2022 Integrated Resource Plan

Draft | December 2022

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1 Letter from the General Manager

The energy industry is undergoing enormous change.

In recent years, the cost of batteries, wind and solar generation have declined, making them among the least-cost energy sources available. At the same time, there continue to be substantial hurdles to integrating these resources into the electric grid in an efficient, cost-effective way. Dispatchable, flexible fossil fuel resources face tighter and tighter constraints, and transmission availability is anticipated to be a key limitation as new renewable generation is added to the grid to meet increasing demand.

To navigate this volatile energy landscape, EWEB's 2022 Integrated Resource Plan forecasts EWEB's energy demands and examines a variety of energy resources that may fit those future needs. As EWEB's current contracts expire over the next two to eight years, EWEB will need to decide how to procure the energy that we serve to our customers.

The results in this document include a reference case – the first version of a potential energy portfolio. The reference case is not an ideal or preferred portfolio. Rather, it's a comparison point. EWEB analysts drew clear parameters to define boundaries, and assumptions, including abiding by EWEB's Climate Change Policy, which states that our energy will be 95% carbon-free by 2030. We had our modeling software test different resources and select a portfolio that can meet EWEB's future energy needs at the lowest cost, within the boundaries.

To generate this portfolio, a team of EWEB analysts and external consultants worked to define a set of assumptions about future resource costs, inflation, regulatory standards, transmission availability and market conditions, among other factors. As we discovered during the modeling process, if you shift the assumptions, a new suggested portfolio arises. Thus, testing these assumptions will provide insight into the future resiliency of our resource decisions.

Though the details of our analysis will change as we continue modeling, we can begin to see a few key themes emerge:

EWEB's energy load will grow. In the past few decades, EWEB's energy load has remained flat, despite population growth. We expect this trend to change. Electrification is happening. Massive investments in electric vehicles and electric heating and cooling will add more demand to the grid. It's not a question of if, but rather how much and how soon.

Legacy hydropower is a good fit. EWEB has relied on hydropower from the Bonneville Power Administration (BPA) and our own projects for many decades, and for good reason. It's a cheap, carbon-free resource that can be dispatched at a moment's notice to meet our customer's demand. We will start evaluating BPA's 2028 product options in our next IRP, which we plan to publish in 2024. We will also test the sensitivity of hydro to climate changes and further fish and wildlife-driven operational constraints.

Wind and batteries offer a possible viable path forward. The reference case suggests that EWEB pursue a buildout of batteries, paired with new wind resources. This makes sense. In the greater Northwest, wind is an abundant renewable resource that generally produces power during the same seasons we have peak needs. And utility-scale batteries will help smooth gaps in that power generation.

We need to develop customer programs responsive to our energy needs. Utilities around the country are developing innovative projects and policies that partner with customer to reduce demand for electricity. Some shave peak demand through demand response programs and time-of-use rates. Others use novel rate structures to ensure that the cost of maintaining and improving the grid is equitably shared. We will need to explore similar innovations as we begin to understand our individual customer's electricity loads better.

We have a multitude of questions about possible energy portfolios that we want to explore and that will help EWEB sail towards this new energy future. Using the reference case as a baseline, we will adjust our inputs and assumptions and use the model to answer questions such as:

- How do low water years and more protective fish regulations influence hydropower resources?
- What happens if buildout if transmission capacity is constrained or the costs of new transmission rises? In other words, how much does location matter?
- To what extent are conservation and demand response programs more cost-effective compared to procuring additional generating resources?
- What happens if we're required to have a greater power reserves available in our energy planning?

We are excited to begin exploring these questions throughout the first half of 2023, and we want to know what questions you, our customer-owners, want us to explore. We'll continue the modeling process, and we'll continue generating results for our community to learn about and discuss.

We encourage you to read the report and tell us what you think at www.eweb.org/irp. We are looking forward to charting our path to a future of clean, reliable, and affordable energy.

Sincerely,

Frank Lawson
CEO & General Manager

2 EXECUTIVE SUMMARY

The Eugene Water and Electric Board (EWEB) has been providing power to the Eugene community since 1911 when the Walterville Dam on the McKenzie River was completed. EWEB is the largest publicly owned utility in Oregon and is governed by a five-member Board of Commissioners who are elected by Eugene residents.

EWEB's 2022 Integrated Resource Plan is the first in a decade, although the next one will arrive much sooner. EWEB is embarking on an iterative, biennial process in which we develop and publish a new IRP every two years. This will allow EWEB staff to continually update assumptions and forecasts to plan for a more dynamic energy future. The 2022 IRP provides directional long-term guidance; it does not mandate specific near-term actions.

What is an IRP?

An Integrated Resource Plan is a long-term planning document to identify EWEB's energy needs and the best resource options to meet those needs. The IRP relies on modeling, analysis and public input to provide a 20-year look at future portfolio options and identify a nearer-term (2-5 year) action plan.

Aurora Modeling Software

EWEB's energy resource modeling software, Aurora, relies on hour-by-hour data to forecast energy prices and demand in the Western U.S. Aurora is used by utilities across the region for long-term energy resource planning.

Goals of EWEB's 2022 IRP:

1. Modernize our approach to energy resource planning to make it more robust, dynamic, routine, and useful, while developing in-house expertise.
2. Understand EWEB's needs for energy and capacity in the future.
3. Identify least-cost, "best fit" resources.
4. Consider trade-offs and values when developing action plans.

Climate Change

EWEB expects that climate change will impact both energy loads and resource performance in the future. EWEB staff continue to look for opportunities to incorporate climate change assumptions into our analysis.

Modeling Results: Reference Case Inputs and Assumptions

The draft 2022 IRP contains a reference case that represents a baseline upon which to conduct additional sensitivity analysis and answer further questions. The reference case is the energy resource portfolio suggested by EWEB's modeling software based on a specific set of inputs and assumptions. *It is not a preferred portfolio*.

Reference Case Peak Capacity Additions by 2042	
Demand Response	7 MW
Conservation	18 MW
Battery	100 MW
Wind	50 MW
Small Modular Nuclear	10 MW

EWEB staff designed the modeling process to select the lowest cost, optimized portfolio within the constraints set by EWEB Board Policy and regulatory obligations. These constraints include a requirement for EWEB's energy to be 95% carbon-free by 2030.

The calculated reference case results showed that continuation of EWEB's contract with the Bonneville Power Administration (BPA) was a key element of EWEB's least-cost portfolio. Currently, that contract includes Block and Slice products, but BPA may change those products in the future. The reference case suggested that additional resource needs could primarily be met with conservation, demand response, batteries and wind power.

Key Insights from the Reference Case

Energy demand will rise. While our overall demand has fallen or remained flat in recent years due to conservation investments, we expect this trend to change starting around 2030 due to electrification.

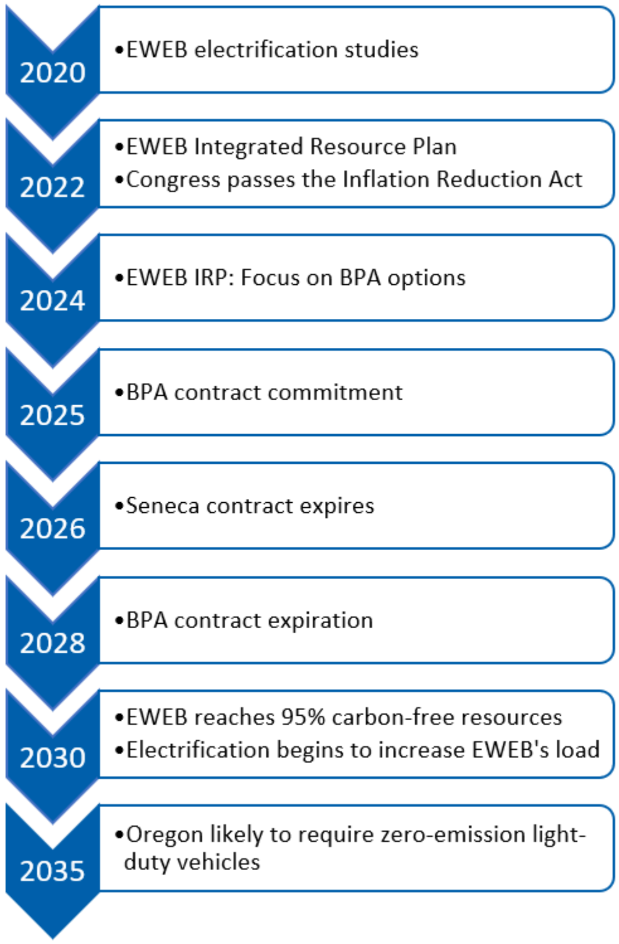
Peak needs are during the winter. EWEB's capacity needs are calculated using a 1-in-2 peak hour standard, meaning the portfolio of resources should be sufficient to meet EWEB's highest hour of load in a typical year. Throughout the study period, EWEB is assumed to be a winter peaking utility and the primary driver for increased peak energy use is due to unmanaged EV charging behavior.

