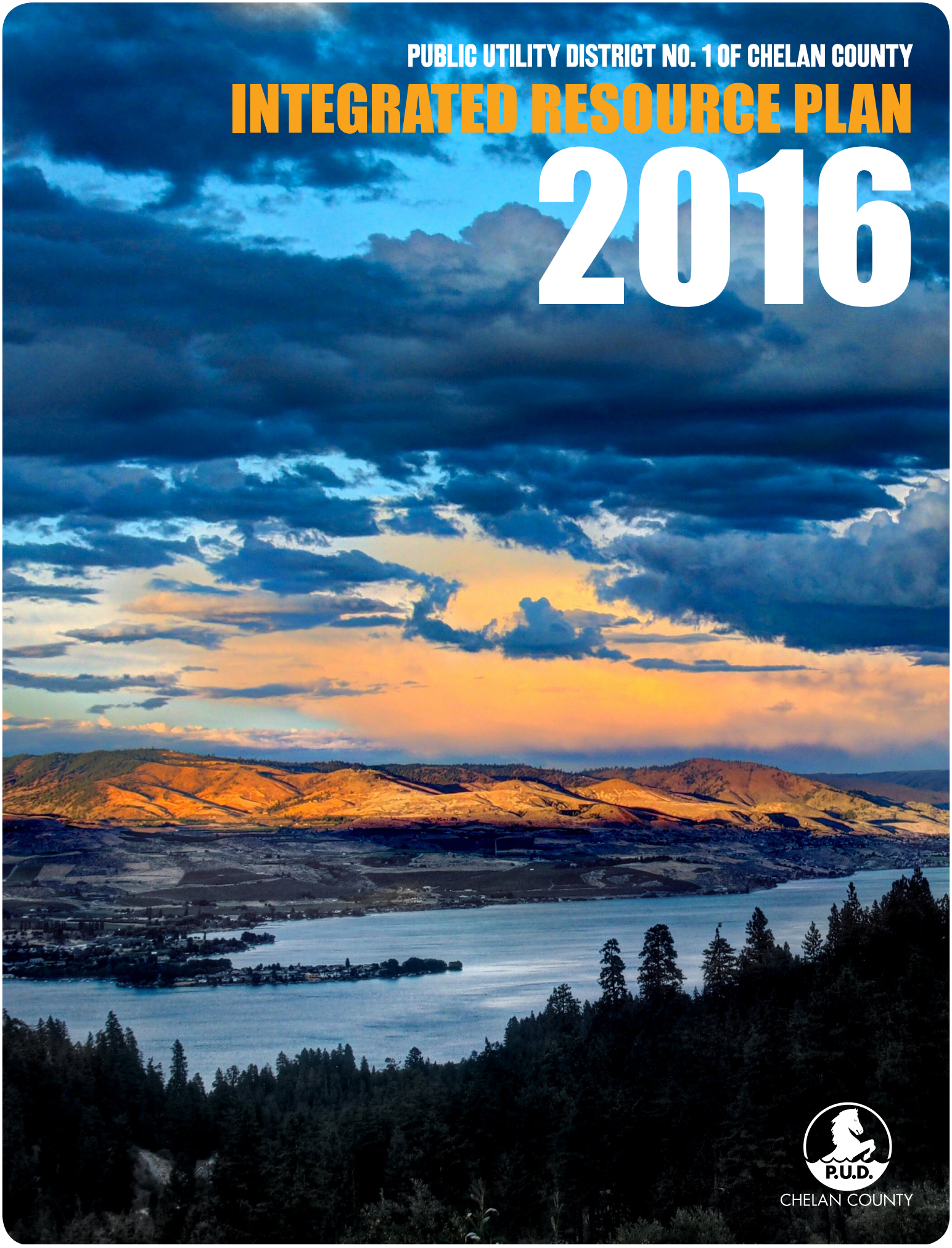
PUBLIC UTILITY DISTRICT NO. 1 OF CHELAN COUNTY

INTEGRATED RESOURCE PLAN

2016



P.U.D.
CHELAN COUNTY

2016 Integrated Resource Plan

June 2016

PUD No. 1 of Chelan County
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2016 Integrated Resource Plan

Summary of Determinations

The District has completed its 2016 Integrated Resource Plan (IRP). This IRP 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 2016-2026 planning period, the Board of Commissioners of Chelan County Public Utility District (Chelan PUD or District) has approved this 2016 IRP 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 2015 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 2016 IRP 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 2015 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
- Submittal of the final IRP to Commerce by September 1, 2016 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 (2016-2026).

In late 2011 and mid 2012, several long-term Rocky Reach and Rock Island power purchaser contracts, respectively, expired. Going forward, the District retained a larger portion of the output at both projects and entered into shorter-term contracts for a portion of the output providing the District more 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.

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 meet 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 2016 IRP 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

Resource Adequacy vs. Seventh Power Plan

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 2020 and 2021 operating years was released in May of 2015. Results indicate that the regional power supply is expected to remain adequate through 2020, assuming that the region continues to acquire the targeted Sixth Power Plan energy efficiency savings. In 2021, however, with the retirement of the Boardman, Oregon and Centralia, Washington-1 coal plants (1,330 megawatts of combined nameplate capacity), the report shows that the likelihood of a shortfall rises to a little over 8%, which is above the Council's 5% standard. Adding 1,150 megawatts of gas-fired generation would bring the 2021 LOLP back down to the 5% limit. However, any comparison of the results of the Council's annual

adequacy assessments with results from the multitude of scenarios examined while developing a power plan should be done with extreme caution. The adequacy assessment is intended to be a single-year spot check to indicate whether resource development is on track to maintain adequacy. Power plan analyses examine the operation and cost of thousands of different resource plans over a 20-year horizon, with many more future uncertainties than are accounted for in the adequacy assessment. However, in spite of these difficulties, certain specific years, with specific conditions can be compared so long as the differences in the purpose of these two analyses are understood.

One of the major differences between these two approaches is that the Seventh Power Plan (adopted February 10, 2016) analyses use the Council's frozen efficiency load forecasts, which do not include any new energy efficiency measures but do incorporate the effects of standards and codes. In contrast, the loads forecast used to assess resource adequacy come from the Council's short-term model, which does include trends for future energy efficiency but does not account for standards and codes. Also, the frozen efficiency loads are weather-normalized whereas loads used for the adequacy assessment are temperature dependent.

On the resource side of the equation, for the Seventh Power Plan, the Council has amended the hydroelectric system capability to reflect a greater allocation of that resource to carry regional within-hour balancing reserves. This reduces hydroelectric system peaking capability to serve firm on-peak loads by about 1,000 megawatts compared to the capability used for the May 2015 adequacy assessment, which only assumed the Bonneville Power Administration's (BPA) balancing reserves.

The 2021 resource adequacy assessment LOLP was reported as about 8% and included about 1,700 average megawatts of expected new energy efficiency. The 2021 Seventh Power Plan frozen efficiency LOLP is on the order of 15% (for the medium load forecast) and includes no new energy efficiency but does incorporate savings from standards and codes. It also assumed the reduced hydroelectric system capability, adjusted to reflect regional balancing reserves.

To get the 2021 resource adequacy assessment LOLP down to the 5% standard, 1,150 megawatts of gas-fired generation were added to the expected 1,700 average megawatts of new energy efficiency savings. To get the 2021 power plan LOLP down to the 5% standard, the Council's Regional Portfolio Model shows an average addition of 2,380 average megawatts of new energy efficiency and about 1,300 megawatts of demand response, which for modeling purposes is equivalent to the addition of about 1,100 megawatts of gas-fired generation. Thus, in spite of the vastly different assumptions between these two cases, the overall conclusions are very similar. In both cases, the 2021 power supply would be inadequate under medium loads with no new resources or energy efficiency savings. In all likelihood, some combination of new generation and load reduction programs will be used to bridge the gap.

These analyses only count existing resources and those that are sited and licensed. Northwest utilities, as reported in the Pacific Northwest Utilities Conference Committee's 2015 Northwest Regional Forecast, show a combined 900 megawatts of planned generating capacity over the next 10 years. However, 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 2016 IRP.

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).

