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2019 DRAFT

Integrated Resource Plan

CITY OF BURBANK

Water and Power

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Table of Contents

Chapter 1

Overview

1.1 Introduction

This is the 2019 Integrated Resource Plan (IRP) of Burbank Water and Power (BWP). The IRP is a long-term planning document designed to provide policy guidance for BWP's electric supply to its customers over the next twenty years, from 2019 through 2038. The IRP, like all long-term planning, is ***directional rather than determinative.*** In other words, the IRP helps Burbank see the broad contours of its energy future and the general direction Burbank should head to reach that future; it is not a roadmap for decision-making beyond the near-term.

The utility industry is undergoing dramatic change and this IRP reflects it. Concerns for climate change, the growth of cost-effective renewable energy and energy storage, and the pending retirement of one of BWP's primary legacy energy sources, a coal-fired power plant called Intermountain Power Project (IPP), are all elements in the mix.

At the same time, the IRP is informed by public input: what are the perspectives of Burbank residents, businesses, and other stakeholders with respect to Burbank's energy future? BWP had a robust interaction with the public for this IRP, focused on major issues impacting BWP's provision of ***reliable, affordable, and sustainable*** electric service to Burbank.

This Chapter provides a brief overview of the highlights of the IRP, major changes in BWP's business since its last IRP in 2015, proposed policy direction, and actions to fulfill that policy direction. The remainder of this IRP goes into greater detail on BWP's business, both today and through the lens of long-term planning. Finally, detail on BWP's public outreach can be found in Chapter 5.

1.2 Assumptions and Implications

As a long-term planning document, the IRP is necessarily based on significant assumptions about the future: this carries inherent uncertainty, especially with the utility industry undergoing dramatic change. This IRP must make significant assumptions about a variety of key aspects of BWP's business over the next 20 years, from federal and state policy direction to the availability of cost-effective renewable energy generation and electric transmission resources to the growth of electric demand in Burbank.

With respect to generation and transmission resources, the IRP assumes that the economies of scale available in joint procurement with Los Angeles Department of Water and Power (LADWP) and others will remain. Also, for the purposes of this IRP, BWP forecasts little to no peak demand or energy growth over the next 20 years. This forecast is consistent with the California Energy Commission's (CEC) forecast for the same period and reflects some (but not all) development under consideration in Burbank.

The IRP is also based on Burbank's and California's energy policies. These include the "loading order", whereby electricity demand is to be met first with energy efficiency and demand-side resources, then with renewable energy and then, to the extent that these are insufficient, with clean conventional electricity supply. These also include Senate Bill 350 (SB350) and Senate Bill 100 (SB100) which, among other things, mandate energy efficiency and renewable energy requirements for utilities like BWP.

BWP, working with expert consultants, used those assumptions, public input, and legislative and policy framework to create illustrative views of Burbank's energy future over the next 20 years. This complex analysis, referred to as "modeling", yielded a number of major implications for Burbank's energy future. These major implications are summarized here and discussed in greater detail in the body of the IRP.

Major Implications

- BWP should pursue cost-effective ***energy efficiency*** (EE) and ***demand response*** (DR) programs to fulfill California EE requirements and place additional emphasis on peak demand reduction.
- BWP's share of the ***Intermountain Power Project*** (IPP) coal-fired generating plant in Utah will be retired in 2025.
- In accordance with SB100, procurement of additional ***renewable energy*** resources to increase BWP's current 32% of retail sales in 2017 to 60% by 2030 and increasing thereafter. By the end of the planning period in 2038, BWP would have renewables equivalent to a 67% RPS – approximately double the current level.
- Additional quantities of fast-ramping ***energy storage*** and other resources would be needed to address the intermittency of renewable resources.
- BWP's greenhouse gas emissions (***GHG***) should be dramatically reduced by about 87% over the planning period, consistent with California Air Quality Board (CARB) targets.
- While IRP results depend on the future outcomes of many currently-uncertain assumptions, BWP should maintain ***future electric rate increases*** at or below the long-run rate of inflation.

1.3 Major Changes Since 2015 IRP

The utility industry in general, and the California utility industry and BWP in particular, have seen significant changes since BWP's 2015 IRP. These significant changes include:

- Renewable procurement requirements increasing and accelerating as a result of SB100;
- Increasing planning clarity on the repowering of IPP, including a reduction in the replacement power plant's size from 1,200 megawatts (MW) to 840 MW; and
- Closer to home, increasing adoption of electric vehicles and associated charging infrastructure.

