Chelan County Public Utility District No. 1

2015 Conservation Potential Assessment

November 18, 2015*

Prepared by:

EES Consulting

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* Revised May 2, 2016

November 18, 2015

Mr. Jim White
Chelan County Public Utility District
Post Office Box 1231
327 N. Wenatchee Avenue
Wenatchee, WA 98807

SUBJECT: 2015 Conservation Potential Assessment – Final Report

Dear Jim:

Please find attached Final Report summarizing the 2015 Chelan Public Utility District Conservation Potential Assessment (CPA). This report covers the time period from 2016 through 2035 (20 years). Significant changes have occurred since the last CPA due to updated measure and appliance standard information. The overall energy efficiency potential is significant, but due to changes in market conditions and measures since the Sixth Power Plan, it is lower than the previous assessment.

We would like to acknowledge and thank you and your staff for the excellent support in developing and providing the baseline data for this project.

Best Regards,

Gary Saleba
President

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Executive Summary

This report describes the methodology and results of the Chelan County Public Utility District (Chelan PUD) 2015 Conservation Potential Assessment (CPA). This assessment provides estimates of energy savings by sector for the period 2016 to 2035. The assessment considers a wide range of conservation resources that are reliable, available and cost-effective within the 20-year planning period.

Chelan PUD provides electricity service to approximately 48,000 customers in Chelan County, Washington. Washington's Energy Independence Act (EIA), effective January 1, 2010, requires that utilities with more than 25,000 customers (known as qualifying utilities) pursue all cost-effective conservation resources and meet conservation targets set using a utility-specific conservation potential assessment methodology.

The EIA sets forth specific requirements for setting, pursuing and reporting on conservation targets. The methodology used in this assessment complies with RCW 19.285.040 and WAC 194-37-070 Section 5 parts (a) through (o) and is consistent with the methodology used by the Northwest Power and Conservation Council (Council) in developing the Sixth Power Plan. Thus, this Conservation Potential Assessment will support Chelan PUD's compliance with EIA requirements.

This assessment builds on Chelan PUD's CPA conducted in 2011, and updated in 2013, by utilizing the same methodology and similar models. However, significant changes in the marketplace have taken place since 2010; many of these changes are documented in the Council's Sixth Power Plan Mid-Term Assessment[1]. As a result, substantial revisions to the planning assumptions were required for this CPA. The primary model updates include the following:

- New Avoided Cost – recent forecast of power market prices
- Updated Financial Parameters – including discount rate, transmission and distribution credits, risk credits and other inputs
- Updated Customer Characteristics Data
  - New commercial data from the 2014 Commercial Building Stock Assessment (CBSA)
  - Updated kWh consumption and Energy Use Intensity (EUI) data

[1] Northwest Power and Conservation Council. (2013). *Sixth Power Plan Mid-Term Assessment Report*.

- Measure Updates
  - Added new measures from the Regional Technical Forum (RTF) and the Northwest Power and Conservation Council (Council)
  - Removed measures that have expired or are now covered by Federal standards or state energy codes
    - Thirty five new or revised standards have been adopted since the 6th Plan
    - A new edition of the Washington State Energy Code (WSEC) became effective in 2013
  - Revised/updated measure data for existing measures
  - Updated measure saturation data from the Council
- Accounting for Recent Achievements
  - Internal programs
  - NEEA programs

The first step of this assessment was to carefully define and update the planning assumptions using the new data. The Base Case conditions were defined as the most likely market conditions over the planning horizon, and conservation potential was estimated based on these assumptions. Additional scenarios were also developed to test a range of conditions.

Results

Table ES-1 shows the high level results of this assessment. The economically-achievable potential by sector in 2, 5, 10, and 20-year increments is included. The total 20-year energy efficiency potential is 17.45 aMW. The most important numbers per the EIA are the 10-year potential of 9.09 aMW, and the 2-year potential of 1.66 aMW.

Table ES-1
Cost-Effective[2] Potential (aMW)

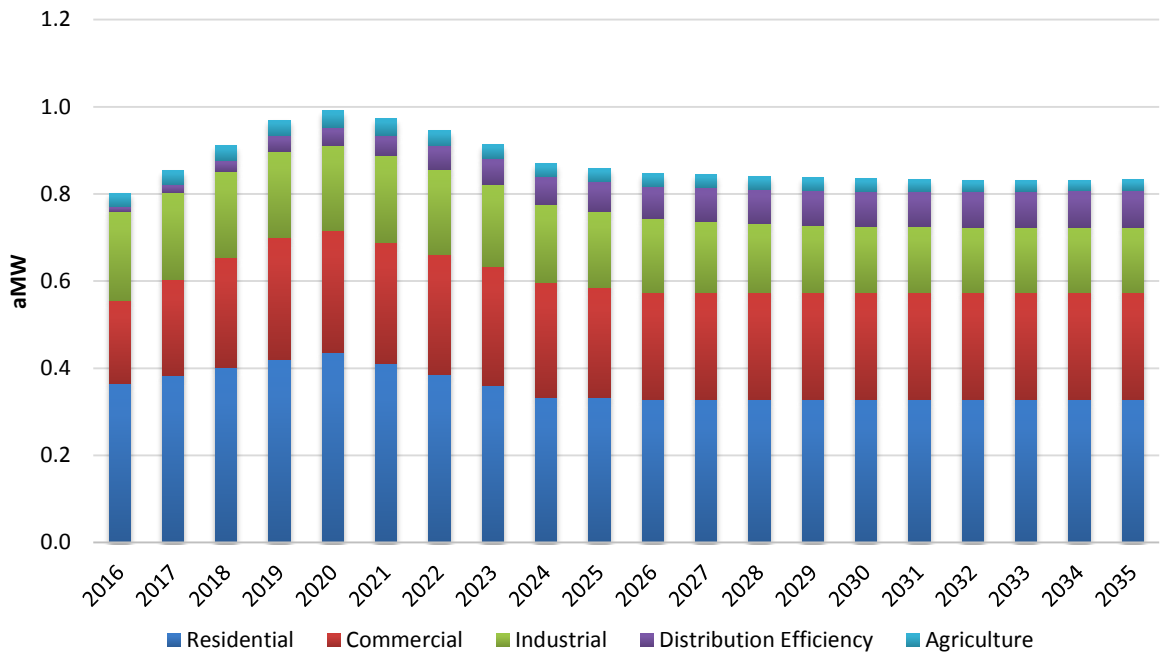
	2 Year*	5 Year	10 Year	20 Year
Residential	0.75	2.01	3.83	7.10
Commercial	0.41	1.22	2.56	5.02
Industrial	0.40	1.00	1.93	3.49
Distribution Efficiency	0.03	0.13	0.42	1.23
Agriculture	0.06	0.17	0.34	0.61
Total	**1.66**	**4.53**	**9.09**	**17.45**

[2] Cost-effective potential identified in this report refers to potential that has passed the Total Resource Cost test and has had the regional applicability factors applied (e.g., 85% for retrofit measures). Cost-effective potential is both cost-effective AND achievable.

These estimates include energy efficiency that could be achieved through Chelan PUD's own utility programs and also through the utility's share of the Northwest Energy Efficiency Alliance (NEEA) accomplishments. In addition, it is likely that some code changes will account for part of the potential, especially in the later years of the 20-year planning period.

The 20-year energy efficiency potential is shown on an annual basis in Figure ES-1. This assessment shows annual potential starting at 0.80 aMW in 2016 and ramping up to 0.99 aMW in 2020. Potential is gradually ramped down through the remaining years of the planning period. Ramp rates from the Seventh Power Plan are used to develop the annual savings potential estimates over the 20-year study. Potential estimates are further accelerated in the early years since conservation is a preferred resource for the utility.

Figure ES-1
Annual Cost-Effective Energy Efficiency Potential Estimates – Base Case Scenario



Comparison to Previous Assessment

Table ES-2 shows a comparison of 10 and 20-year Base Case conservation potential by customer sector for this assessment and the results of Chelan PUD's 2013 CPA.

Table ES-2
Comparison of Cost Effective and Achievable Potential: 2013 CPA vs. 2015 CPA
Base Case, aMW

	10-year		20-Year	
	2013	**2015**	**2013**	**2015**
Residential	4.28	3.83	8.87	7.10
Commercial	4.23	2.56	8.02	5.02
Industrial	2.86	1.93	5.87	3.49
Distribution Efficiency	1.53	0.42	3.73	1.23
Agriculture	0.31	0.34	0.31	0.61
TOTAL	**13.21**	**9.09**	**26.81**	**17.45**

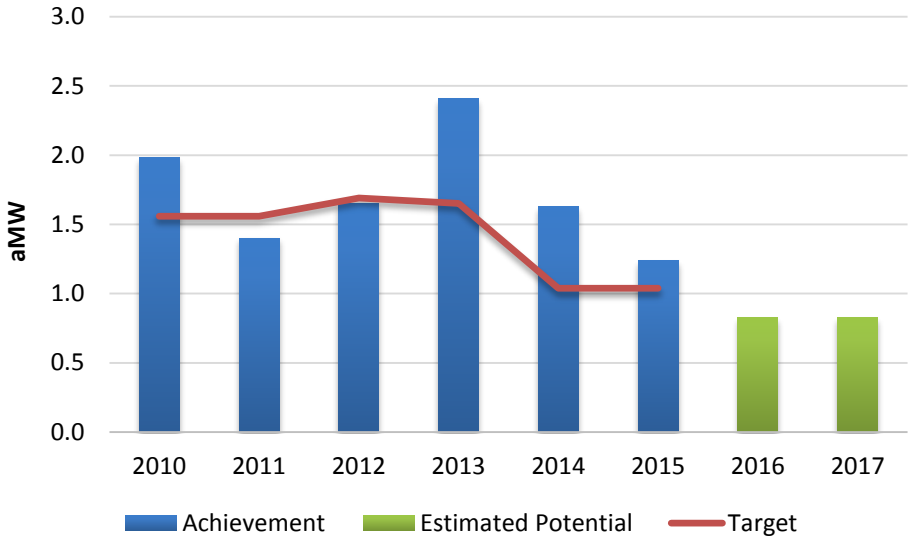
*Note that the 2013 columns refer to the CPA completed in 2013 for the time period of 2014 through 2033. The 2015 assessment is for the timeframe: 2016 through 2035.

The results of this 2015 assessment are lower than the results of previous assessments due to reduced savings values for key measures, new codes and standards, updated financial assumptions and avoided costs, and high achievements by the Chelan PUD. While many new measures were added for the 2015 assessment, the increase in savings estimates from these measures are offset by lower savings in other measure categories, differences in financial assumptions, NEEA program savings, and Chelan PUD's program achievement since the last assessment.

Targets and Achievement

Figure ES-2 compares Chelan PUD's historic conservation achievement with the 2015 CPA potential. The 2016 and 2017 potential estimates are based on the Base Case scenario presented in this report. The biennium potential for this assessment is 1.66 aMW, or approximately 0.83 aMW per year. For comparison, the 2014/15 target was 2.1 aMW (1.05 aMW per year). 2015 savings shown in Figure ES-2 is a combination of estimated remaining savings and year to date achievements. The figure shows that Chelan PUD has consistently met its energy efficiency targets, and that the potential estimates presented in this report are achievable through Chelan PUD's conservation programs and the utility's share of NEEA savings.

Figure ES-2
Comparison of Conservation Targets to Achievements[3]



Conclusion

This report summarizes the CPA conducted for Chelan PUD for the 2016 to 2035 timeframe. Based on the results of the Base Case scenario, the total 10-year cost effective potential is 9.09 aMW and the 2-year potential is 1.66 aMW. The results of this assessment are lower than the previous assessment due to changes in market conditions, code and standard changes, recent conservation achievements, and revised savings values for RTF and Council measures.

[3] Achievement data source: Chelan PUD 2012-2015 Utility EIA Reports. Retrieved from: http://www.commerce.wa.gov/Programs/Energy/Office/EIA/Pages/EnergyIndependence.aspx

Introduction

Objectives

The objective of this report is to describe the results of the Chelan County PUD (Chelan PUD) 2015 Electric Conservation Potential Assessment (CPA). This assessment provides estimates of energy savings by sector for the period 2016 to 2035, with the primary focus on 2016 to 2025 (10 years). This analysis has been conducted in a manner consistent with requirements set forth in 19.285 RCW (EIA) and 194-37 WAC (EIA implementation) and is part of Chelan PUD's compliance documents. Finally, the resulting conservation supply curves can be used as part of the demand-side resources in Chelan PUD's integrated resource plan (IRP).

The conservation measures used in this analysis are based on the most recent set of measures approved by the Regional Technical Forum (RTF) and are representative of the measures that will be used in the Council's Seventh Power Plan. The assessment considered a wide range of conservation resources that are reliable, available, and cost-effective within the 20-year planning period.

Background

Chelan PUD provides electricity service to approximately 48,000 customers located in Chelan County, Washington across a service territory that includes 1,950 miles of distribution lines.

The majority of the utility's power comes from three hydroelectric facilities: Rocky Reach, Rock Island and Chelan Falls, which are all owned by Chelan PUD. Chelan PUD also receives approximately 1 percent of its energy from Energy Northwest's Nine Canyon Wind Project. In accordance with EIA implementation requirements, avoided power acquisition due to conservation is set equal to a forecast of regional market prices. A discussion of Chelan PUD's avoided cost forecast is included in Appendix IV of this report.

Since the passage of Washington's Energy Independence Act (EIA), effective January 1, 2010, Chelan PUD is required to pursue all cost-effective conservation resources and to meet conservation targets. The legislation requires that utilities follow the methodologies used by the Northwest Power and Conservation Council (Council) for their regional power planning. This CPA is consistent with the Council's methodology, so results of this CPA may be used to advise Chelan PUD on reasonable conservation targets for EIA compliance.

Electric Utility Resource Plan Requirements

According to Chapter 19.280 RCW, utilities with at least 25,000 customers are required to develop integrated resource plans (IRPs) by September 2008 and biennially thereafter. The legislation mandates that these resource plans include assessments of commercially available conservation and efficiency measures. This CPA is designed to assist Chelan PUD in meeting these

requirements for conservation analyses. The results of this CPA may be used in the next IRP due to the state by September 2016. More background information is provided below.

Energy Independence Act

Chapter 19.285 RCW, the Energy Independence Act, requires that, "each qualifying utility pursue all available conservation that is cost-effective, reliable and feasible." The timeline for requirements of the Energy Independence Act (EIA) are detailed below:

- By January 1, 2010 – Identify achievable cost-effective conservation potential through 2019 using methodologies consistent with the Pacific Northwest Power and Conservation Council's (Council) latest power planning document.
- Beginning January 2010, 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 ten years.
- By June 2012, each utility shall submit an annual conservation report to the department (the department of commerce or its successor). The report shall document the utility's progress in meeting the targets established in RCW 19.285.040.
- Beginning on January 1, 2014, cost-effective conservation achieved by a qualifying utility in excess of its biennial acquisition target may be used to help meet the immediately subsequent two biennial acquisition targets, such that no more than twenty percent of any biennial target may be met with excess conservation savings.

This report summarizes the preliminary results of a comprehensive CPA conducted following the steps provided for a Utility Analysis. A checklist of how this analysis meets EIA requirements is included in Appendix III.

Study Uncertainties

The savings estimates presented in this study are subject to the uncertainties associated with the input data. This study utilized the best available data at the time of its development; however, the results of future studies will change as the planning environment evolves. Specific areas of uncertainty include the following:

- Customer characteristic data – Residential and commercial building data and appliance saturations are in many cases based on regional studies and surveys. There are uncertainties related to the extent that Chelan PUD's service area is similar to that of the region, or that the regional survey data represents the population.
- Measure data – In particular, savings and cost estimates (when comparing to current market conditions), as prepared by the Council and RTF, will vary across the region. In some cases, measure applicability or other attributes have been estimated by the Council or the RTF based on professional judgment or limited market research.
- Market Price Forecasts – Market prices (and forecasts) are continually changing. The market price forecasts for electricity and natural gas utilized in this analysis represent a snapshot in

time. Given a different snapshot in time, the results of the analysis would vary. However, risk credits are included in the analysis to mitigate the market price risk over the study period.

- Utility System Assumptions – Credits have been included in this analysis to account for the avoided costs of bulk transmission and distribution system expansion and local distribution system expansion. Though potential transmission and distribution system cost savings are dependent on local conditions, the Council considers these credits to be representative estimates of these avoided costs.
- Discount Rate – The Council develops a real discount rate for each power plan based on the relative share of the cost of conservation and the cost of capital for the various program sponsors. The Council has estimated these figures using the most current information. This study reflects the current borrowing market although changes in borrowing rates will likely vary over the study period.
- Forecasted Load and Customer Growth – The CPA bases the 20-year potential estimates on forecasted loads and customer growth. Each of these forecasts includes a level of uncertainty.
- Load Shape Data – The Council provides conservation load shapes for evaluating the timing of energy savings. In practice, load shapes will vary by utility based on weather, customer types, and other factors. Finally, peak savings estimates are based on coincident factors and load factors by end-use. In practice, these data will vary by utility since not all utility peaks occur at the same time and not all customer classes contribute to the peak demand in the same way.
- Frozen Efficiency – Consistent with the Council's methodology, the measure baseline efficiency levels and end-using devices do not change over the planning period. In addition, it is assumed that once an energy efficiency measure is installed, it will remain in place over the remainder of the study period.

Due to these uncertainties and the changing environment, under the EIA, qualifying utilities must update their CPAs every two years to reflect the best available information.

