EUGENE WATER AND ELECTRIC BOARD

2011 INTEGRATED ELECTRIC RESOURCE PLAN

December 2, 2011

Acknowledgements

EWEB's 2011 Integrated Electric Resource Plan was developed through a team effort including input from EWEB customers and staff as well as Northwest Power and Conservation Council staff. EWEB would like to express its appreciation to all those who contributed to this effort.

2011 EWEB IERP Community Advisory Pane

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Executive Summary

Overview

EWEB's Integrated Electric Resource Plan (IERP) serves as a roadmap to guide decisions for how the utility will meet the energy needs of our customers over the next two decades, and to identify specific actions to take over the next five years. The primary purpose of the IERP is to set a strategic path that will meet forecast demand for power while minimizing risks. The 2011 IERP is using a Triple Bottom Line (TBL) framework to consider the economic, social, and environmental aspects of alternative strategies. The TBL includes both quantitative and qualitative information to encourage a more comprehensive and holistic consideration of benefits and impacts of different alternatives.

This year EWEB celebrates its 100th anniversary as a publicly owned water and electric utility. One of the achievements celebrated has been a power portfolio that is largely comprised of renewable resources. Hydroelectric generation makes up the majority of EWEB's portfolio. Other resources include conservation, biomass, wind, and solar photovoltaic (PV) energy. The biggest resource addition to EWEB's portfolio over the last thirty years has been conservation (energy efficiency).

Two key questions for the IERP have always been:

- "*Will existing power resources be sufficient to meet future customer needs?*"
- "*If we need to add resources, what type should EWEB invest in?*"

This year, two important nuances were added to the adequacy question:

- *"Will existing power resources be sufficient to meet future customer needs during the time of peak usage across the system?"*
- *"Does EWEB's existing power portfolio have sufficient flexibility to respond to the emerging issue of variable resource integration?"*

Planning for peak and flexibility add new dimensions to the planning process. Prior resource plans have focused on evaluating resource needs on a month-average or annual-average basis. Customer demand can look very different at the "peak hour" than it does on average over a month. Historically, peak system needs have been less of a concern than average needs due to the large proportion of hydro generation in the region. However, operating constraints and continued growth in energy use have begun to change this picture in the Northwest. In addition to these regional shifts, EWEB lost about 100 MW of peak capacity and 44 MW of firm average energy under the new BPA power purchase contract. As a result, it is important that this plan evaluate whether or not the utility has sufficient hourly peaking resources, in addition to average monthly resources. Flexibility considerations stem largely from the addition of thousands of megawatts of wind generation across the region. Since wind is an intermittent resource, planning to backfill its power supply when the wind isn't blowing adds a level of complexity to regional planning and operations that did not previously exist.

Customer Demand & Scenario Analysis

The twenty-year, base case forecast of both average and peak customer demand show that under most circumstances, EWEB's existing power portfolio is surplus to customer load until the 2020s. Only during an extreme cold snap, which occurs roughly one in ten years, would existing resources be unable to meet forecast peak hourly customer demand. Other scenarios which could prompt the need for new resources sooner would be the addition of a new large customer load to the EWEB system or the loss of a large generating facility used to serve EWEB customers.

In addition to the load variability and weather-related risks noted above, other key elements of forecast uncertainty were reflected in the planning process, namely wind and hydroelectric power availability, natural gas price risk, and carbon tax policies. Each element of uncertainty must be separately forecast and modeled since each significantly impacts both the generating cost and market value of EWEB power. To conduct these analyses, EWEB staff licensed the 'Aurora' planning software tool, used to model generation availability, customer loads, and a range of uncertainties over the 20-year planning horizon. Each potential resource was evaluated with 540 unique combinations of the uncertainties listed above, to model performance under multiple potential futures and help select alternatives with the lowest cost and risk.

As it has historically, staff relied heavily on the Northwest Power Planning Council's 'Sixth Power Plan' for resource cost and operating characteristics data. In its sixth iteration, the regional Power Plan once again found that conservation is the least-cost, least-risk resource when compared to generating resources. In addition to conservation, the following other resource options were evaluated:

- Wholesale Market Purchases (short-term and market options)
- Wind
- Utility-scale PV (local)
- Concentrating Solar Thermal (remote)
- Natural Gas Peaker Plant
- Biomass (combined heat/power)

Only commercially available technologies that were deemed viable for the region were analyzed.

Triple Bottom Line Analysis & Public Process

In addition to the extensive modeling conducted by staff to generate facts and figures for use in this IERP, two other critical efforts were undertaken to ensure EWEB has as much relevant information as feasible for use in making its final Board recommendations. These included both the use of a Triple Bottom Line (TBL) analysis and an extensive public process.

TBL is an approach to decision evaluation that takes into account more than just financial costs and benefits. In particular, it serves to additionally recognize and frame the relevant environmental and societal costs and benefits. In 2010, the EWEB Board adopted a staff recommendation to use the TBL framework in decisions such as these, which have broad implications to more than just the 'bottom line'.

EWEB also sponsored a six-month long public process, within which a group of customers were selected to learn a great deal about the utility planning process and weigh in with their priorities, values and concerns. This information and dialogue provided valuable insight into the process and greatly influenced its outcome. In addition, EWEB conducted an online survey and two topical public meetings to help ensure even wider participation could be granted.

Key Findings and Strategies

Energy Efficiency

EWEB is a nationally recognized leader in energy conservation, acquiring about 65 aMW (14 percent of EWEB's current load requirements) of conservation since its program began. EWEB has a longstanding policy that prioritizes cost-effective conservation as its preferred resource strategy. The modeling and TBL analyses not only confirmed this premise, but helped shape the adoption of an unprecedented target for EWEB in the 2011 IERP: to meet all projected load growth for the next twenty years through conservation. This recommendation was taken forward in August of this year, and the EWEB Board of Commissioners concurred with the strategy.

Demand Response

The recommended strategy also included another new milestone: that EWEB begin building its capabilities to deliver demand response and peak reduction programs over the next five years. As most renewable generating resources are unable to meet the region's growing need for flexibility and peak-time demand, customer programs to encourage demand response, similar to what has been done for energy efficiency, may prove to have lower cost and lower environmental impacts than pursuing new 'peaking' generating resources. One of the goals for this IERP calls for assessing technologies and participating in pilot programs to test customers' willingness to partner with EWEB to manage peak loads.

New Large Load or Loss of Resource Scenario

In the event a new, very large load locates in Eugene, EWEB surplus power and conservation acquisition could be insufficient to meet demand. The analysis of potential new resources found that market purchases would be the most prudent strategy to serve that need over the next five years. Overall, no generating resources were found to be cost-effective over the long-term and economic performance was highly dependent on whether a carbon tax (or cap-and-trade policy) is ultimately levied.

Going Forward

Because EWEB is surplus power, and a carbon tax does not appear likely in the near term, the recommended strategy under this IERP is to maintain the ability of EWEB's existing generation fleet to serve both peak and average customer demand by meeting new average load growth with conservation and the deployment of demand response programs to address peak and flexibility requirements. This strategy results in no long-term commitments for new generating resources over the next five years, thereby minimizing the financial risk to the utility associated with having more power at times of the year when the region is already surplus, especially given the backdrop of a soft economy overall.

Recognizing the tremendous change and uncertainty facing utilities today, part of EWEB's internal implementation plan for the IERP will be to continue to monitor key assumptions and risks, update load and price forecasts, and stay current on regional affairs that will impact future demand and supply realities. EWEB staff believes its recommended strategy best serves to create and enhance customer value. This approach also preserves EWEB's ability to make prudent resource investments if and when market and other conditions change.

For more information on EWEB's 2011 IERP, please see www.eweb.org/ierp.

Introduction

What is the purpose of an Integrated Electric Resource Plan?

An Integrated Electric Resource Plan serves as a roadmap to guide decisions for how the utility will meet the energy needs of customers over the next two decades, and to identify specific actions to take over the next five years. The primary purpose of the planning effort is to set a strategic path for meeting projected demand for power, while minimizing the risks associated with resource acquisition and delivery of power.

The IERP is about the future, but starts with the present by first assessing EWEB's current power supply portfolio and customers' need for power. Next, twenty year forecasts of power generation and customer usage are developed to predict when additional resources may be needed. Last, if more power will be needed, then alternative strategies for meeting that need are evaluated.

An IERP is not a stand-alone document. It must logically tie to other planning and implementation plans throughout the organization. One of EWEB's adopted goals in its 2011 Strategic Plan is to "Deliver Value for Generations". The IERP, which reflects long term strategy decisions and contemplates financial commitments for new power resources, is a fundamental component to achieving this goal. However, delivering value has broader meaning than simple economics. As with past IERPs, EWEB considered a range of other important values during the planning process, such as potential environmental impacts and social implications... For the 2011 IERP, EWEB formalized the inclusion of such considerations through a Triple Bottom Line (TBL) framework, which documents how the economic, social, and environmental aspects of alternative strategies were evaluated.

The utility's previous IERP was adopted in 2004. EWEB did not necessarily *need* to develop a new power resource plan at this time because the utility has surplus generation sufficient to last over a decade. However, several key conditions have changed since the last IERP and looking forward, more challenges to EWEB and the electric industry in general loom on the horizon.

Technology-driven changes such as the next generation of electric vehicles and more customer-owned, *distributed generation* could lead to our customers purchasing significantly more or less energy from EWEB in the future. Local and national economic conditions drive both EWEB customers' need for power, as well as the market value of that power. The emergence of renewable portfolio standards and tax incentives across the country, as well as the potential for carbon regulations are examples of regulatory impacts to the utility. The dramatic build up of variable output wind generation has created a large surplus of generation in the region, along with challenges integrating that intermittent power into the supply portfolio and greater market price volatility. Climate change models are predicting greater variability of hydro generation - wet years will get wetter and dry years will get dryer.

In short, the changes over the next 20 years could exceed the changes experienced by EWEB over its first century of service. By developing a new IERP, the utility has the opportunity to assess such uncertainties and risks and analyze how these may change customer need for power over the coming decades.

It is important to recognize that an IERP is not a recipe that lays out the exact ingredients to achieve a desired result. To be an effective planning document, it must allow EWEB to be responsive when forecasts change and adaptive when new risks appear. In this way, the IERP analysis is intended to help set overall goals and outcomes for the power supply portfolio and to select preferred strategies to help EWEB to meet those goals. By focusing on the desired outcomes, EWEB maintains the flexibility to choose between investing in resource options available today or to hold off in order to consider emerging resources that may appear in the future.

EWEB does not rely on the forecasts and strategies developed in any IERP for the full twenty-year planning horizon. Instead, plans have been updated roughly every five years to ensure that forecasts and strategies reflect changing conditions. The focus of the 2011 IERP is developing strategies and actions that EWEB can take for the next five years to support its commitment to Eugene's energy future.

Road map to the 2011 Integrated Electric Resource Plan

This resource plan lays out the key assumptions used in the analysis and the process used to help ensure a comprehensive assessment of the issues. The public engagement process EWEB used to support the plan findings is described along with an overview of the TBL framework used in the evaluation. The plan provides some history of EWEB loads and resources to help provide context for the future forecasts and the major uncertainties EWEB faces. The results are summarized in a simplified TBL table. Finally, this plan and ends with an overview of next steps to provide guidance for how staff will use and continue to develop this plan going forward.

Public Involvement in the IERP

As a publicly-owned utility, EWEB's Board and management are committed to engaging its community in energy planning. Community involvement was formalized with the first IERP process in 1990. The last 20 years of power resource acquisitions have been made based on planning efforts influenced by EWEB customers. Community engagement doesn't just imply that our customers support the direction of the resulting resource plan; it means that customers help shape the thinking that creates the plan. In this process, staff sought to continue this tradition of encouraging interested community members to participate in the planning effort and offer informed input to the EWEB Board.

To help achieve this objective, a community advisory panel was selected as one of the main components of our engagement efforts. The intent was not to establish a technical committee that would spend multiple meetings on the modeling assumptions and analysis work, but rather a representative group of EWEB customers who could act as a sounding board on key elements of the plan and help ensure that staff was paying attention to the issues that matter most to customers. To ensure a well-rounded applicant pool, staff sent out a press release seeking applicants to serve on the IERP community panel and also canvassed for participants among relevant partner agencies and community organizations. Over fifty responses to the solicitation were received. In evaluating the applications, staff considered the following criteria:

- Relevant background/experience
- Community connection/public involvement
- Representation of diverse perspectives/customer types
- Potential for perceived conflict of interest

The applicant pool was rich in highly educated and experienced candidates. The goal was a group of 11-13 participants who represent different customer groups (residential, commercial, industrial), agency partners (City of Eugene), and stakeholder interests (social justice, environment, climate change, low income, economic development, green technology). Staff also sought to introduce some new voices to the discussion, and to make sure the average customer had a seat at the table. Distribution across age, gender and geographic location was also considered.

Ultimately, twelve people were invited to participate on the panel. Non-selected applicants were added to the interested parties (IP) list and were sent materials developed for the panel meetings. During the process, the IP list grew to about 100 people who received email notifications of all meetings and were invited to related events.