The Seventh Power Plan's resource strategy uses DR to meet winter and summer peak demands, primarily under critical water and extreme weather conditions. The strategy doesn't consider other possible

applications of DR to integrate variable resources like wind for example. The Council's assessment identified more than 4,300 megawatts of regional DR potential. A significant amount of this potential, nearly 1,500 megawatts, is available at relatively low cost; less than $25 per kilowatt of peak capacity per year. When compared to the alternative of constructing a simple cycle gas-fired turbine, DR can be deployed sooner, in quantities better matched to the peak capacity need, deferring the need for transmission upgrades or expansions. In particular, DR is the least expensive means to maintain peak reserves for system adequacy. Its low cost is especially valuable because the need for peaking capacity in the region largely depends on water and weather conditions. The Council's analysis indicates that a minimum of 600 megawatts of DR resources would be cost-effective to develop under all future conditions tested across all scenarios that don't rely on increased firm capacity imports. Moreover, even if additional firm peak power imports during winter months are assumed to be available, developing a minimum of 600 megawatts of DR resources is still cost-effective in over 70% of the futures tested. The Council will determine if the region has made sufficient progress toward acquiring cost-effective DR or confirm the ability to import a minimum of at least 600 megawatts of additional peaking capacity in its mid-term assessment of the Seventh Power Plan.

Most of the DR in the Pacific Northwest is still irrigation load control east of the Cascade Mountains. Current pilot programs include Portland General Electric with a series of ongoing residential pricing, space heating/cooling and smart water heating programs. BPA has been partnering with PUDs on programs that use residential water and space heating controls or scheduled curtailments of large industrial customers to alleviate imbalance reserve needs. BPA also has two large scale DR demonstration projects partnering with aggregators, Energy Northwest (public) for 35 megawatts of imbalance capacity, and EnerNOC (private), to shave winter peaks and ease summer transmission congestion (13 to 25 megawatts).

As mentioned in the 2014 IRP Progress Report, 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). A load shedding event can be implemented electronically by sending a signal from the District's dispatch operations to APGI/Alcoa's plant control remote terminal unit at the McKenzie substation. The agreement allows for a frequency of no more than four times in any calendar year and for an amount of energy up to 20 MW per hour. The District is able to count the 20 MW as part of its operating reserves. 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 Policy

As reported in the 2014 IRP Progress Report, on April 29, 2014, Washington Governor Inslee announced executive action (Executive Order 14-04) to reduce carbon pollution and promote clean energy. He outlined a series of steps to cut carbon pollution in Washington and advance development and use of clean energy technologies.

Emissions in Washington state come from transportation (46%), electricity (20%), industrial sources (16%), residential and commercial buildings (9%), agriculture (6%) and waste (3%).

Inslee's executive order built on earlier studies and work groups to create an action plan in key areas. It did not implement any new programs, instead set out a deliberative and public process. Most of the major action plan elements listed below require either legislative approval or legislative appropriation for funding.

The executive order action plan called for the following:

- Reduce carbon emissions through new cap-and-market program

  A Carbon Emissions Reduction Taskforce (CERT) composed of 21 leaders from business, labor, health and public interest organizations provided recommendations to the governor on design and implementation of a market-based carbon pollution program. Inslee directed the taskforce to consider measures to offset costs to consumers and businesses and to design strategies to help energy-intensive industries transition from carbon-based energy sources.

Final recommendations were delivered November 17, 2014. The four key findings are as follows:

1. Emissions-based or price-based market mechanisms add unique features to an overall carbon emissions reduction policy framework.
2. Thoughtful and informed policy design, drawing on the lessons learned from other jurisdictions, CERT member perspectives, and additional analysis (see #4), will be required to achieve either an emissions-based or price-based policy approach that is workable for the State of Washington.
3. Reaching the State's statutory carbon emissions limits will require a harmonized, comprehensive policy approach.
4. Certain important questions remain unanswered and further analysis will be important to provide the foundation for a well informed and well-functioning policy approach.

- Coal-fired electricity imported from other states ("coal-by-wire")

State agencies are working with key utilities to reduce, and eventually eliminate, the use of electrical power produced by coal.

- Clean transportation

Washington State Department of Transportation is leading an effort with other agencies and governments to promote strategies, policies and investments that support electrification of our transportation system, lower-emission multi-modal options and clean fuels.

- Clean technology

The state Department of Commerce is working with WSU and others on a program to develop and deploy new renewable energy and energy efficiency technologies, including those with an emphasis on solar power.

- Energy efficiency

One of the most cost-effective strategies for reducing carbon emissions is to use energy more efficiently. The state Department of Commerce is working with WSU and others to improve the energy performance of public and private buildings.

- State government operations

The state Dept. of Enterprise Services is leading efforts to achieve carbon reduction and energy efficiency improvements throughout state government including meeting goals established by Governor Inslee's Results Washington, a performance management initiative.

- Carbon pollution limits

The state Department of Ecology is reviewing the state's greenhouse gas emission limits and recommending updates.

National Climate and Energy Legislation

As reported in the 2014 IRP Progress Report, in June 2014, at the direction of President Obama, the Environmental Protection Agency (EPA) proposed emission guidelines, the Clean Power Plan, for states to follow in developing plans to address greenhouse gas emissions (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.

The final version is the first to set a national limit on carbon pollution produced from power plants. The Plan would lower the carbon dioxide (CO2) emitted by power generators. The Clean Power Plan is designed to strengthen to the trend of clean energy by setting standards for power plants and goals for states to cut their CO2 pollution.

The final version of the Plan aims to:

- Cut CO2 emissions from the power sector by 32% nationwide below 2005 levels by 2030.
- Specifically reducing emissions from coal-burning power plants.
- Increase the use of renewable energy and energy conservation.
- Help persuade other countries that emit large amounts of CO2 to officially pledge to reduce their emissions.

In the June 2014 proposed rule, the EPA argued that because the 1990 Clean Air Act amendment is ambiguous, the EPA's interpretation is entitled to judicial deference. The EPA found that the statute is ambiguous because the language in the U.S. Code is from a May 23, 1990 House amendment that conflicts with a never codified April 3 conforming amendment. After the Affordable Care Act was upheld in June 2015, however, the EPA adopted a more aggressive statutory interpretation. In the final rule from August 3, 2015, the EPA now argued that the Senate's language unambiguously allows it to regulate, while the House language in the U.S. Code should be ignored because it is unreasonable under the Clean Air Act's "comprehensive scheme." Opponents immediately declared that the Clean Power Plan was illegal, attempting to sue before the rule was finalized. Ten days after the final rule was announced, 27 states petitioned the U.S. Court of Appeals for the District of Columbia Circuit for an emergency stay. Challengers argue 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. The EPA's Plan is supported by 18 states. 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 and was the first time the Court had ever stayed a regulation before a judgment by the lower Court of Appeals. The Clean Power Plan will likely remain stayed until after the 2016 presidential election.

The Clean Power Plan as written would have required individual states to meet specific standards with respect to reduction of CO2 emissions. States were free to reduce emissions by various means and would have submitted emissions reductions plans by September 2016, or, with an extension approval, by September 2018. If a state had not submitted a plan by then, the EPA would have imposed its own plan on that state.