Report Organization

The main report is organized with the following main sections:

- Methodology – CPA methodology along with some of the overarching assumptions
- Recent Conservation Achievement – Chelan PUD's recent achievements and current energy efficiency programs
- Customer Characteristics – Housing and commercial building data for updating the baseline conditions
- Results – Energy Savings and Costs – Primary base case results
- Scenario Results – Results of all conservation scenarios
- Shaped Savings – Base Case potential results by month and by sector
- Summary

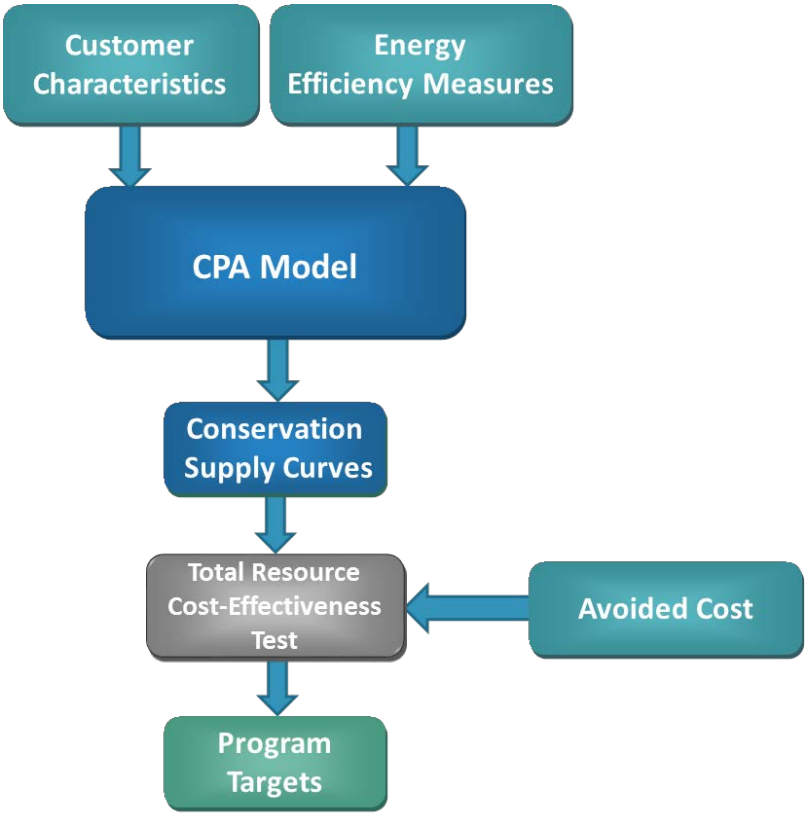
Methodology

This study is a comprehensive assessment of the energy efficiency potential in Chelan PUD's service area. The methodology complies with RCW 19.285.040 and WAC 194-37-070 Section 5 parts (a) through (o) and is consistent with the methodology used by the Northwest Power and Conservation Council (Council) in developing the Sixth Power Plan. This section provides a broad overview of the methodology used to develop Chelan PUD's conservation potential target. Specific assumptions and methodology as it pertains to compliance with the EIA is provided in the appendix of this report.

Basic Modeling Methodology

The basic methodology used for this assessment is illustrated in Figure 1. A key factor is the kilowatt hours saved annually from the installation of an individual energy efficiency measure. The savings from each measure is multiplied by the total number of measures that could be installed over the life of the program. Savings from each individual measure are then aggregated to produce the total potential. The detailed methodology summary that follows the EIA requirements is listed in Appendix III.

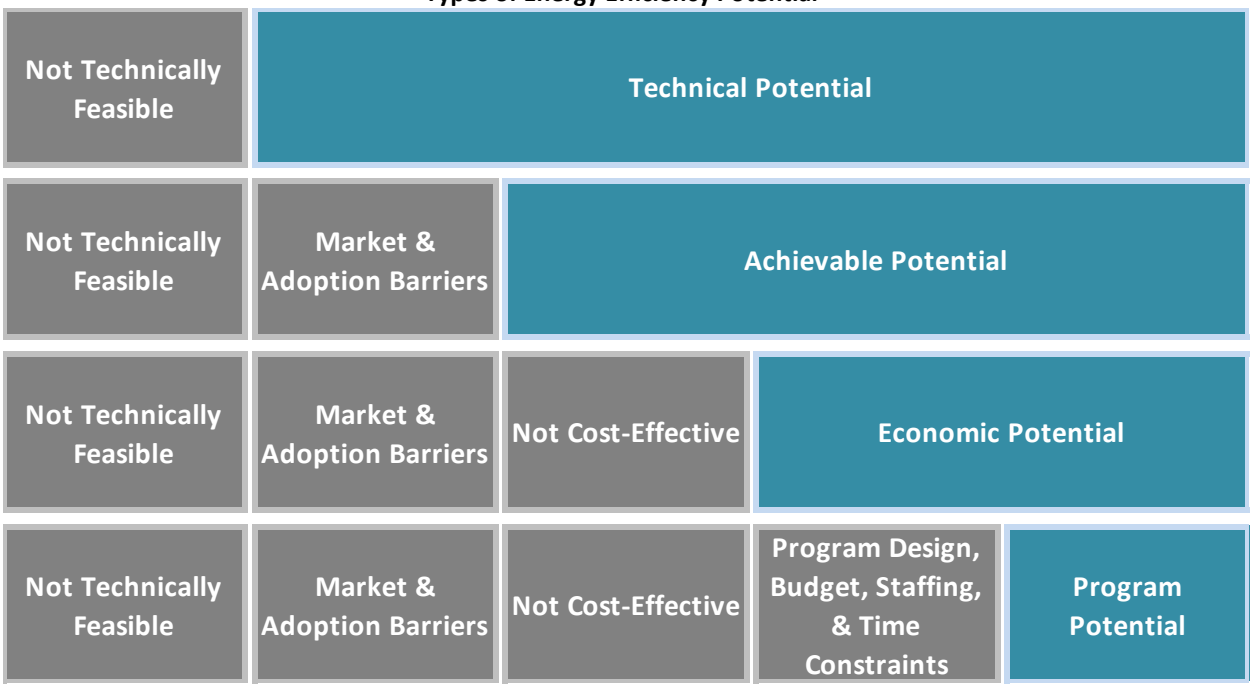
Figure 1
Conservation Potential Assessment Process



Types of Potential

Three types of potential are used in this study: technical, achievable, and economic potential. Technical potential is the theoretical maximum efficiency in the service territory if cost and achievability barriers are excluded. There are physical barriers, market conditions, and other consumer acceptance constraints that reduce the total potential savings of an energy efficient measure. When these factors are applied, the remaining potential is called the achievable potential. Economic potential is a subset of the technical-achievable potential that has been screened for cost effectiveness through a benefit-cost test. Figure 2 illustrates the four types of potential followed by more detailed explanations.

Figure 2
Types of Energy Efficiency Potential[4]



Technical – Technical potential is the amount of energy efficiency potential that is available, regardless of cost or other technological or market constraints, such as customer willingness to adopt measures. It represents the theoretical maximum amount of energy efficiency absent these constraints in a utility's service territory.

Estimating the technical potential begins with determining a value for the energy efficiency measure savings. Then, the number of "applicable units" must be estimated. "Applicable units" refers to the number of units that could technically be installed in a service territory. This includes accounting for units that may already be in place. The "applicability" value is highly dependent on the measure and the housing stock. For example, a heat pump measure may only be

[4] Reproduced from U.S. Environmental Protection Agency. *Guide to Resource Planning with Energy Efficiency.* Figure 2-1, November 2007

applicable to single family homes with electric space heating equipment. A "saturation" factor accounts for measures that have already been completed.

In addition, technical potential considers the interaction and stacking effects of measures. For example, if a home installs insulation and a high-efficiency heat pump, the total savings in the home is less than if each measure were installed individually (interaction). In addition, the measure-by-measure savings depend on which measure is installed first (stacking).

Total technical potential is often significantly more than the amount of economic and achievable potential. The difference between technical potential and economic potential is due to the number of measures in the technical potential that are not cost-effective and the applicability or total amount of savings of those non-cost effective measures.

Achievable – Achievable potential is the amount of potential that can be achieved with a given set of conditions. Achievable potential takes into account many of the realistic barriers to adopting energy efficiency measures. These barriers include market availability of technology, non-measure costs, and physical limitations of ramping up a program over time. The level of achievable potential can increase or decrease depending on the given incentive level of the measure. The Council uses achievability rates equal to 85 for retrofit measures and 65 percent for lost opportunity measures over the 20-year study period. This CPA follows the Council's methodology, including the achievability rate assumptions. Note that the achievability factors are applied to the technical potential before the economic screening.

Economic – Economic potential is the amount of potential that passes an economic benefit-cost test. In Washington State, the total resource cost test (TRC) is used to determine economic potential (per EIA requirements). This means that the present value of the benefits exceeds the present value of the costs over the lifetime of the measure. TRC costs include the incremental costs and benefits of the measure regardless of who pays a cost or receives the benefit. Costs and benefits include the following: capital cost, O&M cost over the life of the measure, disposal costs, program administration costs, environmental benefits, distribution and transmission benefits, energy savings benefits, economic effects, and non-energy savings benefits. Non-energy costs and benefits can be difficult to enumerate, yet non-energy costs are quantified where feasible and realistic. Examples of non-quantifiable benefits might include: added comfort and reduced road noise from better insulation, or increased real estate value from new windows. A quantifiable non-energy benefit might include reduced detergent costs or reduced water and sewer charges.

For this potential assessment, the Council's ProCost models are used to determine cost-effectiveness for each energy efficiency measure. The ProCost model values measure energy savings by time of day using conservation load shapes (by end-use) and segmented energy prices. The version of ProCost used in the 2015 CPA evaluates measure savings on a monthly basis and by four segments. The four segments differentiate savings values across heavy load hour, shoulder, and light load hour periods in each month.

Program – Program potential is the amount of potential that can be achieved through utility administered programs. The program achievable potential excludes savings estimates that are achieved through future code changes and market transformation. The program potential is not the emphasis of this assessment, but understanding the sources of achievement is an important reporting requirement.

Energy Efficiency Measure Data

The characterization of efficiency measures includes measure savings (kWh), demand savings (kW), measure costs ($), and measure life (years). Other features, such as measure load shape, operation and maintenance costs, and non-energy benefits are also important for measure definition. The Council's Seventh Power Plan is scheduled for release at the end of 2015, and the vast majority of the conservation analysis has been completed and made available. Due to the timing of this CPA, the primary sources for conservation measure data are the Council's Seventh Power Plan supply curve workbooks.

The measure data include adjustments from raw savings data for several factors. The effects of space-heating interaction, for example, are included for all lighting and appliance measures, where appropriate. For example, if an electrically-heated house is retrofitted with efficient lighting, the heat that was originally provided by the inefficient lighting will have to be made up by the electric heating system. These interaction factors are included in measure savings data to produce net energy savings.

Other financial-related data needed for defining measure costs and benefits include: current and forecasted loads, growth rates, discount rate, avoided costs, line losses, and deferred capacity-expansion benefits.

The residential and commercial sectors were most heavily impacted by changes since the previous assessment. Some of the key differences by measure or end-use are listed below:

- Residential Weatherization Measures – The RTF released a new set of single-family weatherization measures for existing homes after extensive review of savings estimates for these measure sets. As a result, savings for these new measures are 60 percent lower, on average. Some residential weatherization measures for new homes were removed due to new building codes.
- Residential Appliances – A number of new standards have been passed recently, which affect residential appliances, including dishwashers, refrigerators, freezers, and clothes washers. More standards will become effective in the first few years of the conservation planning period. These changes have resulted in new appliance measures with lower incremental savings over current market conditions, as compared to market conditions assumed in the 2013 CPA (higher baselines).
- Consumer Electronics – Residential consumer electronics potential increased due to the addition of cost-effective advanced power strip measures.

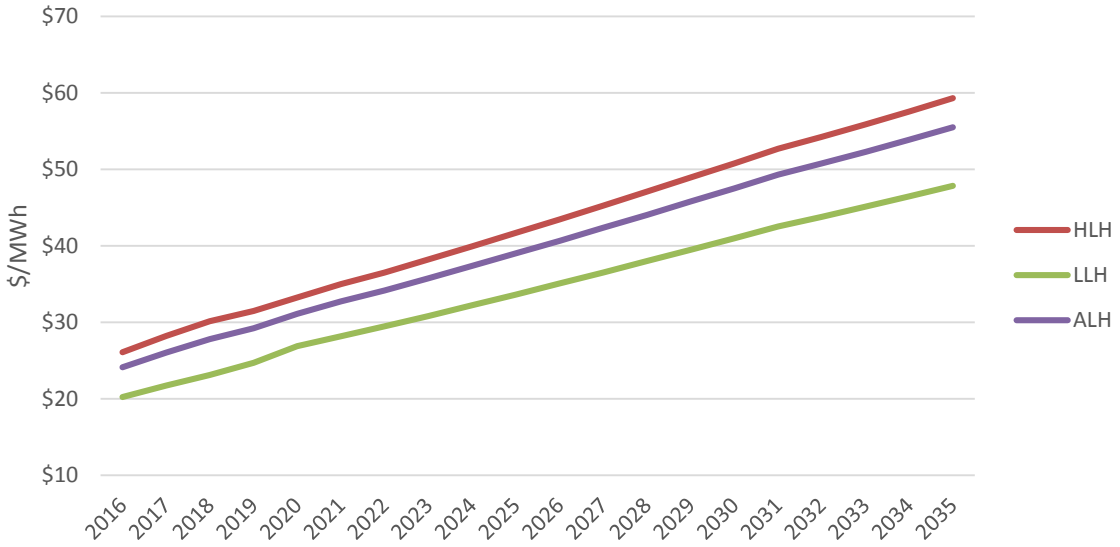
- Commercial Ductless Heat Pumps – Ductless heat pumps are a new measure for the commercial sector. These measures constitute a significant amount of cost-effective commercial conservation.
- Commercial HVAC Controls – New commercial energy management measures added notable savings in the commercial sector.
- Energy Independence and Security Act of 2007 (EISA) – This code change significantly impacted both residential and commercial lighting potential. Standards affecting incandescent and CFL lighting have been phased in since 2012 and CFL measures were eliminated in 2014. New measures have been added for LED lighting and solid state lighting.
- Industrial End-Use Savings – End-use savings distribution in the industrial sector was significantly revised due to Council review.
- Agriculture – The Council has reevaluated irrigation hardware measures and updated savings and costs resulting in increased savings potential. Motors and pumping measures were also added for the Seventh Power Plan.

A list of measures by end-use is included in Appendix V.

Avoided Cost

Avoided costs are used to value energy savings benefits when conducting cost effectiveness tests and are generally included in the numerator in a benefit-cost test. The avoided cost input unit is dollars per MWh of energy. The primary component of the avoided cost of conservation is the forecast cost of an alternative resource, which may be based on the cost of a generating resource, a forecast of market prices, or the avoided resource identified in the integrated resource planning process. However, for CPA analysis the EIA requires that utilities "…set avoided costs equal to a forecast of market prices." Chelan PUD provided a monthly average market price forecast for heavy load hours and light load hours (on-peak and off-peak) for the period 2016 to 2031. The forecast was escalated using a 3 percent growth rate through 2035. Figure 3 shows the resulting market price forecast. The price forecast is shown for heavy load hours (HLH), light load hours (LLH), and average load hours (ALH). The levelized value of market process over the study period is $37.86, assuming a 4 percent discount rate.

Figure 3
20-Year Market Price Forecast (Mid-Columbia)



The EIA requires that deferred capacity expansion benefits for transmission and distribution systems be included in the CPA cost-effectiveness analysis. To account for the value of deferred bulk transmission and system expansion, a credit value of $26/kW-yr was applied to peak savings from conservation measures. Similarly, a local distribution system benefit of $31/kW-yr is included. Both of these credits are sourced from the supporting documents developed for the Seventh Power Plan. As required by the EIA, 10 percent benefit was also added to the measures per the Pacific Northwest Electric Power Planning and Conservation Act.

As part of the Council's cost-effectiveness analysis, risk adders are included to account for uncertainty in market prices inclusive of factors such as fuel price risk, power supply capacity investments, and environmental regulation such as greenhouse gas costs and renewable energy requirements. Due to Chelan PUD's low exposure to market price risk, no additional value or risk credit was applied to the avoided cost in the Base Case scenario. A sensitivity analysis around the value of the risk mitigation credit is included in this study as discussed in the Scenarios section. Additional information regarding the avoided cost forecast and risk mitigation is included in Appendix IV.

Discount Rate

The Council develops real discount rate assumptions for each of its Power Plans. The discount rate is used to convert future cost and benefit streams into present values. The present values are then used to compare net benefits across measures that realize costs and benefits at different times and over different useful lives (years).

The discount rate is developed from two sets of assumptions. The first set of assumptions describes the relative shares of the cost of conservation distributed to various sponsors. Conservation is funded by the Bonneville Power Administration, utilities, and customers. The

second set of assumptions looks at the financing parameters for each of these entities to establish the after-tax average cost of capital for each group. These figures are then weighted, based on each group's assumed share of project cost to arrive at a composite discount rate.

The most recent real discount rate assumption developed by the Council is 4 percent based on recent conservation program data collected from 2008 to 2012.

Customer Characteristic Data

Building characteristics, baseline measure saturation data, and appliance saturation influence Chelan PUD's total conservation potential. For this analysis, the characterization of Chelan PUD's baseline was determined using data from the 2015 customer survey. Details of data sources and assumptions are described for each customer sector later in the report.