These and other changes are discussed throughout this IRP.

1.4 Proposed Policy Guidelines

Through the IRP process BWP has found that, while the business of providing Burbank with reliable, affordable, and sustainable electric service is changing rapidly, the policy guidelines for its business remain largely the same as approved in the 2015 IRP.

1. BWP should continue to ***meet electricity demand growth*** from energy efficiency and conservation, then renewables. BWP does not plan any new fossil-fueled power generation, except as needed to cost-effectively integrate renewable energy and maintain reliability.
2. BWP should ***optimize cost-effective energy efficiency*** and conservation programs.
3. BWP should ***add renewable energy*** to the extent needed.
4. BWP should ***plan to achieve greenhouse gas emissions reductions*** consistent with state goals.
5. BWP should ***maintain low cost of service***, including striving to maintain rate increases at or below the long-run rate of inflation.

1.5 Action Items

To fulfill the policy direction of the IRP, certain primary Action Items are planned. They include activities on both the customer-side and the supply-side of the meter:

a. **Rate Design.** Design time-varying rates that encourage customers to shift their consumption away from higher cost periods to lower cost periods.

b. **Demand Response (DR).** Consider cost-effective BWP customer DR programs.

c. **Beneficial Electrification.** Enhance and extend BWP efforts to encourage growth in beneficial electrification that reduces GHG emissions, including electric vehicles.

d. **Disadvantaged Communities.** Develop and implement a program to target disadvantaged communities with selected BWP energy efficiency, demand response, and beneficial electrification programs.

e. **IPP Coal Replacement.** Work with LADWP and other IPP participants to determine resources that will replace IPP coal plant when it is retired in 2025. Particular focus should be given to BWP's share in the STS transmission line from the IPP site in Utah to Southern California.

f. **Transmission Delivery for Renewables.** Identify options and costs for transmission delivery of large quantities of renewable energy resulting from SB100.

g. **Solar Over-Generation.** Work to mitigate the impact of solar generation (including morning and afternoon ramping, overgeneration, and instantaneous intermittency) such that reliability and affordability are maintained.

h. **EIM Participation.** Evaluate possible participation in the California Independent System Operator's (CAISO) Energy Imbalance Market (EIM) if and when BWP's Balancing Authority, LADWP, joins the EIM.

i. **Resource Positioning.** Position BWP's resources to work with the Duck Curve to the greatest extent possible to minimize costs and maximize reliability for Burbank. In this connection, evaluate further improvement in the operational flexibility of the Magnolia Power Project (MPP).

Chapter 2

Executive Summary

2.1 Introduction

2.1.1 About the IRP

The IRP is a long-term planning document designed to provide policy guidance for BWP's electric supply to its customers over the next twenty years, from 2019 through 2038. The IRP, like all long-term planning, is ***directional rather than determinative.*** In other words, the IRP helps Burbank see the broad contours of its energy future and the general direction Burbank should head to reach that future; it is not a roadmap for decision-making beyond the near-term.

The utility industry is undergoing dramatic change and this IRP reflects it. Concerns for climate change, the growth of cost-effective renewable energy and energy storage, and the pending retirement of one of BWP's primary legacy energy sources, a coal-fired power plant called Intermountain Power Project, are all elements in the mix.

At the same time, the IRP is informed by public input: what are the perspectives of Burbank residents, businesses, and other stakeholders with respect to Burbank's energy future? BWP had a robust interaction with the public for this IRP, focused on major issues impacting BWP's provision of ***reliable, affordable, and sustainable*** electric service to Burbank.

As a long-term planning document, the IRP is necessarily based on significant assumptions about the future: this carries inherent uncertainty, especially with the utility industry undergoing dramatic change. This IRP must make significant assumptions about a variety of key aspects of BWP's business over the next 20 years, from federal and state policy direction to the availability of cost-effective renewable energy generation and electric transmission resources to the growth of electric demand in Burbank.

With respect to generation and transmission resources, the IRP assumes that the economies of scale available in joint procurement with Los Angeles Department of Water and Power (LADWP) and others will remain. Also, for the purposes of this IRP, BWP forecasts little to no peak demand or energy growth over the next 20 years. This forecast is consistent with the California Energy Commission's (CEC) forecast for the same period and reflects some (but not all) development under consideration in Burbank.

