



DESTINATION 2050

"The Options for Long Duration Energy Storage"

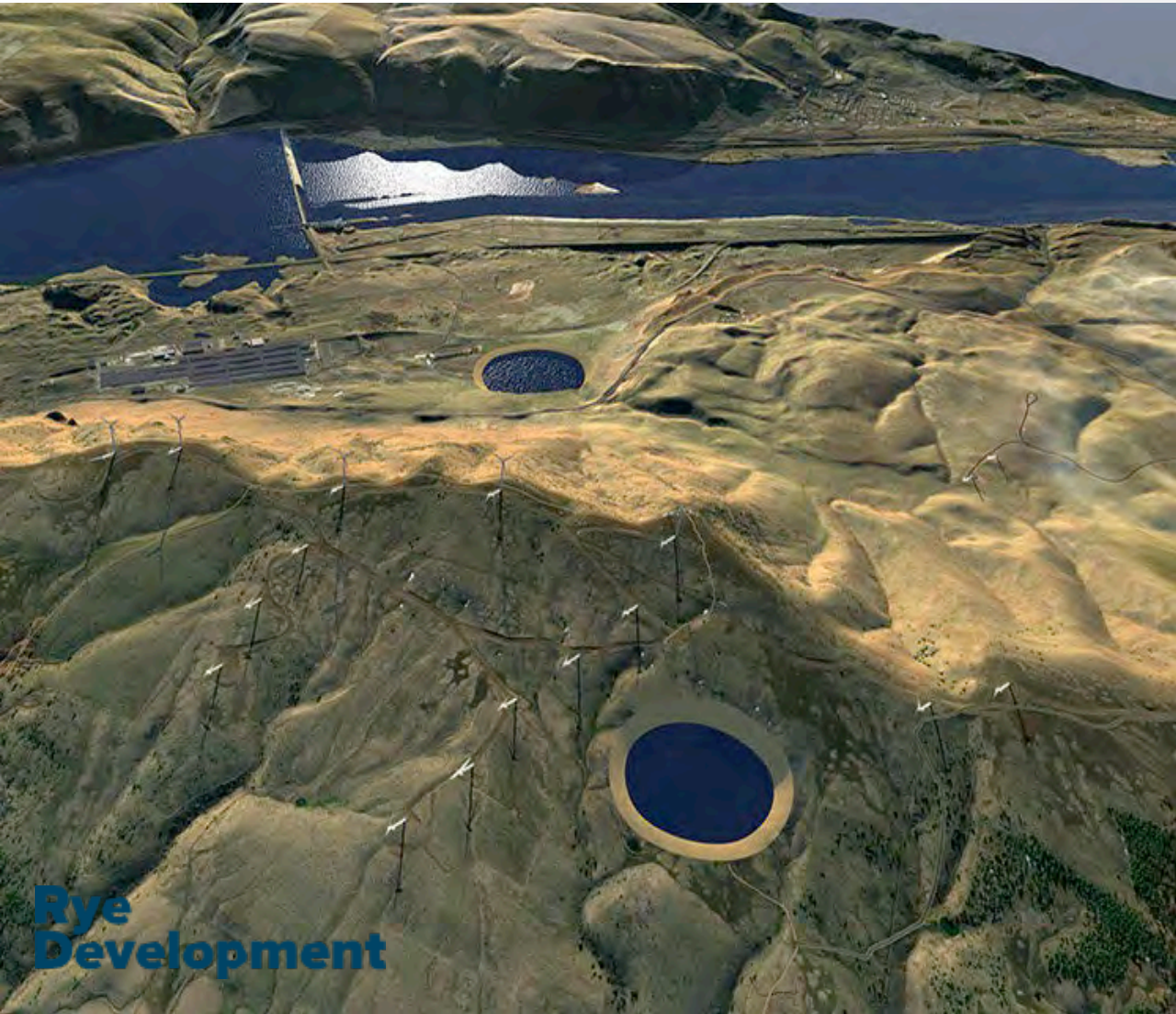
- **Erik Steimle**, Vice President of Project Development, Rye Development
- **Hugh McDermott**, Senior Vice President Sales and Business Development, Energy Storage Systems, Inc.
- **Doug Houseman**, Principal Consultant, 1898 & Co. (Burns & McDonnell)