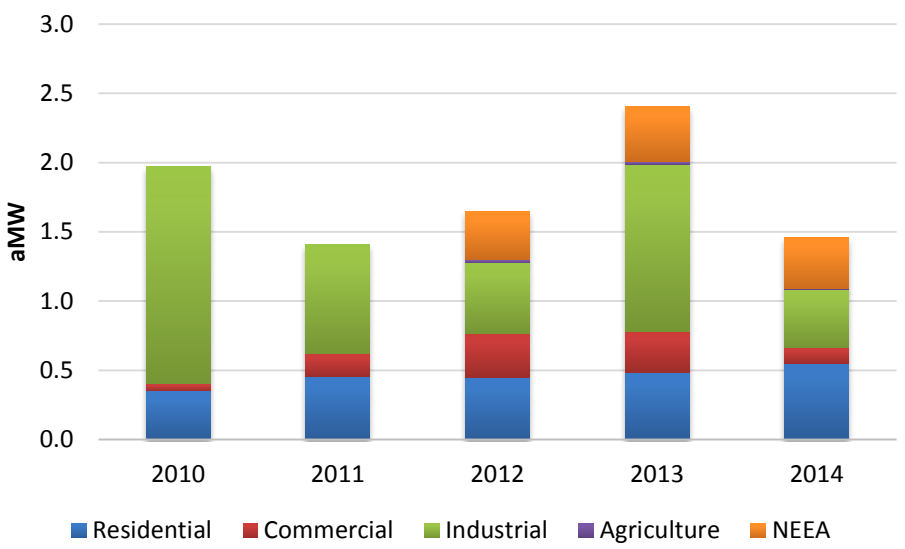
This assessment primarily sourced baseline measure saturation data from the Council's Seventh Power Plan measure workbooks. The Council's data was developed from NEEA's Building Stock Assessments, studies, market research and other sources, and the Council has updated baselines for regional conservation achievement in preparation for the release of the Seventh Power Plan in January 2016. Historic conservation achievement data are often used to update measure saturation levels when current market data is unavailable. EES adjusted measure baselines, using Chelan PUD's conservation achievement history, for those measures with baselines that have not been updated since the 2011 Residential Building Stock Assessment. Chelan PUD's historic achievement is discussed in detail in the next section.

Recent Conservation Achievement

Chelan PUD has pursued conservation and energy efficiency resources since the early 1980s. The utility currently offers several rebate and incentive programs for both residential and non-residential applications. These include weatherization rebates, appliance rebates, commercial and industrial lighting incentives, and loans for most utility-offered energy efficiency programs.

Chelan PUD has consistently conserved energy through its commercial and residential programs and has seen the most significant savings through its industrial projects. Figure 4 shows the distribution of conservation among the utility's customer sectors and also shows conservation achieved through Northwest Energy Efficiency Alliance (NEEA) efforts over the past five fiscal years (October to September). Chelan PUD obtains a share of NEEA savings through the utility's share of regional load.

Figure 4
Chelan PUD Recent Conservation History by Sector



Current Conservation Programs

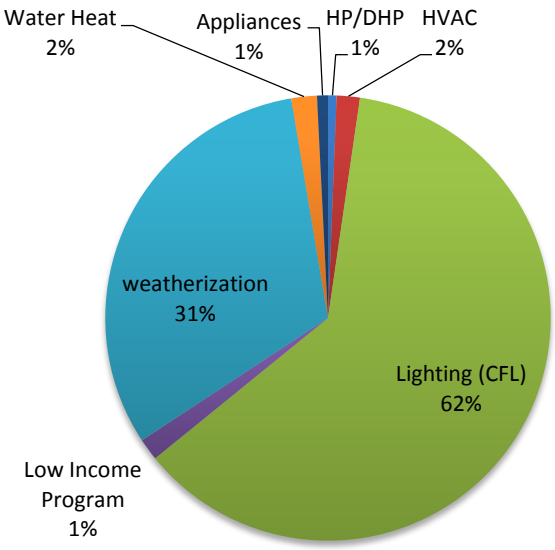
Chelan PUD offers a wide range of conservation programs to its customers. These programs include several residential loan programs, rebates, energy audits, and commercial projects. The current programs offered by Chelan PUD are detailed below followed by recent achievements for these programs.

Residential

- *Weatherization Rebates* – Chelan PUD currently offers rebates for floor, attic, or wall insulation improvements and also offers incentives for window and door replacements. The following incentives are available for weatherization upgrades: $0.50/sq ft for insulation, $6/sq ft for efficient windows and glass doors, $8/sq ft for efficient windows and glass doors with U factors of .22 or lower, and $40 for insulated entry doors.
- *Energy Star Appliance Rebates* – Chelan PUD offers a number of rebates for energy star appliances. These include up to $75 for clothes washers and $50 for freezers.
- *LED Lighting* – The utility offers $10 rebates for LED downlight retrofit kits. These kits replace typical halogen lamps.
- *Heat Pump Conversion and Upgrades* – Rebates of up to $1,400 are available for converting existing electric furnace heating equipment to a qualifying air source heat pump. The utility offers $500 rebates for upgrading existing heat pump systems.
- *Ductless Heat Pump Rebates* – Customers may receive a rebate of up to $750 for installation of a heat pump in a home with an existing zonal or forced air furnace heating system.
- *Heat Pump PTCS Duct Sealing* – Chelan PUD offers $250 and $200 rebates for PTCS duct sealing in electrically-heated single family and manufactured homes, respectfully.
- *Heat Pump Water Heater Rebates* – The utility offers $300 for Tier 1 heat pump water heaters with 50 to 75 gallon tanks and $500 for Tier 1 water heaters with tanks larger than 75 gallons and Tier 2 heat pump water heaters.
- *Energy Star Manufactured Homes* – Manufactured homes which meet Washington State Energy Star Home requirements are eligible for an $800 rebate.

Figure 5 summarizes the distribution of residential conservation program savings across the utility's residential programs from 2010 through 2014. These figures do not include NEEA savings. Heat pumps and ductless heat pumps are denoted as HP and DHP respectively.

Figure 5
Residential Program Achievement by End-Use
CY 2010 – 2014

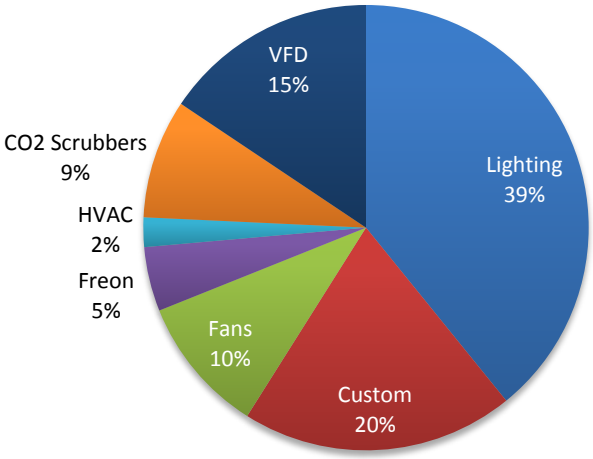


Commercial and Industrial

- *Light$mart: Indoor or Outdoor Lighting* – Chelan PUD offers rebates of 12 cents per kWh (saved) for outdoor lighting projects. The incentive may cover up to 75 percent of the installed cost of lighting projects including LED lighting and lighting controls.
- *Light$mart: Industrial Lighting* – Participating customers can receive up to 15 cents per kWh (saved) or up to 75 percent of the project cost. Incentives depend on existing and proposed power consumption of the light fixtures as well as the number of operating hours.
- *Resource$mart* – Is a custom commercial and industrial program that offers incentives for lighting (Light$mart), efficient refrigeration fans for fruit warehouses, energy efficient CO2 scrubbers, and HVAC system improvements.
- *Ductless Heat Pumps* – The utility currently offers $350/ton of cooling in incentives for ductless heat pumps installed in qualifying commercial facilities.

Figure 6 summarizes the distribution of commercial and industrial conservation program savings across the utility's highest achieving programs over the past five years. These figures do not include end-use savings from Chelan PUD's share of NEEA savings.

Figure 6
Commercial and Industrial Program Achievement by End-Use
CY 2010 – 2014



Agriculture

- *Irrigation Pump* – The utility currently offers $60/horsepower incentive or up to 75 percent of total installed cost for efficient irrigation pumps.
- *VFD* – The utility currently offers $60/horsepower incentive or up to 75 percent of total installed cost for variable frequency drives installed on irrigation pumps.

Over the period 2010 through 2014, Chelan PUD has helped its agriculture customers save 0.45 aMW per year through its pump and VFD programs.

Summary

Chelan PUD plans to continue offering incentives for energy efficiency investments. The programs offered continually evolve as new technologies are available or as incentives and savings are revised. The results of this study will assist Chelan PUD program managers in strategic planning for energy efficiency program offerings, incentive levels, and program review.

Customer Characteristics Data

Chelan Public Utility District serves approximately 48,000 electricity customers in Chelan County. A key component of an energy efficiency assessment is to understand the characteristics of these customers, primarily the building and end-use characteristics. Characteristics for each customer class are described below.

Residential

For the residential sector, the key characteristics include house type, heat fuel type, and water heating. Tables 1 through 3 show relevant data based on the utility customer surveys completed in 2015. Data for Washington State from NEEA's 2011 Residential Building Stock Assessment (RBSA) is provided for reference.

Table 1
Residential Building Characteristics – Single Family

Heating Zone	Cooling Zone	Solar Zone	Residential Households	Total Population
1	**3**	**3**	30,057	74,588

Housing Stock	Existing Homes	New Homes	RBSA, WA State		Existing	New	RBSA, WA State
House Type				Single Family Foundation Type			
Single Family	81%	80%	72%	Crawlspace	34%	44%	62%
Multi-Family	7%	16%	18%	Full Basement	55%	28%	28%
Manufactured Homes	12%	4%	10%	Slab on Grade	11%	28%	10%
Housing Vintage				Water Heating			
Pre-1980	54%	N/A	67%	Electric	98%	98%	61%
1980 - 1993	13%	N/A	14%	Natural Gas	2%	2%	37%
Post 1993	33%	N/A	19%				
Heat Fuel Type				Appliance Saturation			
Natural Gas Homes	3%	0%	30%	Refrigerator	157%	157%	129%
Electric Homes	94%	99%	44%	Freezer	76%	76%	53%
Other Fuel Homes	3%	1%	26%	Clothes Washer	102%	102%	99%
Electric Heat System Type				Electric Dryer	95%	95%	98%
Forced Air Furnace	44%	5%	7%	Dishwasher	82%	95%	89%
Heat Pump	41%	91%	21%	Electric Oven	91%	84%	75%
Zonal (Baseboard)	9%	2%	71%	Room AC	15%	15%	14%
Electric Other	6%	1%	1%	Central AC	34%	34%	48%

Table 2 Residential Building Characteristics – Multi-Family							
Housing Stock	Existing Homes	New Homes	RBSA, WA State		Existing	New	RBSA, WA State
Housing Vintage				Water Heating			
Pre-1980	18%	N/A	67%	Electric	100%	100%	77%
1980 - 1993	42%	N/A	14%	Natural Gas	0%	0%	22%
Post 1993	39%	N/A	19%				
Heat Fuel Type				Appliance Saturation			
Natural Gas Homes	4%	0%	30%	Refrigerator	120%	120%	103%
Electric Homes	94%	99%	44%	Freezer	29%	29%	4%
Other Fuel Homes	2%	1%	26%	Clothes Washer	72%	72%	47%
Electric Heat System Type				Electric Dryer	95%	95%	47%
Forced Air Furnace	38%	5%	2%	Dishwasher	82%	95%	78%
Heat Pump	19%	91%	0%	Electric Oven	91%	84%	97%
Zonal (Baseboard)	30%	2%	97%	Room AC	28%	28%	11%
Electric Other	13%	1%	1%	Central AC	25%	25%	2%

Table 3 Residential Building Characteristics – Manufactured Homes							
Housing Stock	Existing Homes	New Homes	RBSA, Regional		Existing	New	RBSA, Regional
Housing Vintage				Water Heating			
Pre-1980	51%	N/A	31%	Electric	100%	100%	83%
1980 - 1993	26%	N/A	42%	Natural Gas	0%	0%	12%
Post 1993	23%	N/A	27%				
Heat Fuel Type				Appliance Saturation			
Natural Gas Homes	0%	0%	6%	Refrigerator	120%	120%	121%
Electric Homes	94%	99%	82%	Freezer	29%	29%	43%
Other Fuel Homes	6%	1%	12%	Clothes Washer	72%	72%	99%
Electric Heat System Type				Electric Dryer	95%	95%	95%
Forced Air Furnace	38%	5%	69%	Dishwasher	82%	95%	77%
Heat Pump	19%	91%	16%	Electric Oven	91%	84%	90%
Zonal (Baseboard)	30%	2%	15%	Room AC	28%	28%	17%
Electric Other	13%	1%	0%	Central AC	25%	25%	26%

Commercial

Building square footage is the key parameter in determining conservation potential for the commercial sector, as many of the measures are based on savings as a function of building square footage (kWh per square foot, kWh/sf). Commercial square footage estimates were developed for this study based on utility-provided MWh consumption by commercial segment and estimated energy use intensity values. Table 4 shows 2014 commercial MWh consumption, relevant EUI values, and resulting square footage for each of the 18 building categories. Unless otherwise noted, EUI figures are regional values. Regional EUIs are based on the 2014

Commercial Building Stock Assessment (CBSA), coordinated by NEEA.[5] Regional growth rates are used to estimate additional incremental new commercial square footage and reduction of existing commercial square footage due to demolition. The growth rates shown in Table 4 are net of demolition. Demolition rates are based on Council assumptions of -0.4 percent annually (varies by building segment).

Table 4
Commercial Building Floor Area

Segment	2014 MWh	2014 Regional EUI (kWh/sq ft)	2014 Floor Area (sq ft)	Net Growth Rate
Large Office	-	16.6	-	-
Medium Office	6,298,680	23.8	264,991	1.2%
Small Office	76,635,290	13.2	5,795,032	1.2%
Big Box Retail	16,827,868	13.9	1,207,468	0.3%
Small Box Retail	42,068,016	13.0	3,229,318	0.3%
High End Retail	-	14.6	-	-
Anchor	-	15.8	-	-
K-12 Schools	32,231,073	9.2	3,512,923	0.6%
University	7,721,472	16.9	456,352	0.7%
Warehouse	67,025,670	9.1	7,359,468	2.3%
Supermarket	21,580,300	43.5	495,752	-0.5%
Mini Mart	5,185,257	81.1	63,957	0.5%
Restaurant	24,904,070	55.7	447,302	0.7%
Lodging	37,501,743	15.1	2,490,431	0.3%
Hospital	30,467,468	26.6[1]	1,147,180	0.8%
Other Health Facilities	17,323,671	14.9	1,164,337	1.5%
Assembly Hall	15,223,728	11.9	1,278,761	1.0%
Other	94,825,094	13.0	7,281,000	-0.4%
Total	**495,819,400**		**36,194,272**	**0.8%**

1. Based on energy usage and square footage for Wenatchee Valley Clinic.

The commercial square footage estimated for this assessment is higher compared with the values used in the 2013 CPA (30 million square feet). The difference may be due to growth as well as updated EUI values. Total energy consumption in 2014 was 496 GWh compared with 452 GWh in 2011 (the basis for the 2013 square footage values). In addition, the new EUI values are lower compared with the previous CBSA EUI; therefore, square footage estimates may have increased due to the updated data.

[5] Navigant Consulting. 2014. *Northwest Commercial Building Stock Assessment: Final Report.* Portland, OR: Northwest Energy Efficiency Alliance.

Industrial

The methodology employed to estimate industrial sector potential is different than approaches used for the residential and commercial sectors primarily because industrial energy efficiency measure savings are based on the distribution of electricity use among processes at industrial facilities. Industrial potential for this assessment was estimated based on the Council's "top-down" methodology that utilizes annual consumption by industrial segment and then disaggregates total electricity usage by process shares to create an end-use profile for each segment. Estimated measure savings are applied to each sector's process shares.

Chelan PUD provided 2014 energy consumption for the 19 industrial segments shown in Table 5. Consumption for Chelan PUD's fruit storage customers is included in Table 5; however, conservation potential for the fruit storage segment is estimated separately based on utility-provided insight gained from projects completed for this segment. Regional average growth rates are used to forecast load growth by industrial segment over the planning period.

Table 5
Industrial Sector Load by Segment

Segment	2014 MWh	Annual Growth Rate (Regional Average)
Mechanical Pulp	-	-
Kraft Pulp	-	-
Paper	27,157	0.2%
Foundries	17,729	0.6%
Frozen Food	-	-
Other Food	16,075	0.4%
Sugar	-	-
Lumber	1,328	-0.5%
Panel	-	-
Wood	-	-
Electric Fabrication	-	-
Silicon	-	-
Metal Fabrication	-	-
Equipment	-	-
Cold Storage	5,040	2.1%
Fruit Storage	130,701	-
Refinery	-	-
Chemical	-	-
Miscellaneous Manufacturing	21,084	1.0%
Total	**219,114**	**0.6%**

Agriculture

To determine agriculture sector characteristics in Chelan PUD's service territory, EES utilized Chelan County data provided by the United States Department of Agriculture (USDA). The USDA

conducts a census of farms and ranches in the U.S. every five years. The most recent available data for this analysis is from the 2012 census, which was published in 2014.[6]

The key inputs for estimating agriculture sector savings potential include irrigated acreage, number of farms, and head of dairy cattle. Table 6 summarizes the key inputs and data sources.

