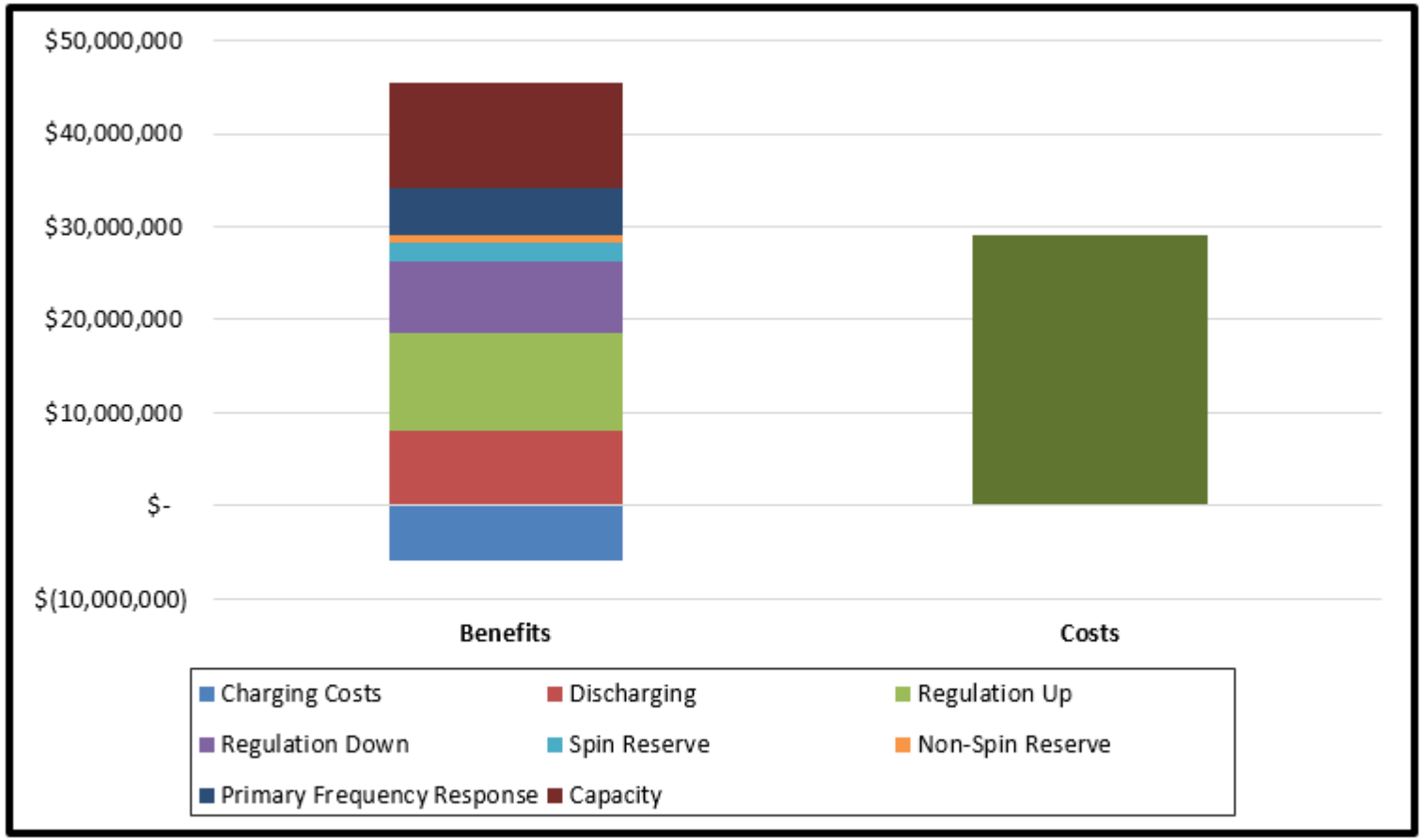


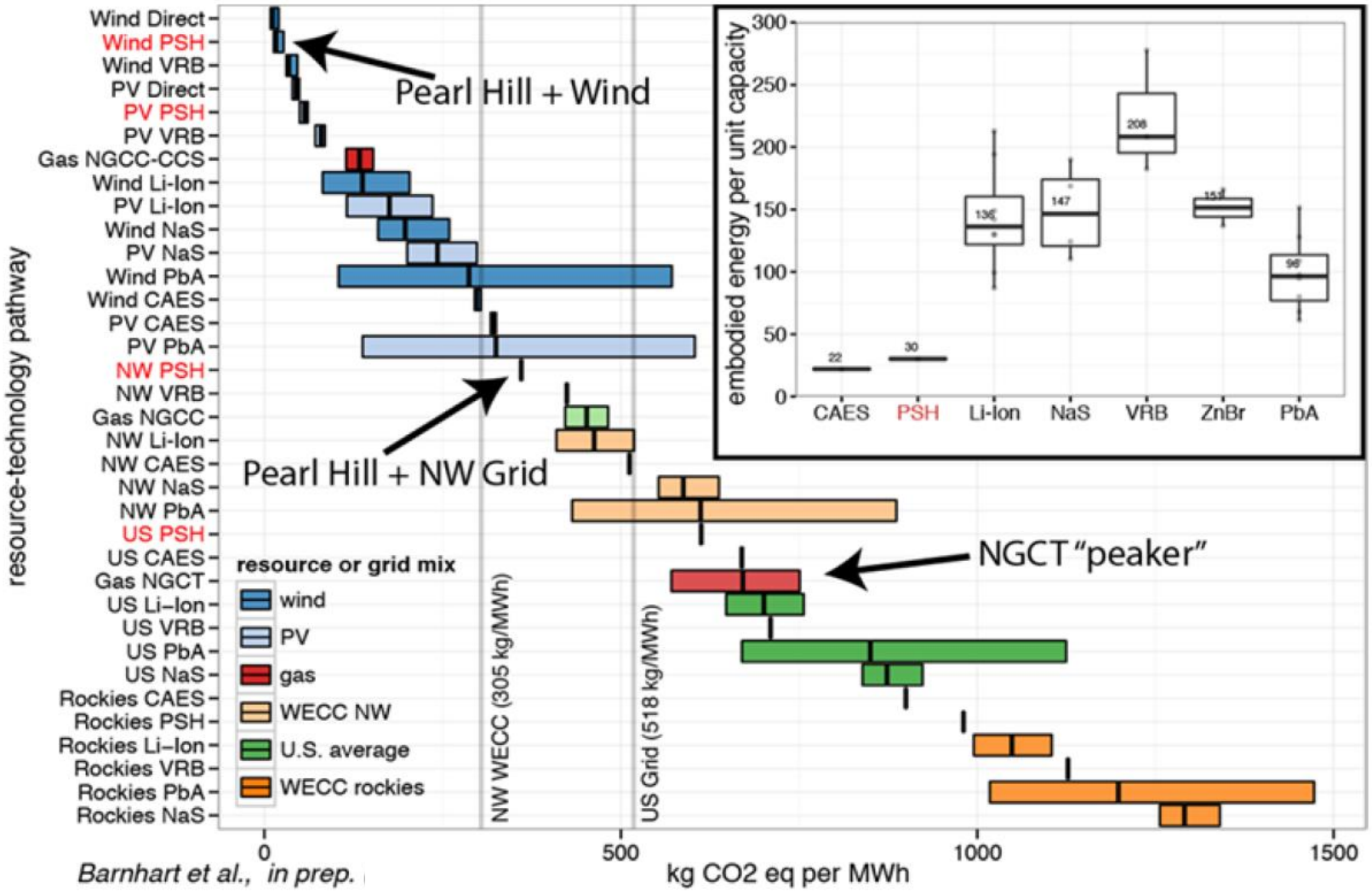
Figure E.1. Base Case Benefits and Costs for SENA Hydro Battery

- Positive net co-optimized benefits base case ~$15/kW-mo
- 42 out of 48 modeled scenarios returned ROI ratios > 1.0
- Capital cost estimate comparable today to Lithium Ion turn-key of similar scale

Pacific Northwest
NATIONAL LABORATORY

Highlights to date

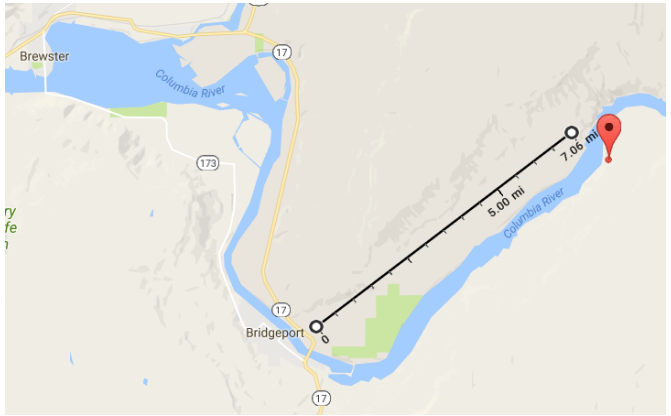
- World's smallest carbon footprint battery?



