MEMORANDUM

EUGENE WATER & ELECTRIC BOARD

Rely on us.

TO: Commissioners Simpson, Brown, Helgeson, Manning and Mital

FROM: Erin Erben, Power and Strategic Planning Manager; Adam Rue, Senior Energy Resource Analyst

DATE: March 1, 2016

SUBJECT: 2016 Annual IERP Update

OBJECTIVE: Board review and feedback

Issue

The most recent Integrated Electric Resource Plan (2011 IERP) was adopted by the EWEB Board in February 2012 and is currently scheduled for its next major update in 2017. Since 2012, the Power & Strategic Planning Department has provided the Board with an annual update that examines the key drivers of the 2011 IERP to ensure the plan remains prudent.

It is clear that uncertainty in our industry is increasing. In addition to traditional volatility in areas such as the economy and customer load, there have been fundamental changes in natural gas markets, regulatory incentives for renewable energy, declining distributed generation and storage costs, and uneven roll-out of carbon regulation across the western states. The resulting aggregate impacts of low gas prices and the prevalence of intermittent resources on electric grid operations and wholesale market prices appear to be far lower energy prices for the foreseeable future. This has resulted in economic hardship for EWEB given its "length" in supply side resources.

The 2011 IERP recommended a shift from large investments in new central station generation to a focus on a future that leverages distributed strategies, such as conservation and demand response. This approach was supported by the public advisory committee that EWEB staff spent the better part of 2011 educating about industry issues. This decision prompted the Board to direct EWEB to engage in pilot program activity to help confirm the viability of a strictly demand-side approach to resource supply, with a particular focus on the viability of meeting peak load with demand response.

Working in partnership with our customer-owners is a key element to the success of this strategy. The primary incentive customers have to shift their usage patterns are potential bill savings, so sending the right price signal to customers and giving them the tools to manage their load are critical elements of success to this approach.

Background

EWEB's IERP was created over a two-year process. EWEB evaluated its need for new

generating resources and engaged a 13 member public stakeholder group to help develop a plan for how EWEB would meet any future resource needs over the subsequent 20 year period. The plan concluded that EWEB had no immediate need for new resources and recommended using energy efficiency programs to meet future customer load growth, augmented by market purchases in the event a new large load were to come to Eugene. The only instance in which EWEB was forecast to have a potential supply shortage over the 20 year period was in the instance of an extreme (1 in 10) weather event. We have since discovered through refined analysis that we are short more frequently than that in peak capacity, but not for many hours and given adequate supply and low prices in the wholesale market, EWEB has been comfortable with its aggregate supply position.

EWEB's overall strategy of not adding new supply side resources and leveraging demand side resources as its first priority for new customer load is still applicable and prudent given the circumstances the utility is currently facing. This year's update serves to refresh key assumptions that influence resource planning decisions, summarize how any changes impact the actions recommended in the plan, and report on progress toward each of the recommended strategies. In summary, the underlying assumptions have not changed much from the last update presented to the Board in 2015.

The current 2011 IERP action items include:

1. Meet load growth with conservation
2. Work with our customers to avoid peaking power plants by using new demand side management programs
3. Continue to cultivate regional partnerships
4. Enact a new large load strategy, if needed
5. Annually update key planning assumptions and look for material changes

These strategies were designed to enable EWEB to adapt to a changing regional market without adding to the current demand-supply ("load-resource") imbalance through the addition of new supply-side resources. The key drivers that influence these findings from the 2011 IERP include:

- EWEB and regional customer load growth,
- EWEB and regional supply availability,
- Natural gas prices, and
- Regulatory constraints such as renewable portfolio standards and carbon pricing mechanisms.

These factors impact both EWEB and the regional load-resource balance, and the market prices that EWEB receives when it sells or buys from the wholesale market. EWEB's load-resource balance and renewable portfolio standard requirements determine what excess resource EWEB has available to sell, or conversely may need to purchase, in order to meet retail customer demand. Keeping these key assumptions current helps to enable near term contract optimization by the Trading Floor and informs long-term planning decisions in the interim as we prepare for the next IERP. Details on the updates to these key assumptions are included in Appendix 1.

Discussion
Each of the following recommended action items has a component of adaptability that aids EWEB in cost effectively meeting customer supply needs. Below is a summary of each 2011 IERP action item, along with a summary of progress on that strategy.

1. *Pursue Conservation to Meet All Forecast Load Growth*
EWEB is currently meeting all energy and peak load growth with conservation. However, load growth continues to be lower than anticipated in the IERP. The 2016 load forecast model projects a 0.5% annual average growth rate over the next 20 years for the combined residential and commercial classes, which is lower than the original 2011 IERP forecast of roughly 1.0%.

Notably, adding in projections for large industrial customers, such as the new Avago site, results in a bump up in the growth rate to 1.2% over the next five years. New large loads are handled on a case by case basis to optimize energy efficiency at the site rather than rolling them into the aggregate conservation targets. This addresses the possible "lost opportunity" of not installing the most efficient equipment at the time a new customer is making it's up front investments.

EWEB has worked to update its load forecasting tools over the past several years. A more robust peak energy forecast was developed in addition to creating customer class-based energy forecasts (vs. a simple system average). This more granular model (reflecting individual customer classes, rather than simply aggregate retail load) allows us greater ability to compare actual load growth to our forecasts, better monitor revenue impacts, develop pricing design strategies appropriate for the our different classes, and generally better understand customer usage patterns. In addition to the more detailed class-based forecast, there are several other changes to the methodology in the 2015 forecast. Most notably, the historical time period was shortened by moving the start date from 1990 to 2001.[1]

To address near-term financial constraints, EWEB management made a decision to use a rolling five-year average load forecast to set the conservation acquisition target in 2012. How this compares to the 20-year average is shown in Table 1 below. *Excluding* the projections for the new customer at the former site of Hynix Semiconductor (Avago), the forecasted acquisition target below represents load growth for 2017 – 2022 is as follows:

Table 1. EWEB load forecasts over time

[1] The shorter time period eliminates some of the relatively high growth periods in the 1990s; it provides a better fit between variables by excluding the significant rate increases that followed the energy crisis and created a structural break in the energy demand. Second, the independent variables were segregated to the respective class forecast based on statistical tests for reasonable inclusion in the model. For example, population is a variable included in the residential customer class model and unemployment is included in the commercial class model. The model enhancements result in a reduced long-term growth trend as seen in the table below. The 2016 forecast shows continued decline, which reflects updated historical data (demand, unemployment, climate data, and population) including 2015 data in the model. This updated reflects that 2015 actual was below weather adjusted forecast for 2015 by 1.3%. This continued decline in forecast is consistent with regional and national industry trends.

Time Period	2010 Forecast	2012 Forecast	2014 Forecast	2015 Forecast	2016 Forecast
5 year average growth (conservation target)	**3.1 aMW**	**1.7 aMW**	**1.6 aMW**	**1.6 aMW**	**1.5 aMW**
20 year average growth	2.7 aMW	2.7 aMW	2.6 aMW	1.3 aMW	1.1 aMW

Updates to the load forecast have reduced the conservation acquisition targets significantly from the targets discussed in the 2011 IERP; however, over the past few years the targets have been relatively consistent. Energy Management Services (EMS) has been very successful in managing customer uptake of program offerings and savings between sectors to meet targets +/- 10%.

