PUBLIC UTILITY DISTRICT NO. 1 OF CHELAN COUNTY

INTEGRATED RESOURCE PLAN
Progress Report
2018

P.U.D.
CHELAN COUNTY

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2018 Integrated Resource Plan Progress Report

Summary of Determinations

The District has completed its 2018 Integrated Resource Plan (IRP) Progress Report. This Progress Report is required by the Revised Code of Washington (RCW) 19.280: Electric Utility Resource Plans passed by the legislature in 2006. According to the statute, "it is the intent of the legislature to encourage the development of new safe, clean and reliable energy resources to meet demand in Washington for affordable and reliable electricity. To achieve this end, the legislature finds it essential that electric utilities in Washington develop comprehensive resource plans that explain the mix of generation and demand-side resources they plan to use to meet their customers' electricity needs in both the short-term and the long-term." The enacted legislation requires investor-owned and consumer-owned utilities with more than 25,000 retail customers to produce a progress report every two years and a fully updated 10-year plan every four years. Consumer-owned utilities shall encourage participation of their consumers in development of their IRPs and progress reports after providing public notice and hearing.

Based upon the analysis over the 2018-2028 planning period, the Board of Commissioners of Chelan County Public Utility District (Chelan PUD or District) has approved this 2018 IRP Progress Report and determined that:

- The District retain its current mix of generating resources.

And additionally:

- The District continue to evaluate and implement conservation programs based on the foundational work performed in the 2017 conservation potential assessment (CPA).
- The District carry on the evaluation and implementation of strategies for additional power and ancillary sales contracts consistent with financial policies and the hedging strategy.

These determinations continue to provide the platform for the District to serve its customer/owners with reliable, low-cost, renewable energy resources for the foreseeable future.

Report Overview

To meet the requirements of RCW 19.280, the development of Chelan PUD's 2018 IRP Progress Report includes the following:

An update of the long-term forecasts of retail electric customer demand

- Revised costs and operational information for Chelan PUD's existing generating resources
- Updated data in regards to the District's existing operational and power sales contracts
- Amended conservation inputs to align with Chelan PUD's December 2017 10-year conservation plan submittal to the Washington State Department of Commerce (Commerce) as required
- A reaffirmation of Chelan PUD's resource adequacy measures
- Analyze the forecasted load/resource balance (using the District's existing portfolio of resources) with the aforementioned input changes, additionally evaluating service reliability and environmental impacts and communicating with customers and the public
- Board approval of the IRP Progress Report
- Submittal of the final IRP Progress Report to Commerce by September 1, 2018 as required

Planning & Regulatory Environment

Resource Planning Situation

Chelan PUD is forecasted to be surplus to its own retail load needs throughout the current planning period (2018-2028).

The District has some longer-term power sales contracts and also enters into shorter-term contracts for a portion of its hydro output providing the District flexibility. The shorter-term contracts, part of the District's hedging policy, are discussed more fully in the Portfolio Analysis section.

The Washington State Renewable Performance Standard (RPS) (Energy Independence Act of 2006) requires utilities to serve a certain percentage of their retail load with renewable resources and acquire all cost-effective conservation. This legislation and other

regional efforts have increased the amount of renewable energy in the wholesale power markets. The effect of increased wind capacity and overgeneration events in the region is discussed in the Resources section.

Regulatory & Statutory Requirements

In addition to the integrated resource planning requirements of RCW 19.280, the District is directly affected by other regulatory and legislative actions that relate to resource planning. Those of greatest focus for Chelan PUD and the region are discussed below. These requirements were specifically evaluated in the preparation and adoption of this IRP Progress Report.

Renewable Portfolio Standard (RPS)

On the District's radar since 2006, RCW 19.285, The Energy Independence Act, requires utilities with a retail load of more than 25,000 customers to use eligible renewable resources (excluding most existing hydroelectric power) or acquire equivalent renewable energy credits (REC), or a combination of both, to have met 3% of retail load by January 1, 2012, 9% by January 1, 2016 and 15% by January 1, 2020. Under the law, the District can count efficiency gains made after March 31, 1999 at its existing hydropower projects toward meeting the RPS. Additionally, the District's entire share of the Nine Canyon Wind Project qualifies as an eligible renewable resource for meeting the requirement of the RPS. The law also required that by January 1, 2010, utilities evaluate conservation resources, submit their initial 10-year conservation plans and begin pursuing all conservation that is cost-effective, reliable and feasible. This 2018 IRP Progress Report includes updates to the evaluations and required reporting under both the renewable and conservation portions of the RPS which are discussed further below.

Resource Adequacy

The current, voluntary standard was adopted in December 2011 by the Northwest Power and Conservation Council (NWPCC or Council). Regional adequacy assessments are not intended to apply directly to individual utilities because no utility has the same load and resource profile as the region. However, the probabilistic methodology imbedded in the standard is recommended for utilities to do their own assessments. The standard uses the system's loss of load probability (LOLP) as the adequacy metric with a maximum allowable LOLP of 5%. A single annual value is assessed, which identifies both energy and capacity problems. It is not intended to be a resource planning target.

The Council's latest resource adequacy assessment for the 2021 and 2022 operating years was released in July of 2017. Results show an LOLP of just under 7% for 2021 and just over 7% for 2022. These results assume the Council's energy efficiency targets, from the Seventh Power Plan, through 2022 will be achieved. To comply with the Council's adequacy standard, the region will need to add an estimated 400 megawatts of new capacity that can be counted on during any shortfall hour of the year by 2021.

Revised load forecasts for 2021 and 2022 project a greater trend toward lower winter peak loads and higher summer peak loads.

- The Canadian hydroelectric operation for 2021 and 2022 under the Columbia River Treaty shows a shift in the timing and amount of inflows into the U.S. The projection is for increased U.S. hydro generation in summer but decreased generation in October.
- For past adequacy assessments, the Council assumed that the regional power supply had no access to the Southwest market during October. However, after a review of current data, and with input from the Resource Adequacy Advisory Committee, this assumption has been modified to allow for some market availability. This offsets the effects of the anticipated shifts in hydro generation due to Canadian operations.
- Expected energy savings by 2022 from the Council's energy efficiency targets and from codes and federal standards will completely offset the loss of generation from the planned retirements of Centralia 1 (688 megawatts), Boardman (642 megawatts), North Valmy 1 (127 megawatts), Colstrip 1 and 2 coal plants (308 megawatts) and the Pasco gas-fired plants (44 megawatts).

The estimated need for new capacity is sensitive to both load and resource assumptions and could vary between zero and 1,000 megawatts. This is why the Council annually updates its adequacy assessment for the power supply five years out. Demand response plays a big role in the Council's Seventh Power Plan resource strategy and could potentially fill the projected gap in resource need for 2021. In its plan, the Council did not establish a target for demand response acquisition but recommended that 600 megawatts be developed by 2021. This is discussed in the following section on demand response.

The analysis only counts existing resources and those that are sited and licensed. As conditions change over the next few years, it is expected that utilities will

amend their resource acquisition strategies to ensure that sufficient investments in new resources will be made to maintain an adequate supply.

The District analyzed its resource adequacy in the preparation of this 2018 IRP Progress Report.

Demand Response

Demand Response (DR) is defined as "changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized" according to the Federal Energy Regulatory Commission (FERC).

One of the key findings from the Seventh Power Plan is the region's need to develop capacity resources to meet growing demands. DR was identified as a resource to meet winter and summer peak demands, primarily under critical water and extreme weather conditions. The plan indicated a minimum of 600 MW of additional DR resources would be cost-effective to develop as soon as possible; significantly more than had been developed or planned. However, the region has limited commercial experience with DR, and thus there is a general lack of understanding and confidence in how to effectively deploy these resources.

The Seventh Power Plan recommended forming a demand response advisory committee (DRAC) to advise the Council on developing the demand response resources identified as cost-effective in the plan. An issue paper written in 2016, available on the Council website, outlined a proposed approach to forming the committee and its focus on implementation, barriers and supply curve development. The paper also proposed that the Council convene a system integration forum to enhance the region's ability to evaluate and analyze enabling technologies and resources similar to DR that could potentially reduce the cost of integrating existing and new resources with customer demands.

The Council finalized a charter and recruited members for the DRAC in 2016. The timeline for convening the system integration forum is in 2018. Upon charter renewal (anticipated summer 2018), the DRAC will likely shift focus to more technical aspects of demand response, leading to supporting the Council in development of the supply curves for the Eighth Power Plan.

As mentioned in the 2016 IRP, Chelan PUD has one agreement falling under the umbrella of DR. It is a load shedding agreement with Alcoa Power Generating, Inc. (APGI) and Alcoa, Inc. (Alcoa). In December 2015, Alcoa idled their Wenatchee Works plant. The District does not have any DR available while the Alcoa plant is idled.

State Climate and Energy Legislation

In 2016, a ballot initiative known as I-732, designed to create the nation's first tax on carbon pollution, was defeated. It was designed, in essence, to return the money from its carbon tax through cuts in sales and manufacturing taxes and with tax rebates to low-income households. I-732 started at $25 per metric ton of carbon emissions and would have eventually risen to $100.

Carbon Washington, the initiative's sponsor, said the plan was revenue-neutral. Its founder, an economist who left the state for Utah after the 2016 election, argued the approach should appeal across party lines. Despite high-profile backing from those such as Leonardo DiCaprio and Washington's Audubon Society, many Washington chapters of national environmental groups, like the Sierra Club and Washington Conservation Voters, declined to support the initiative, and other activists campaigned against it. They claimed the proposal did not generate funds to fight climate change and was developed without the input of communities of color, and as a result, left those communities behind.

In March 2018, Senate Bill (SB) 6203 died during the legislative session. Governor Inslee championed the proposal that originally included a carbon tax at $20 per metric ton of carbon emissions, but was amended to $12. It also included exemptions for various industries, new funding priorities for multi-modal transportation and rural economic development, as well as requirements for utilities, claiming credits, to eliminate carbon in the electric sector by 2050.

After the failure of SB 6203, the coalition of groups spearheading the climate campaign, called the Alliance for Jobs and Clean Energy, filed their statewide initiative for clean air and clean energy. I-1631, an initiative to reduce pollution by imposing a fee on large emitters based on their pollution, may appear (approximately 250,000 signatures are needed by July 6th) on the ballot in Washington in November 2018. The initiative would enact a carbon emissions fee beginning on January 1, 2020 of $15 per metric ton of carbon. The fee would increase by approximately $2 per metric ton plus inflation each year until the state's greenhouse gas (GHG) goals of 2035 are met and the 2050 goals are on track to be met. Revenue from the fee would go into two funds: 1) a fund for air quality and energy programs and projects and 2) a fund for water quality and forest health projects. I-1631 would

establish an oversight board made up of people from different interest groups to decide where and how to spend the revenue.

Clean Air Rule (CAR)

On September 15, 2016, the Washington State Department of Ecology (DOE) adopted emission standards (Chapter 173-442 Washington Administrative Code (WAC) — Clean Air Rule (CAR)) to cap and reduce GHG emissions from significant in-state stationary sources, petroleum product producers, importers, and distributors and natural gas distributors operating within Washington.

Parties covered under the CAR are required to reduce their covered GHG emissions along an emissions reduction pathway or obtain emission reductions from other covered parties, GHG emissions reduction projects or out-of-state emissions market programs. The CAR covers two-thirds of all in-state GHG emissions including a wide array of public and private sector parties. In 2017, businesses and organizations that were responsible for 100,000 metric tons of carbon pollution annually were required to cap and gradually reduce their emissions. Every three years, the threshold to be covered by the rule is lowered by 5,000 metric tons. This brings more emitters into the program. In 2035, the threshold reaches 70,000 metric tons, where it will remain. Businesses categorized as energy-intensive, trade-exposed industries and fuel importers begin participating in 2020.

In addition, DOE amended Chapter 173-441 WAC (Reporting of Emissions of Greenhouse Gases) to change the emissions covered by the existing reporting program, modify reporting requirements, and update administrative procedures.

In March 2018, Thurston County Superior Court ruled that parts of the CAR are invalid. This means that compliance with the rule currently is suspended. Under a separate DOE rule, facilities covered by the CAR are still required to report their emissions for the Greenhouse Gas Reporting program.

National Climate and Energy Legislation

As reported in the 2016 IRP, in 2014, the Environmental Protection Agency (EPA) proposed emission guidelines, the Clean Power Plan, for states to follow in developing plans to address GHG from existing fossil fuel-fired electric generating units. The final version of the Clean Power Plan was unveiled by President Obama on August 3, 2015.

Challengers argued that the EPA overstepped its legal authority in issuing the Clean Power Plan, as it regards the power plants covered by the Plan, and the scope of the "building blocks" for action go beyond standards applied to specific electric generation units, as called for by the Clean Air Act. On February 9, 2016, the Supreme Court ordered the EPA to halt enforcement of the Plan until a lower court rules in a lawsuit against it. The 5-4 vote split along party lines was the first time the Court had ever stayed a regulation before a judgment by the lower Court of Appeals. The Clean Power Plan remains stayed.

During his campaign, Donald Trump made promises to roll back some of the Obama-era regulations enacted with the purpose of combating climate change. He has also expressed that efforts to curb fossil fuel industries hurt the Unites States' global competitiveness. He pledged to roll back regulations placed on the oil and gas industry by the EPA under the Obama administration in order to boost the productivity of both industries.

An executive order was issued by President Trump on January 24, 2017 that removed barriers from the Keystone XL and Dakota Access Pipelines, making it easier for the companies sponsoring them to continue with production. On March 29, 2017, President Trump signed an executive order aimed towards boosting the coal industry. The executive order rolls back on Obama-era climate regulations on the coal industry in order to grow the coal sector and create new American jobs. The White House has indicated that any climate change policies that they deem hinder the growth of American jobs will not be pursued. In addition, the executive order rolls back on six Obama-made orders aimed at reducing climate change and carbon dioxide emissions and calls for a review of the Clean Power Plan.

Load Forecast

A new 11-year econometric retail load forecast was developed for this IRP Progress Report's 2018-2028 planning period. These low, base and high forecasts are prior to planned conservation savings. Future cost-effective conservation is considered as a resource for integrated resource planning purposes, so it can be evaluated on the same basis as other resources.