The main charge of the IERP Community Advisory Panel was to provide feedback to staff, and ultimately the Board, on three questions:

1. *What conservation strategy should EWEB adopt for the next five and twenty years?*

2. *What economic, environmental and social attributes are most important when considering new resource acquisitions?*

3. *What goals or benchmarks should be established in the IERP and what metrics should be used to measure progress towards these goals?*

A professional facilitator managed the meetings and helped maintain independence between the work of the panel and staff. The group's decision-making process was advisory in nature, with each panelist contributing his/her own opinion and perspective rather than voting on any given topic. Six meetings were held between March and September of 2011; all were publicly noticed and included an opportunity for public input. A content-rich webpage was created containing all meeting agendas, minutes, background material and presentations.

In addition to the Community Advisory Panel, a brief electronic survey was created to enable more customers to weigh in on the topic. In all, two-hundred and six people completed the *Survey Monkey* survey, which was available for about three weeks and advertised in numerous venues, including the *Register Guard*. As survey participants were self-selecting, the results were not intended to be statistically valid, but rather provide another way to gather feedback from interested community members and to share those perspectives with the panel.

Key findings from IERP Survey:

• 85 percent supported conservation at current or higher levels; a majority preferred more conservation as a future strategy

• 50 percent thought conservation was the best way to address a new large load. Fewer than five percent wanted EWEB to use power purchases as the only way to meet new loads, but 30 percent said to "do what's most cost-effective". A number of respondents offered other strategies including a combination of conservation and power purchases, requiring new customers to use most efficient building techniques, and/or including on-site renewables

• 81 percent said they would be willing to pay more to facilitate conservation. Of these, a majority favored a $5 monthly bill increase over a $10 increase

• When asked about characteristics that are most important for choosing new resources, environmental impacts and contribution to climate change were valued

Two public education events were held during the plan's development. In July, panelist Julie Daniel and EWEB Power Resource Division Director, Clay Norris were invited to speak at the City Club of Eugene on this topic. Then on October 27th, EWEB hosted a public event titled, "Our Energy Future: Together We're Powerful." This event, attended by about 60 community members, featured three regional energy experts who discussed major paradigm shifts in the utility industry and how customers can get to play a part in meeting energy needs in the future. A world café process followed the panel presentation, allowing participants to share their ideas on priority issues, including what role customers can play to make wiser use of our energy resources.

How Triple Bottom Line Analysis was used

In 2010 EWEB's Board adopted a sustainability policy that called for using a Triple Bottom Line (TBL) framework when making decisions. A TBL analysis considers the economic, social, and environmental aspects of alternative strategies, which helps to identify benefits and risks of those strategies. Sometimes there is one strategy that is preferable in all three aspects of the TBL. More often, however, no one strategy is best in all aspects, so the TBL helps to clarify the trade-offs faced by choosing among alternatives. The TBL can also help identify mitigation opportunities that will reduce potentially harmful impacts of otherwise desirable strategies. This report presents both the analysis and the context that help support staff's recommended strategies.

To this end, staff developed a list of the key issues to consider when comparing potential energy resources, ensuring that all three aspects of the TBL (social, environmental and economic) were represented, and reviewed that list with the Advisory Panel. A summary of the list of the issues is presented below in alphabetical order.

Affordability/Equity & access - New resources typically cost more than legacy resources, but they should not be so expensive as to cause a large rate increase. Conservation programs generally require participants to have money to invest in projects.

Construction Risk - A preferred new resource would have a clear path to construction including land availability, permitting and a relatively short construction lead time. Lead times can be impacted by public approval and permitting processes, as well as actual construction time. Newer technologies may have a higher hurdle to receive approvals, although location can also be an important variable.

Flexibility - Because EWEB's purpose is to serve the electricity needs of its customers, new resources are needed that generate at times when existing resources cannot. A preferred new resource could be controlled by EWEB to only generate when needed. Currently, EWEB relies on the wholesale power market to balance supply and demand. A flexible resource would reduce deficits that require market purchases and not add resources in times when EWEB is already surplus.

Local - Local generation and conservation can provide jobs and keep money in the local economy. It can also improve reliability by reducing dependence on the regional transmission grid.

Peaking - Because EWEB foresees a deficit of resources to meet extreme winter peaks, a preferred resource would be able to produce power at times of system peak. Not all flexible resources can promise this.

Portfolio Diversity - A diverse power portfolio helps to reduce EWEB's financial risk. Currently EWEB gets the majority of its power from the regional hydro system, which has maximum output in winter and spring. EWEB's second biggest resource is wind located in the Columbia River Gorge, which yields maximum output in spring and summer, predominately at night. A preferred new resource would produce power at other seasons and times.

Reduced Environmental Impacts - All generation, including renewable generation, has environmental impacts, so analysis of energy resources requires comparing resources to each other. Conservation is the best resource for reducing environmental impacts as no generation or transmission is required. Carbon reduction benefits are a quantifiable aspect of environmental impacts that is included in the TBL results.

Reliability - A reliable resource has few outages due to either breakdowns or lack of fuel, including renewable fuels like wind and solar radiation. Resources that require lengthy transmission lines to connect to the regional transmission grid or to EWEB's system have lower reliability than resources with short interconnections.

Scalable - Scalable means that EWEB can acquire just as little or as much as it needs and wants. Most of the strategies evaluated for the IERP were scalable resources.

Some metrics required complex quantitative analysis, such as cost-benefit ratios, rate increases and carbon emission reductions. Other metrics relied on spreadsheet calculations using simplified assumptions, such as the local job creation estimates. Finally, some metrics are purely qualitative evaluations, such as whether a project aligns with community values or has local aesthetic impacts.

To evaluate the complex quantitative metrics, staff licensed the AURORAxmp® (Aurora) power planning software to evaluate resource portfolios using scenario analysis. Aurora simulates the operation of the regional power system as well as EWEB's power resource portfolio as part of the regional grid. Aurora tracks total generation, costs, and emissions associated with EWEB's power portfolio, values which are important to six out of nine of the above attributes.

A summary of the TBL analysis results presented (Figures 12 and 16) in the "Recommended strategies" sections outline the differences between various conservation strategies and potential new energy resources, respectively.

EWEB Power Portfolio

EWEB celebrated its 100th anniversary as a public water and electric utility in 2011. Starting with the Walterville hydro-electric facility in 1911, EWEB has been acquiring resources for the last century to meet the needs of EWEB customers. Those early hydro resources and the ongoing contract with the Bonneville Power Administration (BPA) have provided a legacy of low-cost, low-carbon emission power that has benefited our community for decades. Over the last twenty years EWEB has diversified its power portfolio by acquiring wind, biomass, and solar resources, but the largest addition has come from energy efficiency programs. Figure 1 below provides a chronology of EWEB resource additions by decade.

Figure 1. EWEB Resource Additions Over Time

Time Period	EWEB Resource Acquisition by Decade
1910s	Walterville Hydro
1930s	Leaburg Hydro, Steam Plant
1940s	First BPA contract
1950s	Priest Rapids and Wanapum Hydro
1960s	Carmen-Smith and Trailbridge Hydro
1970s	Weyerhaeuser (International Paper) Co-generation
1980s	Energy Conservation, Smith Falls Hydro
1990s	Energy Conservation, Stone Creek Hydro, Foote Creek Wind
2000s	Energy Conservation; State Line, Klondike-III and Harvest wind; solar PV
2010s	Energy Conservation, solar PV, Metro Wastewater Biogas, Seneca Biomass

Figure 2 below shows the 2012 forecast generation for EWEB's power portfolio as measured by annual firm aMW, expected aMW and peak MW capacity. Firm represents a reliable level of generation that EWEB can depend upon receiving, a criterion historically used for planning purposes. For hydro generation resources, firm represents the amount of energy forecast to be produced during the worst droughts. Other power generating technologies have firm generation levels that depend on other factors, such as the average wind speed over a year or rated capacity less planned and unplanned outages. Actual generation almost always exceeds the planned firm.

Figure 2. EWEB Generating Resources Today

Existing EWEB Resource Capabilities				
EWEB Resource	**Type**	**Firm aMW**	**Expected aMW**	**Peak P MW**
BPA	90% hydro	248.9	291.4	440
Carmen-Trail Bridge	hydro	19.8	29.8	92
Leaburg-Walterville	hydro	14.4	19.6	25
Smith Falls	hydro	5.4	8.9	38[1]
Stone Creek	hydro	5.4	7.2	12
Grant County Hydro	hydro	1.4	1.8	2
Foote Creek	wind	1.9	2.3	9[1]
State Line	wind	5.3	6.2	25[1]
Klondike-III	wind	7.0	8.1	25[1]
Harvest Wind	wind	5.0	6.0	20[1]
Seneca Biomass	biomass	16.3	16.7	19
International Paper CHP[2]	60% biomass/ 40% NG	7.3	7.3	13
Metro Wastewater CHP	biomass	0.6	0.6	0.8
Wauna CHP[3]	biomass	0	0	0
Distributed Generation	mostly Solar PV	0.3	0.3	3.0[1]
Total Resources			406.2	721
Total *Reliable* Resources		338.9		606

Expected generation represents the average annual generation which means half of the time EWEB receives less than the expected amount and half of the time it receives more. Expected generation is not as reliable as firm generation. The difference between firm and expected generation is shown in the Figure 3 below as "surplus energy". Peak capacity reflects the maximum amount of energy a facility is capable of generating. Some generating resources have the ability to ramp up to peak capacity when needed, while others have performance profiles that are weather dependent.

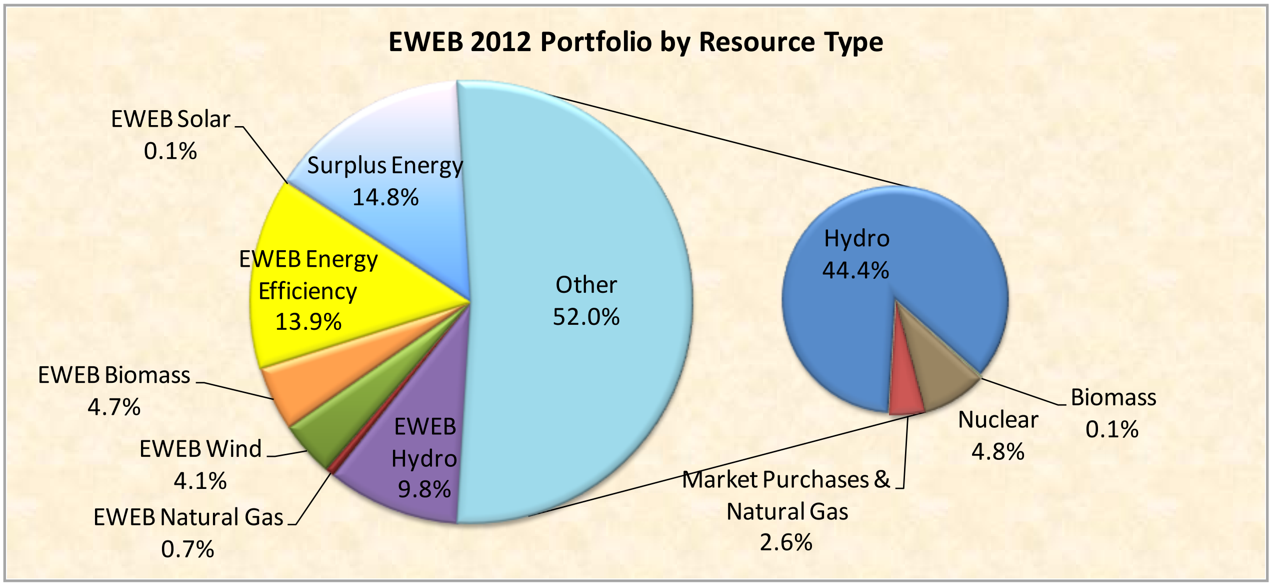
[1] These resources typically do not generate at the time of EWEB's peak load, and are excluded from the Reliable Capacity calculation used to asses EWEB's ability to serve its peak load.

[2] CHP, or combined heat and power, is an efficient technique to generate electricity because it has less waste heat. CHP is also known as cogeneration, or *cogen* for short.

[3] The Wauna cogen is a 20 aMW biomass CHP project located at the Georgia-Pacific paper mill near Clatskanie, Oregon that was completed in 1996. It is owned jointly by EWEB and the Clatskanie PUD. Steam for the mill comes from burning biomass byproduct produced at the mill supplemented with natural gas. Wauna's generation was sold to BPA under a 20 year contract until 2016. EWEB and Clatskanie will each receive half the output from 2016 through 2021, when our contract with Georgia-Pacific expires.

It is important to note that Figure 2 does not include EWEB's accumulated energy conservation resources, which now totals about 65 aMW of resources EWEB has not had to add over the last 30 years. Figure 3 below shows EWEB's current power supply portfolio by technology, including accumulated conservation savings and surplus energy.

Figure 3. EWEB Resource Portfolio



Even with past conservation savings and recent wind and biomass additions, the portfolio is still dominated by hydro because of EWEB's large power purchase contract with BPA combined with EWEB's own hydro resources. The output of EWEB's share of four wind projects and three cogeneration projects total 10 percent of EWEB's portfolio, while conservation represents 14 percent. Surplus energy presently makes up an additional 15 percent of the portfolio.

Over 50 percent of EWEB's power is delivered via its contract with the BPA. This contract was recently renewed and is effective from Oct. 1, 2011 through Sept. 30, 2028. The new contract provides about 100 MW less peaking capacity and 44 MW of firm energy than the previous contract. The BPA contract has two main components, 'Slice' and 'Block'. Block represents a fixed quantity of power within a given month which BPA is obligated to deliver. Slice reflects 1.8 percent of the total power generated by BPA. Under this part, EWEB receives a fraction of what system produces and has more flexibility over when power is generated. A more detailed description is available in the memo EWEB Contract with BPA.