EWEB has an ongoing commitment to provide a minimum level of conservation service for residential, limited income, and small business customers regardless of load growth; however, based on the lower targets noted above, it's important to note that larger commercial customer programs can fluctuate based on EWEB need. In addition, EWEB began targeting a peak reduction for its conservation last year that is also set by the annual load forecast. Unlike the energy target, the peak target is treated as a minimum acquisition threshold. EMS exceeded this target in 2015.

2. *Partner with Customers to Avoid New Peaking Power Plants*

As part of the past IERP direction from the Board, EWEB has been exploring several demand-response related R&D pilots to help test the concept of whether we can meet our peak load requirements through demand-side resources. The result of these efforts is summarized below.

Table 2. EWEB R&D pilots since 2012

SUMMARY OF ACTIVITIES TO DATE SINCE THE 2011 IERP		
Name	**Phase**	**Value/Purpose**
Residential Time of Use "Power Hours Pricing"	Operational	Residential peak shifting, customer choice & control, customer price elasticity
Residential Water Heater (Carina)	Completed	Thermal energy storage and peak shifting
Residential Water Heater (Steffes)	Completed	Demand-side resource flexibility (ancillary service provision), and regional partnerships
SnoTemp Cold Storage Pilot	Completed	Thermal storage, load shifting
Metro Wastewater	Completed	Load shifting, peak reduction, customer choice
EWEB Water Pumping and Storage System	Did not proceed	Load shifting, peak reduction
Commercial Load Aggregation	Did not proceed	DR commercialization, regional aggregation, and centralized load dispatch

While the cross-departmental R&D team continues to meet and explore new opportunities to avoid the need for peaking power plants, this work is largely winding down pending the outcome of the next IERP. Therefore, no new programs are currently planned.

Key Findings from the pilots outlined above[2]:

1. EWEB successfully demonstrated that we have the ability to shift 10s of megawatts of load off-peak;
2. that the Commercial and Industrial sectors will be more cost effective to target for early DR programs;
3. that all customer classes are willing to engage with EWEB to shift load away from peak and have the potential for bill savings;
4. that energy efficiency and demand response, when used together, accomplish greater customer satisfaction and better load management for EWEB than DR alone;
5. that the necessary hardware and software for controls and metering are expensive and the DR programs alone don′ t warrant the investment at this time;
6. therefore key information systems will need to be in place before full scale future programs can be offered, including:
    a. CIS/Billing,
    b. AMI/MDM and/or other metering and telemetry systems, and
    c. and possibly a demand response (DR) aggregation and dispatch system.
7. Lastly, given the regional supply surplus, low wholesale energy prices, and lack of capacity markets in the PNW, BPA and others put a very low value on peak savings at this time;
8. therefore, our short term solution continues to be to buy capacity in the market;
9. however, we do believe DR remains aligned with our core values and is likely cost effective in the long run such that EWEB should continue to advocate for capacity market opportunities in regional policy debates and be ready to engage when the time is right.

Open Project - Power Hours Pricing Study

The primary objectives of the current "Power Hours Pricing Study" include assessing residential customers' ability to shift load to off-peak periods, providing customers an opportunity to save money, testing metering and meter reading solutions for new meter data streams (e.g. interval, 15 minute, data, peak/off-peak usage), performing analysis of data to support load research and demand response applications, and finally evaluating customer responsiveness and acceptance of TOU pricing. We are entering the second year of a two-year study. It is too soon to draw formal conclusions about the amount of energy shifted or average or total bill savings, but overall customers seem pleased with the program and there are definitely some substantial savers. Early results indicate customers achieved on average a 1-2% reduction in peak usage over the past summer. We anticipate greater savings in the winter on this program.

Open Project - Grid Edge Demonstration

EWEB developed the Grid Edge Demonstration project to show how a consumer-owned utility can help increase community resiliency by providing electricity resources when transmission lines and power facilities are down, while testing the concept of a "microgrid" here in Eugene. In disasters such as earthquakes or floods, having distributed renewable

[2] For more information on the pilot findings, see Appendix 2.

power supplies can help provide critical services during response and recovery, under the right circumstances. EWEB's two-year demonstration project will test local stand-alone electric power, or microgrid technology, as well as renewably-charged storage options which offer an added benefit of reduced emissions when compared to traditional back-up diesel generators. Some sort of back-up power is required as a complement to solar energy if it is going to feed the grid in an "islanded" mode.

The project also will give EWEB insight into future options for grid design as technology allows more residents and businesses to self-generate their own power rather than (or in addition to) buying it from the utility. We can also test the possible financial benefit of using the system for demand response/peak shifting capabilities (yielding bill savings for customers and/or EWEB) on an ongoing basis, not just in the event of emergency backup. This would help defray the cost of reinforcing the electric grid for disaster planning.

EWEB has picked three test sites to pilot such power generation/ storage operations, including: the utility's Roosevelt Operations Center in West Eugene; a water pumping and storage system in South Eugene; and the communications tower used by local law enforcement and fire departments on Blanton Heights in South Eugene. These sites will be connected to EWEB's grid to charge the batteries when there's no sunlight, and diesel generators will continue to serve as an emergency backup. All three sites will be connected to one another. A big part of this pilot is getting familiar with storage control technology and dispatch profiles.

The Oregon DOE grant EWEB was awarded was made possible by a joint solicitation from the U.S. Department of Energy's Office of Electricity Delivery and Energy Reliability, which committed $250,000 in federal funds to the project, and the State of Oregon. ODOE is partnering with Oregon BEST to award an additional $45,000 grant to EWEB and its development partners. Sandia National Laboratories will provide technical assistance to ensure strong project performance, with support from the Clean Energy States Alliance. EWEB will be conducting an RFP very soon to find a partner to support the 2-year demonstration project.

3. *Continue to Rely on and Expand Regional Partnerships*

Since many regional utilities and BPA face similar cost pressures, advocating for our needs and finding allies in the region becomes ever more important for helping to generate mutually beneficial solutions to arising regional challenges. As Oregon's largest public utility, EWEB has an important role to advocate for our customer owners in the region and work with BPA to preserve the regional legacy of our shared resources. Staying involved in regional planning efforts and maintaining awareness of other utilities' positions on issues will help EWEB to influence the region in a direction that reduces risk to our customers. In addition, staying abreast of current legislative actions provides significant value to EWEB in its ability to weigh in on decisions that impact our organization, our community and our industry.

EWEB is involved in a number of regional processes and initiatives in both advocacy and analytical roles. Of particular note this past year, EWEB was heavily engaged in the process leading up to the release of Northwest Power and Conservation Council's (NWPCC) 7th

Regional Power Plan. We had analysts involved in every working group to ensure we understood the drivers and could influence the outcome. EWEB analysts continue to follow NWPCC Committees to interpret the recommendations and further develop our own power planning assumptions, enabling us to be consistent with the region as appropriate. In addition, EWEB also maintains leadership positions in the Regional Technical Forum (RTF) to ensure dialogue regarding new and emerging energy efficiency technologies is well understood.