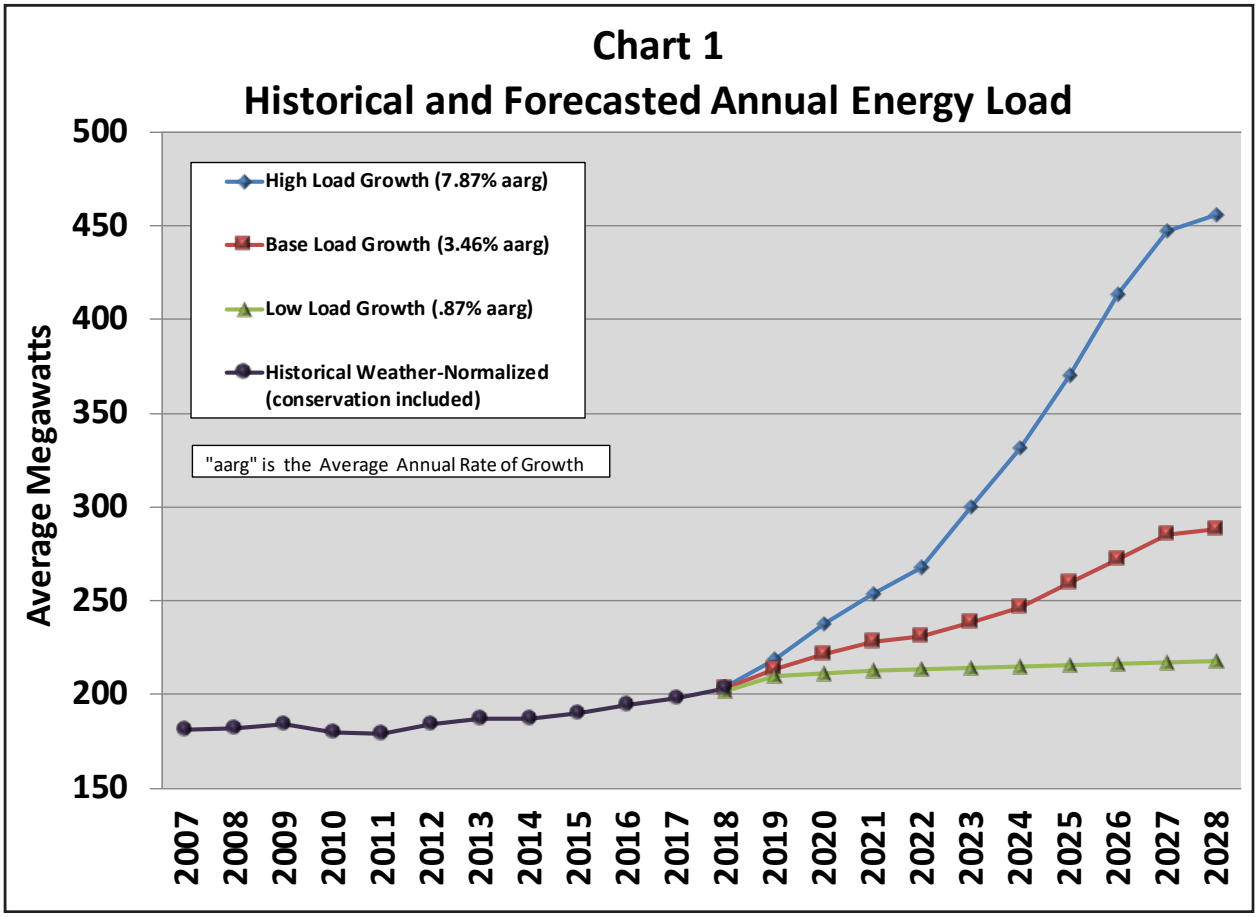
Demographic trends and economic conditions remain the primary drivers used to arrive at the forecasted retail electricity sales by sector. In addition, the resulting forecasts are an integration of economic evaluations and inputs from the District's own customer service planning areas.

Total annual projected megawatt-hours through the planning period were forecasted on an annual incremental or decremental basis by sector, including

system losses at 3.5%, using 2017 weather-normalized loads as the starting point. **The low, base and high average annual composite retail energy sales forecast growth rates, including system losses, otherwise known as the forecasted annual energy load growth rates, are .87%, 3.45% and 7.87%, respectively.** The low forecast has decreased from the 2016 IRP while the base and high forecasts have increased. The weather-normalized average annual rate of growth at the District (before the effects of cumulative conservation) was approximately 1.43% for the 10-year period from 2007-2017. The net of cumulative conservation growth percentage was approximately 0.90% for the same 10-year period. This historical net of cumulative conservation growth average has decreased slightly since 2016 (after restating 2014-2016 weather-normalized loads due to corrections in temperature data) because of continued stagnated load growth as well as continued increased conservation achievements that began in earnest in 2010. The three forecasts for 2018-2028 as well as the actual weather-normalized total District energy load for 2007-2017 are presented in Chart 1. The NWPCC's Seventh Power Plan region-wide forecast for 2015-2035 is between 0.5% and 1.0% per year. Like the District's forecasted annual energy load growth rates, these forecasts do not include any new conservation measures.

High-Density Load (HDL)

As previously reported in 2016, Chelan PUD, like other utilities in this region, has been facing evolving industry changes. In 2013, the District began receiving unprecedented numbers of requests for larger load placements known as cryptocurrency mining operations. The most common among the numerous cryptocurrencies is the Bitcoin which is a system or network that is decentralized. Every machine that mines Bitcoin by processing transactions in the network makes up a part of the network, the machines work together. This decentralization also supports continued operation of the Bitcoin world if some part of the network goes offline. A Bitcoin is a digital currency made up of long, unique strings of digital characters often referred to as the Block-chain. It's exchanged globally between those who collect it and those who accept it as payment. Bitcoins and the growing number of cryptocurrencies' mining processes utilize networked



computer processors that consume large amounts of energy per square foot, sometimes two to 10 times more than a traditional server farm. The heat dissipation from the mining "rigs" requires intensive air handling and cooling systems to regulate air temperatures. Overall, cryptocurrency mining investors have been drawn to North Central Washington primarily due to the mild climate as well as the low cost, reliable and abundant hydroelectric resources. Additionally, low rent costs and available space in vacant commercial buildings offer the miners a quick and easy setup at very low cost. Chelan PUD has witnessed new cryptocurrency mining entrepreneurs from Russia, Asia, Florida, California and many other states across the country. A trend in the mining industry is the "pod" which are prefabricated self-contained units that come equipped with racking systems, network connections and built in electrical service. These pods can be moved in and set up with little effort. A pod measuring 10 feet by 25 feet can use as much as 300 KW demand on a continuous 24 hour, 365 day basis. This relatively new and developing industry creates unique challenges for serving the load and ensuring reliable energy is available.

High Density Loads (HDL) are those loads with intense energy use — 250 kWh per square foot or more per year where the energy is used for server farms or similarly situated loads. The District instituted a moratorium on any new or expanding applications for HDLs effective July 2015 that extended until October 2016. That HDL moratorium affected the cryptocurrency mining and temporarily stabilized their growth as well as other similar server farm operations in the District's service territory. In January 2017, the moratorium was lifted and a new power rate for HDL loads up to five megawatts was implemented.

From October 2017 to January 2018, the District received another series of cryptocurrency applications and inquiries totaling approximately 220 MW as the price of Bitcoin soared. Responding to these applications was hampered by limitations in infrastructure to serve and the District's inability to collectively process the high volume of applications in the expected timeframe.

In March 2018, Chelan PUD, once again, implemented a moratorium on new HDL load applications. District board members unanimously imposed the moratorium after reviewing impacts on utility operations from existing loads and applications for cryptocurrency service. This pause is expected to allow lessons learned to be adopted for the existing, under five megawatt rates and policies as well as to develop new rates and policies for above five megawatt loads. Approved applications with fees and charges paid will go forward. At the time the moratorium was implemented, the District had 22 approved and active HDLs in Chelan County, totaling about nine aMW.

Impacts from cryptocurrency mining applications began hampering responses to the District's overall planned work and threatening Chelan County's electric grid capacity to meet planned growth. Public health and safety concerns due to rogue cryptocurrency operators also led to the cities of Chelan and Wenatchee to curb operations, especially in residential neighborhoods. District staff began finding rogue cryptocurrency operations requiring time and effort to investigate and respond. Many have been in homes without the infrastructure needed to serve heavy load, threatening the safety of neighbors and Chelan PUD workers.

With the moratorium in place, the District plans to: 1) review and update the existing Schedule 35 rate (under five megawatts) including considering adding transmission costs and continue to develop rates, fees and processes for service requests of five megawatts or more, 2) widely communicate the consequences of unauthorized operations including adding fees for investigation, monitoring and equipment damage, 3) keep working with city, county and state building code officials and 4) keep adding technology to meet the challenges of detecting and serving cryptocurrency loads.

Sector Energy Sales

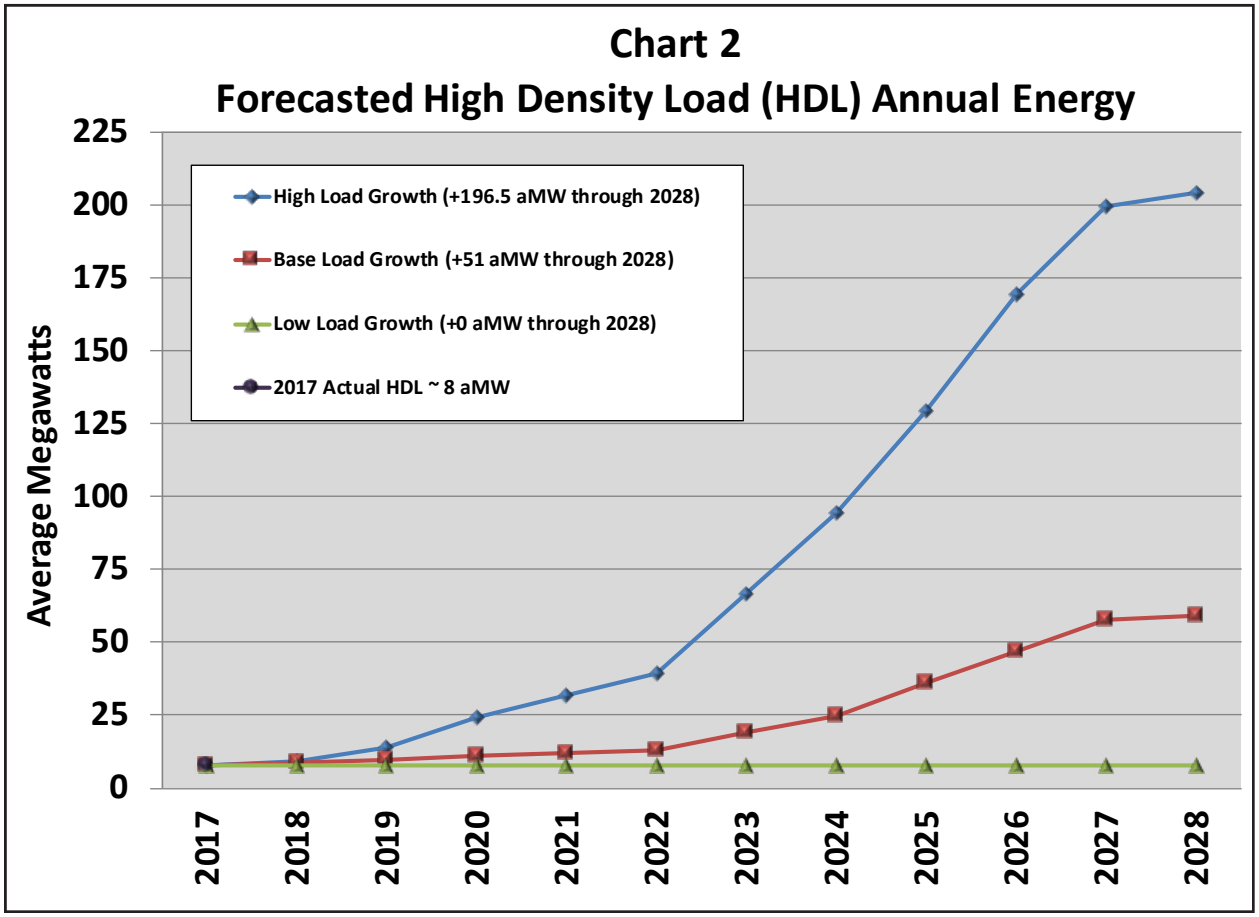
Demographic and economic data used for the load forecast was updated. The Washington State Office of Financial Management (OFM) released its latest Chelan County population projections in 2017. Growth rates over the planning period were adjusted some in the low and high cases to reflect District staff's judgement about the range of Chelan County potential population changes. The growth rates were applied to the OFM actual population estimate for Chelan County for 2017 to arrive at updated population estimates through the planning period. Actual Chelan County population data from the OFM (through 2017), along with actual per capita income data from the U.S. Bureau of Economic Analysis and actual sales revenue data from the Washington State Department of Revenue were used to update the various sector regression analyses.

Residential load was projected based upon population and per capita income. Both have shown to be statistically significant independent variables for residential load. The results were adjusted just slightly based upon known and expected changes coming to the sector. The three average annual growth rates for the residential sector are forecasted at 0.38%, 0.84% and 1.28%. They have decreased since 2016 due

somewhat to actual population growth not being as high as OFM forecasted and reduced population forecasts through the planning period. Additionally, the District continues to be on the lookout for changing end uses including changing federal standards (i.e. more efficient appliances, lighting, etc.) and slower growth in home electronics. It is expected that a significant amount of these changing end uses will continue to be ongoing and take place outside of the District's organized conservation programs.

For this load forecast, the commercial sales forecast is a function of population and sales revenues. Both have shown to be statistically significant independent variables for commercial load. The results were adjusted just slightly in the base case due to known and expected changes coming to the sector. The average annual growth rates for the commercial sector are forecasted at 0.68%, 1.39% and 2.87%. Since 2016, the projections have increased due to the addition of sales revenues as a predictive variable and some potential one-off larger load additions in the high case. As with residential load, the District still believes that ongoing efficiency improvements, particularly in commercial lighting, will lead to longer term decreases in per customer usage. Additionally, the commercial load forecasts take into consideration potential indoor growing operations. These loads have proven to be relatively small and are expected to remain so in the forecasts.

Industrial loads can be very large and can come and go very quickly depending upon the industry, the local economy and much broader regional, national and global economic conditions. Industrial loads have been historically quite stable with moderate, steady growth rates in Chelan County. Industrial sales were again manually estimated based upon ranges of use per customer amounts and ranges of customer counts with some known probable and other potential larger load additions. The average annual growth rates for the industrial sector are forecasted at 2.78%, 4.62% and 5.60%. These have all decreased since 2016, primarily due to projected HDL load having been taken out of industrial and classified as its own sector. Industrial sales are now estimated to increase slightly as a percentage of the District's total load through the planning period in the low and base forecasts, however,



in the high forecast, they are estimated to decrease as a percentage of the total load due to the large amount of HDL load forecasted in the high case.

As previously mentioned, the HDL load is being forecasted and reported as its own sector for the first time for IRP purposes. As indicated in the earlier cryptocurrency discussion, the future of HDL loads in Chelan County remains unknown to a great extent. The low, base and high cases were estimated taking into account existing approved applications, pending applications, the moratorium, infrastructure timing limitations and the potential time it may take to address all the issues at hand. The average annual growth rates for the HDL sector are forecasted at 0.00%, 20.03% and 34.41% for the planning period. Future policy and rate adjustments are expected to have material impacts on actual future HDL load as well as future forecasts. Chart 2 represents the low, base and high HDL forecasts for the 2018-2028 planning period.

The aggregate of "other" energy sales (street lights, interdepartmental use, frost protection and irrigation) growth projections still remains at 0% for all three load cases. This sector was again manually projected based on ranges of use per customer and ranges of customer counts after looking at the subcomponents of this sector.

The District has not studied the potential effects of distributed solar photovoltaic generation on retail load in its service area but believes it to be negligible during the current planning period.

As previously mentioned in the Demand Response section, In December 2015, Alcoa idled their Wenatchee Works plant. Alcoa's load is not forecasted nor considered for District IRP purposes as it is not considered to be Chelan PUD retail load.

Peak Load Forecast

The peak load forecast was also updated to ensure the District has enough resources to meet peak demand, or the maximum one hour average system peak load. The District's peak retail load occurs in the winter. The all-time high retail load peak occurred in January 2017. The peak of 491 MW was established when the temperature was approximately -0.7 degrees Fahrenheit. This occurred on a weekday (Thursday) morning when peak demands are usually higher given business and other commercial needs.