We need new resources starting in 2026. Based on an average single-hour winter peak, EWEB begins to need a small amount of capacity starting in 2026.

Hydropower is a good fit: Currently, more than 80% of EWEB's energy comes from hydropower, both from the Bonneville Power Administration (BPA) and EWEB-owned projects on the McKenzie and Clackamas Rivers. Initial analysis points towards BPA hydropower remaining as a cost-effective, low-carbon way to meet most of EWEB's needs.

Wind and batteries are a promising option. The modeling software selected primarily a combination of wind and batteries to meet growing demand in the future.

Customer partnerships will be vital. Customers are likely to play an integral role in helping reduce peak energy usage. Programs such as conservation, demand response and new rate designs, such as time-of-use rates, were all selected in the reference case portfolio.



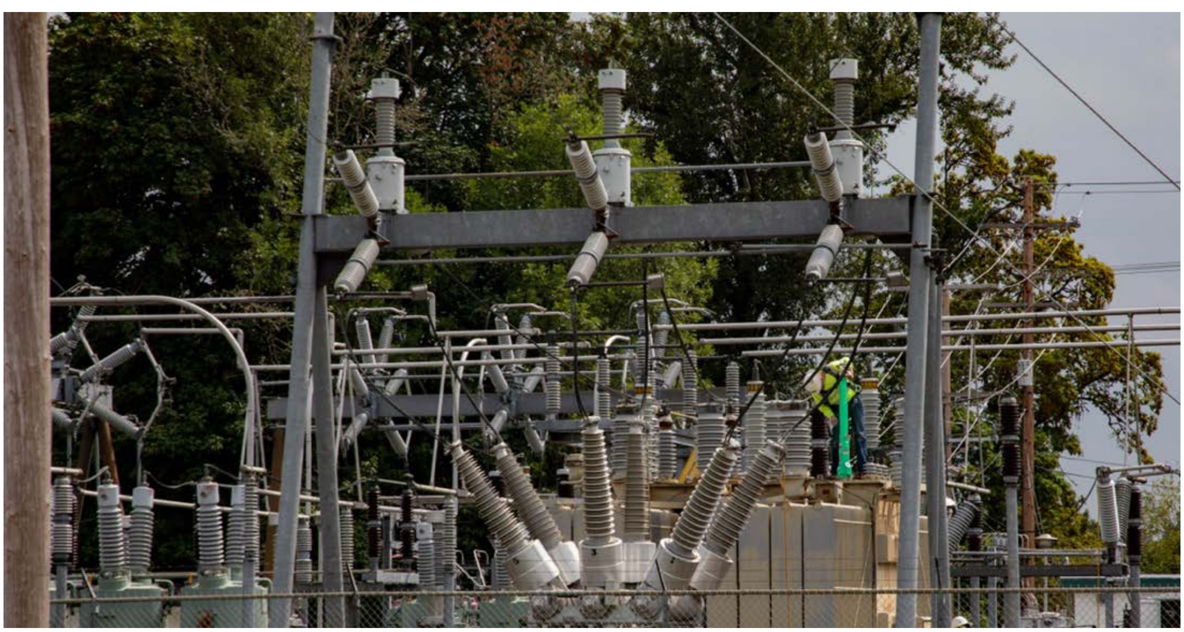
Next Steps – 2023 and Beyond

For the next six months, staff will engage the public to seek input and feedback. This feedback will guide additional sensitivity analysis before we release the final IRP in June 2023. This sensitivity analysis will be useful for understanding future uncertainty and developing a portfolio of resources that is more resilient to a rapidly changing electricity market.

As part of the final IRP, the Board of Commissioners will endorse/approve an action plan informed by EWEB's values, public feedback, staff analysis and modeling results. Typically, these action plans identify steps that can be taken in the next 2-5 years based on the 20-year planning horizon of the IRP.

Prior to 2028, EWEB will need to reassemble an electric supply portfolio as our existing power contracts are coming to an end. Our new, iterative IRP process will allow EWEB to develop near-term strategies while adapting to new information, assumptions, and operational conditions.

Due to a rapidly changing energy landscape – as well as uncertainty around electrification, future technologies and costs, and climate change – the future is increasingly difficult to predict. In response, EWEB's IRP process is evolving to continuously adapt to new assumptions about EWEB's electricity demands and the potential resources that could meet those demands in the future.



3 Action Plan Informed By Our Values

As a publicly owned utility, EWEB is committed to working with our customer-owners to solve problems. EWEB's elected Board of Commissioners takes seriously their responsibility to steward the utility's resources and carefully weigh the tradeoffs inherent in difficult decisions.

The IRP and future energy resource decisions are no different.

At the end of this IRP process, the Board will be responsible for approving an action plan of next steps and priorities to be undertaken by the utility leading up to the next IRP cycle. These action plans can include directing management to look into procuring long-term resources, conducting research to better inform demand-side programs such as conservation or demand response, or directing staff to analyze new topics or questions for the next IRP cycle. The community's values will inform this action plan.

The IRP process is built to provide a roadmap to a future energy resource portfolio that is:

- **Reliable:** Any potential resource portfolio must reliably meet our customers' energy needs, including peak demand.
- **Affordable:** The energy resource modeling software we use always selects energy resource mixes that are the lowest cost, while remaining within certain constraints.
- **Responsible:** All modeled portfolios will meet regulatory and environmental goals, including achieving a 95% carbon-free mix by 2030.
- **Community-aligned:** The IRP Action Plan, including any future resource decisions, will be approved by our elected Board of Commissioners, who weigh tradeoffs to align choices with community values.

In addition to these core values, EWEB is seeking to understand if there are other metrics or values that community members believe should be incorporated into resource decisions. Potential metrics are listed in the table to the right.

Potential Metrics/Values
Cost
Reliability
Local Resiliency
DEI
Carbon
Air Quality
Local Control

EWEB has also begun exploring how values of Diversity, Equity, and Inclusion (DEI) can be incorporated into utility practices and resource decisions in the future. To help generate ideas, the final IRP will include a review of how other utilities in the region are incorporating DEI values into their planning processes.

Diversity

Who is in the room? – include individuals of different backgrounds and identities.

Equity

How are decisions being made? – consider power imbalances and impacts to different groups.

Inclusion

Have all voices been heard? – all perspectives matter.

EWEB Board Goal:

Developing and nurturing an environment based on the principles of diversity, equity, and inclusion.

4 PUBLIC ENGAGEMENT PROCESS

During the first half of 2023, EWEB will conduct a robust public engagement effort, educating customers about the initial IRP results and soliciting comments that will help inform our ongoing analysis process. We have questions about the initial modeling results, and we know customers will, too. We will seek to answer as many of those questions as possible through further analysis.

Customer questions will help inform both our sensitivity analysis in 2023 and our action plans. EWEB's Board of Commissioners will ultimately approve the action plan.

Integrated resource planning is a complex, multifaceted process that will affect EWEB's customers in numerous ways. Some of those effects are behind the scenes; other effects are ones that customers will experience in their daily lives. As we move forward in this process, it's vital that we **educate** customers about the tradeoffs and nuances inherent in energy resource planning. And it's crucial that we have a **dialogue** with customers to verify that we are moving in the right direction.