Over the past decade, BPA costs have increased due to the replacement of aging infrastructure and expenses related to maintaining endangered fish populations. Still, BPA is forecast to remain very competitive compared to alternatives, especially when considering the potential for future taxes on carbon. EWEB has reduced its dependence on BPA through the acquisition of conservation and new renewable resources over the last thirty years.

Impact of Oregon's Renewable Portfolio Standard (RPS)

In 2007 the Oregon Legislature passed the SB 838, the Renewable Portfolio Standard adding requirements that Oregon utilities use increasing amounts of new renewable resources to serve their customers. These requirements overlay EWEB's existing obligation to supply power to its customers, by requiring that a minimum percentage of the power utilities use come from qualifying renewable generation.

Since EWEB's power resources portfolio is overwhelmingly already renewable, this law is expected to have little impact on EWEB in the near term. Because EWEB's conservation programs reduce and eliminate load growth, we expect to maintain that small exposure. Plus, EWEB has already acquired over 30 aMW of renewable resources that qualify under the requirements of the legislation. Therefore, EWEB is well positioned to meet the Oregon RPS obligations for the next twenty years.

Customer Load and Peak Demand Forecasts

After a review of the current power portfolio, the next fundamental question for the IERP is whether existing resources are sufficient to meet future customer needs. EWEB is charged with meeting customer demand for electricity within its service territory at all times. This obligation is called EWEB's load requirements (load). Forecasting EWEB's load for every hour of the day for the next twenty years would be an unwieldy task. Instead, staff developed three forecasts that contain the most important aspects of future load. The first is a forecast of annual average load that represents the total energy usage customers will use in each year. The second is a forecast of the ***peak hour*** load customers will need in a typical year.[4] The third is a forecast of the peak hour load customers will use in an extreme winter peak.[5]

Prior resource plans have focused on evaluating resource needs on a month-average or annual-average basis. Customer demand can look very different at the peak than it does on average over a month. Historically, EWEB's peak needs have been less of a concern than average needs due to the large capacity of hydro generation in the region. However, increasing restrictions on regional hydro operations to help endangered fish populations is reducing system flexibility just as more flexibility services are required by the rapidly growing wind projects in the Northwest. As a result, it is important that this plan evaluate whether or not the utility has sufficient peaking resources, in addition to average monthly resources.

[4] A typical winter results from a winter with "average" cold temperatures. Half of winters have peak loads above the typical peak, and half have peak loads below this forecast.
[5] An extreme winter happens when an arctic air mass reaches the southern Willamette Valley when schools and businesses are operating. Over the past twenty years it has happened only twice, so we expect peaks of these magnitudes only about once every ten years.

Figure 4. EWEB Load - Past and Future

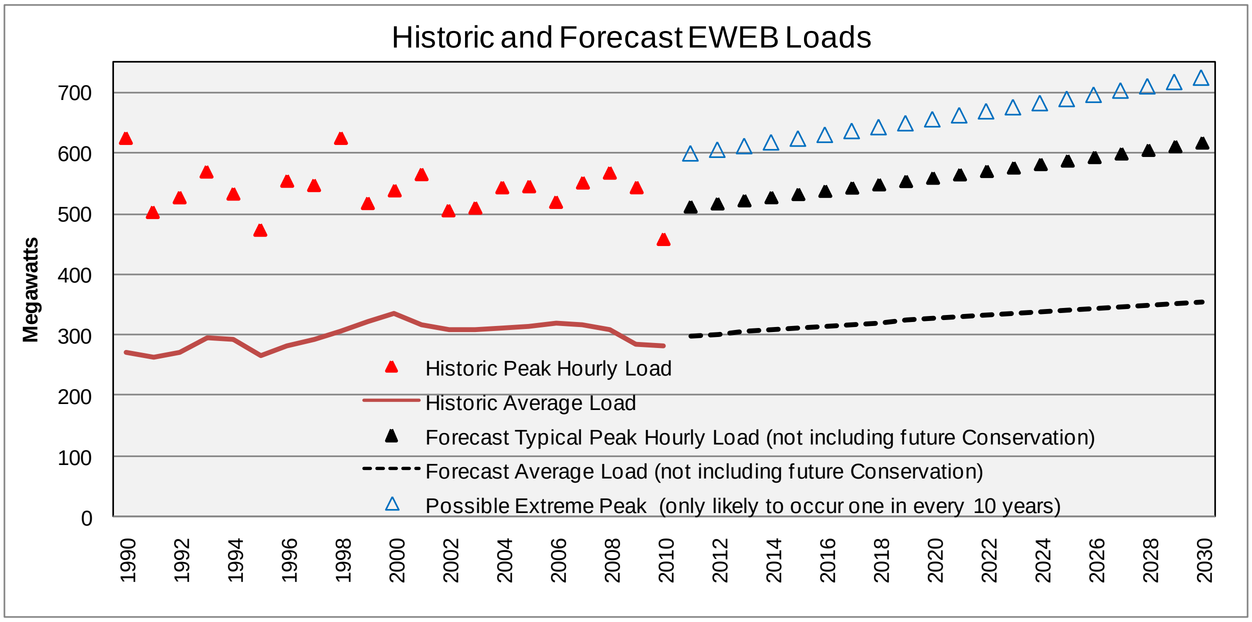


Figure 4 above shows EWEB's actual historic average and peak loads from 1990 through 2010, and compares the Base Case forecast for average load, typical peak hour load and extreme winter peak hour load. Because peak loads are highly dependent on short term weather conditions that vary year to year, they are more volatile than average loads; an important consideration not reflected in the typical peak forecast presented here. Since it is impossible to forecast winter temperatures years in advance, typical winter low temperatures are used in the forecast. Actual peak loads in a given year can be about 15 percent higher or lower than shown in the chart.

What Makes Up A Load Forecast?

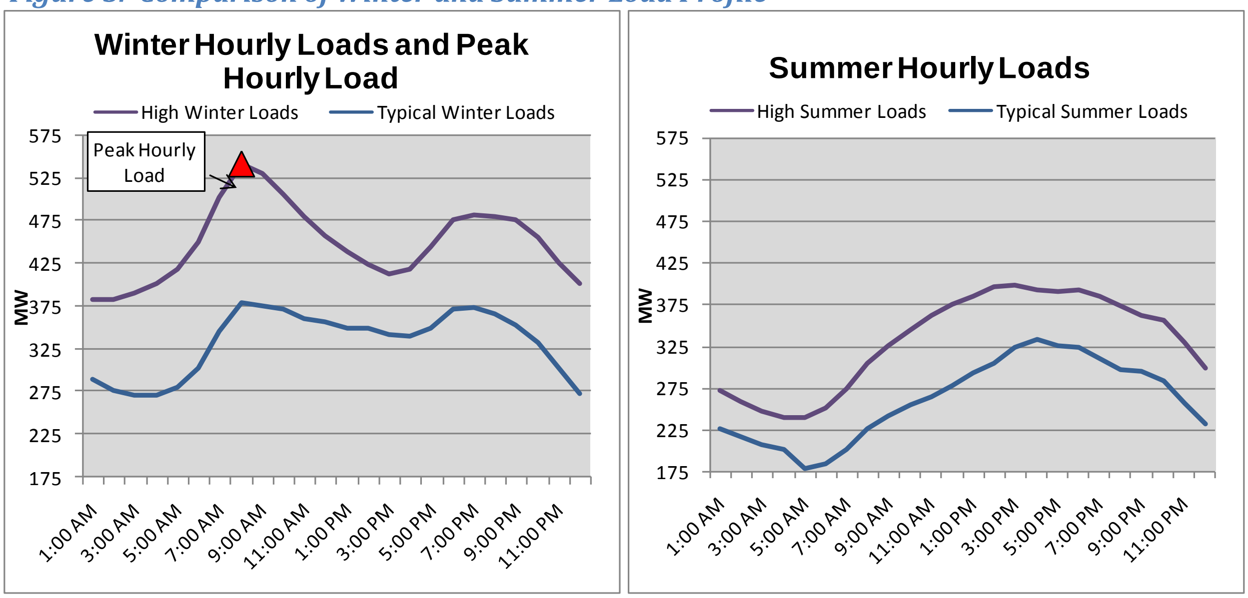
EWEB's load forecasts are based on a number of variables, including heating and cooling degree days, total and expected population growth, Lane County unemployment rate, and EWEB's retail price of power. Most of the forecast load growth is driven by forecast growth in total population. While industrial customers make up a significant portion of EWEB's total load, changes in industrial loads are rarely predicable, so large deviations are seldom modeled. As a further refinement EWEB also factored in a projected Electric Vehicle (EV) adoption rate, which resulted in a small additional increase to the load forecast (about 3 aMW).It should also be noted that the load forecast does not assume future conservation rates higher than those seen to date, but the impact of past conservation is reflected in historical usage used as the baseline for future growth.

Could EWEB Become a Summer Peaking Utility?

EWEB and the other Northwest utilities have always experienced peak hour loads during cold winter months. The relatively mild Northwest summers resulted in relatively small penetration of residential air conditioners. However, many new homes are built with central air conditioning and there is a trend towards adding air conditioning in older homes.

Seasonal models prepared for the IERP indicate perhaps yes, but not in the next twenty years. EWEB's winter loads, while growing less rapidly than summer loads, still exceed the summer peak by 100 MW. Figure 5 below compares 24 hour load shapes for winter and summer, both for an average day as well as for a typical peak day in winter and a high load day in summer.

Figure 5. Comparison of Winter and Summer Load Profile



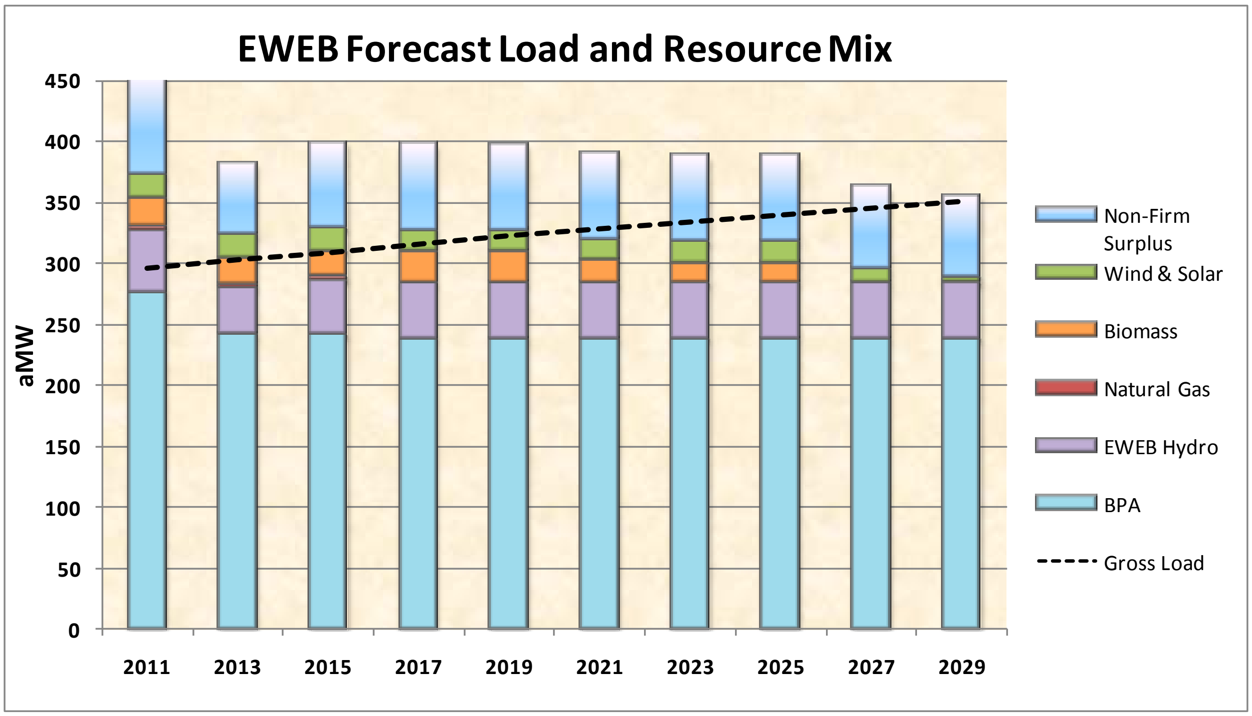
Base Case Need for New Resources

Understanding the need for resource acquisitions requires an exploration of how much longer the existing portfolio is able to meet peak and average loads. This can be accomplished with an evaluation of how the portfolio's future firm and average energy and peak capacity aligns with forecast average and peak hour demand for the next twenty years.

Current EWEB annual load is approximately 300 aMW and is forecast to grow at about one percent per year. Figure 6 below compares the load forecast, without future conservation efforts, to the firm generation of EWEB's existing and contract resources. Surplus energy is primarily hydro generation that is above firm generation. The chart reflects the loss of BPA resources starting October 1, 2011. But even with the loss of BPA power, EWEB has sufficient resources to meet forecast loads with firm resources until approximately 2021.

Because most years EWEB's projects generate more than firm amounts, there is surplus generation that is sold to the wholesale power market, mostly as short-term contracts. The revenues associated with these sales are important to help keep EWEB rates to our customers down.