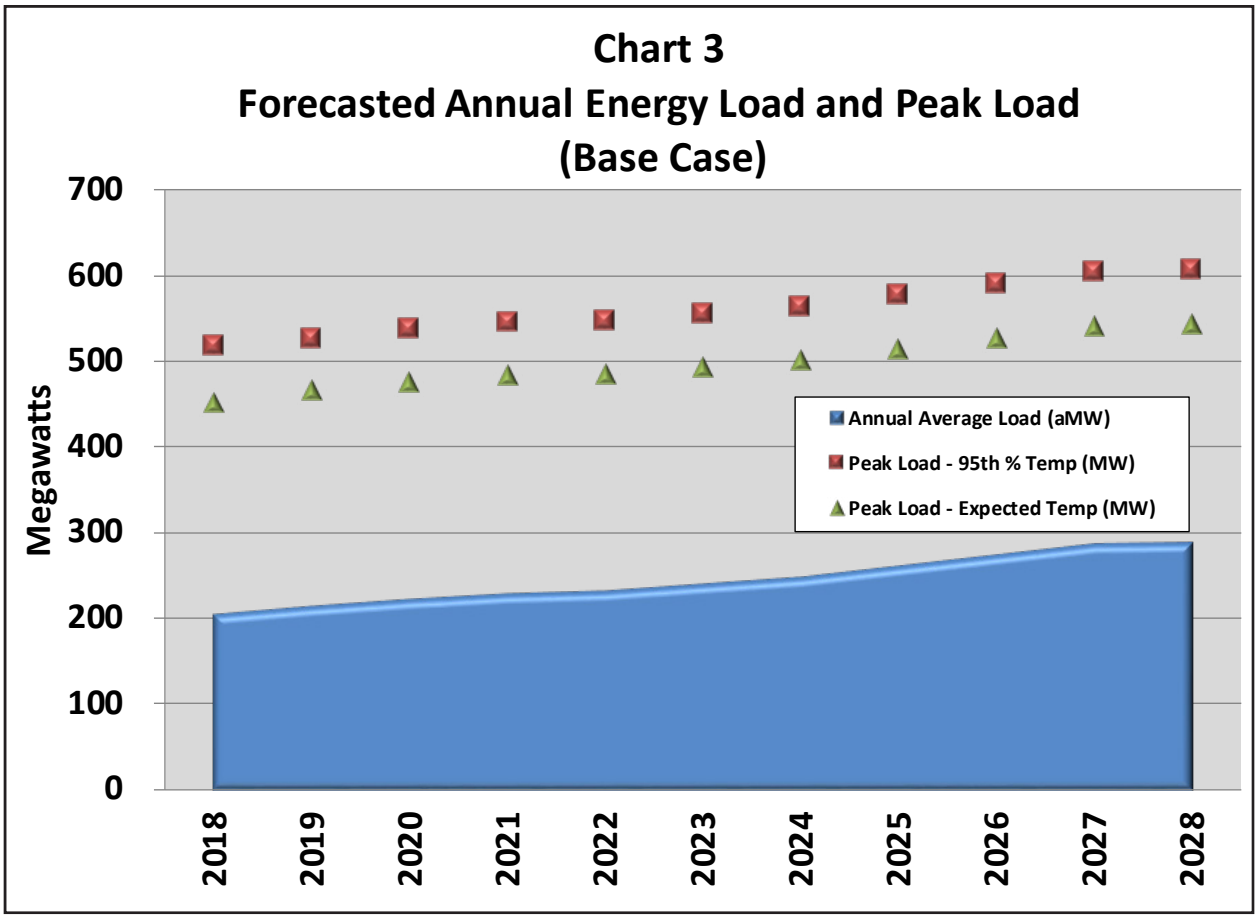
This District recently developed a new methodology for forecasting peak loads. The forecast is broken down by sector, and the expected load factor for each sector is applied to the annual energy forecast for that sector. The load factors are adjusted, as appropriate, to forecast the peak at varying temperatures. District staff believe the new methodology potentially provides more forecast accuracy, particularly if the total retail load shifts over time between the sectors as provided in the base and high energy forecasts. While industrial and HDL loads would add some peak demand, they are not expected to be commensurate with their total energy growth as most industrial and HDL, even more so, are not weather-sensitive. The new peak forecasts resulted in average annual peak load growth rates in winter of between .13% and 4.49% (net of conservation) for the three energy growth forecasts. The weather-normalized winter peak growth rate over the last 10 years was approximately .75% (net of conservation). Chart 3 illustrates both the base case annual energy load forecast with the base case peak load forecast at both an average, or expected, peak temperature and at a 95th percentile extreme peak temperature for 2018-2028.

Electric Vehicles (EVs)

The District began taking a close look at potential future EV retail load during its 2010 IRP Progress Report development. For these purposes, EVs include both plug-in hybrid electric vehicles and battery electric vehicles. Cumulatively, from 2010 through 2017, approximately 750,000 EVs were sold nationwide. As of July 2017, there were 24,624 EV light vehicles registered in the state of Washington, 105 of which are in Chelan County.

As reported by the Deloitte Center for Energy Solutions in 2017, research suggests that the convergence of a series of forces is transforming the way people and goods move. These include maturing powertrain technologies, innovations in lightweight materials, advances in connected vehicle technology, shifts in personal mobility preferences and the emergence of autonomous vehicles or those without a driver. With the predicted rise of EVs - increasingly affordable, road-trip-worthy and pleasing to consumers - EVs may provide new demand for electricity during the power industry's ongoing transformation. EVs and their onboard batteries can potentially help utilities with grid balancing, integrate new and variable distributed resources, improve operating efficiency and reduce costs for all customers in some areas of the country.

The District continues to use the Council's basic EV load forecasting methodology. Based on EV market share, or penetration rates, experienced in the District's service area and various recent national forecasts, the District increased market share for EVs in its overall low, base and high load forecasts through the 2018-2028 planning period from the 2016 IRP, however, they are still somewhat less than the Council's Seventh Power Plan. By the end of the planning period, the



rates vary from 8.5% to 24% in the three cases. This translates into approximately 1,800 to 5,500 EVs in Chelan County (after EV retirements). The three cases now result in forecasts of between .60 and 1.77 aMW by 2028.

Peak load estimates now range from 1.24 MW to 3.69 MW in 2028. Future assumptions about charging behavior have a substantial effect on the peak forecast. The District's peak forecast for EV load occurs in the evening after most cars are assumed to be plugged in at home at the end of the day. Although assumptions about where, how and when EV charging occurs can vary greatly, the District does not expect the peak to be in the morning when Chelan PUD experiences its highest peaks in the winter. For more detail regarding the Council's EV forecasting methodology and other assumptions used, see the Council's Seventh Power Plan.

The District will continue to monitor the development of the EV industry and its potential impact on future retail electric load in Chelan County.

Resources

Existing Portfolio

Chelan PUD's resource mix remains unchanged. The District owns and operates three hydroelectric projects, all located in Chelan County, and is a participant in the Nine Canyon Wind Project, located in Benton County, Washington. The three hydroelectric projects, Rocky Reach, Rock Island and Lake Chelan, together, have capacity to generate nearly 2,000 MW of power. The District continues to invest in modernization and relicensing at the projects to ensure reliable, locally-controlled operation of resources for future generations.

Long-term power sales contracts are currently in place with Douglas County PUD, Alcoa Power Generating Inc./Alcoa Inc. and Puget Sound Energy. District power contracts and the hedging strategy are more fully discussed in the Portfolio Analysis section.

Hydropower has many characteristics that make it highly desirable. It is free of the emissions associated with fossil fuel-fired generating resources. Operational flexibility allows hydropower to quickly follow load changes and provide reserves to the electric grid in a

timely manner, which contributes to overall system reliability. In addition, hydropower provides backup for intermittent resources such as wind. The District avoids transmission availability issues, in relation to serving retail load, by being able to use its own hydropower generation, which is located in Chelan County, near the District's retail load. The amount of hydropower the District is able to generate depends on water availability, which is variable and hinges on a number of factors, primarily snow pack in the mountains upstream of its hydroelectric facilities, precipitation in its watershed, the operations of upstream storage reservoirs, certain operating agreements and the operation of the downstream reservoir from Rock Island belonging to the Wanapum project.

As previously reported, in September 2013, three additional large generating units at Rocky Reach were taken out of service after discovering that the fourth large turbine, out of service since March 2013, had a deep crack in a stainless steel rod that delivers oil to a servo motor. The motor adjusts the angle of the turbine blades. The four units share the same design and were put into service between 1998 and 2002. After making interim repairs, including temporarily fixing the blade positions, all four units were back online in early 2014. Beginning in 2015, the units are being taken out of service one at a time (14 months each) to make more permanent repairs with the goal of having all four units with long-term repairs completed by late 2021. Additionally, due to stator winding failures observed on C11, C8 and C10 and a potential concern for C9, each generator stator is planned to be rewound during the same time the turbine is repaired. The remaining seven smaller units at Rocky Reach do not share the same design in regards to either of these issues and will continue to operate.

During the Rock Island B2 generator stator replacement work, fatigue cracks were observed on the blades of the turbine. From October 2015 through January 2016, District staff made repeated attempts to grind out the cracks and repair the resulting excavations with various welding procedures. After each repair procedure, inspections resulted in the observation of new fatigue cracks. Engineering analysis indicated the B2 turbine is experiencing a phenomenon known as corrosion fatigue. The turbines of B1, B3 and B4 are of similar design and vintage as B2. These three units were taken out of service and inspected to determine if similar cracking existed in their turbine runner blades. These turbines also had significant cracking due to corrosion fatigue. All four turbines will remain out of service until the District can install replacement turbine runners. The District completed the development of specifications for the procurement of turbine runners for B1 through B4 and awarded a construction contract in late 2016. In the best case scenario, the District estimates the first turbine to be on-site and ready for installation by October 2018. The first two turbines will be replaced nearly concurrently with each unit requiring approximately six months to complete. The last installation of the four turbines is expected to be complete in December 2019.

During periodic machine condition monitoring at Rock Island, plant staff observed deterioration of a critical clearance measurement in the generators of B6 and B7. This clearance, referred to as the "air gap" between the rotor and the stator of the generator, has deteriorated over time and is now below acceptable reliable operating limits. Data for B6 and B7 was evaluated and shows a deteriorating air gap clearance. To correct the deterioration of the air gap in B6 and B7, the District is proceeding with unit rehabilitations to install a new stator, replace rotor poles and rim and reshape and align the units to within industry standards for normal operation. B6 was returned to service in April 2018 after the unit rehabilitation was complete. The B7 rehabilitation was initiated in April 2018 and is scheduled to return to service in July 2019.

Rock Island units B5 through B10 are under contract to modernize the turbines, the generators and the control systems. B9 and B10 have already been completed. In June 2017, unit B9 tripped offline due to a turbine blade/wicket gate position deviation from normal. On inspection of the unit, one of the oil pipes inside the turbine/generator shaft failed under strain and twisted into two parts. The design for the turbine oil piping for B5, B6, B7, B8 and B10 is the same as for B9. The modernization contractor was notified and signed a field work order to conduct a root cause analysis of the B9 pipe failure and prove corrective maintenance as required to return the unit to service. B9 is currently expected to return to service in June 2018. Should the root cause identify a problem that also applies to B6 and B10, those units will be scheduled for pre-emptive repairs. If needed, corrective actions for B5, B7 and B8 will occur during the currently scheduled modernization outages.

The risk management plans Chelan PUD has in place are working very effectively. The long-term wholesale sales contracts and hedging program (discussed in the Portfolio Analysis section), insurance program and strong financial policies continue to reduce the impact to the District from the lost generation revenue, repair costs and associated risk mitigation efforts for the aforementioned operational challenges.

Columbia River Treaty

The 1964 Columbia River Treaty (Treaty) between Canada and the U.S. was based on the development and operation of dams in the upper Columbia River basin for power and flood control benefits in both countries. The Treaty provides for the sharing with Canada of one-half of the downstream U.S. power and flood benefits and allows the operation of Treaty storage for other benefits. The Treaty has no expiration date, but operational elements of a basic feature of the Treaty, flood control, expire in 2024. Either party must provide 10 years notice for Treaty termination, so 2014 was a pivotal decision year.

In 2013, the Northwest and a variety of stakeholders endorsed the U.S. Army Corps of Engineers and the BPA's (collectively the U.S. Entity) final recommendation on the Treaty. The recommendation noted that "the region's goal is for the U.S. and Canada to develop a modernized framework for the Treaty that ensures a more resilient and healthy ecosystem-based function throughout the Columbia River basin while maintaining an acceptable level of flood risk and assuring reliable and economic hydropower benefits." A consortium of U.S. utilities has laid down negotiation markers that call for notification of termination if its principles are not met. A primary U.S. concern is the Canadian Entitlement, half of the originally calculated increase in U.S. downstream power benefits that is delivered to Canada. The utilities argue that the payment should be adjusted for diminished downstream benefits and the expense of subsequent U.S. environmental legislation imposed on the hydro system.

In March 2014, British Columbia, on behalf of Canada, released a 14-point position for updating the Treaty. Their principles include that the Treaty should primarily maximize benefits to both countries, the Canadian Entitlement currently does not account for all U.S. benefits or impacts to B.C., post-2024 flood control should include effective use of U.S. reservoirs and a coordinated flood risk management approach, ecosystems are an important consideration and adaption to climate change should be incorporated.

The process is a federal, interagency review under the general direction of the National Security Council on behalf of the President. The Department of State has been designated as the agency to coordinate and oversee this process on behalf of the National Security Council. The U.S. Entity is committed to supporting this effort. On December 7, 2017, the Department of State announced its intention to enter Treaty talks with Canada in 2018.

Climate Impacts to Loads and Resources

As reported in the 2016 IRP, Chelan PUD is following regional efforts to assess the future impacts of climate change on the power industry, including changes to hydroelectric generation and electricity demand. The prediction for the Northwest is for less snow and more rain during winter months, resulting in a smaller spring snowpack and lower summer flows. Winter electricity demands would decrease with warmer temperatures, easing generating requirements. In the summer, demands driven by air conditioning and irrigation loads would rise.

There are at least 20 different global circulation models (GCM) that project future changes in temperature and precipitation. Every one of these models, to varying degrees, forecasts a warming trend for the Earth. Each uses modern mathematical techniques to simulate changes in temperature as a function of atmospheric and other conditions. Like all fields of scientific study, however, there are uncertainties associated with assessing the question of global warming. A computer model is only as good as its input assumptions. The effects of weather (in particular precipitation) and ocean conditions are still not well known and are often inadequately represented in climate models although both play a major role in determining future climate.

Results from the most relevant GCMs have been downscaled for the Northwest. The River Management Joint Operating Committee (RMJOC) (BPA, the Corps of Engineers and the Bureau of Reclamation) leads this process. Most recently, in 2017, contracted researchers in the University of Washington Hydro/Computational Hydrology research group (UW), in conjunction with the Oregon Climate Change Research Institute at Oregon State University, completed a new study known as the Columbia River Climate Change study (CRCC). They have a web-based database that includes temperature, precipitation, snowpack and streamflow forecast projections for the entire Columbia River system.

In the Seventh Power Plan, Council analysis shows that after applying the climate-induced shift in river flows and load, the likelihood of a shortfall in 2035 grows to 15%, which is far above the Council's adequacy standard of 5%. In this case, additional resources would have to be acquired to maintain adequacy.

Other potential climate change impacts include increased flooding concerns in fall and winter, reduced salmon migration survival due to lower summer river flows combined with higher water temperatures and increased summer electricity prices.