There are three key pillars of our public engagement plan:

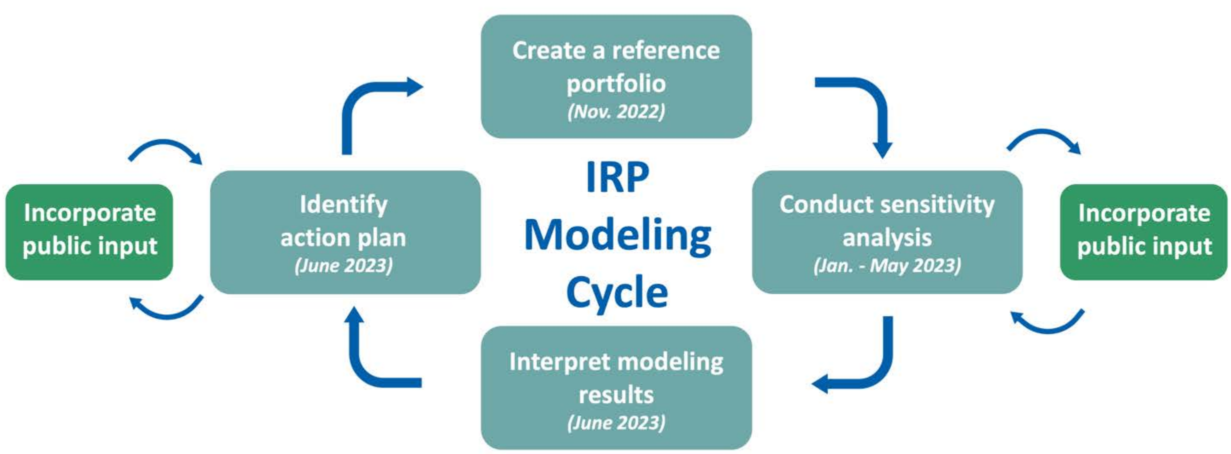
Direct dialogue: We will host dialogue-driven meetings with a broad cross-section of community organizations to present the initial IRP findings and solicit questions. We will strive to reach groups such as: agency and government partners, traditionally under-represented communities, environmental justice organizations, business groups, neighborhood groups and major customers.

- Dialogue events include an EWEB-hosted town hall scheduled for Feb. 21.

Ongoing education: We will implement a robust story-driven public education effort through traditional media, EWEB website content, social media, email newsletters and other channels.

- Educational tools include: PowerPoint presentation for public events, Fast Facts (a one-pager explaining the IRP and main takeaways), a Q&A handout and a key findings handout.

Customer questions: We will collect customer questions via a comment form at **eweb.org/irp**, as well as via comment forms distributed during in-person meetings. Customer questions will help guide EWEB's sensitivity analysis during the first half of 2023, as well as the action items for the 2024 IRP.



5 UPCOMING SENSITIVITY ANALYSIS

The calculated reference case is the output of a specific set of assumptions and modeling choices, but uncertainty exists around many of these assumptions. Because of this, staff are planning to run several sensitivities to test different assumptions and understand the drawbacks and benefits of different portfolio approaches.

Modeling work and sensitivity analysis are designed to help inform the IRP action plan but should not be construed as the only information the Board will consider when developing IRP action plans. In addition to the sensitivities identified by staff below, EWEB is also seeking input and questions from the Board and community prior to the final IRP publication which will be released in June 2023.

Sensitivity analysis will help inform EWEB's action plan and set the stage for the 2024 IRP.

Staff plan to conduct sensitivity analysis on the following inputs:

- **Transmission availability and cost**: Staff will limit transmission availability and/or increase transmission costs to reflect potential future constraints on the existing system. This will provide a new portfolio to be compared to the reference case.
- **EWEB load growth trajectory**: Sensitivities will explore possible resource acquisition strategies for both faster and slower load growth to account for uncertainty around electrification and other factors.
- **Planning reserve margin:** This sensitivity will explore the costs of procuring additional resources to meet a planning reserve margin similar to potential standards required by the Western Resource Adequacy Program. (These standards are still under development.)
- **Hydropower and gas risk:** Staff will conduct risk modeling simulations to test portfolio performance under different hydropower and gas conditions.

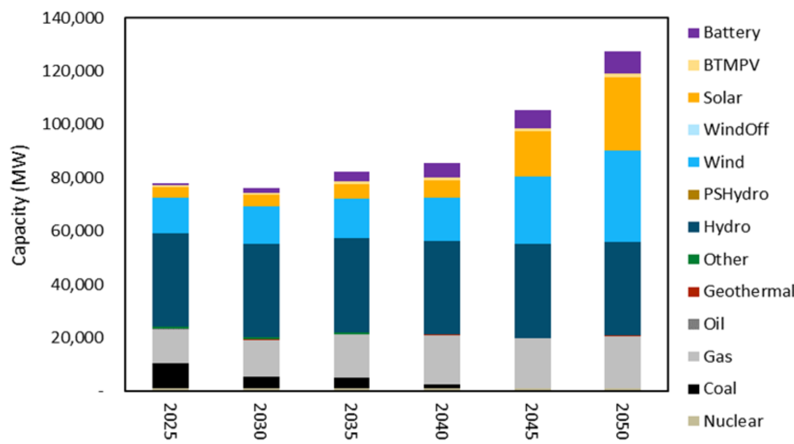
Staff will be seeking guidance and input on additional sensitivity analysis. Potential topics include:

- **Solar**: The calculated reference case did not select solar as a least-cost option, most likely because it contributes little to peak winter needs. Sensitivities could explore the impact of adding solar to the portfolio, or test whether solar is selected if we assume that EWEB's summer needs significantly increase.
- **Resource cost trajectories:** Resource cost trajectories, whether for renewables such as wind and solar, or for emerging technologies such as long-duration storage, are likely to diverge from current forecasts. Sensitivities could explore how falling or rising costs influence possible energy resource portfolios.
- **Other:** Additional sensitivities as identified by staff, the Board or public questions can be included in IRP analysis, time permitting. These could include emerging carbon policies, market price changes and others.

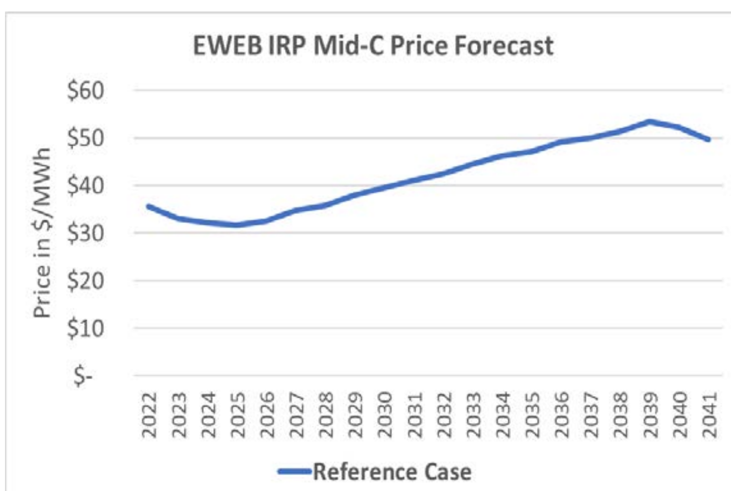
6 FUTURE ELECTRIC SYSTEM

The future electric system is unlikely to resemble the past. Local, state, and national policies focused on carbon reduction continue to evolve, putting constraints on some resources and creating incentives for others. Technological development and government subsidies have brought down the price of many variable renewable resources, making them some of the most cost-effective options on an energy basis.

At the same time, the Northwest region is retiring dispatchable generation such as coal power plants and losing flexibility from hydropower resources due to fish and wildlife considerations. Additionally, many high-quality renewable resources are located far from cities and other load centers, creating challenges in securing firm transmission to deliver the power where it is needed. These changes are putting increased strain on the electric grid and creating concerns about future system reliability.

