Grant County
PUBLIC UTILITY DISTRICT

Integrated Resource Plan

2020

RESOLUTION 8948 | AUGUST 25, 2020 | EXHIBIT A

LETTER FROM THE WHOLESALE MARKETING AND SUPPLY

The next 10 years present significant challenges and opportunities for Grant PUD (Grant). These challenges consist of the magnitude of our forecasted load growth, wholesale energy market transformations, carbon legislation, and regional resource adequacy constraints. The 2020 Integrated Resource Plan (IRP) is Grant's road map for navigating this uncertain but exciting future.

Load Growth

Load growth continues to be the largest driver in Grant PUD's IRP. Grant has continued to see a large amount of load growth over the past five years; an annual growth rate over 3% during this timeframe. Most of this growth continues to be from an increase in a few large industrial customers. The pace of load growth is forecasted to increase over the next 10 years (4.9%), with most of the growth projected again to come from a few large industrial customers. Load concentration continues to present a significant amount of uncertainty in future resource needs as it could grow much faster or decrease almost overnight.

With this projected load growth, Grant is forecasted to be seasonally capacity-deficit starting in late summer of 2026 and winter capacity-deficit beginning in December 2026. The 2020 IRP addresses how Grant plans to meet these needs.

New Wholesale Markets

Over the past several years, the California Independent System Operator's (CAISO) Energy Imbalance Market (EIM) has grown from two Northwest participants to eleven, with an additional ten utilities planning on joining within the next two years.

This real-time energy imbalance market is in direct competition to the current real-time energy market (Mid-Columbia trading hub, Mid-C) Grant relies on to meet its hourly energy needs. In addition, the CAISO has plans for an Extended Day-Ahead Market (EDAM) to supplement the current real-time EIM. This proposed day-ahead market could further reduce liquidity at the Mid-C, making it more difficult for Grant to meet its future energy needs with traditional tools.

Grant continues to monitor CAISO's progress in each of these markets and will look for ways to take advantage of this evolving marketplace in the future.

Washington State's Clean Energy Transformation Act (CETA)

In 2019, Washington Governor Jay Inslee signed into law the Clean Energy Transformation Act (CETA). This Act commits Washington utilities to supply 100% of their electricity from renewable, non-carbon emitting resources by 2045 and be greenhouse gas neutral by 2030. The good news for Grant is its existing hydropower plants (Wanapum and Priest Rapids) are considered renewable and compliant under the new law. The challenge will be choosing additional resources in the next few years that comply with CETA while allowing Grant to serve customers at the lowest possible cost.

Resource Adequacy

Historically, the Northwest has been one of the least capacity constrained regions of the electric grid due to the predominant use of hydro-electric generating resources which produced a system rich in generating capacity and flexibility. But, as the region has added increasing amounts of renewable resources and as the hydro-electric system flexibility has declined, the region finds itself transitioning into a peak-constrained system. The scheduled closing of coal-fired generators in the region has further decreased generation capacity. In 2019, some of the Northwest Power Pool (NWPP) entities began an effort to start a voluntary NW Resource Adequacy (RA) program that would set regional standards for planning methods and metrics, provide load and resource diversity savings, and establish a robust procurement process.

Grant supports this effort and is using the work of the NWPP RA effort to help in determining its resource needs in the 2020 IRP.

The next 10 years are sure to be exciting ones for Grant PUD. The variability in loads, regionalization of wholesale markets, the effects of CETA, and the resource adequacy needs of the region are creating complex uncertainties for Grant PUD. Wholesale Marketing and Supply's mission is to navigate all these uncertainties and provide the most value possible to our customers. This requires maximizing the resources of our hydro projects while finding the most reliable, least-cost, and lowest-risk options to meet customer load. The 2020 IRP is our roadmap to achieve these goals.

Rich Flanigan
Senior Manager of Wholesale Marketing and Supply

<u>RESOLUTION NO. 8948</u>

A RESOLUTION AUTHORIZING AND APPROVING THE 2020 INTEGRATED RESOURCE PLAN (IRP)

<u>R e c i t a l s</u>

1. RCW Chapter 19.280.010 was enacted by the Washington State Legislature in 2006 to encourage the development of new safe, clean, and reliable energy resources to meet future demand in Washington for affordable and reliable electricity;

2. The State Legislature has found that it is essential that electric utilities in Washington develop comprehensive resource plans that explain the mix of generation and demand-side resources (conservation) they plan to use to meet their customers' electricity needs in both the short term and the long term;

3. RCW 19.28.030 requires that by September 1, 2020, Grant PUD adopt an Integrated Resources Plan which includes:

   (a) A range of forecasts, for at least the next ten years, of projected customer demand which takes into account econometric data and customer usage;

   (b) An assessment of commercially available conservation and efficiency resources, as informed, as applicable, by the assessment for conservation potential under RCW 19.285.040 for the planning horizon consistent with (a) of this subsection. Such assessment may include, as appropriate, opportunities for development of combined heat and power as an energy and capacity resource, demand response and load management programs, and currently employed and new policies and programs needed to obtain the conservation and efficiency resources;

   (c) An assessment of commercially available, utility scale renewable and nonrenewable generating technologies including a comparison of the benefits and risks of purchasing power or building new resources;

   (d) A comparative evaluation of renewable and nonrenewable generating resources, including transmission and distribution delivery costs, and conservation and efficiency resources using "lowest reasonable cost" as a criterion;

   (e) An assessment of methods, commercially available technologies, or facilities for integrating renewable resources, including but not limited to battery storage and pumped storage, and addressing overgeneration events, if applicable for the utility’s resource portfolio;

   (f) An assessment and ten-year forecast of the availability of regional generation and transmission capacity on which the utility may rely to provide and deliver electricity to its customers;

   (g) A determination of resource adequacy metrics for the resource plan consistent with the forecasts;

   (h) A forecast of distributed energy resources that may be installed by the utility's customers and an assessment of their effect on the utility's load and operations;

(i) An identification of an appropriate resource adequacy requirement and measurement metric consistent with prudent utility practice in implementing RCW 19.405.030 through 19.405.050;

(j) The integration of the demand forecasts, resource evaluations, and resource adequacy requirement into a long-range assessment describing the mix of supply side generating resources and conservation and efficiency resources that will meet current and projected needs, including mitigating overgeneration events and implementing RCW 19.405.030 through 19.405.050, at the lowest reasonable cost and risk to the utility and its customers, while maintaining and protecting the safety, reliable operation, and balancing of its electric system;

(k) An assessment, informed by the cumulative impact analysis conducted under RCW 19.405.140, of: Energy and nonenergy benefits and reductions of burdens to vulnerable populations and highly impacted communities; long-term and short-term public health and environmental benefits, costs, and risks; and energy security and risk; and

(l) A ten-year clean energy action plan for implementing RCW 19.405.030 through 19.405.050 at the lowest reasonable cost, and at an acceptable resource adequacy standard, that identifies the specific actions to be taken by the utility consistent with the long-range integrated resource plan.

4. RCW 19.280.050 requires that Grant PUD's Commission encourage participation of its consumers in development of the Integrated Resources Plan and approve the plan after it has provided public notice and hearing which occurred on July 28, 2020;

5. Grant PUD's staff has prepared and submitted an Integrated Resources plan which meets the requirements of RCW Chapter 19.280.010 et seq., a copy of which is attached hereto as Exhibit A; and

6. Grant PUD's General Manager has reviewed the proposed Integrated Resources Plan and it complies with the requirements of RCW Chapter 19.280.010 et seq. and recommends its adoption by the Commission.

NOW, THEREFORE, BE IT RESOLVED by the Commission of Public Utility District No. 2 of Grant County, Washington, that the attached Integrated Resources Plan is hereby approved and Grant PUD's General Manager is directed to file the plan with the Washington Department of Commerce.

PASSED AND APPROVED by the Commission of Public Utility District No. 2 of Grant County, Washington, this 25th day of August, 2020.

/s/
President

ATTEST:

/s/
Secretary

/s/
Vice President

/s/
Commissioner

/s/
Commissioner

Table of Contents

1 | Executive Summary

Grant PUD has prepared this updated Integrated Resource Plan (“IRP”), which is a detailed load and resource analysis as part of its long-term planning process and pursuant to state requirements. This analysis indicates that during the next ten years, Grant PUD’s need for physical capacity and energy beyond its current generation assets will need to be addressed. Grant PUD will acquire these resources through market purchases of firm generation as well as Purchaser Power Agreements (PPAs) which may include solar and natural gas resources and call options on firm capacity to cover peak demand. In addition, Grant PUD will need to reevaluate using large market purchases to cover any Estimated Unmet District Load (EUDL) considering possible Resource Adequacy (RA) issues in the Northwest. Grant PUD will also continue to invest in programs to achieve cost-effect conservation as determined by the 2019 Conservation Potential Assessment.

Grant PUD has enough qualified resources to meet the Washington State Renewable Portfolio Standard (“RPS”) through 2024. Beginning in 2025, requirements resulting from the projected load growth will exceed Grant PUD’s projected qualified resource generation. To cover the projected deficit, Grant PUD will purchase eligible Renewable Energy Certificates (RECs) from the market and acquire qualifying renewable resources as appropriate.

The loads and resources for the base year (2019) and two future years (2025 and 2030) are shown in Table 1-1 below. This table will be submitted to the Washington State Department of Commerce prior to the submittal deadline of September 1, 2020.

Table 1-1

	Base Year			5 Year Estimate			10 Year Estimate		
Estimate Year	2019			2024			2029		
	Winter	Summer	Annual	Winter	Summer	Annual	Winter	Summer	Annual
Units	(MW)	(MW)	(MWa)	(MW)	(MW)	(MWa)	(MW)	(MW)	(MWa)
Loads	772.41	810.43	598.09	967.88	1,069.73	768.74	1,229.95	1,342.51	964.76
Exports									
Resources:									
Future Conservation/Efficiency						3.40			1.80
Demand Response									
Cogeneration									
Hydro	764.45	707.15	551.17	885.38	827.12	642.65	885.38	819.42	642.33
Wind			3.24			3.24			3.24
Other Renewables	0.00	10.13	6.05	0.00	10.13	6.05	66.67	176.79	106.05
Thermal - Natural Gas							120.00	345.00	100.00
Thermal - Coal									
Net Long Term Contracts	104.00	89.00	79.57						
Net Short Term Contracts	210.00	257.80	212.59	301.55	458.59	320.63	345.37	400.63	319.58
BPA	6.38	5.50	5.25	6.38	5.50	5.25	6.38	5.50	5.25
Other									
Imports									
Distributed Generation									
Undecided									
Total Resources	**1,084.83**	**1,069.58**	**857.87**	**1,193.31**	**1,301.34**	**981.22**	**1,423.80**	**1,747.34**	**1,178.25**
Load Resource Balance	**312.42**	**259.15**	**259.78**	**225.43**	**231.61**	**212.48**	**193.85**	**404.83**	**213.49**

Notes for Table:

1. *Base year 2019 data is actual load and actual generation. Base year 2019 peak capability is the actual generation on the observed peak load hours for 2019.*
2. *Hydro values include Grant PUD rights in Wanapum, Priest Rapids, P.E.C, and Quincy Chute. Wanapum and Priest Generation is based on expected water. Grant PUD uses a 15% planning margin to cover various events such as a low water year, unplanned generation outages, extreme weather, unanticipated load growth, etc.*
3. *Conservation based on economic potential study performed in November 2019.*

GRANT PUD DRAWS THE FOLLOWING CONCLUSIONS FROM THE IRP ANALYSIS:

1. Current Grant PUD strategy of large market purchases made to cover Estimated Unmet District Load (EUDL) needs to be reconsidered due to possible resource adequacy issues in the WECC.

2. Based on the anticipated annual energy projections, Grant PUD has enough existing physical resources and EUDL dollars to meet expected load growth on an annual basis through 2028.

3. As a result of the 15% planning margin, additional resources requirements are forecasted as soon as 2026.

4. Grant PUD is forecasting to be seasonally capacity-deficient during summer of 2026.

5. To meet these seasonal deficiencies, current models indicate the least-cost resources to be power purchase agreements or ownership of solar and natural gas generation with an emphasis on firm delivery. Market purchases will also be necessary to fill in any gaps that are not economical to fill with purchase power agreements.

6. Grant PUD will continue to meet its state-mandated renewable portfolio obligations without acquiring new resources until 2025. At that time Grant PUD will acquire any expected RPS deficits with market purchases of eligible RECs and other qualifying resources such as solar.

7. Grant PUD's long-term load forecast contains significant uncertainty due to the relatively high percentage of industrial load. Industrial loads could be significantly higher or lower than the forecast based on a number of factors, many of which are outside Grant PUD's control. Grant PUD has reviewed the potential risks associated with this load uncertainty and will continue monitoring these loads and expectations of this customer segment.

8. Grant PUD will need to stay abreast of changes to markets and regulations in the utility industry affecting the District's planning processes.

ACTION PLAN

Grant PUD should take the following actions based on the results of this IRP.

1. Assemble a team of internal subject matter experts to determine strategy and execute a plan to research the acquisition of resources to meet forecasted energy and capacity needs. This will most likely include one or more full-time IRP staff resources. Monitor opportunities to procure low-cost, long-term generating resources (particularly resources that qualify for I-937 and CETA compliance), with an eye towards opportunities priced better than new-build costs. Preference will be given to firm resources to address regional Resource Adequacy concerns.

2. Continue to implement and achieve cost-effective conservation available within the county as indicated in the District's Conservation Potential Assessment.

3. Continue to enhance the capacity planning process and standards to ensure Grant PUD adequately plans to reliably meet both the energy and peaking needs of Grant PUD's electric system. Grant's capacity planning process and standard should conform to the evolution in power planning for the Pacific Northwest. Therefore, Grant PUD should participate in and monitor regional forums related to resource planning.

4. Continue to refine and improve the retail energy load forecasts, with an emphasis on monitoring changes from the large industrial customers, given their ability to affect Grant's load and resource balance.

5. Evaluate the opportunities presented by the expansion of the Northwest EIM and the possible growth of the California Independent System Operator into the Northwest. Grant PUD should work to identify the best strategy (from a cost, opportunity and risk basis) to interact with this evolving market.

6. Continue to participate in regional utility groups that monitor and influence legislation that could affect Grant PUD's ratepayers.

2 | Overview

Grant PUD has developed this Integrated Resource Plan ("IRP") to assess the long-term power supply condition of the District as required in the Revised Code of Washington, Chapter 19.280. Grant PUD will use this IRP in conjunction with other long-term planning activities to meet the power needs of District customers at the lowest reasonable cost.

REQUIREMENTS AND OBJECTIVES FOR INTEGRATED RESOURCE PLANNING

The state of Washington has provided regulations for how public utility districts are to develop Integrated Resource Plans and describes the uses for the information provided in these plans. Grant PUD has used the requirements listed in these regulatory documents as objectives for this IRP.

Revised Code of Washington, Chapter 19.280

RCW 19.280 outlines the requirements of electric utility resource plans. The intent of this chapter of the Revised Code of Washington is to encourage the development of safe, clean, and reliable energy resources. Information from the integrated resource plans that are developed will be used to identify and develop: new energy generation; conservation and efficiency resources; methods, commercially available technologies, and facilities for integrated renewable resources, including addressing over-generation events; and related infrastructure to meet the state's electricity needs. The requirements listed in RCW 19.280 for large utility districts are as follows:

(a) A range of forecasts, for at least the next ten years, of projected customer demand which takes into account econometric data and customer usage;

(b) An assessment of commercially available conservation and efficiency resources, as informed, as applicable, by the assessment for conservation potential under RCW **19.285.040** for the planning horizon consistent with (a) of this subsection. Such assessment may include, as appropriate, opportunities for development of combined heat and power as an energy and capacity resource, demand response and load management programs, and currently employed and new policies and programs needed to obtain the conservation and efficiency resources;

(c) An assessment of commercially available, utility scale renewable and nonrenewable generating technologies including a comparison of the benefits and risks of purchasing power or building new resources;

(d) A comparative evaluation of renewable and nonrenewable generating resources, including transmission and distribution delivery costs, and conservation and efficiency resources using "lowest reasonable cost" as a criterion;

(e) An assessment of methods, commercially available technologies, or facilities for integrating renewable resources, including but not limited to battery storage and pumped storage, and addressing overgeneration events, if applicable for the utility's resource portfolio.

(f) An assessment and ten-year forecast of the availability of regional generation and transmission capacity on which the utility may rely to provide and deliver electricity to its customers;

(g) A determination of resource adequacy metrics for the resource plan consistent with the forecasts;

(h) A forecast of distributed energy resources that may be installed by the utility's customers and an assessment of their effect on the utility's load and operations;

(i) An identification of an appropriate resource adequacy requirement and measurement metric consistent with prudent utility practice in implementing RCW 19.405.030 through 19.405.050;

(j) The integration of the demand forecasts, resource evaluations, and resource adequacy requirement into a long-range assessment describing the mix of supply side generating resources and conservation and efficiency resources that will meet current and projected needs, including mitigating overgeneration events and implementing RCW 19.405.030 through 19.405.050, at the lowest reasonable cost and risk to the utility and its customers, while maintaining and protecting the safety, reliable operation, and balancing of its electric system;

(k) An assessment, informed by the cumulative impact analysis conducted under RCW 19.405.140, of: Energy and nonenergy benefits and reductions of burdens to vulnerable populations and highly impacted communities; long-term and short-term public health and environmental benefits, costs, and risks; and energy security and risk; and

(l) A ten-year clean energy action plan for implementing RCW 19.405.030 through 19.405.050 at the lowest reasonable cost, and at an acceptable resource adequacy standard, that identifies the specific actions to be taken by the utility consistent with the long-range integrated resource plan.

Washington State Initiative measure number 937

I-937 was the Washington State clean energy initiative passed in 2006, which is now written in the Revised Code of Washington, Chapter 19.285. I-937 requires large utilities to obtain 15% of their electricity from renewable resources by 2020.

KEY RISKS ADDRESSED IN THE 10 YEAR IRP:

Many different risks and uncertainties have been considered while developing Grant PUD's Integrated Resource Plan (IRP). The risks discussed below are among those expected to be significant drivers of uncertainty for Grant PUD over the next decade and beyond. Anticipating changing costs and operating conditions is clearly a critical element of prudent utility management. Each risk is discussed in detail further in the body of this IRP.

Changing Power Market Risk

Significant change is already influencing the WECC power markets. Over the next ten years, this change is expected to accelerate. The market of yesterday was clearly defined and understood by the stakeholders. Most utilities were primarily trading bilaterally in organized markets such as the Mid-C trading hub. Grant PUD, being a pivotal member of the Mid-Columbia region, was well positioned to both buy and sell at this trading hub.

This historic marketing structure is rapidly changing with the advent of more regionally-oriented and much more organized market structures such as the Energy Imbalance Market (EIM) and Two-Settlement RTO/ISO-managed markets evolving in our area. Fortunately, this evolution is not new or unique to our region. Markets throughout the United States have experienced these transformations since the mid-1990's. These transformations are predictable and anticipated to occur in the Pacific Northwest over the next ten years.

Grant PUD must be mindful of these evolving markets when it produces its Integrated Resource Plan. This is especially true as the number of utilities making the transition from the old market structure to the new one grows. Some of Grant PUD's key neighbors who have joined the EIM include Portland General Electric, Puget Sound Energy, Pacificorp, Seattle City Light and Idaho Power. Avista, Tacoma Power and BPA are slated to enter the EIM in 2022. It's only a matter of time before those who are members of such markets become economically distinct from those who have not made the transition.

Environmental/Legislative Risk

Grant PUD faces significant uncertainty regarding the magnitude and cost of carbon-related legislative action. Washington State has passed significant legislation to reduce the carbon release related to electric generation. While the rule making for the Clean Energy Transformation Act (CETA) is still being established and won't be fully understood for several months, this law aims to eliminate the use of coal-sourced generation by 2025 with the ultimate goal of carbon neutral generation by 2030 and greenhouse gas emission free generation by 2045. CETA is seen as a significant accomplishment for advocates of greenhouse gas reduction. This type of legislation concerning the environment and electric generation is expected to continue in the foreseeable future.

Load Risk

More than half of Grant PUD's demand (or load) is attributable to its industrial customers. These customers face the same kind of financial constraints and efficiency needs that all businesses face – including Grant County PUD. Consequently, they tend to be very sensitive to the price of their critical inputs which often include the energy we supply. Specific District customers such as data centers, chemical producers, and agriculture processors are particularly sensitive to rates. Competitive rates can attract significant growth in industrial load over a very short time period. This makes this customer class the highest load risk we face.

Additionally, temperatures are highly variable. Extremely hot summers can easily follow extremely cold winters. Such temperature fluctuations can cause unexpected high loads due to demand for cooling or heating.

Water Risk (and operational risk)

Grant PUD's hydro project's ability to produce power is highly dependent upon the quantity of water available in any particular year. While the entire Columbia River benefits from the extensive water regulation provided by US and Canadian entities, Grant PUD is exposed to significant annual and monthly variability in the amount of power it expects to have to serve its load. Grant PUD's current hedging strategy of selling slices of the Priest Rapids Project resource with quantity-certain physical power buyback provisions has been successful in managing annual variability.

Fuel Risk

Grant PUD anticipates the possibility of using thermal generation to meet future capacity requirements. Consequently, this exposes Grant PUD to the variability in the cost of natural gas. Fortunately, the demand for natural gas has not been stronger than our national supply for many years and is not expected to do so for many years to come. This risk can be managed with standard hedging techniques.

Transmission Risk

Market and environmental changes are also driving a significant change in how the WECC transmission grid is expected to operate. Investment in renewable generation like wind and solar capacity will require significant investments in transmission to reduce the inevitable congestion created by the power delivered by these new resources. This effect has been seen in many regional RTOs/ISOs such as the Midwest Independent System Operator, the Southwest Power Pool, and the Electric Reliability Council of Texas. Central and Eastern Washington are being considered by many renewable developers as prime sites for additional renewable generation development. Grant PUD is currently evaluating several requests for large solar project interconnections to our system.

NORTHWEST POWER AND CONSERVATION COUNCIL SEVENTH POWER PLAN

Grant PUD has based many of its assumptions on the Northwest Power and Conservation Council ("NWPCC") Seventh Power Plan. The NWPCC prepares regular assessments of the regional power supply situation and projects an aggregated load resource balance into the future. This assessment includes detailed modeling of the Pacific Northwest resource mix, detailed information regarding the cost of different supply-side resource technologies, and cost-effective conservation.

In February of 2016, the Council published their Seventh Power Plan. Regional utility and other energy industry staff assisted the NWPCC in the preparation of the plan and Grant PUD staff have reviewed the findings. The Council published a Seventh Power Plan Midterm Assessment in February of 2019. Of interest to this IRP planning process are the following information and findings:

Announced Coal Generation Retirement

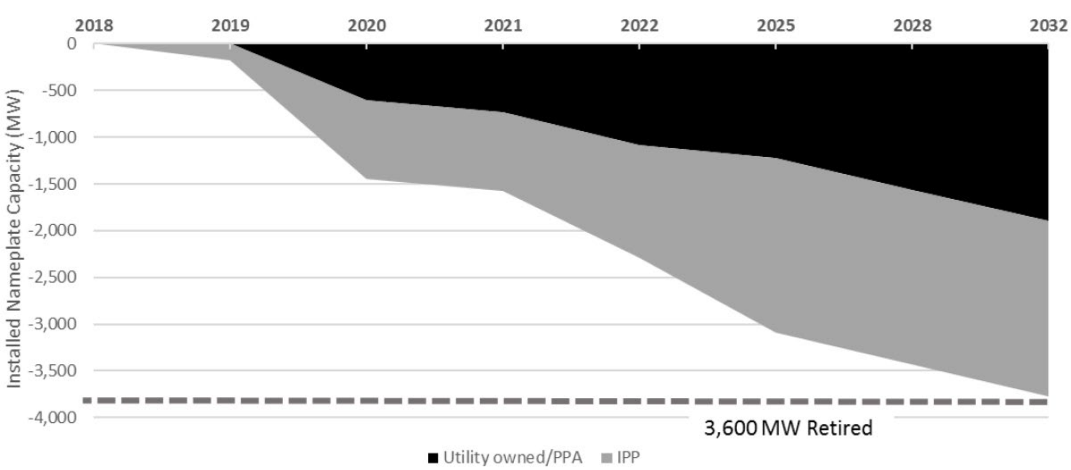
The Midterm Assessment updated the amount of coal generation capacity that is slated for retirement over the next 12 years. The following tables from the Seventh Power Plan Midterm Assessment give the specifics of these planned retirements.

Table 6-5 | Announced Planned Coal Retirements in the Pacific Northwest*

Plant	Retirement Date	Capacity & Operating Year	Location	Ownership
J.E. Corette	2015	173 MW (1968)	MT	PPL Montana
Hardin	2018	116 MW (2006)	MT	Rocky Mountain Power[1]
North Valmy 1 North Valmy 2	2021[2] 2025	254 MW (1981) 268 MW (1985)	NV	Idaho Power, Sierra Pacific Power (50/50)
Boardman	2020	600 MW (1980)	OR	Portland General Electric, Idaho Power (90/10)
Centralia 1 Centralia 2	2020 2025	670 MW (1971) 670 MW (1971)	WA	TransAlta
Colstrip 1 Colstrip 2	2022	360 MW (1975) 360 MW (1976)	MT	Puget Sound Energy, Talen Energy (50/50)
Jim Bridger 1 Jim Bridger 2[3]	2028 2032	578 MW (1974) 578 MW (1975)	WY	PacifiCorp (2/3)[4], Idaho Power (1/3)
Regional Utility Total		**1,899 MW**		
Regional Total (incl. IPPs)		**3,772 MW**		

[1] Not related to PacifiCorp
[2] Idaho Power will end its participation in 2019, NV Energy to retire unit end of year 2021 per 2019 IRP
[3] Per PacifiCorp's 2017 IRP Update
[4] Regional total includes only PacifiCorp's load to the region (38%)
*For detailed project information, please see the Council's generating resources project database

Figure 6-2 | Total Regional Utility + Independent Power Producer Coal Retirements



*Note: J.E. Corette is not included in this figure because it retired in 2015. This figure shows 2018-2032.

Table 6-6 | Net Balance of Coal Retirements and Anticipated New Capacity Additions In MW

All numbers in units of MW	2018-2020	2021-2025	2026-2030	2031-2037	Cumulative 2018-2037
Anticipated Additions	17	379	1,237	2,155	**3,788**
Anticipated Coal Retirements (prorated to reflect % serving Northwest)	(1,270)	(981)	(1,010)	(339)	**(3,600)**
Net Balance Over Period	(1,253)	(602)	227	1,816	**188**
Cumulative balance	(1,253)	(1,855)	(1,628)	188	

The Midterm Assessment indicates that the net planned reduction in generation in the West is 1,628 MW of capacity by 2030. This reduction in baseline generation will play a key role in planning for firm capacity and dealing with Resource Adequacy issues in the WECC.

[1] NWPCC Seventh Power Plan Midterm Assessment page 6-10 Table 6-5

2 NWPCC Seventh Power Plan Midterm Assessment page 6-11 Figure 6-2

3 NWPCC Seventh Power Plan Midterm Assessment page 6-11 Table 6-6

RESOURCE ADEQUACY IN THE NORTHWEST

The Pacific Northwest's bulk electricity system is in transition. Historically it has been one of the least capacity constrained regions of the electric grid due to the predominant use of hydro-electric generating resources, which produced a system rich in generating capacity and flexibility, but subject to energy shortages in years with low precipitation and snowpack. As the region has added increasing amounts of renewable resources and as the hydro-electric system flexibility has declined, the region finds itself transitioning into a peak-constrained system. The industry has been working to better define appropriate resource adequacy standards during this time of transition and to better understand how individual utilities should plan and apply those standards. There is currently no formal approach to regional capacity planning in the Northwest today. Most NW utilities conduct their own reliability studies that often use very different planning methods and metrics. This lack of a centralized set of planning methods and metrics makes it difficult for anyone to know if there are enough resources (generation) to serve load under stressful grid situations such as extreme heat or cold weather. In 2019, some of the Northwest Power Pool (NWPP) entities began an effort to start a voluntary NW Resource Adequacy (RA) program. The RA program would set regional standards for planning methods and metrics, provide load and resource diversity savings, and establish a robust procurement process.

Although the design of the RA program is in its early stages, it will be structured similar to other regional RA programs and run by an organized market administrator. The program is expected to have a forward-showing period in which participating entities would need to prove they meet established regional metrics that ensure reliability. Penalties would then be assessed if these metrics could not be proved. The program would also have an operational component that would unlock the load and resource diversity benefits in times of stress across the NW.

There are many challenges that still need to be overcome for establishing a RA program unique to the NW: the lack of an organized market administrator, the large number of public utilities, the large amount of hydropower and the size and role of BPA. Grant is currently participating in the design of this market and using this effort to better understand and design its RA needs as it looks towards the next ten years.

Grant PUD is also implementing a 15% power planning margin as it models Grant's specific resource requirements. This planning margin is designed to cover most prolonged resource outages, variations in weather, water for generation, economics, and general load growth.

EMERGING CARBON AND ENERGY POLICIES

Clean Energy Standard and State RPS

On May 7, 2019, Washington Governor Jay Inslee signed into law the Clean Energy Transformation Act (CETA) (E2SSB 5116 or RCW 19.405), which commits Washington to 100% greenhouse gas free electricity supply by 2045. By the end of 2025, utilities must eliminate coal-fired electricity from their state portfolios. In 2030, electric generation must be greenhouse gas neutral. To meet this goal, utilities can use a combination of non-emitting resources and renewable resources to meet 80% of their retail load over a 4-year compliance period beginning in 2030 and alternative compliance options, such as renewable energy credits (RECS) or energy transformation projects, for the remaining 20%.

Existing hydropower and incremental hydropower eligible for the state renewable portfolio standard (RPS or Energy Independence Act) are both considered a form of renewable resource under CETA. Under the state RPS, beginning in 2020, 15% of the utility's retail load must be served with renewable energy resources and actions taken under the state RPS count toward the obligations under CETA. CETA also amends the state RPS to allow incremental efficiency increases at federal hydropower projects to count as an eligible renewable resource. By 2045, CETA requires utilities to supply Washington customers with 100% renewable or non-emitting electricity. Currently, there are no penalty provisions in the event a utility does not meet the 100% clean energy obligation. There are some cost-cap provisions and regulatory relief related to electric reliability standards and transmission availability.

CETA also expands the IRP planning process to include a social cost of greenhouse gas emissions as a cost adder and a 10-year Clean Energy Action Plan for implementing CETA's clean energy goals at the lowest reasonable cost and at an acceptable resource adequacy standard. In 2022, each utility must also publish a clean energy implementation plan with targets for energy efficiency and renewable energy. There are also obligations to provide energy assistance to low income customers and obligations to provide an equitable distribution of energy and non-energy benefits under CETA. Each of the plans require Grant PUD Commission approval.

While there will be compliance and reporting requirements, Grant PUD is well-positioned to achieve CETA's requirements due to its non-emitting portfolio of hydropower and wind generation. In addition, CETA has the potential to improve the market value of Grant's hydropower portfolio as demand increases for non-emitting and renewable resources to serve load, integrate increasing amounts of variable energy resources like wind and solar, and provide grid reliability. Grant PUD will continue to be attentive to the need to value these additional services that hydropower provides beyond just the energy. This IRP is intended to assess Grant PUD's resource options to meet its retail load within regulatory constraints at the lowest cost.

The Washington State Department of Commerce, the Washington Utilities and Transportation Commission, and the Washington Department of Ecology have begun developing rules to implement CETA. Moderate risk is inherent in the rulemaking process which may affect the extent to which CETA fully accommodates hydropower in compliance accounting. Grant PUD is actively participating in the rulemaking process to ensure that implemented rules appropriately accommodate hydropower.

Clean Air Rule

In 2008, the Washington State Legislature passed, and the governor signed, legislation requiring reductions in GHG, initiating GHG reporting requirements, and requiring the Department of Ecology to make recommendations for the development of a market-based cap and trade system (RCW 70.235). In 2016, the Washington State Department of Ecology adopted the Clean Air Rule (WAC 173-442), which addressed the major sources of greenhouse gases, including certain electric generators and fuel suppliers in Washington and required businesses that are responsible for large amounts of greenhouse gas emissions to cap and reduce their carbon emissions. Grant PUD is not a covered entity under the rule. However, implementation of the law affects the electric sector and potential demand for clean electricity in Washington State. A few large industrial customers in Grant County could be affected.

In March 2018, Thurston County Superior Court ruled that parts of the Clean Air Rule were invalid. The Superior Court's ruling prevented Ecology from implementing the Clean Air Rule regulations. On January 16, 2020, the Washington State Supreme Court ruled that the portions of the rule that applied to stationary sources were upheld, but that the portions that applied to indirect sources, such as natural gas distributors and fuel suppliers (representing the majority of emissions), were invalid. The Supreme Court remanded the case to Thurston County Superior Court to determine how to separate the rule. As the court deliberates, Ecology is considering whether and how to implement the much narrower rule.

The Court's ruling has also spurred legislative activity to give Ecology authority over indirect emissions and other GHG reduction strategies. In addition to a fix to the Clean Air Rule, activity in the legislature in 2020 included deeper cuts in statewide greenhouse gas emissions by 2020, 2030 and 2050, a carbon cap and invest bill, a community solar bill, a low carbon fuel standards bill and a bill requiring a report on resource adequacy in 2022. Although bills concerning carbon cap and invest, low carbon fuel standards, and Clean Air Rule fix didn't pass in the Washington State legislature this year, similar bills could surface next year. Grant PUD will continue to monitor all legislative activity related to GHG reductions and clean energy requirements for potential effects on operations and market position.

Climate Change

Grant PUD is aware of scientific information regarding climate change which may result from greenhouse gas emissions and accumulations and from other factors. To the extent that regional warming increases the average temperature in the watershed that feeds the Columbia River, such warming could result in earlier run-off into the Columbia River and/or more winter precipitation and less snowpack in the mountains in the winter months. These changes could affect the timing and/or amount of power generation at Grant PUD's hydro-electric projects. Grant PUD continues to monitor and assess the impacts of possible climate change on its operations. Impacts with a medium to high likelihood of occurring within the next 10 years have been integrated into Grant PUD's risk management program. Among the risks evaluated were increased ambient air temperature implications for electric load, possible implications for fish associated with changing river temperatures, precipitation and snowpack effects on generation, potential extreme weather and wildfire events, and water availability. Grant PUD continues to review and update these risks. However, Grant PUD is unable to predict whether any such climate changes will occur, the nature or extent thereof, and beyond those risks identified, the effects they might have on Grant PUD's business operations and financial condition.

State, regional and national policymakers are debating how to manage and mitigate for greenhouse gas emissions from many sectors of the economy, including electric generation. Grant PUD's two primary hydroelectric generating facilities provide low-cost, clean, renewable power that does not generate greenhouse gas emissions. As an electric generator that relies on emission-free hydropower to serve its retail load plus provide energy to thousands of other Northwest customers, Grant PUD has a significant interest in the role that hydropower plays in climate change policy. District management and staff will continue to monitor the latest regional and federal policy proposals.