Table 6
Agriculture Inputs

		2012 Census of Agriculture Data Point
Number of Farms	890	Total number of farms
Irrigated Acres	28,230	Irrigated land
Number of Dairy Farms	1	Dairy Farms
Dairy Cows	76	Washington State Average dairy cows/farm

Distribution Efficiency (DEI)

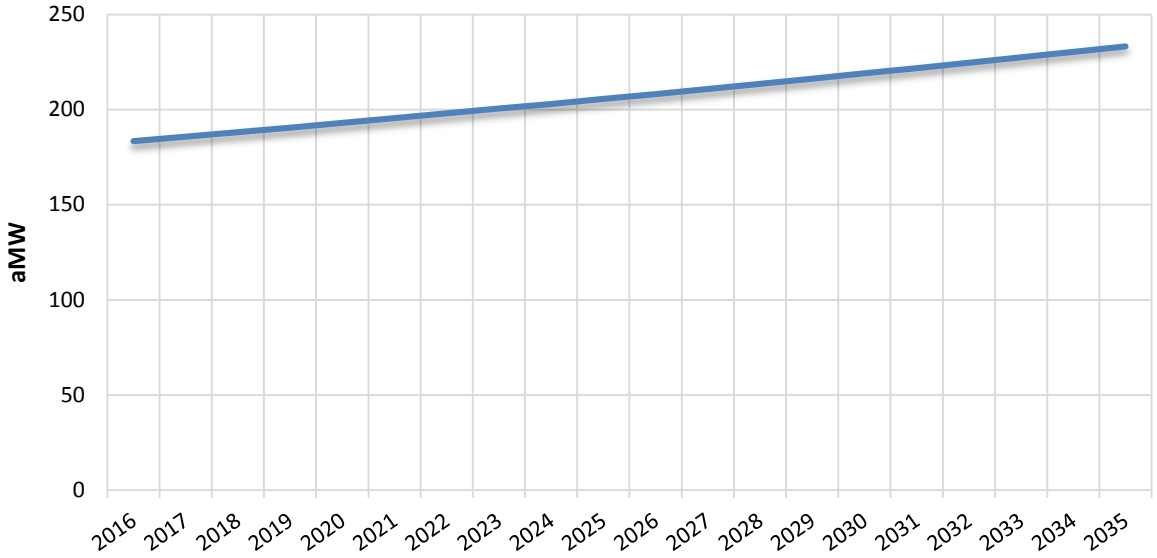
For this analysis, EES developed an estimate of distribution system conservation potential using the Council's Seventh Power Plan approach. The Seventh Power Plan estimates distribution potential as a fraction of end-system electricity sales. Potential savings range from 0.12 to 4.4 kWh per MWh, depending on measure. For reference, the Sixth Power Plan estimated DEI savings as 1.7 to 8.1 kWh per MWh of system sales.

The load forecast used for this assessment was sourced from Chelan PUD's 2014 IRP. The IRP provided incremental load estimates through 2024. The load forecast was extended through the end of the planning period using forecast growth from 2017 to 2024. Average annual growth over the 20-year planning period is 1.3 percent. The utility estimates total line losses at 5 percent of total system load. In order to estimate DEI potential, the forecast was adjusted for line loss, assuming a 5 percent loss factor.[7] The results of Chelan PUD's end system load forecast are shown in Figure 7. Distribution system conservation potential is discussed in detail in the next section.

[6] United States Department of Agriculture. (2014). *2012 Census of Agriculture.* Retrieved from: http://www.agcensus.usda.gov/Publications/2012/

[7] Utility-provided assumption.

Figure 7
20-year End System Load Forecast



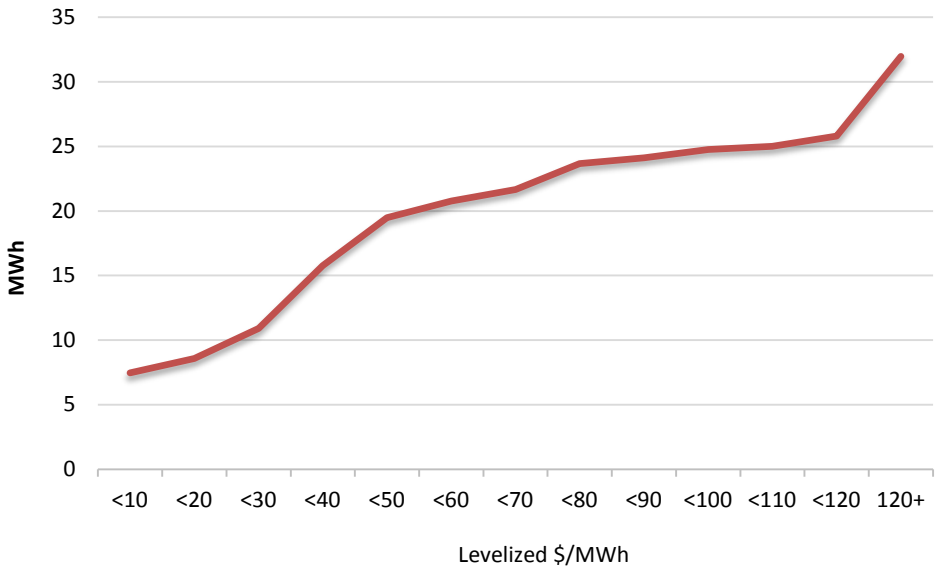
Results – Energy Savings and Costs

Technical Achievable Conservation Potential

Technical achievable potential is the amount of energy efficiency potential that is available regardless of cost. It represents the theoretical maximum amount of energy efficiency when accounting for achievability.

Figure 8, below, shows a supply curve of 20-year, technically achievable potential. A supply curve is developed by plotting energy efficiency savings potential (aMW) against the levelized cost ($/MWh) of the conservation. The technical potential has not been screened for cost effectiveness. Costs are standardized (levelized), allowing for the comparison of measures with different lives. The supply curve facilitates comparison of demand-side resources to supply-side resources and is often used in conjunction with integrated resource plans (IRPs). Figure 8 shows that close to 11 aMW of saving potential are available for less than $30/MWh and approximately 24 aMW are available for under $80/MWh. Total technical achievable potential for Chelan PUD is approximately 34 aMW over the 20-year study period.

Figure 8
20-Year Technical-Achievable Potential Supply Curve



Economic Achievable Conservation Potential

Economic potential is the amount of potential that passes the Total Resource Cost (TRC) test. This means that the present value of the benefits exceeds the present value of the measure costs over the measure lifetime.

Table 7 shows aMW of economically achievable potential by sector in 2, 5, 10 and 20-year increments. Compared with the technical and achievable potential, it shows that 17.5 aMW of the total 33.6 aMW is cost effective for Chelan PUD. The last section of this report discusses how these values could be used for setting targets.

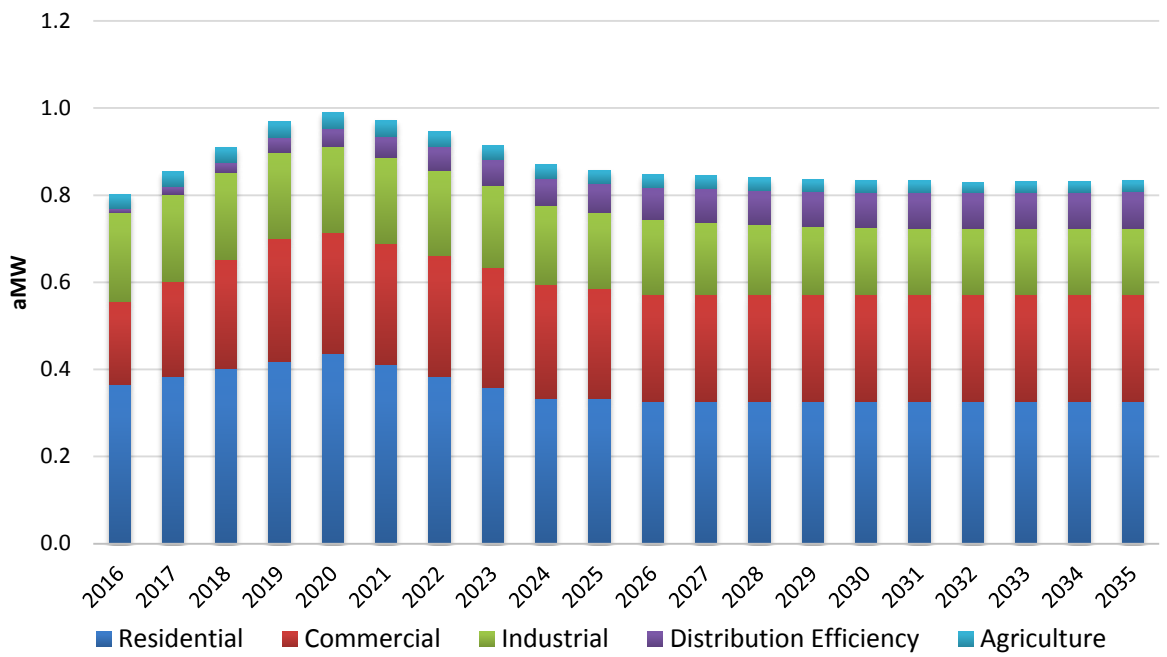
Table 7
Cost-Effective Achievable Potential - aMW

	2 Year	5 Year	10 Year	20 Year
Residential	0.75	2.01	3.83	7.10
Commercial	0.41	1.22	2.56	5.02
Industrial	0.40	1.00	1.93	3.49
Distribution Efficiency	0.03	0.13	0.42	1.23
Agriculture	0.06	0.17	0.34	0.61
TOTAL	**1.66**	**4.53**	**9.09**	**17.45**

Sector Summary

Figure 9 shows achievable potential by sector on an annual basis.

Figure 9
Annual Achievable Potential by Sector

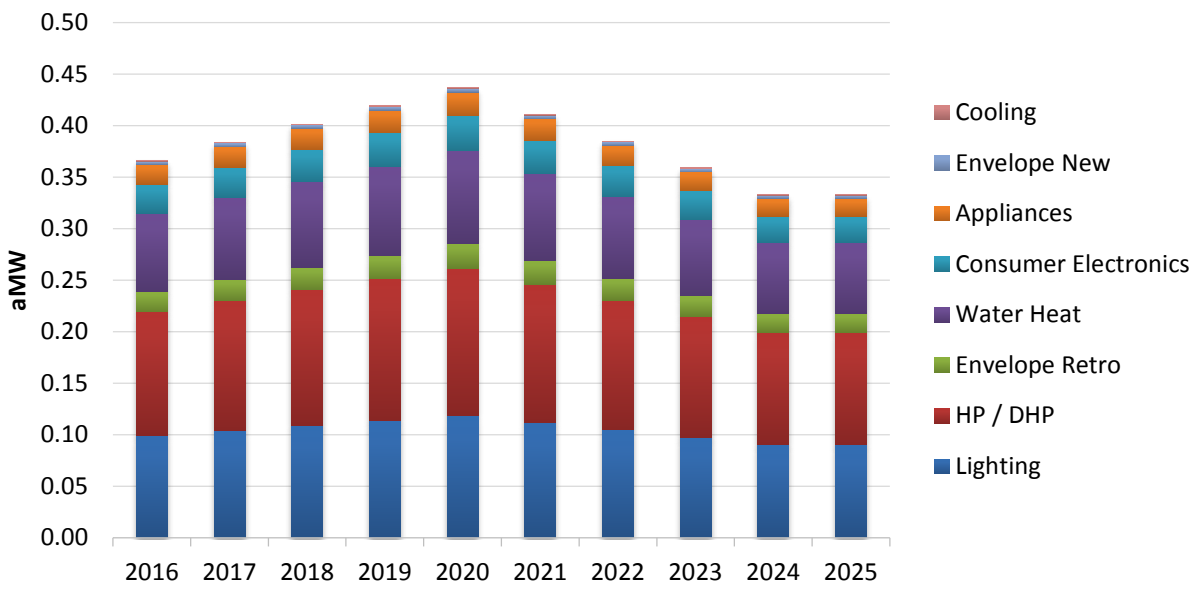


Over half of the potential, on an annual basis, is from the residential sector, followed by substantial savings potential in the commercial sector. The industrial sector potential is significant as well due in part to end-use savings distribution work by the RTF. Ramp rates are used to establish reasonable conservation achievement levels; which are affected by factors including timing and availability of measure installation (lost opportunity), program (technological) maturity, non-programmatic savings, and current utility staffing and funding.

Residential

Residential conservation potential is dominated by lighting (Figure 10). Residential lighting measures have been replaced due to lighting standards that took effect over the past two years. Whereas previous residential lighting measure sets included CFL measures, the new measure set is designed solely around LED lighting. Consumer electronics is another area with significant conservation potential. Though savings have been reduced for some residential consumer electronics measures, overall savings for consumer electronics have increased, due to the addition of cost-effective advanced power strip measures.

Figure 10
Annual Residential Potential by End-Use

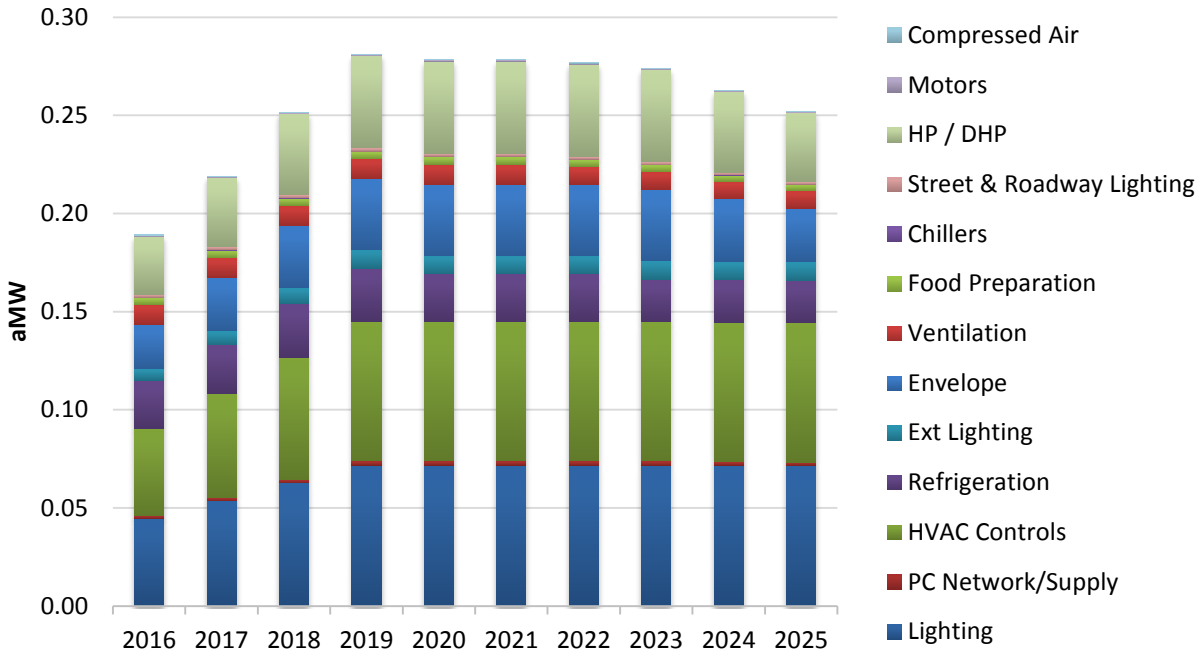


Commercial

Commercial lighting measures remain one of the largest contributors to commercial conservation potential, though savings have been significantly reduced since Chelan PUD's previous CPA (Figure 11). HVAC control measures make up a substantial part of commercial conservation potential for this assessment period due largely to new savings estimates for advanced rooftop controller measures.

Conservation potential for refrigeration measures remains strong although it has been reduced somewhat from previous assessments. RTF changes to deemed refrigeration measures prompted numerous revisions and expirations. Packaged refrigeration measures were removed and grocery refrigeration bundle measures were revised. Additionally, new measures for water cooler controls were added to the refrigeration end-use category. Another notable area for this assessment is savings due to commercial ductless heat pump measures. This is a new measure bundle with notable cost-effective savings. The custom nature of commercial building energy efficiency is reflected in the variety of end-uses and corresponding measures.

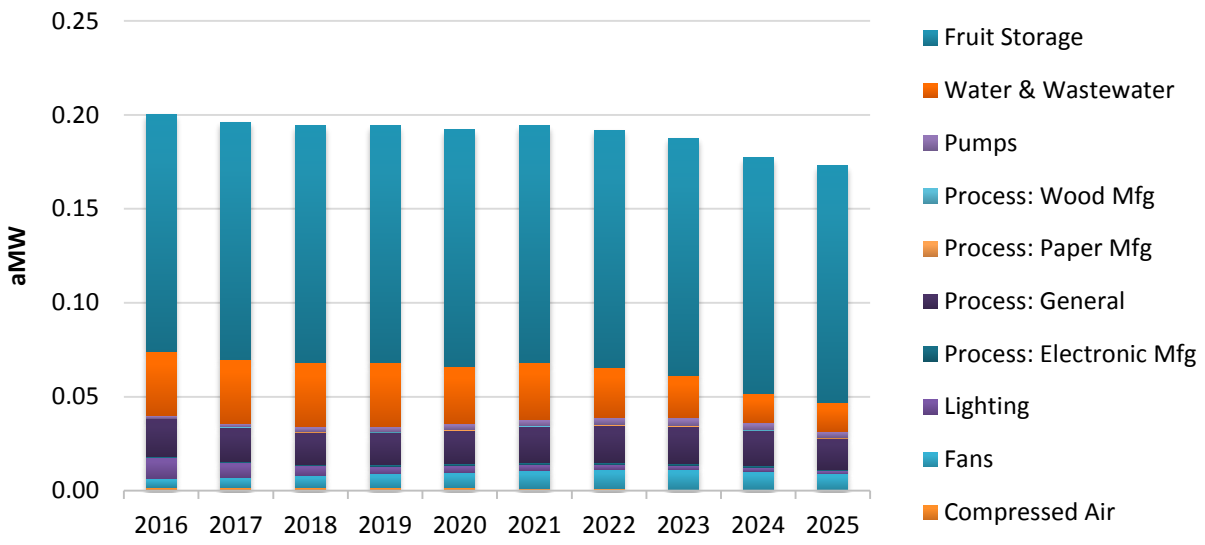
Figure 11
Annual Commercial Potential by End-Use



Industrial

Industrial conservation potential has been significantly impacted by end-use savings distribution work completed by the RTF. Changes to the industrial sector in Chelan PUD's service territory have also affected industrial potential for this assessment. Chelan PUD has achieved notable savings from industrial conservation projects since 2010 which reduces industrial potential estimates for this assessment. Estimated industrial potential for segments other than fruit storage was reduced by 0.77 aMW to account for historic achievement.[8] Chelan PUD estimates that 2.5 aMW of potential remains in the fruit storage segment. Industrial savings by end-use are shown in Figure 12.