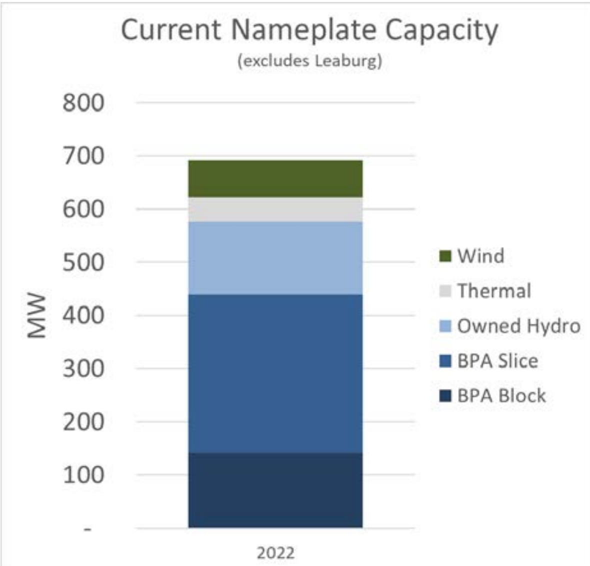


For the IRP, EWEB staff worked with consultants at Energy and Environmental Economics, Inc. (E3) to develop a forecasted future electric system. In the Northwest, E3 is forecasting a decline in dispatchable fossil-fuel generation and an increase in renewable generation and batteries (see chart above). This future assumes that natural gas generators will be needed to integrate renewables and will set market prices. In addition, the increase in electric demand from electrification, and an assumed increase in carbon prices, lead to higher market prices over the 20-year planning horizon.



In the calculated reference case, EWEB's modeling results indicate that these elevated prices can (on average) help reduce EWEB's future portfolio costs since we can sell surplus energy to the market. In addition, daily market price volatility can provide an opportunity for batteries to charge during off-peak periods and discharge during peaks, creating an additional opportunity to generate revenue. However, this surplus energy position can expose EWEB's portfolio to the risk of falling market prices in the future. EWEB staff plan to conduct additional analysis as part of the IRP to understand the potential price risk of the calculated reference case portfolio.

7 EWEB's Existing Resources

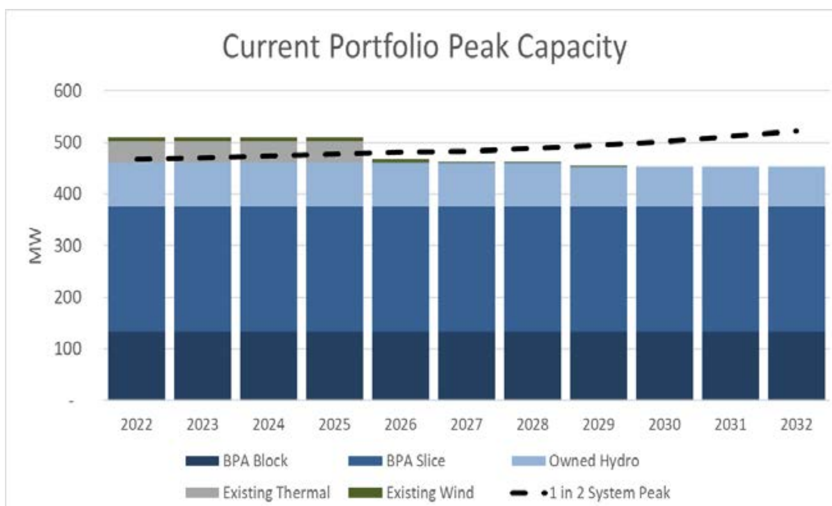


More than 80% of EWEB's power currently comes from hydropower resources. These include EWEB-owned projects on the McKenzie River and one project on the Clackamas River, as well as contracted power from the Bonneville Power Administration (BPA), a federal agency that manages and markets the generation from federal dams in the Columbia River system. In addition to these hydro resources, EWEB has contracts and ownership agreements for several wind farms, as well as biomass and co-generation facilities.

Due to the composition of this existing portfolio, EWEB's resource-based carbon emissions are a fraction of the state and national average. Depending on water conditions and hydro generation, EWEB's portfolio is currently about 90% carbon-free, with the majority of emissions coming from market purchases.

There are several events within the next 10 years that will shape EWEB's portfolio in the future:

- Expiration of EWEB's power contract with BPA in 2028, upcoming decisions on whether to renew that contract going forward, and which products/options to select if renewing[1].
- Licensing requirements and structural issues at several of EWEB's owned hydro plants that have or could lead to these being removed from generation.
- The assumed expiration of thermal contracts in 2025 and wind power contracts between 2026 and 2029.



Peak capacity represents the amount of a resource's nameplate capacity that is expected to be available to serve load during EWEB's single-hour winter system peak.

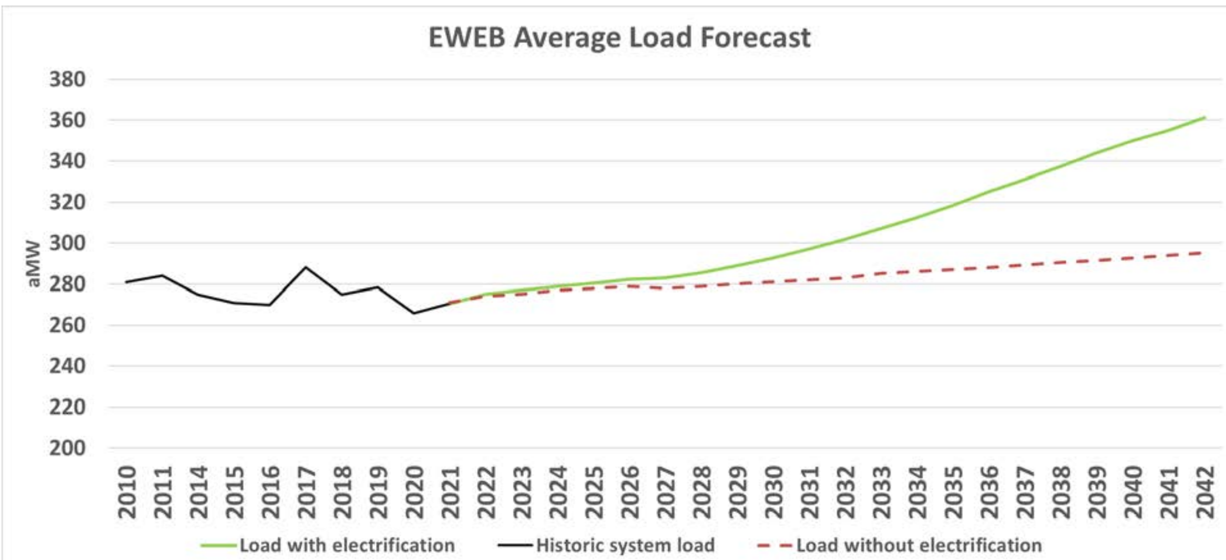
Due to these changes, EWEB will have resource decisions to make over the next two to five years regardless of uncertainty about load growth, electrification, regulations or other factors.

[1] Staff analysis during the reference case modeling found that continuation of the BPA contract after 2028 was one of EWEB's least-cost portfolio strategies. This assumes BPA products would continue at roughly the same pricing as they are today. Further analysis on BPA products and costs will be a key focus of the 2024 IRP.

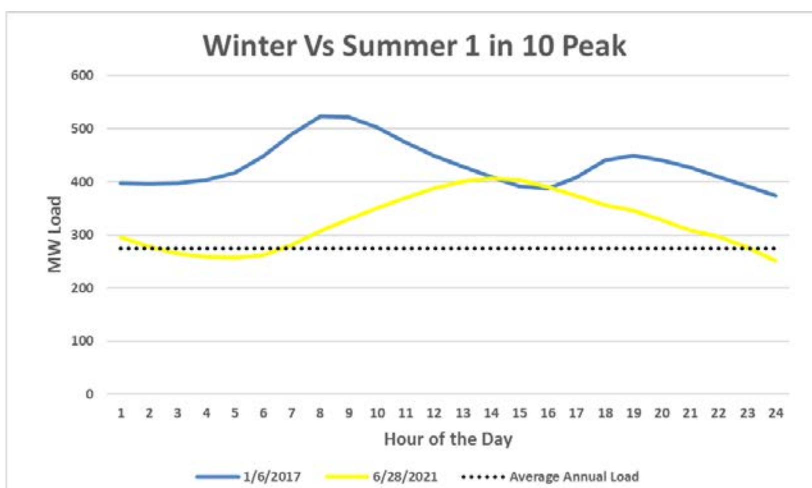
8 EWEB's Forecasted Load

EWEB currently serves roughly 200,000 customers in the Eugene area, with total average annual load of approximately 270 aMW. EWEB's load has remained flat or declined over much of the past decade due to the loss of industrial facilities, as well as the success of EWEB's energy efficiency programs.

