What are considerations around utility-scale storage in EWEB’s future portfolio?

EWEB’s Integrated Resource Plan will help us select resources for the next 20 years.

EWEB’s Integrated Resource Plan (IRP) is a long-term planning process to evaluate the community’s future electricity needs and determine which energy resource options might be the best fit within the context of our organizational values. The IRP combines analysis and modeling results with public involvement to inform the timing of resource acquisition needs and identify lowest-cost alternatives for EWEB’s future power portfolio over a 20-year time horizon. The results of the IRP will guide the utility as we make long-term, strategic decisions about our future energy supply.

The IRP modeling selected utility-scale battery storage as a resource in EWEB’s portfolio in the reference case analysis and in every sensitivity analysis. In some instances, batteries were selected as soon as 2026, when existing resource contracts expire. The purpose of this briefing is to look at the types of batteries considered in the IRP and discuss what options might exist in the coming decades.

What type of storage did EWEB model?

EWEB modeled 4-hour lithium-ion batteries using information compiled by consultant E3, which incorporated data from National Renewable Energy Laboratory (NREL), among other sources. This specific storage configuration has become an industry standard resource option and represents established technology with readily available cost information. E3’s analysis assumes battery costs will decline as the technology and supply chain continue to mature. The “4-hour” distinction means that a battery will be able to provide 4 hours of power at its maximum generation before it runs out of energy and needs to be recharged. EWEB did not model longer duration batteries, specific locations, or renewable-battery pairings in our analysis (for example, a solar facility with on-site battery storage). The batteries modeled are assumed to operate to meet EWEB’s peak loads and earn revenue from variations in wholesale energy prices.

What is a utility-scale battery?

Utility-scale batteries are typically 1 MW or larger systems and located strategically within a utility’s service territory to provide resiliency to key infrastructure and/or minimize local system constraints, or they can be co-located with renewable resources to enable more consistent energy output.

Are these the same as home batteries?

No. While the battery chemistries may be similar, consumer-owned batteries are typically .005 MW or smaller and provide energy for a single household or business.

How long does storage need to last, and how does it contribute to carbon goals?

Board Policy SD15 commits EWEB to procure 95% carbon-free power on a planning basis by 2030. Similarly, Oregon and Washington state policies create requirements for regional utilities to deeply decarbonize by 2040 and 2045, respectively. While these state carbon policies do not directly impact EWEB, they will impact the regional energy mix, and the types of resources that will be valuable for EWEB to operate in an interconnected system.

As discussed in EWEB's other briefings on meeting deep decarbonization goals, studies have shown that three broad carbon-free resource types will be needed to achieve these carbon reduction goals[1]. Eliminating or excluding a resource category as an option in power system modeling consistently results in higher costs, higher emissions, and/or reduced reliability. These carbon-free resource categories include low-cost intermittent generators such as renewable energy, dispatchable longer-duration resources like small modular nuclear reactors and geothermal, and dispatchable shorter-duration resources like batteries and demand response.

In this context, 4-hour lithium-ion batteries play a distinct role in a low-carbon portfolio by helping us meet peak energy demand and integrate renewables. However, shorter-duration storage like this has limitations in meeting prolonged energy needs. For example, in the Northwest, we frequently have multi-day weather events that require the ability to recharge between peaks. In Eugene, more specifically, we tend to need more total energy in the winter than in the summer because of widespread electric heating. To meet this winter need with solar energy, which is much more abundant in the summer, we would need seasonal energy storage like hydrogen power-to-gas (described in more detail below). Lithium-ion batteries and other shorter duration storage technologies have gained more traction in warmer climates such as California where peak needs occur during the summer and solar energy does not need to be shifted seasonally, but rather within a single day. Longer-duration storage solutions that may address some of these challenges are under development and are discussed later in this briefing.

Why were lithium-ion batteries selected in the IRP model results?

As described above, as a dispatchable, flexible resource, battery storage can play a role in helping to meet carbon reduction goals. In addition to this, batteries were selected for two primary reasons in the IRP modeling:

1. **Batteries can benefit from within-day market price variability.** Lithium-ion batteries are fast charging and discharging with minimal energy losses and can take advantage of within-day fluctuations. Essentially, they can earn revenue by buying at low prices and selling at higher prices when the energy is not needed to meet EWEB's peak load. Because the market price forecast used in the IRP had these types of low and high prices, batteries were able to recoup investment costs and provide value to EWEB. This benefit may diminish under alternate market forecasts.