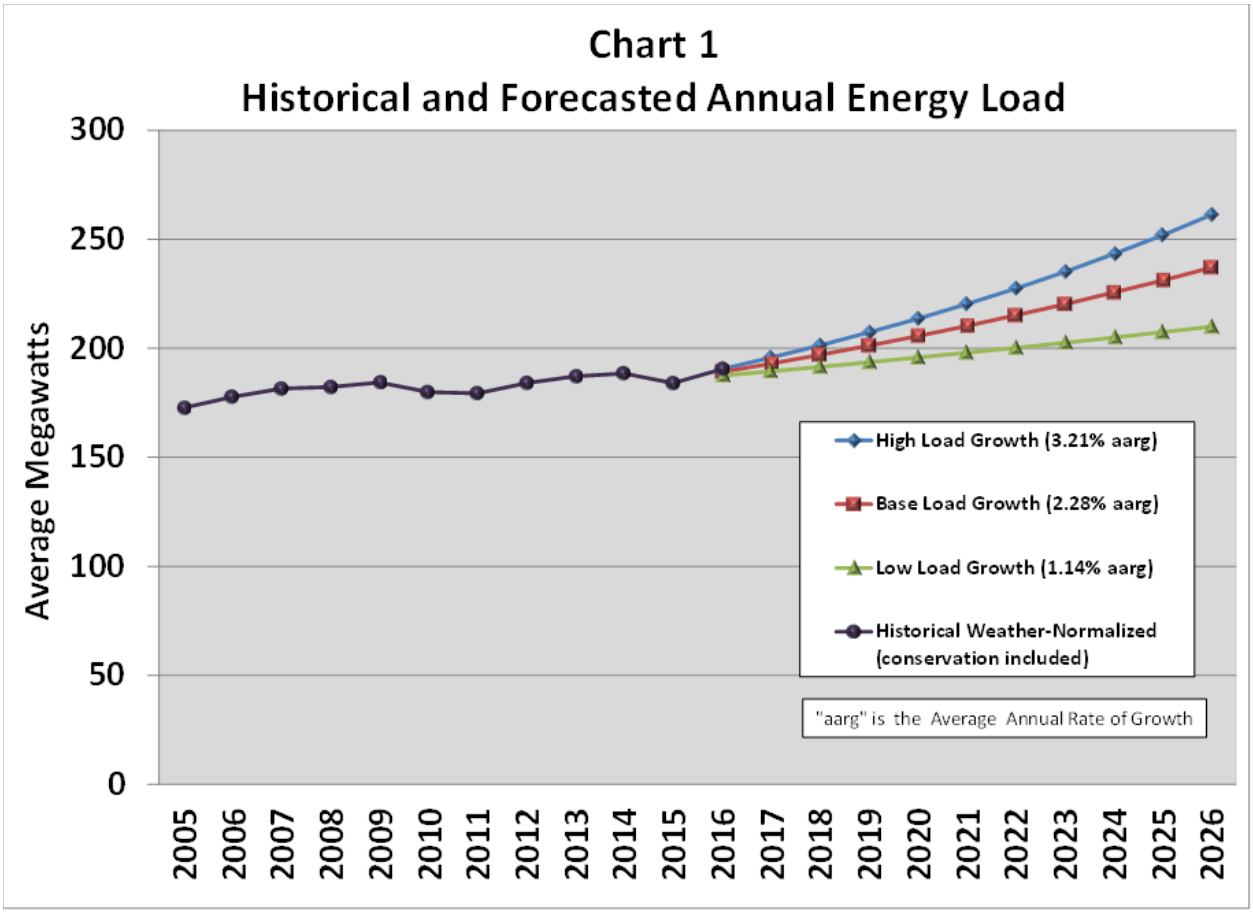
The EPA divided the country into three regions based on connected regional electricity grids to determine a state's goals. States were to implement their plans focusing on three building blocks: increasing the generation efficiency of existing fossil fuel plants, substituting lower CO2 emitting natural gas generation for coal powered generation and substituting generation from new zero CO2 emitting renewable sources for fossil fuel powered generation. States would use regionally available low CO2 generating sources when substituting for in-state coal generation and coordinate with other states to develop multi-state plans.

Load Forecast

A new 11-year econometric retail load forecast was developed for this IRP's 2016-2026 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.

The growth percentages from the sum of the sector energy sales forecasts, with system losses added (3.5%), were applied to the 2015 weather-normalized load to arrive at total projected megawatt-hours through the planning period. **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 1.14%, 2.28% and 3.21%, respectively.** All the forecasts have increased from the 2014 IRP Progress Report. The weather-normalized average annual rate of growth at the District (before the effects of cumulative conservation) was approximately 1.25% for the 10-year period from 2005-2015. The net of cumulative conservation growth percentage was approximately



0.65% for the same 10-year period. This historical net of cumulative conservation growth average has decreased since 2014 in large part due to continued stagnated load growth as well as increased cumulative conservation achievements that began in earnest in 2010. The three forecasts for 2016-2026 as well as the actual weather-normalized total District energy load for 2005-2015 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.

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 2012. To update population projections, the average annual rates of growth for population from the 2012 projections (low, base, high) were retained and applied to the OFM actual population estimate for Chelan County for 2015 to arrive at updated population estimates through the planning period. Additional actual Chelan County population data from the OFM (through 2015) was used to update the various sector regression analyses.

Residential load continues to be projected based upon population. Data for the regression analysis includes only years since 2008 when the District purchased the City of Cashmere's distribution system and these energy sales became integrated with the sector loads for the entire county. Per capita income also showed to be a statistically significant independent variable for residential load, but the correlation for population alone was slightly stronger.

The three average annual growth rates for the residential sector are forecasted at 0.58%, 1.16% and 1.63% with electric vehicle (EV) load included. They have decreased since 2014 due somewhat to actual

population growth not being as high as expected but primarily due to reductions in projections for per customer usage (before the effects of conservation). This is reflective of what the District believes to be recent experience (although an end use survey of the local service area has not been performed) as well as regional forecasts regarding changing federal standards (i.e. more efficient appliances, lighting, etc.) and slower growth in home electronics. The District believes 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.

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 crypto-currency mining operations or more commonly known as co-location server farms. The most common among the numerous crypto-currencies 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. It's exchanged globally between those who collect it and those who accept it as payment. The Bitcoin mining process utilizes 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. Bitcoin miners have been drawn to North Central Washington primarily due to the low cost, reliable and abundant hydroelectric resources. Additionally, moderate temperatures combined with low rent costs and available space in vacant commercial buildings offer the Bitcoin miners a quick and easy setup at very low cost. Chelan PUD has witnessed new Bitcoin mining entrepreneurs from Florida, China, California and many other states across the country. A developing trend in the mining industry is the "pod" which are prefabricated self-contained units that come equipped with racking systems, network connections and electrical service. These pods can be moved in and set up with little effort. The pod is considered a plug and play unit. 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.

The District instituted a moratorium on any new or expanding applications for what are known as High Density Loads (HDL) effective July 2015 that has been extended until October 2016. HDLs 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. Marijuana grow operations are excluded from the HDL moratorium until more information is learned about their impacts on the electrical system. This HDL moratorium affects the Bitcoin mining and has temporarily stabilized their growth as well as other similar server farm operations in the service territory. This load forecast herein represents current policy and known and forecasted new service applications. Pending potential impacts from changes to rates and policies regarding HDLs are not necessarily included.

Additionally, the first legal marijuana growing operations began production in Washington state, including Chelan County, in the past couple of years. Similar to the crypto-currency mining process, these new loads are also energy intensive during the growing process. Largely lighting load, the energy use also includes heating, ventilating and air conditioning (HVAC) and a small increase in energy for water distribution.

For this load forecast, the commercial sales forecast is a function of population only. Like with per capita income for the residential load, sales revenues showed to be a statistically significant independent variable for commercial load, but the correlation for population alone was slightly stronger. The average annual growth rates for the commercial sector are forecasted at 0.54%, 1.02% and 1.41%. Since 2014, the projections are down due primarily to decreases in per customer usage (before the effects of conservation). As with residential load, the District 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 HDL and indoor growing operations. Currently, the District has some of each of these loads in its commercial class. After studying the research performed for the Seventh Power Plan regarding indoor growing operations, the District believes that the potential future increase in this load type is already captured in its commercial sector projections. Potential future larger HDL load additions are captured in the industrial sector forecast.

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 potential larger load additions, including the effects of potential future HDL loads as previously mentioned.

The average annual growth rates for the industrial sector are forecasted at 3.72%, 6.86% and 9.08%. These have all increased since 2014 due to increases in the size of the HDL projections. The projected HDL loads are also the reason for the increase in the overall load forecast since 2014. Industrial sales are now estimated to increase as a percentage of the District's total load through the planning period as commercial sales decrease as well as those belonging to the residential and "other" sectors.

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.

