Chelan County Public Utility District

Chelan County Public Utility District Conservation Potential Assessment Final Report

September 14, 2011

Prepared by:

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EES Consulting

September 14, 2011

Mr. James White
Chelan County PUD
Post Office Box 1231
327 N. Wenatchee Avenue
Wenatchee, WA 98807

SUBJECT: 2011 Conservation Potential Assessment – Final Report

Dear Jim:

The Final Report summarizing the 2011 Chelan County Public Utility District Conservation Potential Assessment is attached. This assessment was completed in a manner consistent with methodologies in the Northwest Power and Conservation Council's Fifth Power Plan as required by the Energy Independence Act (Option 3 – Utility Analysis).

It was great working with you and the team at Chelan PUD. Thank you for all your assistance in developing and providing the necessary data.

Very truly yours,

Kevin L. Smit

Kevin Smit
Manager, Demand-Side Management

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Executive Summary

This report describes the methodology and results of the Chelan County Public Utility District (Chelan PUD) 2011 Conservation Potential Assessment (CPA). This assessment provides estimates of energy savings by sector for the period 2012-2031. The assessment considered a wide range of conservation resources that are reliable, available, and cost effective within the 20 year planning period.

Chelan PUD has offered conservation programs for 30 years and continues to include energy efficiency in its resource planning. Also, due to the number of customers served, Washington's Energy Independence Act (often referred to as Initiative 937 (I-937)), effective January 1, 2010, requires that Chelan PUD pursue all cost-effective conservation resources. This is accomplished by setting and then meeting biennial conservation targets. These targets can be set in one of three ways: 1) use the Council's Target Calculator, 2) a modified Target Calculator, or 3) a utility-specific conservation potential assessment.

This report describes the results of an Option 3 – Utility Specific Conservation Potential Assessment. 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 and data, so results of this CPA may be used to advise Chelan PUD on reasonable conservation targets for I-937 compliance. Also, the resulting conservation supply curves can be used as part of the demand-side resources in Chelan PUD's integrated resource plan (IRP).

Developing targets involved analyzing approximately 1,500 energy efficiency measures (all of the Sixth Plan measures) by applying Chelan service territory information, such as the number of electrically-heated homes and the saturation from previous conservation programs. The savings from these measures are added together to produce the total conservation potential estimates specifically for Chelan PUD.

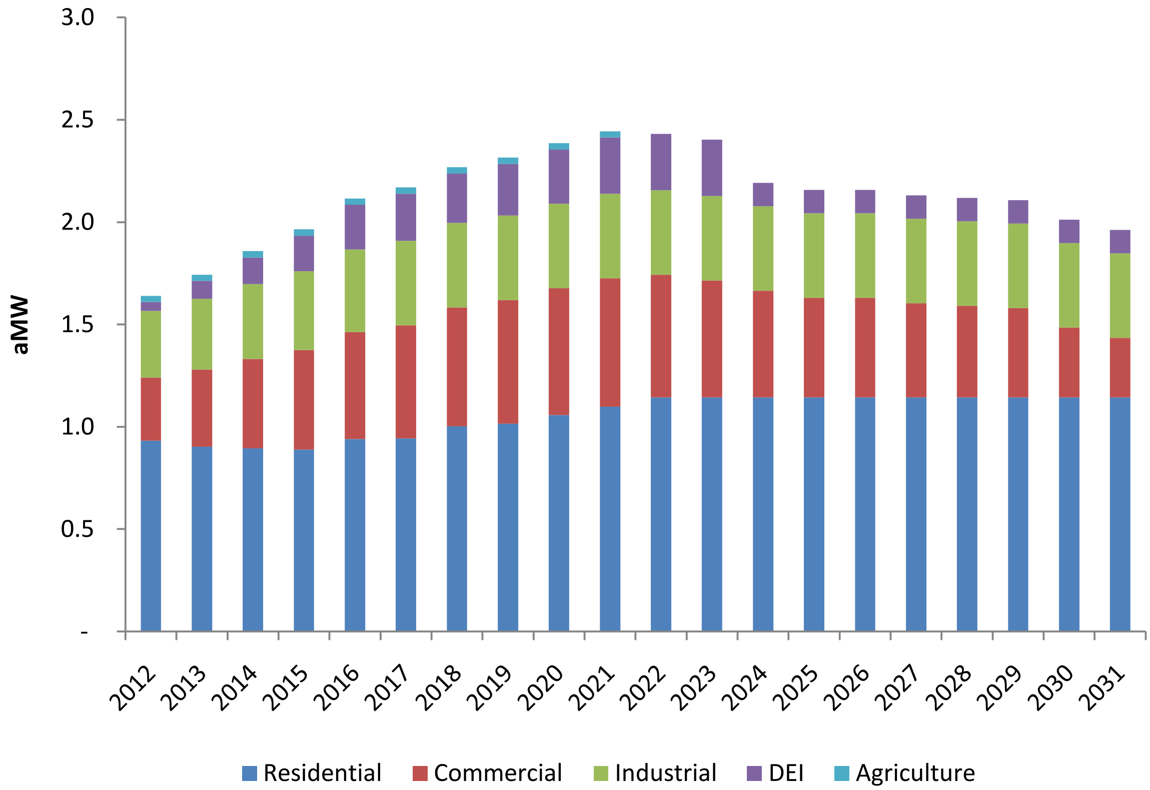
Table ES-1 shows the high-level results of this assessment. The economically achievable potential by sector in 2, 5, 10 and 20 year increments is included. The total 20-year energy efficiency potential is over 42 aMW, while the 10-year potential is 20.91 aMW.

Table ES-1 – Cost-Effective Achievable - aMW

	2 Year	5 Year	10 Year	20 Year
Residential	1.83	4.56	9.68	21.11
Commercial	0.68	2.13	5.12	9.76
Industrial	0.67	1.83	3.90	8.04
Distribution Efficiency	0.13	0.65	1.92	3.38
Agriculture	0.06	0.15	0.31	0.31
TOTAL	**3.38**	**9.33**	**20.91**	**42.59**

This 20-year energy efficiency potential is shown by sector on an annual basis in Figure ES-1. This assessment shows potential starting at just over 1.5 aMW in 2012 and ramping upward over the 10-year planning period. This “ramping” effect was used in both the Council’s Fifth and Sixth plans and accounts for measures that aren’t readily available in the early years of the planning horizon.

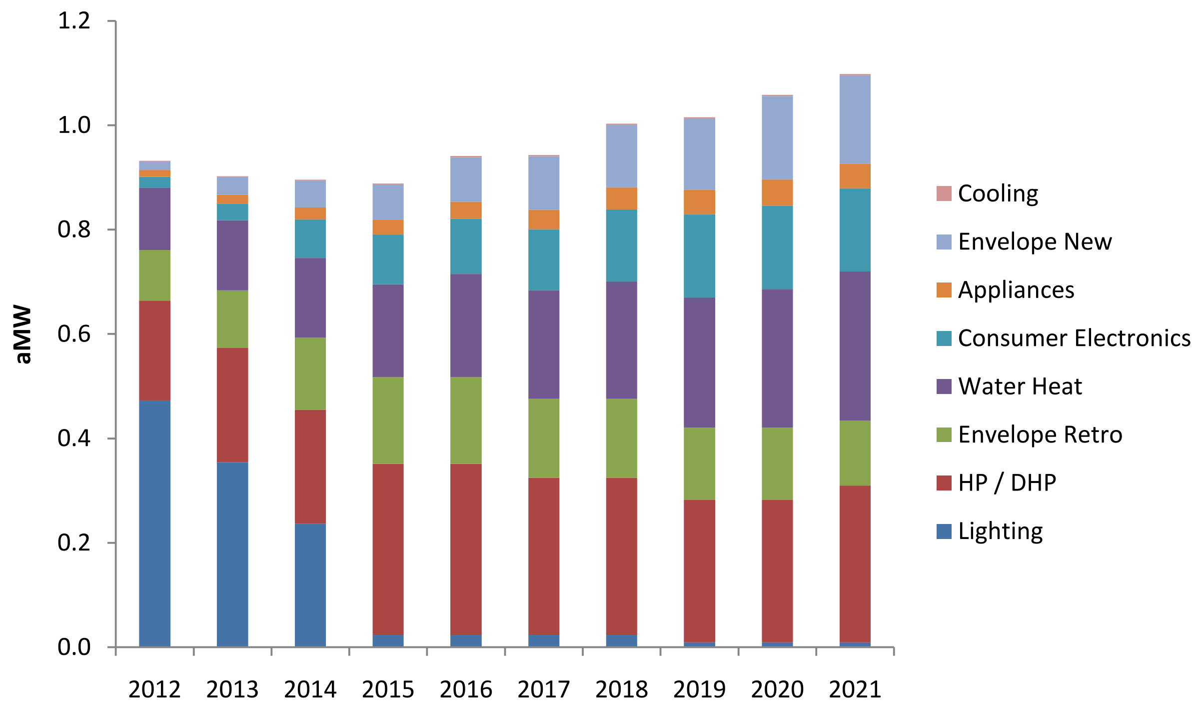
Figure ES-1 – Annual Energy Efficiency Potential Estimates



Also embedded in these potential estimates are savings from regional market transformation efforts as well as new codes and standards. The Northwest Energy Efficiency Alliance (NEEA) conducts region-wide market transformation efforts which also could impact savings in Chelan County. If Chelan PUD participates in funding NEEA, it can claim the associated savings toward meeting biennial targets.

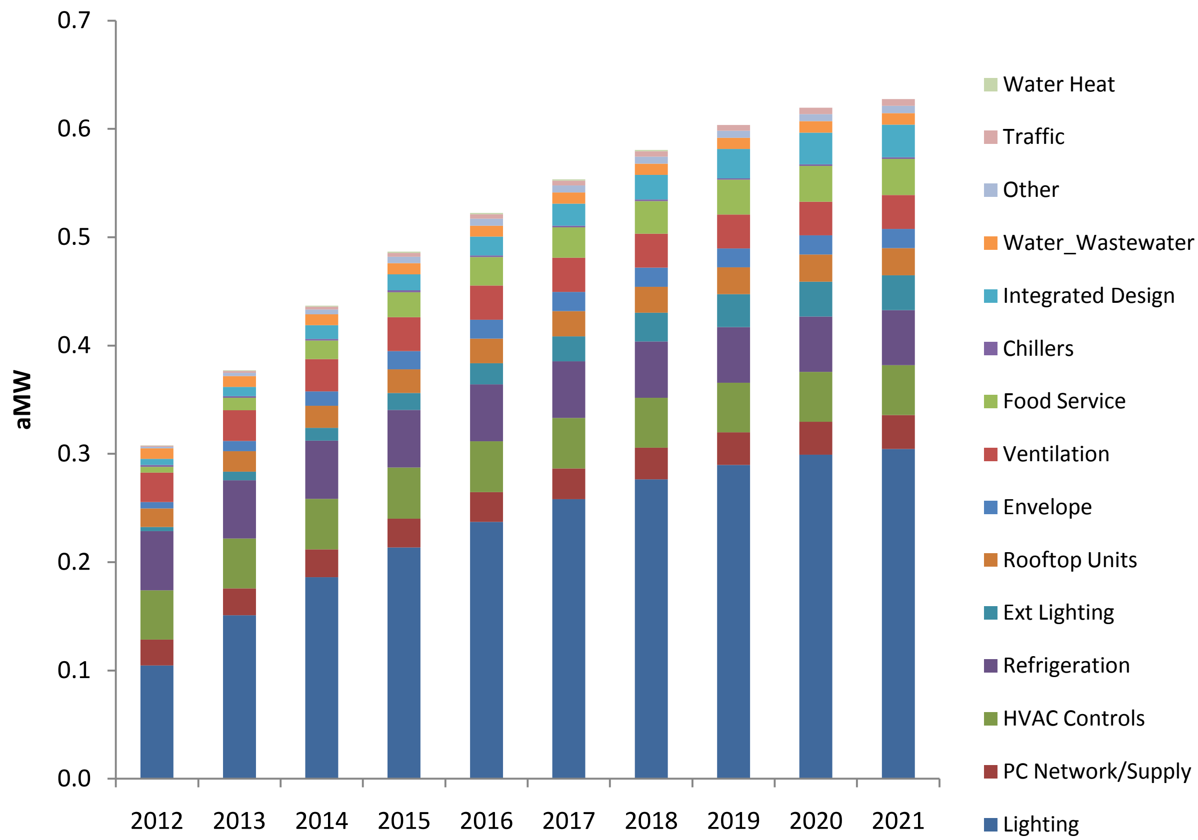
The majority of the potential in this assessment is in the residential sector, and the breakdown of this potential by end-use is shown in Figure ES-2. On average, this represents just under than 1 aMW per year for the next 10 years. Over the next two years there is still significant lighting potential (Compact Fluorescent Bulb replacements). Beyond lighting there is large potential in water heating measures such as low-flow showerheads and electric resistance storage tanks. Heat pump water heaters are ramped up significantly over time. Envelope retrofits as well as heat pumps, both ducted and ductless, will provide opportunities for residential conservation savings.