On a separate matter, earlier this year the multi-year Northwest Power Pool Members' Market Assessment and Coordination Initiative (NWPP MC) ended. Efforts to form a Northwest Energy Imbalance Market (EIM) have shifted to a focus on assessing an adjacent balance authority's stakeholder processes (the Cal ISO). In these forums we work with other regional partners to advocate for:

- Fair energy dispatch and price formation
- Compensation for capacity
- Fair allocation of transmission costs and benefits
- Increased reliability through improved tools for managing congestion
- Appropriate compensation of environmental attributes
- Comparable treatment of internal and external EIM/ISO resources

EWEB is also working closely with its counterparts in the Public Generating Pool (PGP), which is made up of 10 large public utilities in Oregon and Washington. Through PGP activities we strive to understand, address, and support changes that will impact our business, such as the growth of distributed generation, the changing nature of resource adequacy, carbon policy, renewable portfolio standards, California market interactions, and capacity markets in the Pacific Northwest.

<u>BPA Regional Dialogue contract</u>
EWEB's current contract with BPA goes through 2028. Under that contract, BPA customers have a one-time choice to notify BPA (in May 2016) of its desire to change from the Slice/Block product to Block-Only or Load-Following. Staff undertook an in-depth analysis in 2015 to assess this choice, using both a quantitative and qualitative approach in this assessment. From a quantitative perspective a comparison was made of the following estimates: direct BPA bill for the past three years, internal EWEB costs associated with maintaining the Slice product, and the secondary value we receive from Slice. From a qualitative perspective, EWEB's strategic plan as well triple bottom line (TBL) factors were considered. Finally, staff leveraged our regional partnerships to convene with other BPA customers conducting similar analyses in the region to align in our thinking, assumptions and approach.

From a quantitative perspective, centered on the comparison of bill estimates, we found that internal costs and secondary revenue for each of the three product options show Slice/Block as the least cost option. While some of the valuation assumptions were somewhat subjective, there was nevertheless no compelling reason to believe another product option would yield significantly greater benefit to EWEB than our current Slice/Block selection. Therefore the decision was made not to change course at this time. Another assessment of this product closer to contract termination would be warranted.

Qualitatively, staff assessed the social, environmental, and resource planning/portfolio fit view. Under the Slice/Block product option, EWEB has more local control. In addition, the potential complexity associated with product changeover didn't seem to be justified by the absence of clear cost savings. Given EWEB would still have other generation resources to manage in the wholesale market, moving away from the Slice/Block product didn't appear to do much to reduce cost or complexity associated with Trading Floor and Power Planning responsibilities. In fact, it seems possible that Load-Following could require more trade activity given the need to provide a schedule for each individual EWEB nonfederal resource.

4. *Pursue New Large Load Strategy, if Needed*

A key discussion in the 2011 IERP was how to serve a new large load, since it is not anticipated that conservation could be ramped up quickly enough to offset that load growth. The IERP recommendation was to rely on existing resources, energy efficiency where possible, and then market purchases to meet the demands of a new large load (rather than acquiring additional resources or entering new long-term contracts).

Over the past few years, EWEB developed a strategy around new large load that balances the potential risks (i.e. RPS compliance or the potential need to acquire new energy or capacity) with the opportunity presented in growing our customer base (and therefore sharing fixed cost investments) with a new large customer. In balancing the risks and opportunities EWEB updated its standard offer pricing for large customers (the G-4 pricing schedule[3]) and established a business growth and retention price rider. These policies allow EWEB to offer incentives to potential customers to encourage growth in the service territory.

The Hynix site went to auction last year and was awarded to a potential new large customer, Avago. EWEB is including a forecast of increased demand at the site with the new ownership. While demand is uncertain at this time, our flexible strategy of relying on existing resources, energy efficiency and market activities allows us to plan for the potential new load without being left with additional long-term resources if the load does not materialize. The load forecast presented in this document includes assumed load at current levels through mid- 2017 and then picking up to four average megawatts by the end of 2017. The loads are expected to increase to build out of 12 average megawatts by mid-2020.

5. *Review Progress and Key Assumptions Annually*

EWEB continues to monitor its obligations under the Oregon Renewable Portfolio Standard (RPS) adopted by the Oregon legislature in 2007, including changes currently proposed in the 2016 legislative session, and to enhance our compliance strategy going forward. Presently, EWEB has not had a year-end RPS obligation to retire RECs due to the offsetting characteristics of our legacy hydroelectric resources and BPA purchases. Given current load growth projections,

[3] Under this price plan, a new large single load (NLSL), defined by BPA as 10 MW or greater, the customer would be responsible for their share of RPS compliance costs. Current load growth forecast is less than 1% and EWEB currently has about 10 aMW of headroom from its contracted BPA high water mark (HWM). If general load grew and we received more BPA entitlement to serve, the incremental BPA purchase would be applied to the legacy hydro exemption for RPS compliance. In addition, EWEB currently has more than 1 million banked RECs, though most are unbundled.

absent a new large load or extreme weather event, we do not foresee a compliance requirement over the next ten years.

Initially, the RPS standard required that 5% of the load for the top three utilities (by size) be provided by renewable resources (net of any legacy hydro resources and BPA purchases). Beginning in 2015, it increased to 15%, to be followed by 20% in 2020 and 25% in 2025. Currently, legislation is pending that would further increase this requirement only for the State's IOUs, advancing future RPS compliance targets to 50% of load. This pending legislation will not directly impact EWEB's compliance projections, but could have profound impacts on the value of power in the wholesale market.

In summary, EWEB has more than sufficient renewable resources for meeting the Oregon state mandated RPS; however, the surplus of the portfolio creates the need to balance surplus REC sales with future compliance tradeoffs. RPS, future environmental regulations, and policy compliance will continue to be an important consideration for long term portfolio decisions into the future.