Closed-loop Hydroelectric Pumped Storage

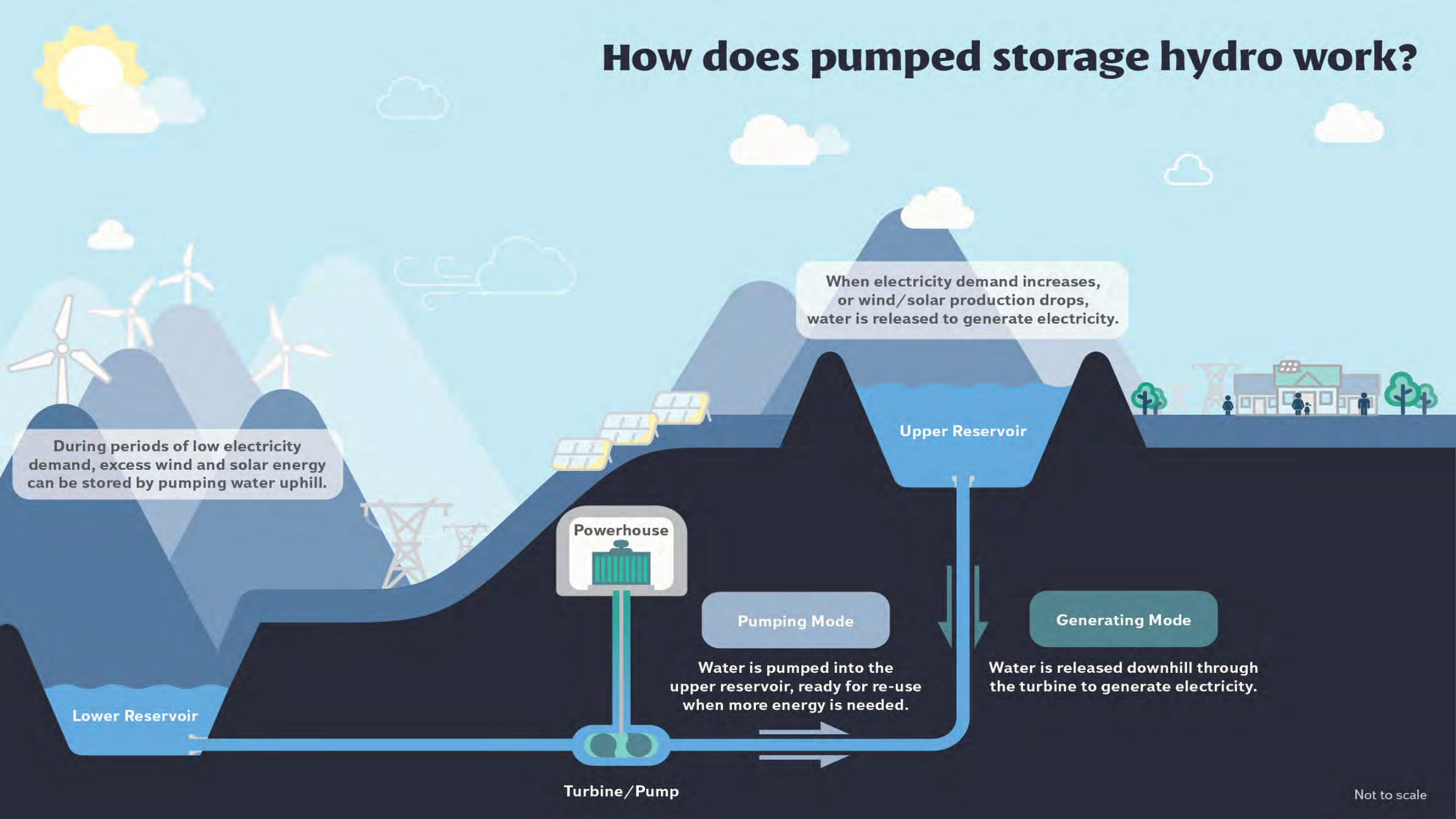
A community-driven approach to a carbon free and equitable power