3 | Wholesale Energy Market

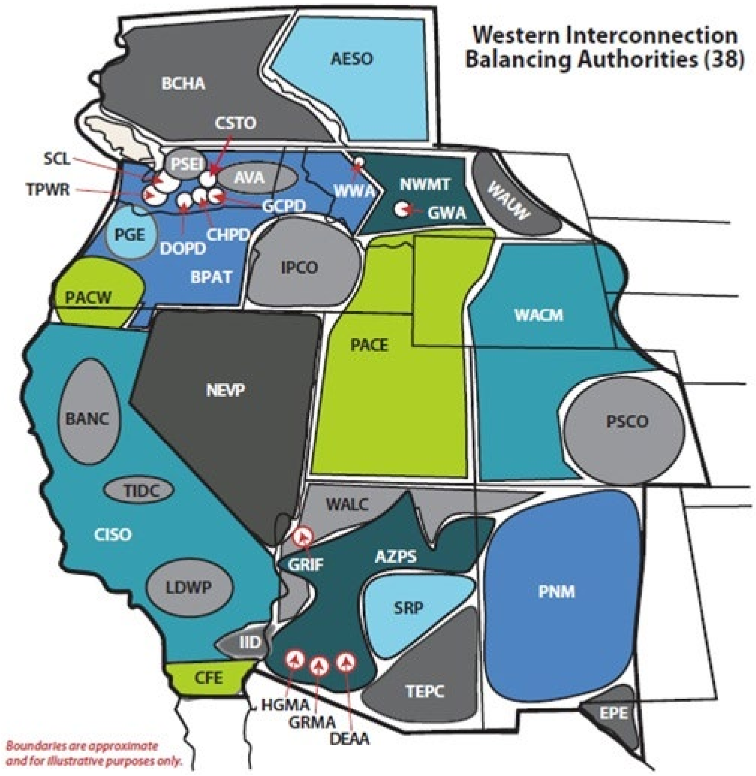
Grant PUD provides reliable power to a diverse set of residential, commercial and industrial consumers. To accomplish this, it needs to use a combination of its own generation capacity and contracts for power from other wholesale market sources. Flexibility is important as customers' needs change from year to year, month to month, day to day, and even moment to moment. Grant PUD does this basically on its own through wholesale energy markets. This is done through portfolio planning down to the hourly level, and by making dynamic adjustments as necessary to cover its load obligations on a moment to moment basis. A robust and liquid wholesale energy market is vital to meeting Grant PUD's energy needs. Grant PUD currently operates within the Western Electric Coordinating Council (WECC). Within the WECC, there are numerous bilateral trading hubs such as the Mid-Columbia (Mid-C), SP15, NP15, COB, and Palo Verde. Grant PUD currently relies heavily on these markets with specific concentration at the Mid-C. There are two other organized markets operating in WECC that Grant PUD does not currently participate in: the California Independent System Operator (CAISO) and the CAISO Western Energy Imbalance Market (EIM). In addition, the CAISO is working on an initiative that will extend participation in the day-ahead market to the EIM entities in a framework similar to the existing EIM approach for the real-time market. This participation would not require full integration into the California ISO Balancing Area (BA). This initiative is called the Extended Day-Ahead Market (EDAM). Grant PUD is monitoring the continued growth in EIM participation by other WECC BAs. At this time, Grant does not believe participation in the EIM or EDAM would provide net benefits to Grant PUD customers, in part due to requisite investments in accounting, metering, and personnel. Grant will continue to evaluate and prepare for the opportunities and risks these evolving markets present.

WECC

In the western electrical interconnection of the United States there are dozens of individual utilities and operating companies that are linked together by transmission lines collectively called the Western Interconnection (see Figure 3-1). The transmission lines allow these utilities to buy and sell power between themselves via several "markets" effectively overlaid upon the grid. Examples of these include the energy, ancillary, and green-attribute markets which separate markets into their primary product offerings. Markets are defined by the relevant time periods under which power is being traded (i.e. real-time/hourly, day-ahead, and long-term) and by the contractual terms and market organizational structures by which these transactions occur (i.e. energy imbalance markets, two-settlement markets, and bilateral markets).

In all cases, these markets are unified by their ability to facilitate the buying and selling of specific amounts of electricity and its attributes for specific periods of time in an organized manner. The benefit of using such markets is that they allow for price discovery as buyers and sellers of power meet to transact clearly defined products for defined time periods at the lowest possible transaction price. As one market evolves, it is often at the detriment to existing markets. This may prove to be the case in our region. The evolution of a new market may cause Grant PUD's participation in a previous preferred market to become less economically viable. However, Grant PUD is aware that the costs of joining a specific market may be higher than the achievable benefits. It is also aware that joining such markets may still be the least-cost alternative. Grant PUD plans to study the relative cost/benefit of joining any of the developing markets.

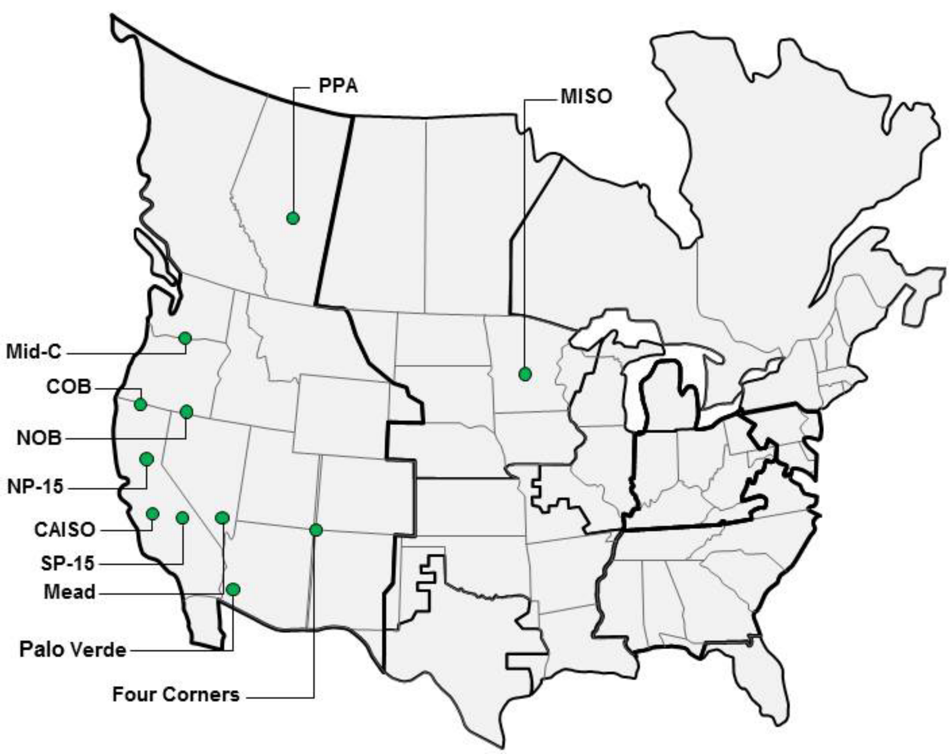
Figure 3-1 | WECC Balancing Authorities



Mid-Columbia

Grant PUD benefits from being interconnected with the transmission facilities comprising the main Pacific Northwest energy trading hub – the Mid-C (Figure 3-2). The Mid-C is one of the most liquid trading hubs in North America and provides Grant PUD with ready access to market energy, both for sales and purchases, as well as market price discovery. Grant PUD's information on forward market prices comes from a variety of sources. The Intercontinental Exchange (ICE) provides a clear forward market indication for both peak and off-peak energy for a ten-year period. In addition to ICE forward prices, the Northwest Power and Conservation Council (NWPCC) provides a forecast of fundamental future markets using the AURORA model and several energy inputs. By controlling inputs, the NWPCC can evaluate the potential impact of different future scenarios, such as changes in fuel prices, changes in supply and demand, and transmission grid constraints.

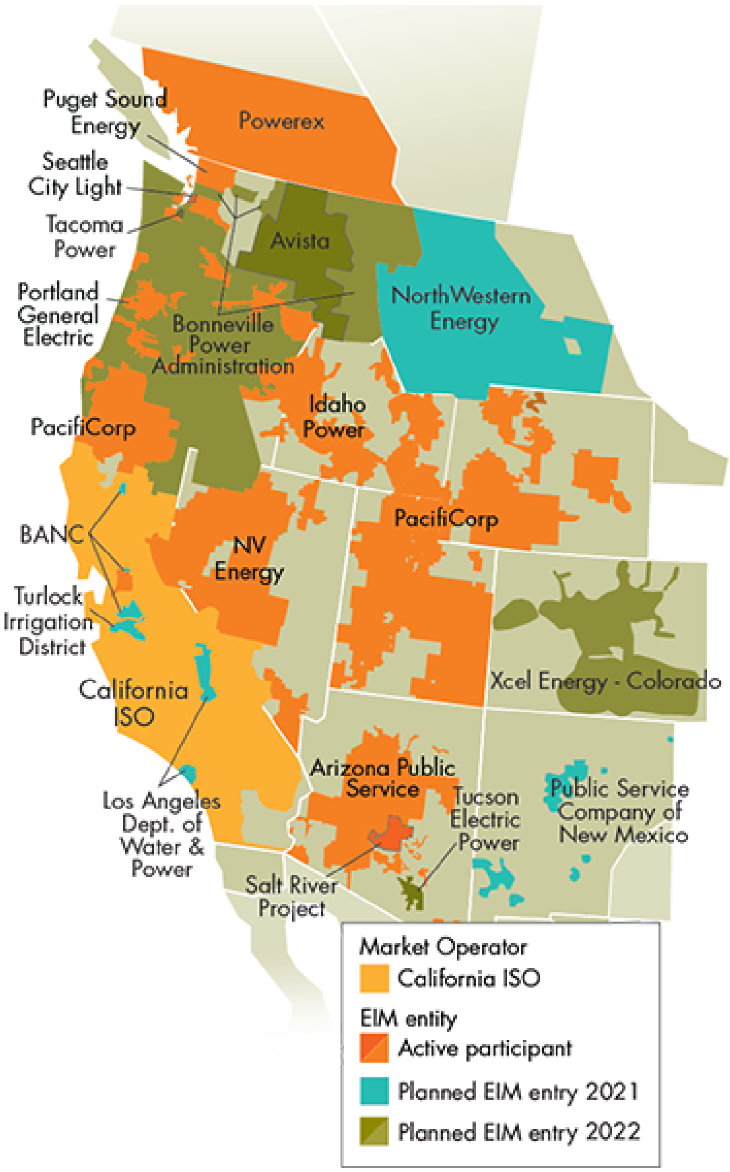
Figure 3-2 | WECC Trading Hubs



Energy Imbalance Market (EIM)

The CAISO Energy Imbalance Market (EIM) is a real-time voluntary energy market in the WECC. Since its launch in 2014, it has grown from its original two participants (CAISO and PacifiCorp) to eleven as of 2020. In addition, ten more participants are planning on joining by 2022 (Figure 3-3).

Figure 3-3 | CAISO EIM Participants



Unlike the hourly real-time markets in the WECC, the EIM has introduced a more efficient option of trading between utilities for smaller amounts of power in shorter time increments (5 or 15 minutes) just for the purposes of balancing. This shorter timeframe allows a utility that might use an expansive solution to balance its own load to buy its needs from another utility who is selling its power for the next 5 to 15 minutes via the EIM. This balancing of load is done by a central model with the objective to find the most efficient and least cost method within transmission constraints.
Grant PUD could potentially gain from participating in an effective EIM with its own competitively priced hydro generation capacity, desirable green attributes, and the ability to store energy as water in our reservoirs.

There are three primary ways Grant PUD may benefit financially from participating in the EIM:

1. It can reduce its balancing costs, by buying from the market whenever it is cheaper than supplying its own needs.

2. It can reduce its transactions costs by taking advantage of economies of scale offered by a single centrally organized and independently managed marketplace.

3. It can benefit from better use of existing regional transmission, allowing access to markets as distant as Southern California and Nevada – a region awash with cheap solar generation.

Staff is currently looking to engage an industry consultant with EIM experience to help evaluate what is requisite for Grant PUD to enter the EIM in the next five years. This includes possible upgrades to systems and meters as well as resource needs. This work is scheduled to be performed in the second half of 2020.

Extended Day Ahead Markets (EDAM)

The CAISO is also proposing an initiative that extends one variant of a fully organized market design to current EIM utilities in WECC called the Extended Day Ahead Market (EDAM). This market, like the EIM, will be voluntary in nature and will give those who are interested a chance to gain more of the benefits of an organized RTO/ISO without the risk of joining CAISO. EDAM would layer additional market services on top of the EIM. Some of these benefits include more efficient day-ahead hourly trading, more efficient day-ahead generator commitment, diversity of imbalance reserves and the potential environmental benefit of reducing renewable curtailments.

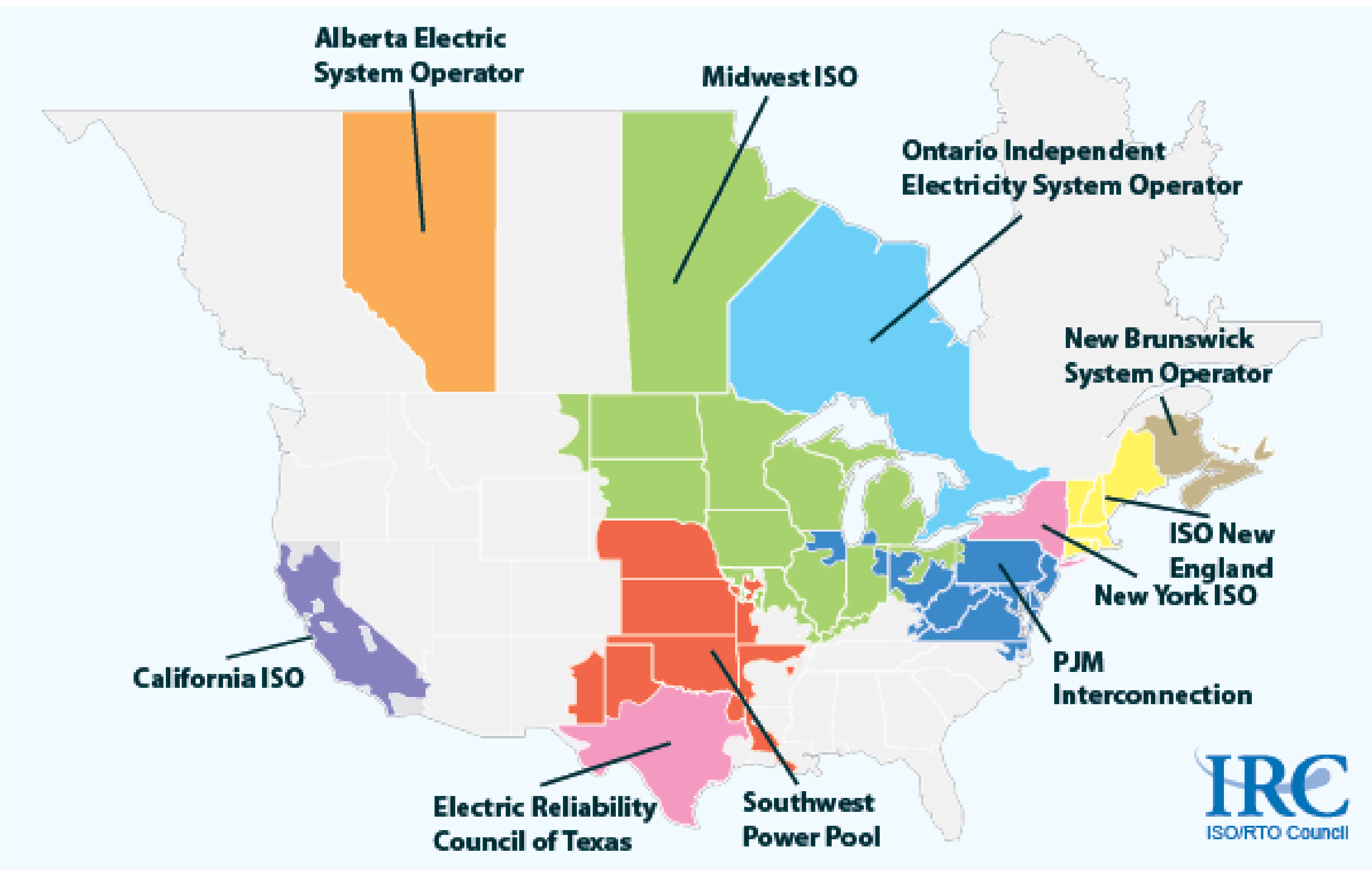
As mentioned previously, EDAM is not equivalent to becoming a full member of an ISO or RTO. EDAM participants will still be responsible for transmission planning and operational control, resource adequacy and planning, and balancing area control performance compliance.

Grant staff is actively monitoring the development of EDAM, with attention being paid to how it may affect Grant PUD and the Pacific Northwest energy markets, especially liquidity in the Mid-C day-ahead trading hub.

Further Development of Pacific Northwest Markets

The Pacific Northwest energy markets are expected to continue to move towards an organized market over the next ten years. With the continued development of renewable generation and the need to integrate these variable energy resources (VER), a move towards an organized market (ISO/RTO) is likely. Organized markets currently supply energy to most of the United States grid (Figure 3-4). Organized markets have many advantages such as facilitating competition among wholesale suppliers, providing non-discriminatory access to transmission by scheduling and monitoring the use of transmission, performing planning and operations of the grid to ensure its reliability, managing the interconnection of new resources, providing market oversight, and increasing the transparency of transactions on the system. Additionally, organized regional markets such as the PJM Interconnection regional transmission market, the Midcontinent Independent System Operator (MISO) market, and Southwest Power Pool (SPP) market have shown that renewable integration challenges are effectively and efficiently addressed in larger and more coordinated footprints. Grant PUD will continue to monitor the expansion of the EIM, EDAM and the possibility of a fully organized market. There are often winners and losers in any newly organized market, and Grant's assets may or may not be more valuable in an RTO/ISO. Grant will continue to invest time and energy to analyze the evolving markets to determine the best strategy for its rate payers.

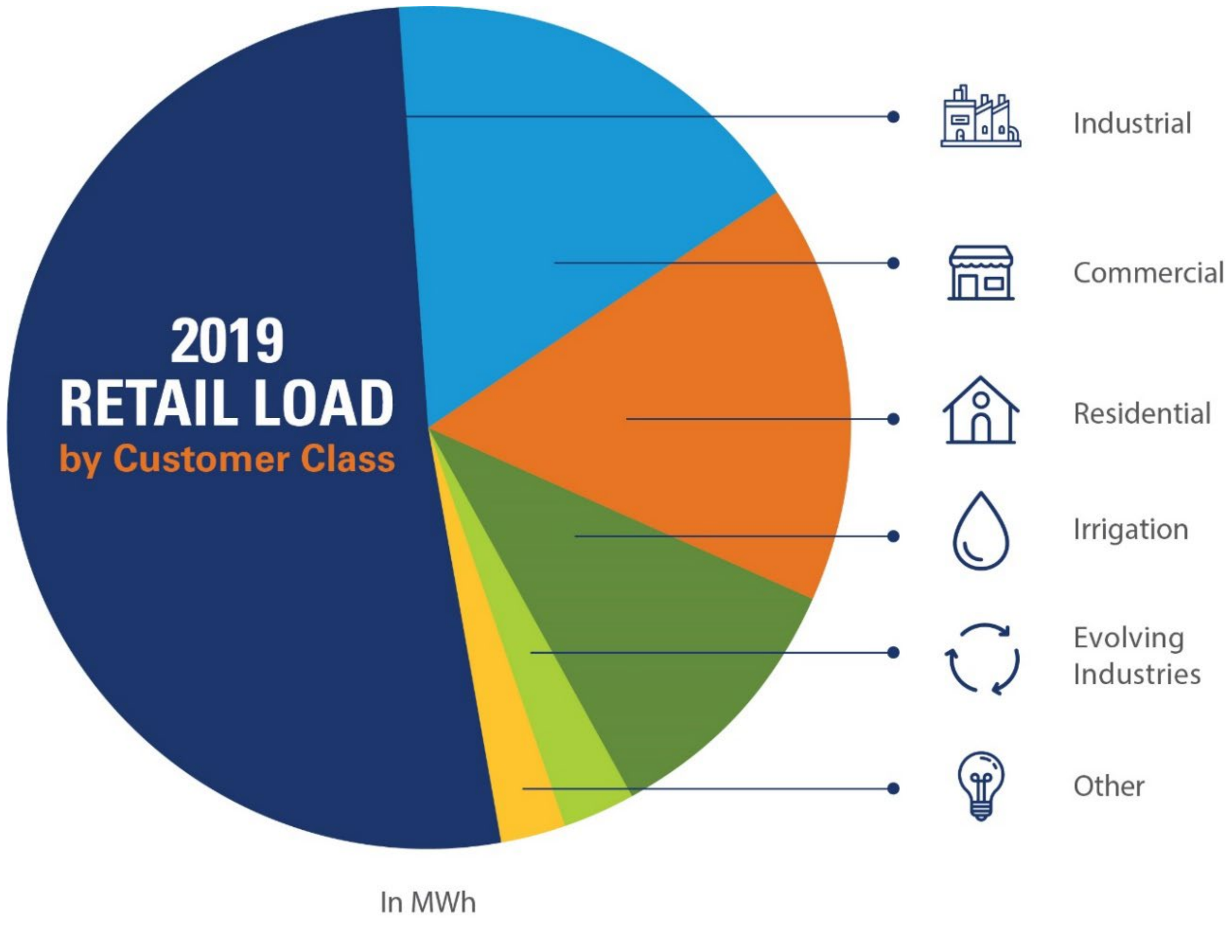
Figure 3-4 | Organized Markets (RTO/ISO) in North America



4 | Energy Load Forecast

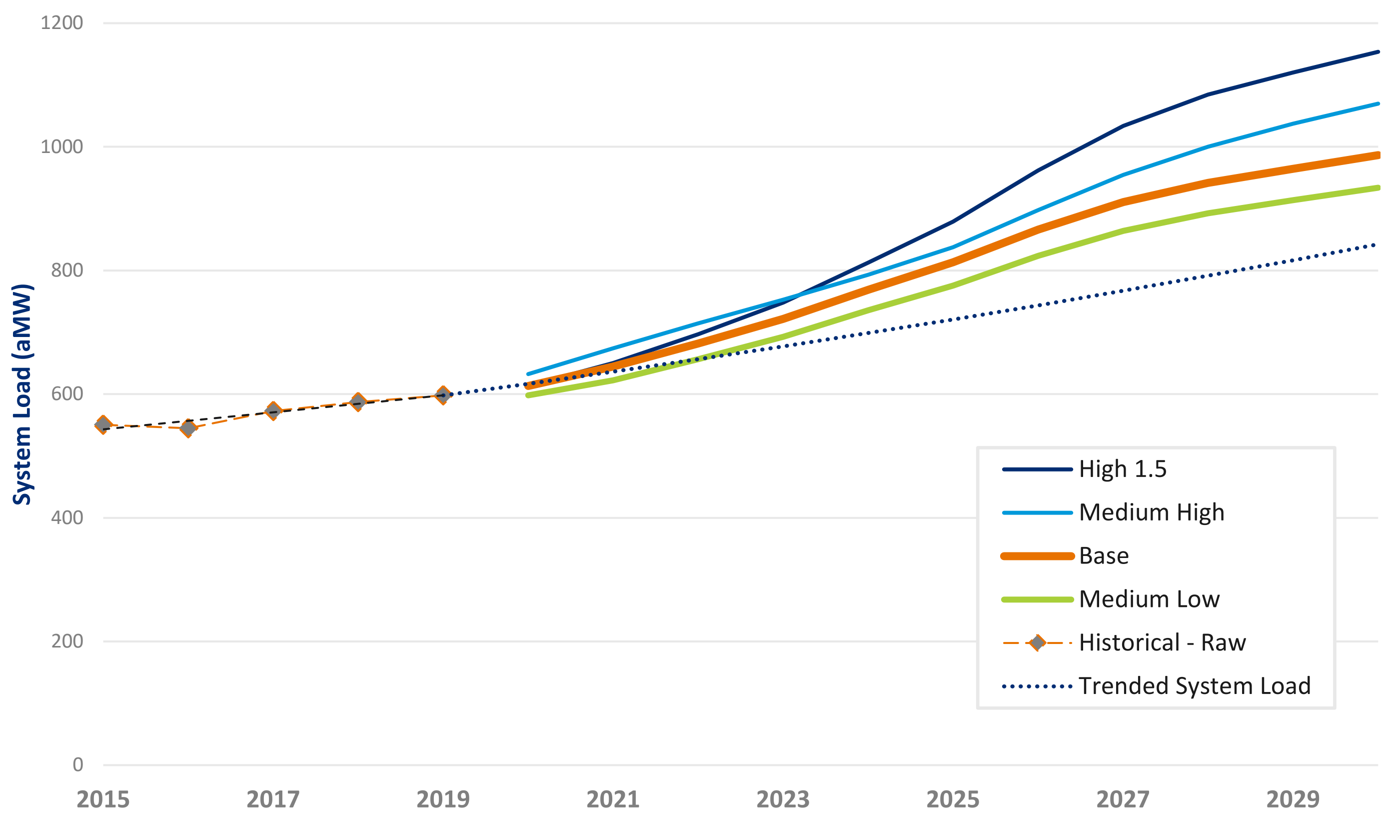
Grant PUD maintains a detailed projection of anticipated load consumption by Grant PUD's retail customers ("Retail Load"). It is helpful to review past Retail Loads to put forecast Retail Loads into context. Grant PUD's 2019 sales to retail customers was 5,163,877 MWh or 589 aMW. 2019 retail sales exceeded prior year sales by 5.3%. The 2019 sales were made to the following customer classes (Chart 4-1).

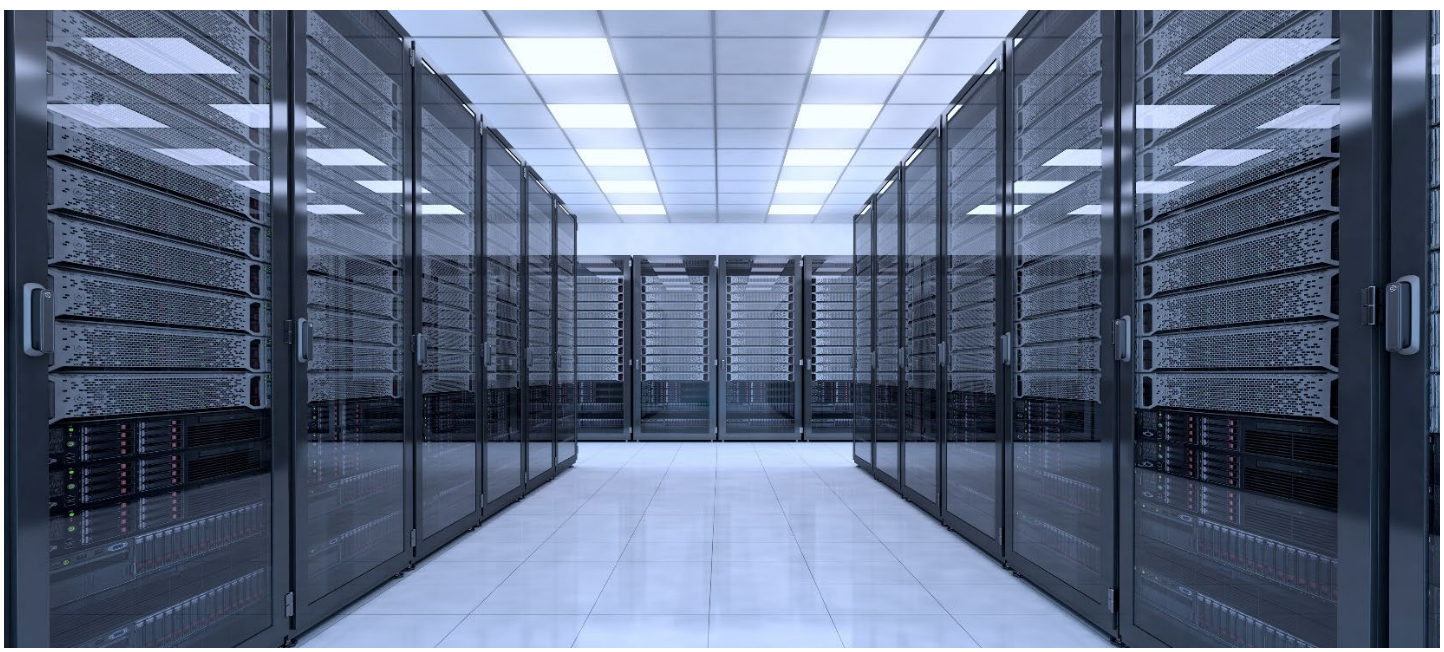
Chart 4-1



Grant's "Base" forecast is deemed to have the highest probability of realization. All other forecasts are modeled to help the PUD plan for other possible outcomes. These forecasts are depicted on Graph 4-2. The "Trended System Load" line give the reader a view of how much the forecasted loads exceed the historical growth experienced by the PUD over the past few years.

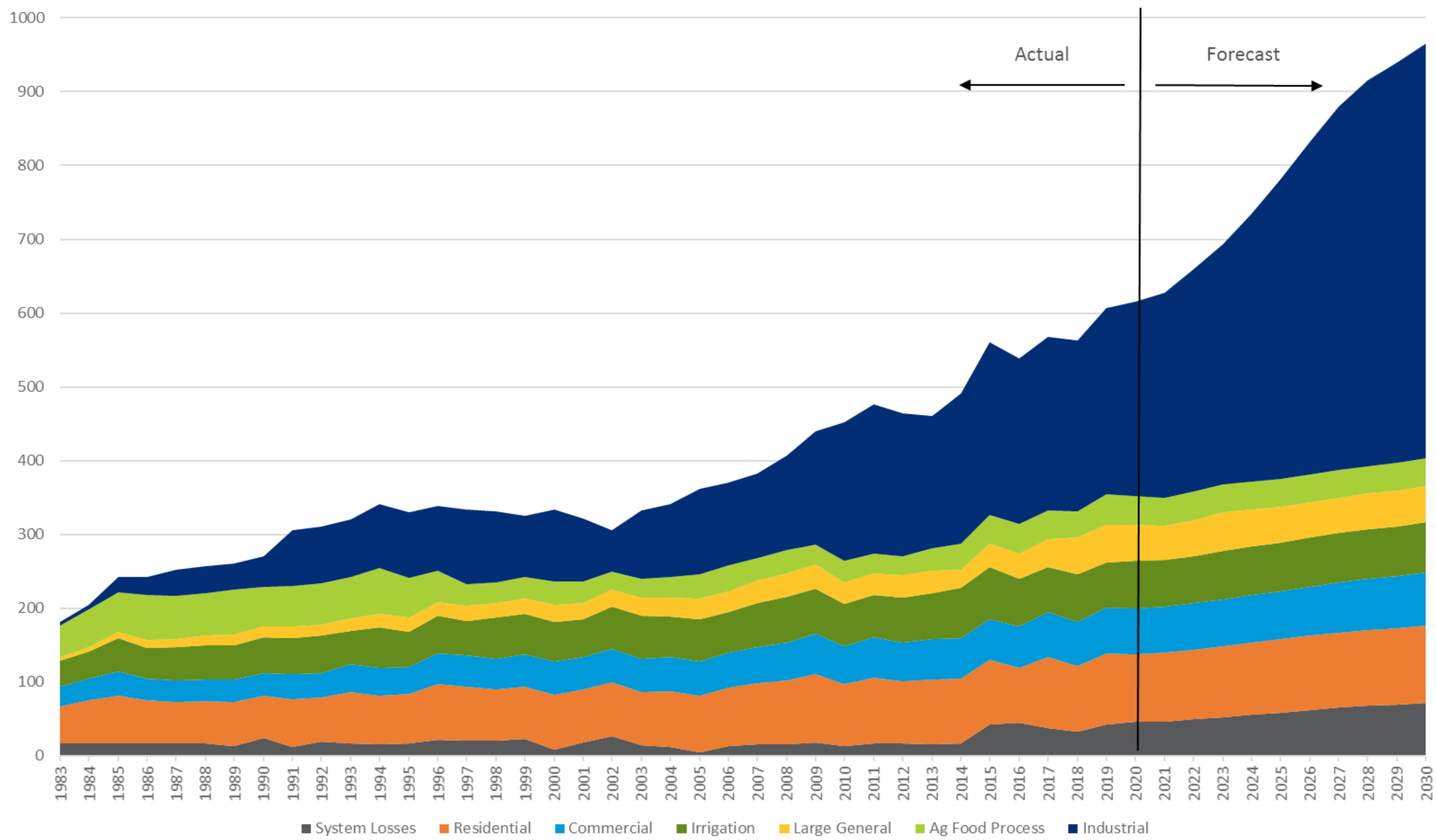
Graph 4-2 | Annual System Load – Historical and Forecasted
District Load Forecast: April 2020





Grant PUD’s Retail Load is increasingly influenced by a handful of large industrial customers. Grant PUD also has a significant irrigation load. The irrigation load means that Grant PUD’s summer and winter peak loads are comparable despite being a northern utility with cold winters. Grant PUD’s relatively low retail rates have resulted in significant growth in the industrial customer sector that is projected to continue into the future. Growth of industrial load introduces a challenge in terms of forecasting future need. Grant PUD’s base load forecast by customer class is shown in Graph 4-3.

Graph 4-3 | Grant PUD 2020 Medium Load Forecast Retail Sales
(Base/Medium Load Forecast)



Load forecasts are based upon our customers’ expected demand for energy assuming normal weather. Hotter or colder than normal temperatures will cause actual load to vary over time. Grant PUD’s 15% planning margin is used in part as a buffer to ensure our customers’ loads will be met regardless of these variances.

From 2009-2019, Grant’s load has experienced an average annual growth rate of 3.1%. Grant PUD’s Base forecast has an average annual growth rate of 4.9% through 2030. The medium forecast is Grant PUD's expected forecast estimated through econometric models and input from industrial customers. The Medium High forecast adjusts the official forecast by changing the standard forecasting error from 50 percentile to 95 percentile and delaying certain customer load increases, but not decreasing the original forecast projection. The High forecast adjusts the original forecast by increasing the growth rate for non-industrial and industrial customers by 25%. The Medium Low forecast adjusts the original forecast by reducing data center load by one average data center load.

5 | Conservation and Efficiency Resources

Grant PUD conducted a Conservation Potential Assessment (CPA) in 2019 to estimate the conservation potential for the coming 20 years. Grant PUD has historically been able to meet the targets set for conservation. Due to the current wholesale market rates and concern of rate increases for our customers, Grant PUD has focused the conservation efforts on the industrial customers. Grant PUD continues to offer several rebate programs for residential and non-residential applications. The full CPA has been attached as an appendix to this document so that the analysis and methodology are clearly provided (Appendix 2).