Figure ES-2 – Annual Residential 10-Year Potential by End-Use



The commercial sector potential in this CPA accounts for approximately one quarter of Chelan PUD's overall potential. A significant portion of this commercial potential is efficient lighting (see Figure ES-3), which represents close to half of the commercial potential annually. The remainder of the potential is distributed among numerous end use areas that include refrigeration, HVAC controls, rooftop units, and better ventilation control.

Figure ES-3 – Annual Commercial 10-Year Potential by End-Use



In addition to the Residential and Commercial sectors, energy efficiency potential is assessed for the Industrial and Agriculture sectors, as well as the distribution system. These portions are smaller than the residential potential. The agriculture sector is quite small accounting for only 0.3 aMW over ten years. Savings in agriculture will be in irrigation hardware replacements. More efficient water usage lowers electricity consumption by reducing pumping energy. After 10 years, it is assumed this potential will be fully realized.

Energy conservation potential in the industrial sector accounts for 8 aMW over the 20 year planning period and is dominated by fruit storage measures. Upgraded refrigeration systems found largely in these facilities account for approximately 70 percent of industrial potential.

Included in distribution efficiency are major system improvements and light system improvements but potential largely comes from a reduction in system voltage. Total savings over the 20 year planning period in DEI accounts for 3.38 aMW – half of that coming from voltage reduction.

Increased conservation requirements will mean increased investment in conservation and conservation marketing. To meet increasing levels of energy efficiency potential, Chelan PUD will likely need to both expand existing programs and develop new ones. The residential sector holds the greatest potential for conservation. Expanded programs may include CFL giveaways, window rebates, and insulation rebates. New programs may include low-flow shower head rebates, HVAC rebates, and new home construction energy incentives.

Introduction

Objectives

The objective of this report is to describe the results of the Chelan County Public Utility District (Chelan PUD) 2011 Conservation Potential Assessment (CPA). This assessment provides estimates of energy savings by sector for the period 2012 to 2031, with the primary focus on 2012 to 2021 (10-years). The assessment considered a wide range of conservation resources that are reliable, available, and cost-effective within the 20-year time horizon.

The conservation measures are based on the Northwest Power and Conservation Council 6th Power Plan. The results provide energy savings estimates that will assist Chelan PUD in resource and energy efficiency planning.

Background

Chelan PUD provides electricity service to more than 47,000 customers located in Chelan County, Washington. Chelan County PUD owns and operates three hydroelectric projects, producing 9 million megawatt hours on an average year. Chelan PUD owns about 25,000 power poles supporting 1,950 miles of line. Chelan PUD has the second lowest electric rate in the nation at about 3 cents per kWh.

Since the passage of Washington's Energy Independence Act, EIA (also known as Initiative 937, or I-937), 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. Also, the resulting conservation supply curves can be used as part of the demand-side resources in Chelan PUD's integrated resource plan (IRP).

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, a progress report every two years, and fully updated 10-year plan every four years. The legislation mandates that these resource plans must include assessments of commercially available conservation and efficiency measures. This CPA is designed to assist in meeting these requirements for conservation analyses.

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 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 (NWPCC) 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 report shall document the utility's progress in meeting the targets established in RCW 19.285.040.

There are two primary components of the Energy Independence Act related to this study: 1) documenting the development of conservation targets (i.e., setting the targets), and 2) documenting the savings (i.e., demonstrating how the targets are being met). If conservation targets are not met, utilities may be required to pay a $50/MWh (2007 dollars) penalty on the shortfall unless they have documented lack of customer participation despite offering to pay an incentive in an amount equal the utility's full avoided cost over the lifetime of measures. Any such shortfall cannot be automatically deducted from the utility's conservation potential assessment for the subsequent biennium.

Setting Conservation Targets

In order to set the conservation targets, utilities can use one of three options:

- The Council's conservation calculator
- A modified version of the calculator
- Utilities can perform their own custom analyses

For reference, each of these approaches is further described below.

Option 1: Conservation Calculator

If a utility chooses to calculate conservation potential using the Council's calculator, the biennial target and ten-year potential values from the calculator become the utility targets. In this case, utility is said to have effectively documented the requirement for customer conservation.

The conservation calculator provides an estimate of each utility's share of the regional conservation target based on its share of regional load. The calculator utilizes utility-specific data for the various sectors of retail sales in MWh: residential, commercial, and industrial and irrigated agriculture.

Option 2: Modified Conservation Calculator

This second option allows for the modification of customer base data in order to arrive at targets lower than a utility's share of regional conservation. Modifications that can be made are the following:

- Add or deduct measures as they apply to the service area
- Modify the number or ratio of applicable units (percent of homes with electric heat)
- Increase or reduce per unit incremental resource savings
- Changes in forecasted program costs
- Changes in retail sales growth rates
- Changes in avoided distribution capacity cost savings

Option 3: Utility Analysis

This last option uses the Council's method to establish targets, but allows utilities to calculate the savings, costs, and applicability of measures for their service areas. This is the option used by EES Consulting for this CPA. Detailed below are the requirements of the utility analysis option from RCW 19.285.040:

(i) Analyze a broad range of energy efficiency measures considered technically feasible.
(ii) 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.
(iii) 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.
(iv) 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.
(v) 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.
(vi) Identify conservation measures that pass the total resource cost test, by having a benefit/cost ratio of one or greater as economically achievable.
(vii) Include the increase or decrease in annual or periodic operations and maintenance costs due to conservation measures.
(viii) Include deferred capacity expansion benefits for transmission and distribution systems in its cost-effectiveness analysis.
(ix) Include all nonpower benefits that a resource or measure may provide that can be quantified and monetized.
(x) Include an estimate of program administrative costs.
(xi) 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.

(xii) 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 non-lost 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

(xiii) 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.

(xiv) Analyze the results of multiple scenarios. This includes testing scenarios that accelerate the rate of conservation acquisition in the earlier years.

(xv) Analyze the costs of estimated future environmental externalities in the multiple scenarios that estimate costs and risks.

Chelan PUD may use any of the above options to set their target. This report summarizes the results of a comprehensive CPA which is consistent with Option 3: Utility Analysis. A checklist of how this analysis meets each of these 13 requirements is included in Appendix VIII.

Report Organization

This report is organized as follows:

- Methodology
- Historic Conservation Achievement
- Assessment Input Data (Assumptions)
- Results – Energy Savings and Costs
    - Residential Savings Potential
    - Commercial Savings Potential
    - Industrial Savings Potential
    - DEI Savings Potential
    - Total Potential

In addition to the main report, the appendices contain supplementary information.

Methodology

This study is a comprehensive analysis that focuses primarily on a "bottom-up approach." Energy efficiency measures are applied to specific end uses, such as number of refrigerators, and assigned a specific savings value in kWh/year. This methodology is consistent with the Council's regional planning methodologies, and is therefore in line with the Utility Analysis Option of WAC 194-37 (Energy Independence Act, Chapter 19.285 RCW). Appendix III summarizes the specific EIA steps and how they were met.

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.

Technical Potential – Amount of energy efficiency potential that is available regardless of cost or other technological or market constraints, such as 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. A sample formula for calculating technical potential for a residential measure is shown below:

Measure Potential = (Per Unit Savings) x (# of households) x (Applicability) x (1- Saturation)

The "Applicability" value is highly dependent on the measure and the housing stock. For example, a heat pump measure may only be applicable to single family homes with electric space heating equipment. The "Saturation" factor accounts for measures that have already been completed.

In addition, technical potential should consider 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 (i.e., interaction). In addition, the measure-by-measure savings depend on which measure is installed first (i.e., stacking).

Total technical potential is often significantly more than the amount of economic and achievable potential. The difference between technical potential and achievable and or economic potential is due to 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 – Amount of potential that can be achieved through a given set of conditions. Achievable potential takes into account many of the realistic barriers to adopting energy efficiency measures. These barriers include consumer willingness to adopt a technology or behavior, 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 and 65 percent for most 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 and before the economic screening.

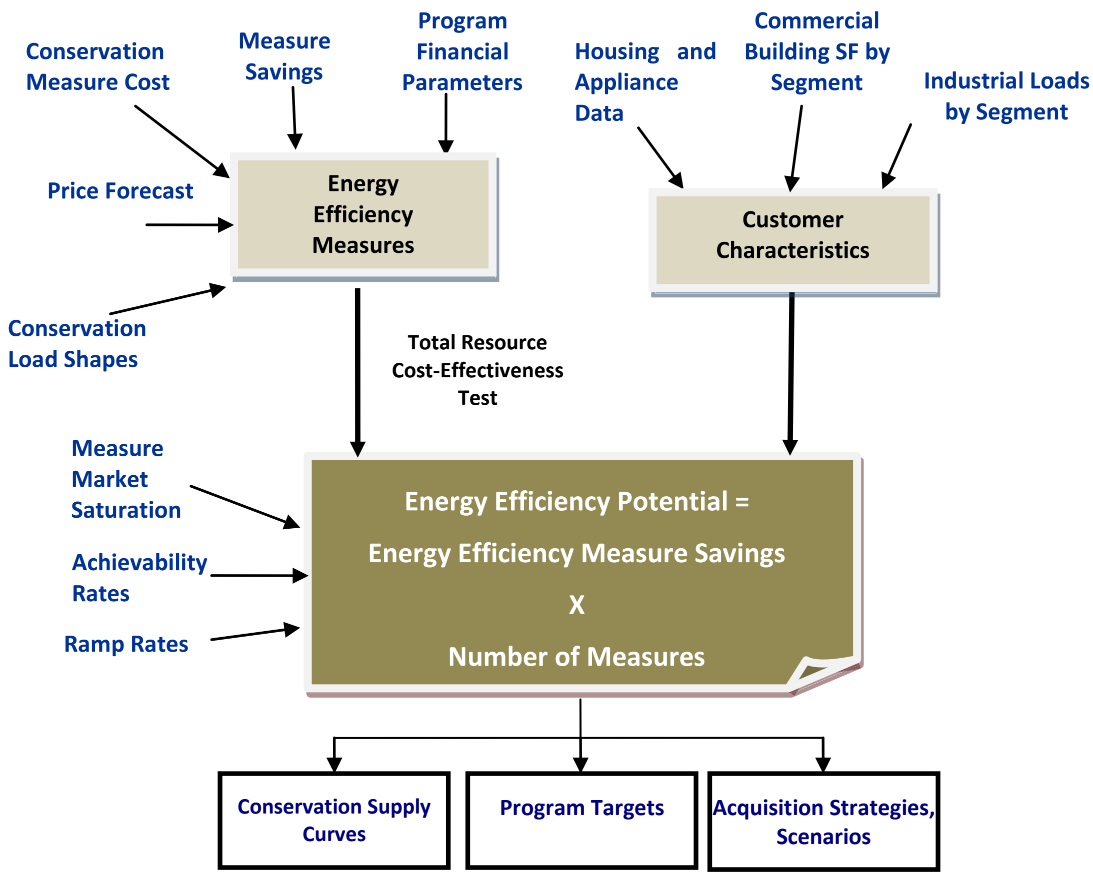
Economic – Amount of potential that passes an economic benefit-cost test; in Washington State, the total resource cost test (TRC) is used per the Independence Act. This means that the present value of the benefits exceeds the present value of the costs over the lifetime of the measure. TRC costs include the incremental costs and benefits of the measure regardless of who pays for it – the utility or the customer. Costs and benefits include: 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.

Basic Modeling Methodology

A simplistic overview of the model 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 is then aggregated to produce the total potential.