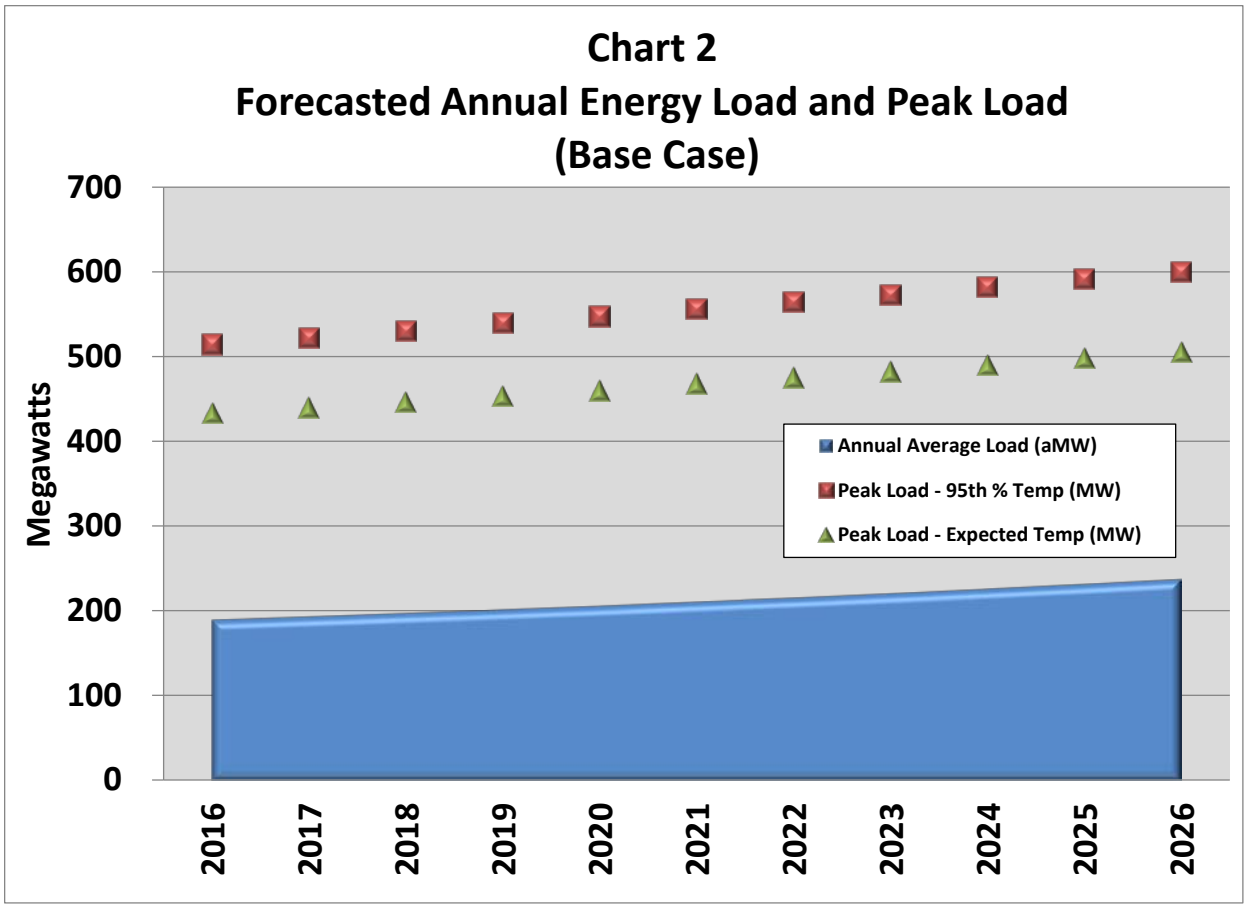
The District has not studied the potential effects of distributed solar photovoltaic generation on retail load in its service area but believes it to be negligible during the current planning period.

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 February 2014. The peak of 464 MW was established when the temperature was approximately 5.5 degrees Fahrenheit. This occurred on a weekday (Thursday) morning when peak demands are usually higher given business and other commercial needs.

Newly updated seasonal regression equations with temperature at time of peak as the independent variable were developed from recent peak hour load and temperature data to project peak load at a given temperature. A 1.10% average annual rate of growth (shaped by month) was applied throughout the planning period. This rate is slightly higher than what the base load forecast would have been without the HDL projections. While HDL loads would add some peak demand, it is not expected to be commensurate with their total growth as most HDL is not weather-sensitive. This resulted in an average annual peak load growth rate in January of 1.56%. This is slightly higher than January peak growth rates over the last 10 years, however the average peak load tends to swing relatively widely from year to year. Chart 2 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 2016-2026.



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 February of 2015, over 300,000 EVs were sold nationwide. Although national availability of EVs has been limited, Washington and Oregon were among states where EVs have been available for purchase. As of July 2015, there were 22,650 EV light vehicles in operation in the region, 42 of which are in Chelan County.

The District has consistently relied on the Council for its basic EV load forecasting methodology and assumptions. The Council updated some of its assumptions in the Seventh Power Plan, including electricity use per vehicle/mile, improvements in efficiency over time and the number of EVs on the road. The District continues to use the Council's basic methodology, however, based on EV market share, or penetration rates, experienced in the District's service area, the District reduced market share for EVs in its overall low, base and high load forecasts through the 2016-2026 planning period. By the end of the planning period, the rates vary from 5% to 16% in the three cases. The three cases now result in forecasts of between .27 and 0.93 aMW by 2026. Peak load estimates now range from 0.56 MW to 1.93 MW in 2026. 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 reported in the 2014 IRP Progress Report, in late February 2014, Grant County PUD discovered a two-inch-wide by 65-foot-long underwater crack in a concrete spillway pier at its Wanapum Project. In response to the crack, Grant PUD took immediate action to drawdown the reservoir behind Wanapum to relieve pressure on the structure and allow for further inspection. Grant PUD worked with internal and external experts, including FERC officials, to determine the cause and extent of the damage and the best way to fix it. Ultimately the cracked pier was anchored into the river bedrock along with other dam structures to reinforce and stabilize the project. The Wanapum forebay elevation was raised back to its normal operating elevation in March 2015.

As reported in 2014, 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 (64 weeks each) to make more permanent repairs with the goal of having all four units with long-term repairs completed by late 2020. The remaining seven smaller units at Rocky Reach do not share the same design and will continue to operate.

Additionally, in late April of 2014, the Rocky Reach large unit C11 was removed from service for investigation of a possible fault in the generator stator winding. Testing revealed an internal strand to strand failure in the A phase of the generator's winding requiring the replacement of two full coils and five half coils for the final repair. Post repair testing on A, B and C phases has indicated no further damage in the stator winding and the unit returned to service in late June 2014.

In January 2015, a strong smell of burning or hot electrical insulation was detected and unit C8 was promptly removed from service. Subsequent inspections and testing revealed strand to strand shorts in the B phase of the stator winding. The burn was not confined to the jumper itself but appeared to extend into the slot area. Shorts in the A and C phases were also confirmed: five shorts in A phase, eight in C phase and two additional shorts in B phase.

In February 2015, unit C10 was removed from service for a pre-planned inspection of the interim

repairs on the turbine hub. During this outage, District staff also inspected end turns on the stator winding. A burned spot on one of the end jumpers was observed. Subsequent inspections of the burned area indicated that the burn spot on the winding insulation was due to an external heat source and not due to winding failures. However, additional testing on the stator indicated several shorts on four of the six stator circuits. Only two circuits are free of shorted strands. Additional temperature and smoke monitors were installed and frequency of personnel walk-throughs was increased to aid in early detection and C10 was returned to service in May 2015. In June 2015, operators observed the smell of hot insulation from the stator windings of C10, the smoke alarms actuated and the unit was shut down. Follow up testing confirmed the presence of additional strand shorts. A contract was prepared and awarded to isolate the shorted windings and make repairs. If repairs are unsuccessful, the entire generator will be rewound beginning in June 2016 and would be expected to return to service in October 2016.

The stator winding failures observed on C11, C8 and C10 are also a potential concern for C9. There are no known strand to strand shorts in C9, but it is expected to be in similar states of winding deterioration as the other three units. The seven smaller units at Rocky Reach do not share the same design. C8 through C11 all have planned repairs for the turbine/servo-motor rod as discussed previously. Each generator stator is planned to be rewound during the same time the turbine is repaired.

In 2015, during the Rock Island unit B2 generator rehabilitation work, fatigue cracks were observed on the blades of the turbine. Through early 2016, District staff made repeated attempts to grind out the cracks and repair the resulting excavations with welding procedures. After each repair procedure, inspections resulted in the observation of new fatigue cracks. Preliminary material and engineering analysis suggest the B2 turbine may be experiencing a phenomenon referred to as corrosion fatigue. Until the District can reliably determine the nature of the observed cracks, B2 will remain out of service indefinitely or until the District can evaluate potential alternatives, of which one alternative is the design, procurement and installation of a replacement turbine runner.

The turbines of units B1, B3 and B4 are of similar design and vintage as B2. Inspections have been performed and revealed similar cracking exists in their turbine runner blades. These District is expecting to schedule these units for rehabilitation.