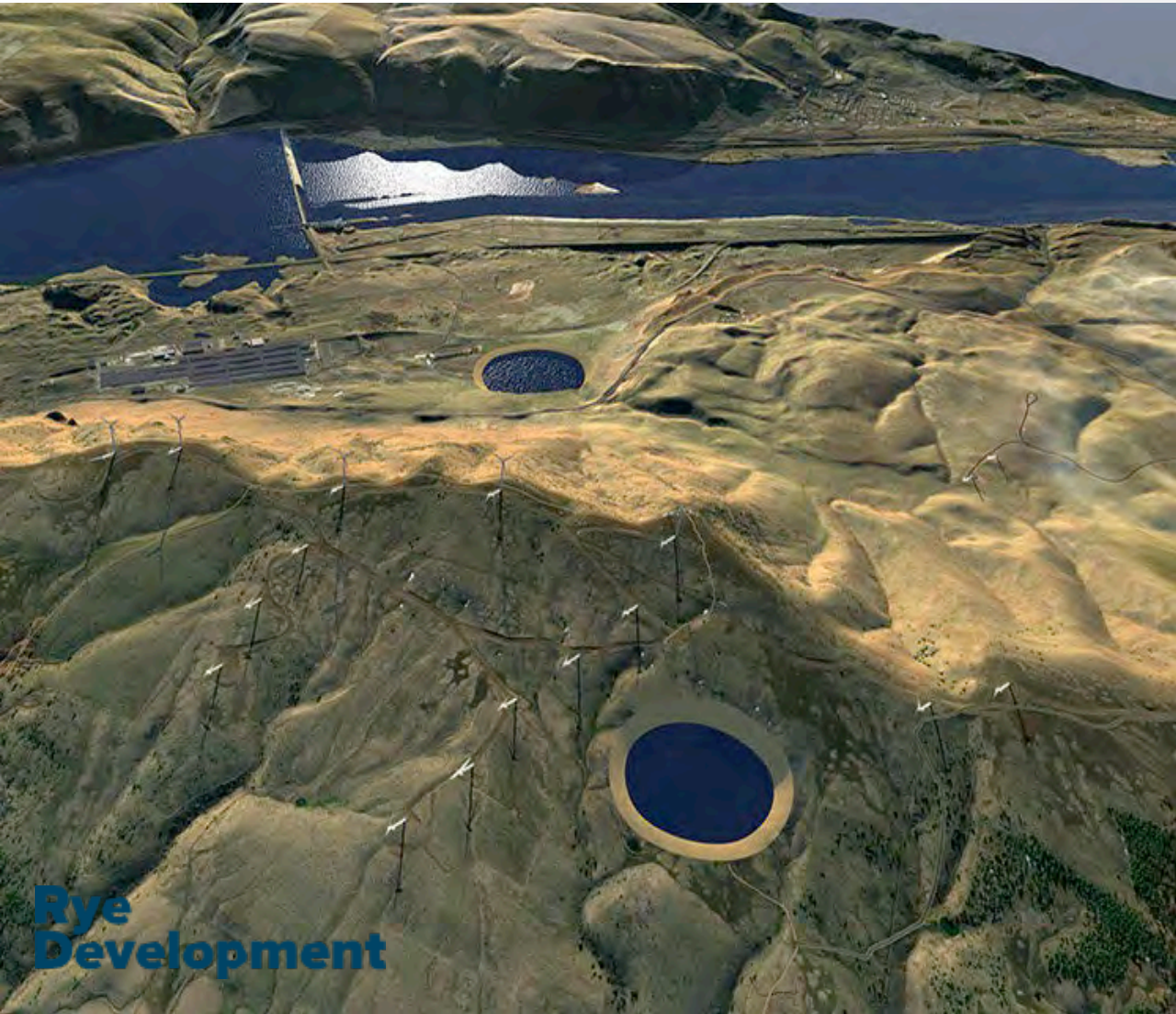
- Building on a legacy of hydropower in the Pacific Northwest to support 100% clean power goals