The District is focusing on the following areas:

Columbia River mainstem modeling — power generation impacts, aquatic resources impacts and water quality impacts

1. Lake Chelan Basin modeling — power generation impacts and water quality impacts
2. Wenatchee and Methow rivers modeling — Habitat Conservation Plan (HCP) hatchery program impacts
3. Distribution system load forecasting

Chelan PUD reviewed the effects on Rocky Reach generation under various climate change scenarios using RMJOC-I regulated hydro data. As anticipated, the result was more generation during winter and spring months (December through June) and less generation during summer months (July through September) with little change during October and November with changes becoming larger over time. The "2020s" (a 30-year period spanning 2010 to 2039) and the "2040s" (a 30-year period spanning 2030 to 2059) were studied. The District is currently waiting for RMJOC-II data to be run through a hydro regulation model to produce regulated streamflows, so the effect on Rocky Reach generation can be studied with newer data. This data is expected in late 2018.

Data is now available to model future climate change scenarios on Lake Chelan operations and reservoir management. In 2018, the District plans to work with the UW to determine which data sets to use and complete its own modeling. Chelan PUD will then determine usefulness of the data and if it can be used to help with future planning.

UW researchers have provided data sets (1980-2010), enabling District staff to perform basic calculations to predict changes to monthly District peak loads (based on 2007-2016 average peak loads and 1980-2010 average temperatures at Saddlerock substation). The current data shows increasing average temperatures for every month, increasing over time and does not account for load growth. The results were as expected; reduced winter demands and increased summer demands. The District will work to determine its usefulness and how it can be used to help with planning.

Chelan PUD will remain attentive to regional work on this issue as science and experience help shed light on the best methods for predicting load changes and water and snowpack inventories and reshaping flood curves.

Integrating Renewable Resources and Overgeneration Events

In 2013, by legislative action, a new requirement was added to Washington State IRPs: an assessment of methods, technologies or facilities for integrating renewable resources and addressing overgeneration events, if applicable to the utility's resource portfolio. It must also include a description of how overgeneration events are mitigated at the lowest reasonable cost and risk to the utility and its ratepayers. An overgeneration event is defined as an event within an operating period of a balancing authority (BA) when the electricity supply, including generation from intermittent renewable resources, exceeds the demand for electricity for that utility's energy delivery obligations and when there is a negatively priced regional market.

Negatively priced regional market occurs, at times, when hydro and wind, which are very low variable cost resources (i.e., free fuel), are forced to the margin during periods of low load and high hydro and/or wind and solar production. This results in very low or negative spot market prices. Negative spot market prices mean that a utility or other market participant has to pay another entity to take unwanted power (i.e., power for which no load exists). The negative pricing occurs for two primary reasons. Sometimes hydro generators and other generators are must-run due to operational constraints, thus adding additional energy to an over-supplied market. Additionally, many wind generators receive federal incentive credits and/or payments based upon their wind production. They can also sell the RECs from this generation. The value of these items combined can be in excess of $20/MWh. These generators can afford to withstand some degree of negative pricing and still make a profit due to these other payments. The federal Production Tax Credit (PTC) for certain wind producers and other renewable energy technologies was again extended at the end of 2015. The PTC provides a 2.3-cent per kilowatt-hour (kWh) incentive. The incentive remained at its previous level through 2016 and started phasing down at 80% of its present value in 2017, 60% in 2018 and 40% in 2019. Projects qualify as long as they start construction before the end of this period. The legislation also included an extension of the solar investment tax credit (ITC), which is also subject to a phase out. Solar projects that are under construction by December 2019 fully qualify for the 30% ITC. The credit falls to 26% for projects starting construction in 2020 and 22% for projects staring construction in 2021. New tax legislation signed into law by President Trump in December 2017, known as the Tax Cuts & Jobs Act, maintained the PTC and ITC for wind and solar, phasing them out according to the timeline agreed to by Congress in 2015.

Chelan PUD's share of Nine Canyon wind is a relatively small portion of its overall resource portfolio

(less than 1%). In most cases, the District is able to integrate this wind operationally without issue due to its hydro resource reserves. The District may have to sell at negative prices when it has already reduced its hydro generation as much as possible under certain operating circumstances.

Oversupply in the region continues to have a financial impact to utilities. In spite of the Northwest seeing a rapid end to the wind fleet buildout as many financial incentives are ending, regional policies, California markets and solar energy continue to create oversupply conditions throughout the Western Interconnect.

For comparison, the spring runoff period (April-July) of 2016 had two day-ahead days with negative local prices and 2017 had 35 days. In the hourly balancing or real-time market, 2016 had 23 hours with negative local prices and 2017 had 368 hours. Snowpack and timing of spring runoff can impact the number of days and hours with oversupply and negative prices.

As wind's intermittent nature can push a region into oversupply, behind-the-meter or unmetered solar (residential) and metered (utility-sized) solar continue to increase due to an exponential drop in solar panel cost and similar growth in solar panel output. Full solar output can just as easily push a region into oversupply as wind alone once did.

In the Northwest, the BPA has developed new business practices that push the burden of oversupply back to the market and away from themselves. These new practices include not selling at negative prices until spilled water reaches dissolved gas limits, holding renewable generators to a fixed schedule, not accepting unplanned surplus and canceling transmission loss returns. The cancelling of transmission loss returns can add hundreds of megawatts to an already oversupplied period and drive prices even more negative.

The recent extension of California's Energy Imbalance Market (EIM) into the Northwest and Canada allows California to extend the boundary to sell their renewables when wind and solar push California into oversupply, thus potentially pushing prices lower in the region when the District has power to sell. Conversely, when solar production drops off for the day, California can meet peak loads by accessing Northwest generation thus increasing local competition for power and therefore, increasing power prices when the District is also in the market to buy power for load.

Energy Imbalance Market

An EIM is a balancing energy market that optimizes generator dispatch within and between participating Balancing Authority Areas (BAAs) every 15 and five minutes. The EIM does not replace the day ahead or hour ahead markets and scheduling procedures that exist in the Western Interconnection today. By allowing BAs to pool load and generation resources, the EIM has the potential to lower total flexibility reserve requirements and minimizes curtailment of intermittent or variable energy resources for the region as a whole. An EIM dispatches generators in a way that attempts to minimize the total cost to serve load (and exports) while honoring all system constraints.

In the fall of 2014, PacifiCorp joined the California Independent System Operator (CAISO) in its EIM. Since then, a number of entities have followed suit by either joining or announcing their intention of joining the western EIM.

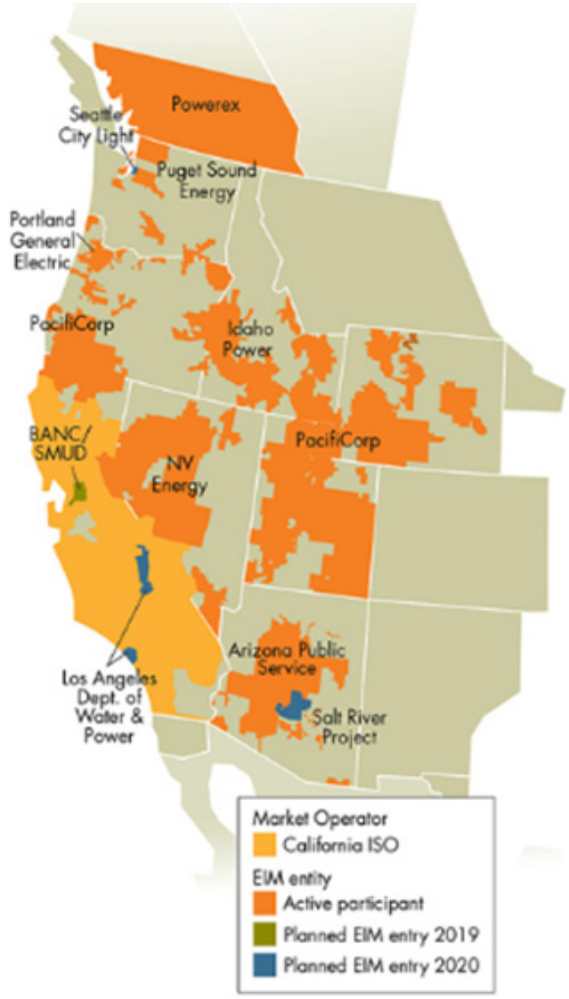
Active

- Idaho Power Company — entered 2018
- Powerex — entered 2018
- Portland General Electric — entered 2017
- Puget Sound Energy — entered 2016
- Arizona Public Service — entered 2016
- NV Energy — entered 2015
- PacifiCorp — entered 2014
- CAISO — entered 2014

Pending

- Balancing Authority of Northern California/ Sacramento Municipal Utility District — entry 2019
- Los Angeles Department of Power & Water — entry 2020
- Salt River Project — entry 2020
- Seattle City Light — entry 2020
- In addition to the Western EIM expansion, the Southwest Power Pool and Peak/PJM are proposing organized market constructs in the West. Also, the Western EIM is proposing to expand the EIM from a within hour market to a day ahead market. Entities in the region moving towards organized markets and the expansion of these markets are a key development in the industry. The District is actively following the transition towards more organized markets and will continue to assess the impact to the region and the District.

Figure 1 — Energy Imbalance Market Footprint (https://www.westerneim.com/Pages/About/default.aspx)



Renewables

The District began complying with Washington State RPS renewable requirements when it became mandatory in 2012. The renewable energy section of the initiative requires utilities to serve percentages of retail load, which increase over time, with eligible renewable energy, RECS or a combination of both. Most hydropower is not an eligible renewable resource under the Washington RPS statute, though certain efficiency gains resulting in incremental hydropower are eligible.

Chelan PUD's existing mix of generating resources complies with the renewable requirement of the RPS throughout the planning period. The District plans on meets its renewable requirements with incremental hydropower. Incremental hydropower is derived from efficiency gains at the District's existing hydropower projects resulting from equipment and operational upgrades, or increased power generation with the same amount of water. The District has made significant investments in equipment upgrades such as generator and turbine rehabilitations, new transformers and trash rack installations. In addition, the District has installed systems designed to optimize generation which have resulted in operational efficiency gains. Only those equipment and operational improvements placed in-service after March 31, 1999 qualify under Washington State RPS rules. The District uses a Hydro Optimization Model to calculate its qualified incremental hydropower under average water conditions.

Based upon the current base load forecast, net of accumulated forecasted conservation, the amount of renewable resources required will be approximately 18-19 aMW in 2018-2019 and approximately 32-41 aMW in 2020-2028. Chart 4 shows the potential target requirements based on the District's three load forecasts.

The District continues to evaluate options to meet its renewable compliance requirements. For the purpose of evaluating the financial impact of the RPS, the District analyzes the cost of renewables as compared to its existing hydro resources.

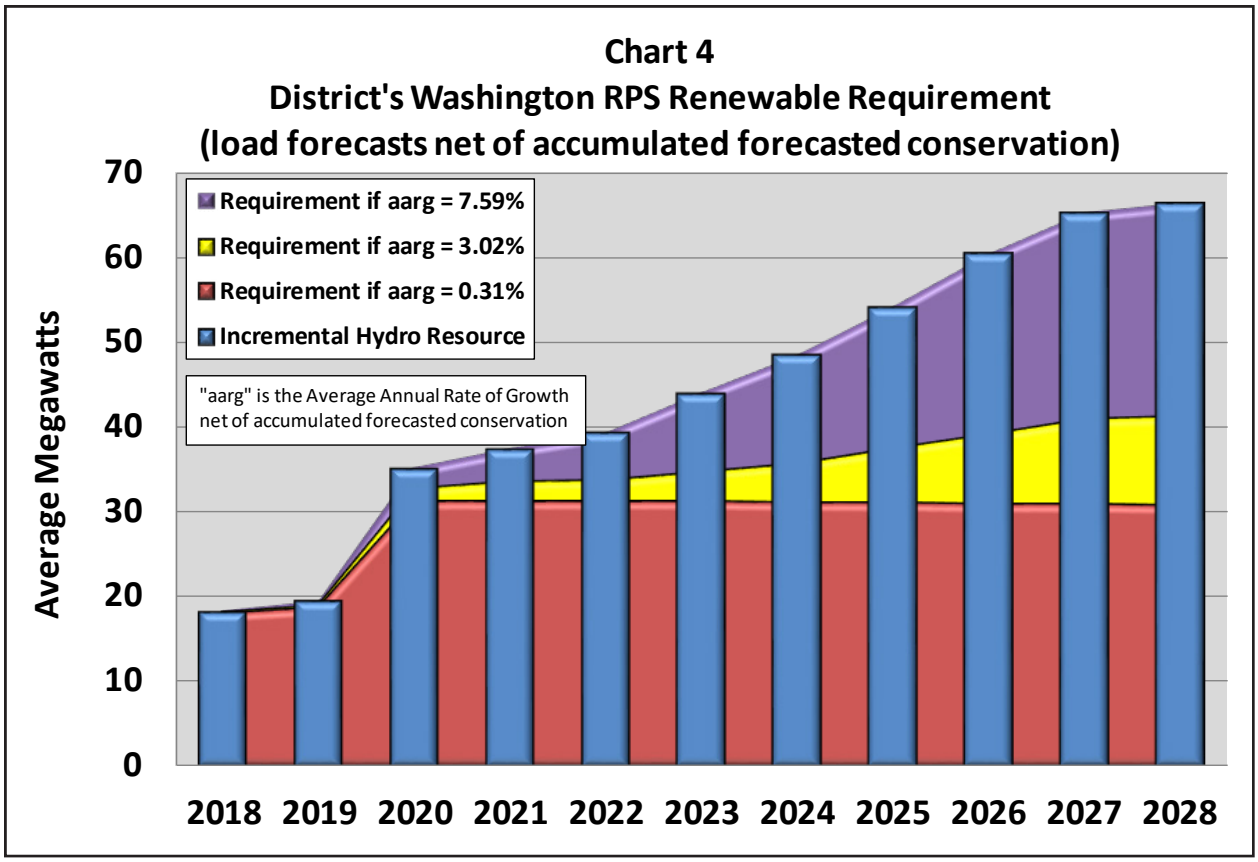
Because Chelan PUD is long resources relative to its retail load, the District's existing hydro resources are considered its "substitute resource" as defined by the WAC rules that pertain to the RPS.

In 2012, an advisory opinion process for eligible renewable resources was authorized to provide additional clarity and certainty. Since 2012, the District has utilized this process to confirm incremental hydropower from both Rocky Reach and Rock Island as qualified under the Washington State RPS and registered the incremental hydro in Western Renewable Energy Generation Information System (WREGIS).

The western renewable markets continue to evolve as compliance rules change and higher renewable targets become a reality for utilities. Chelan PUD is monitoring these renewable compliance markets and evaluating the potential impacts. The District continues to look for opportunities in both the voluntary and compliance renewable markets.

Conservation

Since 2010, Washington's RPS has required that "each qualifying utility pursue all available conservation that is cost-effective, reliable and feasible." The RPS defines conservation as any reduction in electric power consumption resulting from an increase in the efficiency of energy use, production or distribution.



Each utility shall establish a biennial acquisition target for cost-effective conservation that is no lower than the utility's pro rata share for the two-year period of the cost-effective conservation potential for the subsequent 10 years. Every succeeding two years, utilities must review and update their 10-year assessment. In December 2017, Chelan PUD submitted its most recent update. In May 2018, the District submitted its fourth bi-annual conservation report to Commerce. The report documented the District's progress in 2016 and 2017 toward meeting the targets that were established in 2015 to comply with the RPS.