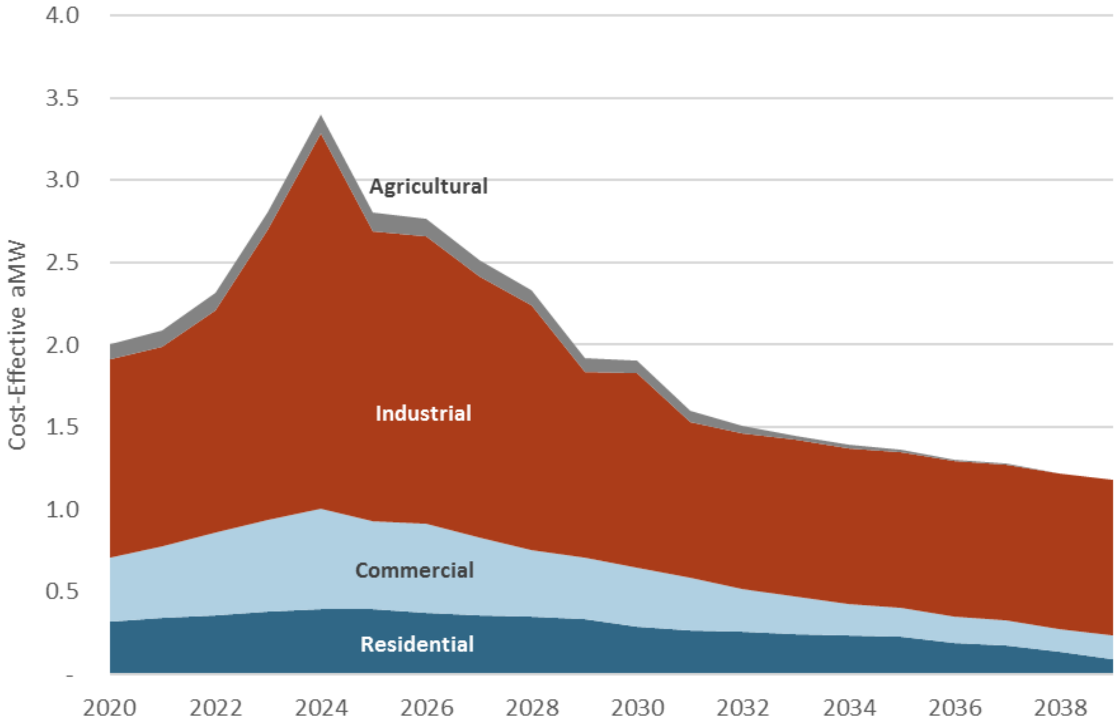
The conservation potential analysis evaluated four sectors including: residential, commercial, industrial, and agricultural. The industrial sector is where Grant PUD receives the greatest gains by installing more energy efficient cooling and power supplies in data centers, converting to more efficient lighting, upgrading refrigeration storage, and performing cold storage equipment tune-ups and retrofits. The commercial sector represents the second greatest potential for conservation with lighting and HVAC upgrades.

The following table and chart are taken directly from the CPA to illustrate the base case of where the conservation potential is through 2039. For the high, low, or accelerated cases, please see Appendix 2 containing the CPA.

Table 5-1 | Cost Effective Potential - Base Case (aMW) | (District 2019 CPA)

	2-Year*	6-Year	10-Year	20-Year
Residential	0.66	2.18	3.59	5.71
Commercial	0.82	3.03	4.83	6.94
Industrial	2.42	9.58	15.53	25.23
Agricultural	0.19	.63	1.01	1.27
TOTAL	**4.09**	**15.42**	**24.96**	**39.15**

Graph 5-2 | District 2019 CPA



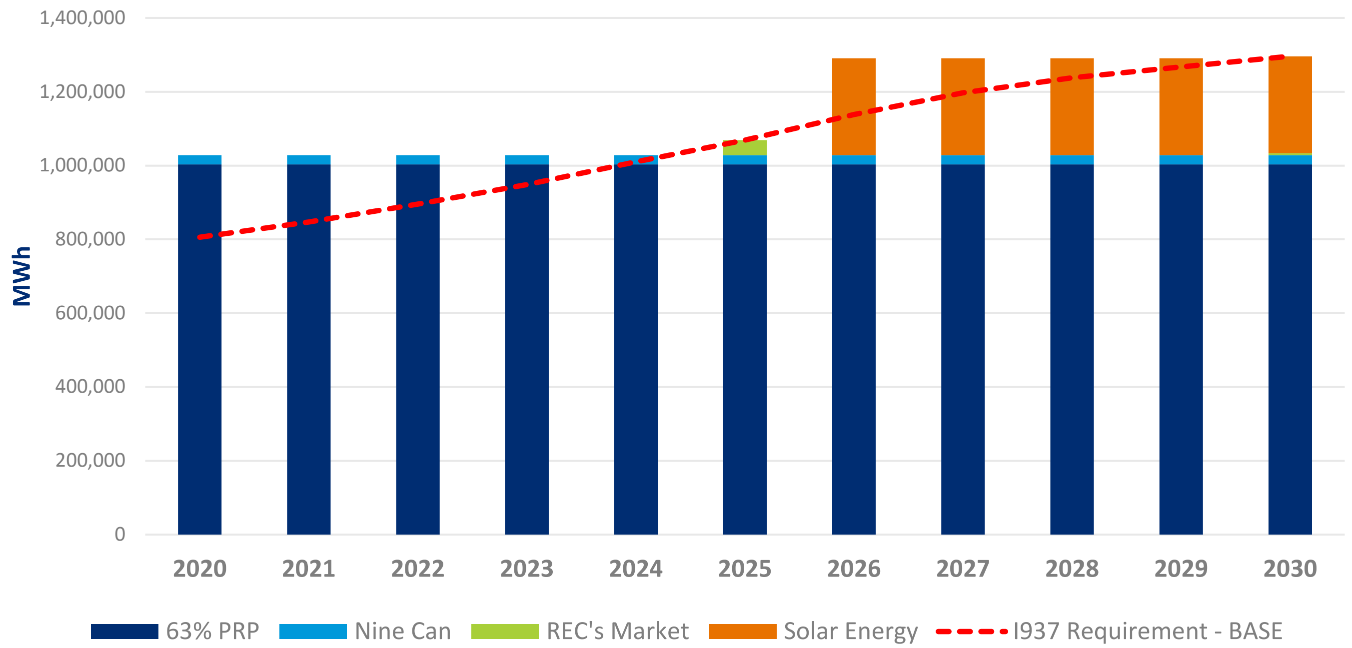
Grant PUD will use the information from the CPA as well as this IRP to pursue its cost-effective conservation targets. The savings to participating retail customers will accumulate for many years.

Washington State recently enacted several laws that impact conservation planning. SB 1257 establishes energy performance standards for large existing commercial buildings. HB 1444 establishes efficiency standards for lights and many appliances. SB 5116 puts forward a Clean Energy Transformation Act (CETA), which was discussed previously. As the IRP is being developed, final rule making is still being developed for many provisions in these laws and as such the full effect these laws will have on Grant PUD is uncertain. CETA sets values for the social cost of carbon and the requirement that all sales be greenhouse gas neutral beginning in 2030, thus increasing the avoided cost of energy efficiency measures. HB 1444, by enacting higher lighting and appliance standards, lowers Grant PUD's future conservation potential. As such, the provisions contained in these laws will be addressed further in the 2022 IRP when there is less uncertainty with regards to the specific implementation rules.

6 | Renewable Portfolio Standard (RPS)

Grant PUD will meet the Washington State RPS (I-937) through its current investment in renewable generating projects and future investment in new renewable capacity and/or Renewable Energy Credits (REC). Grant PUD's current sources include the Wanapum and Priest Rapids Top Spill Fish Bypasses, qualifying improvements made to Wanapum turbines and generators, and the purchase of a portion of the Nine Canyon Wind Project. Based on these investments in renewable generation and current load growth projections, Grant PUD is projected to meet the RPS requirements with existing resources until 2025 (Graph 6-1). In 2025 and beyond, Grant PUD is planning to acquire qualifying RECs and Solar to meet RPS requirements. The methods of acquiring these resources will be discussed in Section 9.

Graph 6-1 | I-937 Eligible Position – Base Case



7 | Existing Supply & Resources

Grant PUD currently meets its load and other energy obligations with a portfolio of supply resources anchored by Grant PUD's right to the output of Wanapum and Priest Rapids Hydroelectric Dams, collectively referred to as the Priest Rapids Project (PRP). Grant PUD augments the output of these facilities with contracts for Nine Canyon wind and two small irrigation projects (Quincy Chute and Potholes East Canal (PEC)). Grant PUD also receives power from the Bonneville Power Administration to meet the load in the Grand Coulee area of Grant County. Historically, this portfolio has provided a foundation for meeting Grant PUD's load in a cost-effective manner.

Significant attributes of Grant generation resources:

- Capacity: the maximum output of electricity that a generator can produce under ideal conditions. Capacity levels are normally determined as a result of performance tests and allow utilities to project the maximum electricity load that a generator can support. Capacity is generally measured in megawatts or kilowatts.

- Energy: the amount of electricity that is produced over a specific period of time. This is usually measured in kilowatt-hours, megawatt-hours, or terawatt-hours.

- Ancillary Services: the specialty services and functions provided by the electric grid that facilitate and support the continuous flow of electricity so that supply will continually meet demand. The term ancillary services is used to refer to a variety of operations beyond generation and transmission that are required to maintain grid stability and security. These services generally include frequency control, regulation, load following, energy imbalance, spinning reserves, operating reserves, scheduling, system control, and dispatch. Some of the highest quality ancillary services are provided by generators with large spinning turbines.

- Energy Storage: in hydro projects like PRP, storage is realized through the ability to store water in reservoirs to be run through turbines when the energy is desired.

- Carbon-Free Energy and Incremental Hydro Renewable Energy Credits: generators that are capable of producing carbon-free power will have an advantage over generators that release carbon whenever there is an explicit price on carbon. These carbon-free attributes can be monetized in the form of Renewable Energy Credits.

THE GENERATING RESOURCES AVAILABLE TO GRANT PUD TO MEET ITS OBLIGATIONS:

The Wanapum Development

The Wanapum Development consists of a dam and hydroelectric generating station with a nameplate rating of 1,204 MW. Located on the Columbia River in Grant and Kittitas Counties, about 160 air miles northeast of Portland, Oregon, 129 air miles southeast of Seattle, Washington, and 18 miles upstream of the Priest Rapids Development, the Wanapum Development includes certain switching, transmission and other facilities necessary to deliver electric output to the transmission networks of Grant PUD, Bonneville and certain other power purchasers.

The Priest Rapids Development

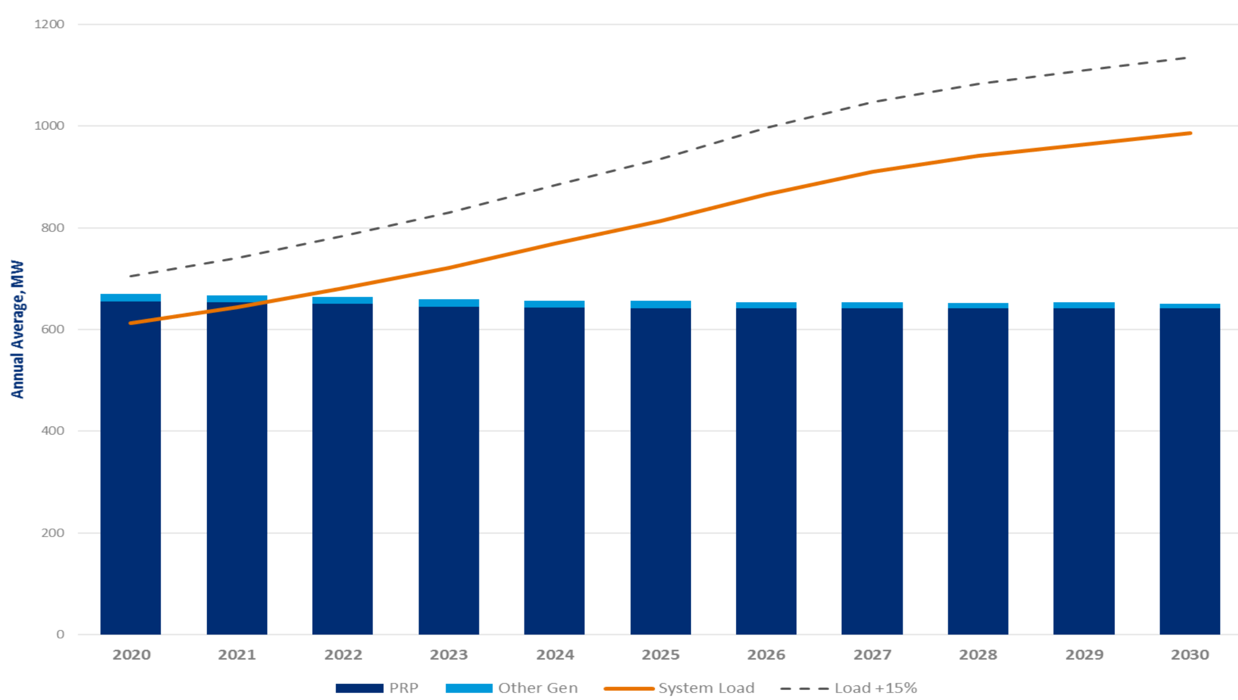
The Priest Rapids Development consists of a dam and hydroelectric generating station with a nameplate rating of 950MW. Located on the Columbia River in Grant and Yakima Counties about 150 air miles northeast of Portland, Oregon, 130 air miles southeast of Seattle, Washington, and 18 miles downstream of the Wanapum Development, the Priest Rapids Development includes certain switching, transmission and other facilities necessary to deliver the electric output to the transmission networks of Grant PUD, Bonneville and certain other power purchasers.

PRP provides Grant PUD with all the significant attributes of value including energy, capacity, ancillary services, energy storage, and carbon-free green attributes defined above. Often these are used exclusively to serve customers' needs. Any excess has value and can be marketed. These large hydroelectric resources have been Grant PUD's foundational supply of carbon-free electricity.

EUDL Market Purchases

Grant PUD has the right to receive financial resources from the Priest Rapids Project to purchase power to serve the Estimated Unmet District Load (EUDL). The financial resources are limited to approximately 30% of the market value of the output of PRP in any given year. The energy and capacity are not received directly from the Priest Rapids Project but through market purchases. This provision allows Grant PUD to serve loads up to roughly 30% of the output of the Priest Rapids Project at the net cost of production for the Priest Rapids Project. In the accompanying graphs in Section 9, this resource is labeled "EUDL Market Purchases." Grant PUD recognizes that this is a financial position that needs to be converted to a physically firm position though the course of Grant PUD's hedging strategy and consistent with the Integrated Resource Plan. Graph 7-1 illustrates Grant's forecasted system load vs the physical resources available to meet that load.

Graph 7-1 | Annual Loads and Resources: Base Case – Physical Resources Only



The EUDL market purchases have been able to meet our system load in the past. Section 9 will illustrate how heavily Grant relies on EUDL market purchases to meet the system load. Grant will evaluate liquidity within the markets and make strategic adjustments to ensure the ability to continue to meet physical firm requirements.

Bonneville Power Administration Contracts

Bonneville charges a cost-based rate, meaning it only recovers its costs. Bonneville conducts a rate case every two years to reset these cost-based rates. Grant PUD's Priority Firm (PF) power contract with Bonneville, effective October 1, 2011, and terminating October 1, 2028, provides that Bonneville serve only Grant PUD's loads in the Grand Coulee area (approximately 5 aMW or roughly 1% of the total District load), which is a small area not interconnected to Grant PUD's transmission system. Grant PUD does not have a contract with Bonneville to serve any other District load. Grant PUD has the right to exercise its statutory rights to apply for more PF power from BPA after 2028. Grant PUD will continue to monitor BPA's rates in order to evaluate the value of expanding the PF power commitment post 2028.

Nine Canyon Wind Project

Grant PUD entered into a power purchase agreement with Energy Northwest for the purchase of 25% of the generating capacity of Phase I of the 48.1 MW Nine Canyon Wind Project. Grant PUD now receives 12.54% of the expanded Phase I, II and III Nine Canyon Wind Project, which is equivalent to the 25% share of the original Phase I project. The power purchase agreement will terminate on July 1, 2030. The Nine Canyon Wind Project is a wind energy generation project located approximately eight miles southeast of Kennewick, Washington, in the Horse Heaven Hills. In 2018, Grant PUD received approximately 30,958 MWh of wind generation output from the project and 24,931 MWh in 2019. This resource provides capacity and produces carbon-free energy with RECs.

Quincy Chute Project

Under an agreement with three irrigation districts, Grant PUD operates and purchases the entire capability and output of the Quincy Chute Project, a 9.4 MW hydroelectric generating facility operating seasonally during the irrigation season (March through October). Grant PUD financed, designed and constructed the project and is responsible for operation and maintenance during the period of the agreement, which expires in 2025. The Quincy Chute Project began commercial operation on October 1, 1985, and its net energy generation was 32,071 MWh in 2018 and 27,858 MWh in 2019. This resource produces capacity and carbon-free energy. Due to the uncertainty of the renewal of this contract, it is not shown as a resource beyond the expiration date in 2025. As we get closer to the expiration of the contract, Grant PUD will evaluate this resource and may negotiate with the irrigation districts for a new contract.

P.E.C. Headworks Power Plant Project

Under an agreement with three irrigation districts, Grant PUD operates and purchases the entire capability and output of the 6.5 MW generating facility at the P.E.C. Headworks at the O'Sullivan Dam, which operates during the irrigation season (March through October). Grant PUD financed, designed and constructed the project and is responsible for operation and maintenance during the period of the agreement, which expires in 2030. The P.E.C. Headworks Project began commercial operation on September 1, 1990, and its net energy generation was 19,982 MWh in 2018, and 19,801 MWh in 2019. This resource produces capacity and carbon-free energy.

Slice Contracts and Energy Purchases

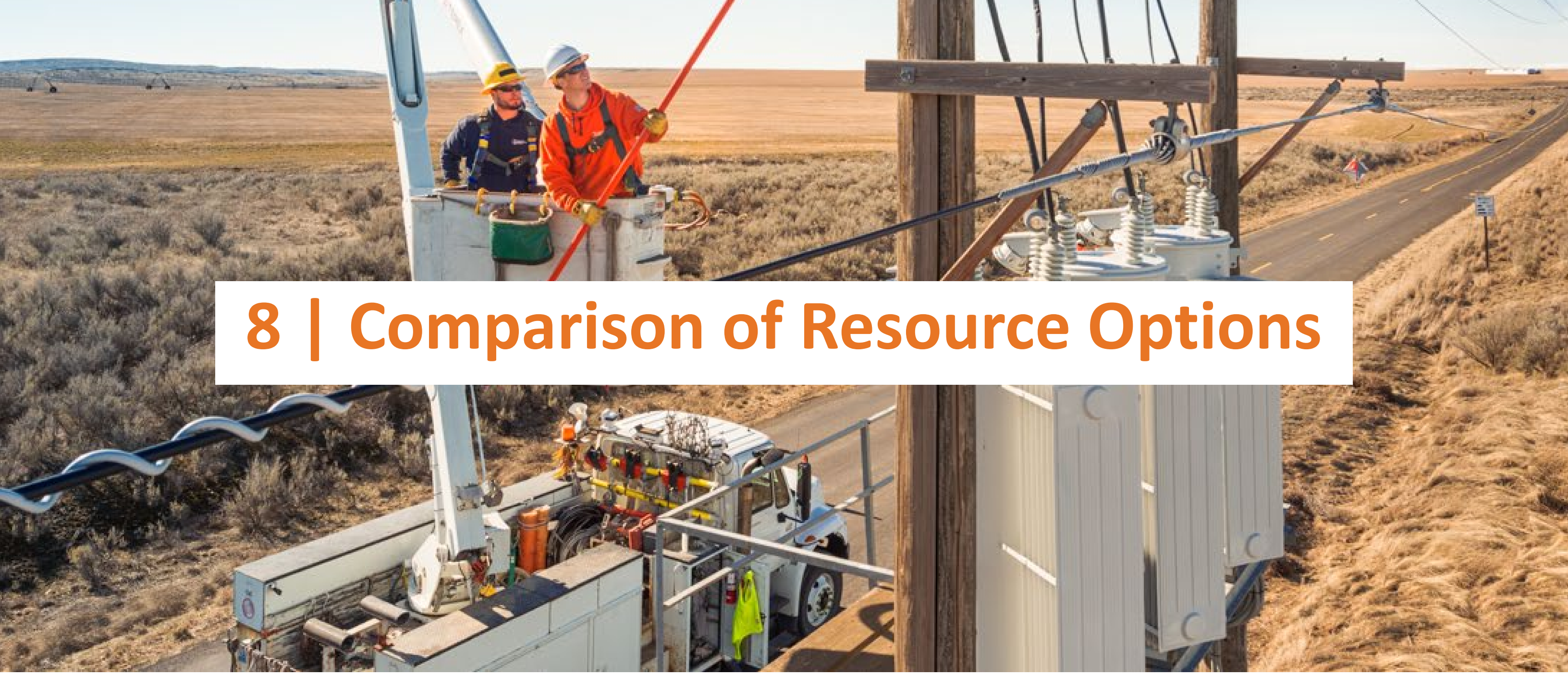
Grant PUD utilizes a "slice" hedging strategy to eliminate the volatility of river flows from year to year. This hedging strategy is accomplished by the selling of Grant PUD's a portion of the 63.31% contractual output (energy/capacity/storage) of the Priest Rapids Project (PRP) to a counterparty and using the funds from the sale to purchase firm energy from the same counterparty.

In September 2015, Grant PUD entered into a 5-year Agreement for Pooling of PRP output (the "Pooling Agreement") with Shell Energy North America ("SENA"). Under the Pooling Agreement, Grant PUD provides SENA 53.3% of the PRP output and SENA provides to Grant firm power sufficient to meet the Electric System's retail load forecast net requirements ("District's Load Forecast"). In addition, SENA provides energy scheduling services for Grant PUD and Grant PUD provides flexibility to SENA within Grant PUD's Balancing Area. The term of this Pooling Agreement runs through September 2020.

In 2019, Grant PUD entered into a contract to sell a 10% slice of PRP to Avangrid Renewables, Inc. for the term of January 1, 2019 through December 31, 2021.

Grant is in the final stages of contract negotiations to replace the SENA Pooling Agreement with similar agreements which will also be for a 5-year period. This new Pooling Agreement will be for 33.31% of the output from PRP, leaving an additional 20% slice for Grant to sell to another counterparty. This 20% slice sale is also under current contract negotiations and will be for a term of 3-years beginning in January 2021.

Grant PUD's hedging strategy will continue to use slice sales to mitigate water volume risk. Slice sales allow Grant PUD to transfer water risk to counter parties in exchange for average water. In addition, Grant PUD has realized a premium associated with environmental attributes and associated ancillary services. This strategy has proven to be the most effective and least-cost approach currently available to Grant PUD.

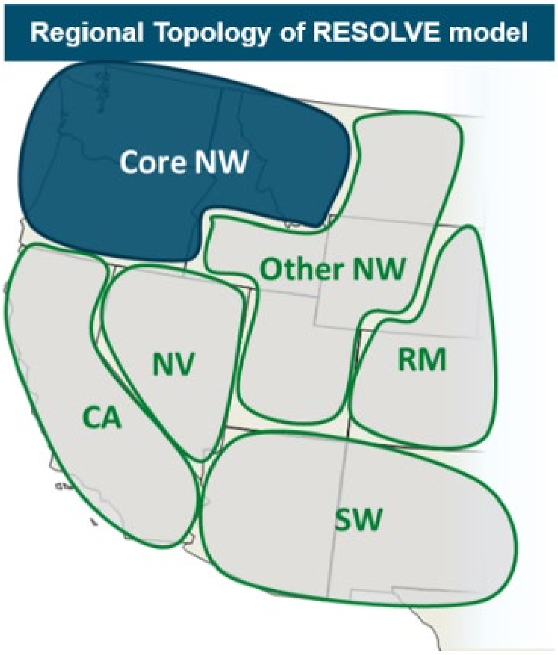


8 | Comparison of Resource Options

Grant PUD evaluates the various external and internal forces that can affect the size and shape of the load it serves and how to meet that load based on anticipated market prices, resource availability, and delivery constraints. Grant PUD hired the consulting firm of Energy + Environmental Economics (E3) to identify the least-cost portfolio needed to serve load growth within its service territory in the context of the broader Pacific Northwest clean energy policies and resource availability. E3 utilized its Pacific Northwest regional capacity expansion model, RESOLVE, to perform the analysis to determine the least-cost portfolio for the new loads within Grant's service territory (See Appendix 1). This least-cost modeling approach is consistent with Grant PUD's mission to safety, efficiently, and reliably generate and deliver energy to our customers.

RESOLVE MODEL SUMMARY

The RESOLVE model used by E3 in their analysis was originally developed for a 2017 study sponsored by the Public Generating Pool (PGP) examining alternative policies for achieving reductions to electric sector carbon emissions in the Northwest. The model has since been updated to analyze deep decarbonization and clean energy policies in the Pacific Northwest. The model takes a regional approach, optimizing resource build for a subset of the Northwest region, labeled "Core NW" representing Washington, Oregon, and parts of Idaho and Montana. The RESOLVE model analyzed Grant's loads representing the Medium, Medium High, and High load growth scenarios. Each load forecast was incorporated into the existing baseline load for the Pacific Northwest. All three scenarios were analyzed with the following regional policies: a). 80% Green House Gas reductions relative to 1990 levels by 2045; b). CETA compliance (elimination of coal-sourced generation by 2025, Carbon-neutral generation by 2030 and greenhouse gas emissions free generation by 2045).



RESOLVE's optimization capabilities allow it to select from among a wide range of potential new resources. In general, the options for new investments considered in this study are limited to those technologies that are commercially available today. This approach ensures that the greenhouse gas reduction portfolios developed in the IRP can be achieved without relying on assumed future technological breakthroughs. The full range of resource options considered by RESOLVE in this study is shown in Table 8-1.

Table 8-1 | Resource options considered in RESOLVE

Resource Option	Examples of Available Resources	Functionality
Natural Gas Generation	• Simple cycle gas turbines • Reciprocating engines • Combined cycle gas turbines • Repowered CCGTs	• Dispatches economically based on heat rate, subject to ramping limitations • Contributes to meeting minimum generation and ramping constraints
Renewable Generation	• Geothermal • Hydro upgrades • Solar PV • Wind	• Dynamic downward dispatch (with cost penalty) of renewable resources to help balance load • Hydro resources have full up and downward flexibility to balance load.
Energy Storage	• Batteries (>1 hr) • Pumped Storage (>12 hr)	• Stores excess energy for later dispatch • Contributes to meeting minimum generation and ramping constraints
Energy Efficiency	• HVAC • Lighting • Dryer, refrigeration, etc.	• Reduces load, retail sales, planning reserve margin need
Demand Response	• Interruptible tariff (ag) • DLC: space & water heating (res)	• Contributes to planning reserve margin needs

The model selects the lowest cost options to meet Grant's loads with a high degree of reliability and full compliance with carbon mandates. The RESOLVE model results indicate solar is the marginal resource added to Grant's portfolio for energy and natural gas is the marginal resource added for capacity. These results were consistent for all load scenarios analyzed. Grant PUD does not anticipate owning either of these resources in the next ten years, but significant load growth or a change in regulatory requirements may make ownership beneficial. Assuming no change in the carbon constraints in Washington, the District projects adding solar generation for energy deficits through market purchases or purchase power agreements beginning in 2026. If Grant PUD is required to purchase capacity, combined cycle natural gas generation would be the least cost option. Capacity deficits are not forecasted until 2026. Medium High or High load growth would necessitate acquiring these additional resources sooner.

Grant PUD is in the process of assembling a team of internal and external experts to evaluate the future energy and capacity needs of our customers. Their findings will guide the PUD's decisions regarding resource requirements and acquisition possibilities.

9 | Integrated Resource Plan

The Base Case represents the expected outcome for Grant PUD under current carbon regulation (I-937 and CETA). Grant PUD is constantly monitoring changes to forecasted loads, resource availability, market prices, market liquidity, and legislation that could affect the price and/or availability of resources. Each of the scenarios modeled in the IRP assumes that we are using our current physical resources or will acquire firm energy and capacity to meet our expected monthly load. Grant PUD will also acquire firm capacity as necessary to meet our 15% planning margin. Table 9-1 below lists the scenarios selected for discussion in this IRP.

Table 9-1 | IRP Scenarios

Grant PUD Load Forecasts
Medium Low Load
Base Load
Medium High Load
High Load

Base Case

The Base Case represents Grant PUD's least-cost path forward to serve expected load requirements under current market conditions. This means Grant PUD is using the base load forecast, existing resources, and selecting new resources under the current legislative environment. Under the Base Case, Grant PUD has enough existing capacity to meet expected load growth on an annual basis through 2028 (Graph 9-3). Grant is forecasting to be capacity deficit on average in the summer of 2027 (Graph 9-4). The RESOLVE model recommends Grant PUD acquire solar purchase power agreements (PPAs) for energy deficits and natural gas PPAs for generation capacity requirements.

It is important to note that a significant portion of Grant PUD's resources to meet load is provided though the Estimated Unmet District Load (EUDL). The "EUDL-Market" in the graphs is a financial resource (dollars) which is used to purchase firm energy in the open market on an annual basis. While acquiring these resources has not been a challenge in the past, Grant is examining alternatives to annual purchases to increase certainty of availability.

Grant PUD will continue to analyze the costs and benefits of building and operating power resources verses purchasing power and/or capacity through PPAs. For purposes of this presentation, PPA's will be shown as the resource of choice to meet energy and capacity shortfalls due to its relative ease of acquisition vs building and operating. Firm purchases of Market energy and capacity will also be shown where the deficit is insufficient for economical acquisition of a PPA. Grant recognizes that Resource Adequacy concerns in the WECC will require careful consideration and planning to maintain reliable resources to meet our load.

The graphs below represent Grant PUD's annual and summer cases which may include:

Existing District Resources:

PRP: The Priest Rapids Project consisting of Wanapum and Priest Rapids Hydro Election Dams

Other Generation: including Nine Canyon, Quincy Chute, PEC, BPA, and Exchange Agreements

EUDL- Market: Power Purchases assumed to be converted to firm physical energy up to Grant Load

Market: Firm physical energy purchases

Solar - PPA: Purchase power agreement for renewable solar resources

Combined Cycle - PPA: Purchase Power Agreement for natural gas generation

Gas Peak Plant - PPA: Purchase Power Agreement for natural gas generation

Capacity Option: Call option on physically firm capacity

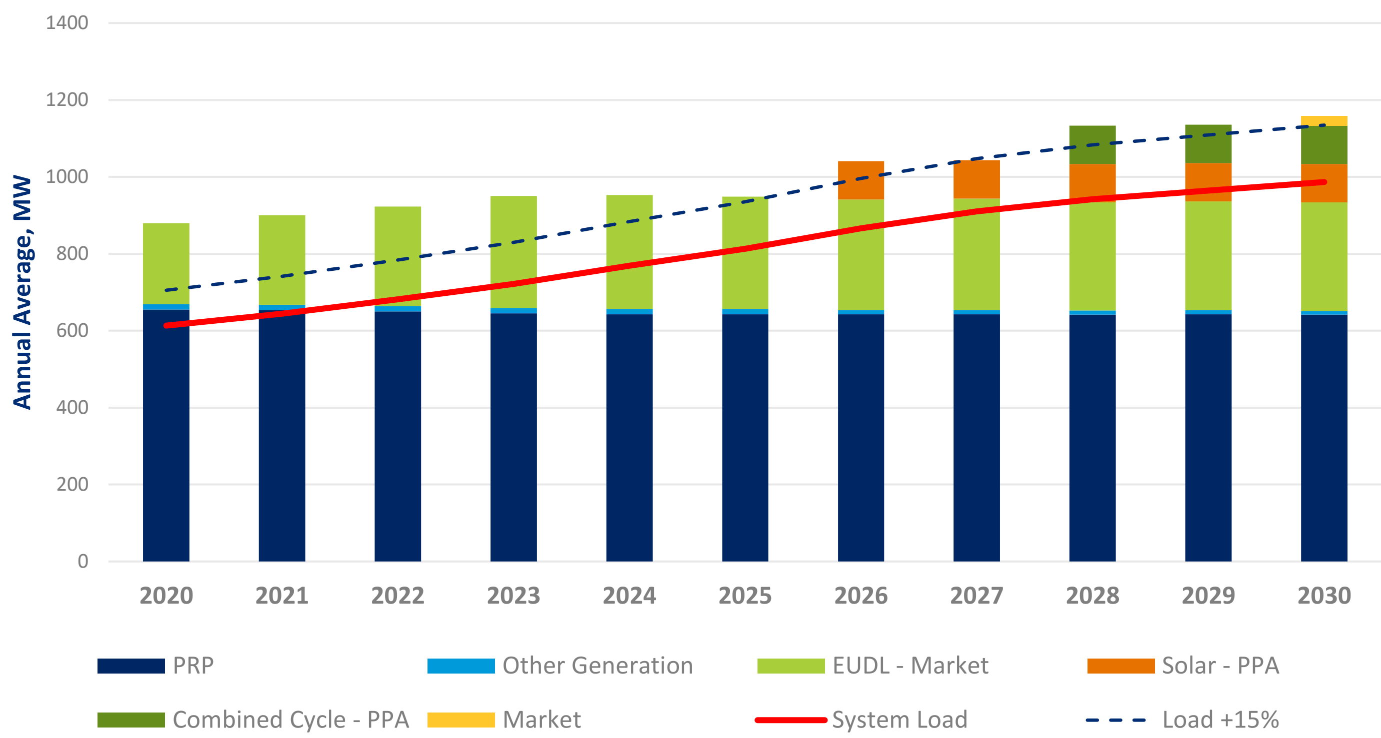
System Load: Grant PUD load forecast (See Section 4)