Figure 12
Annual Industrial Potential by End-Use

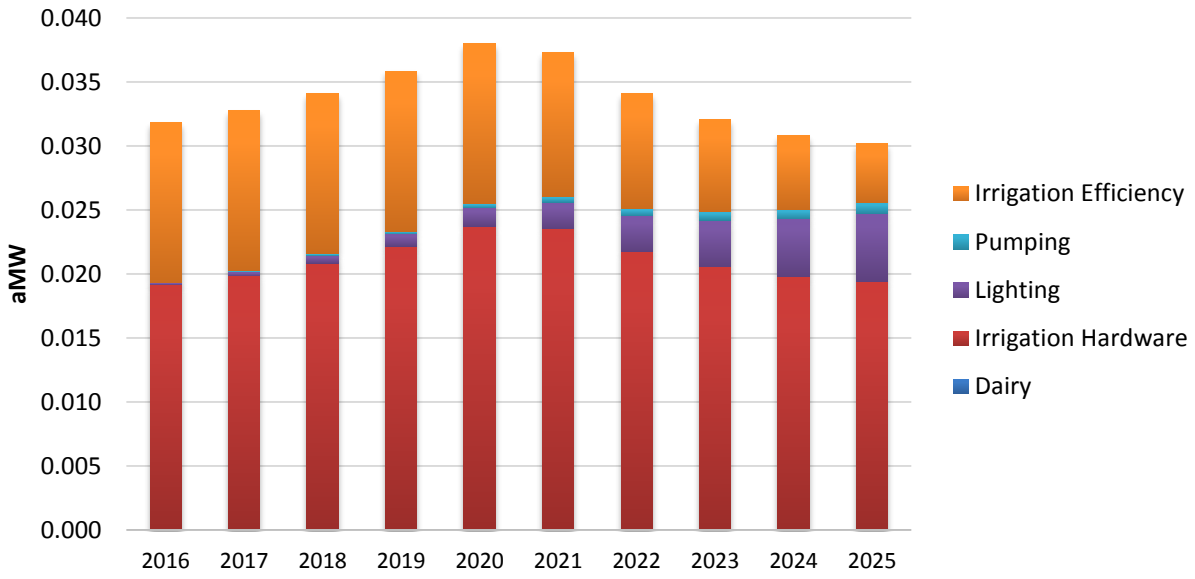


[8] This achievement adjustment does not consider projects completed for customers in the fruit storage segment since this potential is estimated with a different approach.

Agriculture

As shown in Figure 13, irrigation hardware measures account for the largest area of conservation potential in the agriculture sector. Energy efficiency savings are also available through new lighting and irrigation efficiency (low energy spray application) measures. The amount of savings through dairy measures is very small; therefore, the values are not apparent in the figure below.

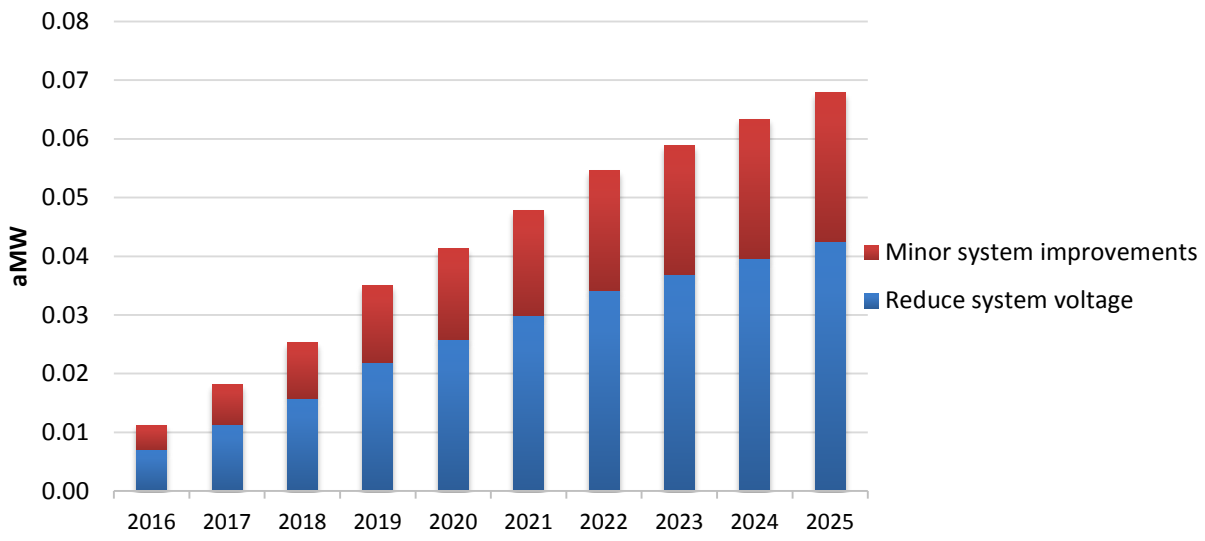
Figure 13
Annual Agriculture Potential by End-Use



Distribution System Efficiency

Distribution efficiency conservation measures (DEI) consist of distribution system improvements and voltage optimization to improve efficiency of the electrical grid, reduce demand and reduce system losses. 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). Distribution system conservation potential is shown in Figure 14. Minor system improvements include var management, phase load balancing and feeder load balancing. The system voltage reduction potential shown in Figure 14 consists of voltage optimization through line drop compensation (LDC) methods.

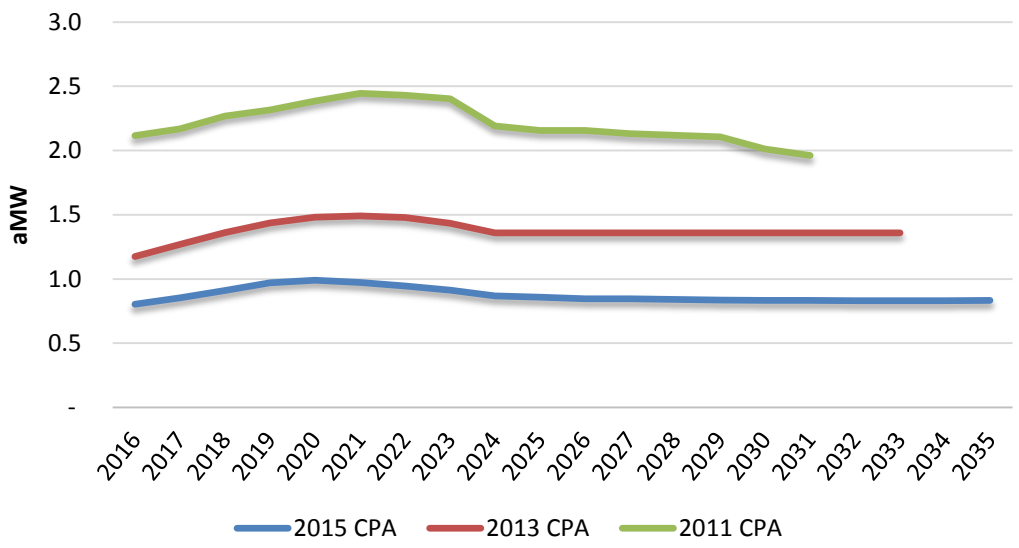
Figure 14
Annual Distribution System Efficiency Potential



Comparison to Previous Assessment

Figure 15 compares the 2015 results with the two previous CPAs completed for Chelan PUD. The figure shows how energy efficiency potential has been declining over the past six years due to increased efficiency standards, achievement, and other factors.

Figure 15
CPA Results Comparison – Cost-Effective Achievable Potential



Key differences in the potential estimated in the 2013 CPA and the 2015 CPA are provided below:

- Market price forecast is 19 percent lower in the 2015 CPA. This change decreases measure cost-effectiveness, which reduces potential estimates.
- A Bulk Transmission System Credit of $26/kw-yr is included in the 2015 CPA (the Council did not include this credit separately in the Sixth Power Plan but includes it separately it in the Seventh Power Plan). This change may or may not increase measure cost-effectiveness.
- The Local Transmission and Distribution Credit was increased from $23/kw-yr to $31/kW-yr. This change may increase measure cost-effectiveness.
- Measure data was updated per Council and RTF work. Generally, the changes decreased technical and economic potential for regional utilities.

Shaped Savings

Energy efficiency is typically reported on an annual basis (kWh, MWh, or aMW). However, savings occur throughout the day and year at different levels. Annual savings for each measure are distributed to the applicable load segments for each month, based on the load shape affected by the measure. The measure load shapes are also used to estimate the value of the measure, based on projected time-differentiated savings.[9]

Figures 16 and 17 show total monthly energy savings by sector for the 20-year planning period. Figure 16 shows heavy load hour (HLH) savings and Figure 17 shows savings during light load hour (LLH) time periods. As would be expected, the savings are higher during the winter months. However, the winter savings are not as pronounced as winter savings estimates from previous assessments. The difference can be attributed to two factors: 1) total residential savings are substantially lower compared with previous assessments; 2) measure savings for residential weatherization measures, which have historically accounted for a significant portion of winter energy conservation, have been substantially reduced. The result of these changes is a seasonal load shape that is flatter compared with the overall shape presented in the 2013 CPA. Another factor affecting the 2015 CPA load savings shape is the introduction of cost-effective commercial heat pump measures, which provide savings in both winter and summer months.

[9] Load segments and load shapes used in this analysis can be found in the Mid-C and Load Shape file.

Figure 16
20-Year Shaped Conservation Savings, HLH

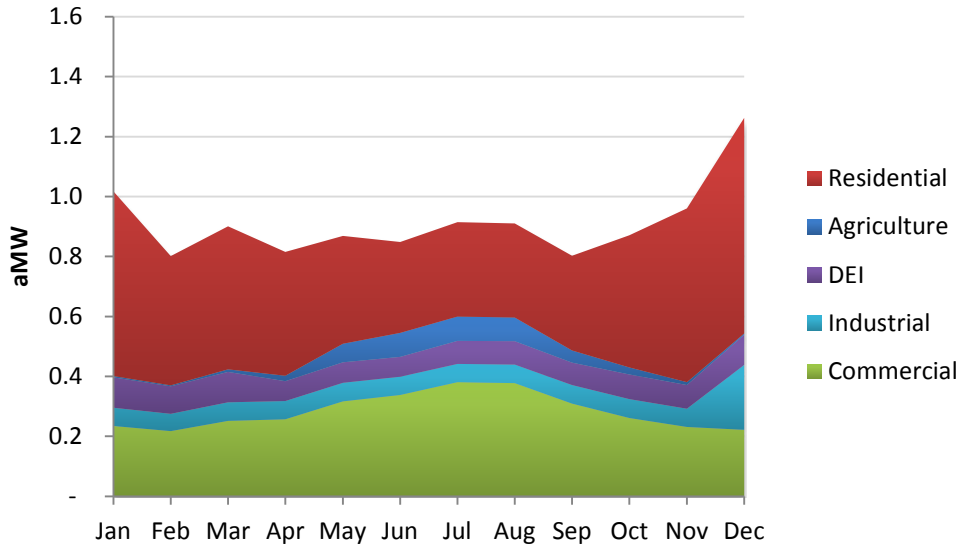


Figure 17
20-Year Shaped Conservation Savings, LLH

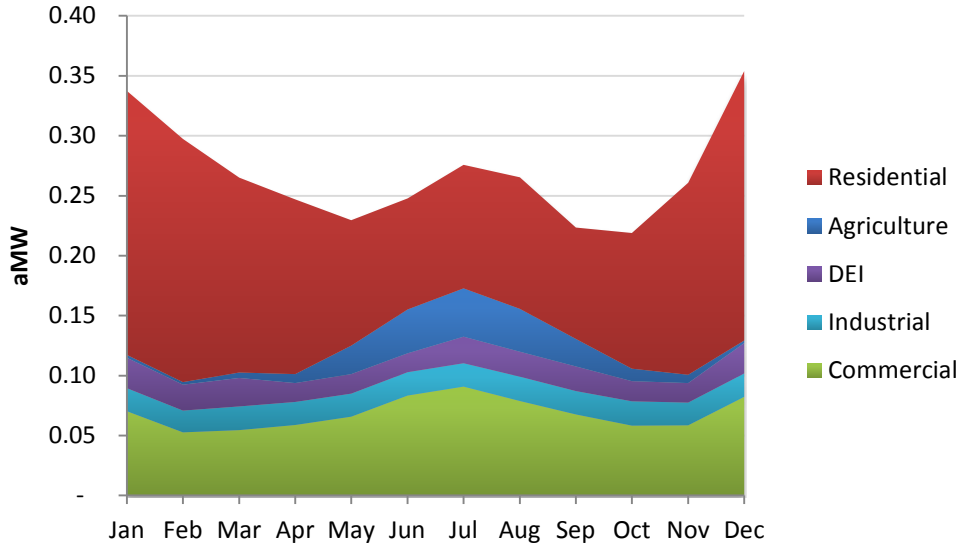
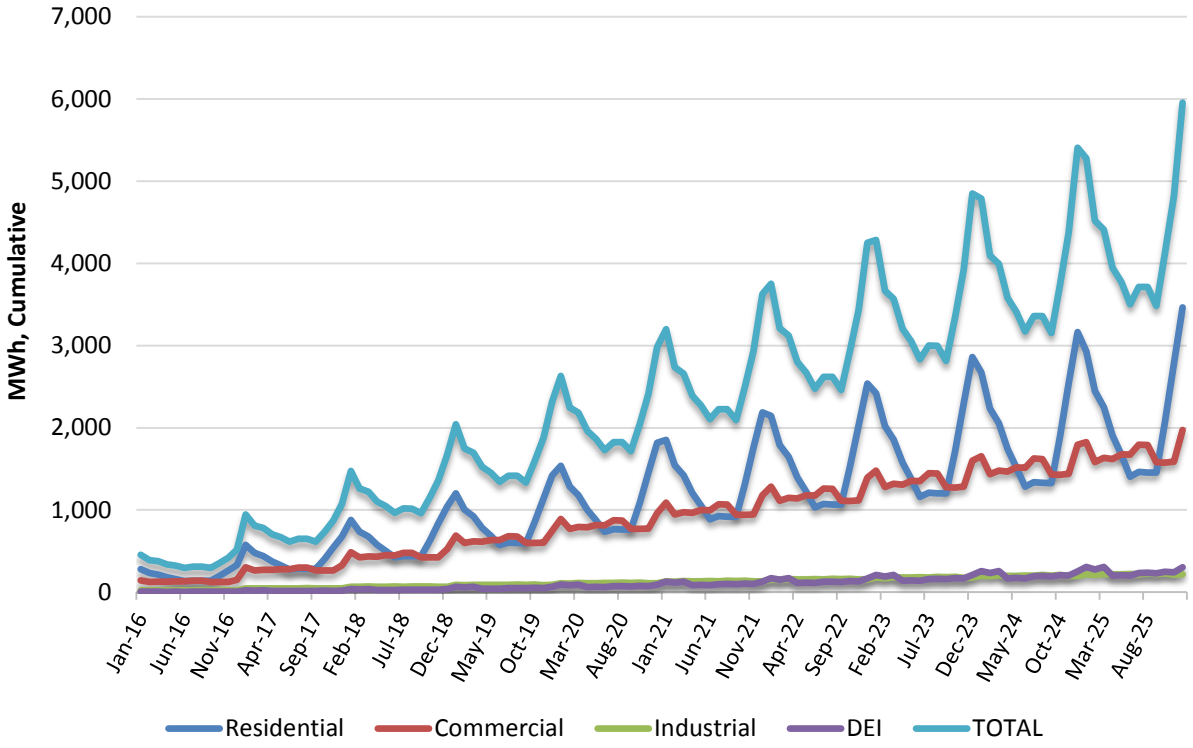


Figure 18 shows the cumulative heavy load hour monthly energy savings over the first 10-years of the planning period.

Figure 18
Monthly Conservation Savings, HLH, Cumulative



As would be expected, energy efficiency savings shapes are similar to the utility electric load shapes from a seasonal perspective.

Cost

Budget costs can be estimated at a high level based on the incremental cost of the measures (Table 8). The assumptions in this estimate include: 20 percent of measure cost for administrative costs and 40 percent of the incremental cost for incentives is assumed to be paid by the utility. A 20 percent allocation of measure costs to administrative expenses is a standard assumption for conservation programs. This figure was used in the Council's analysis for the Sixth Power Plan and will be used again for the Seventh Power Plan. Table 8 costs are calculated based on a 40 percent utility-share. Both the administrative cost allocation and the utility share assumptions are consistent with assumptions used in Chelan PUD's 2013 CPA.

Table 8
Cost for Economic Achievable Conservation Potential, $2016

	Utility First Year Cost			
	2 Year	5 Year	10 Year	20 Year
Residential	$1,965,400	$5,261,800	$10,034,600	$17,590,900
Commercial	$708,800	$2,120,800	$4,432,200	$8,314,800
Industrial	$190,100	$473,000	$843,600	$1,317,800
Agriculture	$8,800	$39,200	$126,700	$367,700
Distribution Efficiency	$28,800	$82,000	$191,600	$411,300
TOTAL	**$2,901,900**	**$7,976,800**	**$15,628,700**	**$28,002,500**
Total ($/MWh, first year)	$200	$201	$196	$183

This chart shows that Chelan PUD can expect to spend approximately $2.9 million to realize estimated savings over the next two years. This estimate includes measure incentives and program administration expenditures.

The bottom row of Table 8 shows the cost per MWh of first-year savings. Utility conservation costs ($/MWh) are higher in the earlier years of the planning period and decrease in later years. Annual conservation potential (and cost) is modeled using the Council's ramp rates. The Council's applies ramp rates at the measure level to reflect the characteristics of a particular program (maturity, measure type, and availability etc.) The decreasing first year costs shown in Table 8 are a result of the measure ramp rates.

The cost estimates presented in this report are conservative estimates for future expenditures since they are based on historic values. Future conservation achievement may be more costly since utilities often choose to implement the lowest cost programs first. In addition, as energy efficiency markets become more saturated, it may require more effort from Chelan PUD to acquire conservation through its programs. This additional effort may increase administrative costs.

The next section provides a range of cost estimates for the planning period.

Cost Scenarios

To provide a range of program costs over the planning period, High and Low cost scenarios are developed for the Base case conservation potential estimates. For the High Cost scenario, administrative costs were increased to 30 percent (compared with 20 percent). The High Cost scenario reflects the case where program administration costs may increase in order for Chelan PUD to connect with hard-to-reach customers.