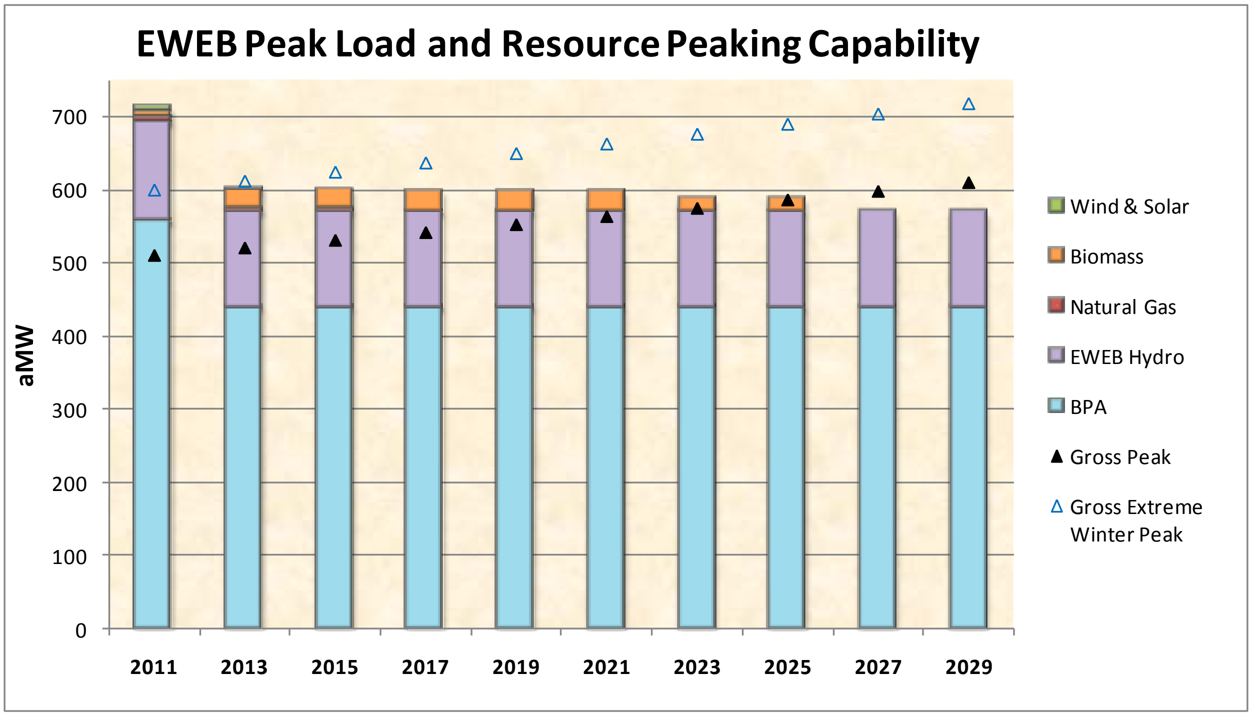
Figure 6. Comparison of Average Loads and Resources



Peak Requirements

As shown in Figure 7 below, EWEB has adequate resources to meet typical winter peak load (represented as black triangles) until 2027. But, in the event of an extremely cold winter morning, the utility is very close to balanced now, and will be slightly deficit in available power to meet an extreme peak (represented as blue triangles) by 2013.

Figure 7. Comparison of Peak Forecast Loads and Resources



Currently, EWEB is able to purchase power from the wholesale market any time our own resources are insufficient, so periodic, short-term deficits are not by default currently a concern. However, there is a risk that power purchases, when the region is experiencing an extreme weather event, will be much more expensive and potentially constrained. Should EWEB acquire new power resources in the next few years to serve a load that is only projected to occur about one year out of ten? If so, what kind of new power resource should EWEB acquire to meet that rare need? Answering these questions requires an assessment of power resource options that can be relied on to meet peak hourly loads, but which do not need to be available most of the time.[6]

[6] Note that Wind and Solar do not appear in Figure 7 because those two resources are not expected to produce any power at the time of EWEB's winter peak.

Transmission and Reliability

The electric power grid is a vast, interconnected network that covers the western United States plus two Canadian provinces and portions of two Mexican states. Closer to home, BPA operates a large network of high voltage transmission lines that connects generation in the Northwest, including EWEB's, to customers throughout the region.

This interconnected system provides many benefits besides simply delivering power from EWEB's far flung renewable generation. The system improves reliability by providing EWEB with back-up generation when its resources are insufficient and lowers costs by permitting sales of power when EWEB has surplus generation. The revenue earned from surplus sales helps lower EWEB's rates.

Media coverage over aging infrastructure has raised concern about the reliability of the transmission grid. While transmission investment had been stagnant for many years, planning and investment is now underway to upgrade the transmission grid.

While new transmission investment isn't cheap, it isn't a large part of EWEB's total costs and is necessary to maintain a reliable power network. In any case, these cost increases are outside of EWEB's control.

New Power Resource Alternatives

To support the resource model, EWEB relied heavily upon data from the Northwest Power Planning Council's (Council) Sixth Power Plan for information on the forecast cost and operating characteristics of new resources, as well as costs associated with transmission lines. [7] Notably, the Sixth Plan also found that Energy Efficiency/Conservation is the lowest cost, lowest risk power resource when compared to generating resource alternatives.

EWEB's previous resource plans have come to very similar conclusions on resource preferences. The first choice has always been conservation, followed by new renewables, and then high efficiency natural gas generation. Not only does conservation cost less than acquiring generating facilities, it provides local jobs, builds consumer awareness about energy consumption, and avoids the environmental tradeoffs associated with new generating technologies. Figure 8 compares the projected costs of numerous alternative power resources, including conservation (energy efficiency).

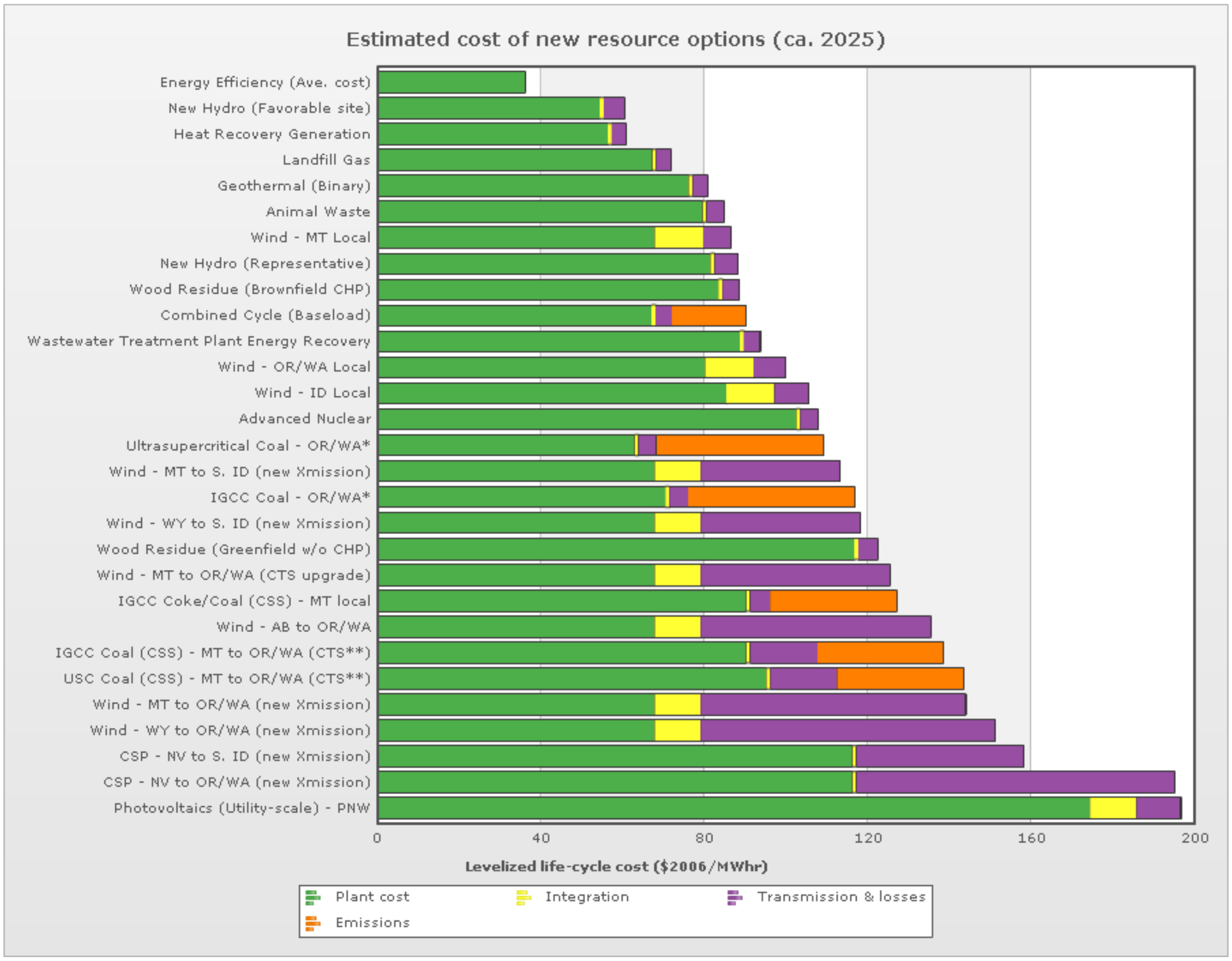
In a few instances, staff believed that it had access to more recent information that was used instead of Council data. The most significant changes are:

- **Updated natural gas price forecast:** Prices have fallen significantly since the Council finalized the Sixth Plan

[7] For more on generating resources see http://www.nwcouncil.org/energy/powerplan/6/default.htm and look at Chapter 6, "Generating Resources and Energy Storage Technologies" and Appendix I, "Generating Resources."

- **Adjusted the start date for potential carbon taxes:** The Plan originally estimated the potential for carbon taxes to start as early as 2009. This Council's forecasts were adjusted to show carbon taxes starting no sooner than 2013
- **Reduced the cost of Solar Photovoltaic (PV) and woody biomass CHP:** Staff reduced costs for these two resources by 50 and 25 percent, respectively, to reflect the cost of technology demonstrated by recently announced contracts for Solar PV and EWEB's power purchase contract with the Seneca Biomass facility

Figure 8. Council's Evaluation of Comparative Resource Cost[8]



The list of potential power resource technologies that could be evaluated in the IERP is fairly lengthy. Figure 9 below clusters these options to help decide whether or not the technology is commercially available or financially feasible for EWEB. While only those resources that had actual cost and operating characteristics data available were analyzed in this planning process, EWEB will continue to monitor emerging technologies and consider them in future plan updates.

[8] See http://www.nwcouncil.org/energy/powerplan/6/newresourcecosts.htm for a larger version of this chart.

Staff did not evaluate nuclear (fission) power plants or coal power plants. First, these technologies do not align with past EWEB resource plan priorities or policy direction. In fact, under Oregon law, a decision to participate in a nuclear power resource requires a public vote. Second, it is impractical for EWEB. Coal and nuclear plants are very large; often exceeding 1,000 MW installed capacity. EWEB could only be a small partner in another utility's project of this size, but no regional utilities are proposing to build either a coal or nuclear power plant. In fact, the two largest coal plants located in Oregon and Washington are slated for retirement.

Figure 9. Potential Resource Categories for Evaluation

Categories of Potential Resource Technologies		
	Commercially Available	**Not Commercially Available**
Conservation	Weatherization Ductless Heat Pumps High Efficiency Appliances	LED lighting Heat Pump Water Heaters
Renewable Generation	Hydro, Wind, Solar PV (Large & small) Solar Thermal Biomass Biogas Landfill Gas	Ocean Wave Ocean Tidal Geothermal (in NW)
Fossil Fuel Generation	Natural Gas Combustion Turbines (both single and combined cycles) Coal	Natural Gas Fuel Cells Coal w/ Carbon Sequestration
Nuclear Generation	Nuclear (Fission)	Small Nuclear (Fission) Fusion

The following technologies were included in the final analysis of potential new resources:

- Wind
- Utility-scale PV (local)
- Concentrating Solar Thermal (remote)
- Natural Gas Peaker Plant
- Biomass (combined heat/power)
- Market purchases

Staff included purchases from the wholesale power market as another resource option. EWEB is an active participant in wholesale power markets, both buying and selling power when we are deficit or surplus, making this an obvious alternative to review. The source of power that EWEB purchases varies just as the source of the power that EWEB sells, but most of the time power market purchases are supplied by regional natural gas plants, which typically represent the marginal power generation in the market. For more information on the technologies/strategies modeled, including basic operating characteristics and 2017 cost estimates please see New Resource Options memo.

Future Uncertainty and Scenarios

The load and resource data presented thus far show only average and peak or extreme peak values. But planning for the electric power industry is much more complex. Long-term planning must incorporate the significant uncertainty over the future value of key forecasts. For instance, whether EWEB loads will be high or low directly impacts when the utility would need more resources.

The IERP analysis focuses on five key variables that impact EWEB's need for power and the regional power market:

- Hydro generation
- Wind generation
- Natural gas prices
- Customer load
- Carbon tax policies

How these future uncertainties are modeled can significantly impact the *relative* cost-effectiveness of alternative power resources. Staff used an analytical approach called Monte Carlo analysis to develop 540 unique combinations of these five key uncertainties. Each potential resource is evaluated in Aurora under the same 540 futures to ensure consistent treatment. This approach is similar to the method used by the Council in both the Fifth and Sixth Power Plans, and is sometimes referred to as "scenarios on steroids". The results presented later in this report represent the average of all 540 futures. This approach is essential to understanding not only which strategies are the lowest cost, but also which strategies are the lowest risk.