Figure 1 – Conservation Potential Assessment Process



Energy Efficiency Measure Data

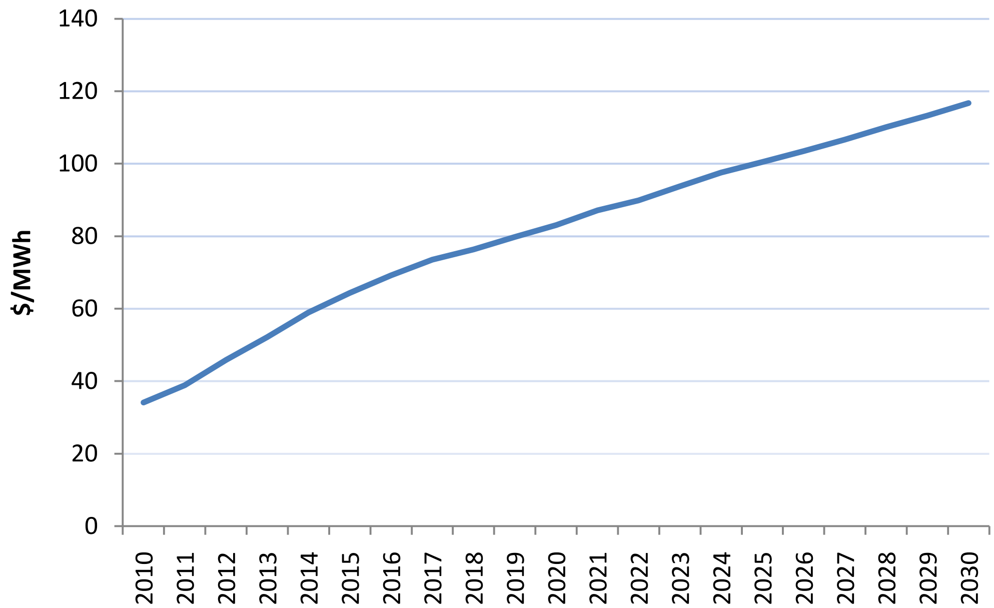
The characterization of efficiency measures includes measure savings (kWh), demand savings (kW), measure costs ($), and measure life (years). Other features, such as measure load shape, operation and maintenance costs, and non-energy benefits, are also important for measure definition. The primary source referenced for conservation measure data is the Council's *6th Power Plan*.

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 avoided cost of energy is represented as a dollar value per MWh of conservation. Avoided costs are used to value energy savings benefits when conducting cost effectiveness tests – generally included in the numerator in a benefit-cost test. These energy benefits are often based on the cost of a generating resource, a forecast of market prices, or the avoided resource identified in the integrated resource planning process. The forecast of regional market prices used for the avoided cost in this assessment was the Sixth Power Plan Base Case avoided cost and was provided by the Council to Chelan PUD. Figure 2 shows the price forecast used for the planning period (average prices are displayed).

Figure 2 – Chelan PUD 20-Year Price Forecast



Avoided costs for transmission and distribution, as well as peak winter demand, are also valued ($/kW). A local distribution credit value of $23/kW-yr was applied to peak savings from conservation measures. A ten percent bonus is added to conservation benefits as required by the Pacific Northwest Electric Power Planning and Conservation Act. Also, a $15/MWh risk premium was added to Lost Opportunity measures and no risk premium was added for non-lost opportunity measures.

Building Characteristic Data

Building characteristics, baseline saturation data, and appliance saturation influence Chelan PUD's total conservation potential. One of the most accurate methods to obtain these data is through original research, such as end-use surveys. End-use surveys can be designed to provide all the detailed housing and commercial building data requirements. For this analysis, the characterization of Chelan PUD's baseline was determined using data provided by Chelan County records and internal data as well as a survey conducted by Robinson Research. Details of data sources and assumptions are described for each sector later in the report. Baseline measure saturation data is determined using historic conservation achievements and the results of the customer survey, which is also discussed in detail in the next section. The 6th Power Plan also includes regional measure saturations for conservation accomplishments over the past years; these values were used in this model where Chelan PUD-specific information was not available.

Historic Conservation Achievement and Current Programs

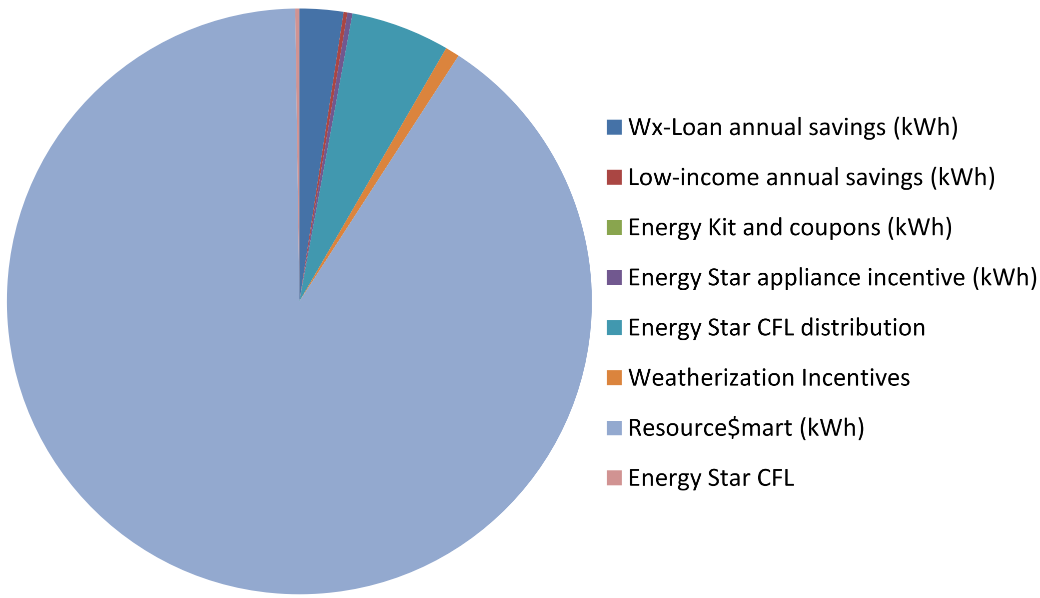
Historic and Current Chelan County Conservation

Chelan PUD has pursued conservation and energy efficiency resources since the early 1980s. Currently, the utility offers several rebate programs for both residential and non-residential applications. These include insulation rebates, window rebates, and low-income weatherization. Industrial projects have dominated past conservation with a large portion occurring in the fruit storage sector. Industrial projects have included refrigeration controls, lighting, and other hardware upgrades. Figure 3 shows the distribution of projects over the past five years and emphasizes the large emphasis on industrial projects.

Figure 3 – Chelan PUD Conservation History by Sector (MWh)

Figure 4 shows the breakdown of Chelan PUD's conservation achievement for 2005 through 2010 by end-use. The Resource$mart program has contributed the largest portion of savings through projects like industrial variable frequency drives and industrial lighting. 2008 and 2010 have been especially active years for this program and 2011 is slated to be another big year. Figure 4 shows the relative proportion of the Resource$mart program over the past six years compared to other programs Chelan PUD has offered.

Figure 4 – Shares of Conservation Achievement 2005-2010
(Total = 4.06 aMW)



Current Conservation Programs

Chelan PUD offers a variety of conservation programs to its customers. These programs include several rebates, energy audits, net metering, commercial projects, and agricultural projects. The current programs offered by Chelan PUD are described below.

Residential

Chelan PUD offers a variety of conservation programs to its customers. These programs include several rebates, commercial funding assistance, and industrial projects. Recent programs offered by Chelan PUD are detailed below.

- *Insulation Rebates* – Chelan PUD will pay 25 cents per square foot for added insulation. Requirements to qualify include: new insulation must increase R-value by 10 or greater, existing attic insulation must be R-19 or less, wall or floor insulation must be R-5 or less, in-cavity insulation only.
- *Window and Glass Door Rebates* – This rebate offers customers $3 per square foot on qualifying glass doors and windows. To qualify, new windows must have a U-factor of .30 or lower. Qualifying glass doors must have a U-factor of .35 or lower.
- *CFL Giveaway* – Starting in February of 2011, Chelan PUD gave out 41,000 CFLs.
- *Low-income weatherization* – Chelan PUD provides funds to the Chelan-Douglas Community Action Council for low-income home weatherization.

Commercial & Industrial

- *Resource$mart Program* – This program helps commercial and industrial customers install energy-efficient equipment in their facility by paying a portion of the up-front costs. Chelan PUD can pay up to 75% of each energy efficient project.

Customer Characteristics Data

Chelan PUD serves over 47,000 customers across the County, with a total population of 72,372. A key part of an energy efficiency assessment is to understand the characteristics of these customers primarily the building characteristics.

Customer Characteristics

Residential

For the residential sector, the key characteristics include house type, heat fuel type, and water heating. Table 1 shows relevant data gathered mainly from the survey conducted by Robinson Research. Residential fuel type was compared with the 2007 U.S. Census. The new homes column information was obtained by parsing out the survey results to isolate residences constructed in the past ten years. The number of residential households was provided by Chelan PUD staff. Regional values are provided for reference.

Table 1 – Residential Sector Characteristics

Heating Zone	**Cooling Zone**	**Solar Zone**	**Residential Households**	**Total Population**			
1	**3**	**3**	27,733	72,372			
Housing Stock	Existing	New Homes	Regional %	Residential Appliances	Existing	New	Regional %
House Type				Water Heating			
Single Family	79%	80%	72%	Electric	98%	97%	64%
Multi-Family	9%	16%	18%	Natural Gas	2%	1%	36%
Manufactured Homes	12%	4%	10%	Appliance Saturation			
Housing Vintage				Refrigerator	139%	112%	112%
Pre-1980	41%		57%	Freezer	54%	50%	57%
1980 - 1993	11%		14%	Clothes Washer	92%	94%	87%
Post 1993	44%		28%	Electric Dryer	93%	95%	82%
Heat Fuel Type				Dishwasher	82%	95%	67%
Natural Gas Homes	1%	0%	37%	Electric Oven	91%	84%	82%
Electric Homes	93%	99%	53%	Room AC	21%	7%	11%
Other Fuel Homes	6%	1%	10%	Central AC	3%	4%	8%
Electric Heat System Type							
Forced Air Furnace	36%	5%	34%				
Heat Pump	40%	86%	20%				
Zonal (Baseboard)	19%	2%	44%				
Electric Other	3%	1%	2%				
Single Family Foundation Type							
Crawlspace	46%	44%	64%				
Full Basement	33%	28%	23%				
Slab on Grade	22%	28%	13%				

The residential survey conducted by Robinson Research provided other important information about energy consumption patterns in the residential sector including:

- Median home size is 1812 sq feet.
- The largest proportion of respondents (35%) reported to having their water heater in an indoor utility closet, followed by the garage (18%).
- The average refrigerator and water heater are approximately 8 years old.
- The average freezer was approximately 13 years old.
- Energy Star appliances and CFLs were the number one and two reported energy efficiency upgrades made to residences.
- Double pane windows are the number one reported most desired energy efficiency upgrade (17%).

The detailed results of the survey are contained in a separate report.

Commercial

In determining potential for the commercial sector, building square footage is the key parameter. Many of the measures are based on savings as a function of building square footage (kWh per square foot, kWh/sf). Table 2 shows commercial square footage in each of the Council's 18 building categories. A large designation in the "Other" category is consistent with regional segmentation in the 6th Power Plan. To establish square-footage numbers, MWh totals associated with council categories were provided by Chelan PUD and then divided by corresponding EUI values to arrive at total square footage in each category.

These data were checked against a third party database (Dunn and Bradstreet) where square footage information data by segment (NAICS Code) could be extracted directly. The two data sets compared quite well, though differed primarily in the warehouse category. As a result, using primarily the SIC and NAICS code designations, some of the establishments initially listed under commercial warehouse were moved to the appropriate industrial segments. As a result, the total commercial square footage used for the potential assessment is approximately 25 million square feet.