Load +15%: Planning margin on system load

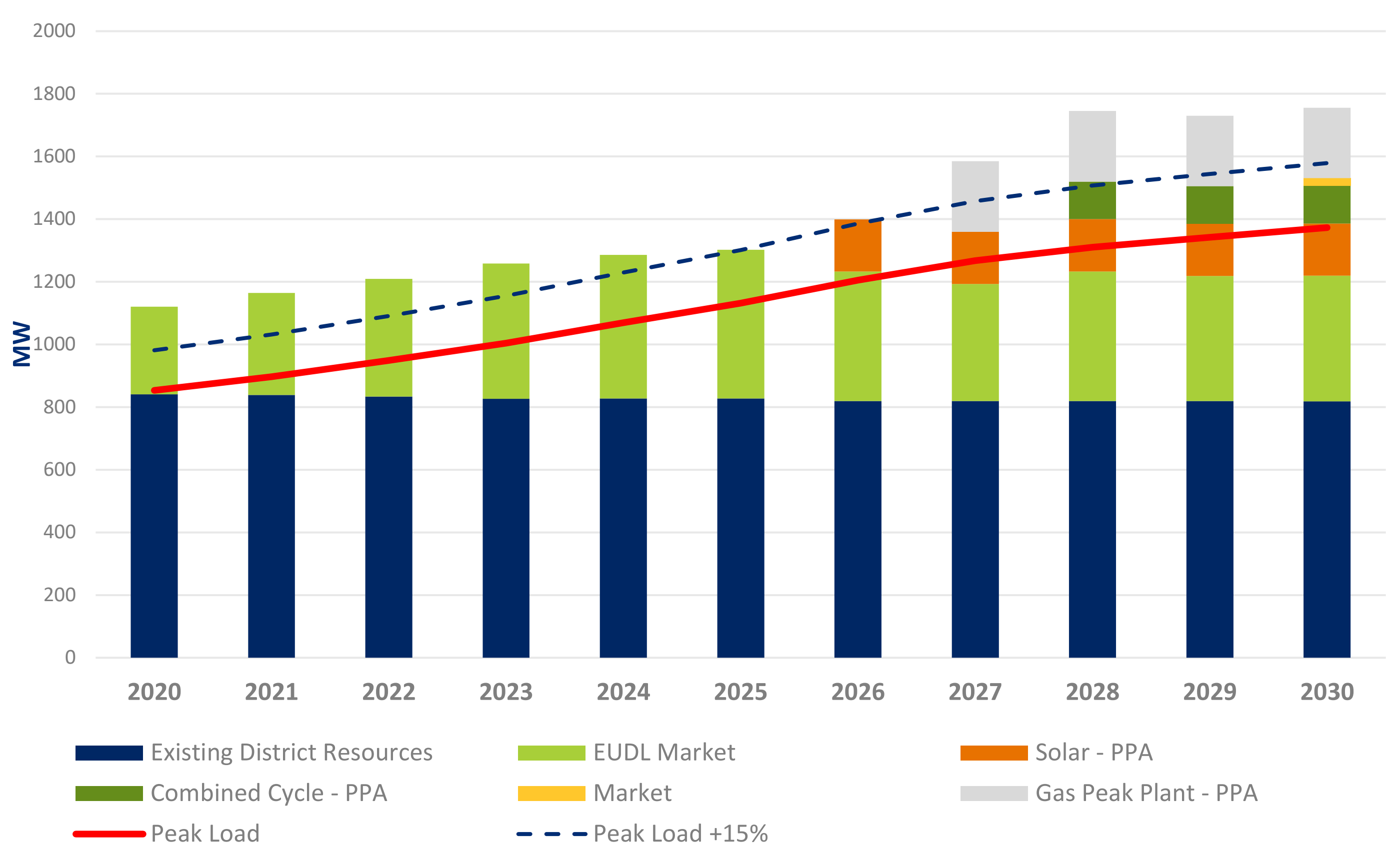
Peak Load: Used for Capacity planning purposes and represents the maximum forecasted demand

Peak Load +15%: Planning margin on Peak Load

Graph 9-3 | Annual Loads and Resources – Base Case – Added Resources



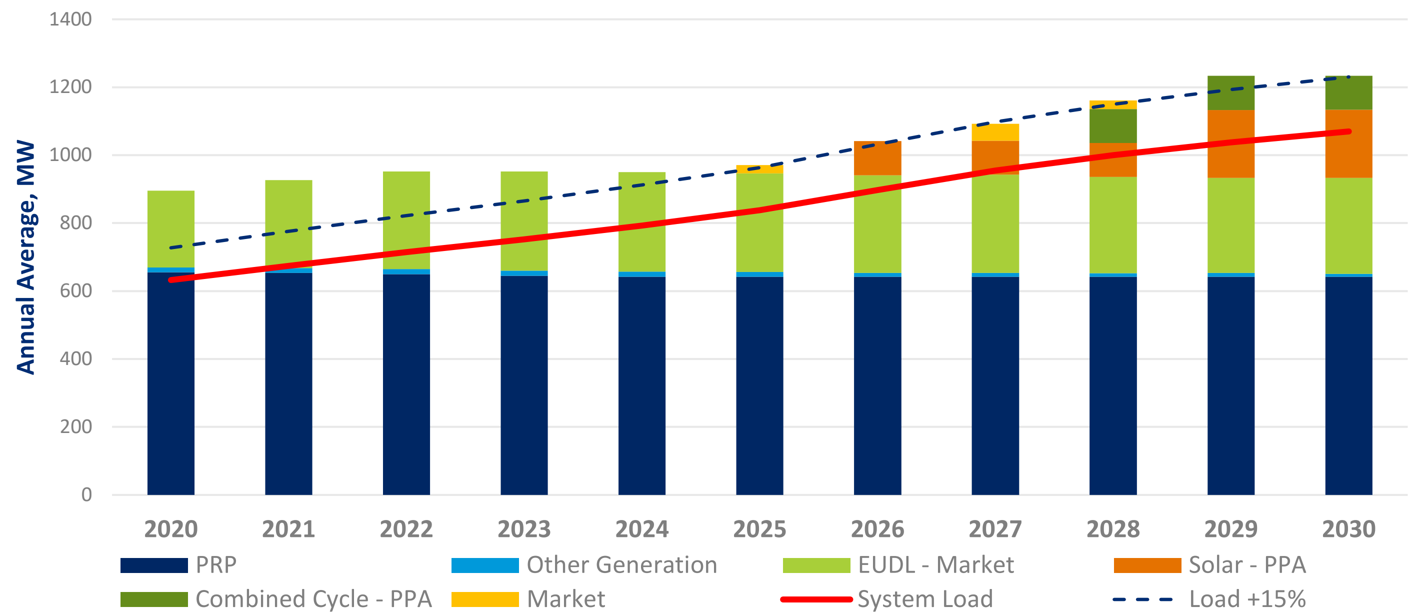
Graph 9-4 | Average Summer Capacity – Base Case – Added Resources



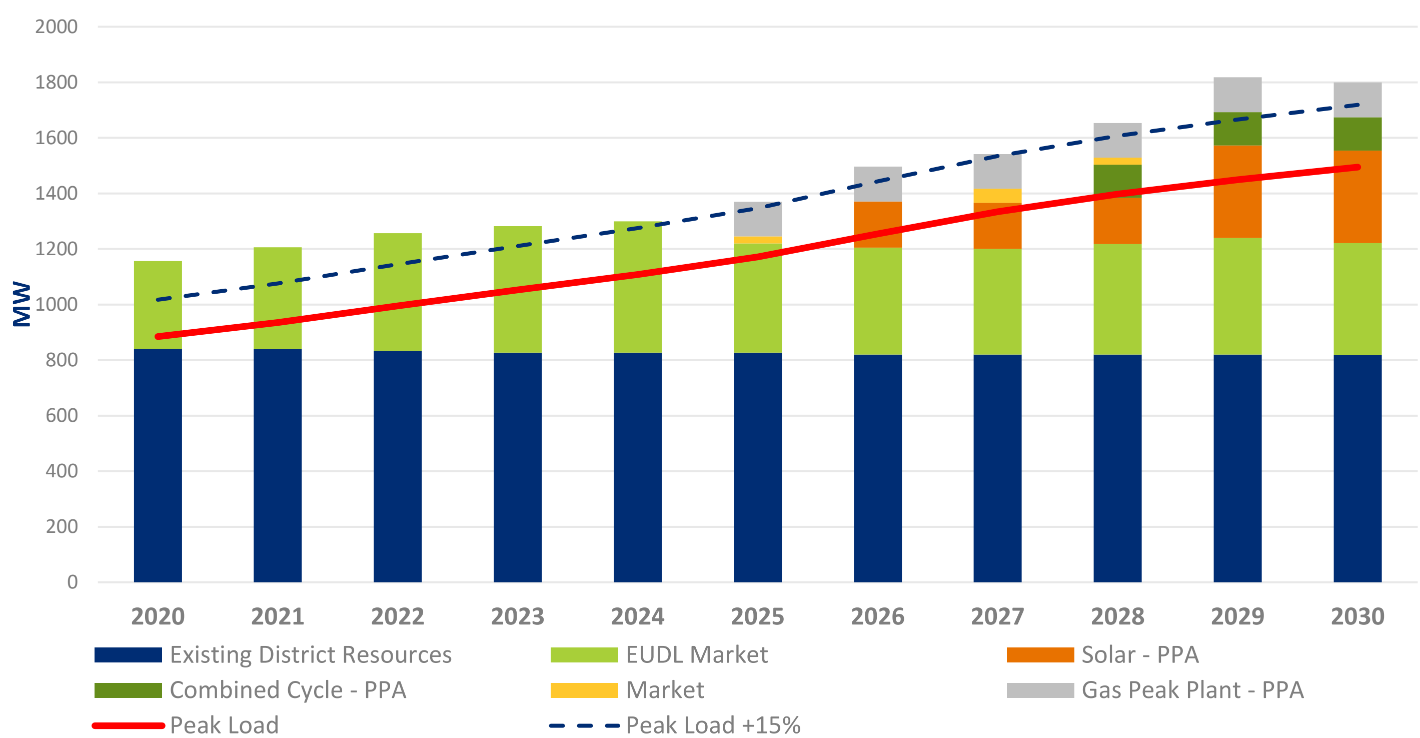
Medium High Load Case

In the Medium High Load Case, all assumptions are the same as the Base Case but with higher load growth. Under this case, Grant PUD, on an annual basis, is expected to require market purchases beginning in 2025 beyond what is supplied through EUDL - Market. Starting in 2026, Grant PUD is forecasted to enter into a PPA for a solar resource to meet its annual load requirements and a PPA for natural gas Combined Cycle (Graph 9-5). Grant is forecasting the need for Gas Peak Plant PPAs to meet its Average Summer Capacity needs beginning in 2025 (Graph 9-6).

Graph 9-5 | Annual Loads and Resources – Medium High Load Case – Added Resources



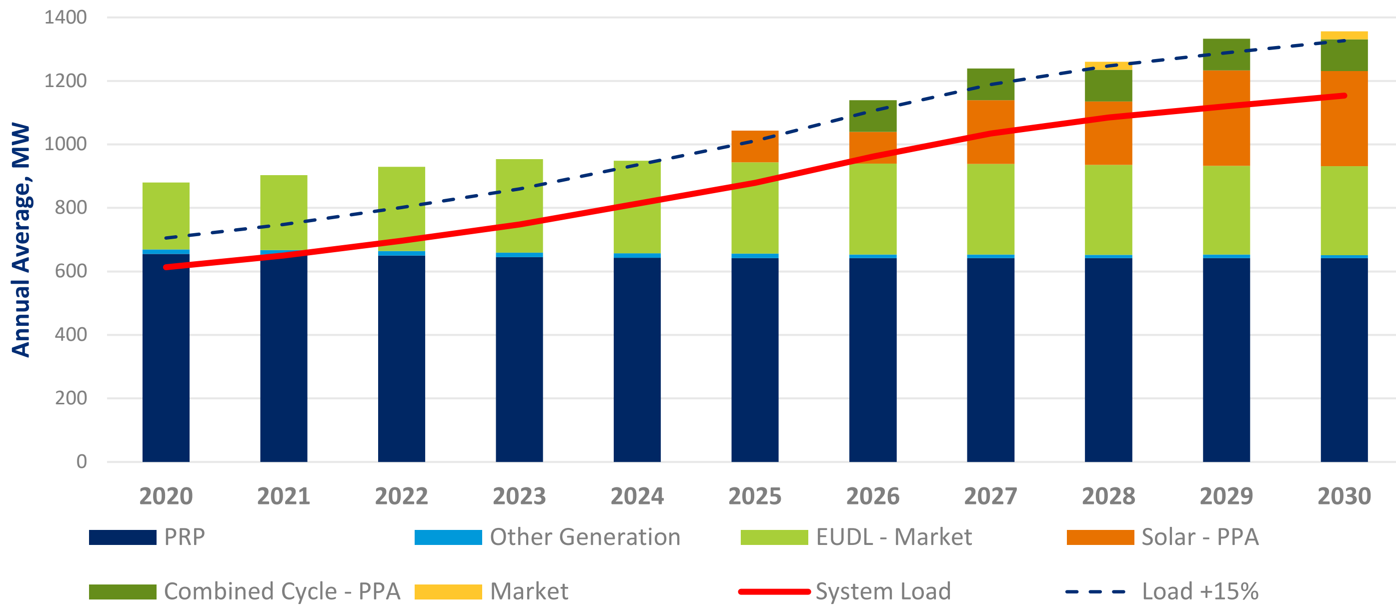
Graph 9-6 | Average Summer Capacity – Medium High Case – Added Resources



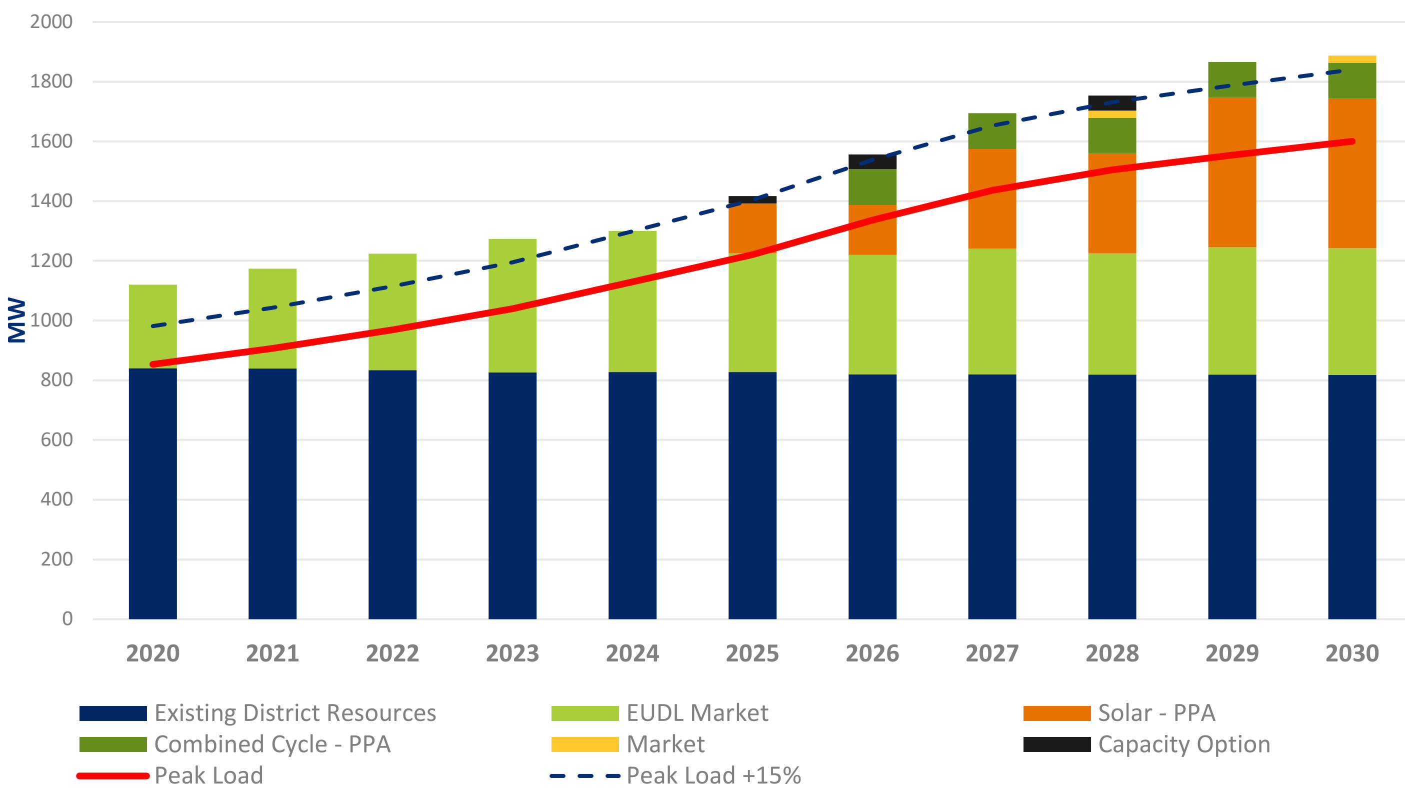
High Load Case

In the High Load Case all assumptions are the same as the Base Case but with the highest load growth forecast. Under this case, Grant PUD is not able to meet, on an annual basis, the expected load with existing physical resources and EUDL-Market purchases, starting in 2026. Grant PUD expects to enter into Solar and Combined Cycle PPA's beginning in 2026 (Graph 9-7). Capacity Options are forecasted to be used to meet summer peaks (Graph 9-8).

Graph 9-7 | Annual Loads and Resources – High Load Case – Added Resources



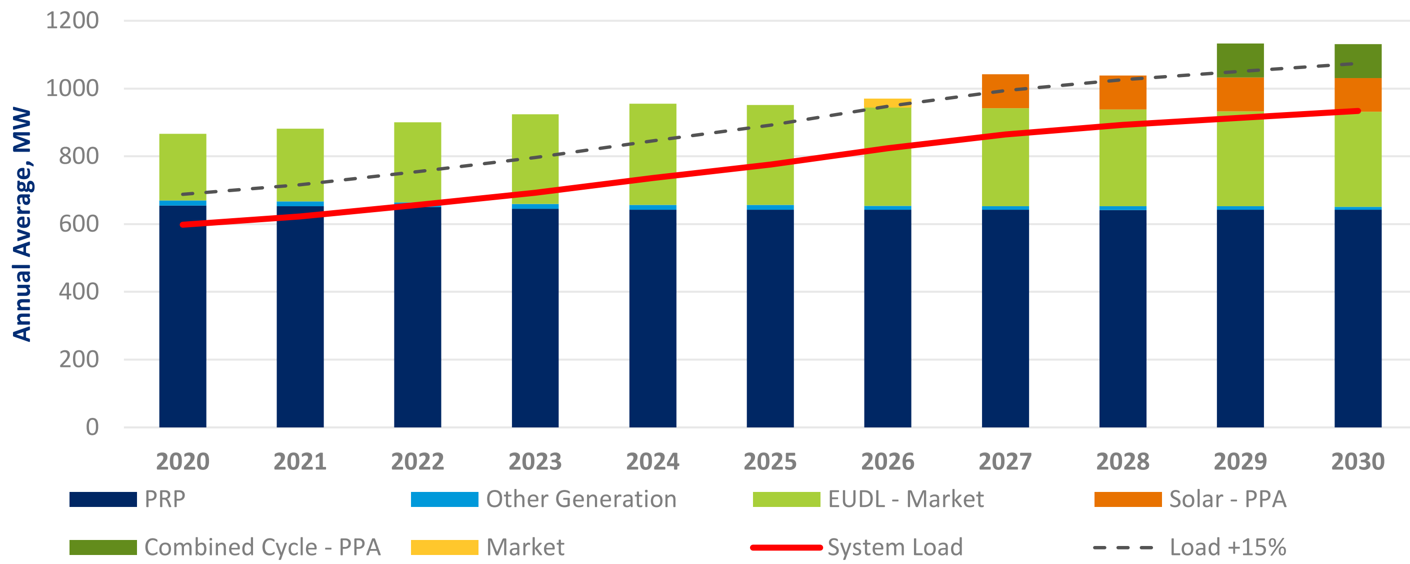
Graph 9-8 | Average Summer Capacity – High Case – Added Resources



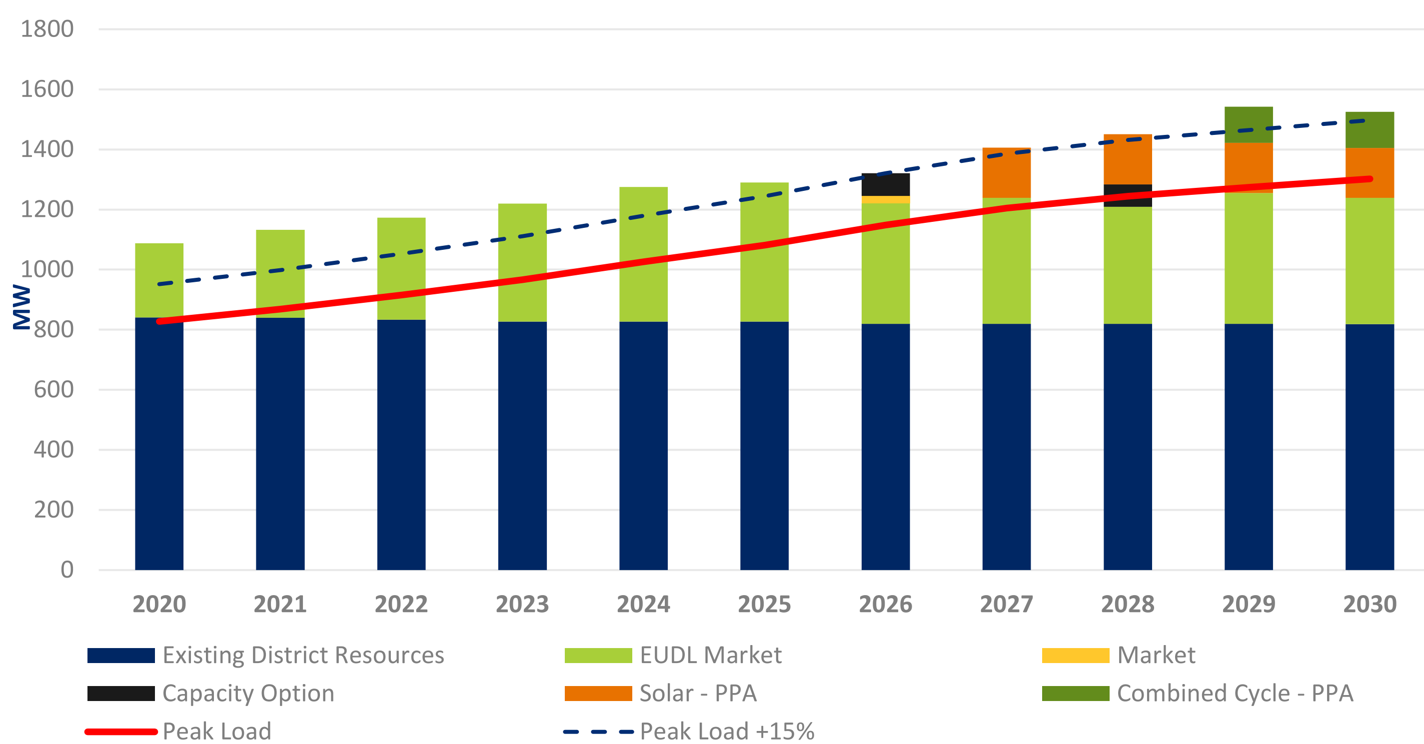
Medium Low Load Case

In the Medium Low Load Case, all assumptions are the same as the Base Case but with lower load growth. Under this case, Grant PUD is able to meet, on an annual basis, the expected load through the 10-year planning horizon with existing resources and EUDL Market Purchases (Graph 9-9). Grant PUD will still use market purchases to meet the 15% planning margin starting in 2026 with solar and Combined Cycle PPA's to meet the 15% planning margin. The Average Summer Capacity is forecasted to also require the addition of Capacity Call Options (Graph 9-10).

Graph 9-9 | Annual Loads and Resources – Medium Low Case – Added Resources



Graph 9-10 | Average Summer Capacity – Medium Low Case – Added Resources



10 | Conclusions & Action Plan

CONCLUSIONS

Grant PUD draws the following conclusions from the IRPanalyses:

1. Current Grant PUD strategy of large market purchases made to cover Estimated Unmet District Load (EUDL) needs to be reconsidered due to possible resource adequacy issues in the WECC.

2. Based on the anticipated annual energy projections, Grant PUD has enough existing physical resources and EUDL dollars to meet expected load growth on an annual basis through 2028.

3. As a result of the 15% planning margin, additional resources requirements are forecasted as soon as 2026.

4. Grant PUD is forecasting to be seasonally capacity-deficient during summer of 2026.

5. To meet these seasonal deficiencies, current models indicate the least-cost resources to be power purchase agreements or ownership of solar and natural gas generation with an emphasis on firm delivery. Market purchases will also be necessary to fill in any gaps that are not economical to fill with purchase power agreements.

6. Grant PUD will continue to meet its state-mandated renewable portfolio obligations without acquiring new resources until 2025. At that time Grant PUD will acquire any expected RPS deficits with market purchases of eligible RECs and other qualifying resources such as solar.

7. Grant PUD's long-term load forecast contains significant uncertainty due to the relatively high percentage of industrial load. Industrial loads could be significantly higher or lower than the forecast based on a number of factors, many of which are outside Grant PUD's control. Grant PUD has reviewed the potential risks associated with this load uncertainty and will continue monitoring these loads and expectations of this customer segment.

8. Grant PUD will need to stay abreast of changes to markets and regulations in the utility industry affecting the District's planning processes.

ACTION PLAN

Grant PUD should take the following actions based on the results of thisIRP.

1. Assemble a team of internal subject matter experts to determine strategy and execute a plan to research the acquisition of resources to meet forecasted energy and capacity needs. This will most likely include one or more full-time IRP staff resources. Monitor opportunities to procure low-cost, long-term generating resources (particularly resources that qualify for I-937 and CETA compliance), with an eye towards opportunities priced better than new-build costs. Preference will be given to firm resources to address regional Resource Adequacy concerns.

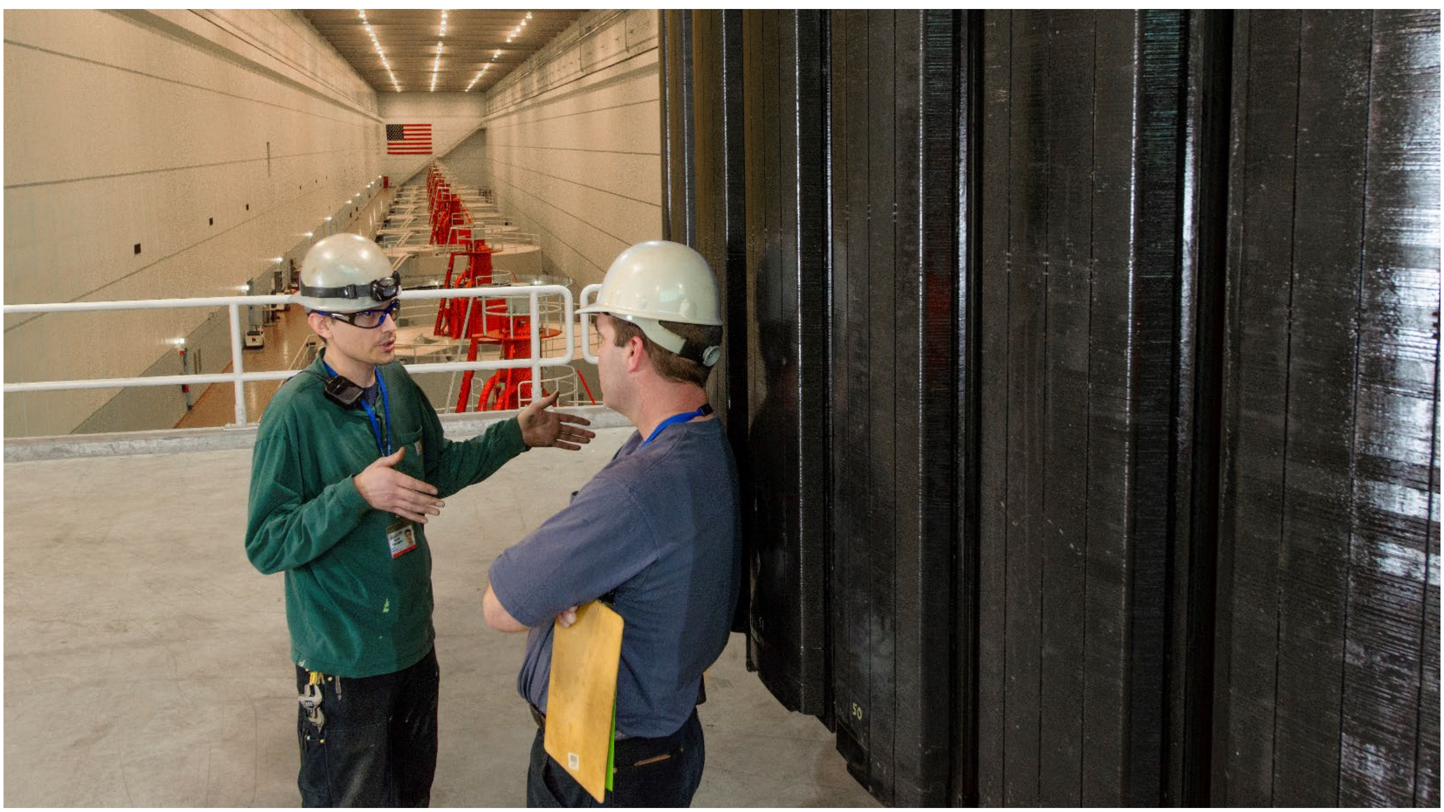
2. Continue to implement and achieve cost-effective conservation available within the county as indicated in Grant PUD's Conservation Potential Assessment.

3. Continue to enhance the capacity planning process and standards to ensure Grant PUD adequately plans to reliably meet both the energy and peaking needs of Grant PUD's electric system. Grant's capacity planning process and standard should conform to the evolution in power planning for the Pacific Northwest. Therefore, Grant PUD should participate in and monitor regional forums related to resource planning.

4. Continue to refine and improve the retail energy load forecasts, with an emphasis on monitoring changes from the large industrial customers, given their ability to affect Grant's load and resource balance.

5. Evaluate the opportunities presented by the expansion of the Northwest EIM and the possible growth of the California Independent System Operator into the Northwest. Grant PUD should work to identify the best strategy (from a cost, opportunity and risk basis) to interact with this evolving market.

6. Continue to participate in regional utility groups that monitor and influence legislation that could affect Grant PUD's ratepayers.



Appendix 1:

RESOLVE Model Description

OVERVIEW

RESOLVE is a resource investment model that uses linear programming to identify optimal long-term generation and transmission investments in an electric system, subject to reliability, technical, and policy constraints. Designed specifically to address the capacity expansion questions for systems seeking to integrate large quantities of variable resources, RESOLVE layers capacity expansion logic on top of a production cost model to determine the least-cost investment plan, accounting for both the up-front capital costs of new resources and the variable costs to operate the grid reliably over time. In an environment in which most new investments in the electric system have fixed costs significantly larger than their variable operating costs, this type of model provides a strong foundation to identify potential investment benefits associated with alternative scenarios.

RESOLVE's optimization capabilities allow it to select from among a wide range of potential new resources. In general, the options for new investments considered in this study are limited to those technologies that are commercially available today. This approach ensures that the greenhouse gas reduction portfolios developed in this study can be achieved without relying on assumed future technological breakthroughs. At the same time, it means that emerging technologies that could play a role in a low-carbon future for the Northwest—for instance, small modular nuclear reactors—are not evaluated within this study. This modeling choice is not meant to suggest that such emerging technologies should not have a role in meeting regional greenhouse gas reduction goals, but instead reflects a simplifying assumption made in this study. The full range of resource options considered by RESOLVE in this study is shown in Table 2-1.

Table 2-1. Resource options considered in RESOLVE

Resource Option	Examples of Available Resources	Functionality
Natural Gas Generation	• Simple cycle gas turbines • Reciprocating engines • Combined cycle gas turbines • Repowered CCGTs	• Dispatches economically based on heat rate, subject to ramping limitations • Contributes to meeting minimum generation and ramping constraints
Renewable Generation	• Geothermal • Hydro upgrades • Solar PV • Wind •	• Dynamic downward dispatch (with cost penalty) of renewable resources to help balance load • Hydro resources have full up and downward flexibility to balance load.
Energy Storage	• Batteries (>1 hr) • Pumped Storage (>12 hr)	• Stores excess energy for later dispatch • Contributes to meeting minimum generation and ramping constraints
Energy Efficiency	• HVAC • Lighting • Dryer, refrigeration, etc.	• Reduces load, retail sales, planning reserve margin need
Demand Response	• Interruptible tariff (ag) • DLC: space & water heating (res)	• Contributes to planning reserve margin needs

1.1.2 OPERATIONAL SIMULATION

To identify optimal investments in the electric sector, maintaining a robust representation of prospective resources' impact on system operations is fundamental to ensuring that the value each resource provides to the system is captured accurately. At the same time, the addition of investment decisions across multiple periods to a traditional unit commitment problem increases its computational complexity significantly. RESOLVE's simulation of operations has therefore been carefully designed to simplify traditional unit commitment problem where possible while maintaining a level of detail sufficient to provide a reasonable valuation of potential new resources. The key attributes of RESOLVE's operational simulation are enumerated below:

+ Hourly chronological simulation: RESOLVE's representation of system operations uses an hourly resolution to capture the intraday variability of load and renewable generation. This level of resolution is necessary in a planning-level study to capture the intermittency of potential new wind and solar resources, which are not available at all times of day to meet demand and must be supplemented with other resources.

+ Aggregated generation classes: rather than modeling each generator within the study footprint independently, generators in each region are grouped together into categories with other plants whose operational characteristics are similar (e.g. nuclear, coal, gas CCGT, gas CT). Grouping like plants together for the purpose of simulation reduces the computational complexity of the problem without significantly impacting the underlying economics of power system operations.

+ Linearized unit commitment: RESOLVE includes a linear version of a traditional production simulation model. In RESOLVE's implementation, this means that the commitment variable for each class of generators is a continuous variable rather than an integer variable. Additional constraints on operations (e.g. Pmin, Pmax, ramp rate limits, minimum up and down time) further limit the flexibility of each class' operations.

+ Zonal transmission topology: RESOLVE uses a zonal transmission topology to simulate flows among the various regions in the Western Interconnection. RESOLVE includes six zones: the Core Northwest region and five external areas that represent the loads and resources of utilities throughout the rest of the Western Interconnection.

+ Co-optimization of energy and ancillary services: RESOLVE dispatches generation to meet load across the Western Interconnection while simultaneous reserving flexible capacity within the Primary Zone to meet the contingency and flexibility reserve needs. As systems become increasingly constrained on flexibility, the inclusion of ancillary service needs in the dispatch problem is necessary to ensure a reasonable dispatch of resources that can serve load reliably.

+ Smart sampling of days: whereas production cost models are commonly used to simulate an entire calendar year (or multiple years) of operations, RESOLVE simulates the operations of the WECC system for 41 independent days. Load, wind, and solar profiles for these 41 days, sampled from the historical meteorological record of the period 2007-2009, are selected and assigned weights so that taken in aggregate, they produce a reasonable representation of complete distributions of potential conditions; daily hydro conditions are sampled separately from low (2001), average (2005), and high (2011) hydro years to provide a complete distribution of potential hydro conditions.[15] This allows RESOLVE to approximate annual operating costs and dynamics while simulating operations for only the 41 days.

+ Hydro dispatch informed by historical operations: RESOLVE captures the inherent limitations of the generation capability of the hydroelectric system by deriving constraints from actual operational data. Three types of constraints govern the operation of the hydro fleet as a whole: daily energy budgets, which limit the amount of hydro generation in a day;[16] (2) maximum and minimum hydro generation levels, which constrain the hourly hydro generation; and (3) maximum multi-hour ramp rates, which limit the rate at which the output of the collective hydro system can change its output across periods from one to four hours. Collectively, these constraints limit the generation of the hydro fleet to reflect seasonal limits on water availability, downstream flow requirements, and non-power factors that impact the operations of the hydro system. The derivation of these constraints from actual hourly operations makes this representation of hydro operations conservative with respect to the amount of potential flexibility in the resource.

1.1.3 ADDITIONAL CONSTRAINTS

RESOLVE layers investment decisions on top of the operational model described above. Each new investment identified in RESOLVE has an impact on how the system operates; the portfolio of investments, as a whole, must satisfy a number of additional conditions.

+ Planning reserve margin: When making investment decisions, RESOLVE requires the portfolio to include enough firm capacity to meet 1-in-2 system peak plus additional 15% of planning reserve margin (PRM) requirement. The contribution of each resource type towards this requirement depends on its attributes and varies by type: for instance, variable renewables are discounted more compared to thermal generations because the uncertainties of generation during peak hours.