[1] The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation: Joule (cell.com)

2. **Batteries were assumed to help meet EWEB's peak needs.** Based on studies of how new resources contribute to reliability under the existing resource mix in the Northwest, EWEB's analysis assumed 4-hour batteries would provide 50% of their maximum capacity towards meeting EWEB's peak winter demand. As more batteries are added to the regional electric system, the incremental value of short-duration batteries (e.g. 4-hours) will fall, and other resources will be needed to fill in the gaps during prolonged energy needs like severe weather events[2].

What are the tradeoffs to lithium-ion batteries?

Lithium-ion batteries have many benefits and were selected for the value they might provide as part of EWEB's portfolio. Below are some quick highlights about the benefits and drawbacks of lithium-ion batteries:

4-hour Lithium-Ion Batteries	
Benefits	**Drawbacks**
Scalable – can be purchased in small increments to meet need.	High up-front costs.
Flexible – quickly ramps energy production up and down to follow load and market fluctuations.	Depend on market volatility to earn revenue.
Meet peak demand – can be dispatched during peak load.	Limited duration – cannot meet prolonged peaking capacity needs (i.e. extreme cold temperatures lasting multiple days).
Local/resilient – can be located near essential services or in places that avoid transmission constraints.	Degradation – battery lifespan is still being studied as more batteries are put in commercial operation
Low carbon – can be charged with renewable resources.	Environmental impacts of mining raw materials.

What other storage technologies are out there?

While the IRP specifically modeled 4-hour batteries, other storage technologies may be available to EWEB in the coming decades. These technologies are in varying degrees of commercial readiness and include broad categories such as chemical energy transfer (batteries), gravitational or mechanical (pumped hydro storage), and chemical reaction (power-to-gas electrolysis), among others.

- *Pumped storage:* Pumped storage technology has existed for over 100 years and consists of pumping water between lower and upper reservoirs. When energy is plentiful or power is cheap, electricity is used to pump water to the upper reservoir, and is then released at a later time to generate power. Pumped storage typically can provide 8-12 hours of energy, has an efficiency of around 80%, and is highly location dependent. Siting and environmental

[2] E3_Resource_Adequacy_in_the_Pacific-Northwest_March_2019.pdf (ethree.com)

considerations are often barriers to pumped storage development, and pumped storage costs are project-specific because each project is unique.

- *Hydrogen power-to-gas (electrolysis):* Electrolysis uses electricity to separate water molecules into hydrogen (H2) and oxygen (O) components. The hydrogen is then used for industrial purposes, fertilizer production, in a combustion process instead of natural gas, or converted back to electricity, among other uses. When the electricity input for electrolysis is from low- or zero-carbon sources, the resulting hydrogen is also considered low carbon, or "green." Hydrogen can be stored for prolonged periods of time – even across seasons. However, because the round-trip efficiency of converting electricity to hydrogen and back again is fairly low, and because hydrogen can be more readily used for other purposes, the U.S. Department of Energy has not identified long-term energy storage as the most likely outcome or best use for green hydrogen[3]. The Oregon Department of Energy noted that over 50% of current hydrogen demand is for production of ammonia and methanal, used in fertilizer and plastic, respectively[4].

- *Alternate chemistry batteries:* Currently, most utility-scale batteries contain lithium-ion chemistries. However, lithium is a rare and expensive mineral, and this limits large-scale installations or future cost reductions. To sidestep these challenges, several companies and research groups are exploring alternate battery chemistries that use more common minerals such as iron or sodium. These chemistries do not result in the same energy density as lithium-ion batteries, but they may not need to. While today's largest purchasers of batteries – car manufacturers – care a great deal about batteries' size and weight, utilities are ultimately more interested in cost per unit of energy. As these technologies mature, they may become options for providing longer-duration storage using heavier, common materials. However, at this time, these technologies are under development and have not reached widespread utility adoption.

- *Other storage technologies:* There are many new storage technologies under development to help the electric sector decarbonize. Many of these are not yet commercially ready, have low energy conversion efficiencies, or are currently cost-prohibitive. Among others, these technologies include compressed air storage, mechanical storage (lifting heavy objects), and flywheels (rotational inertia). EWEB will continue to monitor technology development for resources that may provide value to our portfolio.

What are EWEB's next steps for storage technologies?

As with other options identified in the IRP analysis, EWEB is not currently acquiring resources. Staff plan to continue to communicate with the Board and community as we learn more about the potential storage technologies that will be available to meet EWEB's future energy needs. Future IRP modeling is likely to include more energy storage resource options as technologies mature.

[3] Pathways to Commercial Liftoff - Clean Hydrogen - March 20 - FINAL (energy.gov)
[4] 2022-ODOE-Renewable-Hydrogen-Report.pdf (oregon.gov)