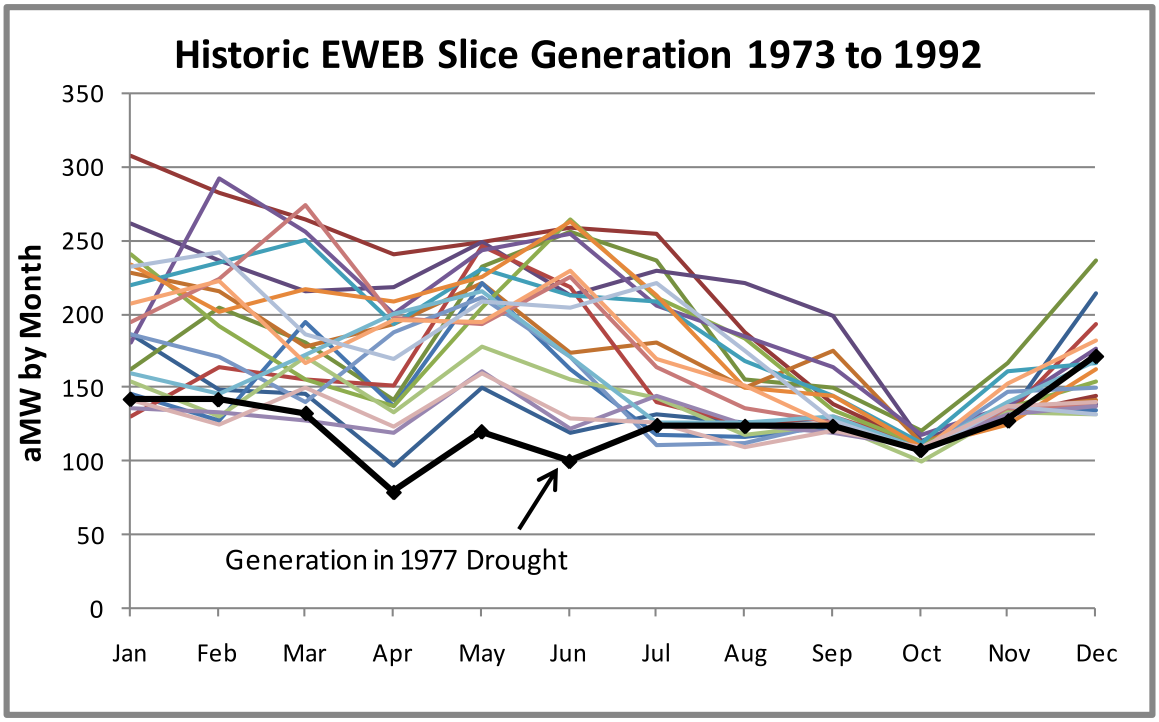
There are other uncertainties that would have significant impacts to EWEB but not impact the relative cost-effectiveness of future choices. These uncertainties are not as important to model in the IERP. For instance, there is no need to model the risk that the Snake River dams will be breached or that the Columbia Generating Station nuclear power plant closes early. If either of these future events occurs then EWEB will need to acquire resources to replace its share of the lost generation from BPA. Staff could rely on the same strategy to replace these lost resources as we would use to guide acquisitions in the event a very large new load locates in EWEB's service territory, which is discussed below. Many other uncertainties would similarly be already represented by the impacts of another variable that is modeled.

Hydro Generation

As EWEB's primary power resource, the availability of hydro generation is critical to serving customer load. In addition, surplus hydro power is sold to wholesale markets in all but the driest years. Those wholesale revenues reduce retail rates. Because hydro generation can vary greatly from month to month and year to year, it is important to test new resource strategies over a variety of conditions.

Drought years pose the biggest risk to EWEB's power supply and generally tend to align with high power prices. Climate change research indicates that the severity of droughts is expected to worsen. To account for this risk, the hydro generation data was modified to include expected impacts from climate change. Please see the memo Climate Change for more information.

Figure 10. Hydro Generation Variability



Because of the growth in wind energy in the region, wet years present the opposite problem: too much power. Production tax credits and other renewable energy credits granted to wind producers are dependent on generation, so wind producers have a financial incentive to continue generating even when demand for power is low, even negative. This means that high hydro output in the spring months has to compete with negatively priced wind in the regional marketplace. During these markets, EWEB may need to pay buyers to take their generation in the wholesale market.

Figure 10 shows the expected generation from the BPA slice contract over 20 different hydro years, demonstrating the extreme variability in hydro generation that must be accounted for in resource planning. The 1977 drought shown in black represents the firm energy that EWEB counts on for planning purposes. Some years the spring and winter generation is almost double the firm hydro amount.

Wind Generation

Nearly 6,000 MW of new wind generation has been built in the Northwest over the last decade, up from just 110 MW. Much of this wind was built and sold to California utilities to meet their RPS obligations. However, no additional transmission to California was built so much of the generation is effectively trapped in the Northwest, while its renewable attributes are stripped and sold to California in the form of Renewable Energy Certificates (RECs).

What is a REC anyway?

A Renewable Energy Certificate (REC) is the mechanism for utilities to track and demonstrate compliance with state Renewable Portfolio Standards. One REC is created in a tracking database for every MWh of qualifying renewable generation. Utilities can supply RECs associated with renewable generation they own or purchase under a long-term purchase, or RECs can be bought and sold independent of the actual electricity that was generated.

REC trading is a more flexible, market-based approach to achieving environmental aims at lower cost compared to requiring each utility to meet its RPS obligations only with its own resources. The use of RECs in meeting RPS compliance obligations are modeled after successful market-based approaches to reducing NOx and SOx emissions in other parts of the US.

Wind is among the lowest cost renewable resources, which is why EWEB and many other utilities have acquired wind in recent years. But because wind generation is variable it is difficult to rely on for serving load. This increasingly poses a significant challenge to utilities across the Northwest as market penetration is reaching levels that are starting to strain the ability of the grid to maintain reliability. The region has been engaged in extensive dialogue around wind integration and is working on possible solutions.

Maximum wind generation in the Northwest occurs over off-peak (low load) hours during the spring and summer. While the summer generation is often needed, spring is when the hydro generation system swells and regional loads are low.

Adding 6,000 MW of wind to the system has resulted in so much generation during off-peak spring hours that it has resulted in very low, sometimes even negative, power prices. Since hydro operations are limited by environmental impacts, utilities have begun to pay buyers to take their excess generation. Hydro-dominated utilities such as EWEB have seen their wholesale revenues from surplus sales plunge during this time period.

Beyond impacting regional power prices, the variability of wind can cause reliability concerns for grid operators. Power grids must be balanced every second, by adjusting generation up or down to meet demand. Since it is difficult to predict precisely when the wind will begin or stop blowing, other resources must stand ready to accommodate fluctuations when they occur. Historically, the hydro system has served in this capacity. However, there are limits to the ability of the hydro system flexibility. Because spilling excess water over the dams creates nitrogen super saturation that is harmful to fish, BPA has begun to restrict wind generation during “high water, high wind” events. This lost wind generation financially harms existing wind projects and reduces the cost-effectiveness of new projects.

A final consideration is that the wind often doesn’t blow during extreme weather events such as heat waves or cold snaps when loads are highest in the Northwest. This is because a high pressure weather front covers the entire region at these times. Therefore, wind generation cannot be relied upon to meet peak loads.

EWEB is actively engaged in the regional discussion around how to best integrate wind in the future. As owners of both hydro and wind resources, and participants in wholesale markets, the outcome will impact the utility. While we can’t directly influence investment decisions of others, we can work to prepare EWEB’s own portfolio to meet the expected challenges ahead. As a result, resource flexibility has become a key desirable attribute of any resource additions considered.

Natural Gas Prices

During most of the year wholesale power prices are closely related to wholesale natural gas prices. While the price of natural gas was stable for many years before 2000, since then prices have increased dramatically and became more volatile and difficult to predict. High gas prices raise wholesale power prices, which increases the value of surplus power EWEB sells into the market. The price of natural gas began to retreat in 2008 in response to economic conditions and additional supplies that are now being tapped using hydraulic fracturing, or ‘fracking’ techniques. This has led to lower wholesale power prices, which reduces EWEB’s revenues.

However, concerns that fracking is polluting ground water sources may lead to legislative restrictions on fracking, which could slow drilling and drive prices up again. Therefore, the analysis incorporates a wide distribution of potential NG prices.

Customer Loads

EWEB loads vary from month to month and year to year based on a variety of drivers, including weather patterns, adoption of new technologies, the economy, population growth and retail prices. Regional loads vary for similar reasons, driving market prices up if demand is high and depressing prices if regional demand is low, as it is now during the slow economy. Monthly and hourly variations in load, especially peak demand periods, are important to consider in the analysis because they spotlight a new resource’s ability to compliment and add value to the existing portfolio.

Climate change has the potential to impact loads by changing the number and severity of heating and cooling events. Staff investigated modifying the forecast loads to account for climate change, but found the changes small compared to historic volatility of loads. The historic volatility includes the impact not just of weather and climate changes to date, but also economic and technological changes. For the analysis, variability in load was based on historic volatility.

Carbon Taxes

Carbon taxes are a mechanism to place a monetary penalty on the negative impacts associated with carbon dioxide emissions, the primary greenhouse gas contributing to climate change. While there is no legislation currently, draft proposals indicate that carbon taxes would be levied on the fossil-fuel based generator owners based on the amount of CO_2 emissions from the generator. If a carbon tax were to be enacted as a way to, it would make fossil fuel generators more expensive to operate and as a result, level the playing field for renewable energy sources by increasing the market price of power. For the purposes of this analysis, three carbon tax futures were combined with the other variables: no carbon tax (still includes current RPS policy), a medium carbon tax, and a high carbon tax both starting in 2014.

Base Case Analysis

Under the Base Case forecast of both average and peak customer load, EWEB's existing power portfolio is surplus until the 2020s under most circumstances. Only in an extreme cold snap, which occurs roughly one in ten years, are existing resources forecast to be unable to meet forecast peak hourly customer loads. Only during extreme droughts, which occur about every twenty years, would existing resources be unable to meet average load in some months.

Under these circumstances, adding more generating resources is not advisable. As detailed in the next section, new generating resources are not cost-effective to EWEB now or in the near future. Furthermore, the power they generate is not needed most of the time. Most generating technologies increase EWEB's surplus generation, which increases EWEB's exposure to power market price volatility.

Meet Load Growth with Increased Conservation

EWEB is a nationally recognized leader in energy conservation. Due to conservation undertaken to date, customer load is 14 percent lower than it would have been without the programs. For three decades EWEB has been a leader in conservation programs designed to improve the energy efficiency of its community and reduce its customers' bills. Additional background is included in the memo "Energy Efficiency as a Resource". EWEB has a longstanding policy that prioritizes cost-effective conservation as its preferred resource strategy. Early in the IERP process, the Board reaffirmed EWEB's direction to prioritize conservation.

As part of the IERP analysis, staff evaluated five different levels of conservation acquisition and presented the results to the Advisory Panel. Three of the levels represented significant increases in how much conservation is acquired every year, one represented a significant decrease in the rate of acquisition, and one a small increase over the current rate. This last option was set to match conservation acquisition to forecast load growth in order to keep EWEB loads approximately flat over the next twenty years.

To help confirm EWEB's ability to achieve higher levels EWEB conducted its own Conservation Potential Assessment earlier in the year to validate the Council's regional Sixth Power Plan findings as applicable to EWEB. Staff believes these higher levels of conservation are achievable with the addition of new technologies and new approaches to reach difficult to serve customers.

The three higher levels of conservation acquisition all increased the cost of conservation programs, some dramatically. If EWEB were to increase its already aggressive conservation targets it would require the utility to establish programs for more expensive energy efficiency measures, and also pay higher incentives under existing ones to customers to increase participation rates. Importantly, we found that the benefits of higher conservation dropped because higher rates of acquisition resulted in a loss of low cost BPA power. Under EWEB's new power purchase contract with BPA, the amount of power sold to EWEB will be reduced if forecast need for power falls below 2007 / 2008 baseline loads. A key learning of the IERP analysis is that displacing low cost BPA power with higher cost conservation would result in higher future rates and bills, especially for non-participants.

Another key learning is that more conservation does not lower the carbon intensity of EWEB power. BPA power comes primarily from the system of federal dams in the region plus one nuclear power plant. The only carbon associated with BPA power comes from modest power purchases made to support sales. As a result, reducing EWEB load and giving up the low cost, low carbon BPA power does little to reduce EWEB's carbon emissions. Instead, the benefit of higher levels of conservation by EWEB would result in lower carbon emissions at other utilities that purchase the BPA power no longer needed by EWEB.

While the strategy which reduced EWEB's level of conservation acquisition was cost-effective, it was not selected because it "left money on the table" compared to the recommended level. Furthermore, this strategy did not acquire all cost-effective conservation, which is contrary to EWEB Board policy directives.