+ Renewables Portfolio Standard (RPS) requirement: RPS requirements have become the most common policy mechanism in the United States to encourage renewable development. RESOLVE enforces an RPS requirement as a percentage of retail sales to ensure that the total quantity of energy procured from renewable resources meets the RPS target in each year.

+ Greenhouse gas cap: RESOLVE also allows users to specify and enforce a greenhouse gas constraint on the resource portfolio for a region. As the name suggests, the emission cap type policy requires that annual emission generated in the entire system to be less than or equal to the designed maximum emission cap. This type of policy is usually implemented by having limited amount of emission allowances within the system. As a result, thermal generators need to purchase allowances for the carbon they produced from the market or from carbon-free generators.

+ Resource potential limitations: Many potential new resources are limited in their potential for new development. This is particularly true for renewable resources such as wind and solar. RESOLVE enforces limits on the maximum potential of each new resource that can be included in the portfolio, imposing practical limitations on the amount of any one type of resource that may be developed.

RESOLVE considers each of these constraints simultaneously, selecting the combination of new generation resources that adheres to these constraints while minimizing the sum of investment and operational costs.

[15] An optimization algorithm is used to select the days and identify the weight for each day such that distributions of load, net load, wind, and solar generation match long-run distributions.

[16] Sometimes hydro operators can shift hydro energy from day to day: for example, if hydro operators know that tomorrow will be a peak day, they can save some hydro energy today and use them tomorrow to meet the system need. This flexibility can help integrating renewable into the system and it is going to be more and more valuable as the % of system renewable penetration increases. To capture this flexibility, model allows up to 5% of the hydro energy in each day to be shifted around within two months.

1.1.4 KEY MODEL OUTPUTS

RESOLVE produced a large amount of results from technology level unit commitment decisions to total GHG emission in the system. This extensive information gives users a complete view of the future system and makes RESOLVE versatile for different analysis. The following list of outputs is produced by RESOLVE and are the subject of discussion and interpretation in this study:

+ Total revenue requirement ($/yr): The total revenue requirement reports the total costs incurred by utilities in the study footprint (the combination of Washington and Oregon) to provide service to its customers. This study focuses on the relative differences in revenue requirement among scenarios, generally measuring changes in the revenue requirement relative to the Reference Case. The cost impacts for each scenario comprise changes in fixed costs (capital & fixed O&M costs for new generation resources, incremental energy efficiency, new energy storage devices, and the required transmission resources with the new generation) and operating costs (variable O&M costs, fuel costs, costs of market purchases and revenues from surplus sales).

+ Greenhouse gas emissions (MMTCO2e): This result summarizes the total annual GHG emission in the system with imports and exports adjustments. The GHG emission is one of the most important metrics for the studies. By comparing the GHG emission and total resource costs between different policy scenarios, we can conclude the relative effectiveness of policies in GHG reduction.

+ Resource additions for each period (MW): The selected investment summarizes the cumulative new generation capacity investments by resources types. It provides an overview of what kinds of generation are built and the timing of the investments.

+ Annual generation by resource type (aMW): Energy balance shows the annual system load and energy produced by each resource type at yearly intervals. It provides insights from a different angle than capacity investments. It can help answer questions like: Which types of resources are dispatched more? How do the dispatch behaviors change over the years? And how do curtailment, imports, and exports vary year by year?

+ Renewable curtailment (aMW): RESOLVE estimates the amount of renewable curtailment that would be expected in each year of the analysis as a result of "oversupply"—when the total amount of must-run and renewable generation exceeds regional load plus export capability—based on its hourly simulation of operations. As the primary renewable integration challenge at high renewable penetrations, this measure is a useful proxy for renewable integration costs.

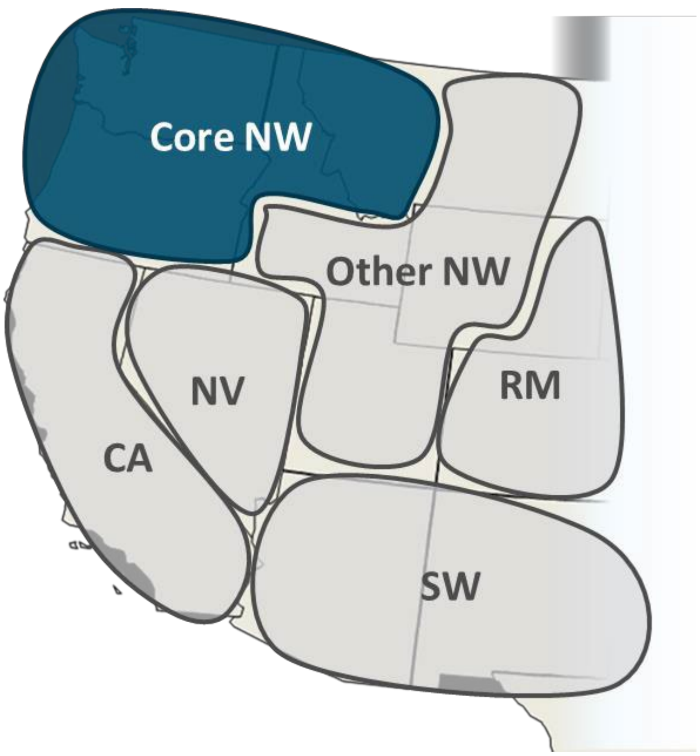
+ Wholesale market prices ($/MWh): outputs from RESOLVE can be used to estimate wholesale market prices on an hourly basis (or during the standard HLH and LLH trading periods). As an optimization model, RESOLVE produces "shadow prices" in each hour that represent the marginal cost of generation given all the resources available at the time; these marginal costs serve as a proxy for wholesale market prices.

+ Average greenhouse gas abatement cost ($/metric ton): RESOLVE results can also be used to estimate average and marginal costs of greenhouse gas abatement by comparing the amount of greenhouse gas abatement achieved (relative to a Reference Case) and the incremental cost (relative to that same case).

1.2 STUDY FOOTPRINT

This report analyzes the different policy mechanisms that could be used to achieve GHG reduction goals in predominantly Washington and Oregon, with a small portion of Idaho and Montana loads that fall in BPA and AVA control areas. In this respect, the footprint of this study differs from the Northwest Regional Planning Area established by the Pacific Northwest Electric Power Planning and Conservation Act and used by regional planning entities in much of their work. This narrower study footprint representing only a portion of what is traditionally considered the Pacific Northwest is motivated by the desire to focus on the electric power sector within the states of Oregon and Washington, where policy discussions surrounding potential measures to facilitate decarbonization are considerably more advanced than elsewhere in the Pacific Northwest. Figure 2-1 shows a diagram summarizing the study footprint.

Figure 2-1 | Northwest low carbon grid study footprint



This study focuses on the ratepayers of Grant PUD in addition to the Core Northwest region shown as the "Primary Zone"—the zone for which RESOLVE makes generation investment decisions. For the purposes of simulating west-wide operations, the remaining balancing authorities outside of the Core Northwest are grouped into five additional "Secondary Zones." Investments in these zones are not optimized; the trajectory of new build for the external regions is based on regional capacity needs to meet PRM targets, as well as renewable needs to comply with existing RPS policies in those regions.

Table 2-2. Balancing authorities included in each study region.

Category	Study Zone	Constituent Balancing Authorities
Primary Zone	Core Northwest	• Avista Corporation (AVA) • Bonneville Power Administration (BPA) • Chelan Public Utilities District (CHPD) • Douglas Public Utilities District (DOPD) • Grant County Public Utilities District (GCPD) • Pacificorp West (PACW) • Portland General Electric (PGE) • Puget Sound Energy (PSE) • Seattle City Light (SCL) • Tacoma Power (TPWR)
Secondary Zones	Other Northwest	• Idaho Power Company (IPC) • NorthWestern Energy (NWMT) • Pacificorp East (PACE) • WAPA – Upper Wyoming (WAUW)
	California	• Balancing Authority of Northern California (BANC) • California Independent System Operator (CAISO) • Imperial Irrigation District (IID) • Los Angeles Department of Water and Power (LADWP) • Turlock Irrigation District (TIDC)
	Nevada	• Nevada Power Company (NEVP) • Sierra Pacific Power (SPP)
	Rocky Mountains	• Public Service Company of Colorado (PSC) • WAPA – Colorado-Missouri (WACM)
	Southwest	• Arizona Public Service Company (APS) • El Paso Electric Co (EPE) • Public Service Company of New Mexico (PNM) • Salt River Project (SRP) • Tucson Electric Power (TEP) • WAPA – Lower Colorado
Excluded		• Alberta Electric System Operator (AESO) • British Columbia Transmission Company (BCTC) • CFE (CFE)

Alberta and British Columbia and their interactions with the rest of the Western Interconnection are not modeled in the scenarios due to lack of publicly available data. While its interactions with the Canadian provinces is an important characteristic of the Northwest electricity system, the omission of this portion of the Western Interconnection is not expected to fundamentally alter the general dynamics or overall findings of this analysis.

Appendix 2

Grant County County Public Utility District

2019 Conservation Potential Assessment
Final Report

October 23, 2019

Prepared by:

EES Consulting

570 Kirkland Way, Suite 100
Kirkland, Washington 98033

A registered professional engineering corporation with offices in
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Telephone: (425) 889-2700 Facsimile: (425) 889-2725

EES Consulting

October 23, 2019

Mr. Richard Cole
Grant County Public Utility District
30 C Street, SW
Ephrata, WA 98823

SUBJECT: 2019 Conservation Potential Assessment

Dear Mr. Cole:

Please find attached the final report summarizing the 2019 Grant County Public Utility District (Grant PUD) Conservation Potential Assessment.

This report covers the 20-year time period from 2020 through 2039. The measures and information used to develop Grant PUD's conservation potential incorporate the most current information available for Energy Independence Act reporting. The near-term potential has increased slightly from the 2017 assessment, due to a multitude of competing factors. Over the 20-year study period, savings potential is down slightly.

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.

Regards,

Ted Light

Ted Light
Senior Project Manager

570 Kirkland Way, Suite 100
Kirkland, Washington 98033

Telephone: 425 889-2700 Facsimile: 425 889-2725

A registered professional engineering corporation with offices in Kirkland, WA and Portland, OR

Contents

Executive Summary

This report describes the methodology and results of the 2019 Conservation Potential Assessment (CPA) for Grant County Public Utility District (Grant PUD). This assessment provides estimates of energy savings for the period 2020 to 2039. The assessment considered a wide range of conservation resources that are reliable, available, and cost-effective within the 20-year planning period.

Background

Grant PUD provides electricity service to more than 46,900 customers in Grant County, Washington.

Washington's Energy Independence Act (EIA), effective January 1, 2010 and modified October 4, 2016, 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 (d) and is consistent with the methodology used by the Northwest Power and Conservation Council (Council) in developing the Seventh Power Plan. Thus, this Conservation Potential Assessment will support Grant PUD's compliance with EIA requirements.

This assessment was built on the same model used in the 2017 CPA, which was based on the completed Seventh Power Plan. The model was updated to reflect changes since the completion of the 2017 CPA. The primary model updates included the following:

- Avoided Cost
  - Recent forecast of wholesale power market prices
  - New transmission and distribution capacity costs based on new values from the Council
  - New environmental costs due to legislation, including the social costs of carbon and standards for carbon-neutral energy specified by Washington's Clean Energy Transformation Act
- A peak hour definition specific to Grant PUD
- Customer Characteristics Data
- Updated Customer Characteristics Data
  - New residential home counts and characteristics
  - Updated commercial floor area
  - Updated industrial sector consumption
  - New forecast of data center loads

- Measure Updates
  - Measure savings, costs, and lifetimes were updated based on the latest updates available from the Regional Technical Forum (RTF)
  - New measures not included in the Seventh Plan but subsequently reviewed by the RTF were added
- Accounting for recent achievements in Grant PUD's programs

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

Results

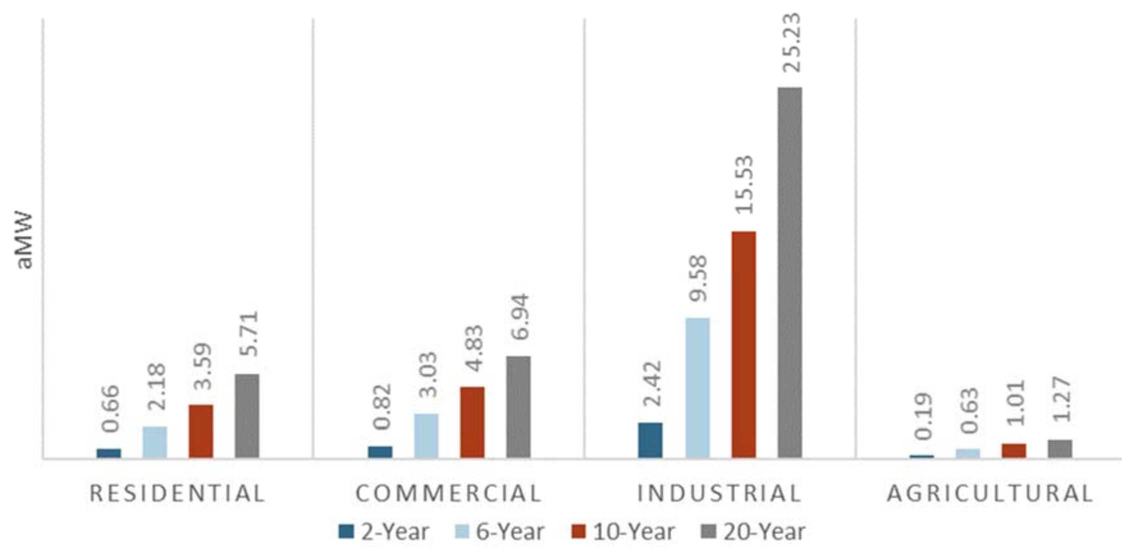
Table ES-1 and Figure ES-1 show the high-level results of this assessment, the cost-effective potential by sector in 2, 6, 10, and 20-year increments. The total 20-year energy efficiency potential is 39.15 aMW. The most important numbers per the EIA are the 10-year potential of 24.95 aMW, and the 2-year potential of 4.09 aMW.

Table ES-1
Cost-Effective Potential (aMW)

	2-Year	6-Year	10-Year	20-Year
Residential	0.66	2.18	3.59	5.71
Commercial	0.82	3.03	4.83	6.94
Industrial	2.42	9.58	15.53	25.23
Agricultural	0.19	0.63	1.01	1.27
Total	**4.09**	**15.42**	**24.95**	**39.15**

These estimates include energy efficiency that could be achieved through Grant PUD's own utility programs, through its share of the Northwest Energy Efficiency Alliance (NEEA) accomplishments, and also through the utility's share of future momentum savings (defined as energy efficiency that occurs outside of utility programs). In addition, it is likely that some of the potential will be achieved through codes and standards, especially in the later years.

Figure ES-1
Cost-Effective Potential



Energy efficiency also has the potential to reduce peak demands. Based on the hourly load profiles developed for the Seventh Power Plan and load data provided by Grant PUD, the reductions in peak demand provided by energy efficiency are summarized in Table ES-2 below. Grant PUD's system was assumed to peak in both summer evenings and winter mornings. The peak demand savings, measured in megawatts, are nearly double the annual energy savings. In addition to these peak demand savings, additional demand savings would occur throughout the year.

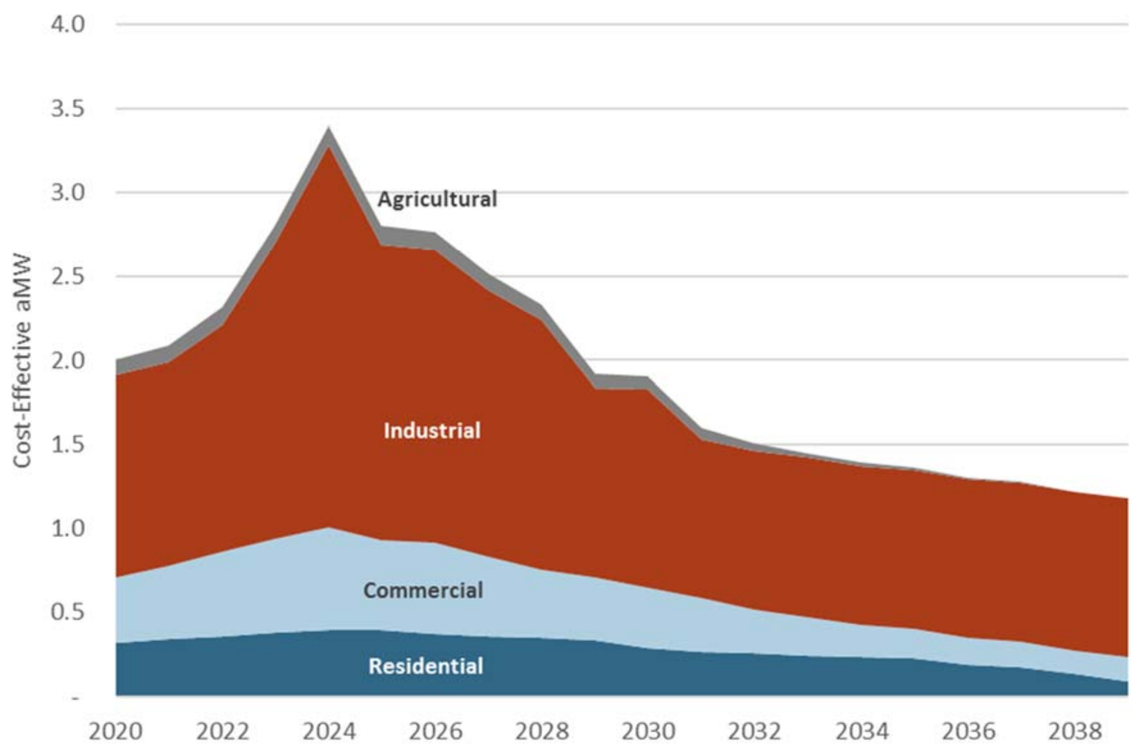
Table ES-2
Cost Effective Demand Savings - Base Case (MW)

	2-Year	6-Year	10-Year	20-Year
Residential	0.82	4.19	10.26	22.96
Commercial	0.68	3.48	8.14	20.93
Industrial	2.66	7.63	11.89	17.74
Agricultural	0.06	0.14	0.19	0.24
Total	**4.22**	**15.44**	**30.47**	**61.88**

The 20-year energy efficiency potential is shown on an annual basis in Figure ES-2. This assessment shows annual potential starting at 2.01 aMW in 2020 and ramping up to a maximum of 3.40 aMW in 2024. Potential gradually ramps down through the remaining years of the planning period.

Ramp rates from the Northwest Power and Conservation Council's (Council) Seventh Power Plan technical documentation were used to develop the annual savings potential over the 20-year study for the residential, commercial, and agriculture sectors. Some measures in these sectors were assigned lower ramp rates than what was used in the Seventh Power Plan to more closely match Grant PUD's recent program achievement levels. Industrial measures were assigned a custom ramp rate developed by EES. Compared with the Seventh Power Plan, the EES industrial ramp rate smooths potential out over a longer period of time. The EES ramp rate reflects Grant PUD's historic achievement patterns where large industrial projects are completed as both the PUD and the companies are able to budget for those projects. Historically, Grant PUD has saved an average of 1.05 aMW in the industrial sector (2014-2017), although larger savings are sometimes achieved with the construction of new data centers.

Figure ES-2
Annual Cost-Effective Energy Efficiency Potential



The largest share of potential is available in Grant PUD's industrial sector, which includes data centers. The notable areas for industrial potential include:

- Energy management measures, including Strategic Energy Management and the efficient operation of other motor-driven industrial systems
- Data center efficiency measures
- Lighting – including high bay and other efficient lighting
- Refrigerated storage – including fruit, food and cold storage equipment tune-ups and retrofits

Significant potential is also available in the commercial sector. Commercial sector potential falls into the main categories of commercial energy usage, lighting and HVAC, with additional savings potential available across a variety of other end uses.

Comparison to Previous Assessment

Table ES-3 shows a comparison of 2 and 10-year conservation potential by customer sector for this assessment and the results of Grant PUD's 2017 CPA.

Table ES-3
Comparison of 2017 and 2019 CPA Cost-Effective Potential

	2-Year			10-Year		
	2017	**2019**	**% Change**	**2017**	**2019**	**% Change**
Residential	0.23	0.66	190%	3.44	3.59	4%
Commercial	0.47	0.82	74%	5.22	4.83	-8%
Industrial	2.40	2.42	0%	10.74	15.53	45%
Agricultural	0.56	0.19	-65%	2.92	1.01	-65%
Total	**3.67**	**4.09**	**12%**	**22.32**	**24.95**	**12%**

Notes:

1. Note that the 2017 columns refer to the CPA completed in 2017 for the time period of 2018 through 2037. The 2019 assessment is for the timeframe: 2020 through 2039.
2. Distribution system potential was not included in the 2017 or 2019 CPA. Grant PUD is unable to measure savings from distribution system efficiency projects; therefore, these measures were excluded from both potential and achievement.

The changes in conservation potential estimated since the 2017 study are the result of several changes to the input assumptions, including measure data and avoided cost assumptions. These are discussed below.

Measure Data

A lighting standard that impacts many common screw-in bulbs takes effect in 2020 and eliminated the consideration of many residential and some commercial lighting measures. The standard requires levels of efficiency found only in CFL and LED technologies. Studies of the lighting market show that CFL bulbs are quickly exiting the market, meaning that consumers will likely only be able to purchase LED bulbs beginning in 2020. This would leave little to no opportunities for utility programs to provide incentives.

Industrial Potential

The industrial potential was updated to include data centers, which were previously counted in the commercial sector. An updated data center forecast and updated industrial sector loads resulted in higher potential in this sector.

Avoided Cost

The Council updated its assumptions on the value of deferred capital expenditures for transmission and distribution capacity, with the new values being significantly lower. The extent to which each measure realizes these values depends on its contribution to reducing peak demands, so measures in the residential and commercial sectors, which tend to contribute more to reducing system peaks, were more impacted. Savings in the industrial sector tend to be more evenly distributed across time, so the changes in assumptions had less of an impact to the industrial sector.

Additionally, Washington state's recently enacted Clean Energy Transformation Act (CETA) will define a specific set of values for the social cost of carbon and set requirements for greenhouse gas neutral power in 2030, with alternate modes of compliance available until 2045. EES has included values that reflect these requirements and rulemaking completed to date. These changes increase the avoided cost of energy efficiency measures.

Ramp Rates

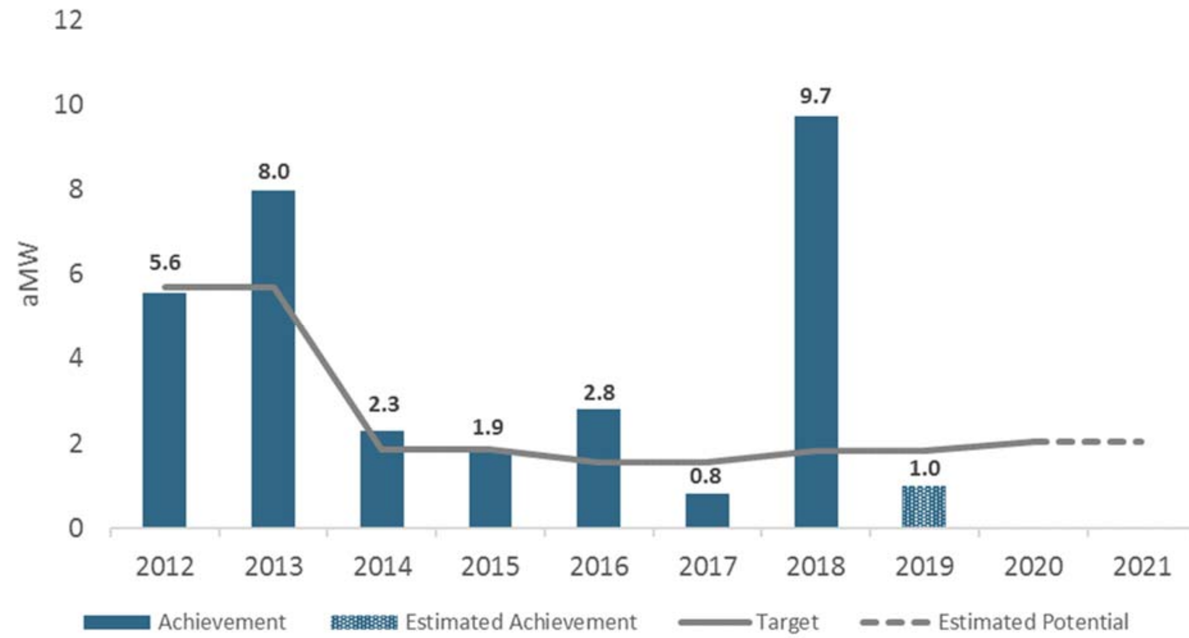
As part of the modeling process, EES uses ramp rates to align near term potential with recent levels of program achievement. This process resulted in further changes to the estimated availability of conservation potential.

Targets and Achievement

Figure ES-3 compares Grant PUD's historic conservation achievement with its targets. The 2020 and 2021 potential estimates are based on the Base Case results of this assessment. The savings from 2018 includes large savings from data center projects. With an average achievement of 3.5 aMW per year between 2012 and 2018, the potential estimates for 2020-2021 of 2.05 aMW per year are achievable through Grant PUD's utility energy efficiency programs, the utility's share of NEEA savings, and Grant PUD's share of future momentum savings.[1]

[1] Targets and potential shown in the figure are based on numbers reported to Washington State Department of Commerce. Note that savings significantly declined in 2014 due to a reduction in Scientific Irrigation Scheduling claimed by Grant PUD.

Figure ES-3
Historic Achievement and Targets



Summary

This report summarizes the CPA conducted for Grant PUD for the 2020 to 2039 timeframe. Many components of the CPA have been updated from the previous CPA, including items such as customer load forecasts, the energy market price forecast, code and standard changes, recent conservation achievements, and revised savings values for RTF and Council measures.

Additionally, the state's new clean energy law required changes to the avoided cost assumptions.

Based on the results of the Base Case scenario, the total 10-year cost effective potential is 24.95 aMW and the 2-year potential is 4.09 aMW.

Introduction

Objectives

The objective of this report is to describe the results of the Grant County Public Utility District (Grant PUD) 2019 Conservation Potential Assessment (CPA). This assessment provides estimates of energy savings for the period 2020 to 2039, with the primary focus on 2018 to 2027 (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 Grant PUD's compliance documentation. The results and guidance presented in this report will also assist Grant PUD in strategic planning for its conservation programs in the near future. Finally, the resulting conservation supply curves can be used in Grant PUD's integrated resource plan (IRP).

The conservation measures used in this analysis are based on the measures that were included in the Council's Seventh Power Plan and were updated with subsequent changes and new measures approved by the Regional Technical Forum (RTF). The assessment considered a wide range of conservation resources that are reliable, available, and cost effective within the 20-year planning period.

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 for the upcoming ten years using methodologies consistent with the Pacific Northwest Power and Conservation Council's (Council) latest power planning document.
- By January 1 of each even-numbered year, each utility shall establish a biennial acquisition target for cost-effective conservation that is no lower than the utility's pro rata share of the ten-year cost-effective conservation potential for the subsequent ten years.
- By June 1 of each year, 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 results of a comprehensive CPA conducted following the requirements of the EIA. A checklist of how this analysis meets EIA requirements is included in Appendix III.

Other Legislative Considerations

Washington state recently enacted several laws that impact conservation planning. Washington HB 1444 enacts efficiency standards for a variety of appliances, some of which are included as measures in this CPA. This law takes effect on July 28, 2019 and applies to products manufactured after January 1, 2021. As the law applies to the manufacturing date, products not meeting the efficiency levels set forth in the law could continue to be sold in 2021 and a reasonable time of six months or more may be necessary for product inventories to turn over. As such, the standards contained in this law will be addressed in the 2021 CPA. HB 1444 also contains a duplicate requirement of the federal lighting standard scheduled to take effect in 2020. While there currently is some doubt about whether the federal standard will come into effect, HB 1444 ensures that the same standards will apply to lighting in Washington state and with the same timing as the federal standard.

Washington also recently enacted the Clean Energy Transformation Act (CETA). The law contains two provisions that impact potential assessments: the use of a specific set of values for the social cost of carbon and the requirement that all sales be greenhouse gas neutral beginning in 2030, although there are alternate modes of compliance available until 2045. These provisions of the law have been incorporated into the assumptions of this CPA.

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 Grant 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. Different avoided cost scenarios are included in the analysis to consider the sensitivity of the results to different market prices over the study period.
- Utility system assumptions – Credits have been included in this analysis to account for the avoided costs of transmission and 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. A value

for generation capacity was also included but may change as the Northwest market continues to evolve.

- Discount and finance rate – For this study, a discount rate specific to Grant PUD was used. Assumptions from the Seventh Plan about measure financing costs were also applied in the model. The Council develops a finance rate for each power plan based on the relative share of the costs of conservation and the cost of capital for the various program sponsors. The Council has estimated these figures using the most current available information. While this study reflects current values for the discount and finance rates, changes in market rates will likely vary over the study period.
- Load and customer growth forecasts – 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. This assessment uses the hourly load shapes used in the Seventh Plan to estimate peak demand savings over the planning period, based on shaped energy savings. Since the load shapes are a mix of older Northwest and California data, peak demand savings presented in this report may vary from actual peak demand savings.
- 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 – Grant 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 scenarios
- Summary
- References & Appendices

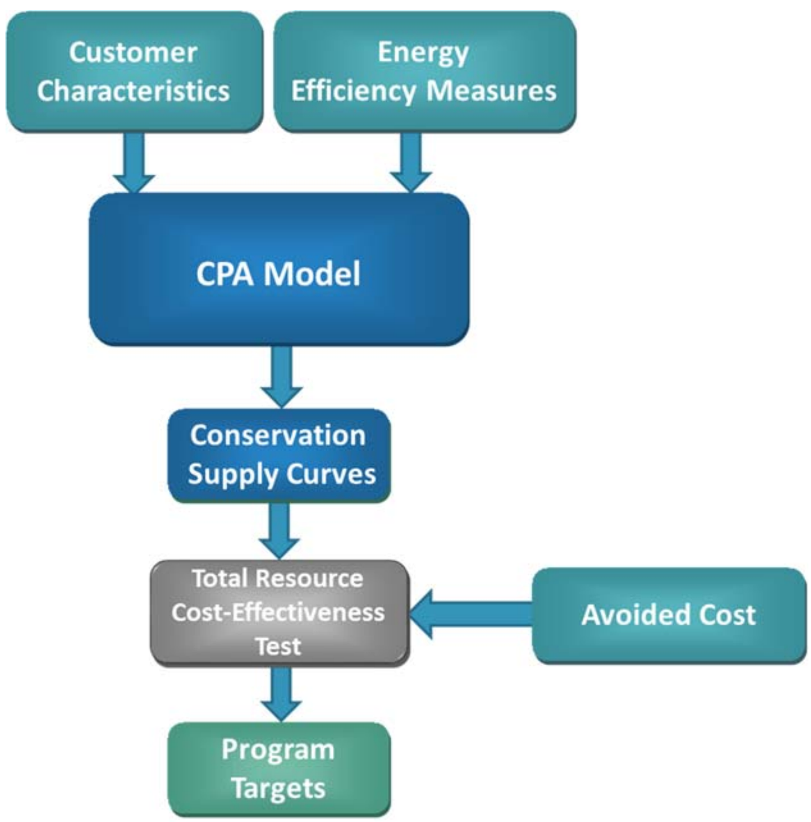
CPA Methodology

This study is a comprehensive assessment of the energy efficiency potential in Grant PUD's service area. The methodology complies with RCW 19.285.040 and WAC 194-37-070 Section 5 parts (a) through (d) and is consistent with the methodology used by the Northwest Power and Conservation Council (Council) in developing the Seventh Power Plan. This section provides a broad overview of the methodology used to develop Grant PUD's conservation potential estimates. 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 energy 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 study period. 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



Customer Characteristic Data

Assessment of customer characteristics includes estimating both the number of locations where a measure could be feasibly installed as well as the share—or saturation—of measures that have already been installed. For this analysis, the characterization of Grant PUD's baseline was determined based on information provided by Grant PUD's staff, NEEA's commercial and residential building stock assessments, and census data. Details of data sources and assumptions are described for each sector later in the report.

This assessment primarily sourced baseline measure saturation data from the Council's Seventh Plan measure workbooks. The Council's data was developed from NEEA's Building Stock Assessments, studies, market research and other sources. This data was updated with NEEA's 2016 Residential Building Stock Assessment and Grant PUD's program achievements. Grant PUD's historic achievement is discussed in detail in the next section.

Energy Efficiency Measure Data

The characterization of efficiency measures includes measure savings, costs, and lifetime. 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 the primary source for conservation measure data. Where appropriate, the Council's Seventh Plan supply curve workbooks have been updated to include any subsequent updates from the RTF. New measures reviewed by the RTF were also added to the model.

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: discount rate, line losses, and deferred capacity-expansion benefits.

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

Types of Potential

Once the customer characteristics and energy efficiency measures are fully described, energy efficiency potential can be quantified. Three types of potential are used in this study: technical, achievable, and economic or cost-effective potential. Technical potential is the theoretical maximum efficiency available in the service territory if cost and market barriers are not considered. Market barriers and other consumer acceptance constraints 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 achievable potential that has been screened for cost effectiveness through a benefit-cost test. Figure 2 illustrates the three types of potential followed by more detailed explanations.

Figure 2
Types of Energy Efficiency Potential[2]

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 a given measure. It represents the theoretical maximum amount of energy efficiency that is possible in a utility's service territory absent these constraints.

Estimating the technical potential begins with determining a value for the energy efficiency measure savings. Additionally, the number of applicable units must be estimated. Applicable units are the units across a service territory where the measure could feasibly be installed. This includes accounting for units that may have already been installed. The 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. 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, interaction occurs when a home installs energy efficient lighting and the demands on the heating system rise due to a reduction in heat emitted by the lights. If a home installs both insulation and a high-efficiency heat pump, the total savings of these stacked measures is less than if each measure were installed individually because the demands on the heating system are lower in a well-insulated home. Interaction is addressed by accounting for impacts on other energy uses. Stacked measures within the same end use are often addressed by considering the

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

savings of each measure as if it were installed after other measures that impact the same end use.

The total technical potential is often significantly more than the amount of achievable and economic potential. The difference between technical potential and achievable potential is a result of the number of measures assumed to be affected by market barriers. Economic potential is further limited due to the number of measures in the achievable potential that are not cost-effective.

Achievable Technical – Achievable technical potential, also referred to as achievable potential, is the amount of potential that can be achieved with a given set of market conditions. It takes into account many of the realistic barriers to adopting energy efficiency measures. These barriers include market availability of technology, consumer acceptance, non-measure costs, and the practical 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 assumes that 85% of technical potential can be achieved over the 20-year study period. This is a consequence of a pilot program offered in Hood River, Oregon where home weatherization measures were offered at no cost. The pilot was able to reach 85% of homes. The Council also uses a variety of ramp rates to estimate the rate of achievement over time. This CPA follows the Council's methodology, including both the achievability and ramp rate assumptions.