Even year reports are audited for RPS compliance by the Washington State Auditor. The District's June 2016 report was audited and met the requirements of the RPS.

There are two primary components of the RPS as it relates to conservation:

1. Documenting the development of conservation targets (i.e., setting the targets) and
2. Documenting the savings (i.e., demonstrating how the targets are being met).

To set its 10-year plan and two-year conservation target for the 2018-19 biennium, in 2017 the District used a utility-specific analysis, also known as a conservation potential assessment (CPA). This CPA, which was conducted by Applied Energy Group (AEG) established the conservation targets that are used in this 2018 IRP Progress Report. The CPA used data specific to Chelan County on demographics and building construction to more accurately estimate local conservation potential. The CPA was developed in a manner consistent with the Council's methodology. The resulting conservation supply curves are used in the analysis of this IRP Progress Report.

Conservation Potential Results

The District has pursued conservation and energy efficiency resources since the early 1980s. Historically, the utility offered several programs for both residential and non-residential applications. Industrial projects have dominated past conservation savings, but since 2014, there has been an increased emphasis on residential and commercial projects.

During the two-year period from 2016 through 2017, preliminary results show that the District saved 4.12 aMWs. Of that total, the breakout was as follows: industrial 1.09 aMW, residential .067 aMW, District's

share of the Northwest Energy Efficiency Alliance (NEEA) 0.60 aMW, commercial 1.86 aMW and no savings from agricultural.

The 2017 CPA provides estimates of energy and peak demand savings by sector for the period 2018-2037. The methodology complies with RCW 19.285.040 and WAC 194-37-070 section 6 parts (a)(i) through (xv) and is consistent with the methodology used by the Council in developing the Sixth and Seventh Power Plans.

The primary baseline changes in the 2017 CPA included the following:

Lower avoided costs — the current market price forecast used for the avoided cost is much lower than the previous assessment.

- Code changes — significant impacts of recent code changes that have taken effect result in lower remaining potential (e.g., new lighting standards).
- Accounting for past achievements including:
  - Internal programs, especially in the industrial sector
  - NEEA programs
- Revised/updated measure data from the Regional Technical Forum (RTF) is included.
- Updated customer characteristics data using:
  - Updated 2016 commercial sales/ consumption data and actual commercial building audit information

Table 1 shows the high-level results of this CPA. The economically achievable potential by sector in two, five, 10 and 20-year increments is included. The 10-year potential is approximately 11.73 aMW. The total 20-year energy efficiency potential is approximately 20.94 aMW.

Table 1
2017 Conservation Potential Assessment
Cost-Effective & Achievable Savings
aMW

Sector	2 Year	5 Year	10 Year	20 Year
Residential	0.76	1.58	3.44	6.90
Commercial	0.86	2.08	4.68	9.32
Industrial	0.47	1.18	1.89	2.15
Street Lights	0.21	0.26	0.26	0.26
Distribution	0.03	0.21	1.10	1.91
Agriculture	0.08	0.22	0.36	0.40
TOTAL	**2.41**	**5.53**	**11.73**	**20.94**

Chart 5 illustrates the 10-year conservation potential and two-year target on an annual basis. This CPA shows potential starting at just over 1.1 aMW in 2018, ramping up and down annually through 2028.

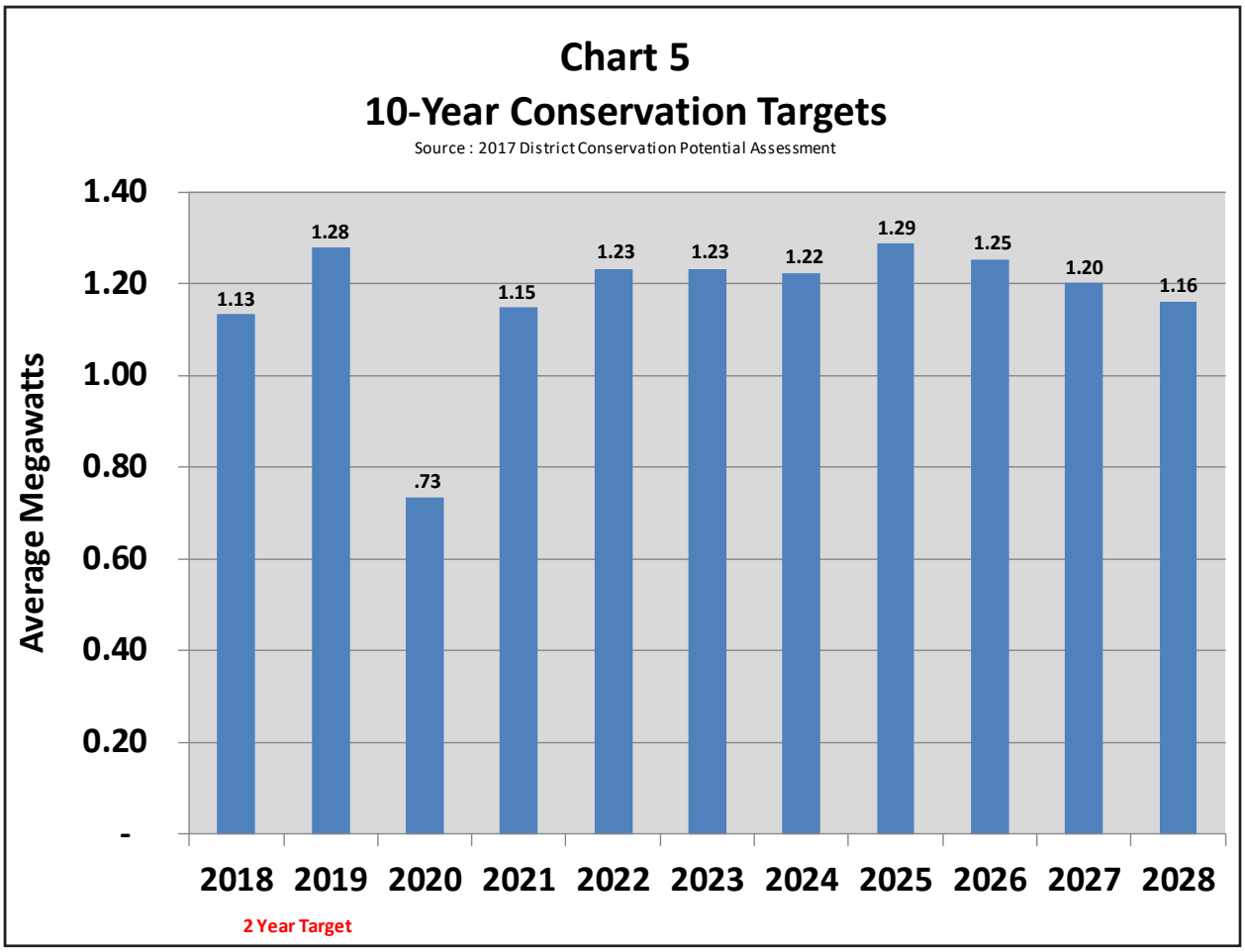
Embedded in these potential estimates are savings from regional market transformation efforts, as well as new codes and standards. Regional market transformation is achieved through the NEEA. As a member, the District applies a pro-rata share of regional NEEA saving projections toward meeting biennial targets. NEEA defines market transformation as "the strategic process of intervening in a market to create lasting change in market behavior by removing identified barriers or exploiting opportunities to accelerate the adoption of all cost-effective energy efficiency as a matter of standard practice."

Residential

During the 2018-2027 period, envelope improvements make up 36% of the projected energy savings in the residential sector. Consumer electronics and appliances are expected to make up almost 1%. Lighting is expected to make up 26%, and 24% is expected to come from hot water energy savings, which is primarily from low flow showerheads. HVAC improvement savings are projected at 13% of total savings. The two-year pro-rata share of the 2027 potential is 0.76 aMW and the 10-year potential is 3.44 aMW.

Commercial

During 2016 and 2017, the District conducted detailed energy conservation potential assessments at approximately 1200 businesses in Chelan County. This provided a much more accurate estimate of the energy savings potential that exists in the commercial sector in Chelan County.



Lighting measures are projected to comprise approximately 56% of the commercial savings for the 2018-2027 period. A significant portion of this will be the conversion of existing light sources to light-emitting diode (LED) technologies. HVAC upgrades and controls are expected to provide about 19% of the savings. Because of a drop in projected wholesale prices, building insulation and windows improvements were not found to be cost-effective and consequently did not show any savings in the CPA. Refrigeration savings at fruit warehouses represented 9% of the savings potential. The remaining 16% was comprised of a variety of many small individual items such as electronics, commercial kitchen upgrades and commercial water heaters. The two-year pro-rata share of the 2027 potential is 0.86 aMW and the 10-year potential is 4.68 aMW.

Street Lighting

During 2016, the District also conducted a detailed inventory and study of all publicly-owned street and area lights to determine the cost-effectiveness of replacing the existing lights with LED technology. The two-year pro-rata share of the 2027 potential is 0.021 aMW, and the 10-year share is .26 aMW. AEG developed a custom ramp rate, applied as a retrofit, which reflects the District's street lighting upgrade plan. In this plan, 60% of potential will be realized in 2018 and 20% in 2019. The remaining 20% was distributed between years 2020 and 2037 using the shape of a fast ramp rate.

Industrial

AEG assigned the medium growth rate to industrial potential to reflect ramp rates for controlled atmosphere and refrigeration measures. Potential in the industrial sector is 0.47 aMW for the first two years, eventually reaching a total of 1.89 aMW after 10 years.

Agriculture

AEG assigned a medium growth rate to irrigation potential provided by Chelan PUD to reflect the steady retrofit of existing irrigation motor controls. The two-year pro-rata share of the 2027 potential is 0.08 aMW and the 10-year potential is .36 aMW.

Distribution Efficiency Improvements (DEI)

Distribution efficiency measures improve the efficiency of utility distribution systems by operating in the lower end of the acceptable voltage range (120-114 volts), feeder and phase load balancing and volt-ampere reactive (VAR) improvements. The two-year distribution savings is calculated to be 0.04 aMW, and the 10-year potential was calculated to be 1.10 aMW. Distribution system conservation potential is estimated using the Council's methodology which estimates savings as a fraction of end-system sales (total utility system load less line losses).

Cost

Energy saved in homes and businesses reduces the need to purchase power on the wholesale market or can be sold into the wholesale electric market when the District is already surplus to its own local retail load. Both cases, in turn, help keep local electric rates low.

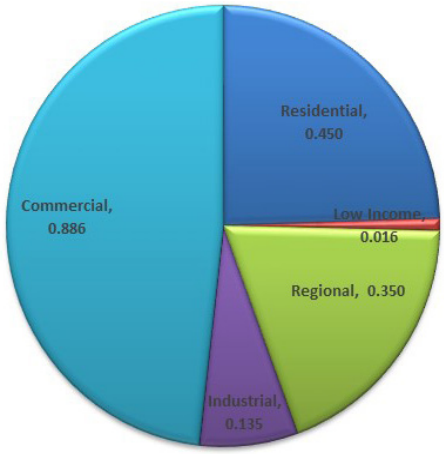
The District has budgeted $4.22 million in non-labor expenditures to acquire cost-effective conservation during 2018. Of the $4.22 million budgeted, the District initially expects to acquire at least 1.84 aMW in 2018 at a cost of approximately $3.77 million dollars. The 2017 CPA identified a total of 2.41 aMW of cost-effective and achievable conservation for 2018 and 2019 combined.

As mentioned previously, AEG utilized the utility-specific methodology as allowed by the RPS when completing the CPA. Chelan PUD utilized a forward market projection of wholesale market power prices as its avoided cost for the evaluation of the cost-effectiveness of potential conservation measures. The levelized costs for all conservation measures that resulted from the 2017 CPA were $18.73/MWh over the 2018-2027 period and $27.13/MWh over the 2018-2037 period (2016 real dollars).

Current Demand-Side Offerings

The goal of Chelan PUD conservation programs is to offer diversified, cost-effective measures that maximize the value to District ratepayers while striving to meet the RPS conservation targets. The District offers a variety of conservation programs to its customers. These programs include several rebates for residential customers, commercial funding assistance and industrial projects. Recent programs offered by the District are detailed below. The 2018 expected energy savings are represented in Figure 2.

Figure 2 — 2018 Budgeted Conservation Programs (Estimated Annual Energy Savings, aMW)



Insulation Rebates

For residential customers, the District pays 50 cents per square foot for added insulation. Requirements to qualify include:

Existing attic insulation must be R19 or less. Customers must add insulation to achieve R38 or greater.

- For walls, there can be no existing insulation. Added wall insulation must achieve R11 or greater.
- For floors, there can be no existing insulation. Added floor insulation must achieve R19 or greater.

Exterior Entry Doors, Window and Glass Door Rebates

Incentives are available to residential customers who replace older inefficient windows, and glass and substandard exterior entry doors.

This rebate offers customers:

- $4 per square foot on qualifying double pane glass doors and windows. To qualify, new windows must have a U-factor of 0.30 or lower. Qualifying glass doors must have a U-factor of 0.35 or lower.
- The rebate for upgrading single-pane windows is $6 per square foot.
- $40 rebate per door for replacement of substandard entry doors with new Energy Star® rated insulated doors.

Multi-Family Window and Glass Door Rebates

- Incentives are available to residential multi-family apartment owners who replace older inefficient windows and glass doors. This

rebate offers owners $4 per square foot on qualifying glass doors and windows. To qualify, new windows must have a U-factor of 0.30 or lower. Qualifying glass doors must have a U-factor of 0.35 or lower.

Low-income weatherization

The District provides funds to the Chelan-Douglas Community Action Council (CDCAC) for low-income home weatherization. The District has partnered with the CDCAC to weatherize income-eligible electrically heated residences. Income eligibility is based on 200% of federal poverty guidelines. Chelan PUD offers an annual grant of $90,000, which is matched by the Washington State Energy Matchmaker program administered by the state Department of Commerce. CDCAC crews complete the weatherization measures which are inspected by the Department of Commerce and the District. In addition to the weatherization funding, CDCAC may install Ductless Heat Pumps in selected dwellings.

Super-Efficient Heat Pumps and Heat Pump Water Heaters

Air Source Heat Pumps

The District offers a rebate to customers installing or upgrading to a super-efficient heat pump. In order to qualify, the customer must install a 9 heating season performance factor (HSPF) or greater and a 14 seasonal energy efficiency ratio (SEER) or greater heat pump. The install must be done by a performance tested comfort system (PTCS) qualified contractor and must be commissioned to PTCS standards. If the customer is replacing an electric furnace, the rebate is $1,400. If the customer is updating a heat pump, installing a heat pump above code for new construction or installing a heat pump with natural gas backup, the customer qualifies for a $500 rebate.

Ductless Heat Pump

Customers who are displacing zonal electric, radiant or electric furnaces with a qualified ductless heat pump system in Chelan County qualify for a $1000 rebate. Customers must get pre-approved for the application and must use an authorized contractor (through the NW Ductless Heat Pump Project) for the installation.

Heat Pump Water Heaters

New and single family existing home customers in Chelan County are eligible for a heat pump water heater rebate. These products are given qualifications through the Northern Climate Heat Pump Water Heater Specifications. The District offers a $300 rebate for a Tier 1 50-75 gallon model and a $500 rebate for a Tier 2 or Tier 3 or greater model in any size.