However, with changing technologies such as heat pumps and electric vehicles (EVs), as well as policies that promote electrification, EWEB expects to see increasing load growth over the next decade. This view is informed by EWEB's 2020 electrification study and is consistent with other utility IRPs and analysis by industry leaders. Major impacts from electrification are not anticipated until around 2030 when light-duty EV adoption becomes more widespread.



EWEB is a winter peaking utility, with average single hour peaks of roughly 465 MW, and once in ten-year peaks of over 500 MW. In contrast, recent summer peaks have been between 380 and 410 MW, although these have generally trended upwards. EWEB's load can fluctuate by over 100 MW within 24 hours due to changes in temperature and customer behavior.



9 New Resource Options

New resource options have shifted dramatically over the past decade as carbon policies have made investment in fossil fuel plants challenging and risky, and the costs of solar and wind generation have declined dramatically.

The wind and solar resources included in the 2022 IRP are some of the most cost-effective resource options available to EWEB. However, renewable resources are not dispatchable (available on-demand), and their energy production may not align with EWEB's needs. Other resources, such as biomass, hydro, batteries, and demand response, provide this type of dispatchable capability. Because the value of renewable resources is highly location-dependent, the IRP includes several distinct wind and solar options, including local community and residential rooftop solar.

It's important to note that resource options in the IRP do not represent specific power purchase agreements or resources available for sale, but instead use publicly available data to estimate the costs of typical new generation or demand-side programs. The list of resources under consideration is not meant to be exhaustive, but instead provides touchpoints to understand what types of options might be valuable to EWEB in the future.

In the 2022 IRP, EWEB used a standard approach to evaluating model candidate resources. To be considered, a resource must be:

- An existing or proven technology
- Deliverable to EWEB load
- Commercially operational today, or under contract to be operational within the next 10 years

Below is a table of the resources considered in the IRP:

Key Energy, Cost, and Carbon Attributes

Resource Category	Resource Type	Levelized Cost of Energy $/MWh	Cost of Winter Peaking Capacity $/kW-mo	Transmission Risk/Cost	Carbon Intensity MTCO2e/MWh
Wind	MT/WY Wind	22	16	High	-
	Offshore Wind	102	102	High	-
Solar	Residential Rooftop Solar	196	451	-	-
	Community Solar	69	161	-	-
	Utility Solar (Eastern OR)	28	51	Moderate	-
Battery and DR	Battery (4hr)	N/A	15	-	N/A
	Demand Response	N/A	22	-	N/A
Conservation	Energy Efficiency Bin 1	33	16	-	Savings
Thermal	Natural Gas SCCT (40%)	74	9	Moderate	0.53
	Cogeneration/Biomass	74	48	Low	0.39
	Small Modular Nuclear (80%)	76	43	Moderate	-
BPA	BPA Contract (Slice & Block)	33	18	Low	0.02

10 Modeling Approach – Calculated Reference Case

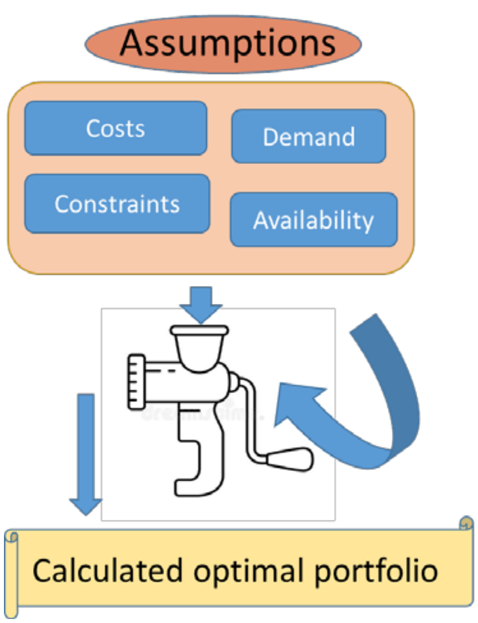
EWEB's planning team uses Aurora simulation software, in addition to other tools and analysis, to explore EWEB's resource needs and portfolio options. This practice is standard across the energy industry, as it allows for more granular and sophisticated examination of different scenarios and uncertainties. Modeling allows staff to look at resource performance under a variety of conditions. We can also create optimized solutions that reduce both cost and risk based on the assumptions used.

The draft 2022 IRP includes a single, modeled future portfolio, called the calculated reference case. This is intended to serve as the starting point for further analysis and feedback from the Board and community.

The reference case represents the portfolio of future resources that the Aurora model selected through simulation, given a specific set of inputs and assumptions. ***The goal of the calculated reference case is to provide a reasonable benchmark against which to compare other sensitivities and portfolios***. In general, we relied on 'business as usual' constraints and assumptions to generate the reference case. Almost any assumption can be explored in sensitivity analysis, discussed further in the Appendix.

Key Assumptions

- The calculated reference case modeling is constrained to select just enough resources to meet an average winter single-hour peak load event.
- EWEB's BPA contract is assumed to continue throughout the study period (post-2028), with cost adjustments for inflation starting in 2027.
- Transmission availability for new resources is not materially constrained or adjusted for future cost risk.
- Results assume typical planning conditions, including median water years.
- EWEB's portfolio is constrained to meet Board Policy SD15, which requires our portfolio to be 95% carbon-free by 2030.
- Additional assumptions are listed in the Appendix (such as carbon pricing and resource costs).



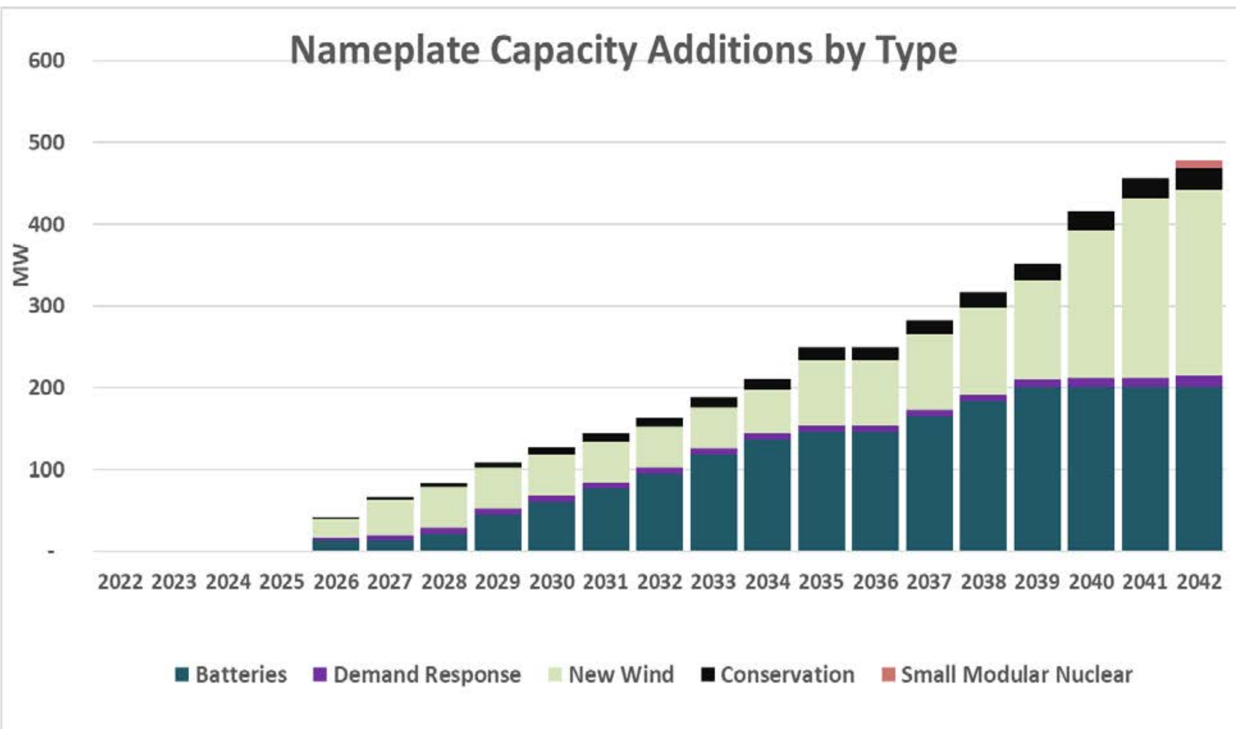
Key Reference Case Assumptions	
Electrification load growth?	Yes
Transmission availability?	No major constraints
BPA cost?	Similar to today
Peak load?	Average winter
Carbon limit?	95% carbon-free by 2030