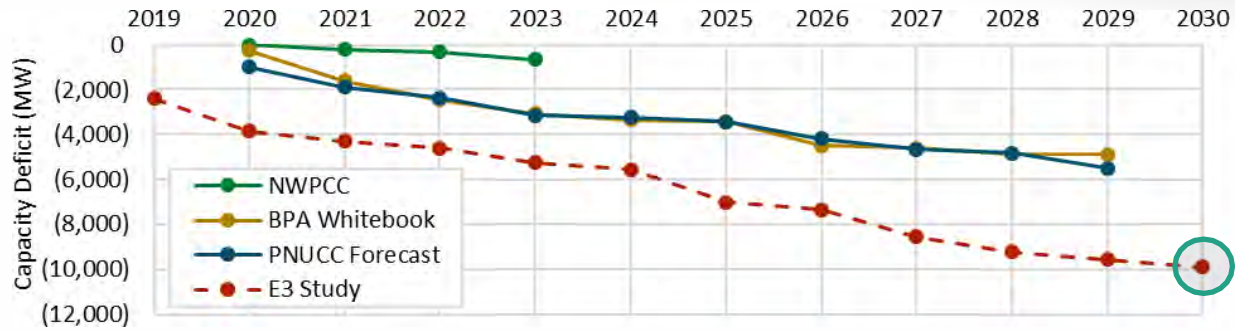
- Rye Development is the largest developer of new low impact certifiable hydropower in the us
- Focused on 24/7 renewable electricity and carbon free capacity
 - Closed loop pumped storage in the renewable-heavy Pacific Northwest
 - Summer peaking conventional hydro in the southeastern US
 - Baseload new hydropower in the mid-Atlantic
 - 24 fully permitted projects
 - 3.7-billion USD under development

How does pumped storage hydro work?



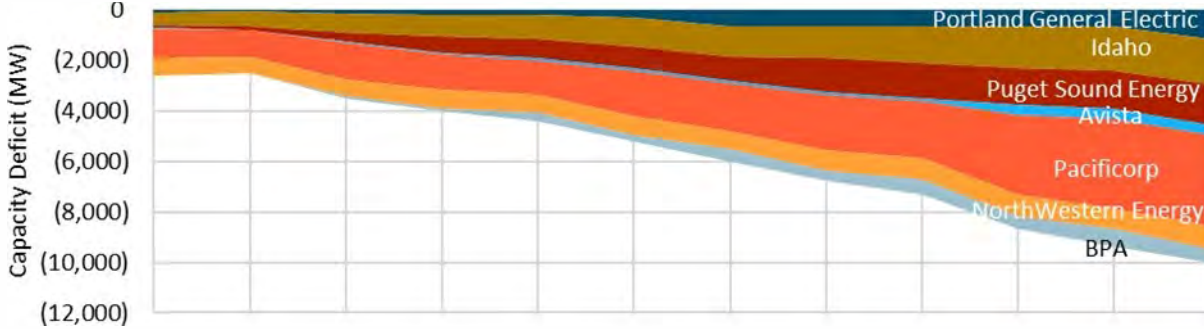


- Supporting regional clean energy and climate goals
- Washington
 - 100% renewable energy by 2050 mandate
- Oregon
 - 100% Renewable energy by 2040 mandate
- California
 - 100% renewable energy by 2040 mandate