Table 2 – Commercial Sector Square Footage by Segment

Segment	Annual Load (MWh)	Electricity Use Intensity (EUI – kWh/sf)	Building Floor Area (Square Feet)	Growth Rate
Large Office	0	18.0	0	1.5%
Medium Office	8,979	16.5	545,088	1.5%
Small Office	73,640	15.4	4,784,705	1.5%
Big Box Retail	20,633	33.1	623,906	0.8%
Small Box Retail	39,962	13.8	2,897,375	0.8%
High End Retail		16.3		0.8%
Anchor		16.2		0.8%
K-12 Schools	32,552	10.0	3,255,200	1.0%
University	8,292	14.0	592,286	1.1%
Warehouse	68,513	10.0	248,000	2.7%
Supermarket	19,602	39.2	500,258	0.4%
Mini Mart	5,630	51.7	108,960	1.0%
Restaurant	23,965	45.0	532,556	1.2%
Lodging	38,063	18.0	2,114,611	0.6%
Hospital	5,032	32.0	157,250	1.1%
Health Facilities	18,419	20.0	920,950	1.7%
Assembly Hall	14,104	14.0	1,007,429	1.4%
Other	74,602	14.0	6,805,207	0.5%
TOTAL	**451,988**		**25,093,779**	

Industrial

The Industrial sector potential estimates rely primarily on electricity use by major process end-use. Energy conservation measures are applied to the end-use as a percent savings and associated cost. To determine the load attributed to each of the Council's categories, industrial customers were parsed from a list of large customers provided by Chelan PUD and combined with an industrial list also provided by Chelan PUD, as shown in Table 3. Customers were then placed into the Council's categories based on industry. Industrial MWh consumption totaled 297,295.

Table 3 – Industrial Sector Load by Segment

Annual Base Load in 2009	MWh	Annual Growth Rate (Regional Average)
Mechanical Pulp		0.8%
Kraft Pulp		1.0%
Paper	43,964	0.2%
Foundries	20,980	0.6%
Frozen Food		-0.3%
Other Food	58,766	0.4%
Sugar		-0.1%
Lumber		-0.5%
Panel		-0.3%
Wood	835	0.6%
Electric Fabrication	5,054	0.5%
Silicon		-1.0%
Metal Fabrication	3,785	1.0%
Equipment		-1.9%
Cold Storage	9,485	2.1%
Fruit Storage	143,240	2.2%
Refinery		-0.9%
Chemical		0.5%
Miscellaneous Manufacturing	11,816	1.0%
TOTAL	**297,925**	

The annual consumption values in the commercial and industrial sectors differ slightly from the data provided by Chelan PUD staff for several reasons. A variety of establishments in Chelan PUD's rate class (mostly classified as Warehouse or Other) are classified as industrial by NAICS and therefore the Council. This resulted in a reduction of the kWh consumption and therefore building square footage for data input to the commercial sector portion of the model. These establishments were then re-classified by their NAICS codes and added to the industrial MWh consumption. Conversely, hospitals are classified as industrial by Chelan PUD but as commercial under NAICS, so this information was moved to the commercial sector.

In addition, two of the industrial segments provided by Chelan were not included: data warehouse and rail facility. The data warehouse category was excluded for consistency with the Council's Sixth Plan, where this segment was also not included. The data warehouses or "server farms" are often very competitive and therefore is difficult to obtain equipment and related energy efficiency information from them. Also, the significantly value reliability over energy efficiency, so if there is any relationship between energy efficiency and reduced reliability, the energy efficiency measure will likely not be considered. Also, many server farms have the latest and most efficient equipment already, so energy efficiency measures may be implemented without utility involvement. The rail facility has already been retrofit with energy efficient variable frequency drives.

The methodology for estimating industrial potential is different than that of residential and commercial, primarily because most energy efficiency opportunities are unique to specific industrial segments. This "top-down" methodology starts with the segment annual consumption, disaggregates it by end-use, and then estimates savings for measures applicable to each end-use. A brief example of the potential estimation process and assumptions are described below.

Table 4 provides an example for estimating the Refrigeration Retrofit measure in the Fruit Storage industrial segment. The annual consumption for that segment in Chelan County is 143,240 MWh. When escalated by 2.19% over 20 years, this annual consumption becomes 221,088 in 2031. Since most of the load in this segment is associated with refrigeration (83%), the energy efficiency measures are based on that portion of the load. For this measure, an estimated 61% savings is possible over this 20-year timeframe. However, this savings potential is discounted by several factors:

- Applicability – Includes both physical applicability and uncompleted measures (also described as "measure saturation"). The physical applicability is 54% (Council value) and the "fraction uncompleted" is 56% (estimated based on past achievement)
- Achievability – 85% is the default for all retrofit measures
- Inventory – accounts for measure interaction

Table 4 - Sample Potential Estimate Calculation for Fruit Storage Refrigeration Retrofit

Current Annual MWh	143,240
Forecasted MWh (in 2031) (2.19% growth rate)	221,088
Refrigeration Load (%)	83%
Measure Savings (% of refrigeration load)	61%
Applicability (Physical Applicability% x Uncompleted%)	30%
Achievability (Council Default)	85%
Inventory (Measure Interaction)	94%
Total Savings	**26,886**

In this example, when all factors are applied, the end-use savings for the refrigeration retrofit is 14.6% of the fruit storage load.

Agriculture

Potential in Chelan County in the Agricultural sector is determined by the number of acres under irrigation. According to the 2007 census of agriculture, there are 28,230 irrigated acres in Chelan County. This is relatively small and yields a small portion of the overall energy efficiency potential.

Distribution Efficiency

The final area where energy efficiency potential is estimated is for the distribution system. There are no customized "inputs" for this section as the results are entirely based on Chelan PUD's share of regional load. The Council's Sixth Plan assumptions are used in estimating distribution efficiency potential.

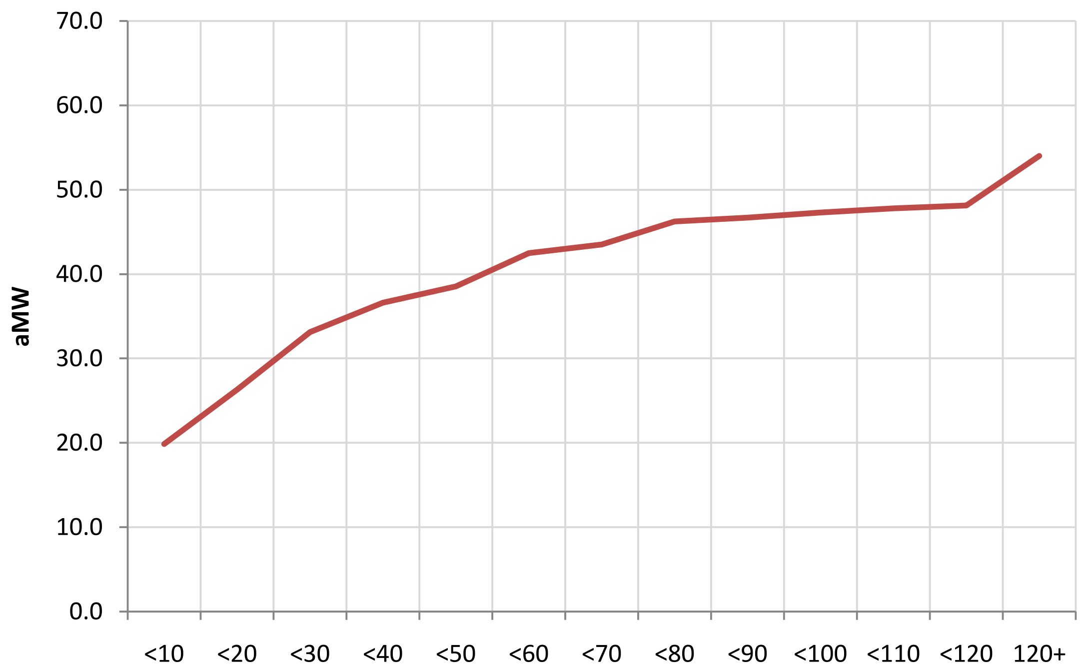
Results – Energy Savings and Costs

Technical Achievable Conservation Potential

Technical achievable potential is the amount of energy efficiency potential that is available regardless of cost or other constraints, such as willingness to adopt measures. It represents the theoretical maximum amount of energy efficiency if these constraints are not considered.

Figure 5, below, shows a supply curve of 20-year, technically achievable potential. A supply curve is energy efficiency savings potential (aMW) plotted against the levelized cost ($/MWh). The technical potential has not been screened for cost effectiveness, but rather it shows the full range of conservation by measure. 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 5 shows that over 30 aMW are available for less than $30/MWh and approximately 46 aMW are available for under $80/MWh. Total technical achievable potential for Chelan PUD is approximately 54 aMW over the 20-year study period.

Figure 5 – 20-Year Technical Potential Supply Curve by Sector



Economic Achievable Conservation Potential

Economic potential is the amount of potential that passes an economic cost-benefit test. This generally means that the present value of the benefits exceeds the present value of the measure costs over its lifetime. Often, the levelized cost of an efficiency measure is compared with levelized market prices or an alternative conventional supply-side energy resource (avoided cost).

Table 5 shows aMW of economically achievable potential by sector in 2, 5, 10 and 20-year increments. Compared with the technical potential, it shows that 43 aMW of the total 58 aMW is cost effective for Chelan PUD.

Table 5 – Cost-Effective Achievable Potential- aMW

	2 Year	5 Year	10 Year	20 Year
Residential	1.83	4.56	9.68	21.11
Commercial	0.68	2.13	5.12	9.76
Industrial	0.67	1.83	3.90	8.04
Distribution Efficiency	0.13	0.65	1.92	3.38
Agriculture	0.06	0.15	0.31	0.31
TOTAL	**3.38**	**9.33**	**20.91**	**42.59**

Included in these potential estimates are savings from numerous measures and sector-specific programs. In addition to utility programs, this potential can be achieve through regional efforts such as those conducted by the Northwest Energy Efficiency Alliance (NEEA). If Chelan PUD participates in NEEA (i.e., through funding), it can claim its share of the NEEA savings towards meeting the targets.

Sector Summary

Figure 6 shows the achievable potential by sector on an annual basis. The potential ramps up from 1.5 aMW in 2012 to close to 2 aMW in year 2017. The drop in potential after ten years is due primarily the completion of some measures during the first 10 years.

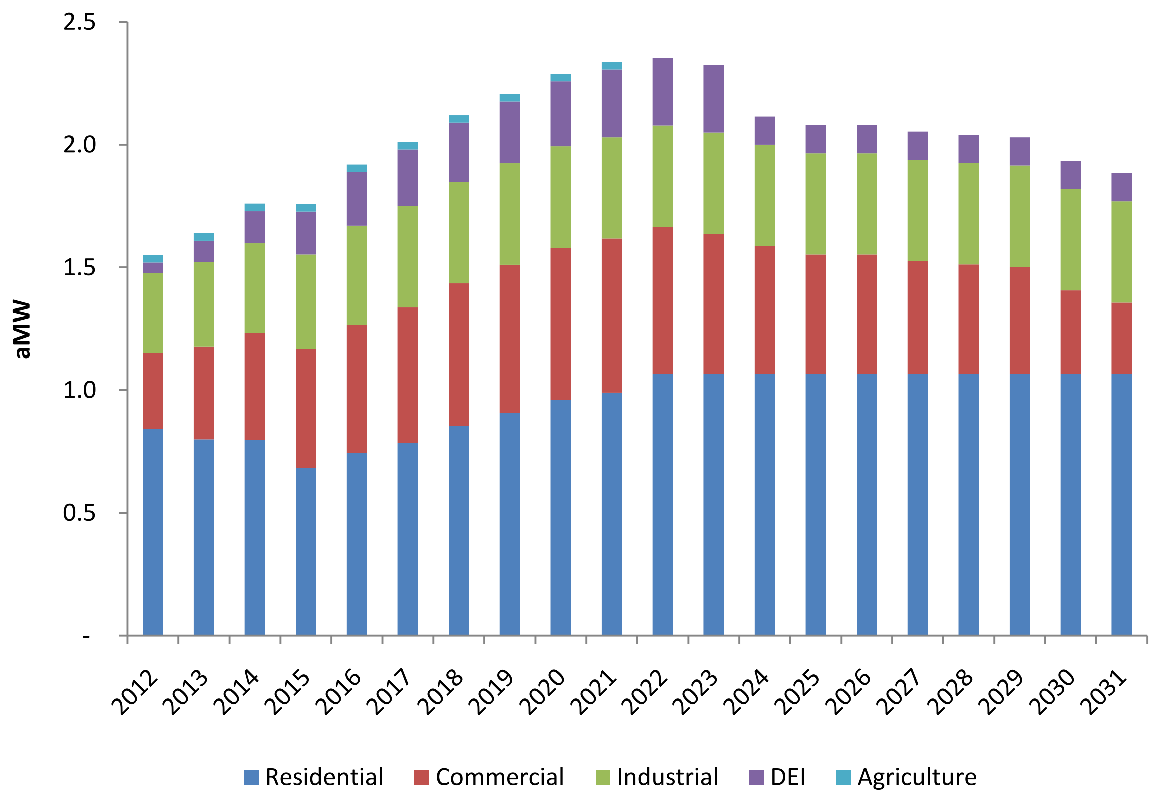
This figure clearly shows the impact of the use of conservation “ramp rates”. The Council methodology uses individual ramp rates for conservation measures or measure types. Conservation measures are both ramped up (increasing over time), and also ramped down so that they decrease or end over time. A few examples of the council ramp rates are summarized below:

- Residential Lost Opportunity Emerging Technology – this ramp rate is used for heat pump water heaters. The implementation level is very low in the early years of the plan and ramps up sharply over the 10 years.