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.

As reported in 2014, 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.

No further information has been made available by the federal government. 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. How or if operations under the Treaty, or the Treaty itself, may change and whether or not the U.S. will decide to discuss any matters with Canada is not yet determined and is ultimately a matter for the President. The U.S. Entity is committed to supporting this effort. Further updates will be provided in this forum as the national level review progresses and there is new information to share.

Climate Impacts to Loads and Resources

There are at least two ways in which climate change can affect the power industry. First, long-term changes in temperature will alter electricity demand and change precipitation patterns, river flows and hydroelectric generation. Second, policies enacted to reduce GHG will affect future resource choices. This section is focused on the first of these potential effects.

In the Seventh Power Plan, Council analysis shows that climate induced changes to loads and river flows will not affect resource choices during the near term. However, beyond 2026, if load growth is higher than average, resource decisions would be different under a scenario in which climate change is considered. Because of this, the Council will continue to monitor and participate in efforts to improve climate change data and analysis, as provided by the Intergovernmental Panel on Climate Change (IPCC) and regional entities that downscale that data for Northwest use. The most recent IPCC report (Assessment Report (AR) 5) indicates that future global temperatures are very likely to increase. Data collected from global climate modeling will not be downscaled and processed for the Northwest region until early 2017. However, some of the new IPCC data can be used in combination with existing data to analyze potential physical impacts to the Northwest power system.

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.

Generally, results from the most relevant GCMs are downscaled for the Northwest by several groups in the region, in particular the Climate Impacts Group at the University of Washington in conjunction with the River Management Joint Operating Committee (RMJOC). The BPA, the Corps of Engineers and the Bureau of Reclamation have initiated a regional process to collect, review and make available all climate change data related to river operations. This process is being developed under the auspices of the RMJOC and will ultimately result in a web-based database that will include climate change data needed to perform river operation analyses. The downscaled data will include, among other things, 1) a set of climate change adjusted unregulated river flows (including an appropriate set of reservoir rule curves); and 2) a set of projected monthly and daily temperature changes for future years. The temperature data are used to adjust future load forecasts and the river flow data are used as input to

resource modeling to determine the output of the region's hydroelectric system. As previously mentioned, the RMJOC is scheduled to complete its work to translate the AR5 results into useable data by early 2017.

From previous climate modeling downscaling efforts, 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. The power supplies for both 2026 and 2035, as projected by the Council under a future high load path, were examined under two scenarios, one without climate change and one with projected climate change effects. Results show that the 2026 power supply meets the Council's adequacy standard in both cases. Thus, up through 2026, no additional resources are required to maintain an adequate supply, even under a climate change scenario. The same is true in 2035 for the no climate change case. However, 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.

Chelan PUD's response will depend significantly on how river flows are reregulated by Grand Coulee. Therefore, it will be extremely difficult for the District to predict changes to its generation under a future climate change scenario. However, 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 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.

The 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 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 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 amount of wind generation. They can also sell the RECs for this generation. The value of these items combined is somewhere 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 remains at its current level through 2016 and starts 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 includes an extension of the solar investment tax credit (ITC), which will also be subject to a phase out. Solar projects that are under construction by December 2019 will fully qualify for the 30% ITC. The credit will fall to 26% for projects starting construction in 2020 and 22% for projects staring construction in 2021.

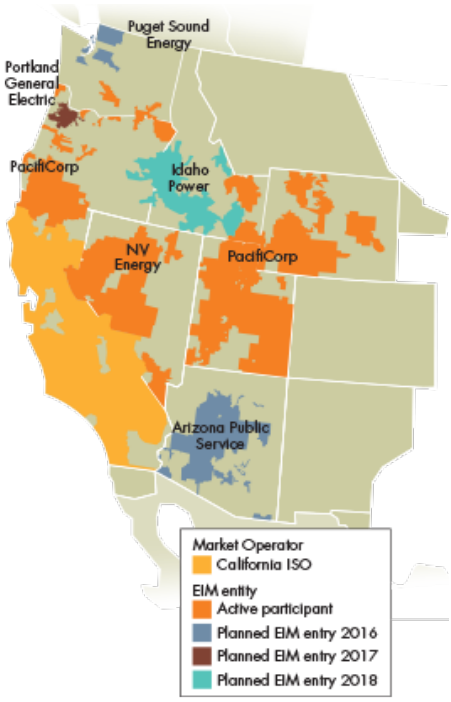
Chelan PUD's share of Nine Canyon wind is a relatively small portion of its overall resource portfolio (less than 1%). In most cases, the District is able to integrate this wind operationally without issue due to its hydro resource reserves. The District may have to sell at negative prices when it has already reduced its hydro generation as much as possible under certain operating circumstances.

Energy Imbalance Market

An Energy Imbalance Market (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 Balancing Authorities (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 EIM: Nevada Energy, Puget Sound Energy, Arizona Public Service, Portland General and Idaho Power. Additionally, PacifiCorp announced its intention to join the CAISO as a Participating Transmission Owner (PTO) (joining the CAISO as one BA and a full market participant beyond just the EIM). PacifiCorp's process is likely to take multiple years since it has six state utility commissions to work with to get approvals. PacifiCorp is likely to join the CAISO as a PTO in 2019. This transition of PacifiCorp may be followed by others entities. Figure 1 is a map depicting the EIM footprint.

Figure 1- Energy Imbalance Market Footprint
(http://www.caiso.com/informed/PublishingImages/EIMmap.png)

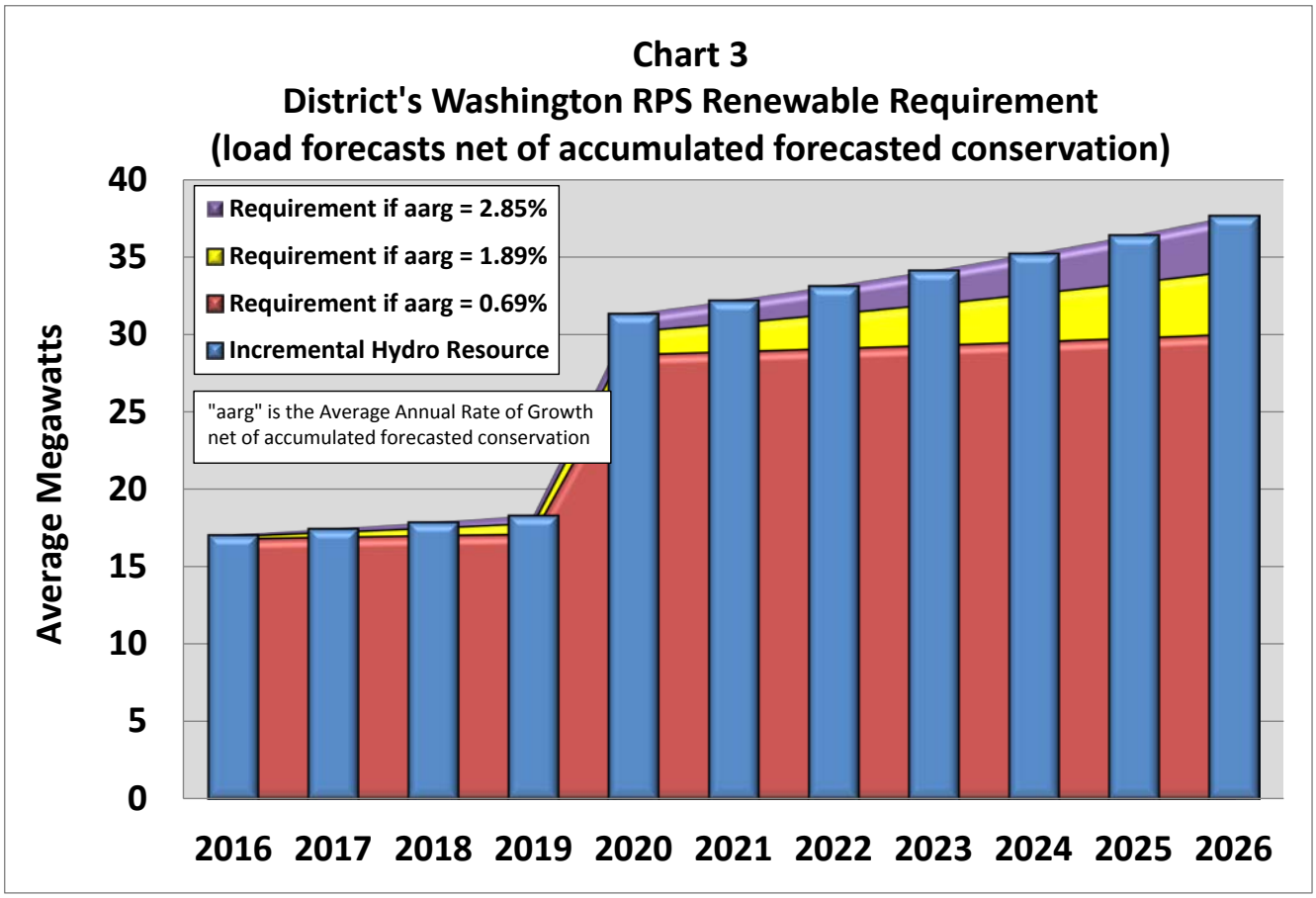


The District is actively following the EIM activity and will continue to assess the impact that such a market has on the region and the District.