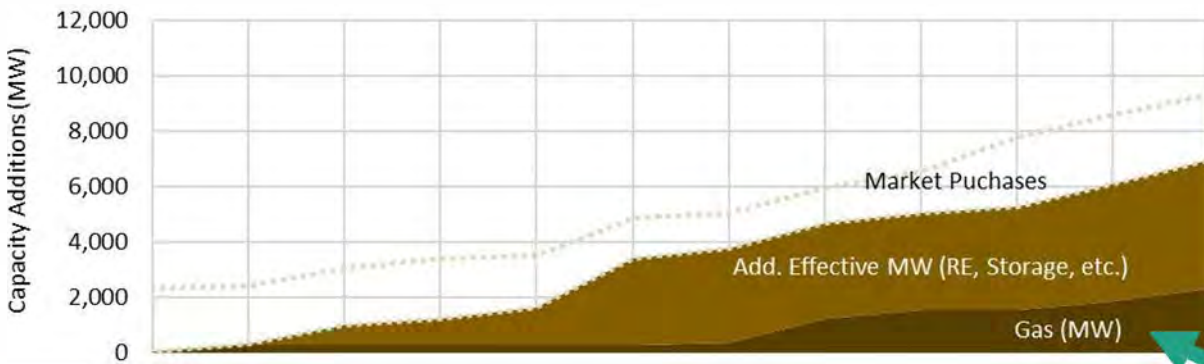
“Top-Down” Regional Assessments

5,000 – 10,000 MW capacity
need by 2030



“Bottom-Up” Review of Utility IRPs

10,000 MW capacity need by 2030,
before planned additions



IRP Planned Resource Additions

Only ~7,000 MW effective capacity additions and only 5,000
MW when gas is excluded