Economic – Economic potential is the amount of potential that passes an economic benefit-cost test. In Washington State, EIA requirements stipulate that the total resource cost test (TRC) be used to determine economic potential. The TRC evaluates all 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, avoided social costs of carbon emissions, reduced renewable portfolio standard costs, 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 from energy efficient clothes washers.

For this potential assessment, the Council's ProCost model was used to determine the cost effectiveness of 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 2019 CPA evaluates measure savings on an hourly basis, but ultimately values the energy savings during two segments covering high and low load hour time periods. The avoided costs used in the economic screening are discussed below.

Avoided Cost

The avoided cost of energy is the cost that is avoided through the acquisition of energy efficiency in lieu of other resources. Avoided costs are used to value energy savings benefits when conducting cost effectiveness tests and are included in the numerator in a benefit-cost test. The avoided costs typically include energy-based values and values associated with the demand savings provided by energy efficiency. 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 IRP process.

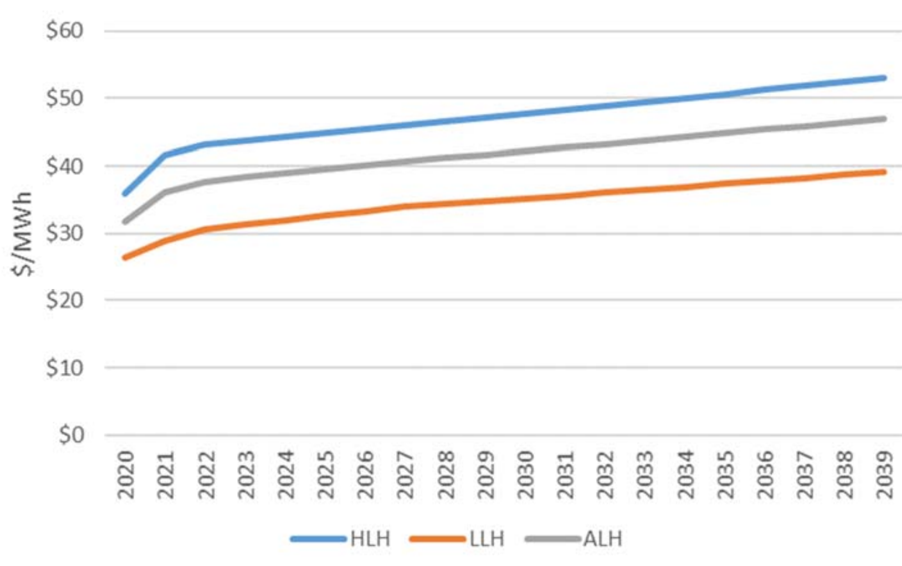
Each component of the avoided cost of energy efficiency measure savings is described below. Additional information regarding the avoided cost forecast is included in Appendix IV.

Energy

The EIA requires that utilities "…set avoided costs equal to a forecast of market prices." Figure 3 shows the price forecast used as the primary avoided cost component for the planning period.

The price forecast is shown for heavy load hours (HLH), light load hours (LLH), and average load hours (ALH). The market price forecast was provided by the utility and is used by the utility for power planning purposes. The levelized value of market prices over the study period is $44.75/MWh, assuming a 7 percent nominal discount rate.

Figure 3
20-Year Market Price Forecast



Social Cost of Carbon

In addition to the avoided cost of energy, energy efficiency provides the benefit of reducing carbon emissions. The revised EIA rules require the inclusion of the social cost of carbon, which is a cost that society incurs when fossil fuels are burned to generate electricity. Further, Washington state's recently enacted Clean Energy Transformation Act (CETA) specified that utilities use the social cost of carbon developed by the federal Interagency workgroup using the 2.5 percent discount rate. These values were used in the base and high scenarios of the CPA. The CPA also included assumptions about the carbon intensity of Grant PUD's marginal resource as well as the recently expanded Renewable Portfolio Standard (RPS) requirements, discussed below.

Renewable Portfolio Standard Compliance Cost

By reducing Grant PUD's overall load, energy efficiency provides a benefit of reducing the RPS requirement. The EIA currently requires Grant PUD to source 9% of its energy from renewable energy sources. In 2020, the requirement increases to 15% and Washington's CETA requires that all sales be greenhouse gas neutral in 2030, with an allowance that up to 20% of the requirement can be met through REC purchases. Under a 15% RPS requirement, for every 100 units of conservation achieved, the RPS requirement is reduced by 15 units. After 2030, due to the increased requirement, the CPA assumes that the marginal cost of power includes the full price of a REC when the marginal resource is assumed to be carbon emitting.

Transmission and Distribution System Benefits

The EIA requires that deferred capacity expansion benefits for transmission and distribution systems be included in the CPA cost-effectiveness analysis. The Council recently updated its previous estimates for these capacity savings, which were $31/kW-year and $26/kW-year for distribution and transmission systems, respectively ($2012). These values were used in the Seventh Plan. The new values, $3.08/kW-year and $6.85/kW-year for transmission and distribution systems, respectively, will be used in the next Power Plan.

Generation Capacity

New to the Seventh Plan was the explicit calculation of a value for avoided generation capacity costs. Since the Northwest does not have an organized capacity market, the uncertainty of this value was addressed through a scenario analysis, where low, base, and high values were considered. For the base scenario, a three percent premium was added to market energy prices, which represents the premium value for capacity made available for sale through energy efficiency.

Risk Analysis

In the past, Grant PUD's CPAs have included risk mitigation credits in the scenario analysis to account for risks that were not quantified. Rather than including an explicit risk credit in each of the scenarios, this CPA addresses the uncertainty of the inputs by varying the avoided cost values. The avoided cost components that were varied included the energy prices, generation capacity value, and the social cost of carbon. Through the variance of these components, implied risk credits averaging $6/MWh and $115/kW-year were included in the high avoided cost scenario.

Additional information regarding the avoided cost forecast and risk mitigation credit values is included in Appendix IV.

Pacific Northwest Electric Power Planning and Conservation Act Credit

Finally, a 10 percent benefit was also added to measures per the Pacific Northwest Electric Power Planning and Conservation Act and as required by the EIA.

Discount and Finance Rate

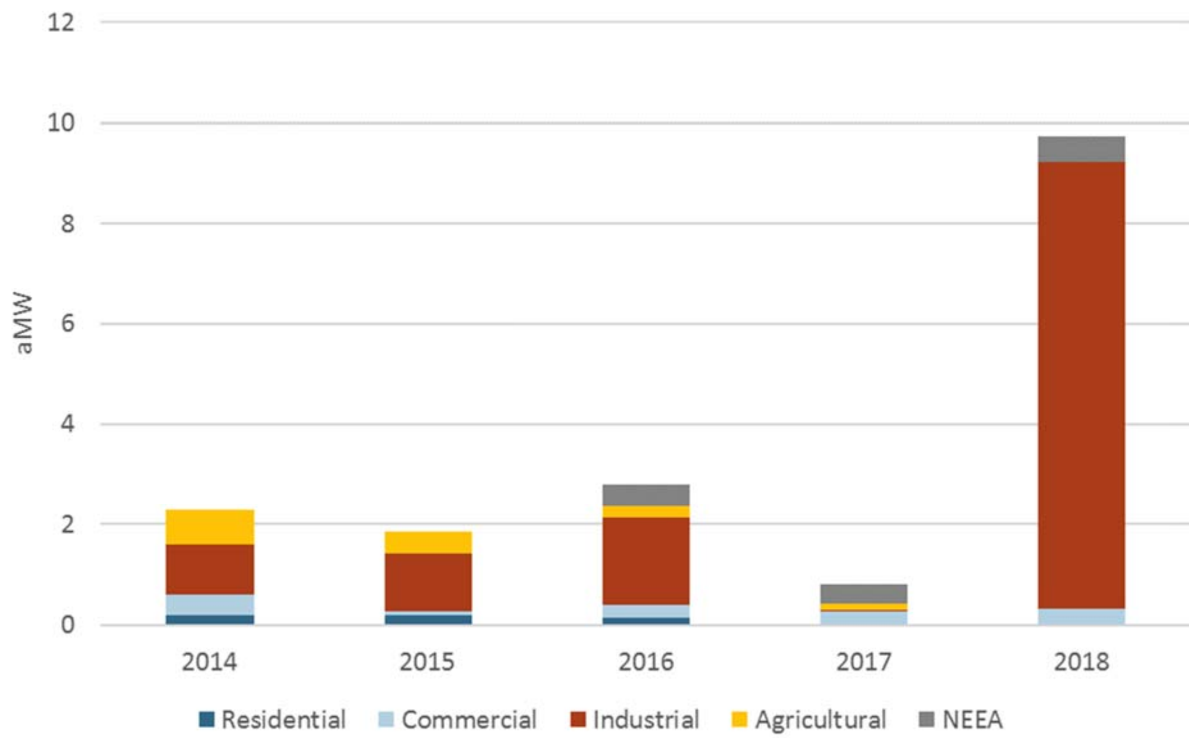
A discount rate is used to convert future cost and benefit streams into present values. The present values are then used to compare net benefits across measures that realize costs and benefits at different times and over different useful lives. This analysis uses a nominal discount rate of 7 percent (equivalent to a 5.7 percent real discount rate).

In addition, the Council uses a finance rate 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 both 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 finance rate.

Recent Conservation Achievement

Grant PUD has pursued conservation and energy efficiency resources for many years. Currently, the utility offers several rebate programs for both residential and non-residential applications. These include incentives for weatherization upgrades, heat pumps and ductless heat pumps, and custom projects. In addition to utility programs, Grant PUD receives credit for market-transformation activities that impact its service territory. These market-transformation activities are accomplished by the Northwest Energy Efficiency Alliance (NEEA). Figure 4 shows Grant PUD's conservation achievement from 2014 through 2018.

Figure 4
Grant PUD's Recent Conservation History by Sector

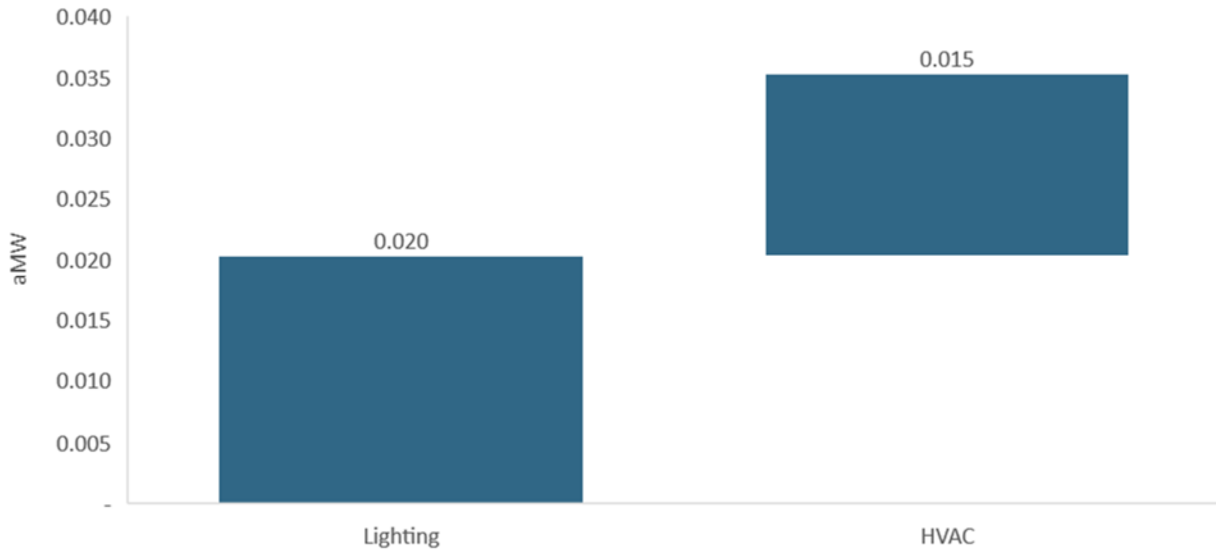


Grant PUD has achieved an average of 3.51 aMW of energy savings per year since 2014. This includes savings achieved through utility program efforts and NEEA savings. More detail on Grant PUD's utility program achievement is provided below for each customer sector.

Residential

Figure 5 shows recent conservation achievement by program in the residential sector. Due to the large share of electric heat in Grant PUD's service area, heating and weatherization measures account for just under half of the savings in the residential sector. Lighting savings account for the largest portion of recent program history, but these savings were not included in this CPA due to product standards taking effect in 2020.

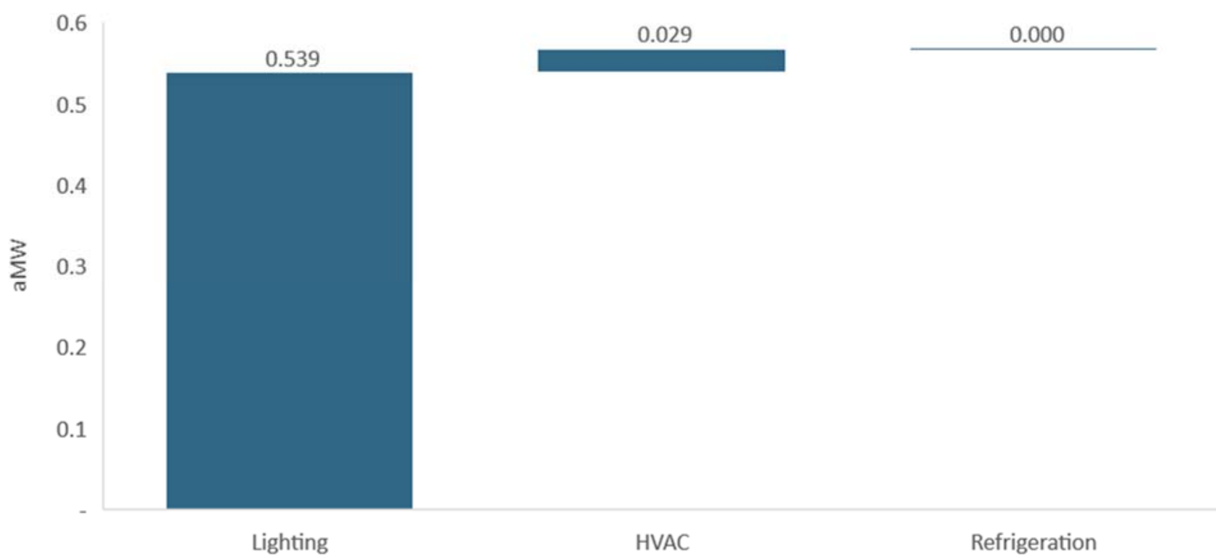
Figure 5
2017-2018 Residential Savings



Commercial

Historic achievement in the commercial sector is primarily due to lighting projects. Figure 6 shows the breakdown of commercial sector achievement from 2017-2018.

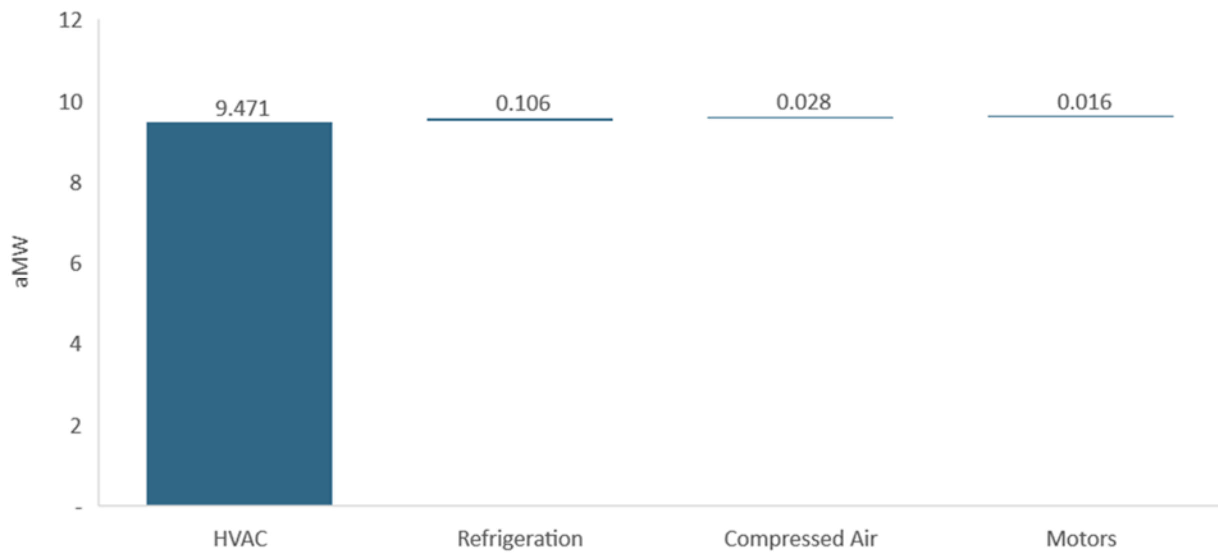
Figure 6
2017-2018 Commercial Savings



Industrial

Recent industrial achievement has been acquired through custom projects at Grant PUD's large data centers as well as smaller savings from other end uses. Figure 7 summarizes the industrial sector achievement in 2017-18.

Figure 7
2017-2018 Industrial Savings



Agriculture

Agriculture program achievement has been acquired through irrigation hardware and other system upgrades, such as variable frequency drives. Achievement from 2017-2018 in this sector totals 0.16 aMW.

Summary

Grant PUD plans to continue offering incentives for energy efficiency investments. The results of this study will assist Grant PUD program managers in strategic planning for energy efficiency program offerings, incentive levels, and program review.

Customer Characteristics Data

Grant PUD serves over 46,900 electric customers in Grant County, Washington, with a service area population of approximately 97,331. A key component of an energy efficiency assessment is to understand the characteristics of these customers – primarily the building and end-use characteristics. These characteristics for each customer class are described below.

Residential

For the residential sector, the key characteristics include house type, space-heating fuel, and water heating fuel. Tables 1, 2, and 3 show relevant residential data for single family, multi-family and manufactured homes in Grant PUD's service territory. Residential characteristics are based on data collected through home audits provided by Grant PUD. These data provide estimates of the current residential characteristics in Grant PUD's service territory and are utilized as the baseline in this study.

This assessment assumes an average annual residential growth rate of 1.2 percent, based on sales forecasts, and uses the regional average annual demolition rate.

Table 1
Residential Building Characteristics

Heating Zone	Cooling Zone	Solar Zone	Residential Households	Total Population
1	3	3	37,967	97,331

Table 2
Existing Homes - Heating / Cooling System Saturations

Electric Heat/Cooling System Saturations	Single Family	Multifamily - Low Rise	Manufactured
Electric Forced Air Furnace	25%	1%	85%
Heat Pump	35%	1%	15%
Ductless Heat Pump	1%	2%	0%
Electric Zonal/Baseboard	39%	96%	0%
Central Air Conditioning	48%	2%	11%
Room Air Conditioners	42%	35%	3%

New Homes - Heating / Cooling System Saturations

Electric Heat/Cooling System Saturations	Single Family	Multifamily - Low Rise	Manufactured
Electric Forced Air Furnace	0%	0%	74%
Heat Pump	97%	2%	26%
Ductless Heat Pump	2%	97%	0%
Electric Zonal/Baseboard	0%	0%	0%
Central Air Conditioning	97%	2%	26%
Room Air Conditioners	1%	0%	10%

Table 3

Existing Homes - Appliance Saturations			
Appliance Saturation	Single Family	Multifamily - Low Rise	Manufactured
Electric Water Heaters	97%	97%	97%
Refrigerator	129%	103%	121%
Freezer	53%	4%	43%
Clothes Washer	99%	47%	99%
Clothes Dryer	98%	47%	95%
Dishwasher	89%	78%	77%
Electric Oven	98%	97%	98%
Desktop	96%	44%	71%
Laptop	68%	26%	42%
Monitor	102%	45%	72%

New Homes - Appliance Saturations			
Appliance Saturation	Single Family	Multifamily - Low Rise	Manufactured
Electric Water Heaters	99%	99%	99%
Refrigerator	129%	103%	121%
Freezer	53%	4%	43%
Clothes Washer	99%	47%	99%
Clothes Dryer	99%	47%	99%
Dishwasher	89%	78%	77%
Electric Oven	98%	97%	98%
Desktop	96%	44%	72%
Laptop	68%	26%	52%
Monitor	102%	45%	72%

Commercial

Building floor area 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 area. Grant PUD provided 2018 consumption for each of the 18 building categories shown in Table 4. Floor area for each category was calculated based on 2018 consumption and regional energy use intensity (EUI) values. The regional EUI values used for this assessment are based on data collected for the 2014 Commercial Building Stock Assessment (CBSA).[3]

Commercial square footage estimates for this assessment are slightly higher than those used in the 2017 CPA.

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

A growth rate of 2.2 percent was used based on the forecast of sales for the commercial rate class. In addition, a demolition rate was used based on the Council's regional assumption.

Table 4
Commercial Building Square Footage by Segment

Segment	Area (Square Feet)	EUI (kWh/sf)*	Growth Rate
Large Office	22,128	15.9	
Medium Office	777,053	15.9	
Small Office	1,035,713	15.9	
Extra Large Retail	730,992	12.7	
Large Retail	225,658	12.7	
Medium Retail	773,412	12.7	
Small Retail	1,723,534	12.7	
K-12 Schools	4,019,941	9.77	
University	883,927	17.9	
Warehouse	23,158,268	5.46	
Supermarket	348,008	54.6	
Mini Mart	203,509	54.6	
Restaurant	467,747	44.1	
Lodging	2,137,264	14.3	
Hospital	632,421	23.7	
Residential Care	42,059	12.7	
Assembly Hall	1,434,465	14.5	
Other	5,640,209	11.6	
Total	**44,256,309**		**2.2%**

*NEEA 2014 Commercial Building Stock Assessment.

The Council includes data center savings potential in the commercial sector as the Seventh Plan analysis focuses on server room measures. Since Grant PUD data centers are large centralized loads, these are treated as industrial customers in the next section.

Industrial

The methodology for estimating industrial potential is different than approaches used for the residential and commercial sectors primarily because industrial energy efficiency opportunities 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.

Grant PUD provided 2018 energy use for its industrial customers. Individual industrial customer usage is summed by industrial segment in Table 5. The 2018 industrial sector consumption totaled 1,551 GWh compared with 1,658 GWh in 2016. Grant PUD's sales forecast projects a growth of 1.2% for the industrial sector.

Table 5 Industrial Sector Load by Segment		
Segment	**MWh**	**Annual Growth Rate**
Paper	14,914	
Foundries	28,022	
Frozen Food	236,214	
Other Food	17,099	
Silicon	50,340	
Metal Fabrication	3,281	
Equipment	140,923	
Cold Storage	40,047	
Fruit Storage	42,111	
Refinery	158,970	
Chemical	555,539	
Miscellaneous Manufacturing	422,780	
Total	**1,551,271**	**1.2%**

The table above does not include data centers, which represent a large portion of Grant PUD's load and have been an occasional source of large amounts of savings. Through discussions with Grant PUD staff, it was determined the opportunities to work with these customers on energy efficiency generally occurs during construction, and typically on measures relating to the shell and mechanical systems. Many data center operators are intrinsically motivated to install energy efficient servers, or their business model prevents such upgrades from happening after the start of operations. As such, of the measures applicable to data centers, only the measures relating to building shell and mechanical systems were included, and the opportunities were quantified based only on the forecasted growth of data centers.

Agriculture

To determine agriculture sector characteristics in Grant PUD's service territory, EES utilized 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.[4] EES further refined this data based on zip code data published in an earlier census.

Irrigated acreage of 406,093 acres was used for this assessment, down slightly from the 2017 CPA. Dairy farms with a total of 28,103 cattle was also used to quantify dairy farm potential. According to our estimates, there are 1,517 farms in Grant PUD's service territory. The number

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

of farms is used to determine potential for an area lighting measure. Table 6 shows key agriculture sector characteristics and applicable data.

Table 6 Agriculture Sector Inputs		
Agriculture Data	**Count**	**2012 Census Data Point**
Number of Farms	1,517	Total number of farms
Irrigated Acres	406,093	Irrigated land
Dairy Cows	28,103	Milk Cows

Conservation potential for Scientific Irrigation Scheduling (SIS) was excluded from this assessment, as was done in the 2017 CPA. A review of savings conducted by the Bonneville Power Administration confirmed Grand PUD's findings that the measures do not provide savings.

Results – Energy Savings and Costs

Achievable Conservation Potential

Achievable potential is the amount of energy efficiency potential that is available regardless of cost. It represents the theoretical maximum amount of achievable energy efficiency savings.

Figure 8 below shows a supply curve of the 20-year, achievable potential. A supply curve is developed by plotting cumulative energy efficiency savings potential against the levelized cost of savings when measures are sorted in order of ascending cost. The potential has not been screened for cost effectiveness. Costs are 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. The cost used is the net levelized cost, and includes credits for deferred transmission and distribution system costs, avoided periodic replacements, non-energy impacts, etc. As such, some measures with non-energy savings like clothes washers and showerheads, measures that avoid future equipment costs like long-lasting LED lighting, and measures that provide significant reductions in peak demand have a negative net levelized cost. This net levelized cost facilitates a more direct comparison to other supply-side options.

Figure 8
20-Year Achievable Potential Supply Curve

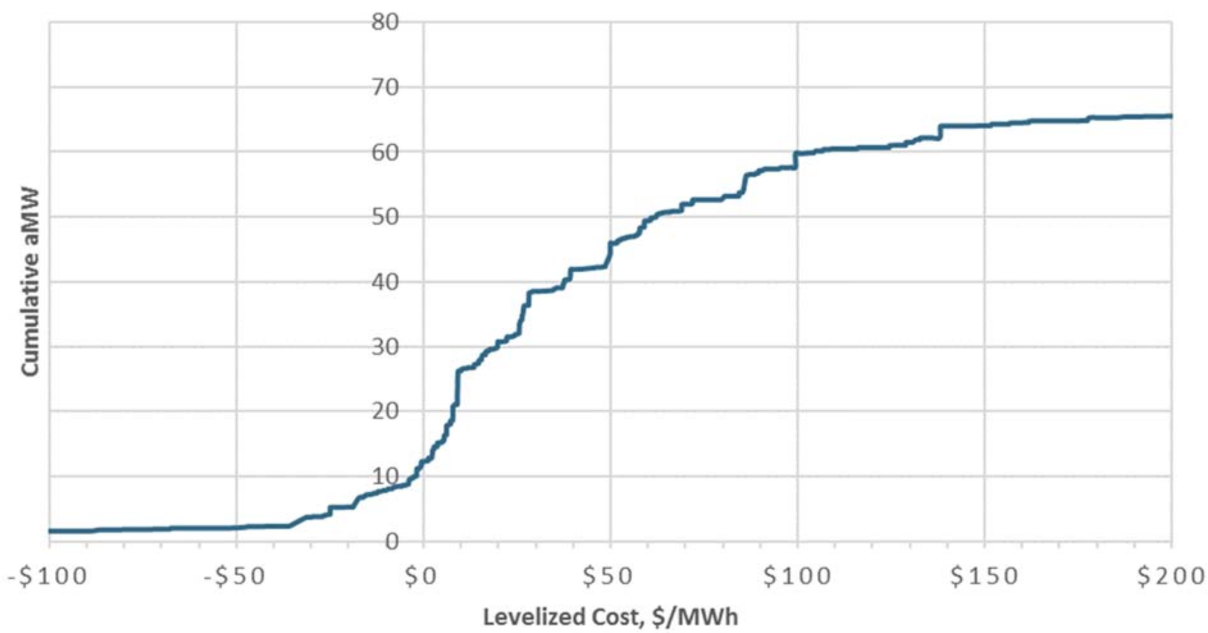
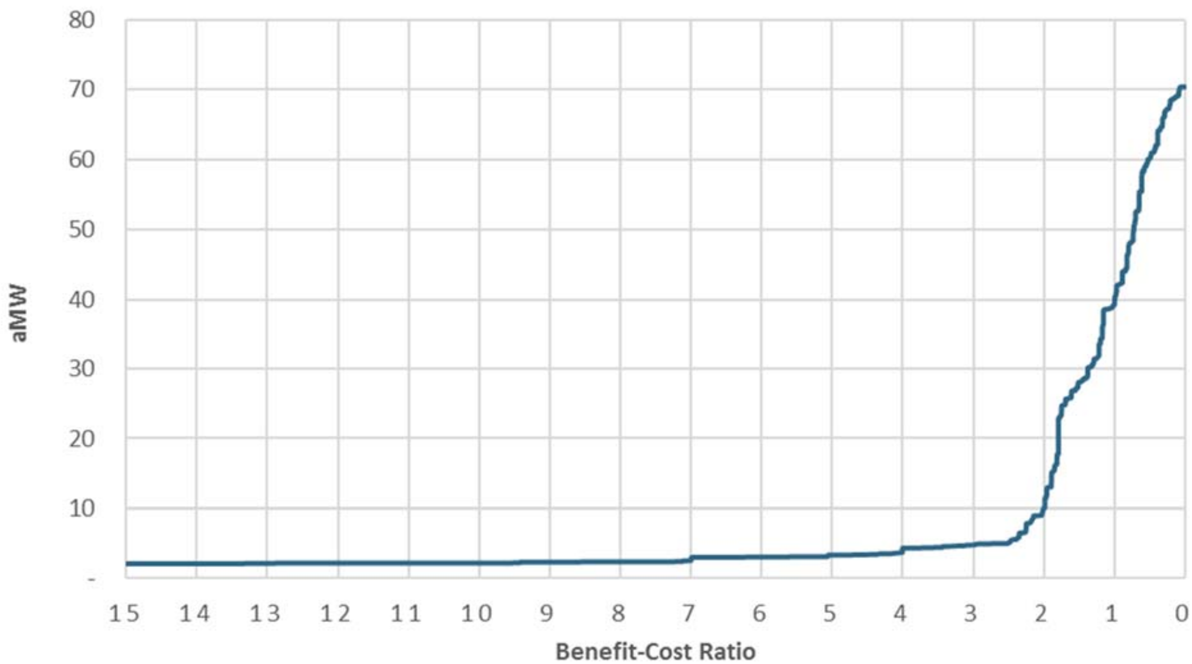


Figure 8 shows that approximately 38.6 aMW of savings potential is available for less than $30/MWh and 52.7 aMW are available for under $80/MWh. The total achievable potential for Grant PUD is approximately 70 aMW over the 20-year study period.

While useful for considering the costs of conservation measures, supply curves based on levelized cost are limited in that not all energy savings are equally valued. Another way to depict a supply curve is based on the benefit-cost ratio, as shown in Figure 9 below. This figure repeats the overall finding that approximately 39 aMW of potential is cost-effective with a benefit-cost ratio greater than or equal to 1.0. The potential rises and falls steeply to the right of the line where the benefit-cost ratio equals 1.0, suggesting significant changes in potential if avoided cost parameters are changed in either direction.

Figure 9
20-Year Benefit-Cost Ratio Supply Curve



Economic Conservation Potential

Economic or cost-effective potential is the amount of potential that passes the Total Resource Cost (TRC) test. This means the present value of the benefits attributed to the conservation measure exceeds the present value of the measure costs over its lifetime.

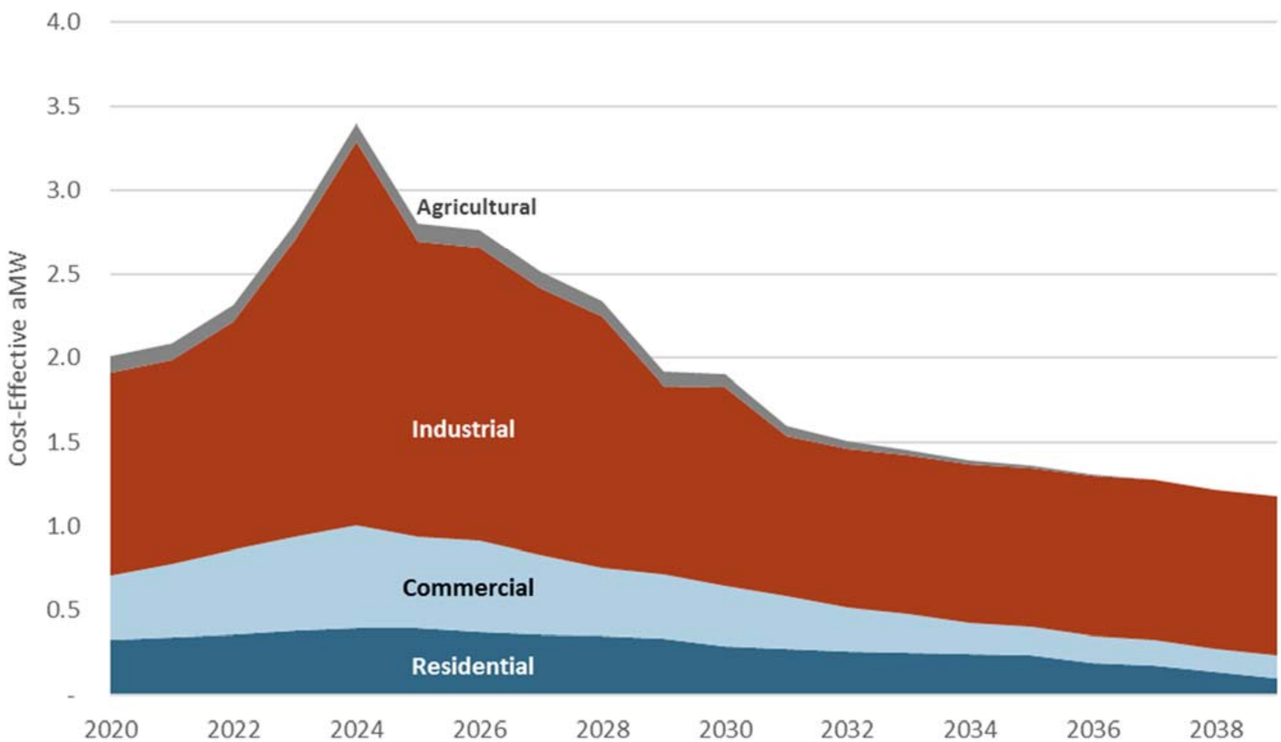
Table 7 shows aMW of economic (cost-effective) potential by sector in 2, 6, 10 and 20-year increments. Compared with the achievable potential, it shows that 39.15 aMW of the total 70 aMW is cost effective for Grant PUD. The last section of this report discusses how these values could be used for setting targets.

Table 7 Cost Effective Achievable Potential (aMW)				
	2-Year	**6-Year**	**10-Year**	**20-Year**
Residential	0.66	2.18	3.59	5.71
Commercial	0.82	3.03	4.83	6.94
Industrial	2.42	9.58	15.53	25.23
Agricultural	0.19	0.63	1.01	1.27
Total	**4.09**	**15.42**	**24.95**	**39.15**

Sector Summary

Figure 10 shows the cost-effective potential by sector on an annual basis.

Figure 10
Annual Cost-Effective Potential by Sector



The largest share of the potential is in the industrial sector followed by savings potential in commercial and residential sectors. Achievement levels are affected by factors including timing and availability of measure installation, program maturity, and current utility staffing and funding. Figure 10 shows savings estimates are ramped up over the initial years of the study period as opportunities in each sector grow. The ramp rates selected reflect both resource availability and Grant PUD's current program levels and achievements.