Retail buy-down of LED specialty bulbs, light fixtures and water efficient showerheads

The District buys down a portion of the cost of certain energy-efficient specialty lamps, hard-wired fixtures and showerheads sold in local retail stores. The District pays an incentive at the wholesale level and retailers agree to pass the savings on to customers in Chelan PUD's service area. This program is operated regionally by a third-party vendor.

Residential Single Family New Construction

In 2018, the District plans to begin offering a whole house new construction rebate for customers who want to build above code. The details still need to be completed, but this is part of the 2018 plan.

Residential Audits

Over the next three years, the District intends to offer a Residential Audit program. The plan is to get better data to feed into future conservation potential assessments. The District has been using regional data, but local data will allow us to understand the area's residential building stock assessment in greater detail. The goal is to begin offering audits by the end of 2018.

Public Street and Area Lighting Conversion to LED Study

In 2018, the District is planning to replace approximately 3,800 public and District-owned street lights in Chelan County with LED technology.

Commercial Building Audits

During 2016, the District conducted energy efficiency evaluations at over 1000 commercial businesses to determine the actual amount of cost-effective conservation potential that exists within each of the major business sectors. The information was used to establish future commercial incentive programs and a more accurate assessment of the actual conservation potential that exists within the county.

Resource$mart and Light$mart

Resource$mart is the District's program for helping commercial and industrial customers install energy efficiency equipment and lighting in their facilities by paying a portion of the up-front costs. The District can pay up to 75% of each energy efficient project. Measures include lighting projects, fast-acting doors on large refrigerated spaces, energy efficient fruit warehouse controlled atmosphere equipment, improved heating and cooling equipment and commercial or industrial tune-ups.

Local Government Initiative

Under this program, local government officials are encouraged to participate in a Chelan PUD initiative to improve the energy efficiency of public buildings. To assist local governments improve the energy efficiency of their facilities and equipment, the District provides financial incentives that can cover up to 100% of the local government's cost of implementing the energy efficiency measures. The maximum amount of the incentives is capped at the net present value of the energy savings over the projected life of the projects.

Next Steps

In March 2014, a legislative change was made to the RPS. Engrossed Substitute House Bill 1643 allows utilities to bank conservation in excess of a biennial target and use it to meet up to 20% of each of the next two targets. Chelan PUD expects to significantly exceed the 2018-2019 conservation target that was established in 2017. This legislation gives the District additional flexibility in future energy efficiency planning.

Portfolio Analysis

Chelan PUD is still long in terms of its resource position. The District is expected to be able to serve its retail load throughout the planning period (2018-2028) without adding new resources and is also expected to meet Washington State RPS renewable requirements through this period as well. Additionally, Chelan PUD's resource portfolio is comprised primarily of carbon-free, base load, reliable, low-cost hydro resources. For all these reasons, as in prior analyses, no new resources were added to the portfolio of resources.

Portfolio Costs

The hydroelectric facilities' costs shown in Table 2 and Chart 6 represent all costs incurred, including debt service, operations and maintenance (O&M), taxes, reserve fund requirements and contractual fees. The Nine Canyon cost is the District's power purchase contract payments to Energy Northwest.

The 2017 cost for the District's existing portfolio is shown in Table 2. These costs were calculated two ways. The second column, reading left to right, are the actual cost per megawatt hour based on actual costs and actual generation in 2017. Columbia River runoff conditions were 117% of average and Lake Chelan runoff conditions were 130% of average in 2017. Wind generation conditions at Nine Canyon were below average at 95%. The column on the right was calculated using actual 2017 costs and average hydro and wind generation for any given year. This column illustrates what current costs were without the effects of runoff (including timing), wind variability and other factors, including unit outages and spill. As seen in the table, cost per megawatt hour of generation can vary significantly depending upon actual generation. This is because almost all costs are fixed, that is, they don't vary with the amount of generation (e.g., debt service, taxes).

Table 2
District's Existing Portfolio Cost
2017

Project	$/MWh w/actual generation	$/MWh w/ average generation
Rocky Reach	$17.06	$15.92
Rock Island	$37.33	$35.11
Lake Chelan	$17.16	$19.16
Nine Canyon	$70.67	$66.97

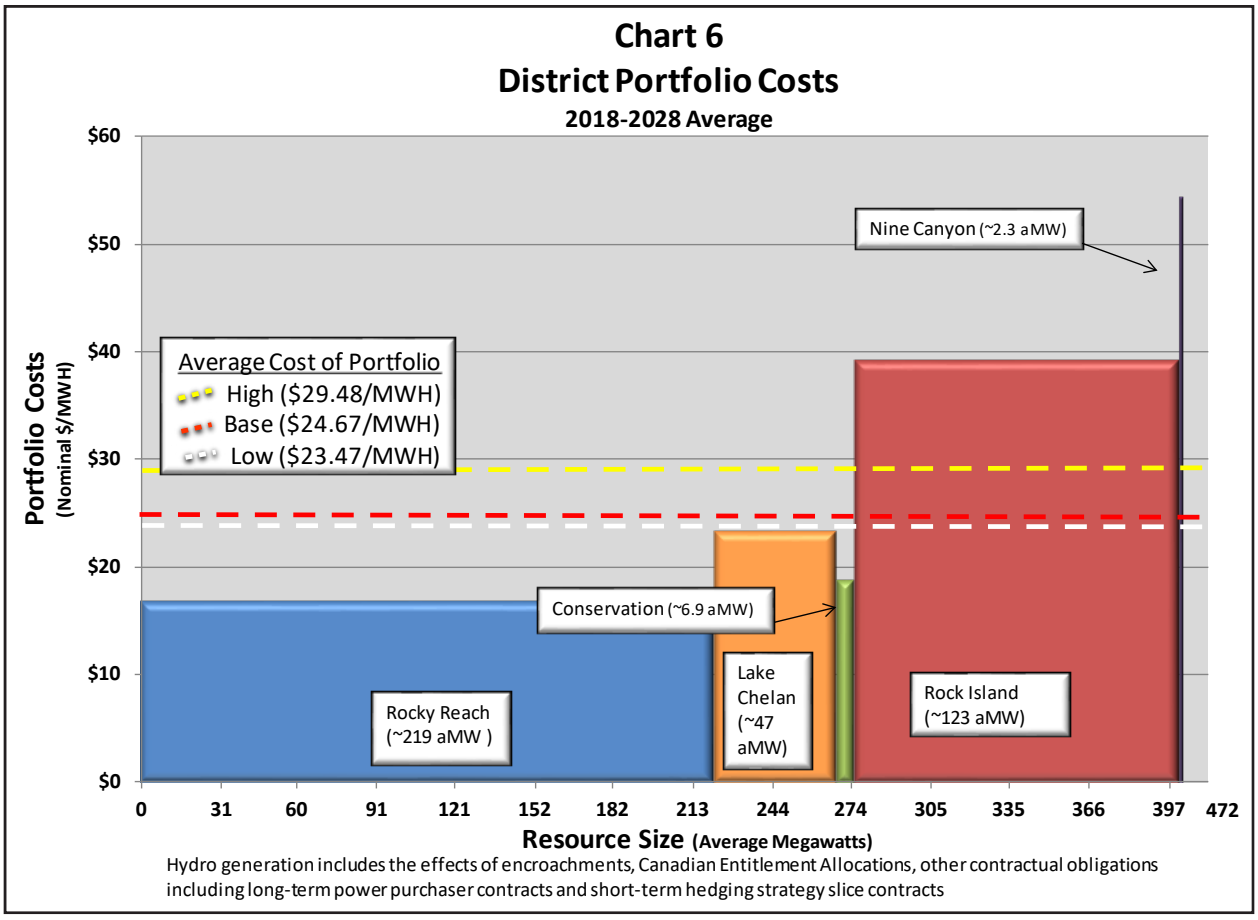
Chart 6 describes the projected base District portfolio costs by resource and relative size of each resource. To address the uncertainty in the District's hydro portfolio costs, two additional scenarios were developed along with the base costs' projection. The high scenario represents a 20% overall increase in hydro costs and the low scenario represents a 5% overall decrease in hydro costs. The weighted average cost of all resources under these scenarios are shown as dotted lines.

Hydro

The District forecasts the future costs of the hydro projects by compiling long-term operating plans and capital replacement programs, which are then incorporated into the forecasted debt service requirements of each facility. This cost-based activity is then adjusted to include other long-term power contract requirements to determine the overall cost of production.

Examples of long-term power contract requirements include, but are not limited to:

- Capital Recovery Charge (base scenario-50% of average annual capital expenditures)
- Debt Reduction Charge (base scenario-3% of outstanding project debt)
- Examples of significant capital and/or operational requirements include, but are not limited to:



- Costs associated with license and HCP implementation
    - Fish survival, hatchery programs, etc.
    - Plant rehabilitation and improvements

The forecasted hydro O&M costs for the base case scenario in this IRP consist of general cost growth rates for standard programs, while project-specific O&M such as unit overhauls, licensing, fish, hatchery and major park maintenance are accounted for with specific forecasts for each project. The average project O&M growth rates are:

- Rocky Reach — 2.5%
- Rock Island — 2.5%
- Lake Chelan — 3.5%

Debt service is driven by existing debt schedules and forecasted financing needs that are driven by specific project capital requirements. In addition, the anticipated use of other long-term power contract requirements such as the debt reduction charge account and capital recovery charge account are included as offsets to future debt service needs.

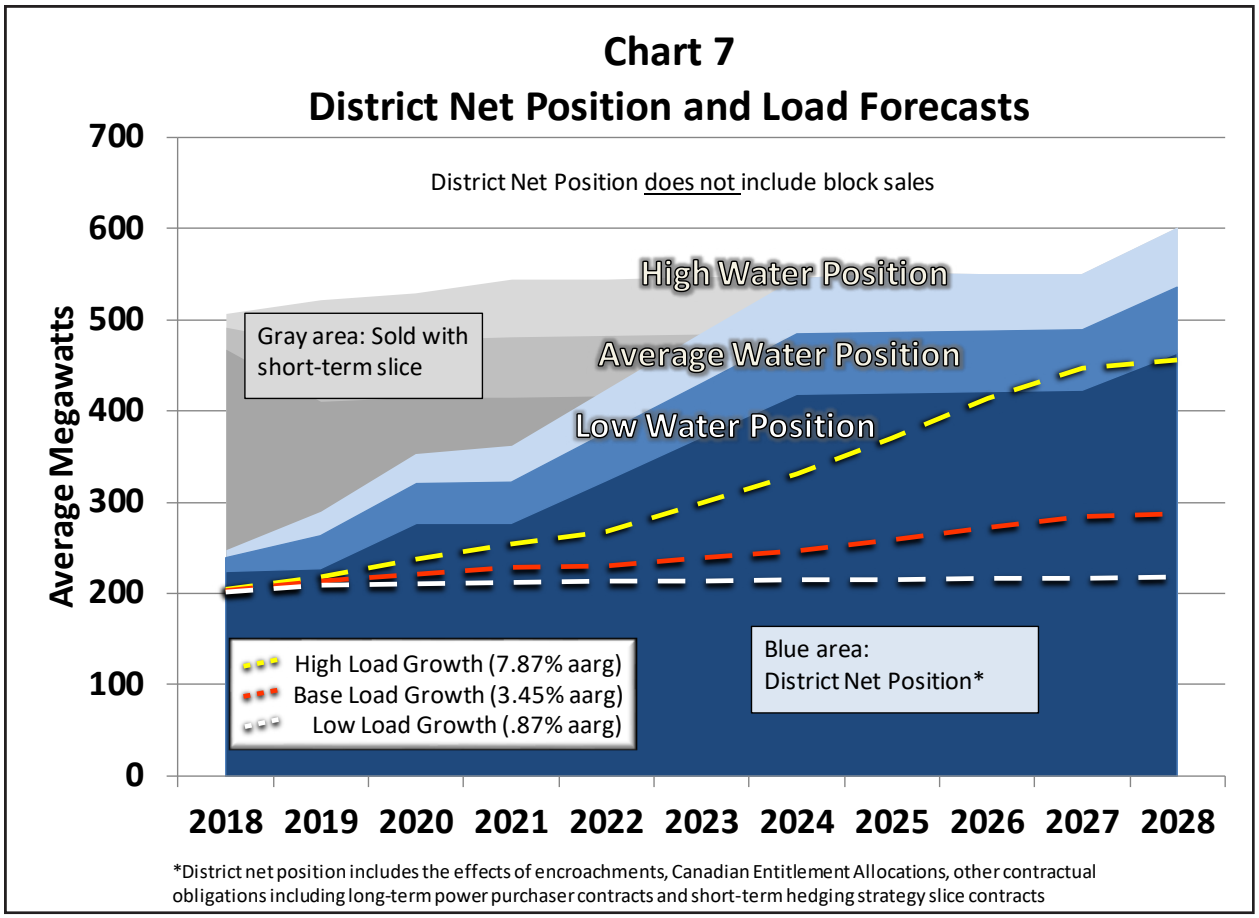
Nine Canyon Wind

The projected future costs of production at the Nine Canyon Wind Project are taken from an annually updated budget that includes the next year and projected future years. The budget is developed by Energy Northwest in conjunction with project participants.

Since increasing approximately 70% in 2008 due to higher than expected maintenance and repair costs and the cessation of anticipated federal Renewable Energy Production Incentive payments, the cost of production rates have lowered just slightly. They are projected to hold steady through 2023 at which time the Phase I and II debt is scheduled to be paid in full. Rates are then expected to decline by over 50% and hold steady through the remaining life of the purchase contract which expires in 2030.

Hedging Strategy

Chelan PUD has a comprehensive forward hedging strategy. The District pursues the sale of market-based products such as slice contracts (i.e., a percentage share of project capacity and energy), block sales (i.e., a predetermined quantity of energy) and/or other



products approved by the District's internal Power Risk Management Committee and outlined in its Power Risk Management Policy to help manage wholesale revenue risk and stabilize such revenue at least five years into the future. Typically, the District uses a stair-stepped approached to hedging with more hedged in the near-term years and less hedged in future years. As of early 2018, hedges have been executed for as far out as 2030. If a carbon tax is enacted, the cost of carbon will be embedded in energy prices within Washington State, and the District will realize the benefit of its clean, carbon-free resources as it hedges and transacts in the future.

Portfolio Results

The District analyzes its forecasted portfolio of resources in relation to its load forecasts. The load/resource balance, service reliability and environmental impacts are all factors considered and evaluated.

Although it is not adding new resources, the District is focused on three major categories of risk which include uncertainties related to:

- Electricity usage by the utility's retail electric customers (loads)
- Stream flows that affect the availability of hydroelectric generation (volume and timing)
- Operational or outage risk

Load/Resource Balance

For this IRP Progress Report, the District's existing mix of resources, at low, average and high levels of hydro generation, was stressed with the low, base and high load forecasts. Chart 7 represents each of these net positions and load projections.

As mentioned previously, analysis continues to indicate that Chelan PUD is expected to be able to serve its retail load throughout the planning period without any new supply-side resource additions. The amount of demand-side resources included in this evaluation has increased from what was included in the 2016 IRP to match Chelan PUD's 2018 required 10-year conservation plan submittal to Commerce that is approximately 1.17 aMW per year through the study period (based on the 2017 CPA previously discussed). Conservation has the effect of reducing the amount of

renewable generation required under Washington's RPS because that requirement is based on a percentage of retail load.

More detail behind the District's load forecasts, resources and contracts can be found in Appendix A — Portfolio Detail & Assumptions.

Service Reliability

The District load/resource balance throughout the planning period was modeled using three hourly time periods per month. The load/resource balance showed that based on the voluntary regional resource adequacy standard discussed previously, the District has adequate capacity and energy to meet its retail customers' load through the planning period thus providing for service reliability.