For the Low scenario, the utility share of measure capital cost is reduced to 35 percent. A situation where the utility is responsible for a lower share of measure capital cost may result from higher conservation achievement through programs for which the customer is responsible for a higher fraction of measure cost. An example of this would be if more conservation were achieved through commercial or industrial custom projects where lower incentives may be needed. Table 9 shows 2, 5, 10 and 20-year program costs for the Expected, High and Low cost scenarios. Table 10 shows the cost per megawatt hour for each of the cost scenarios.

Table 9
Program Cost for Economic Achievable Conservation Potential
Base Case Conservation Potential, $2016

	Utility First Year Cost ($2015)			
	2 Year	5 Year	10 Year	20 Year
Expected Case	$2,901,900	$7,976,800	$15,628,700	$28,002,500
Low Cost Case	$2,660,200	$7,312,000	$14,326,300	$25,669,000
High Cost Case	$3,385,600	$9,306,300	$18,233,500	$32,669,800

Table 10
Cost per MWh for Economic Achievable Conservation Potential
Base Case Conservation Potential, $2016

	Utility First Year Cost ($/MWh)			
	2 Year	5 Year	10 Year	20 Year
Expected Case	$200	$201	$196	$183
Low Cost Case	$183	$184	$180	$168
High Cost Case	$233	$235	$229	$214

Over the next two years, conservation programs are expected to cost between $183 and $233/MWh (first year savings). Overall, Chelan PUD can expect acquisition of the biennium potential estimates presented in this report to cost between $2.7 and $3.4 million for utility incentives and administrative expenditures.

Levelized Cost

The measure levelized cost is based on the present value of associated measure costs, including incremental capital costs, administrative cost assumptions, and costs for maintaining or replacing

the measure over the measure lifetime. The levelized costs presented in this section do not consider the time-differentiated value of the measure savings. The present value costs are a product of the measure life and the utility discount rate. The levelized cost is then divided by the busbar measure savings over the measure life or program length. Weighted values are based on the cost-effective potential for each year and customer sector and are shown in Table 11.

Table 11
Weighted Levelized Cost of Conservation ($/MWh), $2016

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential	55.72	55.72	55.72	55.72	55.72	55.72	55.72	55.72	55.72	55.72
Commercial	22.66	22.13	21.71	21.31	21.13	21.12	20.88	20.68	19.19	17.92
Industrial	31.68	34.24	36.65	38.08	38.85	39.67	40.38	40.92	41.34	41.68
Agriculture	14.36	14.62	14.99	15.43	15.92	16.59	17.52	18.48	19.40	20.24
Distribution Efficiency	6.96	6.96	6.96	6.96	6.96	6.96	6.96	6.96	6.96	6.96
Total	40.52	39.83	39.11	38.37	38.56	37.87	37.24	36.63	35.71	35.34

Note that the levelized cost values in this table were calculated in a more traditional manner than the TRC levelized cost shown in the supply curve in that they do not include measure benefits such as avoided energy costs, and deferred transmission and distribution expansion costs.

Scenario Results

The costs and savings discussed throughout the majority of this report describe the Base Case scenario. Under this scenario, annual potential for the planning period was estimated by applying the Council's 20-year ramp rates to each measure and then adjusting the 20-year savings shape to accelerate potential in the first 10 years of the plan to more closely reflect Chelan PUD's recent historic conservation achievement. The two-year target is lower than Chelan PUD's recent achievement; however, the utility's recent achievement is based on deemed measure savings values that are higher compared with the updated deemed savings values (those used in this study). For reference, some of the key parameters of the Base Case are listed below.

Base Case:

- Base market price forecast
- Residential growth = 1.3%
- Commercial growth = 0.8%
- Industrial growth = 0.6%
- Population growth = 0.7%[10]
- Load growth = 1.3%
- Risk-mitigation credits = $0/MWh
- Bulk system transmission credit = $26/kW-yr
- Local system distribution credit = $31/kW-yr
- Act credit = 10%
- Discount Rate = 4%

Scenarios

Three additional scenarios were developed to identify a range of possible outcomes and to account for uncertainties over the planning period. In addition to the Base Case scenario, this assessment tested a Low scenario, High scenario and an Accelerated Base Case scenario. The Low scenario and High scenarios are relative to the Base Case.

Table 12 summarizes the assumptions used to develop each of the scenarios. The basis for developing the alternative conservation scenarios is the range of load growth scenarios discussed in Chelan PUD's 2014 IRP. Unless noted otherwise in Table 12, scenario input assumptions are

[10] Office of Financial Management. (2012). Washington State Growth Management Population Projections for Counties: 2010 to 2040. [Data files]. Retrieved from: http://www.ofm.wa.gov/pop/gma/projections12/projections12.asp

the same as the Base Case assumptions listed above. Additional information regarding the development of conservation scenarios is provided in Appendix IV.

Table 12
CPA Scenario Summary

	Risk Credit ($/MWh)	Residential Growth	Commercial Growth	Industrial Growth	Load Growth	Other
Base Case	$0	1.3%	0.8%	0.6%	1.3%	
Low Case	$0	1.0%	0.7%	0.6%	0.9%	Avoided cost 20% lower
High Case	$41.60 – LO* / $59.50 – Retrofit	1.7%	2.4%	0.6%	2.3%	
Accelerated Base	$0	1.3%	0.8%	0.6%	1.3%	Accelerated ramp rates

* LO = Lost Opportunity

Low Scenario

The Low Conservation scenario evaluates energy efficiency cost effectiveness under a low growth scenario. Load growth is consistent with the low load growth scenario presented in Chelan PUD's 2014 IRP. Under the Low scenario, residential growth is 0.3 percent lower compared with the Base Case, and commercial growth is reduced by 0.1 percent. The population growth forecast used in the Low scenario is consistent with the Washington State Office of Financial Management's (OFM) low population growth scenario for Chelan County. Similar to the Base Case, because Chelan PUD is long on resources in the low load growth scenario, risk adders are not included. In addition to these adjustments, the avoided cost forecast was also decreased by 20 percent to represent a scenario where natural gas prices continue to fall over the planning period, resulting in a reduction of market prices. Results of the Low scenario analysis are shown in Table 13. Under this scenario, 31.9 aMW of technically-achievable potential is available over the 20-year planning period.

Key parameters for the Low scenario include:

- 20% lower market price forecast
- Residential growth = 1.0%
- Commercial growth = 0.7%
- Population growth = 0.5%
- Load growth = 0.9%

Table 13 Cost-Effective Achievable Potential: Low Scenario (aMW)				
	Cost Effective and Achievable			
	2 Year	5 Year	10 Year	20 Year
Residential	0.47	1.23	2.28	4.25
Commercial	0.29	0.87	1.84	3.76
Industrial	0.34	0.82	1.60	3.00
Distribution Efficiency	0.03	0.13	0.41	1.18
Agriculture	0.05	0.13	0.22	0.30
TOTAL	**1.17**	**3.18**	**6.36**	**12.49**

High Scenario

As part of the cost-effectiveness analysis in the Council's Sixth Power Plan,[11] risk adders are included in the High scenario to account for market price risk. The High conservation scenario includes risk adders of $41.60 and $59.50/MWh for non-lost opportunity and lost opportunity measures, respectively. These risk adders represent uncertainty in market prices inclusive of factors such as fuel price risk, capacity costs for new resources, and environmental regulation such as greenhouse gas costs.

Load growth under the High scenario is consistent with the high load growth scenario presented in Chelan PUD's 2014 IRP. Additionally, residential growth is 0.6 percent higher and commercial growth is 0.4 percent higher compared with the Base Case scenario. Population growth is 1.7 percent, which reflects the OFM's high growth scenario for Chelan County. Results of the High scenario are shown in Table 14. Under this scenario, 36.4 aMW of technically-achievable potential is available over the 20-year planning period.

Key parameters for the High scenario include:

- Residential growth = 1.7%
- Commercial growth = 2.4%
- Industrial growth = 0.6%
- Population growth = 1.7%
- Load growth = 2.3%
- Risk-mitigation credit = $41.60/MWh – Retrofit; $59.50/MWh – Lost Opportunity

[11] Northwest Power and Conservation Council. *Sixth Northwest Power Plan.* February 2010. Retrieved from: https://www.nwcouncil.org/energy/powerplan/6/plan/

Table 14 Cost-Effective Achievable Potential: High Scenario (aMW)				
	Cost Effective and Achievable			
	2 Year	5 Year	10 Year	20 Year
Residential	1.76	4.72	8.93	16.09
Commercial	0.62	1.81	3.78	7.07
Industrial	0.44	1.10	2.10	3.75
Distribution Efficiency	0.04	0.19	0.63	1.95
Agriculture	0.05	0.13	0.23	0.32
TOTAL	**2.91**	**7.95**	**15.68**	**29.19**

Accelerated Base Scenario

Finally, an Accelerated Base scenario represents a case where Chelan PUD is able to very quickly ramp up program savings from the measures included in this analysis, or savings from NEEA initiatives are realized sooner than expected. The Accelerated Base scenario assumes more aggressive ramp rates compared with the Base Case scenario, but the assumptions for the scenarios are otherwise identical to the Base Case. The Accelerated Base biennial target for 2016-2017 is approximately 75 percent higher compared with the Base Case biennial target (Table 15).

The Accelerated Base Scenario assumptions are identical to the Base Case with the exception that ramp rates are accelerated at a higher rate in the early years of the study. The potential modeled under this scenario is similar to Chelan PUD's recent achievement; however, because the RTF has reduced the deemed savings for many measures, the utility would likely need to implement more projects compared with what has been done in the past in order to maintain achievement consistent with the historic level.

Table 15 Cost-Effective Achievable Potential: Accelerated Base Scenario (aMW)				
	Cost Effective and Achievable			
	2 Year	5 Year	10 Year	20 Year
Residential	1.52	3.79	5.61	7.12
Commercial	0.41	1.22	2.56	5.02
Industrial	0.40	1.00	1.94	3.49
Distribution Efficiency	0.03	0.13	0.42	1.23
Agriculture	0.05	0.13	0.23	0.32
TOTAL	**2.42**	**6.27**	**10.76**	**17.17**

Scenario Comparison

Table 16 shows the results of each scenario compared with the Base Case and Figure 19 graphs 2015 CPA scenarios.

Table 16
Scenario Results Comparison (aMW)

	2 Year	5 Year	10 Year	20 Year
Base Case	1.66	4.53	9.09	17.45
Accelerated Base Case	2.42	6.27	10.76	17.17
High Case	2.91	7.95	15.68	29.19
Low Case	1.17	3.18	6.36	12.49

Figure 19
Conservation Scenarios – Annual Potential (aMW)

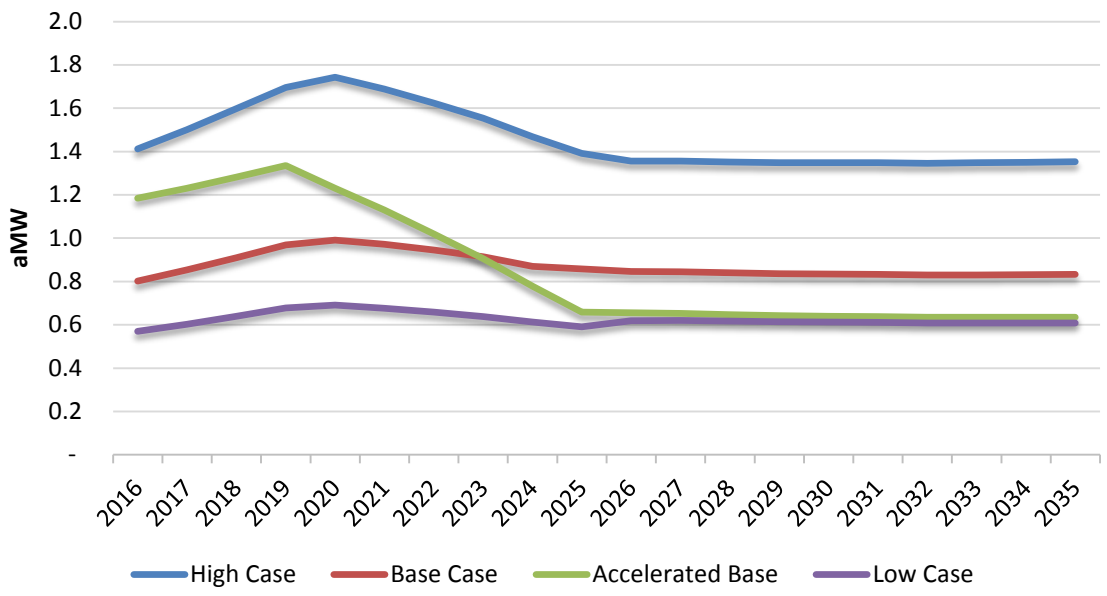


Figure 19 shows that the 20-year Low scenario potential is approximately 28 percent lower compared with the Base Case. The near-term potential estimates based on the Accelerated scenario are consistent with Chelan PUD's average annual achievement for the four years preceding this assessment (approximately 1.8 aMW per year). However, this level of achievement in the future may require significant effort from the utility and would also likely require that Chelan PUD continue to receive the same level of NEAA savings. As mentioned previously, because the RTF has reduced the deemed savings for many measures, Chelan PUD would likely need to implement more projects annually compared with historic completed projects in order to maintain achievement consistent with historic levels.

Summary

This report summarizes the results of a CPA conducted for Chelan County Public Utility District. The assessment provides estimates of energy savings by sector for the period 2016 to 2035 with a focus on the first 10 years of the planning period, as required by the EIA. The assessment considered a wide range of conservation resources that are reliable, available, and cost effective within the 20-year planning period.

Market conditions that include codes and standards changes, lower electricity market prices, and recent high achievements by Chelan PUD resulted in an assessment with lower potential compared with the prior assessment conducted in 2013. However, the 10 and 20-year potential for energy efficiency remain strong and energy efficiency is expected to remain an integral part of the Chelan PUD resource portfolio. Conservation remains the lowest cost and lowest risk resource and will serve to keep future electricity costs to a minimum.

Methodology and Compliance with State Mandates

The energy efficiency potential reported in this document is calculated using methodology consistent with the Council's methodology for assessing conservation resources. Appendix III lists each requirement and describes how each item was completed. In addition to using methodology consistent with the Council's Sixth Power Plan, this assessment utilized many of the measure assumptions that the Council developed for the Sixth and Seventh Regional Power Plans. Specific utility data about customer characteristics, service-area composition, and historical conservation achievements were used, in conjunction with the measures identified by the Council, to determine the energy-efficiency potential available. Conservation potential was assessed for multiple periods: 2 years, 5 years, 10 years, and 20 years. This close connection with the Council methodology enables compliance with the Washington EIA.

Three types of energy-efficiency potential were calculated: technical, economic, and achievable. Most of the results shown in this report are the "achievable" potential, or the potential that is economically achievable in the Chelan PUD service territory. The achievable potential considers savings that will be captured through utility program efforts, market transformation implementation of codes and standards, and future momentum savings (which may be defined as naturally occurring conservation). Often, full savings from a technology, particularly new or emerging technologies, will require efforts across all three areas. Historic efforts to measure the savings from codes and standards have been limited, but regional efforts to identify and track savings are increasing as they become an important component of the efforts to meet aggressive regional conservation targets.

Conservation Targets

The EIA states that utilities must establish a biennial target that is "no lower than the qualifying utility's pro rata share for that two year period of its cost-effective conservation potential for the subsequent ten-year period."[12] However, the State Auditor's Office has stated that:

> The term pro-rata can be defined as equal portions but it can also be defined as a proportion of an "exactly calculable factor." For the purposes of the Energy Independence Act, a pro-rata share could be interpreted as an even 20 percent of a utility's 10 year assessment but state law does not require an even 20 percent.[13]

The State Auditor's Office expects that qualifying utilities have analysis to support targets that are more or less than the 20 percent of the ten year assessments. This document serves as support for the selected conservation target.

Summary

This study shows a range of conservation target scenarios. These scenarios are estimates based on the set of assumptions detailed in this report and supporting documentation and models. Due to the uncertainties discussed in the Introduction section of this report, actual available and cost-effective conservation may vary from the estimates provided in this report.

[12] RCW 19.285.040 Energy conservation and renewable energy targets.

[13] State Auditor's Office. Energy Independence Act Criteria Analysis. Pro-Rata Definition. CA No. 2011-03. https://www.sao.wa.gov/local/Documents/CA_No_2011_03_pro-rata.pdf

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Appendix I – Acronyms

aMW –Average Megawatt

BPA – Bonneville Power Administration

CFL – Compact Fluorescent Light Bulb

Chelan PUD – Chelan County Public Utility District

EIA – Energy Independence Act

EUI – Energy use intensity

HLH – Heavy load hour energy

HVAC – Heating, ventilation and air-conditioning

kW – kilowatt

kWh – kilowatt-hour

LED – Light-emitting diode

LLH – Light load hour energy

MF –Multi-Family

MH –Manufactured Home

MW –Megawatt

MWh –Megawatt-hour

NEEA – Northwest Energy Efficiency Alliance

NPV – Net Present Value

O&M – Operation and Maintenance

OFM – Washington State Office of Financial Management

RPS – Renewable Portfolio Standard

UC – Utility Cost

Appendix II – Glossary

6th Power Plan: Sixth Northwest Conservation and Electric Power Plan, Feb 2010. A regional resource plan produced by the Northwest Power and Conservation Council (Council).

Average Megawatt (aMW): Average hourly usage of electricity, as measured in megawatts, across all hours of a given day, month or year.

Avoided Cost: Refers to the cost of the next best alternative. For conservation, avoided costs are usually market prices.

Achievable Potential: Conservation potential that takes into account how many measures will actually be implemented. For lost-opportunity measures, there is only a certain percent of expired units or new construction for a specified time frame. The Council uses 85 and 65 percent achievability rates for retrofit and lost-opportunity measure respectively. Sometimes achievable potential is a percent of economic potential, and sometimes achievable potential is defined as a percent of technical potential.