11 MODELING RESULTS - CALCULATED REFERENCE CASE

Initial Modeling Results

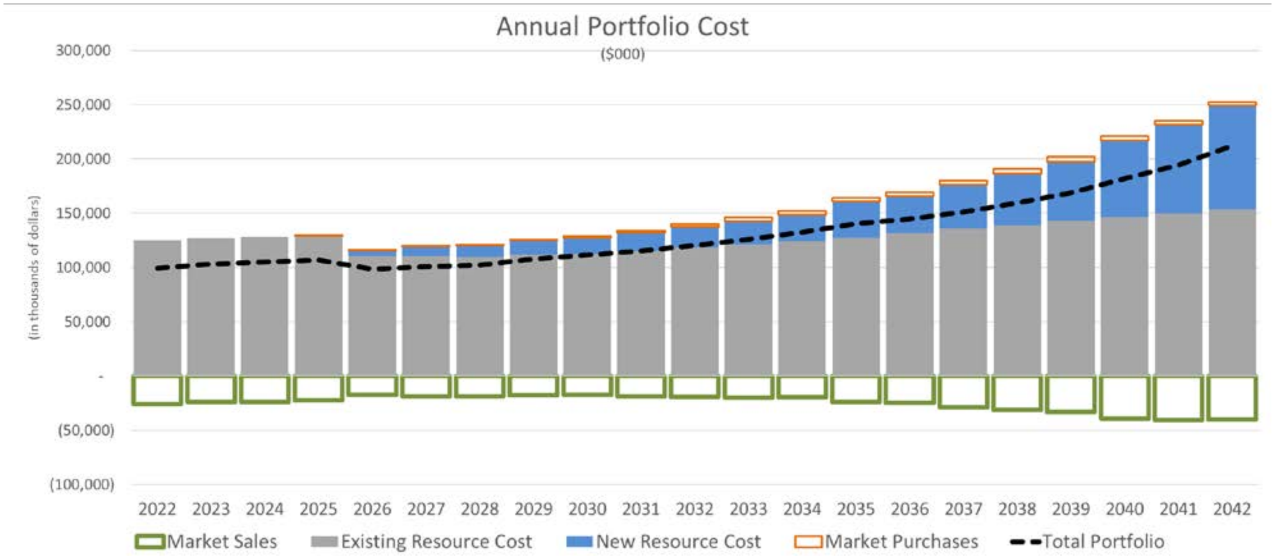
- Using a 1-in-2 planning standard, EWEB does not have a need to acquire resources until 2026, when existing thermal and wind resource contracts expire.
- Starting in 2030, forecasted unmanaged electric vehicle (EV) charging begins to increase peak capacity needs by 2% per year, driving increased portfolio costs.
- BPA products appear to be one of EWEB's least-cost portfolio options. The assumption that these products will be similar in price and design to today is a key factor in the least-cost calculated reference case results.
- Calculated reference case portfolio additions are primarily batteries, wind, demand response and energy efficiency throughout the study period.
- 10 MW of small modular nuclear reactors (SMR) are added in the final year of the study period, 2042.
    - SMR additions represent a potential future need for a firm, dispatchable resource in the future. The exact technology, however, may change by 2042.

The calculated reference case is a suggested portfolio based on modeling results and certain inputs and assumptions. These results are not EWEB's preferred or expected portfolio, but instead are computed results which act as a benchmark for further iteration, informing EWEB's future strategic decisions. The modeling results discussed herein are the beginning of a longer process and discussion that will include conducting sensitivity analysis and developing an IRP action plan.



In the chart below, EWEB's portfolio cost remains relatively stable through the 2020's, despite some retirements of existing contracts for wind and biomass. During this time period, EWEB expects relatively flat or small load growth, which keeps the need for additional resources, and by proxy additional cost, to a minimum.

However, increases in annual load due to vehicle electrification begin in the early 2030's. This increase in turn drives the need for more energy and capacity resources to serve the load, raising portfolio costs throughout the 2030's. Starting in 2033, the portfolio also begins to make market purchases (represented by the orange boxes below) of approximately 10 aMW instead of building more resources. This indicates that market purchases may be part of EWEB's least-cost portfolio strategy.



Over the study period, total portfolio costs increase an average of 4% annually, which includes both the impacts of load growth from electrification (2% growth per year) and inflation, indicating that portfolio costs relative to load would remain relatively flat. Portfolio costs represent one portion of end-use customers' retail rates. In the Reference Case, although total portfolio costs are expected to increase, so is energy demand, which would spread those costs among more kilowatt-hours. In effect, rates could remain stable even if overall costs increase.

A key aspect of meeting demand with intermittent renewable generation is the generation of surplus energy. Renewable resources – whether wind, solar, or hydro – generate energy at times when EWEB does not need them to serve load. EWEB's ability to create revenue from this surplus energy is an important part of reducing total portfolio costs.

Throughout the study period, sales of excess energy (represented by the green boxes above) averaged approximately $60/MWh and generated an average annual benefit of $25 million per year. Assumptions around future market prices and the value of surplus energy are a key driver of resource selection and portfolio cost and risk.

12 Planning Context – Overview

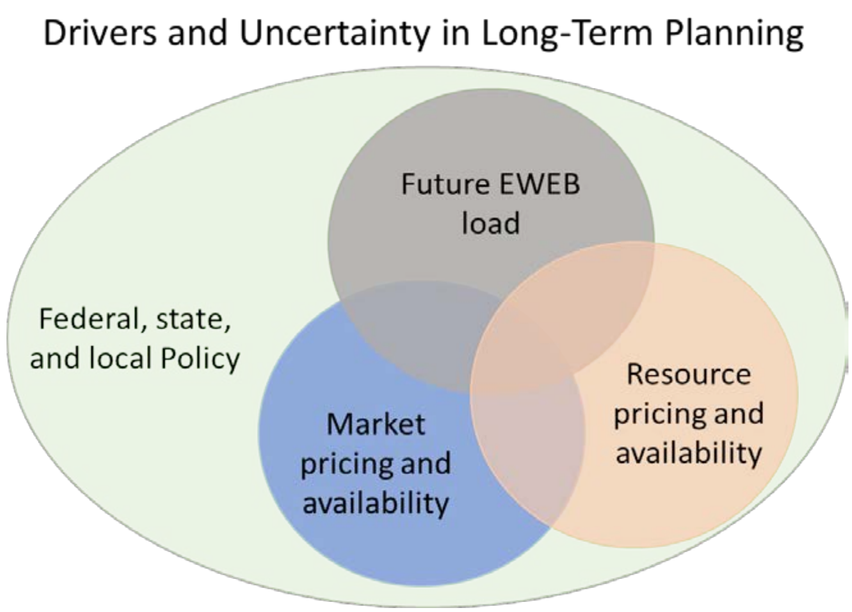
The following several "Planning Context" sections of the IRP aim to give an overview of the broader environment in which EWEB will be making resource decisions over the next decade.

Utilities and others in the energy industry have talked about oncoming dramatic change for well over a decade, and there are signs that it is here. For example, in just the past few years, renewable resources have become the cheapest source of power on an energy basis and are the resources of choice in nearly all IRPs in the region.

Additionally, in August 2022, the federal government passed the Inflation Reduction Act, which contains unprecedented levels of funding for renewable and clean resources, as well as incentives for homeowners to invest in fuel-switching technologies that could increase electricity demand.

Even though there does not appear to be anything on the horizon that would cause a shift back to the old dynamics, there is a large amount of uncertainty over the speed of change. EWEB needs to have a plan that considers these trends and uncertainties, as well as the supply risks associated with action or inaction. EWEB staff have worked closely with leading industry consultants to incorporate assumptions around key drivers into the 2022 IRP. In addition, sensitivities and future IRP work will analyze alternate assumptions to find tipping points and areas of opportunity or risk.