Figure 12 below shows a summary of the TBL analysis comparing the five conservation strategies. The analysis found that adding conservation is still cost-effective and environmentally and socially preferable, even with EWEB surplus for the next decade, up to the point that loads are kept flat over time. Acquiring either more or less conservation reduced the economic benefits. Analysis of other key attributes, including affordability, local job creation, carbon emissions, feasibility of acquisition, and financial cost of strategies helped to differentiate the strategies and lend clarity to the decision making process.

The IERP recommendation is that EWEB meet its need for additional power over the next twenty years by acquiring conservation to keep loads flat because this strategy:

- maximizes economic benefits to the community,
- minimizes participants' bills while not increasing non-participants' bills, and
- retains EWEB's low cost, low carbon BPA power.

This recommendation was taken to the Board in August of this year, and the EWEB Commissioners concurred with the strategy. Figure 11 shows EWEB's load and resources after adding the recommended strategy to acquire sufficient conservation to offset growth in load over the next twenty years. Since conservation acts as a resource for both participants and non-participants by reducing the need for supply-side investment and because maximum results can only be achieved when all customers participate, it is imperative that no customer be exempt from funding conservation measures in its rates. This approach serves as a model of what is achievable to the industry given a long term commitment to conservation and maintains EWEB's position as a leader in the region.

Figure 11. Base Case Load and Resource Mix with Recommended Strategy

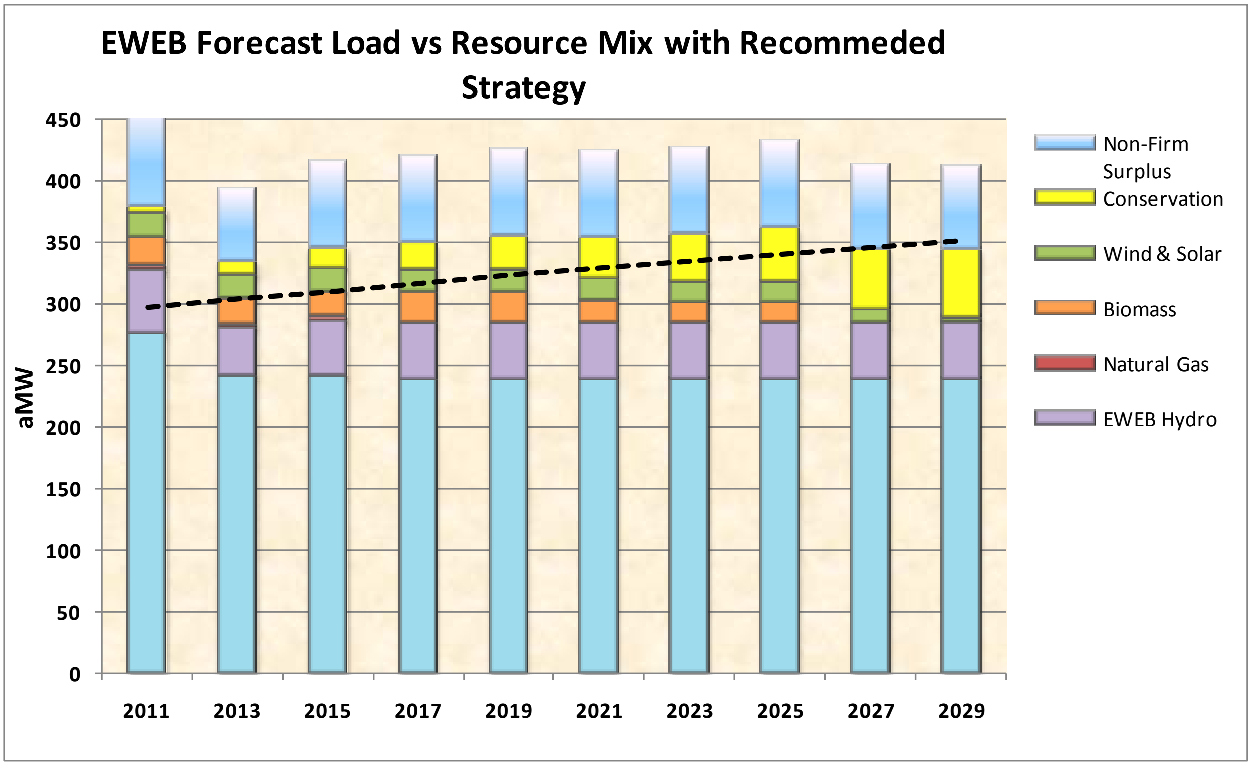


Figure 12. Conservation Strategy TBL Summary (Green=Good, Yellow=Neutral, Red=Caution)

TBL issue	**Recover BPA Payment**	**Meet all load growth**	**"Break Even" Zero NPV**	**Regional Target**	**Accelerated Regional Target**
Affordability, Equity and Access	No rate impacts	Bill reductions for participants, no rate impact on non-participants	Some rate impacts, bill impacts mostly for non-participants. Program benefits may not reach customers equally	Significant rate impacts, bill impacts for participants and non- participants. Program benefits may not reach customers equally	Significant rate impacts, bill impacts for participants and non- participants. Program benefits may not reach customers equally
Affordability: Base Case 20 yr Net Present Value	NPV≈$50 Million NPV	NPV≈$65 Million maximizes value	NPV≈$0, break even	NPV≈($45 Million) loss over 20 years	NPV≈($90 Million) loss over 20 years
Construction Risk	No additional land or transmission needed, short lead time	No additional land or transmission needed, short lead time	No additional land or transmission needed, short lead time	No additional land or transmission needed, short lead time	No additional land or transmission needed, short lead time
Flexibility	Reduces need for additional flexibility, potential added flexibility with Demand Response	Reduces need for additional flexibility, potential added flexibility with Demand Response	Reduces need for additional flexibility	Reduces need for additional flexibility	Reduces need for additional flexibility
Local Jobs	Job loss as programs scale back	Maintains current job level, 100 jobs/year over 20 years	Steady increase in jobs. 169 jobs/year over 20 years	Steady increase in jobs. 238 jobs/year over 20 years	More jobs initially, job loss after 10 years
Peaking	Can help to reduce peaks, demand response could increase this ability	Can help to reduce peaks, demand response could increase this ability	Can help to reduce peaks	Can help to reduce peaks	Can help to reduce peaks

Portfolio Diversity/Need	Leads to resource need sooner than other strategies, balances resource position in near term	Maintains reasonable cushion of surplus and eliminates need for new resources until 2027	Displaces BPA but economic benefit and loss net out	Exacerbates existing surpluses, displaces BPA hydro	Exacerbates existing surpluses, displaces BPA hydro
Reduced Environmental Impacts: Carbon Emissions	Less emission reductions than current program	Reduces EWEB carbon from market purchases	Reduces EWEB carbon from market purchases, displaces regional carbon	Reduces EWEB carbon from market purchases, displaces regional carbon	Reduces EWEB carbon from market purchases, displaces regional carbon
Reliability	Reduces the need to rely on supply side resources that could have outages	Reduces the need to rely on supply side resources that could have outages	Requires increased investment in unproven technologies which may be less reliable	Requires increased investment in unproven technologies which may be less reliable	Requires increased investment in unproven technologies which may be less reliable
Scalability	Ability to ramp up if desired, easy target	Ability to ramp up if needed to meet additional growth	Some risk of not being able to sustain increased acquisition levels over time	Some risk of not being able to sustain increased acquisition levels over time	May not be sufficient local work-force to accomplish near term goals

Partner with Customers to Manage Peak Demand

EWEB's recommended strategy in this IERP includes another new milestone: that EWEB begin building its capabilities to deliver demand response and peak reduction programs over the next five years. Demand response (DR) represents programs through which customers can actively participate in the utility's ability to meet load, often with compensation. DR has been increasingly deployed by utilities to help meet needs for short time periods as it is more cost effective overall to incent a few customers to change behaviors than it is to build a new power plant when needed only part of the time. For more information on DR, please see the Demand Response memo.

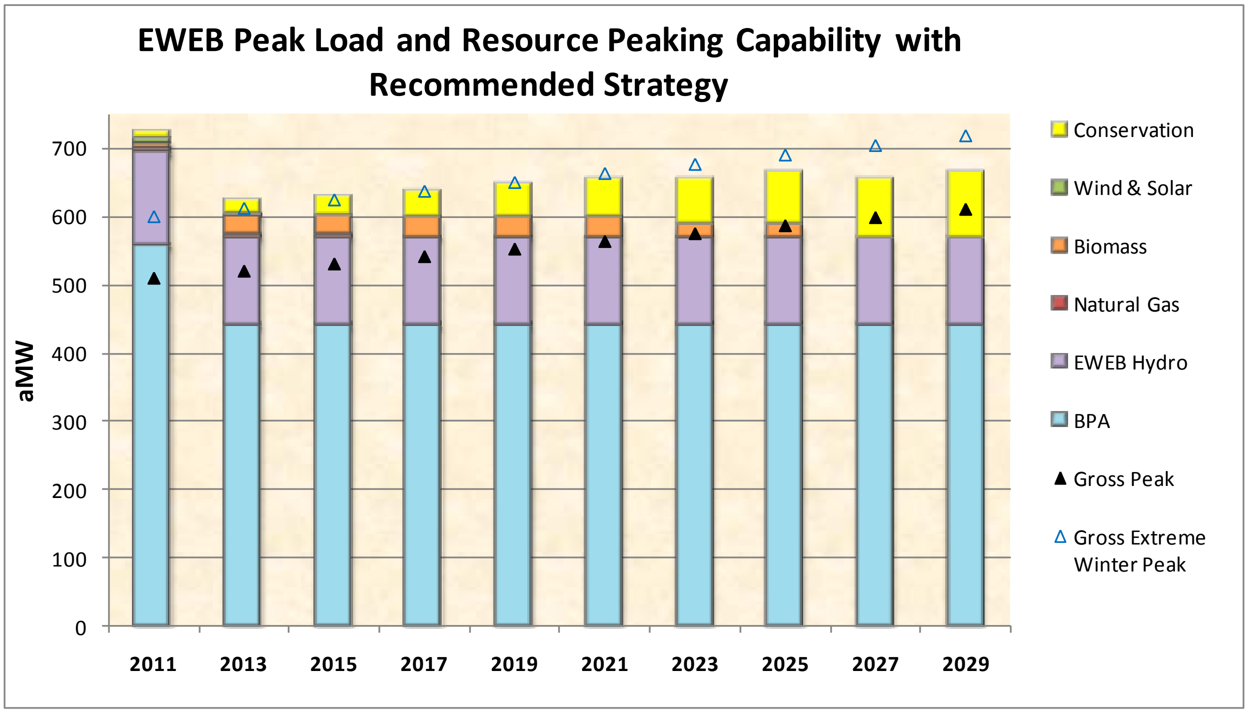
Beyond meeting average load growth through conservation, demand response and peak reduction strategies provide better economic and environmental value than any other strategy. As most renewable generating resources are unable to meet the region's growing needs for flexibility and peak-time demand, customer programs to encourage demand response, are likely to have lower cost and environmental impacts than pursuing new 'peaking' generating resources.

What is AMI?

AMI provides two-way digital communications between EWEB and its customers. EWEB is reviewing the potential for an Automated Metering Infrastructure (AMI) system to provide additional new capabilities to work with our customers to manage and reduce peak loads. In addition to helping reduce customer demand during times of extreme peak, these strategies can add value to the existing portfolio and enable EWEB to utilize a larger fraction of our wind generation. Customer awareness of demand response will be an important next step in the evolution of energy efficiency programs and help evolve the customer/utility relationship to more of a partnership. AMI could help enable capabilities for cost-savings for EWEB and the provision of new services to customers while reducing carbon emissions associated with site visits to read meters that will no longer be required with the new meters.

Figure 13 compares EWEB's forecast winter peak loads to peak resource capability the estimated peak benefits of EWEB's conservation programs, but excluding any benefits associated with demand response programs, because those programs are not yet developed. Staff forecasts that EWEB will have sufficient resources to meet typical winter peak loads for the next twenty years, but starting in 2021 EWEB is facing a small but growing short-fall to meet an extreme winter peak. Demand response programs could be ready to fill that gap in the next decade.

Figure 13. Peak Resources vs. Load with Recommended Conservation Strategy



New Large Load Scenario Analysis

While conservation and DR are likely the only resources EWEB will need to add over the next twenty years, there are scenarios where the need for additional resources exceeds available cost-effective conservation. To plan for this possibility, the IERP team evaluated what strategies EWEB would follow if a very large 50 aMW new load were to locate in Eugene in the next few years[9]. Eight different potential resource strategies reflecting a mix of additional conservation, new generating resources, and market purchases were evaluated, including:

- Short-term Market
- Wind
- Local utility scale PV
- Concentrating Solar Thermal
- Natural Gas Peaker
- CHP Biomass
- Market Options (Recommended Strategy)
- Additional Conservation

This is not an exhaustive list of resource technologies, but rather represents the most feasible options given EWEB's previously stated priorities and objectives.

All strategies were modeled as 20 MW acquisitions. For wind, natural gas peaking, and concentrating solar thermal plants, 20 MW is just a portion of a larger project. Biomass and local utility scale solar PV were modeled as 20 MW facilities, with EWEB taking the entire output of the project. Market Options, which can be purchased in any amount, were also modeled as 20 MW to facilitate comparison.

Cost–Effectiveness of Alternative Strategies

Figure 14 presents the levelized cost and benefit-cost ratio for all of the strategies evaluated for this scenario. Levelized cost is the "average" cost over the life of the resource, taking into account the time value of money. Conservation programs are levelized over 20 years; all other resources strategies, including both market options, are levelized over 30 years which is consistent with the expected life of investment.