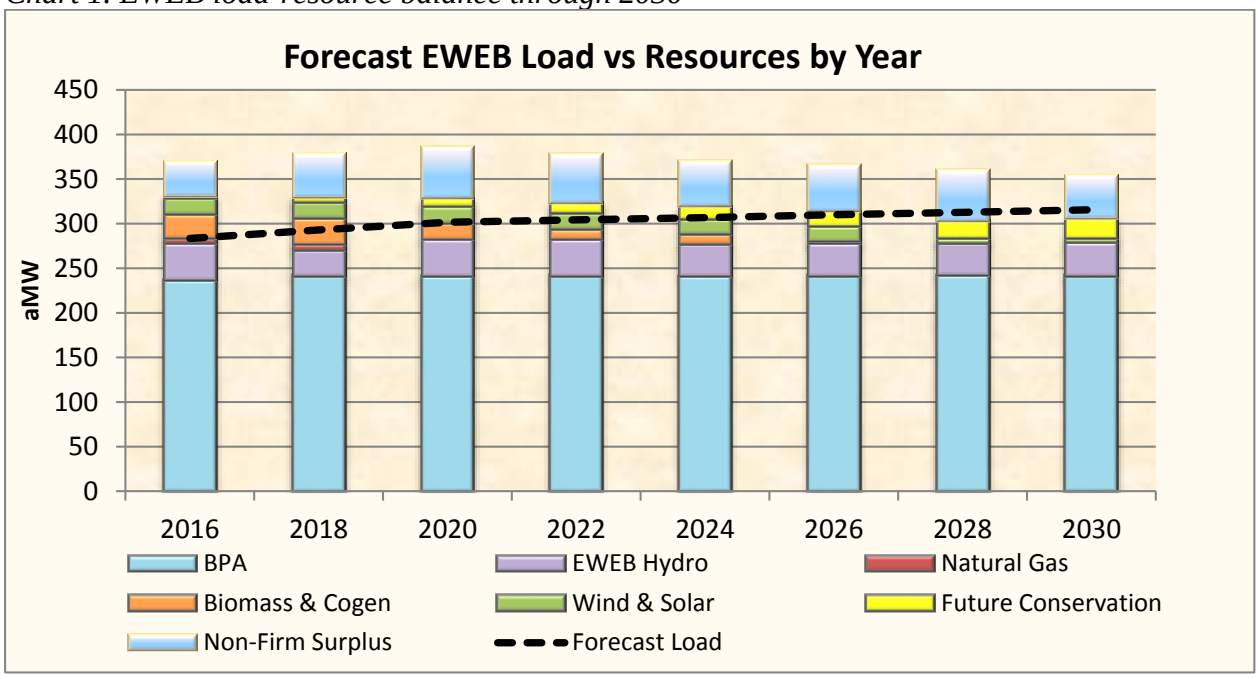
2017 IERP

Resource adequacy on a planning and operational basis is the main goal of integrated resource planning. If EWEB's proposed strategy were no longer sufficient for maintaining resource adequacy then a new IERP would be warranted. As depicted in Chart 1 below, EWEB could most likely go another 10 years without adding resources and still be able to meet its customers' energy requirements.

Historically, EWEB has performed a comprehensive review of its resource acquisition strategy (its IERP) roughly every five years. (Notably, some PUC-related utilities are mandated to do so every two-years.) However, more recently, EWEB has also begun providing annual assessments to the Board regarding any changes to our underlying assumptions and any impact on the current strategy. To date, lower market prices and lower load growth have been the primary findings, neither of which suggest the need to add additional resources.

Ultimately, the update interval is under the purview of the Board, EWEB's governing body. Therefore, the Board has a decision to make regarding: 1) whether to extend the current IERP due to the fact that no new resources are required to serve load, or 2) it can direct management to conduct a new IERP analysis in 2017.

Chart 1. EWEB load-resource balance through 2030



One of the most noteworthy changes that has occurred since the last IERP is the legislation promoting, and subsequent cost reduction of, distributed supply side technologies such as solar energy and, to a lesser degree, energy storage. While there is value in assessing the public interest in such technologies, and their associated willingness to pay, the fact remains that due to EWEB's continued surplus energy supply position, there is no reliability or financial driver for EWEB to acquire new resources.

Another consideration is EWEB's conservation strategy. In the last IERP, the energy efficiency target was tied to load growth. Since then, load growth has decreased dramatically and is not expected to recover to prior levels any time soon. There would be value in exploring with the public whether they are willing to pay for additional conservation.

Assessing customer interest and willingness to pay for both DG and EE could be done within the context of the next IERP, or it could be done as a separate endeavor. Additionally, the nature and extent of the associated public process is at the discretion of management and the Board. For the last IERP, a public advisory panel of 13 was recruited and engaged over a six month period to review the various aspects of resource planning and provide input into staff's final recommendation to the Board. How we approach the next one is a matter for review.

In summary, the electric industry is changing and requires looking at new ways in which power can be generated, delivered, and used to improve efficiency, reduce costs, improve reliability, minimize environmental impacts, and respond to changing market dynamics. A utility's willingness to modernize is vital.

As part of EWEB's current modernization program, the utility is upgrading its hardware and software infrastructure to allow customers to have more control over their electric and water use.

This modernization initiative not only will make EWEB more efficient, but will challenge us to seek new ways to serve the changing needs of our customers. We need to do our part to be ready to meet our customers changing expectations. How we manage our supply portfolio will be a key factor in that future.

TBL Analysis

A Triple Bottom Line analysis was included as an integral part of the original 2011 IERP. Its elements were used in the decision making process for advising the strategies that were ultimately recommended to, and approved by, the EWEB Board of Directors in 2012. The IERP also looked at risk and uncertainty and discussed the value of adaptive strategies suited to changing conditions. For further reading on the tradeoffs that were discussed in the IERP and the official TBL analysis for the strategies please see the 2011 IERP document at: http://www.eweb.org/public/documents/ierp/2011ierpfinaldraft.pdf.

Recommendation

Management is providing this annual update as committed to in the 2011 IERP. Additionally, we will plan to begin the 2017 IERP update process, unless otherwise directed by the Board. Management will be providing additional information on how this process may align with the Pricing Reform Advisory committee ask during the March 15 Strategic Planning Workshop.

Requested Board Action

Management is seeking feedback on the timing and scope of the next IERP public process.

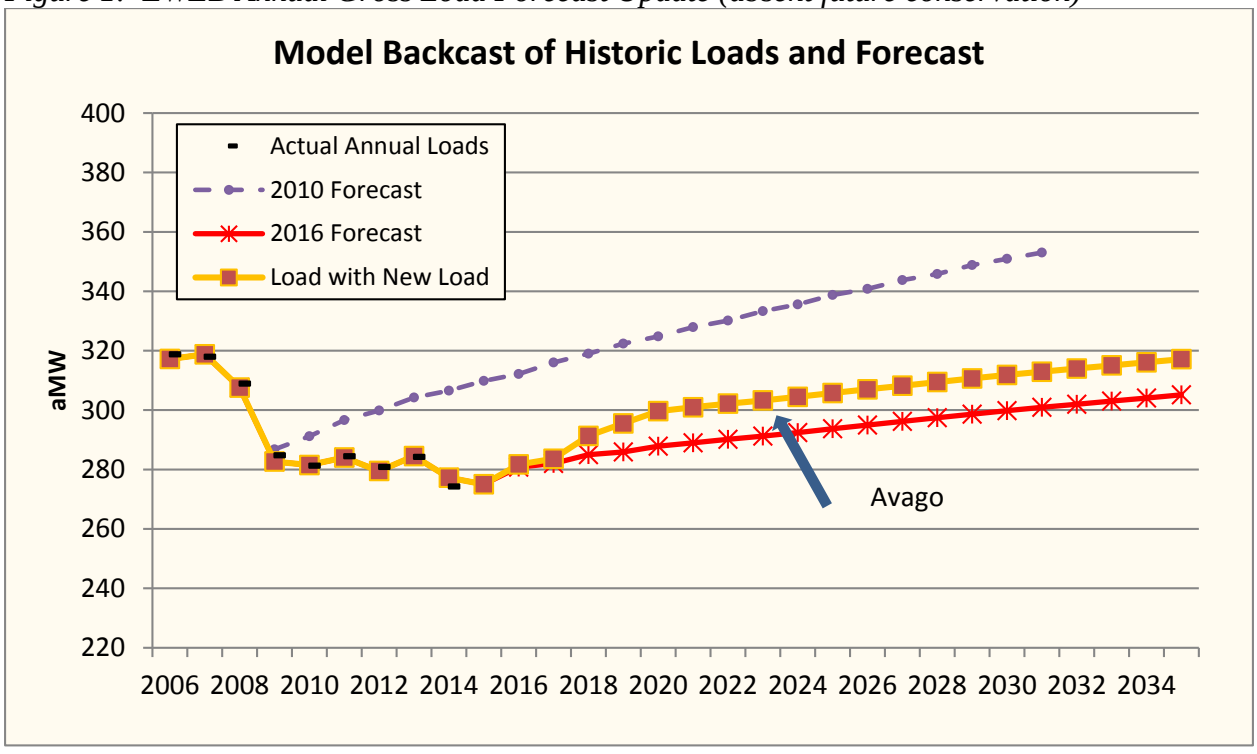
APPENDIX 1: Updates to Key Planning Assumptions

The Power and Strategic Planning department updates long-term planning assumptions and forecasts annually or as significant changes are observed. Documenting these changes is important for staff to keep track of the changing landscape, but also serves to check in on assumptions underlying EWEB's resource plan and which impact other long term energy resource management decisions, such as our asset sale strategy. This appendix summarizes updates to the key drivers in the IERP.