2,300 MW of market purchases generally do not address regional
need

**Faces political
opposition**




The Options for Long Duration Energy Storage

Hugh McDermott
SVP Sales & Business Development

Powergen
May 23, 2022



Company profile

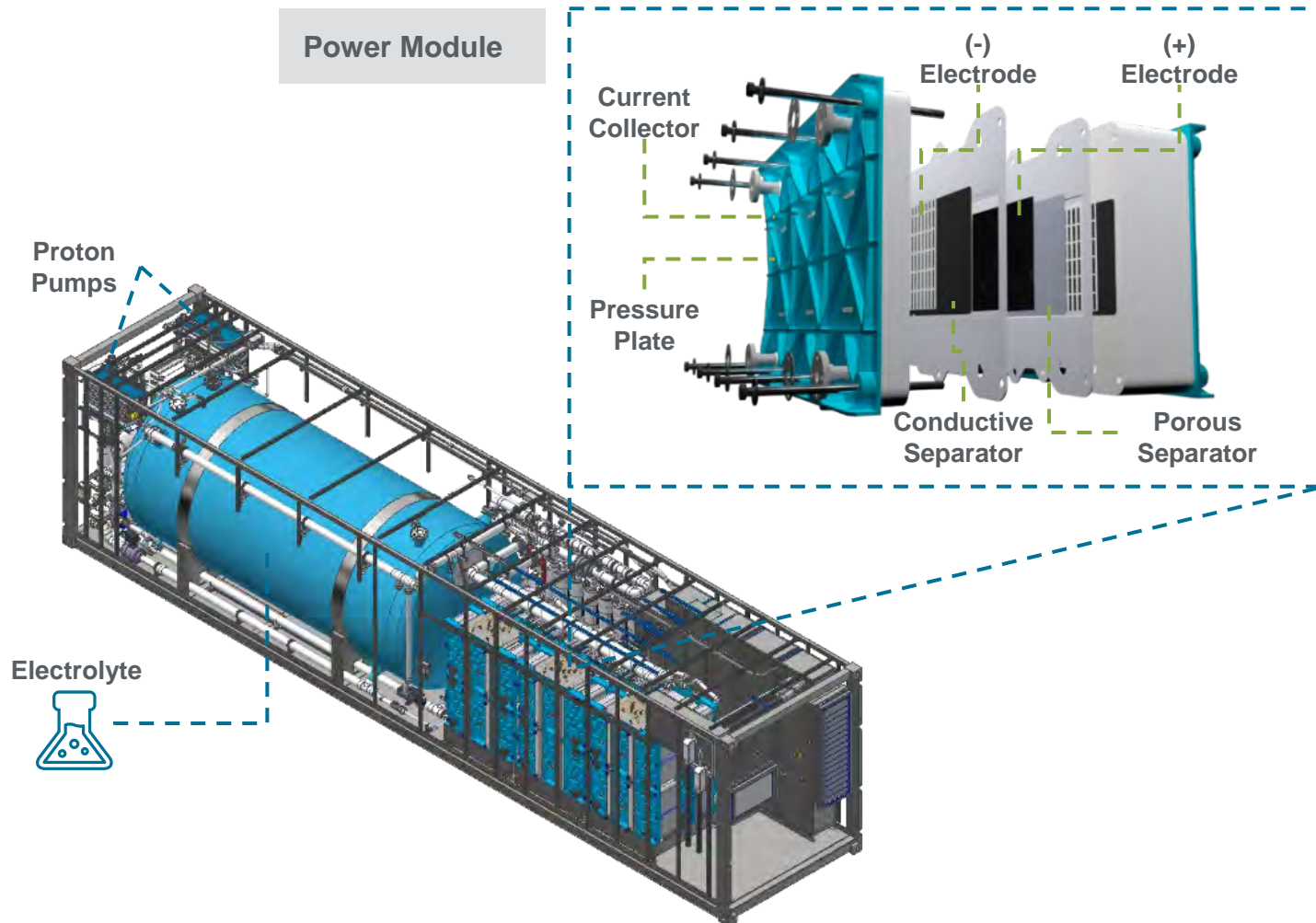
ESS	Founded in 2011 with mission to develop lowest cost long-duration energy storage technology
Headquarters	Wilsonville, OR
Facilities	250,000 ft ² manufacturing plant Automated production line currently scaling to 2GWh annual production
Employees	240+
Technology	Iron flow battery for utility-scale and commercial applications
Key investors and partners	     
NYSE symbol	GWH

Manufacturing facilities in Oregon

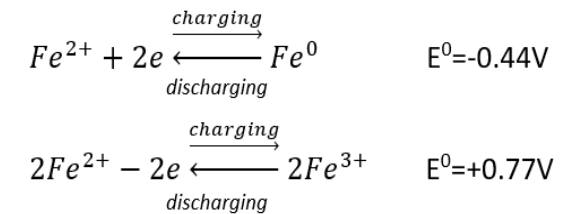
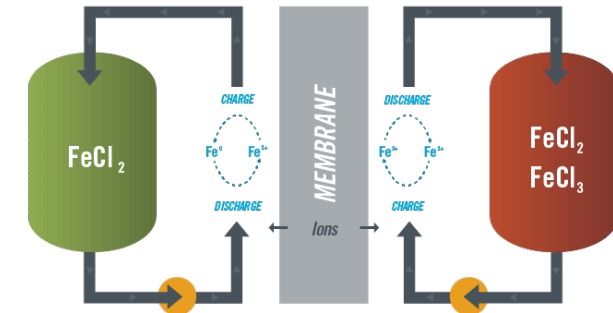


Iron Flow Battery – Unlimited Cycling

ESS technology



Electrochemistry



- ✓ Iron + Salt + H₂O electrolyte
- ✓ Power Module = 12hr storage capacity
- ✓ Made in USA with US-sourced materials
- ✓ Non-toxic, non-flammable, non-explosive