Cost information was based on a 2017 on-line date, which is the first year EWEB would need more power under this scenario. All resources and strategies were evaluated over a 30 year period, the expected life of most of the resources. The market strategies do not require a 30 year commitment, which provides additional flexibility that is not captured in the analysis.

The benefit-cost ratio is the metric by which staff measured the cost-effectiveness of the alternatives. The benefit – cost ratio (B/C) divides the total benefits by the total cost. A new resource is cost-effective if its B/C ratio is above 1.0, is not cost-effective it its B/C ratio is below 1.0, and break-even if its B/C ratio is exactly 1.0.

[9] Notably, this same analysis can be used to evaluation the impact of the loss of a generating resource.

Figure 14. Level Cost and Cost-effectiveness of New Load strategies

	No Carbon Tax Scenario		Medium Carbon Tax Scenario	
Resource strategies	Levelized Cost ($/MWh)	Benefit- Cost Ratio	Levelized Cost ($/MWh)	Benefit- Cost Ratio
Short Term Market	$95	Not Defined[10]	$135	Not Defined
Recommended Conservation (2.75 aMW/yr)	$70	Not Defined	$70	Not Defined
Maximum Conservation Strategy (1.79 aMW/yr additional)	$150		$150	1.49
Market Options	$115	0.96	$165	0.70
Natural Gas Peaker	$490	0.04	$1,025	0.04
Biomass	$190	0.30	$165	0.67
Wind	$170	0.37	$170	0.57
Concentrating Solar Thermal	$255	0.33	$255	0.46
Local Utility Scale Solar PV	$580	0.10	$580	0.16

This analysis found that pursuing the maximum available conservation is the only cost-effective strategy. No other new resource strategies are cost-effective, although Market Options was close to break-even. New renewable resources have high up-front costs while most of the power generated by these resource options occurs at times when EWEB already has sufficient power, increases EWEB's must-sell surplus.

The New Large Load scenario was assessed both with and without a carbon tax assumption. Including a carbon tax improves the cost-effectiveness of the renewable resources, but does not bring them up to the break-even point. The level cost of energy from the natural gas plant increased dramatically under a carbon tax, but interestingly the cost-effectiveness does not shift at all.

In the event a very large new load locates in Eugene, then EWEB's peak loads will increase above the capability of existing resources. Neither wind nor the two solar resources are able to meet EWEB's winter peak needs. The natural gas peaker and the biomass projects can meet EWEB's peak load reliably, but both are very expensive.

Carbon Considerations

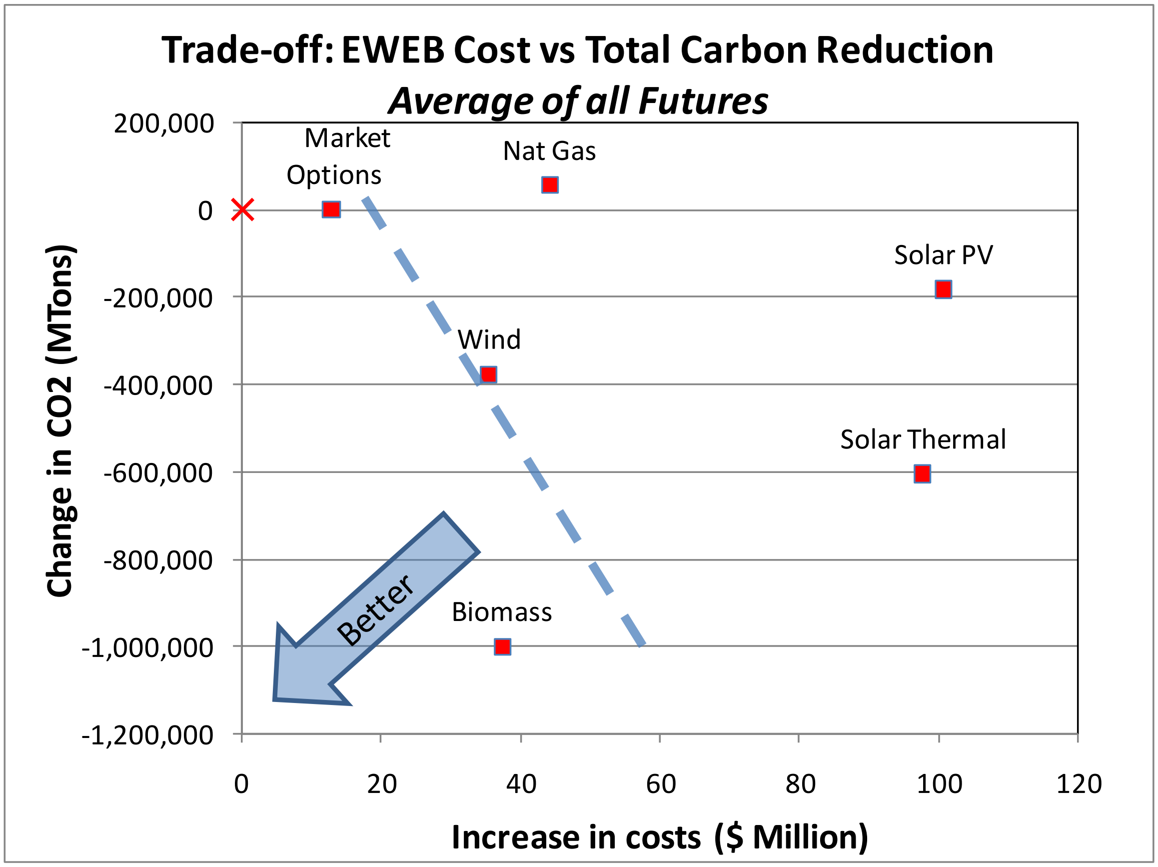
While EWEB's overall carbon intensity is low compared to almost any other utility in America, our stewardship values are to protect and preserve our environment so EWEB continues to consider the carbon impact of its decisions. The recommended approach to incorporating

[10] The Benefit/Cost ratio requires comparing an investment cost to the benefits. Conservation and short term market purchases were included in all New Load analyses, so cannot compare.

carbon emissions into resource decisions is to evaluate scenarios that include a cost of carbon (i.e. a carbon tax). Although no carbon tax currently exists (and it is unclear when, if, or how big a carbon tax might be), by including a tax in the TBL analysis EWEB will both consider the very real potential risk that there will be a carbon tax, as well as provide a proxy for the externalized impacts of energy use on climate change.

Including a cost of carbon is a preferred approach to making direct carbon mitigation assumptions because it allows for more holistic decision-making. For instance, strategies that support electric vehicles would likely reduce community carbon emissions, but increase EWEB's load and potentially its carbon footprint. A carbon tax approach allows comparison of a broader range of mitigation strategies versus establishing a carbon emission reduction goal.

Figure 14. Cost of Carbon Reduction



The trade-off between carbon reduction and cost was evaluated for each of the resource strategies. Findings based on Aurora analysis are shown in Figure 14. New wind generation causes about the same increase in total costs as biomass, but provides less carbon reducing benefit because of wind has lower annual generation. Both wind and biomass are preferred technologies compared to either solar technology because they produce more carbon reductions at lower cost.

Figure 15 translates the tradeoff chart above into a cost per ton of carbon reduced over the life of the generating assets. Also shown is the cost of carbon offsets currently about $10 per

MTon. This chart shows that there are much less expensive ways to reduce carbon associated with EWEB's power portfolio than building new renewable generation. Use of carbon offsets is a common practice worldwide where carbon legislation has been implemented. Local solar PV continues to be the most expensive resource because of the impact of both high cost and relatively low power factor (output) when compared to the other alternatives.

Figure 15. Carbon Cost in $/MTon

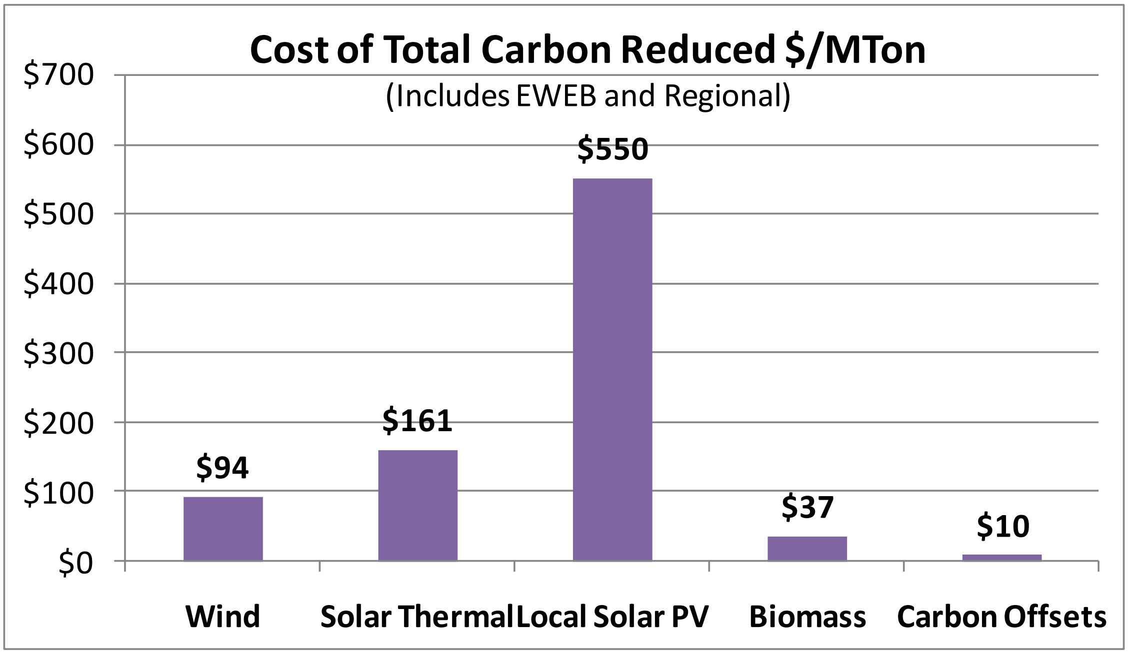


Figure 16 below provides a summary of the TBL analysis undertaken to compare the potential new energy resources modeled to serve a new large load. In addition to the criteria evaluated for the base case conservation scenario, the new load TBL was modified to include new issues, such as landscape impacts, water requirements and a benefit to cost ratio.

Figure 16. New Load Future TBL results (Green=Good, Yellow=Neutral, Red=Caution)

TBL Issue	Additional Conservation (extra 1.79 aMW/yr)	Wind	Local Utility Scale PV	Remote Solar Thermal	Natural Gas Peaker	Local Biomass CHP	Market Options
Affordability, Equity and Access	Program benefits may not reach customers equally	Lowest cost renewable if there is no carbon tax	High cost compared to other renewables	Highest cost renewable under all futures	Big investment for operating relatively few hours	Lowest cost renewable if there is a carbon tax	Reduces market risk while minimizing costs
Affordability: Benefit/Cost Ratio	1.49	0.57	0.17	0.46	0.05	0.78	0.71
Construction Risk	Avoids construction of new supply-side resource	High capital for development, potential regional transmission constraints	Could be difficult to find enough land locally, high capital for development	Requires new transmission, could have citing challenges with land footprint, high capital for development	Flexible citing, lowers regional transmission constraints	Could have local air quality control issues lowers regional transmission constraints	Uses existing infrastructure
Flexibility and Availability	Reduces need for additional flexibility	Not flexible, only available when the wind blows, ~ 32% availability	Not flexible, only available when the sun shines in Eugene, ~12% availability	Not flexible, only available when the sun shines in Nevada, ~36% availability	Very flexible, ~90% availability, able to turn on/off to meet peaks	Flexible, ~80% availability, able to turn on/off to meet peaks	Flexible, can be used selectively as needed
Local Jobs, Local Power Supply	Steady increase in jobs, helps reduce need for non-local resources	Jobs would be remote, transmission needed for remote resource	Steady increase in jobs, adds to local power portfolio	Jobs would be remote, transmission needed for remote resource	Small number of jobs, could be local	Small number of local jobs, emergency power supply for essential services locally	Small number of local jobs, uses existing infrastructure

Peaking	May help to reduce peak demand	Often not available during peak demand	Generation seldom coincides with peak demand	Generation seldom coincides with peak demand	Able to turn on/off to meet peaks	Able to turn on/off to meet peaks	Can call upon to help meet peaks while limiting market exposure
Portfolio Diversity/Need	Helps to reduce market purchases or need for supply side resource, reduces carbon cost risk	Potential to exacerbate existing surpluses, reduces carbon cost risk	Low output, maximum output during spring surplus and summer deficit, reduces carbon cost risk	Maximum output during spring surplus and summer deficit, reduces carbon cost risk	Operates to meet peak needs, often more expensive than market, potential future carbon cost and natural gas price volatility risk	Hedge against hydro generation volatility, operates to meet need	Can be used selectively as needed
Reduced Environmental Impacts: ***Carbon Reduction***	Reduces EWEB market purchases, displaces regional carbon	Aligns with existing surpluses, leading to regional carbon reductions more than EWEB reductions	Low output if located in Eugene so smallest carbon reduction benefit of renewables	High output, displaces regional carbon during surpluses and reduces EWEB carbon by reducing market purchases	Increases regional and EWEB carbon, environmental concerns surrounding natural gas fuel recovery	High output, displaces regional carbon during surpluses and reduces EWEB carbon by reducing market purchases	Takes advantage of near term surpluses in renewables, no change from current conditions
Reliability	Reduces need for new supply side resources	Variable generation with integration challenges	Variable generation, potential integration challenges	Variable generation	very reliable, has natural gas price volatility risk	Reliable, potential to provide emergency power supply for essential services locally	Can be used selectively as needed
Scalability	May not be sufficient local work-force to accomplish near term goals	May have transmission constraints	Large local land footprint might make it difficult to have a large project	May have transmission constraints	Would likely be a share in a larger project, easily scalable	Could have size restrictions	Only used as needed providing regional build continues

Key Learning from the New Load Scenario Analysis

The key learning from the New Load analysis includes the following:

- Only the additional conservation measures prove cost-effective.