Residential

Within the residential sector, water heating and HVAC measures, which includes both heating equipment and weatherization measures, account for a significant share of cost-effective conservation (Figure 11). In the water heating end use, heat pump water heaters, clothes washers, and showerheads provide the most opportunity. Notable savings are available through duct sealing and weatherization measures within the HVAC category. Lighting measures were a leading measure in the 2017 CPA but were not included in the 2019 assessment due to product standards that take effect in 2020.

Figure 11
Annual Residential Potential by End Use

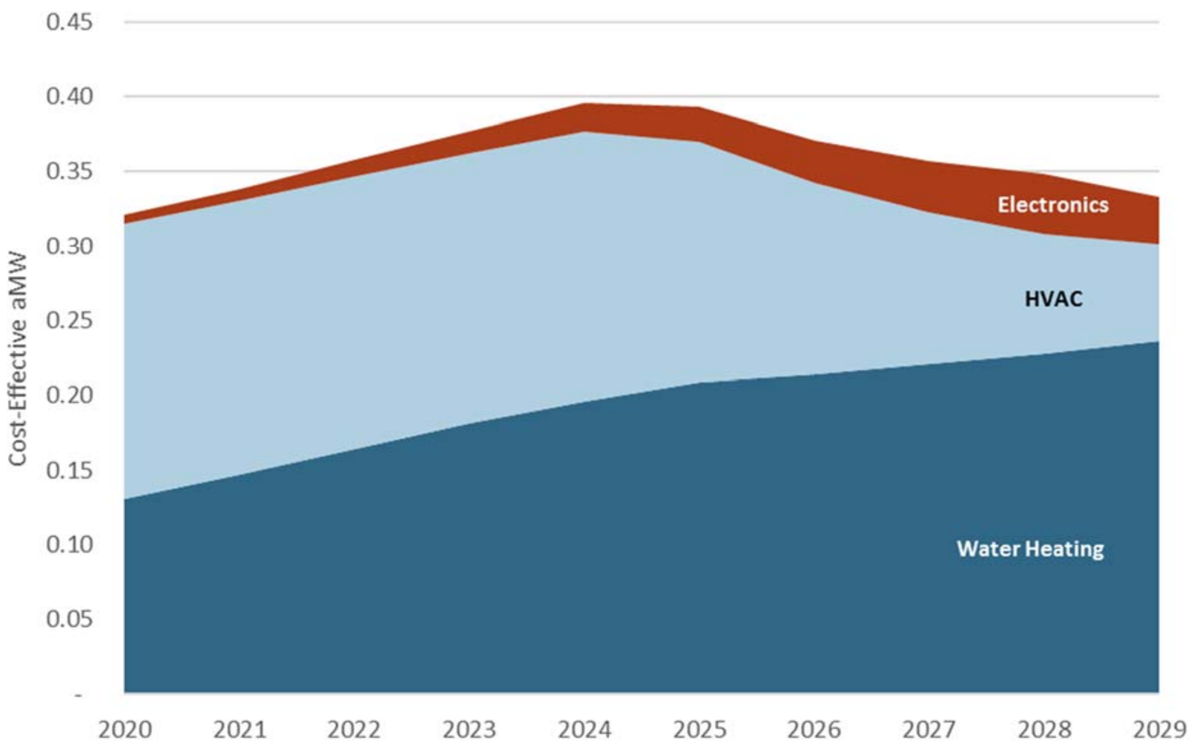
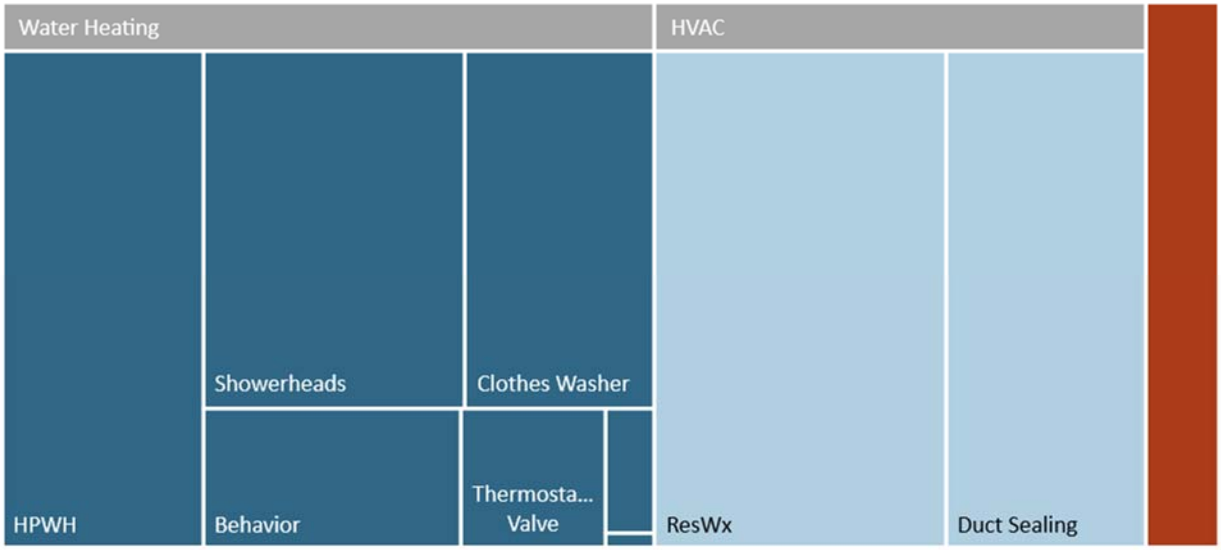


Figure 12 shows how the 10-year residential potential breaks down into end uses and key measure categories. The area of each block represents its share of the total 10-year residential potential.

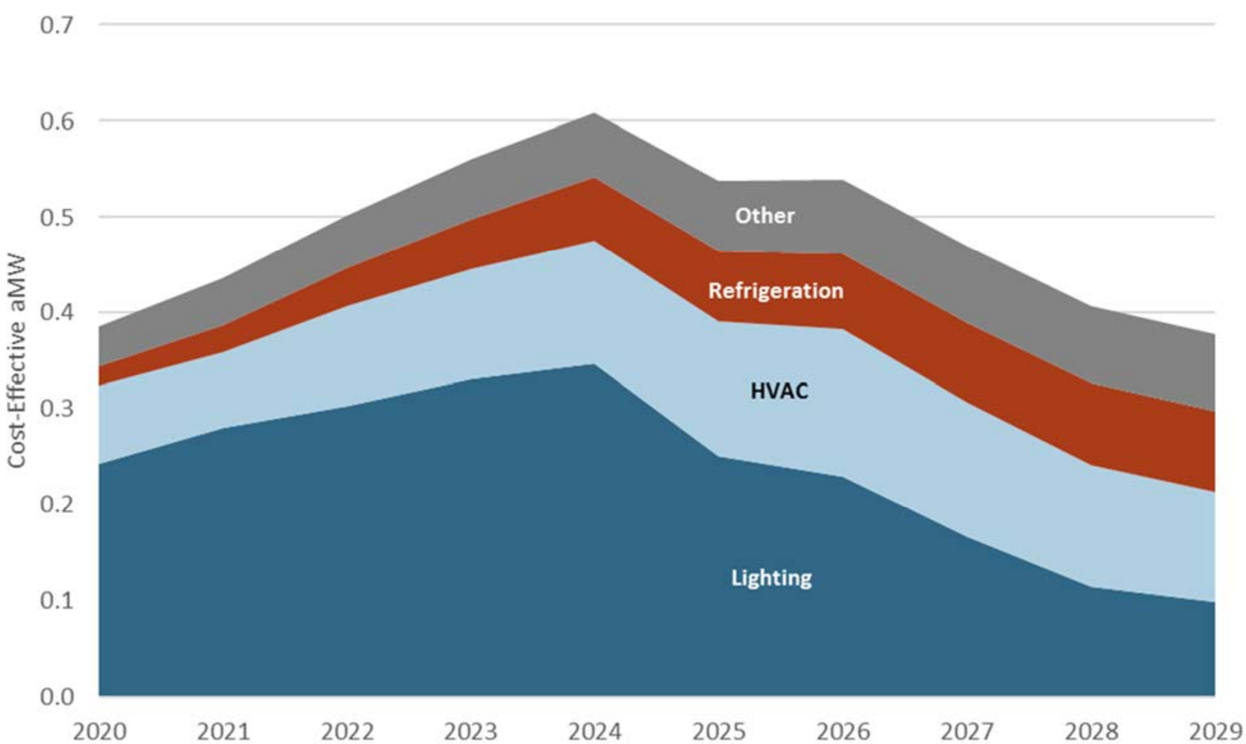
Figure 12
Residential Potential by End Use and Measure Category



Commercial

Lighting measures continue to make up the largest share of commercial conservation potential (Figure 13). This assessment shows the savings from those measures declining later in the study, suggesting that the remaining opportunities may be limited.

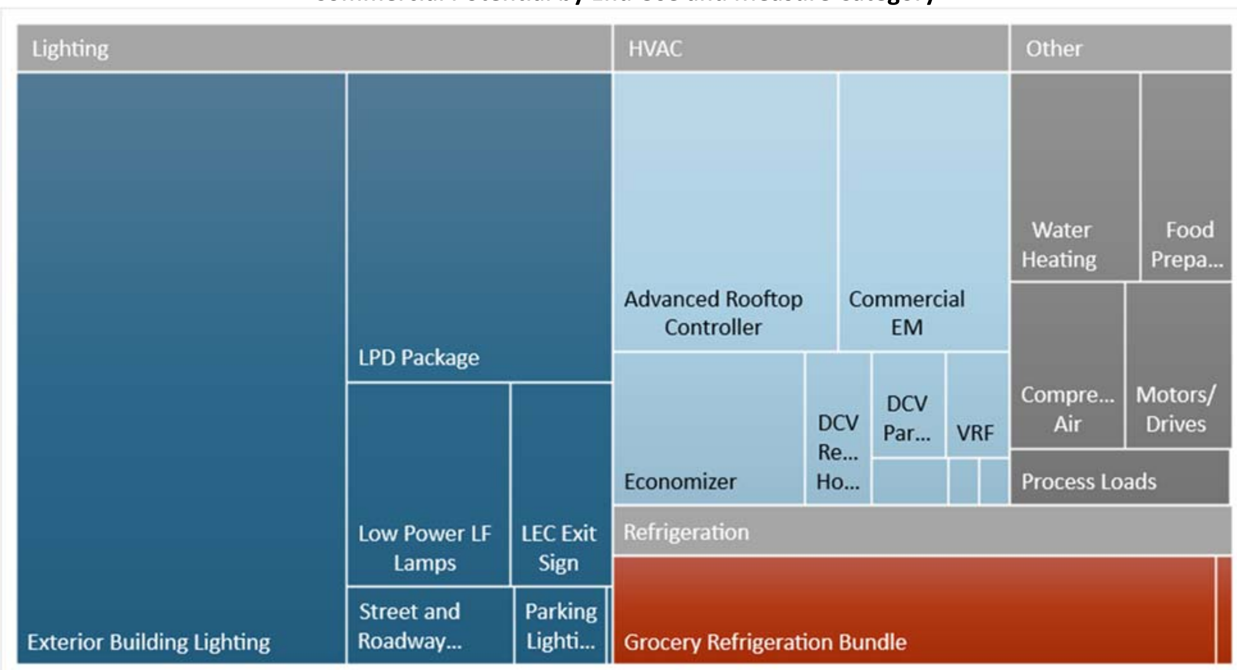
Figure 13
Annual Commercial Potential by End Use



Consistent with the 2017 CPA, the end use with the next highest amount of potential is the HVAC category. Measures with high potential in this category include rooftop controllers, energy management, and economizer retrofits. A variety of end uses make up the remaining commercial potential, reflecting the variety of systems used across the different building types.

The key end uses and measures within the commercial sector are shown in Figure 14. The area of each block represents its share of the 10-year commercial potential.

Figure 14
Commercial Potential by End Use and Measure Category



Industrial

Savings from large data centers make up the largest share of potential in the industrial sector, followed by energy management measures. The energy management category includes Strategic Energy Management measures, such as those implemented in Grant PUD's Track & Tune program, as well as the efficient operation of motor-driven industrial systems.

Industrial potential was adjusted for Grant PUD's historic industrial sector achievement through the application of a custom ramp rate. This ramp rate aligns with Grant PUD's recent level of industrial sector achievement and holds steady over time. This allows for the utility and the industrial facilities to budget for larger industrial projects over time while still acquiring all cost-effective potential. The potential with data centers was modeled independently and is based on the forecast of new data center load in Grant PUD's service territory.

Figure 15
Annual Industrial Potential by End Use

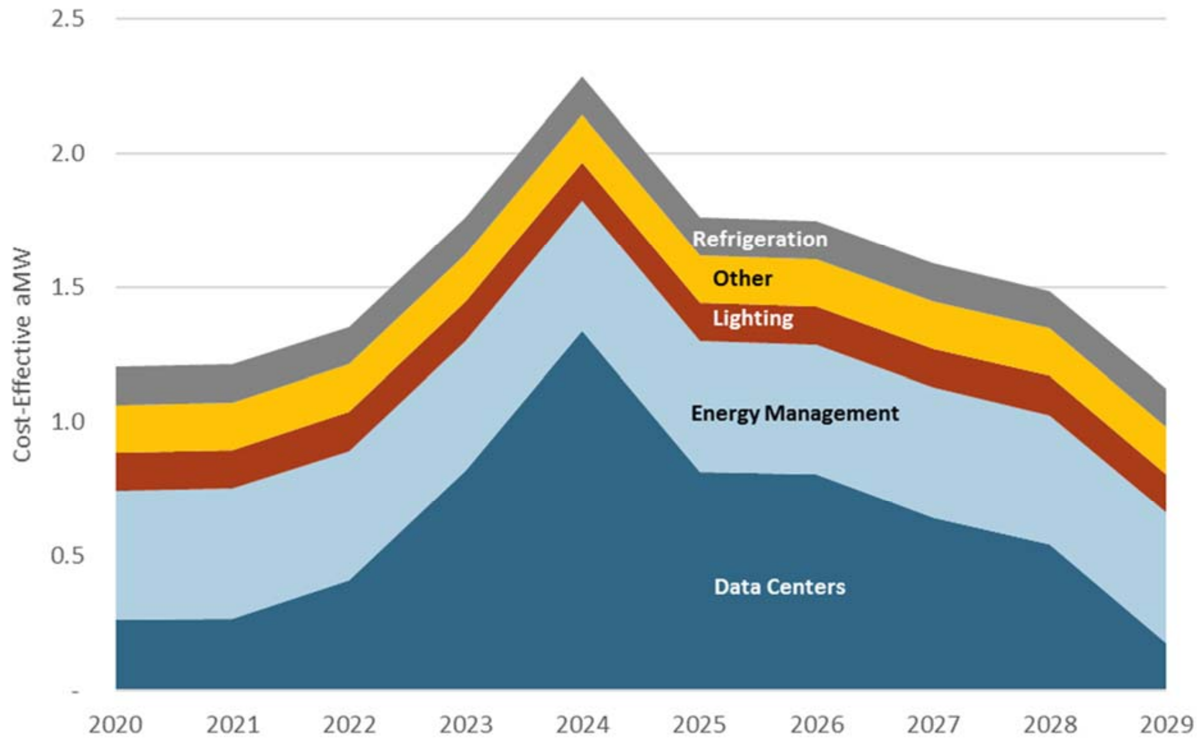
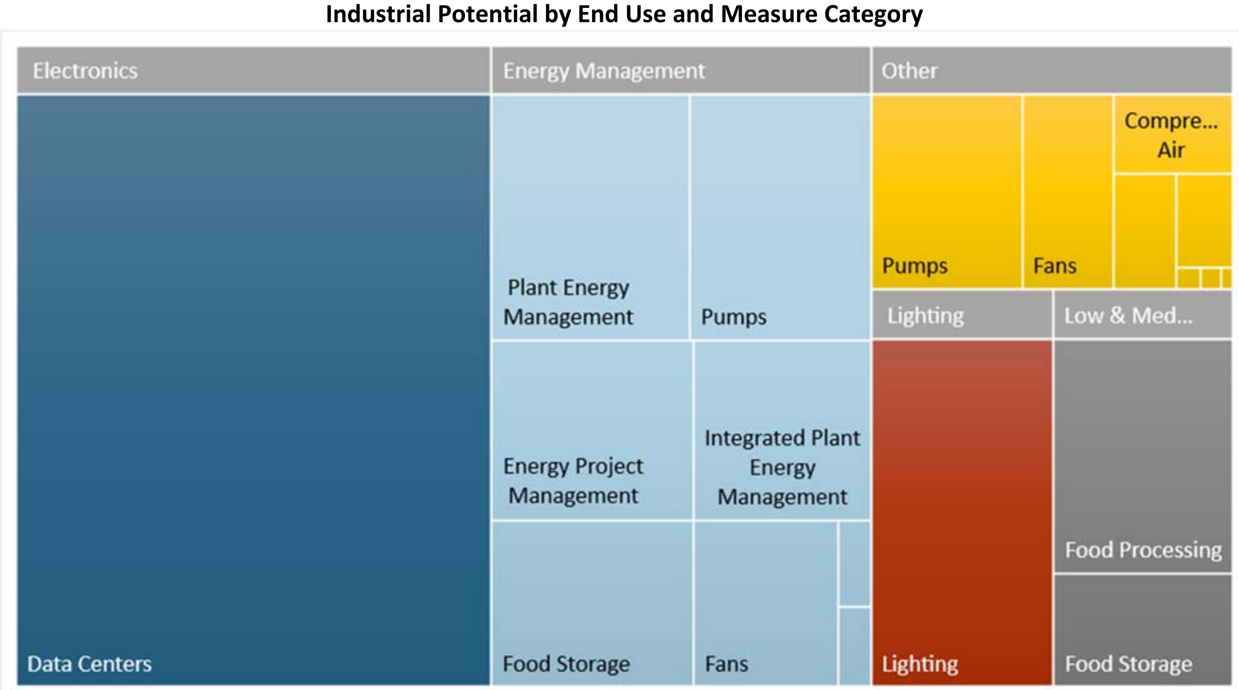


Figure 16 shows how the 10-year industrial potential breaks down by end use and measure categories.

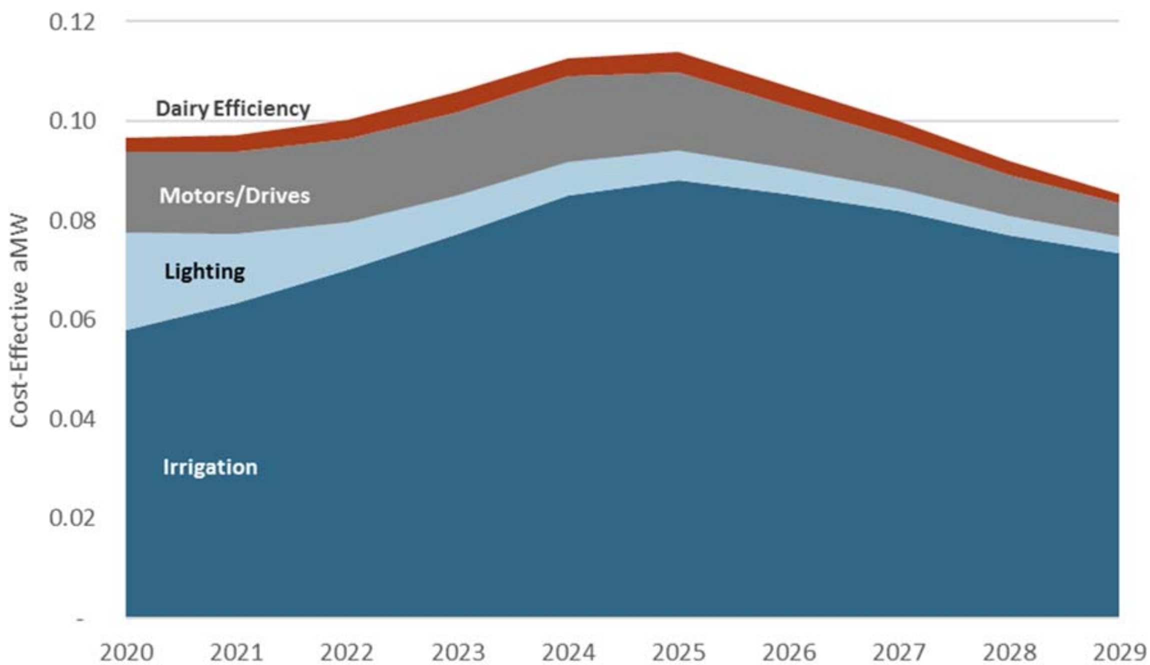
Figure 16
Industrial Potential by End Use and Measure Category



Agriculture

The agriculture sector potential is a product of total acres under irrigation in Grant PUD's service territory, amount of dairy production, number of pumps, and the number of farms. As shown in Figure 17, irrigation measures account for the largest area of conservation potential in the agriculture sector. The irrigation category includes irrigation hardware measures as well as the conversion of irrigation systems to more efficient, lower pressure systems. Additional savings are available from irrigation pump motors, lighting, and dairy systems, but these savings categories are relatively small.

Figure 17
Annual Agriculture Potential by End Use



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 assumption was used in the Council's analysis for the Seventh Power Plan. Both the administrative cost allocation and the utility incentive share assumptions are consistent with assumptions used in Grant PUD's 2015 and 2017 CPAs.

Table 8 Utility Program Costs (2019$)				
	2-Year	**6-Year**	**10-Year**	**20-Year**
Residential	$1,674,000	$5,167,000	$7,615,000	$9,604,000
Commercial	$1,341,000	$4,897,000	$7,870,000	$11,653,000
Industrial	$2,720,000	$10,623,000	$17,244,000	$28,346,000
Agricultural	$275,000	$809,000	$1,193,000	$1,436,000
Total	**$6,010,000**	**$21,496,000**	**$33,922,000**	**$51,039,000**
$/First Year MWh	$168	$159	$155	$149

This table shows that Grant PUD can expect to spend approximately $6 million in order to acquire estimated savings over the next two years. This estimate includes program administration costs and incentives provided by Grant PUD's programs. The estimated cost is higher than the cost estimated in the 2017 CPA, largely due to the elimination of cost-effective lighting measures.

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 Grant PUD to acquire conservation through its programs. The additional effort may increase administrative or incentive costs.

Besides looking at the utility cost, Grant PUD may also wish to consider the total resource cost (TRC) cost of energy efficiency. The total resource cost reflects the cost the utility and ratepayers will together pay for conservation, similar to how the costs of other power resources are paid. The TRC costs are shown below (Table 9), levelized over the measure life of each measure. Most measures are in the neighborhood of $30 to $40 per MWh.

Table 9 TRC Levelized Cost (2019$/MWh)				
	2-Year	**6-Year**	**10-Year**	**20-Year**
Residential	$37	$36	$34	$30
Commercial	$37	$37	$37	$37
Industrial	$32	$33	$33	$33
Agricultural	$36	$34	$31	$30
Total	**$34**	**$34**	**$34**	**$32**

Scenario Results

The costs and savings discussed up to this point describe the Base Case scenario. Under this scenario, annual potential for the planning period was estimated using Grant PUD's expected avoided costs. Additional scenarios were then tested to identify the change in cost-effective potential when key avoided cost inputs were changed.

The additional scenarios identify a range of possible outcomes that account for uncertainties over the planning period. In addition to the Base Case scenario, this assessment tested low and high scenarios to test the sensitivity of the results to different future avoided cost values. The avoided cost values in the low and high scenarios reflect values that are realistic and lower or higher, respectively, than the Base Case assumptions.

To understand the sensitivity of the identified savings potential to avoided cost values alone, all other inputs were held constant while varying avoided cost inputs.

Table 10 summarizes the Base, Low, and High avoided cost input values. Rather than using a single generic risk adder applied to each unit of energy, the Low and High avoided cost values consider lower and higher potential future values for each avoided cost input where uncertainty exists. These values reflect potential price risks based upon both the energy and capacity value of each measure. The final row tabulates the implied risk adders for the Low and High scenarios by summarizing all additions or subtractions relative to the Base Case values. Risk adders are provided in both energy and demand savings values. The first set of values is the maximum (or minimum in the case of negative values). The second set of risk adder values are the average values in energy terms. Further discussion of these values is provided in Appendix IV.

Table 10
Avoided Cost Assumptions by Scenario

	Base	Low	High
Energy	Market Forecast	-20%	+20%
Social Cost of Carbon	Federal 2.5% Discount Rate Values	$0	Federal 2.5% Discount Rate Values
Value of REC Compliance	Current RPS + WA CETA	Current RPS	Current RPS + WA CETA
Distribution System Credit, $/kW-year	$6.85	$6.85	$6.85
Transmission System Credit, $/kW-year	$3.08	$3.08	$3.08
Deferred Generation Capacity Credit, $/kW-year	3% Premium	$0	$115
Implied Risk Adder	N/A	Up to: -$52/MWh $0/kW-year Average of: -$39/MWh $0/kW-year	Up to: $10/MWh $115/kW-year Average of: $6/MWh $115/kW-year

Table 11 summarizes results across each avoided cost scenario, using Base Case load forecasts and measure acquisition rates.

Table 11
Cost-Effective Potential - Avoided Cost Scenario Comparison (aMW)

	2-Year	6-Year	10-Year	20-Year
Base Case	4.1	15.4	25.0	39.2
Low Avoided Costs	1.9	6.7	11.1	18.9
High Avoided Costs	5.5	20.7	34.8	58.7

Table 11 shows that the amount of cost-effective potential varies significantly with the changes in avoided cost. The changes in potential are approximately 50% higher and lower with the high and low avoided costs, respectively.

These results should be considered along with the relative likelihood of each scenario. For example, with the current low market prices and predictions of regional capacity constraints on the horizon, lower market prices may be unlikely. Beyond the uncertainties in avoided costs, energy efficiency remains a low-risk investment since it is purchased in small increments over time, instead of singular large investments, such as investments in generation resources.

Summary

This report summarizes the results of the 2019 CPA conducted for Grant County Public Utility District. The assessment provides estimates of potential energy savings for the period 2020 to 2039, with a focus on the first 10 years of the planning period, per EIA requirements. The assessment considered a wide range of conservation resources that are reliable, available, and cost effective within the 20-year planning period.

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 Seventh Power Plan, this assessment utilized many of the measure assumptions that the Council developed for the Seventh Power Plan. Additional measure updates subsequent to the Seventh Plan were also incorporated. Utility-specific data regarding customer characteristics, service-area composition, and historic conservation achievements were used, in conjunction with the measures identified by the Council, to determine available energy efficiency potential. This close connection with the Council methodology enables compliance with the Washington EIA.

Three types of energy-efficiency potential were calculated: technical, achievable, and economic. Most of the results shown in this report are the economic potential, or the potential that is cost effective in Grant PUD's service territory. The economic potential considers savings that will be captured through utility program efforts, market transformation and implementation of codes and standards. Often, realization of the full savings potential from a measure 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 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."[5] 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

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

> 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.[6]

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 target selected by Grant PUD and approved by its Commission.

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.

[6] 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

ALH – Average Load Hours

aMW – Average Megawatt

BCR – Benefit-Cost Ratio

BPA – Bonneville Power Administration

CFL – Compact Fluorescent Light

CPA – Conservation Potential Assessment

EIA – Energy Independence Act

EUI – Energy Use Intensity

HLH – Heavy load hour energy

HPWH – Heat Pump Water Heater

HVAC – Heating, ventilation and air-conditioning

IRP – Integrated Resource Plan

kW – kilowatt

kWh – kilowatt-hour

LED – Light-emitting diode

LLH – Light load hour energy

MW – Megawatt

MWh – Megawatt-hour

NEEA – Northwest Energy Efficiency Alliance

NPV – Net Present Value

O&M – Operation and Maintenance

SEM – Strategic Energy Management

RPS – Renewable Portfolio Standard

RTF – Regional Technical Forum

TRC – Total Resource Cost

UC – Utility Cost

Appendix II – Glossary

7th Power Plan: Seventh Northwest Conservation and Electric Power Plan, Feb 2016. 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 after considering market barriers. For lost-opportunity measures, there is only a certain number of expired units or new construction available in a specified time frame. The Council assumes 85% of all measures are achievable. Sometimes achievable potential is a share of economic potential, and sometimes achievable potential is defined as a share of technical potential.

Cost Effective: A conservation measure is cost effective if the present value of its benefits is greater than the present value of its 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. All benefits and costs for the utility and its customers are included, regardless of who pays the costs or receives the benefits.

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 straightforward comparison.

Lost Opportunity: Lost-opportunity measures are those that are only available at a specific time, such as new construction or equipment at the end of its life. Examples include 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.

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 can be 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 ratio of the present value of all benefits (no matter who receives them) to 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 – "Grant PUD 2019 Conservation Potential Assessment". Final Report –October 23, 2019.
2) Model – "EES CPA Model-v3.3" and supporting files
    a. MC_and_Loadshape-Grant-Base-.xlsm – referred to as "MC and Loadshape 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) **Technical Potential:** Determine the amount of conservation that is technically feasible, considering measures and the number of these measures that could be physically be installed or implemented, without regard to achievability or cost.	The model includes estimates for stock (e.g. number of homes, square feet of commercial floor area, industrial load) and the number of each measure that can be implemented per unit of stock. The technical potential is further constrained by the amount of stock that has already completed the measure.	Model – the technical potential is calculated as part of the achievable potential, described below.
b) Achievable Potential: Determine the amount of the conservation technical potential that is available within the planning period, considering barriers to market penetration and the rate at which savings could be acquired.	The assessment conducted for Grant PUD used ramp rate curves to identify the amount of achievable potential for each measure. Those assumptions are for the 20-year planning period. An additional factor of 85% was included to account for market barriers in the calculation of achievable potential.	Model – the use of these factors can be found on the sector measure tabs, such as 'Residential Measures'. Additionally, the complete set of ramp rates used can be found on the 'Ramp Rates' tab.
c) **Economic Achievable Potential**: Establish the economic achievable potential, which is the conservation potential that is cost-effective, reliable, and feasible, by comparing the total resource cost of conservation measures to the cost of other resources available to meet expected demand for electricity and capacity.	Benefits and costs were evaluated using multiple inputs; benefit was then divided by cost. Measures achieving a benefit-cost ratio greater than one were tallied. These measures are considered achievable and cost-effective (or "economic").	Model – BC Ratios are calculated at the individual level by ProCost and passed up to the model.

WAC 194-37-070 Documenting Development of Conservation Targets; Utility Analysis Option		
NWPCC Methodology	**EES Consulting Procedure**	**Reference**
d) **Total Resource Cost**: In determining economic achievable potential, perform a life-cycle cost analysis of measures or programs	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 Seventh Plan. The life-cycle cost calculations and methods are identical to those used by the Council.
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	Cost analysis was conducted per 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 one are cost-effective).	Model – the "Measure Info Rollup" files pull in all the results from each avoided cost scenario, including the BC ratios from the ProCost results. These results are then linked to by the Conservation Potential Assessment model. The TRC analysis is done at the lowest level of the model in the ProCost files.
f) Include the incremental savings and incremental costs of measures and replacement measures where resources or measures have different measure lifetimes	Savings, cost, and lifetime assumptions from the Council's 7th Plan and RTF were used.	Model – supporting files include all of the ProCost files used in the Seventh Plan. The life-cycle cost calculations and methods are identical to those used by the Council.
g) Calculate the value of 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 Seventh Plan measure load shapes were used to calculate time of day of savings 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 Seventh Power Plan models.	Model – See MC file for load shapes. The ProCost files handle the calculations.
h) 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 per the Council's assumptions.	Model – the ProCost files contain the same assumptions for periodic O&M as the Council and RTF.

WAC 194-37-070 Documenting Development of Conservation Targets; Utility Analysis Option		
NWPCC Methodology	**EES Consulting Procedure**	**Reference**
i) Include avoided energy 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 Grant PUD. A discussion of methodologies used to develop the avoided cost forecast is provided in Appendix IV.	Report –See Appendix IV. Model – See MC File ("Base Market Price" worksheet).
j) Include deferred capacity expansion benefits for transmission and distribution systems	Deferred transmission capacity expansion benefits were given a benefit of \$3.08/kW-year in the cost-effectiveness analysis. A distribution system credit of \$6.85/kW-year was also used.	Model – this value can be found on the ProData page of each ProCost file.
k) Include deferred generation benefits consistent with the contribution to system peak capacity of the conservation measure	Deferred generation capacity expansion benefits were based on a 3% market price premium in the cost effectiveness analysis. This is based upon Grant PUD's marginal cost for generation capacity. In the high scenario, the Council's value of \$115/kW-year was used, while the low scenario included no credit for generation capacity.	Model – this value can be found on the ProData page of the ProCost Batch Runner file. The generation capacity value was not originally included as part of ProCost during the development of the 7th Plan, so the value has been combined with the other capacity benefits.
l) Include the social cost of carbon emissions from avoided non-conservation resources	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.
m) Include a risk mitigation credit to reflect the additional value of conservation, not otherwise accounted for in other inputs, in reducing risk associated with costs of avoided non-conservation resources	In this analysis, risk was considered by varying avoided cost inputs and analyzing the variation in results. Rather than an individual and non-specific risk adder, our analysis included a range of possible values for each avoided cost input.	The scenarios section of the report documents the inputs used and the results associated.
n) Include all non-energy impacts 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 Council's Seventh Power Plan. Non-energy benefits include, for example, water savings from clothes washers.	Model – the ProCost files contain the same assumptions for non-power benefits as the Council and RTF. The calculations are handled in by ProCost.

WAC 194-37-070 Documenting Development of Conservation Targets; Utility Analysis Option		
NWPCC Methodology	**EES Consulting Procedure**	**Reference**
o) 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 the Fifth, Sixth, and Seventh Power plans.	Model – this value can be found on the ProData page of the ProCost Batch Runner file.
p) Include the cost of financing measures using the capital costs of the entity that is expected to pay for the measure	Costs of financing measures were included utilizing the same assumptions from the Seventh Power Plan.	Model – this value can be found on the ProData page of the ProCost Batch Runner file.
q) Discount future costs and benefits at a discount rate equal to the discount rate used by the utility in evaluating non-conservation resources	Discount rates were applied to each measure based upon the Council's methodology. A nominal discount rate of 7% was used, based on the Council's most recent analyses in support of the Seventh Plan	Model – this value can be found on the ProData page of the ProCost Batch Runner file.
r) Include a ten percent bonus for the energy and capacity benefits of 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 the ProCost Batch Runner file.

Appendix IV – Avoided Cost and Risk Exposure

EES Consulting (EES) has conducted a Conservation Potential Assessment (CPA) for Grant PUD (the District) for the period 2020 through 2039 as required under RCW 19.285 and WAC 194.37. According to WAC 197.37.070, the District must evaluate the cost-effectiveness of conservation by setting avoided energy costs equal to a forecast of regional market prices. In addition, several other components of the avoided cost of energy efficiency savings must be evaluated including generation capacity value, transmission and distribution system capacity costs, risk, and the social cost of carbon. This appendix describes each of the avoided cost assumptions and provides a range of values that was evaluated in the 2019 CPA. The 2019 CPA presents three avoided cost scenarios: Base, Low, and High. Each of these is discussed below.