Conservation Calculator: Refers to Excel program developed by the Council which calculates conservation potential for Northwest utilities based on their share of the regional load.

Cost Effective: A conservation measure is cost effective if its present-value benefits are greater than its present-value costs. The primary test is the Total Resource Cost test (TRC), in other words, the present value of all benefits is equal to or greater than the present value of all costs. Benefits and costs are for society as whole.

CTED (Department of Community Trade and Economic Development): CTED Energy Policy Division helps deliver an economically and environmentally sound energy future to the State of Washington and its citizens. The department provides information, analysis and support and assists in developing energy policies and programs.

Economic Potential: Conservation potential that considers the cost and benefits and passes a cost-effectiveness test.

Energy Use Intensity: A building's energy use as a function of its size; measured in kWh/square foot. *Levelized Cost:* Resource costs are compared on a levelized-cost basis. Levelized cost is a measure of resource costs over the lifetime of the resource. Evaluating costs with consideration of the resource life standardizes costs and allows for a straight comparison.

Levelized Cost: A measure of resource costs over the lifetime of the resource. Evaluating costs with consideration of the resource life standardizes costs and allows for a straight comparison.

Lost Opportunity: Lost-opportunity measures are those that are installed as new construction or at the end of the life of the unit. Examples include weatherization, heat-pump upgrades, appliances, or premium HVAC in commercial buildings.

MW (megawatt): 1,000 kilowatts of electricity. The generating capacity of utility plants is expressed in megawatts.

MWh (megawatt hour): Equal to one megawatt of electricity used continuously for one hour.

Non-Lost Opportunity: Measures that can be acquired at any time, such installing low-flow shower heads.

Northwest Energy Efficiency Alliance (NEEA): The alliance is a unique partnership among the Northwest region's utilities, with the mission to drive the development and adoption of energy-efficient products and services.

Northwest Power and Conservation Council "Council": The Council develops and maintains a regional power plan and a fish and wildlife program to balance the Northwest's environment and energy needs. Their three tasks are to: develop a 20-year electric power plan that will guarantee adequate and reliable energy at the lowest economic and environmental cost to the Northwest; develop a program to protect and rebuild fish and wildlife populations affected by hydropower development in the Columbia River Basin; and educate and involve the public in the Council's decision-making processes.

Regional Technical Forum (RTF): The Regional Technical Forum (RTF) is an advisory committee established in 1999 to develop standards to verify and evaluate conservation savings. Members are appointed by the Council and include individuals experienced in conservation program planning, implementation and evaluation.

Renewable Portfolio Standard (RPS): Washington state utilities with more than 25,000 customers are required to meet defined percentages of their load with eligible renewable resources by 2012, 2016, and 2020.

Retrofit (discretionary): Retrofit measures are those that are replaced at any time during the unit's life. Examples include lighting, shower heads, pre-rinse spray heads, or refrigerator decommissioning.

Technical Potential: Technical potential includes all conservation potential, regardless of cost or achievability. Technical potential is conservation that is technically feasible.

Total Resource Cost Test (TRC): This test is used by the Council and nationally to determine whether or not conservation measures are cost effective. A measure passes the TRC if the present value of all benefits (no matter who receives them) over the present value of all costs (no matter who incurs them) is equal to or greater than one.

Appendix III – Documenting Conservation Targets

References:

1) Report – "Chelan PUD 2015 Conservation Potential Assessment". Final Report – November 2015
2) Model – "Chelan PUD CPA 2015 - Base.xlsm" and supporting files
    a. MC_and_Loadshape_Chelan.xlsm – referred to as "MC file" – contains price and load shape data

WAC 194-37-070 Documenting Development of Conservation Targets; Utility Analysis Option		
NWPCC Methodology	**EES Consulting Procedure**	**Reference**
a) Analyze a broad range of energy efficiency measures considered technically feasible.	All of the Council's current energy efficiency measures (Sixth and Seventh Power Plan measures) were evaluated to determine which had greater benefits than costs.	Model – "All Measures" worksheet
b) Perform life-cycle cost analysis of measures or programs, including the incremental savings and incremental costs of measures and replacement measures where resources or measures have different measure lifetimes.	The life-cycle cost analysis was performed using the Council's ProCost model. Incremental costs, savings, and lifetimes for each measure were the basis for this analysis. The Council and RTF assumptions were utilized.	Model – supporting files include all of the ProCost files used in the Sixth Plan. The life-cycle cost calculations/methods are identical to those used by the council.
c) Set avoided costs equal to a forecast of regional market prices, which represents the cost of the next increment of available and reliable power supply available to the utility for the life of the energy efficiency measures to which it is compared.	A regional market price forecast for the planning period was created and provided by Chelan PUD and is consistent with the forecast used for power planning purposes.	Report – See Figure 3 and associated discussion. Also see Appendix IV. Model – See MC File ("Chelan Base" worksheet).
d) Calculate the value of the energy saved based on when it is saved. In performing this calculation, use time differentiated avoided costs to conduct the analysis that determines the financial value of energy saved through conservation.	The Council's Sixth Plan default measure load shapes were used to calculate time of day usage and measure values were weighted based upon peak and off-peak pricing. This was handled using the Council's ProCost program so it was handled in the same way as the Sixth Power Plan models.	Model – See MC file for load shapes. The ProCost files handle the calculations.

WAC 194-37-070 Documenting Development of Conservation Targets; Utility Analysis Option		
NWPCC Methodology	**EES Consulting Procedure**	**Reference**
e) Conduct a total resource cost analysis that assesses all costs and all benefits of conservation measures regardless of who pays the costs or receives the benefits. The NWPCC identifies conservation measures that pass the total resource cost test as economically achievable.	Cost analysis was conducted according to the Council's methodology. Capital cost, administrative cost, annual O&M cost and periodic replacement costs were all considered on the cost side. Energy, non-energy, O&M and all other quantifiable benefits were included on the benefits side. The Total Resource Cost (TRC) benefit cost ratio was used to screen measures for cost-effectiveness (I.e., those greater than or equal to 1 are cost-effective).	Model – the Chelan PUD CPA main file pulls in all of the results, including the BC ratios. However, the TRC analysis is done at the lowest level of the model in the ProCost files.
f) Identify conservation measures that pass the total resource cost test, by having a benefit/cost ratio of one or greater as economically achievable.	Benefits and costs were evaluated using multiple inputs; benefit was then divided by cost. Measures achieving a BC ratio of >=1 were tallied. These measures are considered achievable and cost-effective (or "economically achievable").	Model – BC Ratios are calculated at the ProCost level and passed up to the sector and total levels of the model.
g) Include the increase or decrease in annual or periodic operations and maintenance costs due to conservation measures.	Operations and maintenance costs for each measure were accounted for in the total resource cost according to the Council's assumptions.	Model – the ProCost files contain the same assumptions for periodic O&M as the Council and RTF.
h) Include deferred capacity expansion benefits for transmission and distribution systems in its cost-effectiveness analysis.	Deferred capacity expansion benefits were given a benefit of $26/kW for bulk transmission and $31/kW-yr for local distribution in the cost-effectiveness analysis. These are the same assumptions used by the Council in the development of the Seventh Power Plan.	Model – this value can be found on the ProData page of each ProCost file.
i) Include all nonpower benefits that a resource or measure may provide that can be quantified and monetized.	Quantifiable non-energy benefits were included where appropriate. Assumptions for non-energy benefits are the same as in the Councils Sixth/Seventh Power Plan. Non-energy benefits include, for example, water savings from clothes washers.	Model – the ProCost files contain the same assumptions for nonpower benefits as the Council and RTF. The calculations are handled in exactly the same way.

WAC 194-37-070 Documenting Development of Conservation Targets; Utility Analysis Option		
NWPCC Methodology	**EES Consulting Procedure**	**Reference**
j) Include an estimate of program administrative costs.	Total costs were tabulated and an estimated 20% of total was assigned as the administrative cost. This value is based on historic program expenses.	Model – this value can be found on the ProData page of each ProCost file.
k) Discount future costs and benefits at a discount rate based on a weighted, after-tax, cost of capital for utilities and their customers for the measure lifetime.	Discount rates were applied to each measure based upon the Council's methodology. Real discount rate = 4%, based on the Council's research supporting the Seventh Power Plan.	Model – this value can be found on the ProData page of each ProCost file.
l) Include estimates of the achievable customer conservation penetration rates for retrofit measures and for lost-opportunity (long-lived) measures. The NWPCC's twenty-year achievable penetration rates, for use when a utility assesses its twenty-year potential, are eighty-five percent for retrofit measures and sixty-five percent for lost opportunity measures achieved through a mix of utility programs and local, state and federal codes and standards. The NWPCC's ten-year achievable penetration rates, for use when a utility assesses its ten-year potential, are sixty-four percent for nonlost opportunity measures and twenty-three percent for lost-opportunity measures; the weighted average of the two is a forty-six percent ten-year achievable penetration rate	The assessment conducted for Chelan PUD was for the 20-year planning period, thus 85% for retrofit measures and 65% for lost opportunity measures were used to determine potential.	Model – these factors can be found on some of the hidden worksheets in the main model (e.g., "Applicability Table DHW Light"). These tables show the 85% value and how it is applied to the number of units. For the commercial sector, these applicability values can be found in the "SC" worksheets of the ProCost files.
m) Include a ten percent bonus for conservation measures as defined in 16 U.S.C. § 839a of the Pacific Northwest Electric Power Planning and Conservation Act.	A 10% bonus was added to all measures in the model parameters per the Conservation Act.	Model – this value can be found on the ProData page of each ProCost file.

WAC 194-37-070 Documenting Development of Conservation Targets; Utility Analysis Option		
NWPCC Methodology	**EES Consulting Procedure**	**Reference**
n) Analyze the results of multiple scenarios. This includes testing scenarios that accelerate the rate of conservation acquisition in the earlier years.	Accelerated, High, and Low scenarios were run and plotted next to the base-case scenario. Ramp rates were also utilized to adjust for the utility's programs.	Report – see "Scenario Results" section and Figure 20. Model – there is a separate model for each scenario. In addition, there is an "Accelerated Base" model that additionally accelerates the ramp rates of the base case in the early years.
o) Analyze the costs of estimated future environmental externalities in the multiple scenarios that estimate costs and risks.	The avoided cost data include estimates of future high, medium, and low CO_2 costs.	Multiple scenarios were analyzed and these scenarios include different levels of estimated costs and risk.

Appendix IV – Avoided Cost and Risk Exposure

EES Consulting (EES) has conducted a Conservation Potential Assessment (CPA) for Chelan County Public Utility District (Chelan PUD) for the period 2016 through 2035 as required under RCW 19.285 and WAC 194.37. According to WAC 197.37.070, Chelan PUD must evaluate the cost-effectiveness of conservation by setting avoided costs equal to a forecast of regional market prices. Chelan PUD has provided a forecast of market prices for the Mid-Columbia trading hub. This forecast of market prices is also used by the utility for its power system planning. This section provides details about the market price forecast and compares the forecast used for this assessment to the market forecast used for Chelan PUD's 2013 CPA (2014/15 biennium).

Market Price Risk

As part of the cost-effectiveness analysis in the Northwest Power and Conservation Council's (Council) Sixth Power Plan,[14] risk adders are included to account for market price risk (inclusive of deferred capacity investments to production, environmental factors, and fuel price volatility). In order to evaluate market price risk in Chelan PUD's CPA, three conservation scenarios are evaluated: Base, High, and Low. These scenarios model market price risk deterministically by evaluating energy efficiency under different market price levels with the inclusion of risk adders. These scenarios are described below, but first background information on Chelan PUD's resource balance, market price forecast and market price risk exposure is provided.

Market Price Forecast

According to WAC 197.37.070, Chelan PUD must evaluate the cost-effectiveness of conservation by setting avoided costs equal to a forecast of regional market prices. Chelan PUD provided EES with a forecast of monthly peak and off peak market prices from January 2015 through December 2031. The forecast is escalated at 3 percent for the remaining months of the study period. Figure A-1 compares the market price forecast used in Chelan PUD's 2013 CPA with the market price forecast used in the 2015 CPA. The levelized value of prices over the 2015 CPA planning period is $37.86, assuming a 4 percent discount rate. The 2015 market price forecast is 19 percent lower than the market price forecast used in Chelan PUD's most recent CPA. The difference in price level can be attributed to lower natural gas prices at the time the most recent forecast was developed.

[14] Northwest Power and Conservation Council. Sixth Northwest Power Plan. February 2010. https://www.nwcouncil.org/energy/powerplan/6/plan/

Figure A-1
Market Price Forecast Comparison

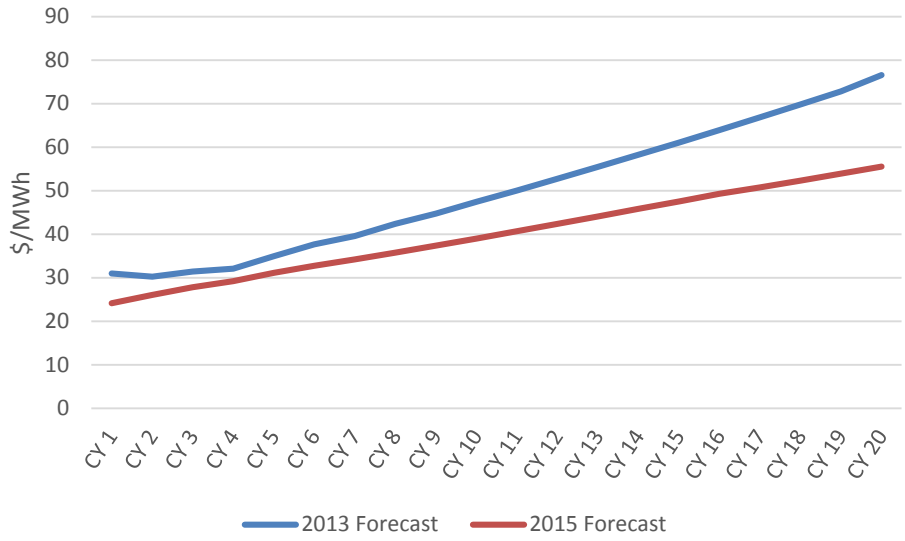
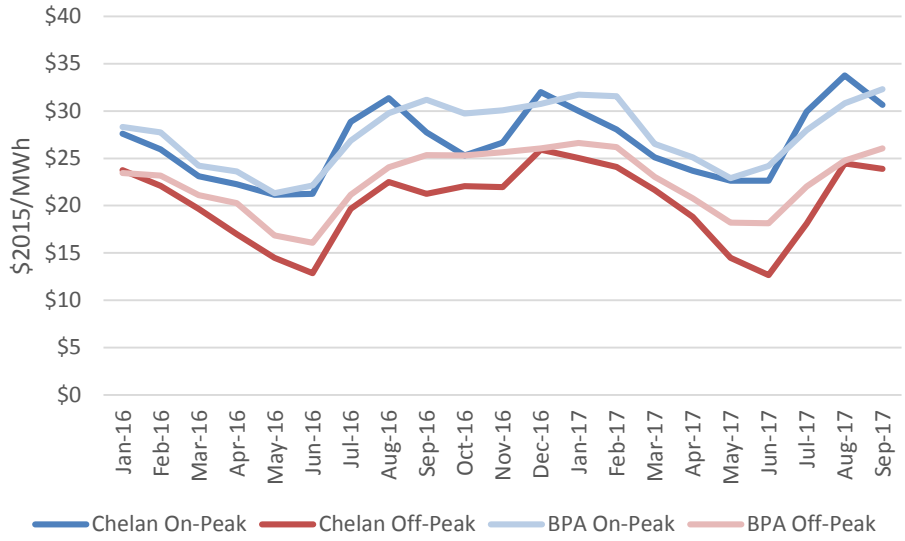


Figure A-2 benchmarks Chelan PUD's market price forecast with the forecast developed for BPA's final record of decision (2016 rate case). Figure A-2 shows that both the price level and monthly shape of the forecast are similar.

Figure A-2
Market Price Forecast Comparison to BPA



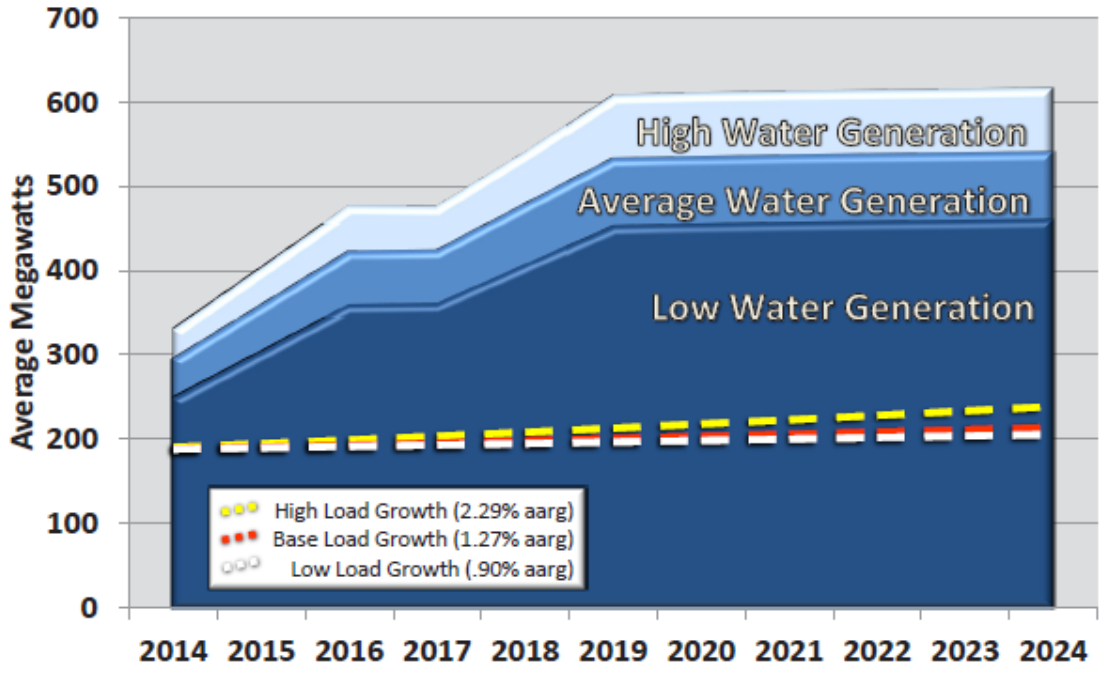
Load Resource Balance

Chelan PUD owns and operates three hydroelectric projects, which produce over 1,000 aMW in an average year. Less than 20 percent of the output is used in Chelan PUD's service territory. The rest is sold through long-term power purchase contracts and on the wholesale power market.