Barnhart et al., in prep.

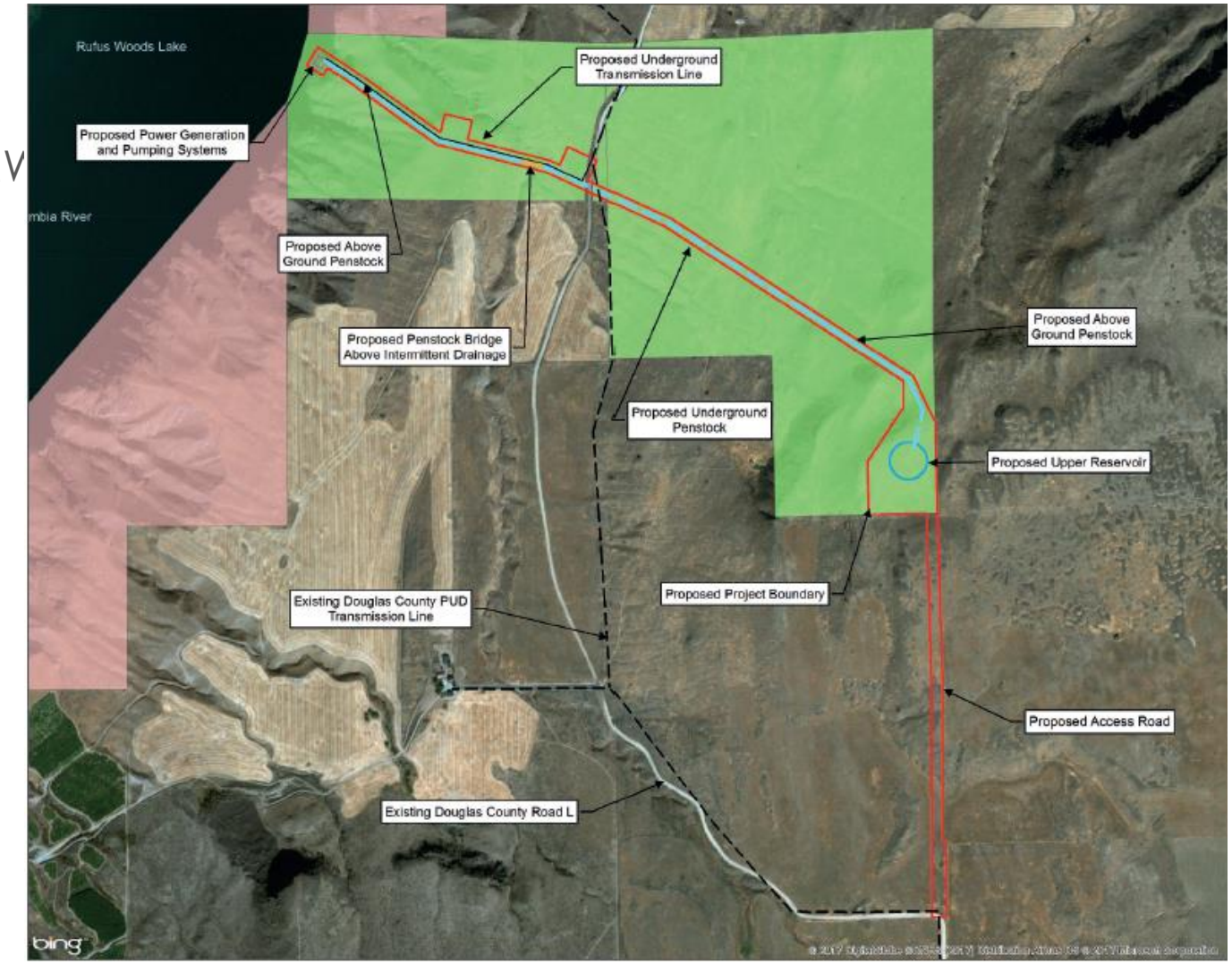
Hydro Battery
Pearl Hill

- Flagship configuration in Eastern WA
- Capacity: 5 MW generation, 9 MW load, 30 MW
- FERC License Application Filed
- McMillen Jacobs Delivery
- 3D Fly-over



LEGEND

- Proposed Project Boundary
- Platform
- Proposed Above Ground Penstock
- Penstock Bridge Above Drainage
- Proposed Underground Penstock
- New Transmisison Line
- Existing Transmission Lines
- Tank

Land Ownership

- State of Washington
- USA