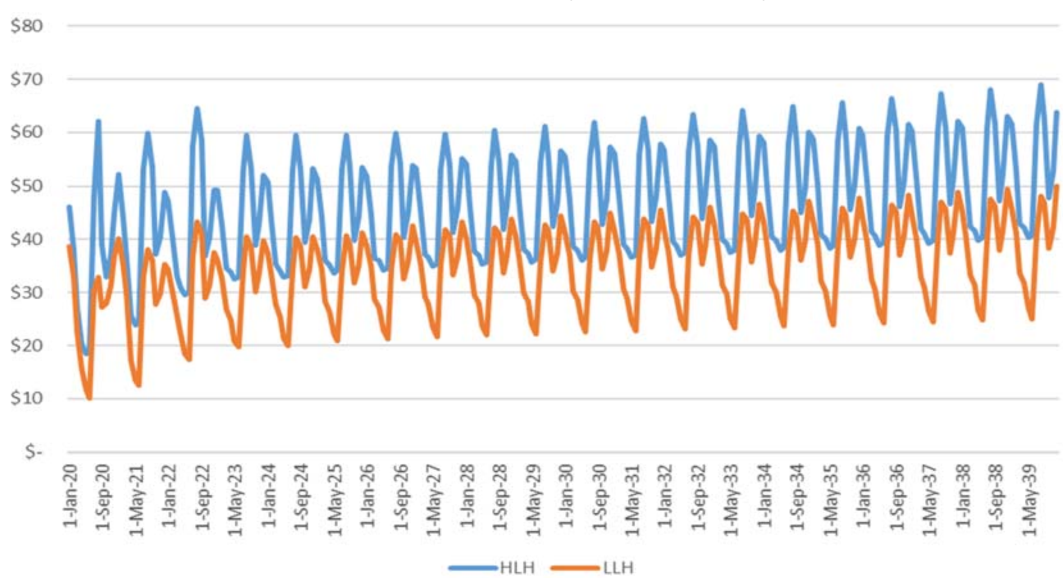
Avoided Energy Value

For the purposes of the 2019 CPA, EES has used a forecast of market prices for the Mid-Columbia trading hub prepared by District staff. This section summarizes the market price forecast, compares the forecast to the market forecast used for the District's 2017 CPA, and benchmarks it against other recent forecasts.

Results

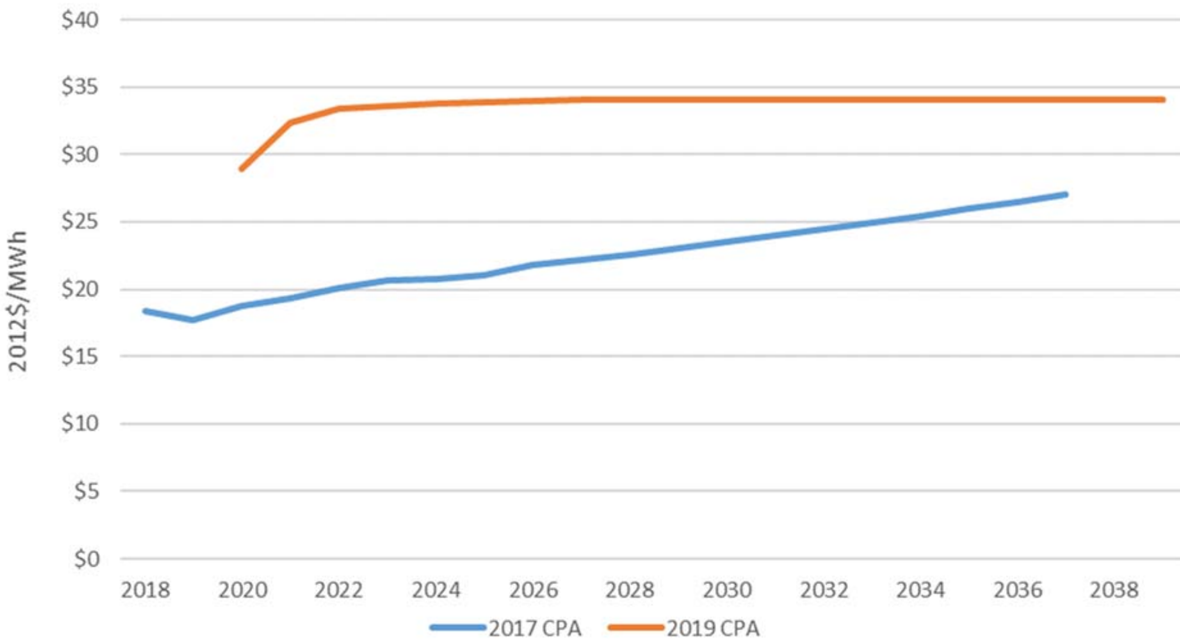
Figure IV-1 illustrates the resulting monthly, diurnal market price forecast. The levelized value of market prices over the study period is $44.75/MWh assuming a 7 percent nominal discount rate. The compound average annual growth rate over the 20-year study period is 2.1% percent.

Figure IV-1
Forecast Market Prices (Nominal $/MWh)



The 2019 market price forecast is higher than the market price forecast used in the District's 2017 CPA. Figure IV-2 compares the price forecasts after both were converted to 2012 dollars. The difference is approximately $13/MWh for the early years of the study period but then decreases to $7/MWh at the end.

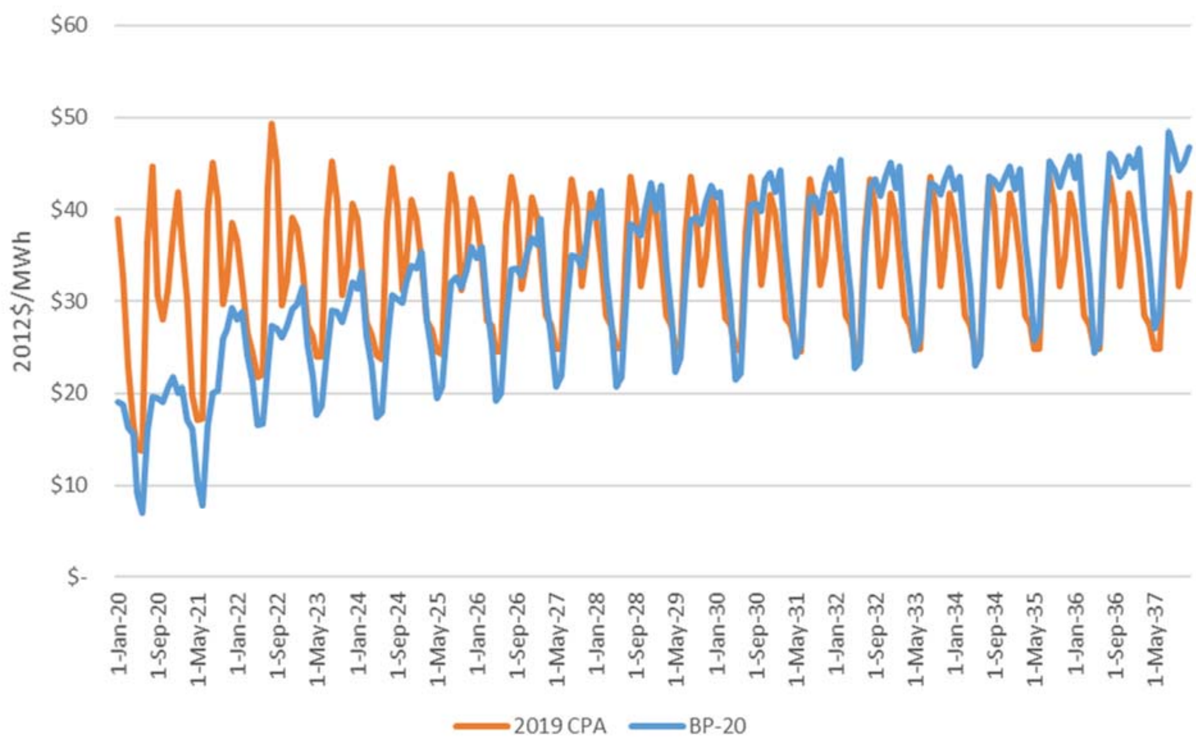
Figure IV-2
Forecast Market Prices in 2017 CPA and 2019 CPA (2012$/MWh)



Benchmarking

Figure IV-3 compares the forecast with the forecast included in BPA's proposed FY20-21 rates. The forecasts are similar, although BPA's forward prices are lower through the initial years and slightly higher in the later years. The difference is likely due to the timing of the forecasts, as BPA's forecast was developed in late 2018.

Figure IV-3
Forecast Market Prices compared to BPA's Market Price Forecast (2012$/MWh)



High and Low Scenarios

To reflect a range of possible future outcomes, the analysis includes scenarios with high- and low-case market price forecasts. The high and low forecasts were created by adding or subtracting 20% from the base price forecast, respectively. This approach reflects possible error in the forecast while maintaining the annual shape and relationship between months.

Figures IV-4 and IV-5 compare the base, high, and low price forecasts, for high and low load hours, respectively.

Figure IV-4
High Load Hour Market Price Forecast Comparison (Nominal $/MWh)

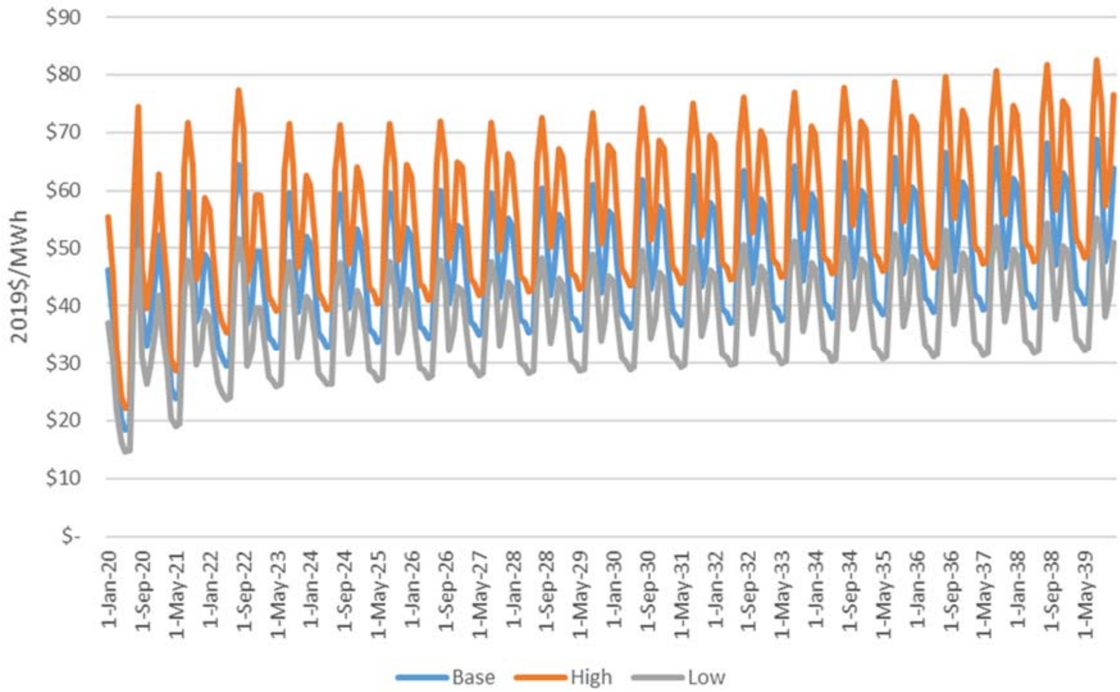
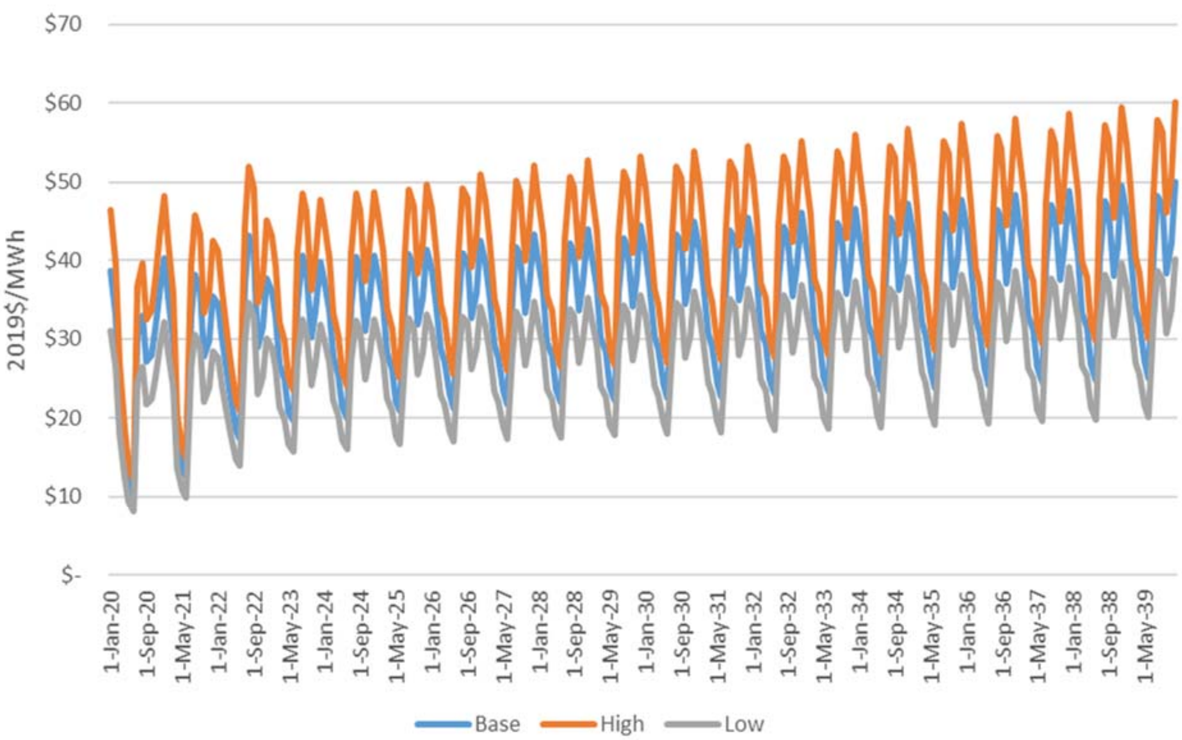


Figure IV-5
Low Load Hour Market Price Forecast Comparison (Nominal $/MWh)



Avoided Cost Adders and Risk

From a total resource cost perspective, energy efficiency provides multiple benefits beyond the avoided cost of energy. These include deferred capital expenses on generation, transmission, and distribution capacity; as well as the reduction of required renewable energy credit (REC) purchases, avoided social costs of carbon emissions, and the reduction of utility resource portfolio risk exposure. Since energy efficiency measures provide both peak demand (kW) and energy savings (kWh), these other benefits are monetized as value per unit of either kWh or kW savings.

Energy-Based Avoided Cost Adders:

1. Social Cost of Carbon
2. Renewable Energy Credits
3. Risk Reduction Premium

Peak Demand-Based Adders:

1. Generation Capacity Deferral
2. Transmission Capacity Deferral
3. Distribution Capacity Deferral

The estimated values and associated uncertainties for these avoided cost components are provided below. EES will evaluate the energy efficiency potential under a range of avoided costs, identifying the sensitivity of the results to changes in these values.

Social Cost of Carbon

The social cost of carbon is a value that society incurs when fossil fuels are burned to generate electricity. EIA rules require that the social cost of carbon be included in the total resource cost (TRC) test. Further, Washington state's recently enacted Clean Energy Transformation Act (CETA), will specify what values are used through rulemaking underway at the time this CPA was under development. The currently proposed rules would require utilities to use the social cost of carbon developed by the federal Interagency Workgroup using the 2.5 percent discount rate and inflated using the implicit price deflator for gross domestic product published by the US Department of Commerce.

In the 2017 CPA, the high avoided cost scenario used the 3 percent discount rate version of these values, which were also used in scenarios of the Seventh Power Plan. The 2.5 percent discount values are approximately 50% higher than these values, beginning at $62/ton (2007$) in 2020 and rising to $93/ton over the 20-year study period.

These carbon costs were included in the base and high scenarios. No carbon cost was included in the low scenario.

In addition to these carbon costs, the variation of the marginal generation resource over time also needs to be considered. The District provided their average marginal carbon emissions rate of 0.428 metric tons per MWh, or 0.94 lbs per kWh. This value was used in the 2017 CPA.

Beginning in 2030, the clean energy law requires that all energy be effectively greenhouse gas neutral. As such, the CPA assumes that all energy will be carbon-free from 2030 through the end of the study period.

Value of Renewable Energy Credits

Related to the social cost of carbon is the value of renewable energy credits. Washington's Energy Independence Act established a Renewable Portfolio Standard (RPS) for utilities with 25,000 or more customers. Currently, utilities are required to source 9% of all electricity sold to retail customers from renewable energy resources. In 2020, the requirement increases to 15%. Washington's clean energy bill requires that 100% of sales be greenhouse gas neutral in 2030, although 20% can be achieved through alternate compliance options such as the purchase of Renewable Energy Credits. Due to these requirements, energy efficiency's value changes over time.

From 2020 to 2029, energy efficiency can reduce the cost of compliance associated with the 15% RPS requirement by reducing the District's overall load. Under a 15% RPS requirement, for every 100 units of energy efficiency acquired, the District's RPS spending requirement is reduced by 15 units. In effect, this adds 15 percent of the costs of RECs to the avoided costs of energy efficiency. EES has used a blend of several forecasts of REC prices and incorporated them into the avoided costs of energy efficiency accordingly.

As stated above, Washington's clean energy bill requires that, beginning in 2030, all energy sales be greenhouse gas neutral, allowing for 20% of the compliance to be achieved through purchases of RECs or other means. Accordingly, the CPA assumes that the marginal cost of power in 2030 would be the market price of power plus the full cost of a REC. The requirements discussed above were included in the base and high scenarios while the low scenario only considers the 15% RPS requirement.

Risk Adder

In general, the risk that any utility faces is that energy efficiency will be undervalued, either in terms of the value per kWh or per kW of savings, leading to an under-investment in energy efficiency and exposure to higher market prices or preventable investments in infrastructure. The converse risk—an over-valuing of energy and subsequent over-investment in energy efficiency—is also possible, albeit less likely. For example, an over-investment would occur if an assumption is made that economies will remain basically the same as they are today and subsequent sector shifts or economic downturns cause large industrial customers to close their operations. Energy efficiency investments in these facilities may not have been in place long enough to provide the anticipated low-cost resource.

In order to address risk, the Council includes a risk adder ($/MWh) in its cost-effectiveness analysis of energy efficiency measures. This adder represents the value of energy efficiency savings not explicitly accounted for in the avoided cost parameters. The risk adder is included to ensure an efficient level of investment in energy efficiency resources under current planning conditions. Specifically, in cases where the market price has been low compared to historic levels, the risk adder accounts for the likely possibility that market prices will increase above current forecasts.

The value of the risk adder has varied depending on the avoided cost input values. The adder is the result of stochastic modeling and represents the lower risk nature of energy efficiency resources. In the Sixth Power Plan the risk adder was significant (up to $50/MWh for some measures). In the Seventh Power Plan the risk adder was determined to be $0/MWh after the addition of the generation capacity credit. While the Council uses stochastic portfolio modeling to value the risk credit, utilities conduct scenario and uncertainty analysis.

For the District's 2019 CPA, the avoided cost parameters have been estimated explicitly, and, a scenario analysis is performed. Therefore, a risk adder of $0/MWh is used for the base case. Variation in other avoided cost inputs covers a range of reasonable outcomes and is sufficient to identify the sensitivity of the cost-effective energy efficiency potential to a range of outcomes. The scenario results present a range of cost-effective energy efficiency potential, and the identification of the District's biennial target based on the range modeled is effectively selecting the utility's preferred risk strategy and associated risk credit.

Deferred Local Distribution and Bulk Transmission System Investment

Energy efficiency measure savings reduce capacity requirements on both the transmission and distribution systems. The Council recently updated its previous estimates for these capacity savings, which were $31/kW-year and $26/kW-year for distribution and transmission systems, respectively ($2012). These values were used in the Seventh Plan. The new values, $3.08/kW-year and $6.85/kW-year for transmission and distribution systems, respectively will be used in the next Power Plan. These assumptions are used in all scenarios in the CPA.

Deferred Investment in Generation Capacity

The District's 2016 IRP identifies that the current forward market provides a cost-effective option for meeting future demand and load growth, but cautions that the forward market may not always be available for capacity purchases, or available at the low prices present today. To represent the value of capacity in the base case, the District provided a value that represents a 3 percent premium over market prices. This value is based on the opportunity cost of selling excess capacity created by energy savings in the market. In the low case, a value of $0/kW-year was used. This represents a future in which the market will continue to be available for meeting peak demands.

In the Council's Seventh Power Plan[7], a generation capacity value of $115/kW-year was explicitly calculated ($2012). This value will be used in the high scenario.

Summary of Scenario Assumptions

Table 1 summarizes the recommended scenario assumptions. The Base Case represents the most likely future.

Table 1
Avoided Cost Assumptions by Scenario

	Base	Low	High
Energy	Market Forecast	-20%	+20%
Social Cost of Carbon	Federal 2.5% Discount Rate Values	$0	Federal 2.5% Discount Rate Values
Value of REC Compliance	Current RPS + WA CETA	Current RPS	Current RPS + WA CETA
Distribution System Credit, $/kW-year	$6.85	$6.85	$6.85
Transmission System Credit, $/kW-year	$3.08	$3.08	$3.08
Deferred Generation Capacity Credit, $/kW-year	3% Premium	$0	$115
Implied Risk Adder	N/A	Up to: -$52/MWh $0/kW-year Average of: -$39/MWh $0/kW-year	Up to: $10/MWh $115/kW-year Average of: $6/MWh $115/kW-year

[7] https://www.nwcouncil.org/energy/powerplan/7/home/

Appendix V – Measure List

This appendix provides a high-level measure list of the energy efficiency measures evaluated in the 2019 CPA. The CPA evaluated thousands of measures; the measure list does not include each individual measure; rather it summarizes the measures at the category level, some of which are repeated across different units of stock, such as single family, multifamily, and manufactured homes. Specifically, utility conservation potential is modeled based on incremental costs and savings of individual measures. Individual measures are then combined into measure categories 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. Each of these 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. 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 category level) that were used to model conservation potential presented in this report. Measure data was sourced from the Council's Seventh Plan workbooks and the RTF's Unit Energy Savings (UES) workbooks. 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 VI-1 Residential End Uses and Measures		
End Use	**Measures/Categories**	**Data Source**
Dryer	Heat Pump Clothes Dryer	7th Plan
Electronics	Advanced Power Strips	7th Plan, RTF
	Energy Star Computers	7th Plan
	Energy Star Monitors	7th Plan
Food Preparation	Electric Oven	7th Plan
	Microwave	7th Plan
HVAC	Air Source Heat Pump	7th Plan, RTF
	Controls, Commissioning, and Sizing	7th Plan, RTF
	Ductless Heat Pump	7th Plan, RTF
	Ducted Ductless Heat Pump	7th Plan
	Duct Sealing	7th Plan, RTF
	Ground Source Heat Pump	7th Plan, RTF
	Heat Recovery Ventilation	7th Plan
	Attic Insulation	7th Plan, RTF
	Floor Insulation	7th Plan, RTF
	Wall Insulation	7th Plan, RTF
	Windows	7th Plan, RTF
	Wi-Fi Enabled Thermostats	7th Plan
Lighting	Linear Fluorescent Lighting	7th Plan, RTF
	LED General Purpose and Dimmable	7th Plan, RTF
	LED Decorative and Mini-Base	7th Plan, RTF
	LED Globe	7th Plan, RTF
	LED Reflectors and Outdoor	7th Plan, RTF
	LED Three-Way	7th Plan, RTF
Refrigeration	Freezer	7th Plan
	Refrigerator	7th Plan
Water Heating	Aerator	7th Plan
	Behavior Savings	7th Plan
	Clothes Washer	7th Plan
	Dishwasher	7th Plan
	Heat Pump Water Heater	7th Plan, RTF
	Showerheads	7th Plan, RTF
	Solar Water Heater	7th Plan
	Thermostatic Valve	RTF
	Wastewater Heat Recovery	7th Plan
Whole Building	EV Charging Equipment	7th Plan

Table VI-2
Commercial End Uses and Measures

End Use	Measures/Categories	Data Source
Compressed Air	Controls, Equipment, & Demand Reduction	7th Plan
Electronics	Energy Star Computers	7th Plan
	Energy Star Monitors	7th Plan
	Smart Plug Power Strips	7th Plan, RTF
	Data Center Measures	7th Plan
Food Preparation	Combination Ovens	7th Plan, RTF
	Convection Ovens	7th Plan, RTF
	Fryers	7th Plan, RTF
	Hot Food Holding Cabinet	7th Plan, RTF
	Steamer	7th Plan, RTF
	Pre-Rinse Spray Valve	7th Plan, RTF
HVAC	Advanced Rooftop Controller	7th Plan
	Commercial Energy Management	7th Plan
	Demand Control Ventilation	7th Plan
	Ductless Heat Pumps	7th Plan
	Economizers	7th Plan
	Secondary Glazing Systems	7th Plan
	Variable Refrigerant Flow	7th Plan
	Web-Enabled Programmable Thermostat	7th Plan
Lighting	Bi-Level Stairwell Lighting	7th Plan
	Exterior Building Lighting	7th Plan
	Exit Signs	7th Plan
	Lighting Controls	7th Plan
	Linear Fluorescent Lamps	7th Plan
	LED Lighting	7th Plan
	Street Lighting	7th Plan
Motors/Drives	ECM for Variable Air Volume	7th Plan
	Motor Rewinds	7th Plan
Process Loads	Municipal Water Supply	7th Plan
Refrigeration	Grocery Refrigeration Bundle	7th Plan, RTF
	Water Cooler Controls	7th Plan
Water Heating	Commercial Clothes Washer	7th Plan, RTF
	Showerheads	7th Plan
	Tank Water Heaters	7th Plan

Table VI-3 Industrial End Uses and Measures		
End Use	**Measures/Categories**	**Data Source**
Compressed Air	Air Compressor Equipment	7th Plan
	Demand Reduction	7th Plan
Energy Management	Air Compressor Optimization	7th Plan
	Energy Project Management	7th Plan
	Fan Energy Management	7th Plan
	Fan System Optimization	7th Plan
	Cold Storage Tune-up	7th Plan
	Chiller Optimization	7th Plan
	Integrated Plant Energy Management	7th Plan
	Plant Energy Management	7th Plan
	Pump Energy Management	7th Plan
	Pump System Optimization	7th Plan
Fans	Efficient Centrifugal Fan	7th Plan
	Fan Equipment Upgrade	7th Plan
Hi-Tech	Clean Room Filter Strategy	7th Plan
	Clean Room HVAC	7th Plan
	Chip Fab: Eliminate Exhaust	7th Plan
	Chip Fab: Exhaust Injector	7th Plan
	Chip Fab: Reduce Gas Pressure	7th Plan
	Chip Fab: Solid State Chiller	7th Plan
Lighting	Efficient Lighting	7th Plan
	High-Bay Lighting	7th Plan
	Lighting Controls	7th Plan
Low & Medium Temp Refrigeration	Food: Cooling and Storage	7th Plan
	Cold Storage Retrofit	7th Plan
	Grocery Distribution Retrofit	7th Plan
Material Handling	Material Handling Equipment	7th Plan
	Material Handling VFD	7th Plan
Metals	New Arc Furnace	7th Plan
Misc.	Synchronous Belts	7th Plan
	Food Storage: CO2 Scrubber	7th Plan
	Food Storage: Membrane	7th Plan
Motors	Motor Rewinds	7th Plan
Paper	Efficient Pulp Screen	7th Plan
	Material Handling	7th Plan
	Premium Control	7th Plan
	Premium Fan	7th Plan
Process Loads	Municipal Sewage Treatment	7th Plan
Pulp	Efficient Agitator	7th Plan
	Effluent Treatment System	7th Plan
	Premium Process	7th Plan
	Refiner Plate Improvement	7th Plan
	Refiner Replacement	7th Plan
Pumps	Equipment Upgrade	7th Plan
Transformers	New/Retrofit Transformer	7th Plan
Wood	Hydraulic Press	7th Plan
	Pneumatic Conveyor	7th Plan

Table VI-3 Agriculture End Uses and Measures		
End Use	**Measures/Categories**	**Data Source**
Dairy Efficiency	Efficient Lighting	7th Plan
	Milk Pre-Cooler	7th Plan
	Vacuum Pump	7th Plan
Irrigation	Low Energy Sprinkler Application	7th Plan
	Irrigation Hardware	7th Plan, RTF
	Scientific Irrigation Scheduling	7th Plan, BPA
Lighting	Agricultural Lighting	7th Plan
Motors/Drives	Motor Rewinds	7th Plan

Appendix VI – Energy Efficiency Potential by End-Use

Table VI-1 Residential Economic Potential (aMW)				
	2 Year	6 Year	10 Year	20 Year
Dryer	-	-	-	-
Electronics	0.01	0.08	0.22	0.27
Food Preparation	-	-	-	-
HVAC	0.37	1.07	1.45	1.64
Lighting	-	-	-	-
Refrigeration	-	-	-	-
Water Heating	0.28	1.03	1.93	3.80
Whole Bldg/Meter Level	-	-	-	-
Total	**0.66**	**2.18**	**3.59**	**5.71**

Table VI-2 Commercial Economic Potential (aMW)				
	2 Year	6 Year	10 Year	20 Year
Compressed Air	0.03	0.08	0.13	0.26
Electronics	0.00	0.00	0.00	0.00
Food Preparation	0.01	0.06	0.13	0.21
HVAC	0.16	0.65	1.18	1.56
Lighting	0.52	1.75	2.37	3.33
Motors/Drives	0.02	0.07	0.12	0.28
Process Loads	0.02	0.06	0.09	0.09
Refrigeration	0.05	0.28	0.61	0.87
Water Heating	0.01	0.08	0.19	0.34
Total	**0.82**	**3.03**	**4.83**	**6.94**

Table VI-3
Industrial Economic Potential (aMW)

	2 Year	6 Year	10 Year	20 Year
Compressed Air	0.05	0.14	0.24	0.47
Electronics	0.53	3.90	6.07	6.30
Energy Management	0.97	2.90	4.84	9.68
Fans	0.09	0.27	0.44	0.89
Hi-Tech	0.04	0.11	0.18	0.36
Lighting	0.29	0.86	1.44	2.88
Low & Med Temp Refr	0.28	0.85	1.42	2.84
Material Handling	0.00	0.01	0.01	0.02
Metals	0.00	0.00	0.01	0.01
Misc	-	-	-	-
Motors	-	-	-	-
Paper	0.00	0.01	0.01	0.03
Process Loads	0.03	0.08	0.13	0.27
Pulp	-	-	-	-
Pumps	0.15	0.44	0.73	1.47
Transformers	-	-	-	-
Wood	-	-	-	-
Total	**2.42**	**9.58**	**15.53**	**25.23**

Table VI-4
Agricultural Economic Potential (aMW)

	2 Year	6 Year	10 Year	20 Year
Dairy Efficiency	0.01	0.02	0.03	0.04
Irrigation	0.12	0.44	0.76	0.99
Lighting	0.03	0.06	0.08	0.09
Motors/Drives	0.03	0.10	0.14	0.16
Total	**0.19**	**0.63**	**1.01**	**1.27**

Appendix VII – Ramp Rate Documentation

This section is intended to document how ramp rates were reviewed for alignment between the near-term potential and recent achievements of Grant PUD's programs.

Grant PUD's program achievements from 2017-2018 were compared with the potential identified in this CPA, using the ramp rates assigned to each measure in the Seventh Power Plan. Savings from NEEA's market transformation initiatives were allocated to the appropriate sectors to determine total sector savings.

Table VII-1 compares recent program history as reported per the EIA with the potential after ramp rates were adjusted, showing the potential in each sector is reasonable and achievable given program history. Note that this table and Table VII-2 below exclude residential lighting, as these measures were not considered in the CPA.

Table VII-1
Comparison of Sector-Level Program Achievement and Potential (aMW)

	Program History			CPA Potential		
	2017	**2018**	**Average**	**2020**	**2021**	**2022**
Residential	0.31	0.41	0.39	0.32	0.34	0.36
Commercial	0.34	0.42	0.32	0.39	0.44	0.50
Industrial	0.06	9.60	3.34	1.20	1.21	1.35
Agricultural	0.15	0.02	0.08	0.10	0.10	0.10
Total	**0.86**	**10.45**	**4.13**	**2.01**	**2.08**	**2.31**

Beyond this sector-level comparison, the residential and commercial sectors were analyzed at the end-use level to ensure alignment.

Table VII-2 below compares recent residential achievement with the potential identified in this assessment.

Table VII-2 Comparison of Residential End Use Program Achievement and Potential (aMW)						
	Program History			CPA Potential		
	2017	2018	Average	2020	2021	2022
Dryer					-	-
Electronics					0.01	0.01
Food Preparation					-	-
HVAC	0.01	0.01		0.01	0.18	0.18
Lighting	0.02	0.00		0.01	-	-
Refrigeration					-	-
Water Heating					0.13	0.15
Whole Building					-	-
NEEA	0.31	0.40		0.35	-	-
Total	**0.31**	**0.41**	**-**	**0.36**	**0.32**	**0.34**

To achieve this alignment, several measures in the electronics end use were given slower ramp rates. While NEEA has a consumer electronics initiative that targets this end use, savings to date have been slow and Grant PUD does not have its own programs.

While the savings potential in the HVAC and water heating end uses may seem to be higher than recent program achievement, NEEA's savings contribute to these categories. On the whole, the residential sector potential is aligned with recent program history.

Table VII-3 compares the final alignment between commercial achievement and potential. In this sector, ramp rates for lighting measures slowed somewhat while several measures in the HVAC, energy management, water heating, and refrigeration end uses were given slower ramp rates given the lower level of historic achievement in these categories.

Table VII-3 Comparison of Commercial End Use Program Achievement and Potential (aMW)						
	Program History			CPA Potential		
	2017	**2018**	**Average**	**2020**	**2021**	**2022**
Compressed Air					0.01	0.01
Electronics					0.00	0.00
Food Preparation					0.01	0.01
HVAC	0.02	0.01		0.01	0.08	0.08
Lighting	0.22	0.32		0.27	0.24	0.28
Motors/Drives					0.01	0.01
Process Loads					0.01	0.01
Refrigeration	0.03	-		0.01	0.02	0.03
Water Heating					0.01	0.01
NEEA	0.07	0.09		0.08	-	-
Total	**0.34**	**0.42**		**0.38**	**0.39**	**0.44**

Finally, while the industrial sector was not reviewed at the end use level, measures in this sector were given a custom ramp rate. This ramp rate matches Grant PUD's recent level of industrial achievement and allows for an even level of savings acquisition over time, allowing both Grant PUD and industrial facilities to plan and budget for savings acquisition over time while still acquiring all cost-effective potential.

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PUBLIC HEARING

on the 2020 Integrated Resource Plan

Grant PUD

JULY 28, 2020

2:00 p.m.

The public can access the meeting remotely via phone by calling 509-703-5291 and using conference ID 678 050 6#.