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 meeting 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 17-19 aMW in 2016-2019 and approximately 29-38 aMW in 2020-2026. Chart 3 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 Washington Administrative Code (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. In 2012 and 2014, the District utilized this process to confirm incremental hydropower from both Rocky Reach and Rock Island as qualified under the Washington State RPS.

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 2015, Chelan PUD submitted its most recent update. In May 2016, the District submitted its third bi-annual conservation report to Commerce. The report documented the District's progress in 2014 and 2015 toward meeting the targets that were established in 2013 to comply with the RPS.

Even year reports are audited for RPS compliance by the Washington State Auditor. The District's June 2014 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 2016-17 biennium, in 2015 the District used a utility-specific analysis, also known as a conservation potential assessment (CPA). This CPA, which was conducted by EES Consulting (EESC), established the conservation targets that are used in this 2016 IRP. 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.

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 2014 through 2015, preliminary results show that the District saved 3.65 aMWs. Of that total, the breakout was as follows: industrial 0.56 aMW, residential 1.02 aMW, District's share of the Northwest Energy Efficiency Alliance (NEEA) 1.29 aMW, commercial 0.78 aMW and agricultural 0.008 aMW.

The 2015 CPA provides estimates of energy and peak demand savings by sector for the period 2016-2035. 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 2015 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 2014 commercial sales/consumption data

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 9 aMW. The total 20-year energy efficiency potential is approximately 17.5 aMW.

Table 1
2015 Conservation Potential Assessment
Cost-Effective & Achievable Savings aMW

Sector	2 Year	5 Year	10 Year	20 Year
Residential	.75	2.01	3.83	7.10
Commercial	.41	1.22	2.56	5.02
Industrial	.40	1.00	1.93	3.49
Distribution	.03	0.13	0.42	1.23
Agriculture	.06	0.17	0.34	0.61
TOTAL	**1.66**	**4.53**	**9.09**	**17.45**

Chart 4 illustrates the 10-year conservation potential and two-year target on an annual basis. This CPA shows potential starting at just over 0.8 aMW in 2016 and ramping upward to approximately 1.0 aMW by 2020. Over the full 10-year planning period, the potential drops slightly after 2020 due primarily to the completion of some earlier measures.

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 2016-2025 period, 27% of the projected energy savings in the residential sector is expected to come from lighting and 33% from heat pump upgrades. An additional 21% is expected to come from hot water energy savings, which is primarily from heat pump water heaters. Envelope improvements, consumer electronics and appliances make up the remaining 19%.

Commercial

Lighting measures are projected to comprise approximately 29% of the commercial savings for the 2016-2025 period. A significant portion of this will be the conversion of existing light sources to light-emitting diode (LED) technologies.

HVAC controls are expected to provide about 26% of the savings. Replacing electric resistance heating with air source pumps is expected to account for 16% of the projected commercial energy savings.

Building insulation and windows are estimated to make up 13% of the projected savings, followed by 10% for refrigeration savings at commercial refrigerated fruit warehouses.

During 2016 and 2017, the District will be conducting detailed energy conservation potential assessments at more than 500 businesses in Chelan County. This will provide a much more accurate estimate of the energy savings potential that exists in the commercial sector in Chelan County. During 2016, the District is also doing 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.

Industrial

The largest portion of the industrial potential is in the refrigerated storage sector, which is consistent with its majority of the industrial energy consumption. The energy savings in this sector consist of speed

controls on large ammonia compressors and on refrigerated room fan motors.

Agriculture

The irrigated agriculture sector is a small portion of Chelan PUD's load and, therefore, the energy efficiency potential is relatively small. There is some potential in upgrading irrigation hardware, which in turn reduces pumping energy. The two-year irrigation hardware upgrades potential is 0.06 aMW and the five-year potential is 0.17 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 0.05 aMW, and the five-year potential was calculated to be 0.21 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.

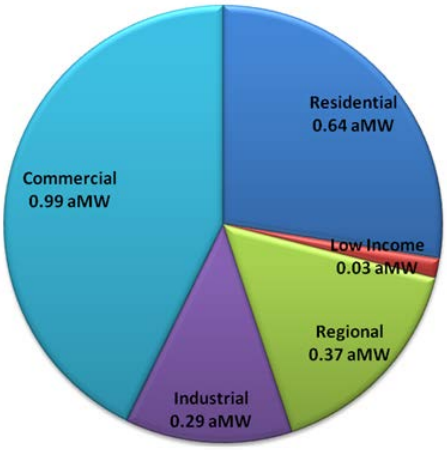
Budget costs can be estimated at a high level based on the incremental cost of the measures. If Chelan PUD spends 40% of incremental measure cost on incentives and has an overall administrative cost of 20% of measure cost, then it will need to spend approximately $2.9 million to acquire the CPA conservation in 2016 and 2017. There are many factors that could result in either higher or lower costs.

As mentioned previously, EESC 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 cost for all conservation measures that resulted from the 2015 assessment was $20.06/MWh over the 2016-2035 period (2015 real dollars).

Current Demand-Side Offerings

The goal of Chelan PUD conservation programs is to offer diversified, cost-effective conservation programs 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 2016 expected energy savings are represented in Figure 2.

Figure 2- 2016 Budgeted Conservation Programs



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:

- $8 per square foot on qualifying glass doors and windows. To qualify, new windows must have a U-factor of .22 or lower.
- $6 per square foot on qualifying glass doors and windows. To qualify, new windows must have a U-factor of .30 or lower. Qualifying glass doors must have a U-factor of .35 or lower.
- $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 .30 or lower. Qualifying glass doors must have a U-factor of .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.

Retail buy-down of CFL and 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.

Northwest Energy Efficient Manufactured Housing Program (NEEM)

Incentives of $1000 are available to Chelan County residents who purchase and site in the county an Energy Star® or Eco-Rated manufactured home.

Energy Efficient Appliance Rebate Program

Energy Star® rated refrigerators and washing machines qualified by the Consortium for Energy Efficiency (CEE) are eligible for rebates. Customers purchase qualifying products and submit an application and a copy of the receipt and model number. Chelan's conservation team verifies that the appliance is qualified and pays the incentive by check.

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 $750 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 1 greater than 75 gallons or Tier 2 or greater model in any size.

Residential Single Family New Construction

In 2016, 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 2016 plan.

Residential Audits

Over the next three years, the District intends to offer 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 2016 and to scale up in 2017.

Residential Mail-In

The Seventh Power Plan developed by the Council calls for measures such as plug load management, showerheads and residential lighting still to be a large part of the mix for residential conservation. Chelan County PUD plans to offer customers a mail-in program that may offer a package with a mix of LED screw-in light bulbs, a quality water saver showerhead and a Tier 2 plug strip at a discounted cost to its customers.

Public Street and Area Lighting Conversion to LED Study

In 2016, the District is conducting a study that will inventory and assess every public and District-owned street light in Chelan County to determine the viability of replacing it with LED technology. The analysis is expected to be completed in 2016. Based on the recommendations and economic viability, the District will then decide which lights should be retrofitted starting in 2017.

Commercial Building Audits

During 2016, the District will be conducting energy efficiency evaluations at hundreds of commercial business to determine the actual amount of cost-effective conservation potential that exists within each of the major business sectors. The information will be 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. This legislation gives the District additional flexibility in future energy efficiency planning. Chelan PUD expects to exceed its conservation targets that were established at the end of 2015.