Economic Recovery and Loads

EWEB load growth recovery post-recession has turned out to be much slower than previously anticipated. This is largely due to a slow regional economic recovery, but may also be the result of energy efficiency, changing codes and standards, technology, net metering, customer price elasticity and fuel switching to natural gas. The current load forecast includes the projection with and without the incremental load at the former Hynix site (now Avago). If the load materializes this is the best available forecast for the site. The combined result is a retail load forecast that is much lower than what was evaluated in the 2011 IERP.

Figure 1: EWEB Annual Gross Load Forecast Update (absent future conservation)



Peak Load Forecast Update

Since the EWEB peak forecast varies significantly by season EWEB has begun developing both a winter and a summer peak forecast. Under median weather conditions, a typical one hour summer peak is forecast at 363 MW whereas a winter peak is forecast at 484 MW. Even with summer peaks growing faster than winter, much would have to change for EWEB to become a summer peaking utility.

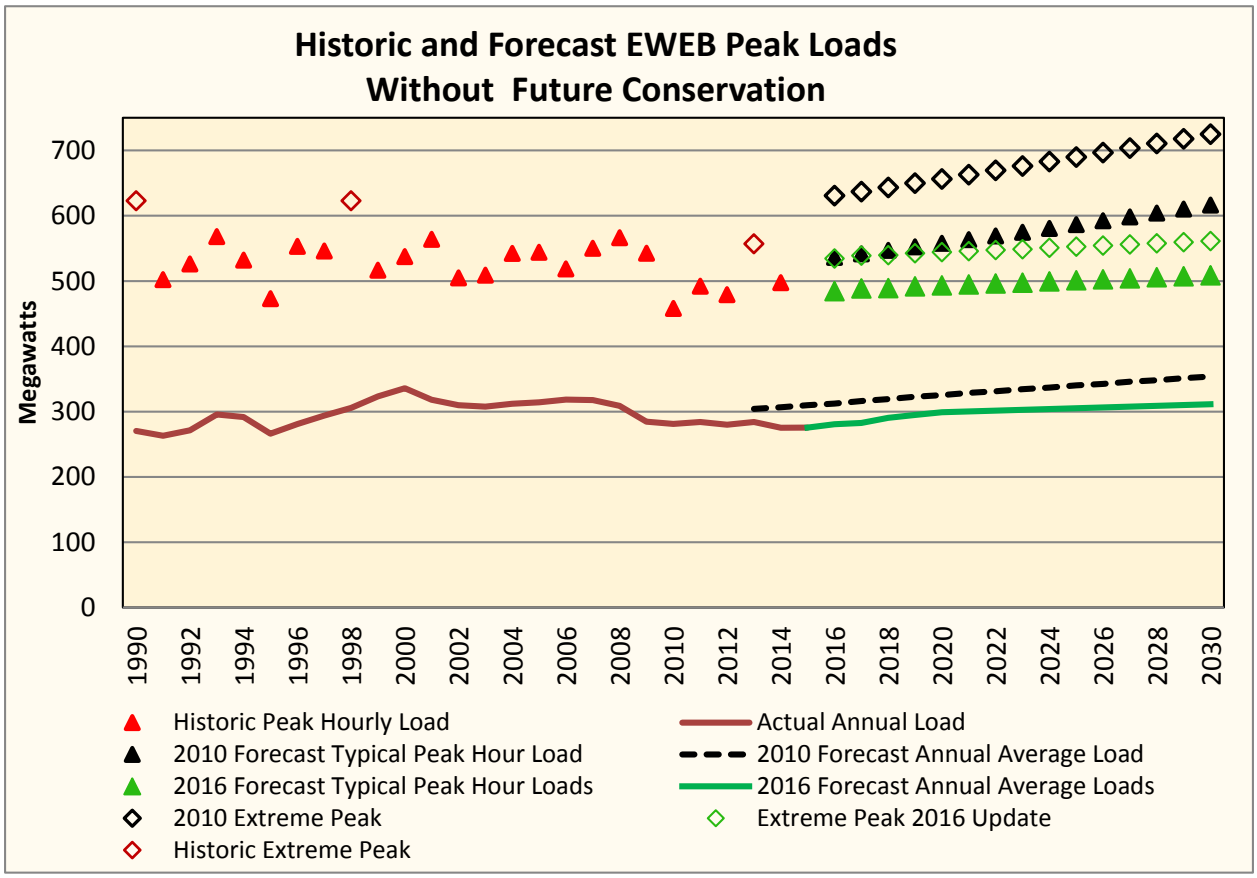
Although in absolute terms the summer peak is lower than the winter peak, summer load is growing faster. This is largely due to an increase in air conditioning load, which is typically provided by electricity - versus heating load which could also be provided by natural gas, oil or wood as the fuel source. In addition to fuel switching, energy efficiency measures have served to dampen the growth of winter peaks. In the current forecast, EWEB does not anticipate becoming a summer peaking utility in the foreseeable future; however, summer peaking is much more common nationally and therefore EWEB monitors these trends.

EWEB's winter peak is driven by heating load and the summer peak by cooling load. In the winter the peak can occur in either the morning or the evening, depending on the weather conditions. Typically, the winter peak occurs between 7:00 and 9:00 a.m. and/or in the evening between 4:00 and 7:00 p.m. The summer peak occurs late midday between 4:00 and 6:00 p.m. Due to the fact that the peaks are largely weather driven; the forecast is developed for both normalized conditions and "extreme" climate conditions.

The Eugene climate typically experiences winter temperatures below eighteen degrees one in every two years. The low temperature typically occurs in December or January, but can occasionally occur in February or November. EWEB forecasts peaks based on extreme weather conditions to ensure we have adequate supply at these times of critical need. Approximately once in every ten years, Eugene experiences a winter low temperature around six degrees. In 2013, Eugene experience low temperatures of negative ten degrees. These extreme conditions were well below our expected or even our extreme winter forecast modeling.

Figure 2 below shows the historic volatility in peak demand, primarily driven by weather. Historic conservation measures are added back into these forecasts so we can see the net result of the activity on load and use it as a resource to meet customer demand.