Environmental Impacts

The District's hydropower and wind generation do not produce any air emissions, but during certain hours of the year, depending upon load and hydro conditions, the District is a net purchaser in the wholesale power market. Those market purchases come from a "market mix" of different generating resources. Some of those resources produce air emissions. Table 3 shows Chelan PUD's calculated fuel mix for 2016, based on the amount of wholesale purchases the District made, as well as the overall Washington State Electric Utilities' Aggregate Fuel Mix for 2016.

The cost of air emissions from carbon dioxide (CO2) remain an industry uncertainty. Efforts are underway in Washington State to enact some sort of carbon tax as discussed in the State Climate and Energy Legislation section. It is expected that any carbon-reducing regulations or other developments regarding climate change will affect the energy markets in which the District participates. Any proposed change to the District's mix of generating resources in the future would need to be evaluated for its environmental impacts.

Table 3
2016 Fuel Mix

Generation Type	District Calculated Fuel Mix	WA Electric Utilities: Aggregate Fuel Mix
Biogas	0.00%	0.17%
Biomass	0.04%	0.77%
Coal	0.83%	14.65%
Geothermal	0.00%	0.00%
Hydro	98.55%	63.69%
Natural Gas	0.47%	11.36%
Nuclear	0.06%	4.93%
Other Biogenic	0.01%	0.05%
Other Non-Biogenic	0.02%	0.08%
Petroleum	0.01%	0.07%
Solar	0.00%	0.00%
Waste	0.00%	0.04%
Wind	0.01%	4.19%
TOTAL	100.00%	100.00%

Short-Term Plan

The following is an update to the 2016 "short-term plan" as required by RCW 19.280.

Conservation Resources

- Implement cost-effective conservation programs which comply with requirements of the Washington State RPS. UPDATE — During 2016-17, the District significantly exceeded the amount conservation needed to meet the minimum requirements. The District achieved 4.12 aMW of savings, even though it was only required to achieve 1.78 aMW.
- During 2016, the District has budgeted and will attempt to achieve over 2.0 aMW of conservation energy savings, which is 150% higher than half of the District's 2016-17 biennial conservation target. UPDATE — During 2016, the District met its goal and achieved 2.04 aMW of conservation.
- During 2016, the District will be conducting energy efficiency audits in residential and commercial buildings to help determine the actual amount of cost-effective and

achievable energy efficiency opportunities that exist in these two sectors. This will help the District improve the accuracy of future CPAs conducted by the District. UPDATE — During 2016, the District conducted residential energy efficiency audits of approximately 450 homes and approximately 1,200 commercial buildings. Using actual audit data instead of regional conservation data greatly improved the accuracy and confidence in the results of the District's CPA that was conducted in 2017 by AEG.

- The District will also be conducting Strategic Energy Management (SEM) surveys at 10 or more large commercial customers to determine operational and management opportunities that they may have to reduce energy consumption. UPDATE — The District has hired a consultant that is working with approximately 10 large commercial customers to help them establish a continuous energy efficiency program within their organization.
- Conducting a detailed assessment of all publically-owned street lighting in Chelan County in 2016. Results of this study will be used to evaluate the cost-effectiveness of replacing all of these lights with LED in 2017. UPDATE — The District completed the detailed inventory of all street lights in the county and is in the process of going out to bid to retrofit approximately 3,700 street lights to LED. The District has acquired grant funding of up to $692,000 from the state of Washington to help pay for the estimated $1.9 million dollar project. The street light project is expected to be completed by the end of 2018.
- Participating in the NEEA regional collaboration to improve energy efficiency of new consumer products. UPDATE — The District continues to participate.
- In 2016, the District began using an improved conservation financial model that accounts for hourly and seasonal variations of energy savings and wholesale energy prices. UPDATE — The hourly model has been used to evaluate energy efficiency measures and potential demand response programs.
- In 2016, the District is looking at implementing new residential programs such as a new home construction. UPDATE — The new smart thermostat program has been very successful as a retail self-install and a HVAC contractor-driven thermostat program. The new construction pilot program did not receive any applications, so it has not yet turned into a full-scale program. Chelan PUD is still looking for builders interested in building beyond code requirements.

Resource Planning

- Continue to track climate change and other environmental legislation (federal, state and regional) to assess how they may impact the District's resource portfolio. UPDATE — Efforts continue to enact a carbon tax in Washington State. See the State Climate and Energy Legislation section for more detail.
- Monitor the continued build out of renewable generation and the effect on reliability, reserves and wholesale power market prices. In conjunction, monitor the development and implementation of the western EIM and the expansion of the CAISO footprint and its effect on the aforementioned elements. UPDATE — Oversupply in California has the ability to push power prices in the Northwest lower when the District has power to sell. Prices in the Northwest can be pushed higher when California needs power to meet peak loads at times when the District is also in the market to buy power for load. See the Integrating Renewable Resources and Overgeneration Events section for more detail.
- Continue to follow regional discussions and emerging research regarding the impact of climate change on regional loads and hydrology and the potential effect on the District's future loads and hydro generation. In particular, examine the Northwest data expected to be disseminated by the RMJOC in 2017 and evaluate its potential use in District analysis. UPDATE — RMJOC-I regulated hydro data resulted in more generation during winter and spring months and less generation during summer months with little change during October and November with changes becoming larger over time. The District is currently waiting for RMJOC-II data expected in late 2018. In 2018, the District plans to work with the UW on a data set to model Lake Chelan operations and reservoir management. Impacts on peak loads indicate reduced winter

demands and increased summer demands. See the Climate Impacts to Loads and Resources section for more detail.

- Continue to monitor the growth of EVs in the automobile marketplace and their presence in Chelan County as well as applying the latest in technical developments to the modeling of projected EV load in the District's service territory. Based on the District's current analysis, the potential impacts remain very minimal during the planning period. UPDATE — EV growth in Chelan County and its effects on District retail load continue to be monitored very closely. Growth was slightly above the base case in 2016. See the Load Forecast section for more detail.
- Continue to closely monitor District HDL rates, policies and load growth to aid in future load growth forecast development. UPDATE — The District is in its second moratorium regarding new HDL load applications in the last few years. Rates, policies and new developments continue to be closely monitored. See the Load Forecast section for more detail.

Final Remarks

Chelan PUD intends to retain its existing supply-side resources while implementing its 2017 CPA results. Complying with both the renewable resources and conservation portions of the Washington State RPS remains a significant focus for the District. The District will continue to monitor uncertain variables that affect its load/resource balance, including available stream flows, District load and the availability of generating units undergoing significant repair. Additionally, the District will continue to evaluate and implement its hedging strategy to help reduce the risks associated with these and other uncertainties.

Chelan PUD will publish a new IRP in 2020.

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Appendix A — Portfolio Detail & Assumptions

Resources

Hydro

- To represent the stream flow uncertainty, historical monthly re-regulated stream flow data, 1929-2007, supplied by PNUCC and actual hydro project data from 2008-2016 was grouped together to create average, low and high stream flow scenarios. The average scenario is the average of the entire dataset, the low scenario is the bottom 20% percentile and the high scenario is the top 20% percentile. The monthly values in each scenario were then allocated to each hour using normalized historical hourly flow values.
- A model that is informed with system constraints (capacity, pond limits, outage estimates, etc.) is used to convert the hourly stream flow estimates into generation.
- For each month, three time periods are modeled; one representing Monday — Friday, one representing Saturday and one representing Sunday. The model requires hourly inputs for each time period. The model optimizes the generation within each time period. The outputs are then aggregated up to a monthly and annual granularity for reporting.
- Generation is net of all project obligations (i.e., Canadian Entitlement Allocations (CEAs) and encroachments)
- Rocky Reach — Chelan PUD's share (net of long-term purchaser contracts and executed slice contracts)
    - 15.46% -1/2018 through 12/2018
    - 18.46% -1/2019 through 12/2019
    - 23.46% -1/2020 through 12/2021
    - 28.46% -1/2022 through 12/2022
    - 33.46% -1/2023 through 12/2023
    - 38.46% -1/2024 through 10/2028
    - 64.46% -11/2028 through 12/2028
- Rock Island — Chelan PUD's share (net of long-term purchaser contracts and executed slice contracts)
    - 21% - 1/2018 through 12/2018
    - 24% - 1/2019 through 12/2019
    - 29% - 1/2020 through 12/2021
    - 34% - 1/2022 through 12/2022
    - 39% - 1/2023 through 12/2023
    - 44% - 1/2024 through 11/2028
    - 70% - 11/2028 through 12/2028
- Lake Chelan — Chelan PUD's share
    - 100% - 1/2018 through 12/2028

Wind

- All available historical Nine Canyon hourly wind generation (2004-2017) was used to calculate average energy

Conservation

- Used the quantities from the 2017 CPA (also used for RPS compliance in January 2018)

Contracts

Long-term Power Sales

- Rocky Reach
  - Puget — 25% - 1/2018 through 12/2028
  - Alcoa — 26% - 1/2018 through 10/2028
  - Douglas — 5.54% - 1/2018 through 12/2028
- Rock Island
  - Puget — 25% - 1/2018 through 12/2028
  - Alcoa — 26% - 1/2018 through 10/2028

Executed Slices of Rocky Reach & Rock Island

- Executed "slice of the system" contracts as part of long-term hedging strategy
- Slice contracts represent between 0% and 28% of the capacity and energy of Rocky Reach and Rock Island from 2018-2028
- Slice contracts are removed from Chelan PUD's shares of Rocky Reach and Rock Island listed under "Resources" above

Load

- The three load forecasts represent average annual rates of growth of : 0.87%-low, 3.45%-base, 7.87%- high

Table 4 shows the District's average annual resources for the planning period. The generation is the amount available to serve load under normal hydro conditions and includes the effects of encroachments, fish and other spill, CEA's, the long-term power purchaser contracts and the executed slice contracts.

Table 4
District's Average Annual Resources (aMW)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Net Rocky Reach Gen	109	130	165	165	200	236	271	271	271	271	301
Net Rock Island Gen	70	80	97	97	114	131	147	147	147	147	162
Net Lake Chelan Gen	47	47	47	47	47	47	47	47	47	47	47
Net Nine Canyon Gen	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Conservation	1.13	2.41	3.15	4.30	5.53	6.76	7.98	9.27	10.52	11.73	12.89

Appendix B — Washington State Electric Utility Integrated Resource Plan Cover Sheet 2018

	Base Year			5 Year Estimate			10 Year Estimate		
Estimate Year		2017			2023			2028	
Period	Winter	Summer	Annual	Winter	Summer	Annual	Winter	Summer	Annual
Units	(MW)	(MW)	(MWa)	(MW)	(MW)	(MWa)	(MW)	(MW)	(MWa)
Loads	436.00	241.00	198.00	493.00	295.00	239.00	544.00	342.00	288.00
Exports									
Resources:									
Future Conservation/Efficiency				14.88	8.46	6.76	28.40	16.14	12.89
Demand Response									
Cogeneration									
Hydro (*Critical Water)	419.00	220.00	189.00	683.00	345.00	301.00	847.00	423.00	370.00
Wind	0.35	0.25	2.13	1.67	0.45	2.25	1.67	0.45	2.25
Other Renewables									
Thermal - Natural Gas									
Thermal - Coal									
Net Long Term Contracts									
Net Short Term Contracts									
BPA									
Other									
Imports									
Distributed Generation									
Undecided									
Total Resources	419.35	220.25	191.13	699.55	353.91	310.01	877.07	439.59	385.14
Load Resource Balance	-16.65	-20.75	-6.87	206.55	58.91	71.01	333.07	97.59	97.14

The following notes help to describe the numbers in the table above.

- Requirements
  - Loads
    - Peak loads are based on expected load factors, by temperature and by sector, applied to the annual sector energy forecasts.
    - Annual energy loads are based on the District's Base Load Growth Forecast of 3.45%.
    - Peak and annual energy loads, including the base year (2017), are adjusted for normal weather (i.e. an expected or 1 in 2 peak).
    - Future peak and annual energy loads do not include conservation savings.
- Resources
  - Hydro
    - For all years, it was assumed that during a single hour winter peak demand period, all projects would be at full seasonal capability. For all years, it was assumed that during a single hour summer peak demand period, *1936-37 PNUCC critical period generation was available to all projects. Values reported are net of encroachments and CEAs.
    - For all years, annual energy was calculated by using *1936-37 PNUCC critical period generation data. Values reported are net of encroachments and CEAs.
    - For all years, hydro is reported net of long-term purchaser contracts and executed slice contracts.
  - Wind
    - Base year (2017) wind data reflects actual Nine Canyon experience in that year.
    - 2023 and 2028 projected peak wind capacity is based on median (50th percentile) hourly Nine Canyon historical generation (2004-2017).
    - 2023 and 2028 projected average annual wind energy is based on median (50th percentile) average annual energy from Nine Canyon historical generation (2004-2017).

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Acronyms

aarg	Average Annual Rate of Growth
AEG	Applied Energy Group
aMW	Average Megawatt
APGI	Alcoa Power Generating, Inc.
BA	Balancing Authority
BAA	Balancing Authority Area
BPA	Bonneville Power Administration
CAISO	California Independent System Operator
CAR	Clean Air Rule
CDCAC	Chelan-Douglas Community Action Council
CEA	Canadian Entitlement Allocation
CO2	Carbon Dioxide
CPA	Conservation Potential Assessment
CRCC	Columbia River Climate Change
DEI	Distribution Efficiency Improvements
DR	Demand Response
DRAC	Demand Response Advisory Committee
EIM	Energy Imbalance Market
EPA	Environmental Protection Agency
EV	Electric Vehicle
FERC	Federal Energy Regulatory Commission
GCM	Global Circulation Model
GHG	Greenhouse Gas
HCP	Habitat Conservation Plan
HDL	High Density Load
HSPF	Heating Season Performance Factor
HVAC	Heating, Ventilating and Air Conditioning
IRP	Integrated Resource Plan
ITC	Investment Tax Credit
KW, kWh	Kilowatt, Kilowatt-hour
LED	Light-Emitting Diode
LOLP	Loss of Load Probability
MW, MWh	Megawatt, Megawatt-hour
NEEA	Northwest Energy Efficiency Alliance
NWPCC	Northwest Power and Conservation Council
O&M	Operations and Maintenance
OFM	Office of Financial Management (Washington State)
PTC	Production Tax Credit

PTCS	Performance Tested Comfort System
PUD	Public Utility District
RCW	Revised Code of Washington
REC	Renewable Energy Credit
RMJOC	River Management Joint Operating Committee
RPS	Renewable Portfolio Standard
RTF	Regional Technical Forum
SB	Senate Bill
SEER	Seasonal Energy Efficiency Ratio
SEM	Strategic Energy Management
VAR	Volt-Ampere Reactive
WAC	Washington Administrative Code
WREGIS	Western Renewable Energy Generation Information System

Glossary

Average Annual Rate of Growth (aarg)

The average percentage increase in value of a given item over the period of a year. The energy load forecast is referred to in terms of the average annual rate of growth.

Average Megawatt (aMW)

A unit of energy for either load or generation that is the ratio of energy (in megawatt-hours) expected to be consumed or generated during a period of time to the number of hours in the period (total energy in megawatt-hours divided by the number of hours in the time period).

Avoided Cost

The marginal cost that a utility avoids by not having to acquire one more unit of power whether by producing the power from owned resources, building new resources or purchasing it from another entity.