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 (2016-2026) 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 5 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 2015 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 2015. Columbia River runoff conditions were 92% of average in 2015. Wind generation conditions at Nine Canyon were below average at 89%. The column on the right was calculated using actual 2015 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) and wind variability. 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
2015

Project	$/MWh w/actual generation	$/MWh w/average generation
Rocky Reach	$17.03	$15.70
Rock Island	$35.12	$35.11
Lake Chelan	$18.60	$19.81
Nine Canyon	$75.65	$68.01

Chart 5 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:

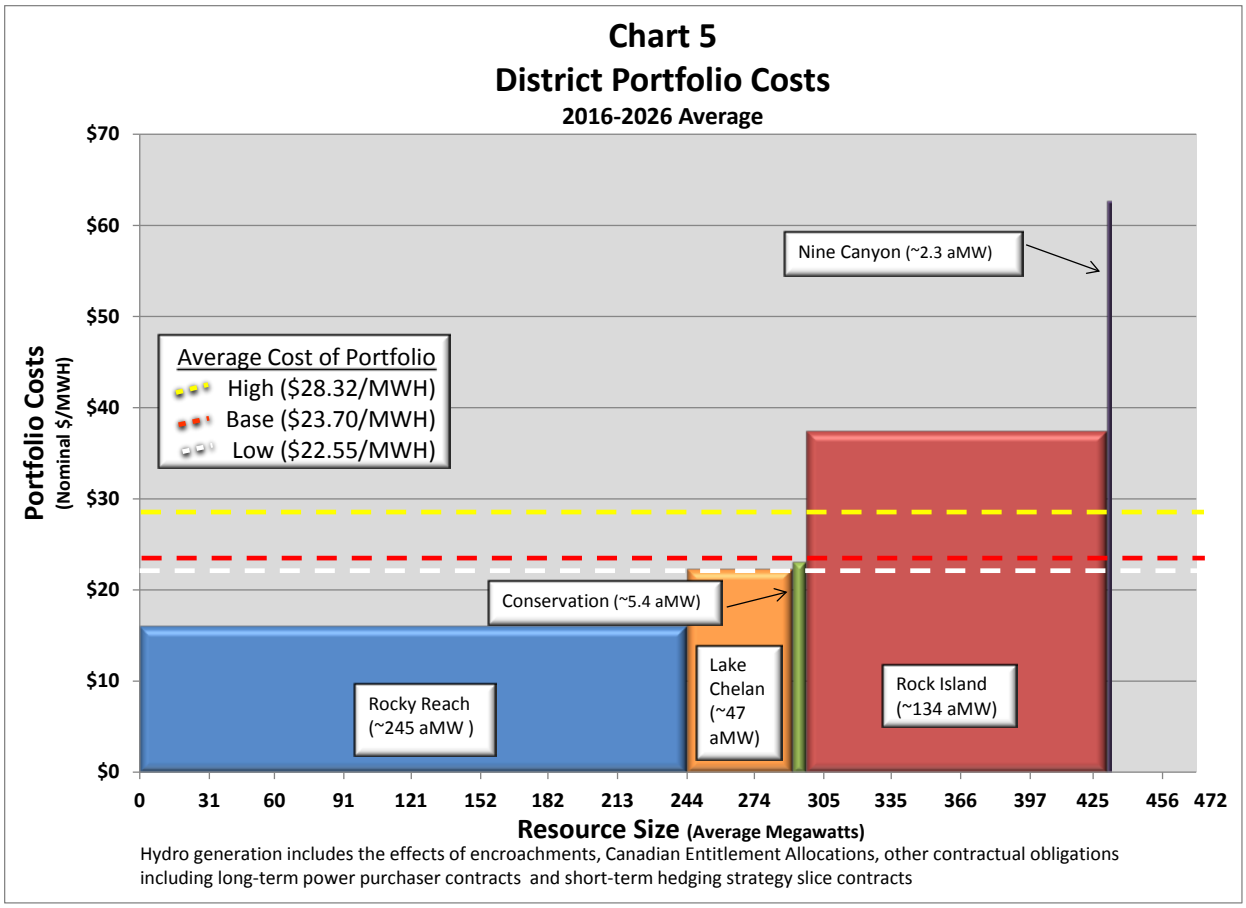
- Capital Recovery Charge (base scenario-50% of average annual capital expenditures)
- Debt Reduction Charge (base scenario-3% of outstanding project debt)

Examples of significant capital and/or operational requirements include, but are not limited to:

- Costs associated with license and habitat conservation plan 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 – 3.0%
- Lake Chelan – 3.0%



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 raised 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

As mentioned in previous reports, Chelan PUD has developed a comprehensive forward hedging strategy.

The District pursues the sale of market-based products such as shorter-term 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 five years into the future. These contracts will have a maximum term of five years and can be executed up to one year in advance of a five-

year term. Typically, the District uses a stair-stepped approached to hedging with more hedged in the current year and slightly less hedged in future years. As of mid-2016, shorter-term slice and block contracts have been executed for as far out as 2021.

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.

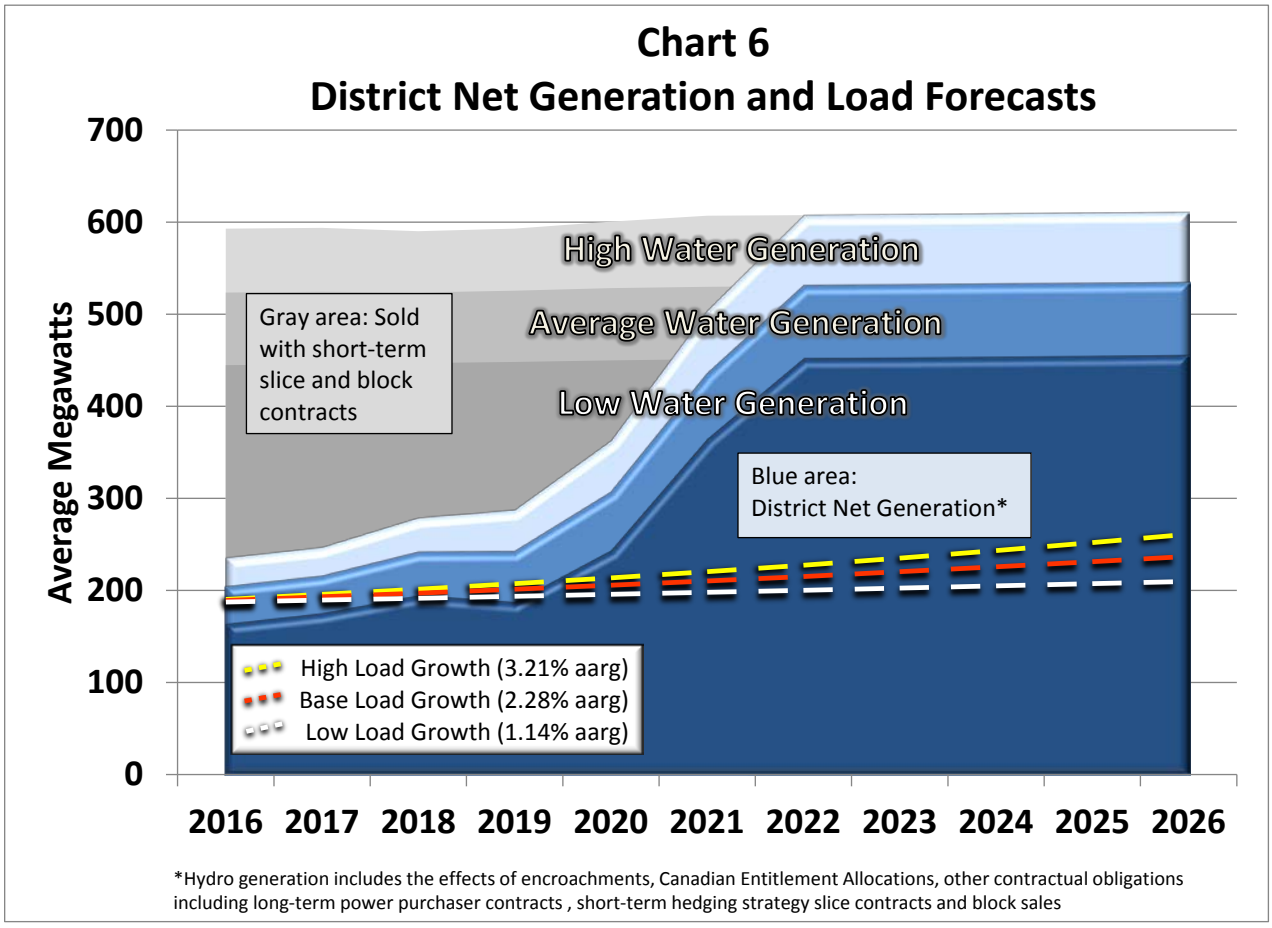
Although it is not adding new resources, the District is focused on three major categories of risk which include uncertainties related to:

- 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, 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 6 represents each of these levels of generation 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 decreased from what was included in the 2014 Progress Report to match Chelan PUD's 2016 required 10-year conservation plan submittal to Commerce that is approximately 0.90 aMW per year through the study period (based on the 2015 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 2014, based on the amount of wholesale purchases the District made, as well as the overall Northwest Power Pool Net System Fuel Mix for 2014.