Key Context sections include:



- **Policy**: EWEB expects that carbon policies will have a substantial impact on future resource costs and acquisition strategies. EWEB does not expect backsliding from current policy directions.
- **Adequacy, Risk, and Planning Standards:** As the Northwest region retires dispatchable fossil fuel generators, it is expected that tangible, physical investments will be needed to maintain system reliability.
- **Electrification**: Electrification is expected to be a major driver of increased load by 2030, with most of this coming from the shift to electric vehicles.
- **Transmission:** Transmission constraints and cost will be key drivers of resource acquisition decisions. Many of the best solar and wind locations are in Eastern Oregon or Montana and Wyoming, where transmission availability is limited.

13 Planning Context - Policy

Federal, state, and local policies impact EWEB's portfolio by imposing standards, fees or other constraints on resource and generation decisions.

Over the past decade, carbon policies have been one of the significant drivers of resource decisions, as legislators and others have attempted to mitigate or prevent the worst impacts of climate change. In general, policies have the potential to both increase electric demand (through promoting technologies that lead to electrification) and alter electric supply (through incentives or fees on certain types of resources).

Future carbon legislation and policies may create incentives to develop new clean resources, streamline transmission builds, or implement a price on carbon that would impact electric market dispatch. Uncertainty around these outcomes presents a supply risk to EWEB's future portfolio. To the extent possible, IRP modeling includes existing carbon legislation (excluding the Inflation Reduction Act) and uses constraints to represent EWEB's obligations to Board policy and Oregon Renewable Portfolio Standard requirements.

Key Policies:

- **Inflation Reduction Act**: The Inflation Reduction Act, passed in August of 2022, includes billions of dollars for additional tax incentives and rebates for clean and renewable technologies, both on the supply side (such as renewables and clean generation) and on the demand side (such as heat pumps and electric vehicles). This is likely to make renewable resources cheaper, while increasing demand for electricity.
- **Renewable Portfolio Standards (RPS)**: EWEB is currently subject to Oregon RPS, which requires EWEB to purchase the output of wind, solar or other designated "renewable" resources. (EWEB also receives an exemption for its hydro resources and contracts.)
- **Carbon Taxes or Cap-and-Trade:** Both California and Washington have passed cap-and-trade bills that require regulated entities to purchase allowances for their emissions. Oregon may also institute a carbon market. But even if the state doesn't, neighboring carbon markets will affect buildout of renewable resources regionwide.
- **Vehicle Emissions Standards:** Oregon is poised to follow both California and Washington in requiring all new light-duty vehicles to meet zero-emission standards by 2035. This is likely to increase electricity demand.
- **Building Standards:** Many municipalities, including Eugene, have passed, or are considering some level of bans on natural gas usage for heating buildings. A local natural gas ban would likely cause only a small increase in electricity demand in Eugene– much lower than other types of electrification.
- **EWEB Board Policies:** EWEB's Board has passed Strategic Direction 15, requiring EWEB's portfolio to be at least 95% carbon free by 2030.

As EWEB navigates these policies, we seek to limit cost and risk, while also maintaining compliance. Additionally, not all policies are equally effective, and some may have unintended adverse consequences. To manage these risks and represent the interests of the Eugene community, EWEB staff remain engaged in policy development at all levels.

14 Planning Context – Adequacy, Planning Standards, and Risk Management

EWEB cannot eliminate supply risk, but we can manage it through planning.

A key part of the IRP is defining EWEB's supply needs. This involves assembling information not just about EWEB's historical load, but also planning standards and risk tolerances. The 2022 IRP uses EWEB's forecasted average annual peak hour (also called 1-in-2 peak) as the Calculated Reference Case planning standard. As described in the section "Upcoming Sensitivity Analysis," exploration of other planning standards will be included in IRP analysis.

Balancing Authority

The reliability of any electrical grid is based on supply equaling demand at all times. Any over- or under-supply will cause instability in the grid. The national power grid is divided into independent "balancing areas" (BA), where each BA has assigned a utility or other entity that is responsible for keeping that balance – the Balancing Area Authority (BAA). EWEB is not a BAA, but instead operates within the Bonneville Power Administration's BA.

Because EWEB is not a balancing authority charged with managing the electric grid, it is unlikely that EWEB would experience blackouts if the utility does not procure enough resources to serve load. However, there are likely to be serious financial consequences for not doing so. EWEB's adequacy obligations, planning standards and risk policies are discussed further in the Appendices.

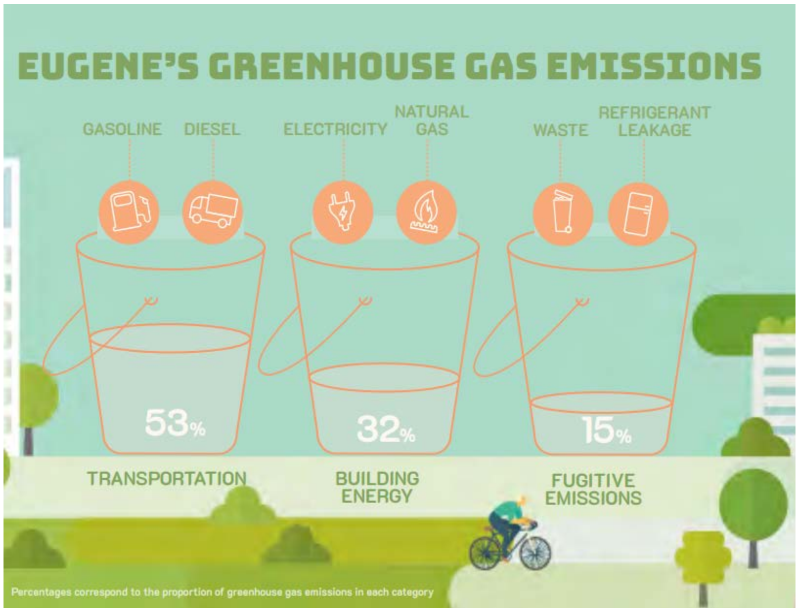
Resource selection and portfolio optimization are a balancing act between EWEB's specific needs and the broader electric system. If market prices are high, it is beneficial for EWEB to build resources and sell surplus energy on the market. If market prices are low, it is more cost-effective for EWEB to rely on the market rather than make large capital investments. Each approach carries its own benefits and risks. For much of the past decade, EWEB's portfolio has been 'long' to its average energy needs, meaning that the utility has had rights to more generation than it needed to serve average load.

Several factors contributed to this trend, among them the departure of several energy-intensive industrial customers, as well as EWEB's primarily hydro-based resource mix, which often provides excess energy depending upon water conditions. Having ownership or contractual rights to more power than our average needs puts EWEB in a net selling position. When market prices for power are below the cost of the investments EWEB has made, this surplus power presents a risk. However, with recent increases in natural gas and energy prices, EWEB's long portfolio has insulated the utility from some cost exposure.

Going forward, a number of factors point to continued market volatility and higher prices, as well as potential resource shortages if the region does not invest in new generating facilities. EWEB cannot eliminate supply risk, but we can manage it. The 2022 IRP is intended to continue laying the groundwork for developing strategies for planning standards, long-term risk management, portfolio optimization and alignment with community values.

15 PLANNING CONTEXT – ELECTRIFICATION

The impacts of electrification are expected to be significant by 2030. However, the benefits of electrification depend on the cost and carbon content of electric power.



Currently, most societal carbon emissions come from sources other than the electric industry. However, as new technologies become available, many energy-intensive processes are expected to be transitioned from fossil-fuel energy sources to electric ones. This process is referred to as electrification. While electrification is expected to substantially reduce carbon emissions, there is still uncertainty about how quickly change will occur, and whether these changes can happen without increasing costs.[2]

In 2021, EWEB partnered with energy consultant E3 to conduct an electrification study. The study looked at the economics and trends behind electrification to determine potential impacts to EWEB's service territory and to identify areas of opportunity for the utility. The study found that transportation electrification, particularly light-duty cars and trucks, was likely to increase average and peak loads in EWEB's service territory by the 2030s. In contrast, fuel switching for heating was expected to be less likely in 2021 because individual customers would not see significant financial benefit. This could change with mandates or legislative incentives.