- Cost-effectiveness of renewable resources improves under future carbon tax scenarios, but none were cost-effective without a carbon tax.

- Under a future without a carbon tax the market strategy was almost break-even, but under a future with a carbon tax, market options were very not cost-effective.

- The majority of the generation from renewable resources occurs at times when EWEB is already surplus and that additional power would be sold into the market and the utility would remain deficit power at certain times of the year. This limits the potential to reduce EWEB's carbon emissions and most of the benefits accrue to other entities.

- There are a number of ways to reduce carbon emissions including purchasing carbon offsets that may be more cost-effective than additional investments in renewable resources.

New Load Recommended Strategy

Given the results of the new load analysis, the recommended resource strategy is to maximize cost-effective conservation and rely on a market strategy to meet remaining demand, rather than acquire any new long term purchase contracts or build any new resources in the next five years. Additional assessment will be required in the next IERP to determine the best path forward for a new load beyond that time frame. This approach would best leverage EWEB's existing surplus while helping to limit the price risk from low power prices in the region. This approach also helps manage regulatory risk by waiting to see how the future develops for many of the key variables analyzed, especially carbon tax legislation.

Committing to long-term investments today will limit our ability to adapt to new regulation and adopt new technologies that could emerge in the future. The recommended strategy would shift EWEB's power portfolio from almost always selling surplus power to a more balanced position where sometimes the utility purchases and sometimes sells. This is a more stable risk position in the face of volatile power prices.

Guidelines and Strategies for the 2011 IERP

The successful implementation of the IERP relies on a foundation of overarching guidelines and short-term activities to guide Board and staff decisions. Many of the concepts are consistent with past findings, but are even more forward thinking in enabling the utility to address expected future challenges. At the same time, they are not meant to be the sole determinants of plan performance or decision-drivers. The guidelines and strategies provide a meaningful way to monitor progress towards intended outcomes and give early indications if a course correction is needed.

Guidelines

- ***EWEB energy resource analyses and decisions will consider all benefits and costs associated with generation, using a Triple Bottom Line framework for a comprehensive assessment of social, environmental and financial implications.*** This commitment includes decisions regarding whether or not to renew existing power contracts to ensure that values around affordability, portfolio diversity and preferences for local generation are evaluated as part of the resource analysis. The loss or addition of a new large load will also be a trigger for staff review of the resource mix beyond the five-year period.

- ***Power supply decisions will reflect EWEB's commitment to equitable, affordable and stable rates.*** There are numerous variables that impact customer rates, and power supply costs are one of them. The resource strategy of meeting new load growth through conservation and using short-term market purchases to address temporary deficits while building an effective demand response program was most cost-effective compared to other options. This guideline is a commitment to monitor whether the plan's assumptions around frequency of needs and costs for market power is causing pressure on rates and should be re-evaluated.

- ***Incorporate the potential future cost of Greenhouse gas (GHG) emissions in resource decisions.*** While under today's political and economic conditions, a carbon tax is unlikely; our community has a value around shrinking the carbon footprint of our energy usage. Assessing a 'carbon tax' as part of our resource analyses is a way to monetize and compare different resource strategies. This assessment is not meant as a stand-alone evaluation, but would be included as one of a number of social, environmental and economic variables considered under the TBL framework.

- ***Provide for flexible and adaptable implementation.*** For the IERP to be an effective planning document, it must have the flexibility to adapt to new conditions and information. This guideline is a commitment to a more routine and on-going planning effort to monitor progress towards plan goals. This includes an annual update and review of key forecasts to continually refine analyses and ensure that strategies still make sense under current conditions. It also recognizes the level of uncertainty and potential risks facing the utility in the future may necessitate strategy adjustments before the next formal IERP effort is underway.

IERP Recommended Strategies for the next five years

Pursue conservation to meet all forecast load growth

Conservation is the resource alternative with the least cost, minimal risks and fewest environmental impacts. It provides local jobs and keeps more of EWEB's customers' money in the community than any other resource alternative. These are some of the reasons the Sixth Power Plan calls for utilities to meet 85 percent of load growth with conservation. By working to keep EWEB's loads at current levels we maximize the value of conservation investments while maintaining all of the power we are entitled to purchase from BPA. The foundational goal of this IERP is to meet all future load growth through conservation.

Partner with customers to avoid new peaking power plants

While EWEB has surplus power under most circumstances, there are some conditions under which the existing resources are insufficient, such as extreme weather-driven peaks and wind integration requirements in a future with significantly more wind generation in the region. A natural gas peaking plant has the flexibility to meet these needs, but the analysis shows significant tradeoffs from environmental and social impacts. In addition, a new power plant that is only needed to under rare peaks and drought conditions would be very expensive. Operating such a plant at a partial load simply to offset changes in wind generation would be even more expensive.

Rather than rely on new resources to address occasional power deficits, the IERP recommends that EWEB develop strategies to partner with customers to reduce consumption during these times. Specifically, EWEB will pursue the following:

- Target EWEB's conservation and energy efficiency programs toward measures with certain savings during EWEB's peak hours
- Develop contracts with large customers that incentivize short-term load reductions (either via reduced power consumption or via on-site back-up power systems) to help protect EWEB from brief or extended price increases. A similar program was employed during the 2000 / 2001 power crisis and was very effective
- Evaluate results of ongoing and future demand response pilot programs
- Explore the ability of new and existing technology, such as AMI, to cost effectively augment DR program effectiveness

By working with a range of customers to address peak loads, EWEB can avoid expensive resources and increase utilization of excess wind generation, which reduces exposure to price volatility from both buying and selling in the wholesale market.

Continue to rely on and expand regional partnerships

The Pacific Northwest has a long history of cooperation in the energy sector, especially in the public sector. As the many new challenges that face the industry require decisions and buy-in from a wide range of parties, leveraging this network has proved the most effective forum for EWEB to help influence the future. Issues such as transmission expansion, wind integration strategy, regional conservation targets, BPA programs, emerging technologies, and the emergence of intra-hour wholesale power markets and resource scheduling requirements are all actively being debated across the region.

Since EWEB has a high stake in the outcome of many of these discussions, part of the implementation of this IERP is to stay engaged in the regional dialogue and keep an eye out for new and emerging issues and technologies. In addition, BPA has ongoing rate cases which impact EWEB's rates and resource operating requirements, particularly with regard to wind generation. EWEB staff partners with other utilities in the region with similar interests to help strengthen advocacy positions favorable to EWEB's overall best interest in such forums.

Pursue new large load strategy, if needed

The following specific actions are planned in the event that a new large single load locates in the EWEB service territory that exceeds EWEB's surplus power supplies:

- Work with the new customer during design and construction to obtain maximum lost opportunities at the facility
- Evaluate increasing conservation acquisition in rest of community
- Acquire remaining required resources from one to five year market purchases
- Consider contract language that incentivizes additional conservation and/or on-site generation to offset peak load impacts

Review progress toward goal and key assumptions annually

Because the future is full of uncertainties, staff proposes to review and report on the following information on an annual basis. This review will enable staff to make near term course corrections if key assumptions are askew and to ascertain when a new planning process is necessary. This on-going review process will help keep the data fresh, and support continuous improvement to the analytical process.

- Actual EWEB customer load data to see if conservation targets are being met
- Refine and update EWEB's peak-hour forecast methodology
- Key forecasts and assumptions supporting the IERP strategies (i.e. EWEB's need for power, market prices and cost-effectiveness of new power resources)
- New regulations such as enactment of carbon policy, modifications to Oregon RPS, or changes to the court-ordered fish biological opinion that could have a profound impact on EWEB's need for power

Begin steps to prepare for next IERP

The work does not end once the plan in adopted. EWEB staff will continue to assess resource needs and load requirements, in addition to following technology and regulatory trends that will impact our future. Some of these include:

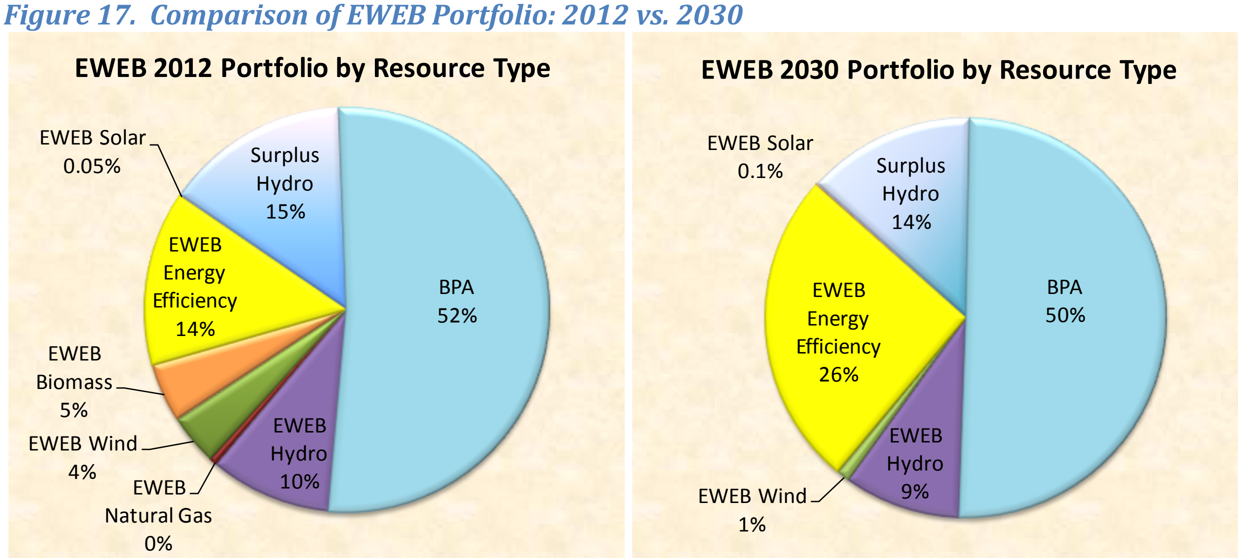
- Further research the potential impact of climate change on hydro generation
- Follow emerging technologies such as wave energy, electric vehicles, and solar PV
- Review and develop recommendations on research gathered regarding customer willingness to participate in demand response programs

Conclusion

What will EWEB's Resource Portfolio Look Like in Twenty years?

Compared to other utilities in the nation and region, EWEB's power portfolio is unique in its abundance of renewable and carbon-free power. The utility is currently surplus and does not need additional resources under most conditions until the early 2020s. The combination of going into the next twenty year period with surplus energy, slower load growth projections and elevated conservation acquisition targets allows EWEB to take the unprecedented step of recommending a resource plan that requires no new generating resources. If the utility follows this strategy in its strictest sense, in 2030, over a quarter of EWEB's resource portfolio will be ascribed to local energy efficiency. Figure 17 compares EWEB's portfolio in 2012 to the proposed portfolio in 2030.

Figure 17. Comparison of EWEB Portfolio: 2012 vs. 2030



This strategy also assumes that as EWEB continues to acquire new conservation the utility can allow other contracts to lapse without consequence to power supply needs, with the exception of the BPA power purchase contract. As a result, EWEB's 2030 power portfolio would have less wind and no biomass resources, and slightly smaller percentage coming from BPA.

However, as stated in the guidelines described earlier, staff will evaluate each contract prior to expiration for highest value to customers using the TBL framework and updated forecast information. The first contract to expire (2014) is for a small amount of power from the Metro Wastewater facility co-generation facility. So while the recommended strategy calls for no long-term resource commitments for the next five years, a flexible and adaptable planning process will facilitate a forward-looking view of how each contract supports EWEB's power supply portfolio. From a power supply and delivery standpoint, EWEB is in a stable and secure position to meet the future energy needs of our customers. The 2011 IERP builds on a foundation of past planning efforts that prioritize energy conservation as the preferred resource choice for the future. It also depends on new partnerships with customers to help address a number of pending challenges associated with peak loads and optimizing available renewable resources.

It is anticipated that the next twenty years will bring numerous changes to the utility industry, some identified as potential risks in this planning process, and some completely unforeseen. Successful implementation will require not only on-going evaluation of new information to adapt to changing conditions, the utility needs to be poised to take advantage of emerging technologies and business practices to respond to community values around affordability, risk mitigation and sustainability.

Next Steps

As a public utility, a draft of this report will be made available for comment from interested community members. Upon public review of this document, EWEB staff will present its findings to the Board of Commissions and seek their approval of the Plan. As part of its ongoing due diligence to the Plan, staff will conduct annual updates of the key forecasts and assumptions and provide a summary update to the Board. Staff will also conduct a mid-plan check-in three years hence, in addition to a full plan update no later than six years from Plan adoption.