The cost of air emissions from CO2 remain an industry uncertainty. 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
2014 Fuel Mix

Generation Type	District Calculated Fuel Mix	NWPP Net System Fuel Mix
Biomass	0.04%	0.33%
Coal	1.62%	15.27%
Cogeneration	0.00%	0.00%
Geothermal	0.00%	0.02%
Hydro	97.50%	65.07%
Landfill Gases	0.01%	0.11%
Natural Gas	0.64%	11.38%
Nuclear	0.13%	5.03%
Other	0.01%	0.07%
Petroleum	0.01%	0.07%
Solar	0.00%	0.01%
Waste	0.03%	0.22%
Wind	0.01%	2.42%
TOTAL	100.00%	100.00%

Short-Term Plan

The following is a new "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.
- 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.

- 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.
- 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.
- 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.
- Participating in the NEEA regional collaboration to improve energy efficiency of new consumer products.
- 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.
- In 2016, the District is looking at implementing new residential programs such as a new home construction.

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.
- 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.
- 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.
- 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.
- Continue to closely monitor District HDL rates, policies and load growth to aid in future load growth forecast development.

Final Remarks

Chelan PUD intends to retain its existing supply-side resources while implementing its 2015 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 Progress Report to this IRP in 2018

Appendix A – Portfolio Detail & Assumptions

Resources

Hydro

- To represent the stream flow uncertainty, historical monthly re-regulated stream flow data, 1929-1997, supplied by PNUCC and actual hydro project data from 1998-2011 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)
    - 18.46% -1/2016 through 12/2017
    - 23.46% -1/2018 through 12/2018
    - 28.46% -1/2019 through 12/2019
    - 33.46% -1/2020 through 12/2020
    - 38.46% -1/2021 through 12/2021
    - 43.46% -1/2022 through 12/2026
- Rock Island – Chelan PUD's share (net of long-term purchaser contracts and executed slice contracts)
    - 24% - 1/2016 through 12/2017
    - 29% - 1/2018 through 12/2018
    - 34% - 1/2019 through 12/2019
    - 39% - 1/2020 through 12/2020
    - 44% - 1/2021 through 12/2021
    - 49% - 1/2022 through 12/2026
- Lake Chelan – Chelan PUD's share
    - 100% - 1/2016 through 12/2026

Wind

- All available historical Nine Canyon hourly wind generation (2004-2015) was used to calculate average energy

Conservation

- Used the quantities from the 2015 CPA (also used for RPS compliance in January 2016)

Contracts

Long-term Power Sales

- Rocky Reach
  - Puget – 25% - 1/2016 through 12/2026
  - Alcoa – 26% - 1/2016 through 12/2026
  - Douglas – 5.54% - 1/2016 through 12/2026
- Rock Island
  - Puget – 25% - 1/2016 through 12/2026
  - Alcoa – 26% - 1/2016 through 12/2026

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 25% of the capacity and energy of Rocky Reach and Rock Island from 2016-2026
- 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 : 1.14%-low, 2.28%-base, 3.21%- 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)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Net Rocky Reach Gen	131	131	166	202	238	274	309	309	309	309	309
Net Rock Island Gen	80	80	97	114	131	148	165	165	165	165	165
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	0.80	1.66	2.57	3.54	4.53	5.50	6.44	7.36	8.23	9.09	9.93

Appendix B – Washington State Electric Utility Integrated Resource Plan Cover Sheet 2016

	Base Year			5 Year Estimate			10 Year Estimate		
Estimate Year		2015			2021			2026	
Period	Winter	Summer	Annual	Winter	Summer	Annual	Winter	Summer	Annual
Units	(MW)	(MW)	(MWa)	(MW)	(MW)	(MWa)	(MW)	(MW)	(MWa)
Loads	416.00	235.00	185.00	468.00	253.00	210.00	505.00	266.00	237.00
Exports									
Resources:									
Future Conservation/Efficiency				9.24	6.71	5.50	16.68	12.11	9.93
Demand Response				20.00	20.00	0.00	20.00	20.00	0.00
Cogeneration									
Hydro	419.00	220.00	189.00	770.00	386.00	338.00	858.00	428.00	375.00
Wind	0.01	0.21	2.00	1.94	0.50	2.25	1.94	0.50	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	419.01	220.21	191.00	801.18	413.21	345.75	896.62	460.61	387.18
Load Resource Balance	3.01	-14.79	6.00	333.18	160.21	135.75	391.62	194.61	150.18

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

- Requirements
  - Loads
    - Peak loads are based on an average an annual peak growth rate of 1.10%.
    - Annual energy loads are based on the District's Base Load Growth Forecast of 2.28%.
    - Peak and annual energy loads, including the base year (2015), 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 (2015) wind data reflects actual Nine Canyon experience in that year.
    - 2021 and 2026 projected peak wind capacity is based on median (50th percentile) hourly Nine Canyon historical generation (2004-2015).
    - 2021 and 2026 projected average annual wind energy is based on median (50^{th} percentile) average annual energy from Nine Canyon historical generation (2004-2015).

Acronyms

aarg	Average Annual Rate of Growth
aMW	Average Megawatt
APGI	Alcoa Power Generating, Inc.
BA	Balancing Authority
BAA	Balancing Authority Area
BPA	Bonneville Power Administration
CAISO	California Independent System Operator
CDCAC	Chelan-Douglas Community Action Council
CEA	Canadian Entitlement Allocation
CEE	Consortium for Energy Efficiency
CERT	Carbon Emissions Reduction Taskforce
CFL	Compact Fluorescent Lamp
CIG	Climate Impacts Group
CO2	Carbon Dioxide
CPA	Conservation Potential Assessment
DEI	Distribution Efficiency Improvements
DR	Demand Response
EESC	EES Consulting, Inc.
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
IPCC	Intergovernmental Panel on Climate Change
IRP	Integrated Resource Plan
ITC	Investment Tax Credit
KW, kWh	Kilowatt, Kilowatt-hour
LED	Light-Emitting Diode
LOLP	Loss of Load Probability
Mid-C	Mid-Columbia
MW, MWh	Megawatt, Megawatt-hour
NEEA	Northwest Energy Efficiency Alliance
NEEM	Northwest Energy Efficient Manufactured Housing Program
NWPCC	Northwest Power and Conservation Council
NWPP	Northwest Power Pool
O&M	Operations and Maintenance
OFM	Office of Financial Management (Washington State)
OMP	Oversupply Management Protocol
PNDRP	Pacific Northwest Demand Response Project
PTC	Production Tax Credit
PTCS	Performance Tested Comfort System
PTO	Participating Transmission Owner
PUD	Public Utility District

RAAC	Resource Adequacy Advisory Committee
RCW	Revised Code of Washington
REC	Renewable Energy Credit
RMJOC	River Management Joint Operating Committee
RPS	Renewable Portfolio Standard
RTF	Regional Technical Forum
SEER	Seasonal Energy Efficiency Ratio
SEM	Strategic Energy Management
VAR	Volt-Ampere Reactive
WAC	Washington Administrative Code
WECC	Western Electricity Coordinating Council
WSU	Washington State University

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.

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 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)

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…" Chelan PUD's next Progress Report will be published in 2018.

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 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.