Obtaining the benefits of electrification is highly dependent on several factors, chief among these being:

1. **The carbon content of electric power**. Any carbon reduction benefit of electrification is directly related to the carbon emissions associated with generating electricity. The lower the carbon content of the electric grid, and EWEB's portfolio, the greater the carbon reduction of electrification will be.
2. **The cost of electric power**. If the shift to low-carbon power supplies causes a material increase in electric rates, the incentive to electrify will be reduced, and the overall cost burden on average customers will increase. Although EWEB's portfolio is already low cost and low carbon compared to the average U.S. utility, EWEB must continue to manage these factors.

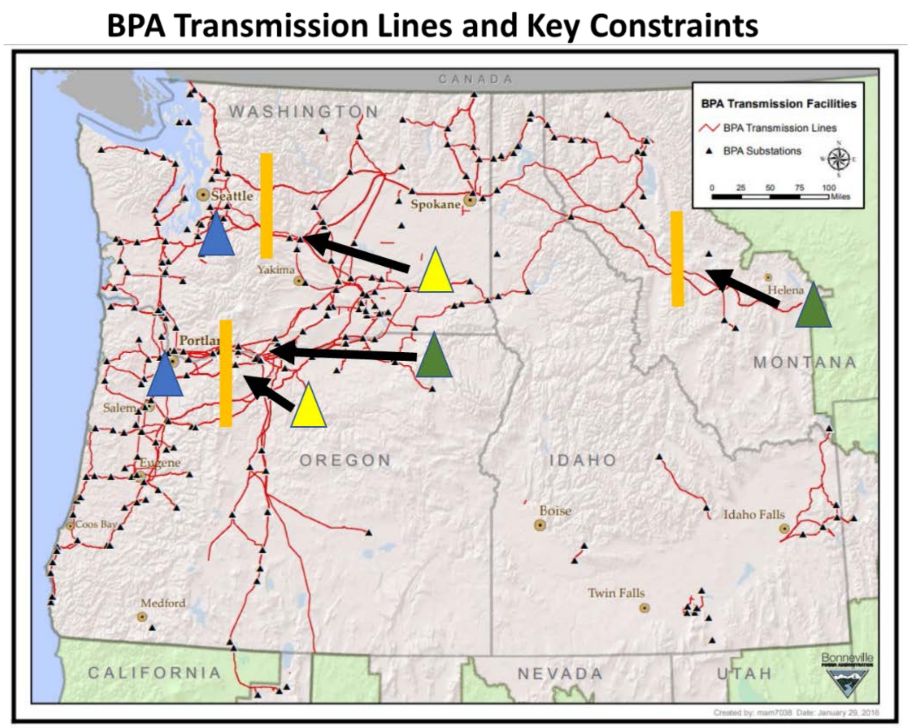
For the 2022 IRP, staff included the "base case" electrification scenario from the electrification study into the load forecast. This anticipates that EWEB's average load will increase 21% by 2040 due to EV adoption and assumes unmanaged peak charging would increase EWEB's system peak by 26% by 2040.

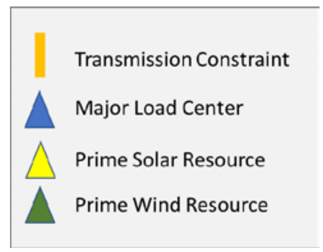
[2] Sources of Greenhouse Gas Emissions | US EPA

16 Planning Context – Transmission

Limited transmission availability is a major challenge to integrating new renewable resources.

To be useful, an energy source, whether it is wind, solar, or a thermal generator, must be delivered from where it is produced to where it is needed. Over the past century, utilities, and other entities such as the Bonneville Power Administration (BPA), constructed thousands of miles of transmission lines to accomplish this. These transmission lines allow energy transfer from one area to another and allow use of the most economically efficient energy resource options.





In Oregon, the best locations for renewable energy are east of the Cascade Mountains, where both solar and wind potential are the highest. Meanwhile, the greatest need for energy is west of the Cascades along the I-5 corridor. However, the existing transmission infrastructure has reached its maximum transfer capability on key east-west paths, and new transmission is notoriously difficult to build[3]. Because of these factors, transmission constraints are one of the biggest challenges to procuring new, high-quality renewable resources and meeting state or local clean energy goals.

BPA, as the primary transmission owner and operator in the Northwest, conducts annual studies to determine the need and cost for new transmission. In 2021, of the roughly 6,000 MW of transmission demand studied, there was only 305 MW of capacity available to offer without a need for transmission upgrades.

Potential BPA Upgrades

Recent BPA transmission studies identified key upgrades on the Cross-Cascades South path near Portland that could provide EWEB access to more renewable resources. These projects are expected to take 8 years to complete.

[3] How are we going to build all that clean energy infrastructure? (niskanencenter.org)

17 GLOSSARY

Assumptions:
Theorized data such as future load, used to model portfolio options.
Carbon:
Short for carbon dioxide, a greenhouse gas produced by burning fossil fuels and other sources.
Capacity:

- Nameplate: The maximum amount of power a resource can generate.
- Peaking: The amount of power that a resource can generate on demand.

Carbon Price:
A charge placed on greenhouse gas pollution mainly from burning fossil fuels. Often involves a cap on the amount of carbon that can be produced, and sometimes allows producers to trade allowances.
Climate Change:
The rise in average surface temperatures on Earth due primarily to the human use of fossil fuels, which releases carbon dioxide and other greenhouse gases into the air.
Demand:
The rate at which energy is being used by the customer.
Distributed Generation (DG):
The process of generating energy close to its point of delivery. Rooftop solar is an example of DG.
Demand Response:
Incentive-based programs that encourage customers to temporarily reduce their demand for power at certain times in exchange for a reduction in their electricity bills.
Demand Management (also Demand-side Resources):
Activities or programs undertaken by a utility or its customers to influence the amount or timing of electricity they use. DM is often used in order to reduce customer load during peak demand and/or in times of supply constraint.
Energy Efficiency:
Refers to programs that are aimed at reducing amount energy used in homes and other building Examples include high-efficiency appliances, lighting, and heating systems.
Forecasting:
Making projections about future load, resource options, economics, etc.
Generation:
The process of producing electricity from hydroelectric turbines, wind, solar, fossil fuels and other sources.
Load:
The amount of electricity on the grid at any given time, as it makes its journey from the power source to all the homes, businesses.
Megawatt:
The standard term of measurement for bulk electricity. One megawatt is 1 million watts. One million watts delivered continuously 24 hours a day for a year (8,760 hours) is called an average megawatt.
Modeling:
Using industry software and other tools to study and analyze portfolio options.
Peak Demand:
The largest instance of power usage in a given time frame.
Planning Standard:
Planning standards are a set of metrics to define an acceptable level of risk where generation may not equal load. A 1-in-2 standard requires resource procurement to meet a single-hour peak load in an

average year. A 1-in-10 standard requires resource procurement to meet a single hour peak load that is expected to occur once every 10 years.

Planning Reserve Margin:
Planning Reserve Margin (PRM) refers to the amount of additional resource procurement desired above a forecasted peak load to ensure that there is enough generation in the event of unforeseen outages or other emergency situations.

Renewable Portfolio Standard:
A renewable portfolio standard (“RPS”) is a regulation that requires the increased production of energy from renewable sources, such as wind, solar, geothermal, and biomethane.

Resource Adequacy:
Ensuring there are sufficient resources when and where they are needed to serve the demands of electrical load in “real time” (i.e., instantaneously).

Resource Portfolio:
All of the sources of electricity provided by the utility.

Scope:
Focus areas for the current planning cycle.

Scenarios:
Possible future conditions outside of EWEB’s control that might affect how we meet customers’ electricity needs.

Sensitivity:
Changes in input assumptions to test how these impact modeling outcomes.

Supply (also Supply-side Resources)
Power generating resources used to meet electricity needs.

Transmission:
An interconnected group of power lines and associated equipment for the movement or transfer of bulk energy products from where they are generated to distribution lines that carry the electricity to consumers.