In addition to the three hydroelectric projects, the utility also receives power from the Nine Canyon Wind Project. This resource accounts for less than one percent of Chelan PUD's resource portfolio though it contributes to the utility's eligible resources for meeting its Renewable Portfolio Standard (RPS) targets.

In Chelan PUD's most recent IRP, the utility presents three retail load growth scenarios. Under the Base Case scenario, average annual growth from 2014 to 2024 is 1.27 percent. The IRP's High scenario growth rate is 2.29 percent and the Low scenario growth rate is 0.90 percent. Under all scenarios, Chelan PUD's existing resources are significantly higher than projected load growth. Figure A-3 shows Chelan PUD's projected retail load growth scenarios and the utility's resource availability under high, low and expected (average) water. This graph includes all of Chelan PUD's hydro generation except generation that has been committed through Slice contracts.

Figure A-3
Chelan PUD Load Resource Balance, Critical Water



Renewable Portfolio Standard

As is the case with all of Washington's qualifying utilities, Chelan PUD is required to meet tiered percentages of service territory load with eligible renewable resources. Chelan estimates that

17 to 18 aMW of renewable energy will be required to meet targets from 2016 to 2017 and 30 to 32 aMW will be required from 2020 to 2024. Chelan PUD's existing resource portfolio complies with its RPS and the utility will have sufficient eligible renewable generation to meet its RPS under any load growth scenario for the foreseeable future.

Risk Adders

For the 2015 CPA, risk credits are $0/MWh for the Base Case scenario because Chelan PUD's risk exposure to power market prices and environmental externalities, such as greenhouse gas and renewable energy credit costs is low. For the 2013 CPA, the High scenario included risk credits of $35/MWh for retrofit measures and $50/MWh for lost opportunity measures. The inclusion of risk credits in the high scenario reflects the upside risk of power market prices. Specifically, if market prices increase significantly over the study period, Chelan PUD may see increased revenues from power sales. Since the 2013 CPA, the market price forecast has decreased by 19 percent on average. While market prices have fallen, the risk of market price increases is unchanged. Therefore, the 2013 CPA risk adders are increased by 19 percent to $41.60 and $59.50/MWh, respectively.

Conservation Scenarios

Conservation scenarios are modeled both for deterministic risk credit values as well as for a range of customer sector growth futures. The residential, commercial and growth rate scenarios are based on expected growth (Base Case), low growth, and high growth. Table A-1 shows proposed growth rates and risk credits for the three scenarios. It may be beneficial for Chelan PUD's conservation planning efforts if the 2015 CPA scenarios match assumptions used in the utility's IRP. Additional data will be necessary for EES to complete scenario planning for Chelan PUD's 2015 CPA.

Table A-1
CPA Scenario Summary

	Risk Credit ($/MWh)	Residential Growth	Commercial Growth	Industrial Growth	Load Growth	Other
Base Case	$0	1.3%	0.8%	0.6%	1.3%	
Low Case	$0	1.0%	0.7%	0.6%	0.9%	Avoided cost reduced by 20%
High Case	$41.60 – LO* / $59.50 – Retrofit	1.7%	2.4%	0.6%	2.3%	
Accelerated Base	$0	1.3%	0.8%	0.6%	1.3%	Accelerated ramp rates

Summary

The three scenarios detailed in Table A-1 represent a range of possible futures based on information available at this time. Chelan PUD continually re-evaluates its resources and updates

the CPA every two years. Any changes in market conditions are captured in subsequent updates and are factored into new conservation targets. EES looks forward to discussing these proposed scenarios with Chelan PUD.

Appendix V – Measure List

This appendix provides a high-level measure list of the energy efficiency measures evaluated in the 2015 CPA. The CPA evaluated approximately 1,400 individual measures; the measure list does not include each individual measure rather it summarizes the major measure bundles. Specifically, utility conservation potential is modeled based on incremental costs and savings of individual measures. Individual measures are then combined into measure "bundles" to more realistically reflect utility-conservation program organization and offerings. For example, single-family attic insulation measures are modeled for a variety of upgrade increments: R-0 to R-38, R-0 to R-49, or R-19 to R-38. The increments make it possible to model measure savings and costs at a more precise level. The individual measures are then bundled across all housing types to result in one measure group: attic insulation.

The measure list used in this CPA was developed based on information from the Regional Technical Forum (RTF) and the Northwest Power and Conservation Council (Council). The RTF and the Council continually maintain and update a list of regional conservation measures based on new data, changing market conditions, regulatory changes, and technological developments. In preparation for the Seventh Power Plan, the final plan is scheduled to be released in early 2016, the Council and RTF have been revising Sixth Power Plan regional conservation measures. Costs, savings, applicability, and other factors have been revised for individual measures and many measures have been added or removed. The measure list provided in this appendix includes the most up-to date information available at the time this CPA was developed.

The following tables list the conservation measures (at the bundle level or lower) that were used to model conservation potential presented in this report. Measure bundles in red are new in the Seventh Power Plan. Measure data was sourced from the Council's Seventh Power Plan workbooks, the RTF's Unit Energy Savings (UES) workbooks, and some of data came from the Bonneville Power Administration (BPA). Please note that some measures may not be applicable to an individual utility's service territory based on characteristics of the utility's customer sectors.

Table A-2
Residential End Uses and Measures

End Use	Measures	Data Source
Appliances	Clothes Washer	7th Plan
	Heat Pump Dryer	7th Plan
	Dishwasher	7th Plan
	Refrigerator	7th Plan
	Freezer	7th Plan
	Oven	7th Plan
	Microwave Oven	7th Plan
Consumer Electronics	Advanced Power Strips	RTF
	LCD Display Monitor	7th Plan
	Desktop Computer	7th Plan
	Set Top Box	RTF
Lighting	LED General Purpose and Dimmable	7th Plan
	LED Decorative and Mini-Base	7th Plan
	LED Globe	7th Plan
	LED Reflectors and Outdoor	7th Plan
	LED Three-Way	7th Plan
Envelope - Retro	Attic Insulation	7th Plan, BPA
	Floor Insulation	7th Plan, BPA
	Wall Insulation	7th Plan, BPA
	Window Upgrade	7th Plan, BPA
	WiFi Enabled Thermostats	7th Plan
Envelope - New	Attic Insulation	RTF
	Floor Insulation	RTF
	Wall Insulation	RTF
	Below Grade Wall Insulation	RTF
	Slab Insulation	RTF
	Vaulted Ceiling Insulation	RTF
	Window Glazing	RTF
Cooling	Window Air Conditioner	7th Plan

End Use	Measures	Data Source
Heat Pump/Ductless Heat Pump	Ductless Heat Pump	7th Plan
	Air Source Heat Pump	7th Plan
	Variable Capacity Central Heat Pump	7th Plan
Water Heating	Heat Pump Water Heater	7th Plan
	Efficient Tank	7th Plan
	Showerhead	7th Plan
	Bathroom Aerator	7th Plan
Solar Water Heating	Solar Water Heater	7th Plan

Table A-3
Commercial End Uses and Measures

End Use	Measures	Data Source
Lighting	Bi-Level Stairwell Lighting	7th Plan
	Interior Lighting Controls	7th Plan
	Low Power Fluorescent Lamps	7th Plan
	Lighting Power Density (LPD) Package	7th Plan
	Exterior Building Lighting	7th Plan
	Parking Garage Lighting	7th Plan
	Light Emitting Capacitor Exit Sign	7th Plan
Refrigeration	Anti-Sweat Heater Controls	7th Plan
	ECM Controllers on Walk-In Evaporator Motors	7th Plan
	Floating Head Pressure Control	7th Plan
	Grocery Retrocommissioning	7th Plan
	LED Case Lighting	7th Plan
	LED Motion Sensors on Display Case	7th Plan
	Replace Shaded Pole with ECM in Walk-in Cooler	7th Plan
	Strip Curtains: Walk-In Coolers/ Freezers	7th Plan
	Water Cooler Controls	7th Plan
Food Preparation	Demand Control Ventilation - Restaurant Hoods	7th Plan
	Pre-Rinse Spray Valve	7th Plan
	Combination Oven	7th Plan
	Convection Oven	7th Plan
	Hot Food Holding Cabinet	7th Plan
	Steamer	7th Plan
HVAC Controls	Advanced Rooftop Controller	7th Plan
	Energy Management	7th Plan
Ventilation	Demand Control Ventilation	7th Plan
	Electrically Commutated Motors on Variable	7th Plan
	Air Volume Boxes (ECM-VAV)	7th Plan
	Low Pressure Distribution Complex HVAC	RTF
	Variable Refrigerant Flow	7th Plan
	Web-Enabled Thermostats	7th Plan

End Use	Measures	Data Source
Heat Pump/Ductless Heat Pump	Ductless Heat Pump	7th Plan
Envelope	Secondary Glazing System - Windows	7th Plan
	Roof Insulation	RTF
Rooftop Units	Economizer	7th Plan
Compressed Air	Compressed Air Improvements	7th Plan
	Compressed Air Controls	7th Plan
Chillers	Variable speed chillers	RTF
PC Network Power Supply	Networked Computer Control	RTF
	Smart Plug Power Strips	7th Plan
Motors	Motors - Rewind	7th Plan
Water Heating	Showerheads	7th Plan, RTF
	Water Heater Tanks	7th Plan
Data Centers	Data Center Measure Suite	7th Plan

Table A-4
Agriculture End Uses and Measures

End Use	Measures	Data Source
Dairy	Efficient Lighting	7th Plan
	Heat Recovery Refrigeration	7th Plan
	Milk Pre-Cooler	7th Plan
	Milking Machine Vacuum Pump VSD	7th Plan
Irrigation Efficiency	Low Energy Spray (LESA) measures	7th Plan
Irrigation Hardware	Center Pivot/Linear Move Systems	7th Plan
	Convert Hand Line Systems to Low Pressure Systems	7th Plan
	Convert High Pressure Center Pivot to Low Pressure System	7th Plan
	Convert Wheel Line Systems to Low Pressure Systems	7th Plan
	Thunderbird Wheel Line Systems	7th Plan
	Wheel Line Systems	7th Plan
	Wheel/Hand Line Systems	7th Plan
Irrigation Scheduling	Irrigation Water Management (Includes SIS)	7th Plan
Lighting	LED Area Lights	7th Plan
Pumping	Motor - Rewind	7th Plan

Table A-5
Industrial End Uses and Measures

End Use	Measures	Data Source
Compressed Air	Air Compressor Demand Reduction	7th Plan
	Air Compressor Equipment	7th Plan
	Air Compressor Optimization	7th Plan
Fans	Efficient Centrifugal Fan	7th Plan
	Fan Energy Management	7th Plan
	Fan Equipment Upgrade	7th Plan
	Fan System Optimization	7th Plan
	Paper: Premium Fan	7th Plan
Lighting	Efficient Lighting Shift	7th Plan
	HighBay Lighting Shift	7th Plan
	Lighting Controls	7th Plan
Motors	Motors - Rewind	7th Plan
Process: Electronic Mfg.	Clean Room: Change Filter Strategy	7th Plan
	Clean Room: Chiller Optimize	7th Plan
	Clean Room: Clean Room HVAC	7th Plan
	Elec Chip Fab: Eliminate Exhaust	7th Plan
	Elec Chip Fab: Exhaust Injector	7th Plan
	Elec Chip Fab: Reduce Gas Pressure	7th Plan
	Elec Chip Fab: Solidstate Chiller	7th Plan
Process: General	Energy Project Management	7th Plan
	Integrated Plant Energy Management	7th Plan
	Material Handling VFD	7th Plan
	Material Handling	7th Plan
	Panel: Hydraulic Press	7th Plan
	Plant Energy Management	7th Plan
	Synchronous Belts	7th Plan
Process: Kraft Mfg.	Kraft: Efficient Agitator	7th Plan
Process: Mech Mfg.	Mech Pulp: Premium Process	7th Plan
	Mech Pulp: Refiner Plate Improvement	7th Plan
	Mech Pulp: Refiner Replacement	7th Plan

End Use	Measures	Data Source
Process: Metal Mfg.	Metal: New Arc Furnace	7th Plan
Process: Paper Mfg.	Paper: Efficient Pulp Screen	7th Plan
	Paper: Large Material Handling	7th Plan
	Paper: Material Handling	7th Plan
	Paper: Premium Control Large Material	7th Plan
Process: Wood Mfg.	Wood: Replace Pneumatic Conveyor	7th Plan
Pumps	Kraft: Effluent Treatment System	7th Plan
	Pump Energy Management	7th Plan
	Pump Equipment Upgrade	7th Plan
	Pump System Optimization	7th Plan
Refrigerated Storage	CA Retrofit -- CO2 Scrub	7th Plan
	CA Retrofit -- Membrane	7th Plan
	Cold Storage Retrofit	7th Plan
	Cold Storage Tune-up	7th Plan
	Food: Cooling and Storage	7th Plan
	Food: Refrig Storage Tune-up	7th Plan
	Fruit Storage Refer Retrofit	7th Plan
	Fruit Storage Tune-up	7th Plan
	Groc Dist Retrofit	7th Plan
	Groc Dist Tune-up	7th Plan
Transformers	Transformers	7th Plan

Table A-6
Distribution Efficiency End Uses and Measures

End Use	Measures	Data Source
Utility Distribution System	LDC Voltage Control Method	7th Plan
	Minor System Improvements	7th Plan
	Major System Improvements	7th Plan
	EOL Voltage Control Method	7th Plan
	SCL Implement EOL w/ Major System Improvements	7th Plan

Table A-7
Other End Uses and Measures

End Use	Measures	Data Source
Water & Wastewater	Municipal Sewage Treatment	7th Plan
	Municipal Water Supply System Measure Suite	7th Plan
Traffic	Street and Roadway Lighting	7th Plan

Appendix VI – Energy Efficiency Potential by End-Use

Table A-8 Residential Economic and Achievable Potential, aMW				
	2 Year	**5 Year**	**10 Year**	**20 Year**
Lighting	0.20	0.55	1.04	1.38
Heat Pump/Ductless Heat Pump	0.25	0.66	1.25	2.06
Envelope Retro	0.04	0.11	0.21	0.69
Water Heat	0.15	0.41	0.79	1.25
Consumer Electronics	0.06	0.15	0.30	1.31
Appliances	0.04	0.11	0.20	0.34
Envelope New	0.01	0.02	0.03	0.04
Cooling	0.00	0.00	0.01	0.03
Total	**0.75**	**2.01**	**3.83**	**7.10**

Table A-9 Commercial Economic and Achievable Potential, aMW				
	2 Year	**5 Year**	**10 Year**	**20 Year**
Lighting	0.10	0.31	0.66	1.13
PC Network/Supply	0.00	0.01	0.02	0.03
HVAC Controls	0.10	0.30	0.65	1.33
Refrigeration	0.05	0.13	0.24	0.32
Exterior Lighting	0.01	0.04	0.09	0.29
Envelope	0.05	0.15	0.32	0.89
Ventilation	0.02	0.05	0.10	0.20
Food Preparation	0.01	0.02	0.04	0.07
Chillers	0.00	0.00	0.00	0.00
Street & Roadway Lighting	0.00	0.01	0.01	0.04
Water Heat	0.00	0.00	0.00	0.00
Ductless Heat Pump	0.06	0.20	0.42	0.70
Motors	0.00	0.00	0.01	0.01
Compressed Air	0.00	0.00	0.00	0.01
Total	**0.41**	**1.22**	**2.56**	**5.02**

Table A-10 Industrial Economic and Achievable Potential, aMW				
	2 Year	**5 Year**	**10 Year**	**20 Year**
Compressed Air	0.00	0.01	0.01	0.01
Fans	0.01	0.03	0.08	0.10
Lighting	0.02	0.03	0.04	0.05
Motors	0.00	0.00	0.00	0.00
Process: Electronic Mfg.	0.00	0.00	0.01	0.01
Process: General	0.04	0.09	0.18	0.25
Process: Paper Mfg.	0.00	0.00	0.00	0.01
Process: Wood Mfg.	0.00	0.00	0.00	0.00
Pumps	0.00	0.01	0.03	0.04
Water & Wastewater	0.07	0.17	0.28	0.46
Refrigerated Storage	0.01	0.02	0.03	0.03
Fruit Storage	0.25	0.63	1.26	2.52
Total	**0.40**	**1.00**	**1.93**	**3.49**

Table A-11 Agriculture Economic and Achievable Potential, aMW				
	2 Year	**5 Year**	**10 Year**	**20 Year**
Dairy	0.00	0.00	0.00	0.00
Lighting	0.00	0.00	0.02	0.06
Pumping	0.00	0.00	0.00	0.02
Irrigation Hardware	0.04	0.11	0.21	0.41
Irrigation Efficiency	0.02	0.06	0.10	0.11
Total	**0.04**	**0.11**	**0.24**	**0.61**

Table A-12 Distribution Efficiency Economic and Achievable Potential, aMW				
	2 Year	**5 Year**	**10 Year**	**20 Year**
Reduce system voltage	0.02	0.08	0.26	0.77
Minor system improvements	0.01	0.05	0.16	0.46
Total	**0.03**	**0.13**	**0.42**	**1.23**