- Residential Non-Lost Opportunity 10-year – this ramp rate assumes the measure is mature today and the potential will be achieved in 10 years (10 percent of the potential achieved per year for 10 years). The residential efficient water tanks measure has this ramp rate.
- Commercial Lost Opportunity Medium – this ramp rate starts at 10% of the potential and ramps up over eight years. Some of the commercial lighting measures fall into this category.

In addition, some of these ramp rates were customized for Chelan PUD. The primary adjustments were related to the different starting year (Sixth Plan started in 2010 while this plan starts in 2012). However, the total 10-year potential does not change with ramp rate adjustments.

Figure 6 – Annual Achievable Potential by Sector

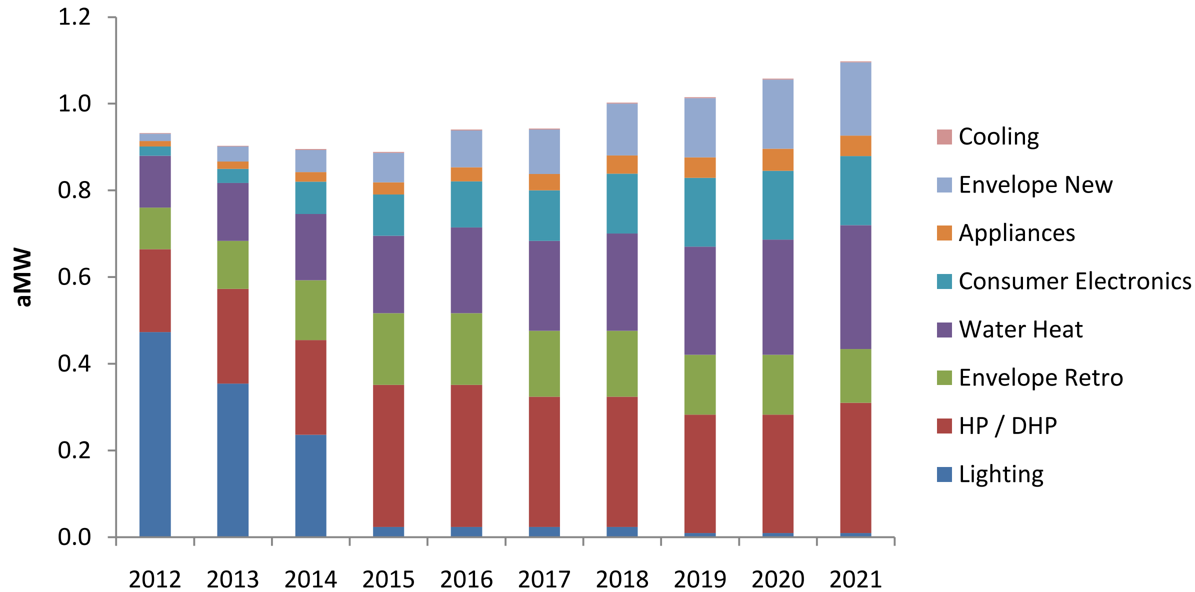


Figures 7 through 9 show the potential by end-use for each sector.

Residential

In the residential sector lighting savings drops off after roughly three years (see Figure 7). This reduction is due to the upcoming changes to lighting codes and standards which require higher efficiency than most current incandescent bulbs. However, there is still significant lighting potential available in the next biennium. The heat pumps category is the second largest portion of the achievable potential in the residential sector, and includes the ductless heat pump. Water heating is also significant and includes low-flow showerhead replacements. Consumer electronic potential is initially low but is ramped up rapidly over the first 10 years. Heat pump water heaters also begin to show significant potential in the later years of the plan.

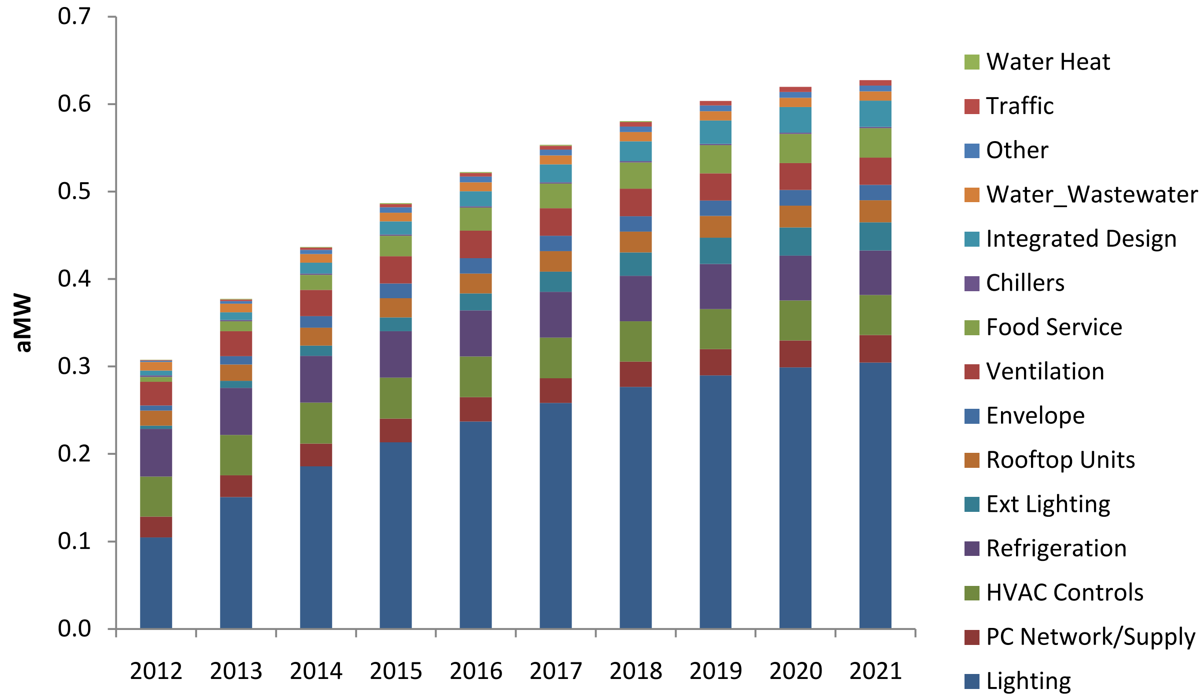
Figure 7 – Ten-Year Residential Potential by End-Use



Commercial

Commercial savings for the 2012-2021 period are largely dominated by lighting measures (see Figure 8). Refrigeration and ventilation measures are the next two largest components of the commercial potential. The custom nature of commercial building energy efficiency is reflected in the variety of end-uses and corresponding measures.

Figure 8 – Ten-Year Commercial Potential by End-Use



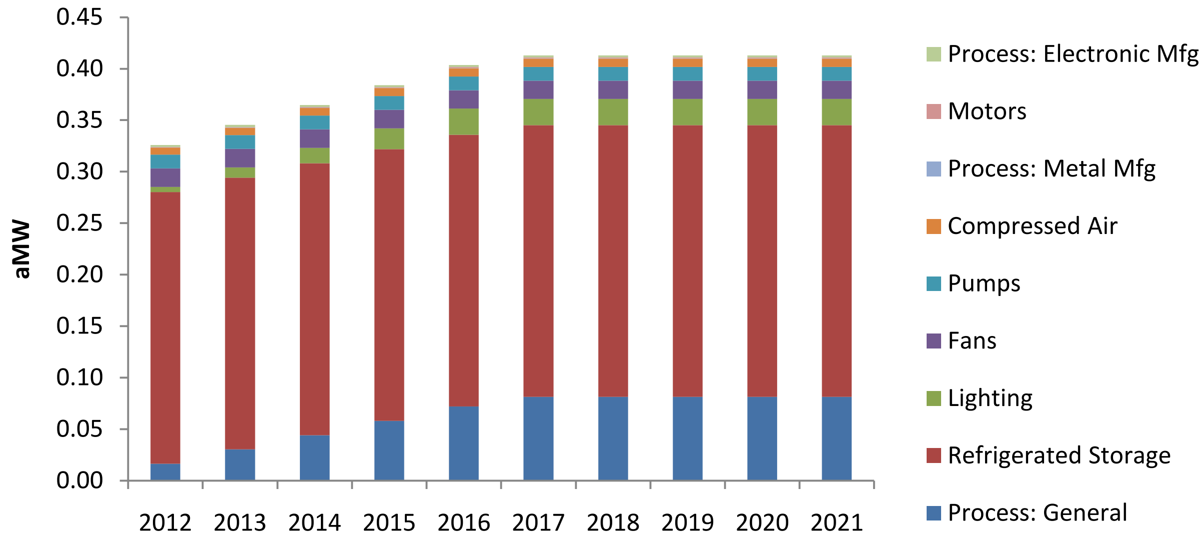
Industrial

In the industrial sector, the methodology differs slightly from the bottom-up approach used in other sectors. A top-down approach is used instead. Because energy efficiency measures are specific to each industrial process, the Council uses a top-down approach to estimate energy efficiency savings for industrial customers. Estimates of energy savings are calculated based on a fractional savings of end-use load. For example, the 6th Power Plan assumes that efficient lighting controls in electronic manufacturing facilities can save 28% of lighting energy.

Summing end-use savings across industry types gives total industrial potential. Industrial savings by end-use are shown in Figure 9. The industrial-sector analysis covers most of the region's non-DSI industries plus refrigerated warehouse storage. However, the assessment does not include savings estimates for the information technology sector (large-scale server facilities). The Council's *Industrial Tool* excel file was used directly for calculations.

The largest portion of the industrial potential is in the Refrigerated Storage sector, which is consistent with its majority of the industrial energy consumption.

Figure 9 – Ten-Year Industrial Potential by End-Use



Agriculture

The irrigated agriculture sector is a small portion of Chelan PUD's load and therefore the energy efficiency potential is relatively small. There is some potential in upgrading irrigation hardware, which in turn reduces pumping energy. The two-year irrigation hardware upgrades potential 0.061 aMW and the five-year potential is 0.153aMW.

DEI Savings Potential

Distribution efficiency measures improve the efficiency of utility distribution systems by operating in the lower end of the acceptable voltage range (120-114 volts). Measures and savings for distribution efficiency are shown in Table 6. These results are based directly on the 6th Power Plan and Chelan PUD's share of regional potential based on load. However, a detailed engineering assessment of Chelan PUD's DEI potential would be required for program planning and to refine savings potential estimates.