Product Summary

Behind-the-meter solution

Containerized fully-integrated design for turnkey delivery

Easy to permit = Fast to deploy

Re-deployable as needs change

Current Specifications

Configurable Range	50kW – 90kW (peak power)
Storage Duration	4 – 12 hours
Usable Energy	400kWh – 600kWh
Response Time	<1 second
Module Cycle Life	>20,000 cycles
Ambient Temperature	-5°C to +50°C (*Additional weatherization option available)
Design Life	25-year service life
Warranty	1 year comprehensive, 10-year extended warranty on battery modules and electrolyte management sys

Stackable
Seismic Rated





Product Summary

Front-of-the-meter solution

“Battery in a Building” platform

Modular design for unlimited scale

Power capacities starting at 3MW

Power Train



Quad Pods



Current Specifications

Configurable Range	Customizable up to GW scale
Storage Duration	6 -12 hours
Usable Energy	Configurable - up to GWH scale
Response Time	< 1 second
Module Cycle Life	>20,000 cycles
Ambient Temperature	-5°C to +50°C (*Expandable range)
Design Life	25-year service life
Warranty	1 year comprehensive, 10-year extended warranty on battery modules and electrolyte management sys

What Customers Demand		How ESS Transforms the Grid
Longer Duration	<ul style="list-style-type: none"> • Up to 12 hours (current version) • No capacity fade • No power fade 	<ul style="list-style-type: none"> • Can replace coal and gas with solar and wind • Designed for utility scale
Low Cost	<ul style="list-style-type: none"> • Lower LCOS than other technologies • Incremental cost of storage <\$20/kWh 	<ul style="list-style-type: none"> • The first truly low-cost flow battery • In commercial production today
Power On Demand	<ul style="list-style-type: none"> • <1 second response time • >20,000 cycle life – \$0 marginal cost per cycle • Flexibility allows multiple revenue streams 	<ul style="list-style-type: none"> • Improved grid resiliency and flexibility • Enables multiple use cases
Safety and Reliability	<ul style="list-style-type: none"> • Non-flammable, non-toxic, no explosion risk • Wide operating temperature range • Munich RE insures technology risk 	<ul style="list-style-type: none"> • Can deploy in a wide range of geographies • No HVAC needed – cuts CAPEX and OPEX • Customers can be confident in the long-term
Sustainability	<ul style="list-style-type: none"> • Easily sourced materials; recyclable components • “Plug and play” with 25-year operating life 	<ul style="list-style-type: none"> • Environmentally sustainable • Accelerates clean energy transition

Safe, sustainable long duration energy storage technology now and for decades to come