Figure 2: EWEB Average and Extreme Peak Loads (not reflecting conservation savings)

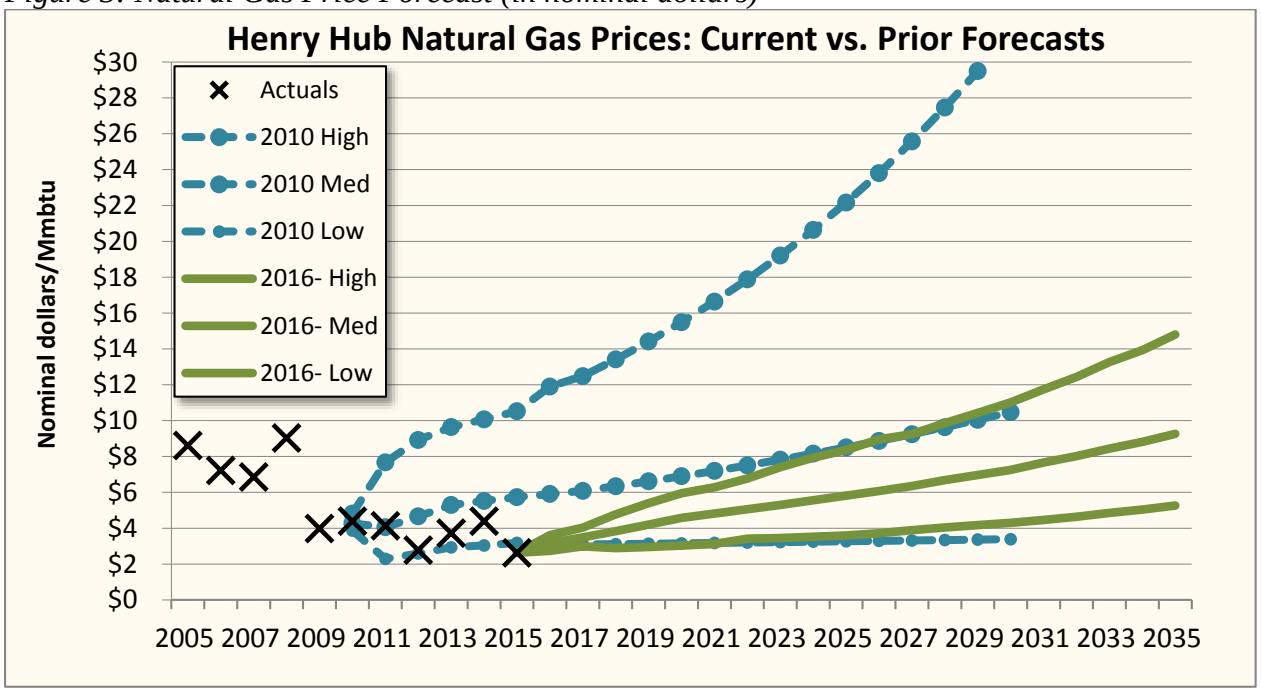


Natural Gas Prices

The forecast of natural gas prices was initially updated in late 2010 for the 2011 IERP public process. The forecast at that time was preceded by a period of volatile and historically high prices. The hydraulic fracturing technology ("fracking") was relatively new and the impacts were not yet known.

Though much uncertainty remains going forward, near term price forecasts have been reduced significantly to reflect the fracking phenomenon, which results in lower wholesale electric price forecasts, due to the high percentage of natural gas fired turbines that supply the region. Robust analysis of a range of natural gas prices, and potential impacts of changes in supply and demand, continues to be a key component of resource planning. Figure 3 below compares the range of natural gas prices that were evaluated under the IERP to the most recent forecast of low, medium, and high natural gas prices.

Figure 3: Natural Gas Price Forecast (in nominal dollars)[4]



Carbon Pricing and Emission Controls

Regional Carbon Pricing

Carbon pricing, via a cap and trade program or taxing mechanism, would be expected to have a substantial impact on wholesale markets. However, while action has been taken already elsewhere in the Western US and Canada (California and British Columbia have both implemented state/province-wide and economy-wide carbon pricing mechanisms), Oregon and Washington have not moved forward at this time. Oregon is not expected to act on carbon pricing legislation in the current 2016 short legislative session, but will likely take that issue up with greater focus in the regular 2017 session although the chances of passage then is at best a 50/50 proposition.

Federal Emission Controls

In the summer of 2015, the U.S. EPA released a landmark rulemaking under Section 111(d) of the Federal Clean Air Act, known as the "Clean Power Plan", although the future of that action is now in doubt. The rule would regulate carbon emissions in the electric sector from existing generation sources, with an expectation that existing sources would reduce carbon emissions to 30 percent below 2005 levels by 2030 in aggregate.

Under 11(d), States are required to submit action plans for how they will achieve the expected level of emission reductions based on changes in three categories: redispatch of existing thermal resources (more natural gas, less coal), increased efficiency of older coal plants, and new

[4] The high, medium, and low gas prices are based on the Northwest Power and Conservation Council Draft 7th Plan.

renewable generation. States may join together to form a regional approach, with potential trading mechanisms employed between participating states.

However, a consortium of 29 states are challenging the Clean Power Plan and on February 9th the U.S. Supreme Court granted a stay of the Clean Power Plan rule. It is anticipated that it will likely take a year or two to resolve the legal challenge. It is not yet known if Oregon will continue the design of a state action plan, or pause for the legal challenge to be resolved.

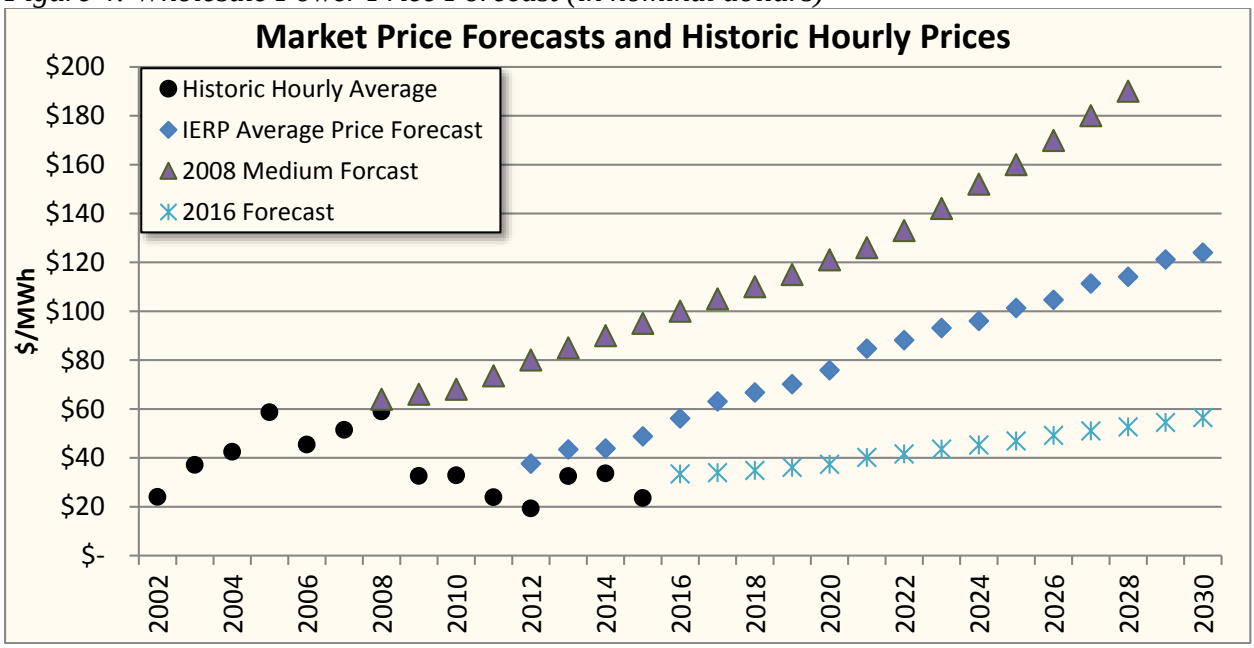
Future of Carbon Pricing

The 2017 IERP will give EWEB the opportunity to forecast scenario-based carbon pricing impacts for the regional wholesale power market. Although the legislative and market mechanisms will likely still be in flux, we are hopeful that many issues will be resolved over in 2016 and early 2017.