Table 6 – Distribution Efficiency Potential, aMW

Measure	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1 - Reduce system voltage w/ LDC voltage control method	0.03	0.06	0.10	0.13	0.16	0.16	0.16	0.16	0.16	0.16
2 - Light system improvements	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06
3 - Major system improvements	0.01	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.05	0.06
Annual (aMW)	0.04	0.09	0.13	0.17	0.22	0.23	0.24	0.25	0.26	0.28
Cumulative (aMW)		**0.13**			**0.65**					**1.91**

Cost

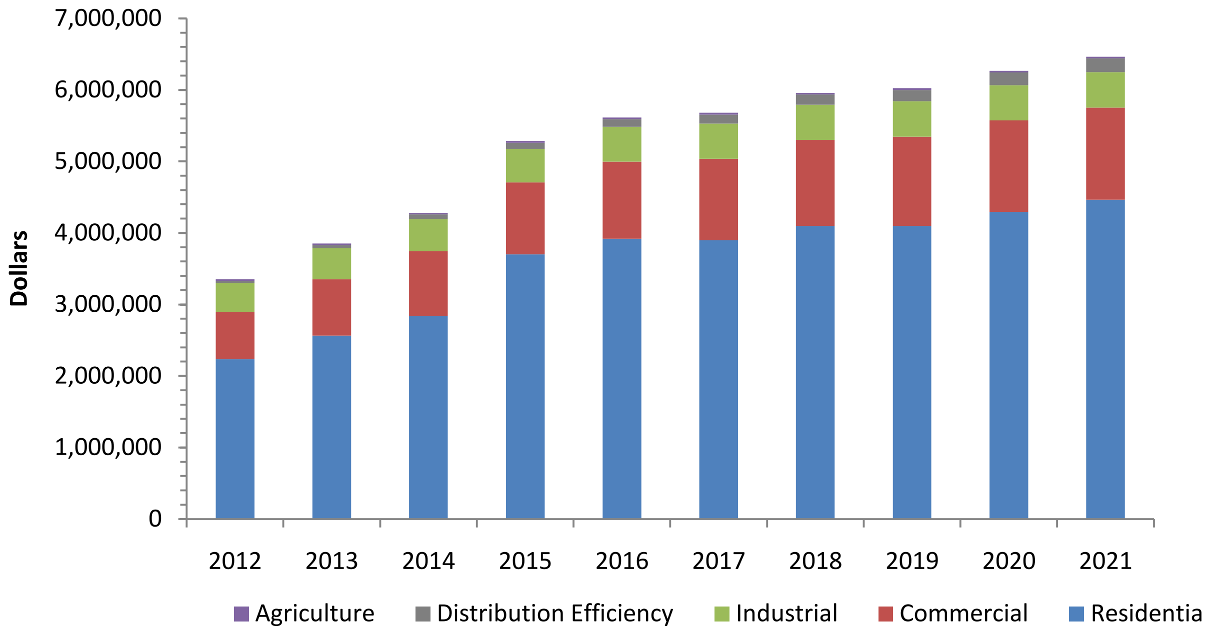
Budget costs can be estimated at a high level based on the incremental cost of the measure (Table 7). The assumptions in this estimate include: 20% of measure cost for administrative cost and 50% of the incremental cost for incentives is assumed to be paid by the utility. This chart shows that if Chelan PUD spends 50% of incremental cost on incentives and has an overall administrative cost of 20% of measure cost, then it will need to spend $7.2 million to acquire the conservation over the next two years. The bottom row of Table 7 shows the cost per aMW. For reference, the overall regional average has historically been $1.69 million per aMW. This average is expected to increase due to the past trend of low cost and high value measures.

Table 7 – Cost for Achievable Conservation Potential

	Utility First Year Cost ($2011)			
	2 Year	5 Year	10 Year	20 Year
Residential	$4,797,376	$15,256,153	$36,112,607	$83,042,511
Commercial	$1,445,512	$4,435,528	$10,587,396	$19,826,805
Industrial	$846,789	$2,249,110	$4,722,533	$9,669,381
Distribution Efficiency	$64,189	$320,943	$1,109,509	$2,845,437
Agriculture	$50,229	$125,573	$251,147	$251,147
TOTAL	**$7,204,095**	**$22,387,306**	**$52,783,192**	**$115,635,281**
Total (Million $/aMW)	**2.13**	**2.40**	**2.52**	**2.72**

Figure 10 shows the data from Table 7 graphically by year over 10 years. Generally, cost per aMW of energy efficiency potential increases over the 20-year study period. Measures in the initial 2-5 year time horizon, such as lighting and showerheads, are generally less expensive than measures later in the study period, such as heat-pump upgrades in the residential sector and building conditioning measures in the commercial sector. The 20% admin and 60% measure-cost assumptions are the same as in Table 7.

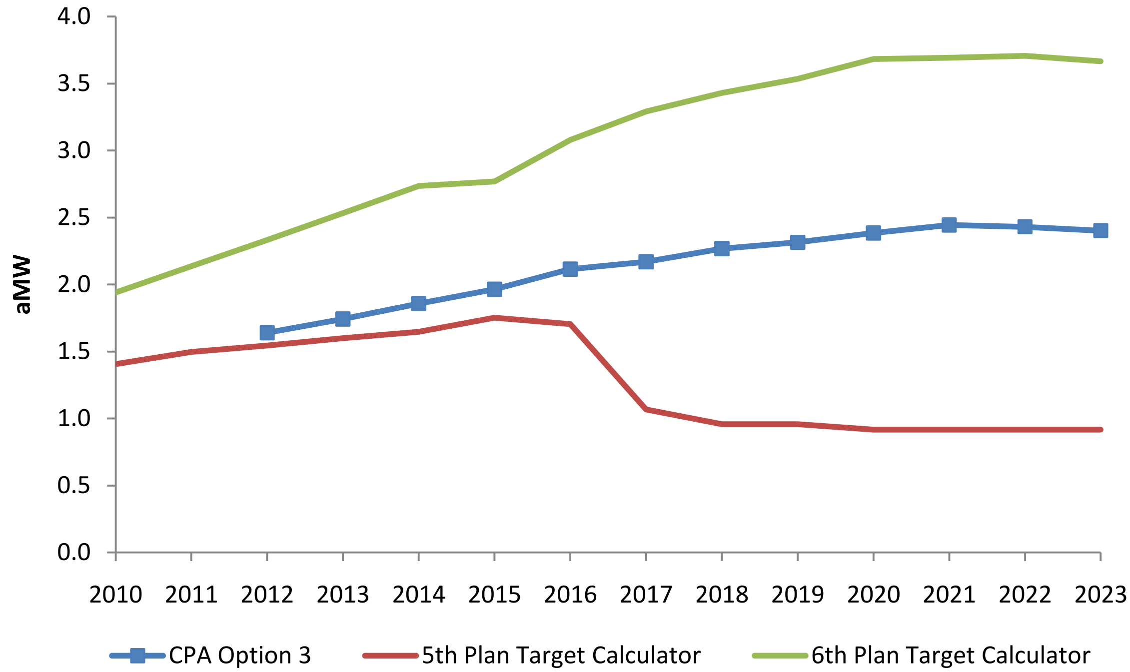
Figure 10 – Annual Initial Cost of Conservation



Comparison to Target Calculator

For reference, the results of this CPA can be compared with high-level target calculators based on percent of regional load. These CPA results are overall lower than the percent-of-load based estimates found in the Council's 6th Plan Target Calculator. The difference is largely due to the avoided cost forecast, but includes other factor such as completion of significant industrial conservation in recent years. Conversely, the results are slightly higher than results from the 5th Plan Target Calculator, as shown in Figure 11.

Figure 11 – CPA Results Compared to 5th and 6th Power Plan Target Calculators



Scenarios

A variety of scenarios were conducted as required by the EIA. The high case represents higher economic growth and higher future electricity prices while the low case represents slightly worse economic conditions and lower future prices. The scenarios are described below:

Base Scenario – The base case is the one presented throughout this report.

Pro-Rata Base Scenario – This scenario has the same 10-year potential as the Base Scenario, but the annual potential is one tenth of the 10-year. This required significant acceleration of measures in the early years.

High Scenario – The High Scenario represents a future with much higher growth in housing and in the general power market. The following parameters define the High Scenario from the Base:

- Residential growth rate increased from 1.3% to 1.7%
- Added 3000 housing units to the residential base to simulate the conversion from unoccupied to occupied (Chelan County has a high number of "Unoccupied" homes according to the US Census)
- Added a $50/MWh risk credit to the avoided cost (results in a 56% increase in EE benefits) and accounts for increased CO_2 costs.
- Added data warehouses to Industrial potential (not in 6th Plan)
- Increased growth rate of Industrial "Other Food" segment to 1.5%

- Accelerated several measures in the early years: commercial lighting, residential weatherization, and residential heat pumps.

Low Scenario - The Low Scenario represents a future with even lower growth than currently being experienced and forecasted. The following parameters define the Low Scenario from the Base:

- Reduced residential growth to 1.1%
- Reduced fruit storage growth rate from 2.2% to 1.5%
- Reduced savings values of Heat Pump Water Heaters and Consumer Electronics by 50% to account for risk of the currently unverified savings.
- Reduced avoided costs by 13% to account for reduced future market prices and lower CO_2 estimates.

The results of these scenarios are plotted in Figure 12.

Figure 12 – Conservation Scenarios

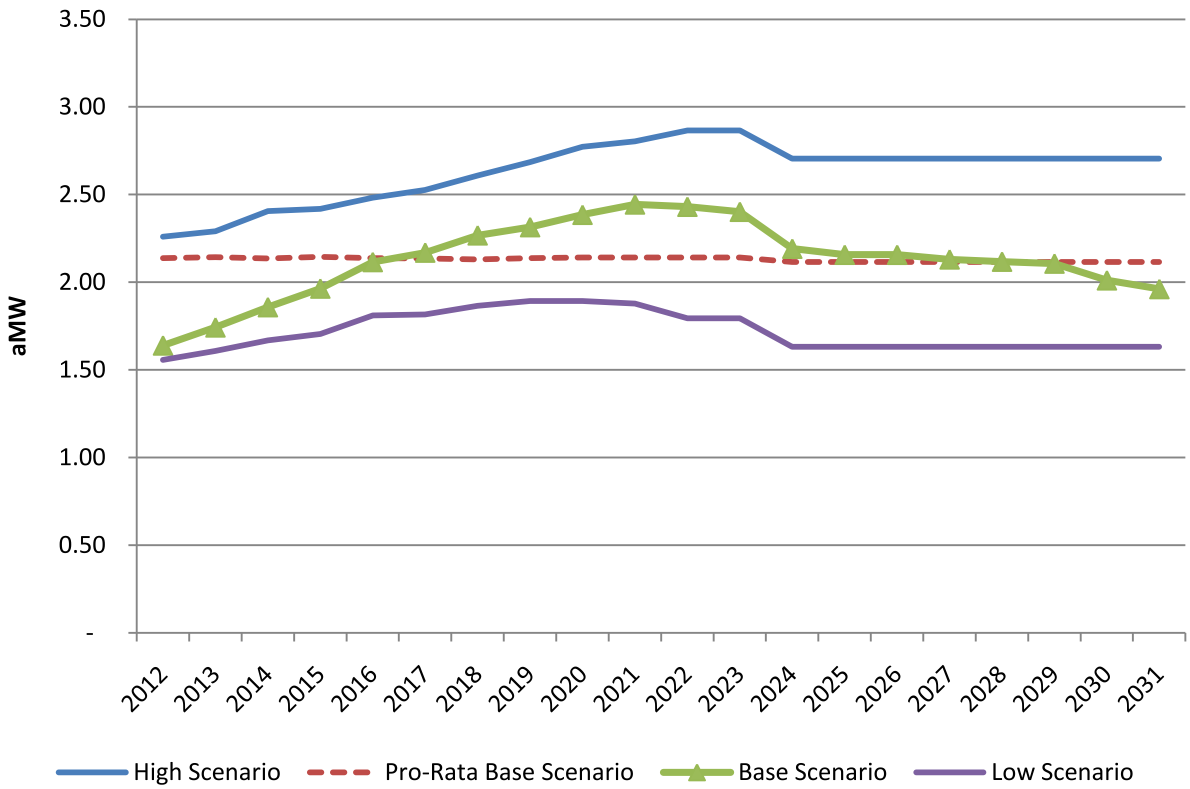
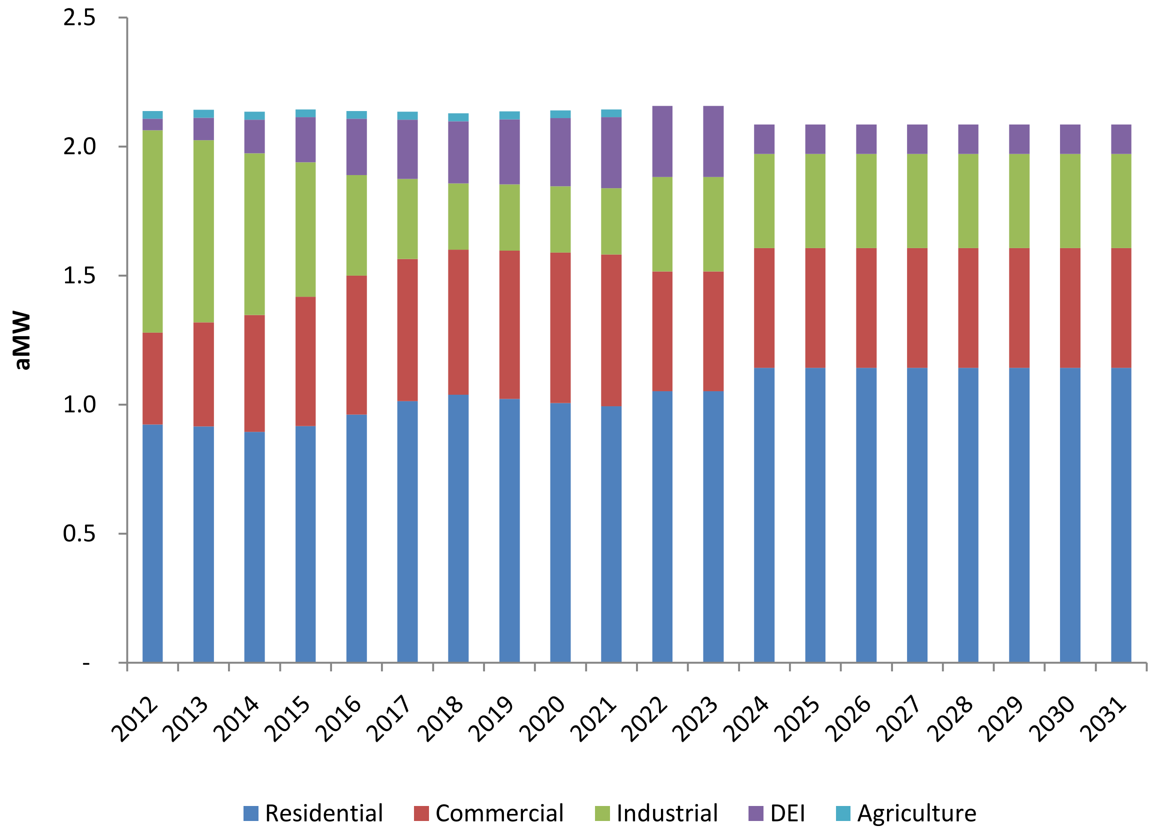