For evaluating future energy acquisitions, including conservation, Chelan PUD uses a forecast of wholesale power market prices as its avoided cost measure due to its surplus energy resource position.

Base Load Generation Resource

Electric generation plants that run at all times, except in the case of repairs or scheduled maintenance, to at least cover a minimum level of demand on an electrical supply system that exists 24 hours a day through the year.

Battery Electric Vehicle

A vehicle that uses only batteries as the source of energy to move the vehicle.

Biomass Resource

Any organic matter which is available on a renewable basis, including forest residues, agricultural crops and waste, wood and wood wastes, animal wastes, livestock operation residue, aquatic plants and municipal wastes. Resulting biogas is recovered and burned for heat and energy production. These biofuels are considered to be short-term "CO2 neutral", meaning they typically remove CO2 from the atmosphere and give up the same amount when burnt.

Block Power Sales

A power sales contract that establishes a fixed amount of energy to be sold for a specific period of time at a fixed price.

Canadian Entitlement Allocations (CEAs)

Energy returned to Canada to fulfill the obligation under the Columbia River Treaty between Canada and the United States for additional water storage constructed in Canada to help regulate hydroelectric generation. Canada is entitled to one half the downstream power benefits resulting from Canadian storage under the treaty.

Capacity

The maximum amount of power that a generator can physically produce.

Chelan PUD

In this report, all these references mean the legal entity of Public Utility District No. 1 of Chelan County. It is also referenced as the "District".

Climate Change

Any long-term significant change in the "average weather" that a given region experiences. It involves changes in the variability or average state of the atmosphere over durations ranging from decades to millions of years.

Cogeneration

The production of electricity using waste heat (as in steam) from an industrial process or the use of steam from electric power generation as a source of heat.

Conservation

Any reduction in electric power consumption that results from increases in the efficiency of energy use, production, transmission or distribution (from RCW 19.280: Electric Utility Resource Plans and RCW 19.285: The Energy Independence Act).

Conservation Potential Assessment (CPA)

A study designed to estimate the potential for electricity conservation in a given geographical area.

Cryptocurrency

A digital currency in which encryption techniques are used to regulate the generation of units of currency and verify the transfer of funds, operating independently of a central bank.

Council

See Power Plan (Sixth, Seventh, etc.)

Demand

The rate at which electric energy is delivered to or by a system at a given instant; usually expressed in megawatts.

Demand Response

Changes in electric usage by end-use customers (e.g., residential, commercial, industrial) from their normal consumption patterns in response to changes in the price of electricity, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.

Demand-Side Resource

Peak and energy savings from conservation measures, efficiencies and load control programs that are considered a resource because they serve increased demand without obtaining new power supplies.

Dispatchable Resource

A resource whose electrical output can be controlled or regulated to match the instantaneous electrical energy requirements of the electric system.

Distribution System

The utility facilities and equipment that distribute electricity from convenient points on the transmission system to the end-use customer.

District

See Chelan PUD.

Econometric

The application of mathematical and statistical techniques to economics in the analysis of data and the development and testing of theories and models.

Electric Vehicle (EV)

A broad class of vehicles that are powered, at least in part, by rechargeable batteries that can be restored to full charge by connecting a plug to an external electric power source. A plug-in hybrid electric vehicle (PHEV) shares the characteristics of both a conventional hybrid electric vehicle, having an electric motor and an internal combustion engine, and of a battery electric vehicle (BEV), which uses batteries as its only source of energy to move the vehicle. The combustion engine in a PHEV works as a backup when the batteries are depleted.

Eligible Renewable Resource

a) Electricity from a generation facility powered by a renewable resource other than fresh water that commences operation after March 31, 1999, where: (i) The facility is located in the Pacific Northwest; or (ii) the electricity from the facility is delivered into Washington state on a real-time basis without shaping, storage, or integration services; b) Incremental electricity produced as a result of efficiency improvements completed after March 31,

1999, to hydroelectric generation projects owned by a qualifying utility and located in the Pacific Northwest or to hydroelectric generation in irrigation pipes and canals located in the Pacific Northwest, where the additional generation in either case does not result in new water diversions or impoundments; and c) Qualified biomass energy (from RCW 19.285: The Energy Independence Act).

Encroachments

When a downstream hydro project is built and increases the tail water elevation of an upstream hydro project, capacity and energy of the upstream hydro project is reduced. To compensate for the loss of capacity and energy, the downstream project delivers energy to the upstream project.

Energy Imbalance Market

An EIM is a balancing energy market that optimizes generator dispatch within and between participating Balancing Authority Areas (BAAs) every 15 and five minutes.

Energy Independence Act

Refers to RCW 19.285, a ballot initiative passed in Washington State in November, 2006. It is otherwise known as the Washington State Renewable Portfolio Standard (RPS.) Under the initiative, utilities with a retail load of more than 25,000 customers are required to use eligible renewable resources or acquire equivalent RECs, or a combination of both, to meet 3% of load by January 1, 2012, 9% by January 1, 2016 and 15% by January 1, 2020. The initiative also required that by January 1, 2010, utilities evaluate conservation resources using methods consistent with those used by the NWPCC and pursue all conservation that is cost-effective, reliable and feasible. Each utility must establish and make publicly available a biennial acquisition target for cost-effective conservation.

Fossil Fuels

They are hydrocarbons found within the top layer of the Earth's crust.

Geothermal Resource

Energy from rock and/or water that is heated by contact with molten rock deep in the earth's core. The heat can be extracted and used for space heating or to generate electricity.

Greenhouse Gas (GHG)

Gases that are present in the earth's atmosphere which reduce the loss of heat into space and therefore, contribute to global temperatures through the "greenhouse effect".

Hedging

Establishing positions in the wholesale power markets with the intent of reducing risk resulting from uncertain fluctuations in all the variables that affect the District's net wholesale power revenue, of which stream flows, retail load and wholesale power market prices are primary drivers.

High Density Load (HDL)

Chelan PUD has defined as those loads with intense energy use of 250 kWh per square foot or more per year where the energy is used for server farms or similarly situated loads.

Hydro Resource

Facilities used to produce electricity from the energy contained in falling water (river, locks or irrigation systems).

Incremental Generation

Electricity produced as a result of efficiency improvements completed after March 31, 1999, to hydroelectric generation projects owned by a qualifying utility and located in the Pacific Northwest or to hydroelectric generation in irrigation pipes and canals located in the Pacific Northwest, where the additional generation in either case does not result in new water diversions or impoundments (from RCW 19.285: The Energy Independence Act).

Integrated Resources Plan (IRP)

An analysis describing the mix of generating resources and conservation and efficiency resources that will meet current and projected needs a the lowest reasonable cost to the utility and it ratepayers (from RCW 19.280: Electric Utility Resource Plans).

Intermittent Resource

An electric generator that is not dispatchable and cannot store its fuel source, and therefore, cannot respond to changes in system demand.

Kilowatt (kW) and Kilowatt-Hour (kWh)

One thousand watts; the standard measure of electric power consumption of retail customers. A kilowatt-hour (kWh) is a measure of electric energy equal to one kilowatt of power supplied to or taken from an electric circuit for one hour.

Landfill Gas

Methane gas from landfills, created when organic waste decomposes, is recovered and burned for heat and energy production. Burning methane converts it from a highly potent GHG (methane has 22 times the GHG impact of CO2) to CO2, which is much less potent.

Levelized Cost

The constant stream of values that produces the same present value as the non-constant stream of values, using the same discount rate. Costs are levelized in real dollars. For example, the amount borrowed from a bank is the present value of buying a house; the mortgage payment including interest on a house is the levelized cost of that house.

Load

The amount of electric power delivered or required at any specified point or points on a system. Load originates primarily at the power-consuming equipment of the customer.

The amount of kilowatt-hours of electricity delivered in the most recently completed year by a qualifying utility to its Washington retail customers (from RCW 19.285: The Energy Independence Act).

Load Forecasting

The procedures used to estimate future consumption of electricity. Load forecasts are developed either to provide the most likely estimate of future load or to determine what load would be under a set of specific conditions (e.g., extremely cold weather or changing demographics).

Load/Resource Balance

A comparative evaluation of future load forecasts in relation to the availability of demand-side and supply-side resources available to meet those future load needs.

Loss of Load Probability (LOLP)

A measure of the probability that a system load demand will exceed capacity during a given period; often expressed as the estimated number of days over a longer period.

Megawatt (MW) and Megawatt-Hour (MWh)

One thousand kilowatts, or 1 million watts; the standard measure of electric power plant generating capacity. A megawatt-hour (MWh) is a measure of electric energy equal to one megawatt of power supplied to or taken from an electric circuit for one hour.

Nominal Dollars

Dollars that are paid for a product or service at the time of the transaction. Nominal dollars are those that have not been adjusted to remove the effect of changes in the purchasing power of the dollar (inflation); they reflect buying power in the year in which the transaction occurred.

Northwest Power and Conservation Council (NWPCC or Council)

See Power Plan (Sixth, Seventh, etc.)

Overgeneration Event

A requirement of RCW 19.280.020: "means an event within an operating period of a balancing authority when the electricity supply, including generation from intermittent renewable resources, exceeds the demand for electricity for that utility's energy delivery obligations and when there is a negatively priced regional market."

Peak Demand (Load)

The maximum demand imposed on a power system or system component during a specified time period.

Peak(ing) Resource

Power generated by a utility system component that operates at a very low capacity factor; generally used to meet short-lived and variable high demand periods.

Plug-In Hybrid Electric Vehicle

A vehicle that shares the characteristics of both a conventional hybrid electric vehicle, having an electric motor and an internal combustion engine, and of a battery electric vehicle (BEV), which uses batteries as its only source of energy to move the vehicle. The combustion engine in a PHEV works as a backup when the batteries are depleted.

Portfolio

A set of supply-side and demand-side resources currently or potentially available to a utility.

Power Plan (Sixth, Seventh, etc.)

A 20-year electric power plan that guarantees adequate and reliable energy at the lowest economic and environmental cost to the Northwest. A new plan is developed every five years as a result of the Northwest Power Act of 1980 that authorized the formation of the Northwest Power and Conservation Council (NWPCC or the Council.) The Seventh Power Plan, the most recent, was adopted in February 2016. The NWPCC is also mandated to develop a fish and wildlife program to protect and rebuild populations affected by hydropower development in the Columbia River Basin and conduct an extensive program to educate and involve the public in the their decision-making processes.

Probability

The likelihood or chance that something will happen.

Progress Report

A requirement of RCW 19.280.030: Electric utility resource plans, which reads "At a minimum, progress reports reflecting changing conditions and the progress of the integrated resource plan must be produced every two years…"

Real Dollars

Dollars that have been adjusted to remove the effects of inflation. Real dollars are sometimes called uninflated dollars, today's dollars or constant dollars.

Regression Analysis

A technique used for the modeling and analysis of numerical data consisting of values of a dependent variable (response variable) and of one or more independent variables (explanatory variables).

Renewable Energy Credit (REC)

A tradable certificate of proof of at least one megawatt-hour of an eligible renewable resource where the generation facility is not powered by fresh water, the certificate includes all of the nonpower attributes associated with that one megawatt-hour of electricity, and the certificate is verified by a renewable energy credit tracking system selected by the department (from RCW 19.285: The Energy Independence Act).

Renewable Portfolio Standard (RPS)

A regulation that an electric power provider generate or purchase a specified percentage of the power it supplies/sells from renewable energy resources. Washington State's RPS is codified in RCW 19.285: The Energy Independence Act.

Renewable Resource

A resource whose energy source is not permanently used up in generating electricity.

Electricity generation facilities fueled by: (a) Water; (b) wind; (c) solar energy; (d) geothermal energy; (e) landfill gas; (f) biomass energy utilizing animal waste, solid organic fuels from wood, forest, or field residues or dedicated energy crops that do not include wood pieces that have been treated with chemical preservatives such as creosote, pentachlorophenol, or copper-chrome-arsenic; (g) byproducts of pulping or wood manufacturing processes, including but not limited to bark, wood chips, sawdust, and lignin in spent pulping liquors; (h) ocean thermal, wave, or tidal power; or (i) gas from sewage treatment facilities (from RCW 19.280: Electric Utility Resource Plans).

Means: (a) Water; (b) wind; (c) solar energy; (d) geothermal energy; (e) landfill gas; (f) wave, ocean, or tidal power; (g) gas from sewage treatment facilities; (h) biodiesel fuel as defined in RCW 82.29A.135 that is not derived from crops raised on land cleared from old growth or first-growth forests where the clearing occurred after December 7, 2006; and (i) biomass energy based on animal waste or solid organic fuels from wood, forest, or field residues, or dedicated energy crops that do not include (i) wood pieces that have been treated with chemical preservatives such as creosote, pentachlorophenol, or copper-chrome-arsenic; (ii) black liquor byproduct from paper production; (iii) wood from old growth forests; or (iv) municipal solid waste (from RCW 19.285: The Energy Independence Act).

Resource Adequacy

A measure defining when a utility has sufficient resources to meet customer needs under a range of conditions that affect supply and demand for electricity.

Resource Mix

The different types of resources that contribute to a utility's ability to generate power to meet its loads.

Scenario

A possible course of future events. In the report, scenarios are used to compare the District's existing portfolio of generating resources under a range of possible future conditions including: various load forecasts and various hydro production cost forecasts.

Seventh Power Plan

See Power Plan (Sixth, Seventh, etc.)

Shape

Refers to the nature of power generation capability and loads to change in quantity over time; changing from day to day and month to month.

Sixth Power Plan

See Power Plan (Sixth, Seventh, etc.)

Slice Power Sales

A power sales contract for a specific percentage share of a generation project's capacity and energy for a specific period of time at a fixed price (i.e., there is no guarantee of the amount of energy that will result from the contract for resources such as hydro and wind where the fuel is driven by nature).

Solar Resource

The generation of electricity from sunlight. This can be direct as with photovoltaics, or indirect as with concentrating solar power, where the sun's energy is focused to boil water which in then used to provide power.

Substitute Resource

Reasonably available electricity or generating facilities, of the same contract length or facility life as the eligible renewable resource the utility invested in to comply with chapter 19.285 RCW requirements, that otherwise would have been used to serve a utility's retail load in the absence of chapter 19.285 RCW requirements to serve that retail load with eligible renewable resources (from WAC 194-37: Energy Independence).

Supply-Side Resources

Those power resources that come from a power generating plant or facility.

Surplus Energy

Energy that is not needed to meet a utility's load or contractual commitments to supply firm or non-firm power.

Transmission (System)

Often referred to as the "grid", it is the system of electrical lines that allows the bulk delivery of electricity to consumers typically between a power plant and a substation near a populated area. Due to the large amount of power involved, transmission normally takes place at high voltage (110 KV or above) and because of the long distances often involved, overhead transmission lines are usually used.

Waste-to-Energy Resource

Incineration process in which solid waste is converted into thermal energy to generate steam that drives turbines for electricity generators.

Wastewater-Treatment Gas Resource

Methane gas, given off in the digestion of sewage, is recovered and burned for heat and energy production. Sewage gas consists of approximately 66% methane and 34% CO2. Burning methane converts it from a highly potent GHG (methane has 22 times the GHG impact of CO2) to CO2, which is much less potent.

Weather-Normalized Load

Actual energy load data that has been mathematically adjusted to represent an energy load that would have occurred in an average weather year.

Wind (Generation) Resource

Energy generated when wind turns the blades of a wind turbine which drive a generator. The longer the blades and the faster the wind speed (up to a point), the more electricity that is generated.

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