Wholesale Market Prices and Impacts on Utilities

Low demand, low natural gas prices, and an abundant supply of energy resources have all contributed to a reduced wholesale market price forecast. While low market prices persist, they negatively impact hydro dominated utilities such as EWEB and BPA by reducing surplus power sales revenue. In the past, EWEB and BPA were able to use surplus sales revenue to help offset retail price increases and to contribute to fixed cost recovery. Since wholesale prices have dropped below retail prices, this has reduced the value of existing resources and increased the risk associated with both over-supply and diminished customer demand. Based on our current load-resource balance, EWEB will be dealing with this reality for years to come.

Figure 4: Wholesale Power Price Forecast (in nominal dollars)[5]

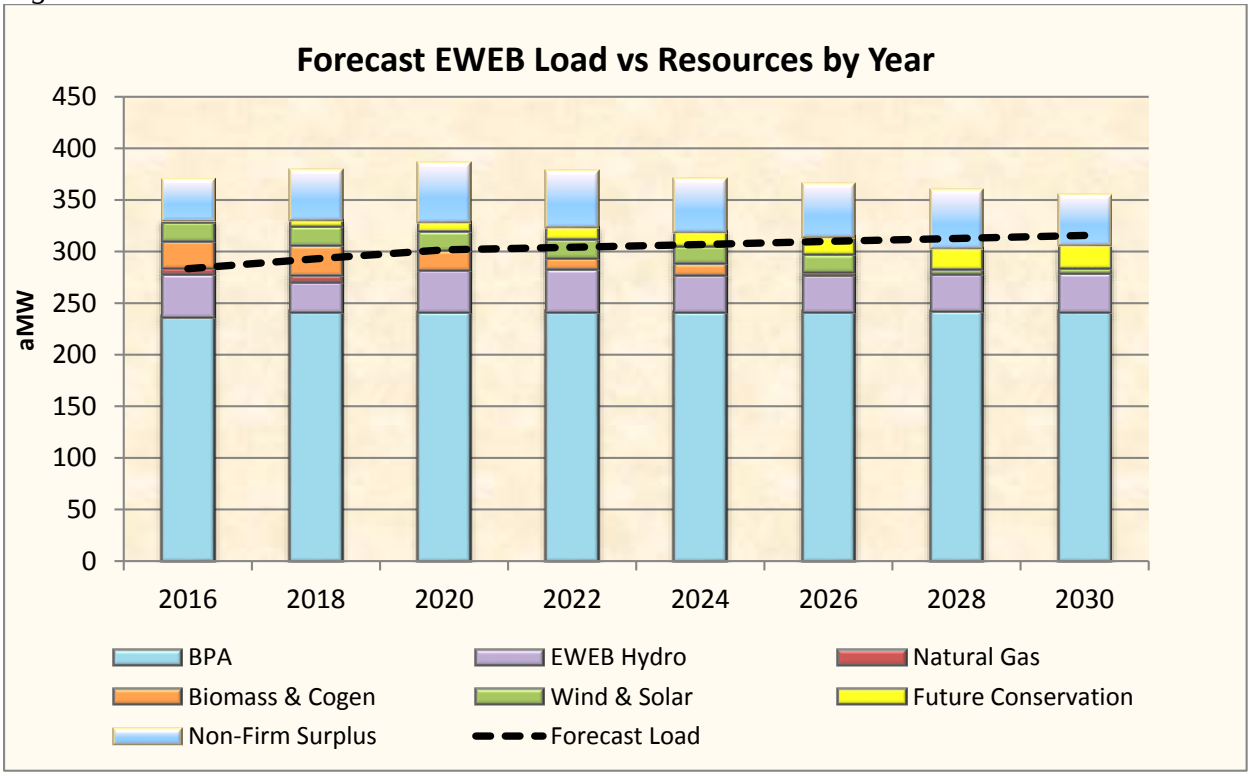


EWEB Load Resource Balance

[5] The 2016 power price forecast is based on the Northwest Power and Conservation Council Draft 7th Plan

Resource adequacy on a planning and operational basis is the main goal of integrated resource planning. If EWEB's proposed strategy was no longer sufficient for maintaining resource adequacy then a new IERP would be warranted. Figure 5 shows EWEB's annual energy supply from different resource types, the annual load forecast, and future energy efficiency acquisition compliant with the current resource plan recommendation.

Figure 5: EWEB Annual Loads and Resources[6]