Figure 13 shows results from the "pro-rata" conservation scenario. This scenario shows an even total rate of conservation achievement by year, but differs by sector. S

Figure 13 – "Pro-Rata" Conservation Scenario



Summary

This report summarizes the results of Chelan PUD's 2011 CPA. The assessment provides estimates of energy savings by sector for the period 2012 to 2031, with a focus on the first 10 years of the planning period, as required by I-937. The assessment considered a wide range of conservation resources that are reliable, available, and cost effective within the 20-year time horizon.

Methodology and Compliance with State Mandates

Energy efficiency potential 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 consistent methodology, Chelan PUD utilized many of the assumptions that the Council developed for the *6th Regional Power Plan*. 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 time horizons: 2 years, 5 years, 10 years, and 20 years. This close connection with the Council methodology enables compliance with the Washington Independence Act.

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 and implementation of codes and standards. 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.

Program and Measure Considerations

Residential

The largest amount of conservation potential is in the residential sector. Potential in the residential sector is concentrated in five end-use categories: Lighting, heat pumps, envelope retrofit, water heating, and consumer electronics. For the next three years, residential CFL potential remains available, prior to the new lighting efficiency standards.

Heat pumps are a measure with a large and steady amount of potential. Since Chelan PUD has significant electric space heating, both heat pumps and weatherization measures will yield significant savings. Low-flow shower heads contribute significantly to savings potential within the water heating end-use. Savings potential from heat-pump water heaters is expected to grow over the planning period and is ramped accordingly. Consumer electronics is aggressively ramped up, though the majority of the potential is expected to be achieved through market transformation.

Commercial

Similar to the residential sector, the commercial sector increases steadily over the planning period starting at 0.3 aMW per year and increasing to around 0.5 aMW per year by the end of the ten-year planning period. Lighting remains the largest source of potential throughout the planning period. Lighting controls for non-lost opportunity applications provide some potential, with lighting power density measures providing a larger portion of potential.

Industrial

In the industrial sector, the fruit storage sector will continue to be the primary industry for conservation potential.

Distribution System

The distribution system efficiency measures can be implemented within a relatively short timeframe (e.g., 2-3 years).

Northwest Energy Efficiency Alliance

Chelan may choose to participate in NEEA. In this regard, NEEA can be viewed as another utility program by claiming and documenting the savings corresponding to the funding provided to NEEA.

Setting Conservation Targets

As of the writing of this report, there have been and still are ongoing discussions among utilities and the State Auditor's Office regarding the setting of targets. Because of the ambiguities in the language and the possible interpretations, there remain a variety of possibilities for setting a conservation target for the next biennium:

- Utility Analysis (this CPA) – 3.38 aMW (sum of 2012 and 2013)
- Utility Analysis (this CPA), Pro Rata 20% of ten-year – 4.18 aMW
- Fifth Plan Target Calculator (v1.7) – 3.20 aMW, (v1.8) – 3.13 aMW (sum of 2012-13)
- Sixth Plan Target Calculator (v2.0) – 4.89 aMW (sum of 2012-13)

The first option is the most applicable to Chelan and its service area. Part of the ongoing discussion is whether or not the Fifth Plan Target Calculator is still an option for the upcoming biennium. If this proves to be a legally acceptable option, then it would result in the lowest target and least liability for Chelan PUD.

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Census Data, http://factfinder.census.gov/home/saff/main.html?_lang=en

Appendix I – Acronyms

aMW –Average Megawatt

BPA – Bonneville Power Administration

Btu – British Thermal Unit

C&RD – Conservation and Renewable Discount

CAA – Conservation Augmentation Agreement

CFL – Compact Fluorescent Light Bulb

CPA – Conservation Potential Assessment

CPP – Critical Peak Pricing

CRC – Conservation and Renewable Credit

DSM – Demand Side Management

EESC – EES Consulting

EIA – Energy Independence Act

GW – Gigawatts. 1,000,000 kW

GWh – Gigawatt-hour

HLH – Heavy load hour energy

HVAC – Heating, ventilation and air-conditioning

I-937 – Washington State Initiative 937

IRR – Internal Rate of Return

kW – kilowatt

kWh – kilowatt-hour

LED – Light-emitting diode

LLH – Light load hour energy

MF –Multi-Family

MH –Manufactured House

MW –Megawatt

MWh –Megawatt-hour

NEEA – Northwest Energy Efficiency Alliance

NPV – Net Present Value

NW – Northwest

O&M – Operation and Maintenance

VFD – Variable Frequency Drive

RIM – Rate Impact Methodology

RPS – Renewable Portfolio Standard

RTP – Real Time Pricing

SF – Single Family

SGC – Super Good Cents

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.

C&RD and ConAug: Conservation and Renewables Discount and Conservation Augmentation are both conservation programs previously offered by BPA. The C&RD program has been replaced by the Conservation Rate Credit (CRC) program.

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.

DSM (Demand Side Management): Actions to modify consumer demand for energy through various methods such as financial incentives and education.

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

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.

Load: The amount of electric power delivered or required at any specific point on a system. Load also refers to the amount of electricity required by a customer or a piece of equipment. When the term refers to the total demand in an electric system it is called system load.

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.

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 "The 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.

On-peak Power: Electricity supplied during periods of high system demand.

Off-peak Power: Electricity generated during periods of typically low consumer demand, such as early morning hours, Sundays, and holidays.

Peak: The maximum demand or load that has occurred during a specified period of time. The time period may be 30 minutes or an hour during a day, month, or year. Peak periods fluctuate by season. Peaks usually occur during the morning hours in the winter and in the late afternoon in the summer.

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 Standards: 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 anytime 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

WAC 194-37-070 Documenting Development of Conservation Targets; Utility Analysis Option		
	NWPCC Procedures	**EES Consulting Methodology**
(i)	Analyze a broad range of energy efficiency measures considered technically feasible.	All of the 1,450 of the Council's 6th Plan measures were evaluated to determine which had greater benefits than costs.
(ii)	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.
(iii)	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 provided by Chelan PUD consistent with their IRP.
(iv)	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 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 Power Plan models.
(v)	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 assumptions used were the same as those used in defining the Sixth Plan measures. The Total Resource Cost (TRC) benefit cost ratio was used to screen measures for cost-effectiveness (I.e., those greater than 1 are cost-effective).
(vi)	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").
(vii)	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.

(viii) Include deferred capacity expansion benefits for transmission and distribution systems in its cost-effectiveness analysis.	Deferred capacity expansion benefits were given a benefit of $23/kW-yr in the cost-effectiveness analysis. This is the same assumption used by the Council in the Sixth Power Plan.
(ix) 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 Power Plan. Non-energy benefits include, for example, water savings from clothes washers.
(x) 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 consistent with regional average and BPA programs. The 20% value was used in both the Fifth and Sixth Power plans.
(xi) 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 = 5%.
(xii) 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 achievability study conducted for Chelan was for the 20-year planning period, thus 85% for retrofit measures and 65% for lost opportunity measures were used to determine potential. These applicability factors were applied in the same way as in the Sixth Power Plan.
(xiii) 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.
(xiv) Analyze the results of multiple scenarios. This includes testing scenarios that accelerate the rate of conservation acquisition in the earlier years.	High and low-cost scenarios were run and plotted next to the base-case scenario. Ramp rates were also utilized to adjust for Chelan PUD's programs. The scenarios are further defined in the body of the report.
(xv) 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.

Appendix IV – DSM Tests

Two general screening methods can be used to rank demand and supply options. These are benefit-to-cost ratios and levelized cost. A benefit-to-cost ratio divides resource benefits by resource costs to calculate a ratio. If the ratio is greater than one, the resource is cost-effective; if the ratio is less than one, the resource is not. Levelized costs sum the fixed and variable costs of a resource over its life, taking into account the time value of money, and divide them by the associated output or savings. A cost per unit of output or savings is developed and is usually expressed in a constant dollar year. This levelized cost can then be compared with a fixed generating resource or power contract to determine cost effectiveness.

Several different economic tests are available for evaluating resource options. All of the tests incorporate benefit-to-cost analyses. However, the perspective from which the costs and benefits are evaluated differs among the tests. The five tests are the total resource cost (TRC) test, ratepayer impact measure (RIM) test, participant test, utility cost test, and societal test.

In the Northwest, the Council uses the TRC as the primary cost test to determine cost effectiveness of DSM options. Using the TRC benefit cost ratio, all DSM measures can be compared with available supply resources. Other tests can then be applied to determine the cost effectiveness from the various perspectives (e.g., utility, ratepayer).

Cost and Benefit Components

Changes in Supply Costs. One of the main benefits of a DSM option is its associated reduction in supply costs. This can occur as a result of a decrease in energy use or as a result of a shift of energy from a more expensive period to a less expensive period. The avoided supply cost is calculated by multiplying the reduction in total net generation by the marginal cost. If energy has been shifted instead of reduced, the resulting increase has to be included on the cost side. The changes in supply cost for periods where energy use increases are costs (increased supply cost), and the changes in supply costs for periods where energy use decreases are benefits (avoided supply cost).

Changes in Revenue and Bills. Another large effect of DSM programs is revenue reduction. Lost revenues are a cost to the utility and tend to increase rates on a per-unit basis. On the other hand, DSM program participants receive equivalent benefits, because their consumption is reduced.

Utility Costs. This category includes all costs of planning, implementing and evaluating a DSM program, except for incentives paid directly to the participant. Also included are those for marketing, administrative, equipment and program monitoring and evaluation.

Participant Costs and Avoided Participant Costs. Participant costs include all out-of-pocket expenses that a participant incurs as a result of participating in the program. These costs are calculated before the participant receives any rebate or incentive payment. If the participant avoids some cost by participating, it is considered a benefit to the participant.

Incentives and Participation Charges. Incentives are any dollar amount that the utility pays directly to the participant. These include rebates, bill reductions, rate discounts and below-market loans. The incentive that a utility pays a dealer or builder is a utility cost unless the incentive is passed through to the participants. A participation charge is the payment by the participant to the utility related to a DSM program.

Externalities. This category includes any costs or benefits that are external to standard cost-accounting methods. Externalities include effects, both positive and negative, to society.