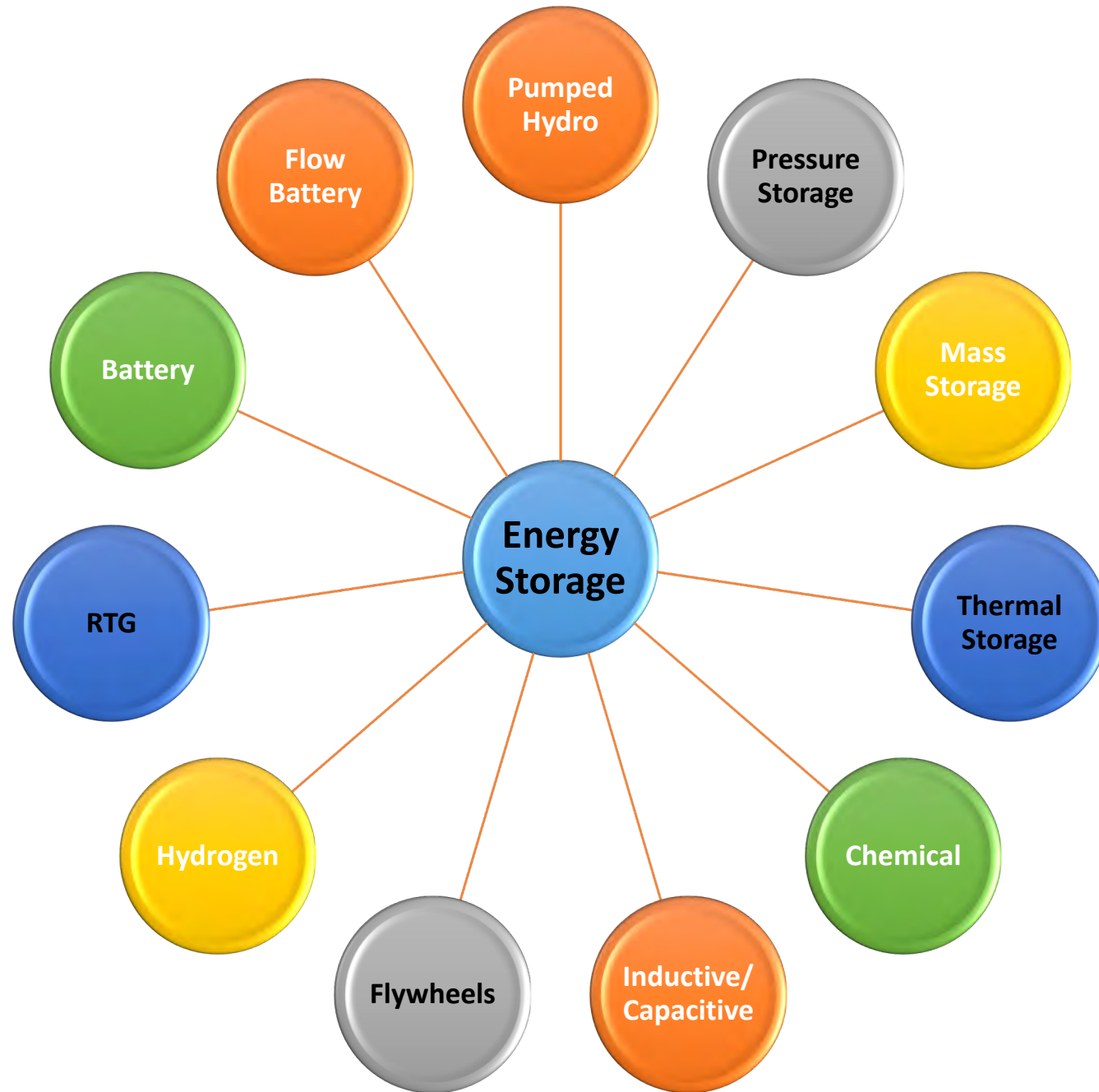
CATALYZING A CLEANER FUTURE. EVERYDAY.

Doug Houseman

- 50 years in the industry
- Work for 130 utilities in 70 countries
- Past chair (finally) of the Emerging Technology committee for IEEE PES
- NIST resiliency fellow
- Chair of IEEE P2030
- Involved in storage related projects since 1984 when seconded to DARPA

Long Duration Storage

- Two key aspects of my definition:
 - Can hold a charge for days to months with little self discharge
 - Can provide energy for 12 hours or longer without recharging
 - For events like Polar Vortex the need is typically 122 hours



Storage technologies



It is not that they can't, but that the current commercial technologies don't

Key characteristics of storage

1. Number of cycles
2. Round trip efficiency
3. O&M costs
4. Initial capital costs
5. Ramp rate
6. Time to switch from charge to discharge
7. Capacity and Energy relationship
8. Hazards, mitigation, and insurance
9. Topological requirements
10. Length of storage
11. Self discharge rate
12. Lifespan of the facility

DESTINATION
2050

POWERGEN
INTERNATIONAL

ORGANIZED BY:



energy-cast.com