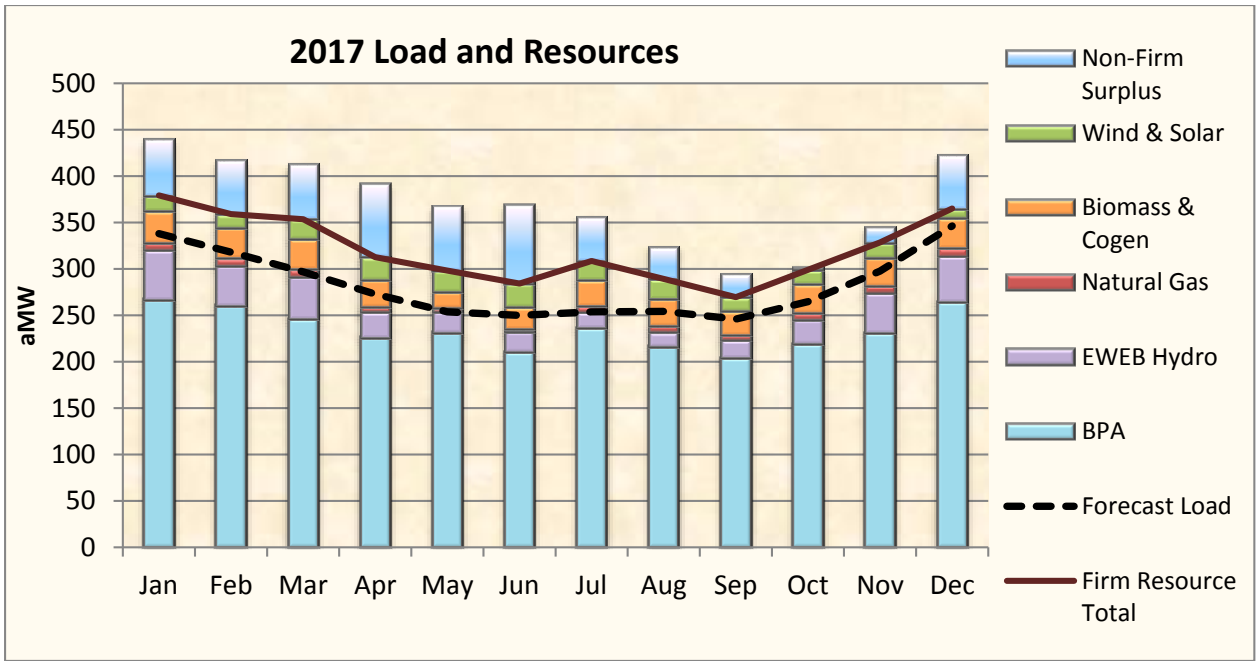


On an annual basis, EWEB has more than sufficient resources to serve its customers' energy requirements even under drought conditions for the next 10 years. While there are hours that peak capacity is not available from EWEB owned, co-owned or contracted for resources, this shortfall and any monthly variations in resources or load are handled through EWEB's Power Operations group by trading activities that are in compliance with EWEB's mid- and short-term risk guidelines.

On a monthly basis, EWEB's aggregate load profile changes a bit from the annual view shown above. In Figure 6, you can see that in the Fall we have far fewer resources available. This is due to the seasonal nature of water flows in the region.

Figure 6: EWEB 2017 Monthly Loads and Resources (pre-hedging activity)

[6] Includes projected new load at former Hynix Semiconductor Site.



In most years, EWEB is expected to have a significant surplus of generation compared to customer demand, due to the PNW tradition of conservatively aligning resource adequacy with "firm", or drought-adjusted water availability. (This is a by-product of our heavy reliance on hydro-electric generation.) However EWEB is still concerned with long term price trends and regional landscape changes that could influence the value of our existing portfolio of generation assets and long-term power purchase agreements. These changes and other sources of uncertainty are considered while making decisions regarding long term asset management.

EWEB Peak Supply and Loads

Beyond annual and monthly energy sufficiency, the IERP evaluated EWEB's resource sufficiency during times of peak consumption. In 2014, Power Planning explored regional standards for peak supply adequacy and developed a methodology to evaluate EWEB's peak supply capability under summer and winter peak conditions over a single hour, multiple hour, and multiple day peaking events. Figure 6 shows the latest version of this analysis, which demonstrates insufficient resources to serve winter peak loads under 1 in 5 year winter peaks with expected hydro conditions. Summer peaks, while growing, did not arise as an area of concern for peak supply availability.

Power Planning has recommended that EWEB secure sufficient resources to meet expected (typical weather) peak customer demand. Given the current availability of resources (we have seen no shortage pricing and other regional utilities are building to meet their reserve requirements) on the wholesale market and the low cost at which they can be acquired, EWEB presently manages its winter peak risk by buying on the short term market rather than securing long-term resources.

The sustained peak adequacy chart shown below reflects several key changes from last year. The current chart reflects the sale of the Smith Creek hydroelectric project and also includes updated

peak demand forecasts including the Avago load projections. The net impact of these changes is moderately higher shortfalls in the constrained periods.

Figure 6: 2020 Average Supply & 1 in 5 Winter Peak Conditions

Condition	Duration	Load	Supply Carmen	Supply Slice	Supply Other	Supply Total	Adequacy shortfall or surplus (aMW)	Calculated Reserve Margin (Should be ≥ 0)
1 in 5 Winter Peak with Average Hydro	1-Hour	538	91	204	200	495	-43	-8%
	18- Hour	474	58	190	200	448	-26	-5%
	72-Hour	424	24	152	196	372	-52	-12%
1 in 5 Summer Peak with Average Hydro	1-Hour	387	72	191	165	418	31	8%
	18- Hour	350	36	179	165	370	20	6%
	72-Hour	305	17	155	161	322	17	6%

The RMC approved the methodology outlined above for inclusion in EWEB's risk management procedures. Recommendations included adoption of a peak adequacy threshold and methodology for evaluating it, an expectation for engagement in regional reliability planning and market watch, as well as the expectation that this reliability threshold will be incorporated into long term resource planning decisions going forward.

Further analysis will be required to evaluate the trading floor methodology for establishing adequacy and the incorporation of a long term firm energy surplus cap to ensure energy adequacy and balance in the future. EWEB will also continue to participate in regional resource planning to gain knowledge on best practices and alternative analytical approaches. How to balance peak supply and demand under numerous time scales and hydro conditions will be more directly incorporated into power planning decisions from here forward.

Over the last 10 year period, wholesale power prices for winter peak periods generally ranged from about \$60 - \$150/MWh[7]. At these prices the adequacy shortfall translates to a general market exposure ranging from about \$225,000 to \$560,000 for a given 18 and 72 hour event. Existing power risk management policies (SD8) prescribe that EWEB will manage its Short-

[7] Several excursion hours were in the \$350 – 375 range. The \$150/MWh range is indicative of the recent December 2013 extreme weather event.

Term position such that there is a 95% probability an adverse market price movement will result in no more than a $2 million risk exposure.[8] The Board delegates the setting of methodologies for determining financial risk to be used to the Risk Management Committee.

[8] Although there is a $2 million value at risk backstop, the typical value at risk is about $200 and rarely reaches $1 million.

APPENDIX 2: Summary of R&D Pilot savings to date

Over the past several years, the R&D work outlined in this document has successfully demonstrated that EWEB has the ability to shift customer load to help meet future demand growth. For example, SnoTemp was able to shift 200-300 kW on a regular basis (30 min - 2 hour window) and Metro Wastewater was able to shift 400 to 500 kW on a regular basis (1-5 hour window). Most importantly, these shifting events had minimal effects on the business operations of these companies. We estimate that there is approximately 10MW of potential peak load available for shift in the commercial and industrial sectors. Based on this research, our technology requirements, and the market viability of these programs, we estimate that we are roughly five years out from a standard offer.

The two biggest challenges to commercial and industrial demand response are high initial costs (metering and telemetry) and the high level of necessary customer engagement. BPA provided funding for much of the infrastructure costs of EWEB′ s pilots, however looking forward we expect that leveraging the AMI system may reduce such metering and telemetry setup costs. Notably, however, the currently planned data intervals may cause latency issues that impede sophisticated options, such fast response products (less than 5 minute response times) that are preferred by the BPA. This type of fast-response DR is required to integrate renewable energy into the grid. We are exploring these and other communication options currently.

The Residential water heater pilots demonstrated that usage was able to be shifted for a typical 4kW water heater, with little to no impact on the customer. On average, approximately 0.2-0.4 kW per water heater was sustained for a 4 hours period. This represents a market potential of about 5 MW[9] if scaled to the EWEB service territory. This is great load because of how quickly it can respond to a signal, however, the cost per site to achieve these results was, on average, several hundred dollars which is a barrier for large scale programs. The viability of accessing the residential water heater market will depend on having DR capability as a standard for new appliances. Based on this research, the market viability of programs is estimated to be at least 5 -10 years out for our region.

[9] Assumes 20% participation rate. EWEB estimates that there are over 60,000 electric water heaters in its service territory.