Overview of the Tests

This section briefly describes the five most commonly used cost-effectiveness tests. Each test represents a different perspective in determining the cost-effectiveness of a program. The source of these tests is the *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects.*

Total Resource Cost Test. The TRC test is a measure of the total net expenditures of a DSM program from the perspective of the utility and its ratepayers. The benefits are avoided supply costs, net avoided participant costs and tax credits. The costs include increased supply, net participant costs and utility costs. Since the utility and its ratepayers are considered together by this method, transfer payments between the two are ignored. This test is a measure of the change in the average cost of energy services. The following formula explains the relationships within the TRC method.

$$B_{TRC} = \sum_{t=1}^{N} \frac{UAC_t + TC_t + PAC_t *}{(1+d)^{t-1}}$$

$$C_{TRC} = \sum_{t=1}^{N} \frac{UC_t + PC*_t + UIC_t}{(1+d)^{t-1}}$$

* Participant costs and participant avoided costs in this test are net of free riders.

Ratepayer Impact Measure Test. The ratepayer impact measure (RIM) test quantifies the impacts on customers' rates resulting from changing utility revenues and operating costs. It assumes that DSM reduces utility revenues and increases costs and that customer rates must be increased to balance the utility's books.

Benefits considered by the RIM test are avoided supply costs and revenue gains. Costs for the RIM test are increased supply costs, utility program administration, incentives and reduced revenues from energy savings. The calculation of the RIM test is as follows.

$$B_{RIM} = \sum_{t=1}^{N} \frac{UAC_t + RG_t}{(1+r)^{t-1}}$$

$$C_{RIM} = \sum_{t=1}^{N} \frac{UIC_t + RL_t + UC_t + INC_t}{(1+r)^{t-1}}$$

Utility Cost Test. The utility cost test is a measure of the changes in total costs to the utility from a DSM program. It evaluates the DSM program from the perspective of a utility's total cost. The benefit component is avoided supply costs. The cost components are increased supply costs, incentives, and utility program costs. The test measures the change in the average energy bills across all customers.

The utility cost test is identical to the RIM test, except that the utility's revenue losses are not included as a cost input in the utility cost test, and revenue gains from increased sales are not included as a benefit. The following formula describes the utility cost test calculations.

$$B_{UC} = \sum_{t=1}^{N} \frac{UAC_t}{(1+d)^{t-1}}$$

$$C_{UC} = \sum_{t=1}^{N} \frac{UC_t + INC_t + UIC_t}{(1+d)^{t-1}}$$

Participant Test. The participant test measures the quantifiable benefits and costs to the customer as a result of program participation. Benefits include reductions in customers' utility bills, avoided customer costs, incentives and tax credits. Participant costs include any customer out-of-pocket expenses resulting from participation. The test is a measure for the average customer and ignores free riders. The participant test provides a good indication of the attractiveness of the program to the average non-free rider expected to participate. The participant test calculation is based on the calculation that follows.

$$B_p = \sum_{t=1}^{N} \frac{BR_t + TC_t + INC_t + PAC_t}{(1+d)^{t-1}}$$

$$C_p = \sum_{t=1}^{N} \frac{PC_t + BI_t}{(1+d)^{t-1}}$$

Societal Test. A common variation on the total resource cost test is the societal test. It measures the benefits and costs to all of society (i.e., including other utilities, government agencies, and citizens outside the jurisdiction). The societal test differs from the total resource cost test in three ways. First, a societal discount rate is used to place value on all future benefits and costs, reflecting society's low-risk view of future investments. Second, environmental externalities are included in the benefit-to-cost equations. Third, this test excludes tax credits because they are transfer payments within society. The mathematical equations for the societal test follow.

$$B_S = \sum_{t=1}^{N} \frac{UAC_t + PAC*_t + EB_t}{(1+s)^{t-1}}$$

$$C_S = \sum_{t=1}^{N} \frac{UC_t + PC*_t + UIC_t + EC_t}{(1+s)^{t-1}}$$

* Participant costs and participant avoided costs in this test are net of free riders.

Glossary of Symbols

B_p	Benefit to participants (participants test)
B_{RIM}	Benefits to rate levels or customer bills (ratepayer impact measure test)
BI_t	Bill increases in year t
BR_t	Bill reduction in year t
B_S	Benefits of the program (societal test)
B_{TRC}	Benefits of the program (total resource cost test)
B_{UC}	Benefits of the program (utility cost test)
C_P	Costs to participants (participants test)
C_{RIM}	Costs to rate levels or customer bills (ratepayer impact measure test)
C_S	Cost of the program (societal test)
C_{TRC}	Costs of the program (total resource cost test)
C_{UC}	Costs of the program (utility cost test)
d	Discount rate
EB_t	External benefits to society due to the program in year t
EC_t	External costs to society due to the program in year t
INC_t	Incentives paid to the participant by the sponsoring utility in year t
PAC_t	Participant avoided costs in year t
PC_t	Participant costs in year t
r	Return on investment
RG_t	Revenue gains from increased sales in year t
RL_t	Revenue loss from reduced sales in year t
s	Societal discount rate
TC_t	Tax credits in year t
UAC_t	Utility avoided supply costs in year t
UC_t	Utility program costs in year t
UIC_t	Utility increased supply costs in year t

Appendix V – Energy Efficiency Potential by End-Use

Energy Efficiency Potential by End-Use

Residential

aMW

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Lighting	0.47	0.35	0.24	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
HP / DHP	0.19	0.22	0.22	0.33	0.33	0.30	0.30	0.27	0.27	0.30	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Envelope Retro	0.10	0.11	0.14	0.17	0.17	0.15	0.15	0.14	0.14	0.12	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Water Heat	0.12	0.13	0.15	0.18	0.20	0.21	0.22	0.25	0.27	0.29	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Consumer Electronics	0.02	0.03	0.07	0.10	0.11	0.12	0.14	0.16	0.16	0.16	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Appliances	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Envelope New	0.02	0.03	0.05	0.07	0.09	0.10	0.12	0.14	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Cooling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.93**	**0.90**	**0.90**	**0.89**	**0.94**	**0.94**	**1.00**	**1.02**	**1.06**	**1.10**	**1.14**	**1.14**	**1.14**	**1.14**	**1.14**	**1.14**	**1.14**	**1.14**	**1.14**	**1.14**

Commercial

aMW

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Lighting	0.10	0.15	0.19	0.21	0.24	0.26	0.28	0.29	0.30	0.30	0.31	0.29	0.23	0.20	0.20	0.20	0.20	0.20	0.16	0.12
PC Network/Supply	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04
HVAC Controls	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.03	0.00	0.00
Refrigeration	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.02	0.01	0.01	0.01	0.01
Ext Lighting	0.00	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.00	0.00
Rooftop Units	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Envelope	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Ventilation	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Food Service	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04
Chillers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Integrated Design	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Water Wastewater	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Other	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Traffic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Water Heat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.31**	**0.38**	**0.44**	**0.49**	**0.52**	**0.55**	**0.58**	**0.60**	**0.62**	**0.63**	**0.60**	**0.57**	**0.52**	**0.49**	**0.49**	**0.46**	**0.45**	**0.44**	**0.34**	**0.29**

Industrial

aMW

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Process: General	0.02	0.03	0.04	0.06	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Refrigerated Storage	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Lighting	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Fans	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Pumps	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Compressed Air	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Process: Metal Mfg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Motors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Process: Electronic Mfg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.33**	**0.35**	**0.36**	**0.38**	**0.40**	**0.41**	**0.41**	**0.41**	**0.41**	**0.41**	**0.41**	**0.41**	**0.41**	**0.41**	**0.41**	**0.41**	**0.41**	**0.41**	**0.41**	**0.41**

Agricultural

aMW

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Dairy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation Hardware	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation Scheduling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Distribution Efficiency

aMW

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Reduce system voltage	0.03	0.06	0.10	0.13	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Light system improvements	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Major system improvements	0.01	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Total	**0.04**	**0.09**	**0.13**	**0.17**	**0.22**	**0.23**	**0.24**	**0.25**	**0.26**	**0.28**	**0.28**	**0.28**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**

Appendix VI – Industrial Measure Assumptions

ECM No.	Conservation Measure	First Cost ($/kWh)	Sector	Enduse App	% Savings	Measure Applicability	Life	Levelized Cost ($/kWh)
1	Air Compressor Demand Reduction	$0.081	All Except Cold Storage	Air Comp	20%	26%	10	$0.035
2	Air Compressor Equipment1	$0.166	Sugar, Wood, Paper, Metal, Equipment, Refinery	Air Comp	35%	0%	10	$0.046
3	Air Compressor Equipment2	$0.064	Sugar, Wood, Paper, Metal, Equipment, Refinery	Air Comp	35%	17%	10	$0.033
4	Air Compressor Optimization	$0.200	Sugar, Wood, Paper, Metal, Equipment, Refinery	Air Comp	50%	36%	10	($0.003)
5	HighBay Lighting 1 Shift	$0.242	Food, Wood, Metal Fab, Other	Lights	51%	varies	10	$0.031
6	HighBay Lighting 2 Shift	$0.142	Food, Wood, Metal Fab, Other	Lights	51%	by	10	$0.018
7	HighBay Lighting 3 Shift	$0.079	All	Lights	51%	sector	10	$0.010
8	Efficient Lighting 1 Shift	$0.077	Food, Wood, Metal Fab, Other	Lights	70%	varies	10	$0.010
9	Efficient Lighting 2 Shift	$0.045	Food, Wood, Metal Fab, Other	Lights	70%	by	10	$0.006
10	Efficient Lighting 3 Shift	$0.025	All	Lights	70%	sector	10	$0.003
11	Lighting Controls	$0.213	All	Lights	28%	15%	10	$0.028
12	Motors: Rewind 20-50 HP	$0.381	Food, Wood, Paper, Metal, Metal Fab, Refinery	All Motors	1%	varies	10	$0.049
13	Motors: Rewind 51-100 HP	$0.331	Food, Wood, Paper, Metal, Metal Fab, Refinery	All Motors	1%	by	10	$0.043
14	Motors: Rewind 101-200 HP	$0.271	Food, Wood, Paper, Metal, Metal Fab, Refinery	All Motors	1%	sector	10	$0.035
15	Efficient Centrifugal Fan	$0.182	Pulp, Paper, Wood	Material Handling	20%	11%	10	$0.024
16	Fan Energy Management	$0.000	All Except Cold Storage	Fan	10%	27%	10	$0.030
17	Fan Equipment Upgrade	$0.086	Paper, Wood	Fan	35%	23%	10	$0.041
18	Fan System Optimization	$0.120	Paper, Wood	Fan	50%	30%	10	$0.013
19	Pump Energy Management	$0.000	All Except Cold Storage	Pump	8%	31%	10	$0.030

20	Pump Equipment Upgrade	$0.125	Paper, Wood	Pump	20%	34%	10	$0.046
21	Pump System Optimization	$0.254	Paper, Wood	Pump	50%	15%	12	($0.031)
22	Transformers	$0.200	All	All Electric	2%	80%	30	$0.013
23	Synchronous Belts	$0.214	All Except Cold Storage, Electronics	All Motors	2%	21%	10	$0.028
51	Cold Storage Tuneup	$0.070	Cold Storage	Refer	10%	66%	3	$0.026
52	Fruit Storage Refer Retrofit	$0.231	Fruit Storage	Refer	61%	30%	10	$0.030
53	CA Retrofit -- CO2 Scrub	$0.240	Fruit Storage	Other (CA)	68%	16%	10	$0.031
54	CA Retrofit -- Membrane	$0.341	Fruit Storage	Other (CA)	38%	19%	10	$0.044
55	Fruit Storage Tuneup	$0.070	Fruit Storage	Refer	10%	56%	3	$0.026
56	Groc Dist Retrofit	$0.300	Cold Storage	Refer	16%	17%	10	$0.039
57	Groc Dist Tuneup	$0.070	Cold Storage	Refer	10%	34%	3	$0.026
58	Plant Energy Management	$0.021	All	All Motors	12%	27%	10	$0.031
59	Energy Project Management	$0.123	Sugar, Wood, Paper, Metal, Refinery	All Motors	29%	27%	11	$0.044
60	Integrated Plant Energy Management	$0.197	Sugar, Wood, Paper, Metal, Refinery	All Motors	50%	22%	11	($0.010)