The IRP is also based on California energy policies and legislation. These include the "loading order", whereby electricity demand is to be met first with energy efficiency and demand-side resources, then with renewable energy and then, to the extent that these are insufficient, with clean conventional electricity supply. These also include Senate Bill 350 (SB350) and Senate Bill 100 (SB100) which, among other things, mandate energy efficiency and renewable energy requirements for utilities like BWP.

While intended as an actionable planning document for the utility, this IRP also fulfills the requirements of SB350. Among other things, SB350 requires BWP and the other 15 largest publicly-owned utilities in the state to secure adoption of their respective IRPs by their City Councils by January 1, 2019, and file them with the California Energy Commission (CEC) not later than April 2019.

2.1.2 Key Policy Drivers

Burbank Water and Power (BWP) is a vertically-integrated, publicly-owned municipal utility. Being vertically-integrated means that BWP generates, transmits, and distributes power to Burbank customers. BWP is owned and operated by the City of Burbank and is governed by the Burbank City Council and an appointed Board. BWP is not-for-profit, delivering service at cost.

BWP is committed to providing ***reliable, affordable and sustainable*** electricity service to Burbank. BWP is one of the most reliable electric utilities in the United States, maintaining electricity service to BWP's customers 99.998% of the time in 2016 and 2017. In terms of affordability, BWP's rates are near the lowest in the region, with annual rate increases at or below the long-run rate of inflation. And BWP is committed to sustainability: in 2007, BWP was the first utility to plan for 33% renewable energy by 2020 and BWP reached 33.3% renewables in fiscal year 2016-17.[1]

BWP incorporates these commitments as it plans for the future. However, BWP faces significant challenge and uncertainty, as the electric utility industry – and BWP's business – continues to transform.

2.1.3 Major Challenges

As BWP plans, the utility builds on past successes but is challenged (like other utilities) in three major areas:

a. **Supply and Demand:** A transformation in aggregate annual net demand for electricity in Burbank, from steady growth to no growth, is expected to continue for the foreseeable future while state renewable energy policy mandates the addition of new renewable power generation resources. These new renewable resources, in turn, may require additional transmission capacity for delivery to Burbank; the availability and cost of this additional transmission capacity is not known at this time.

b. **Intermittency**: A transformation in power generation from controllable conventional power generation resources like coal and natural gas to intermittent (and thus more challenging to manage) renewable power generation sources such as wind and solar.

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[1] BWP reached 31.9% in 2017-18. The slight reduction from the prior fiscal year was the result of an underperforming biomethane supply contract.

c. **Duck Curve:** An increasing mismatch between electricity consumption patterns during the day and evening and the conventional and renewable electricity generation available to meet that demand hour-by-hour. Increasing amounts of non-dispatchable solar energy during the day rapidly decreases the need for conventional generation resources as the sun rises in the morning. Then, it reverses into very fast increases in needs for conventional generation when the sun sets in the evening. This frequently results in surplus electricity during sunny afternoons and an increasing challenge to cost-effectively maintain reliability as the sun sets. (This phenomenon is often referred to as the "Duck Curve" because its effect on daily generation needs is shaped like the profile of a duck. It is described in more detail in Chapter 3.)

The IRP analyzes these challenges in diverse ways.

2.1.4 IRP Overview

The IRP begins with public input from Burbank customers in August 2018. This included a focused education element and sought customer preferences and opinions on topics related to the key IRP decisions. The volume of customer input, secured via town hall meetings and the Internet, was unprecedented and invaluable.

In this context, the IRP forecasts Burbank's aggregate customer energy and peak demand needs for electricity over the planning period. BWP, like other California utilities, is subject to the "loading order" as established in California's 2003 Energy Action Plan. The loading order mandates that energy needs will be met first with energy efficiency, then with renewable energy and, if these are still insufficient, with clean conventional electricity supplies.

Accordingly, BWP applied enhanced customer energy efficiency programs and projected impacts of future peak demand response programs to the forecast. Future additional impacts of transportation electrification (e.g., electric vehicles) were also included.

Finally, energy supply resources were applied to meet the net forecasted need and in compliance with State renewable energy and greenhouse gas legislation. This renewable energy legislation includes SB100, the successor to SB350. Among other things, SB100 accelerates SB350's renewable energy procurement mandates. SB100 is discussed in greater detail in Chapter 4.

Major Implications

- BWP should pursue cost-effective ***energy efficiency*** (EE) and ***demand response*** (DR) programs to fulfill State EE requirements and place additional emphasis on peak demand reduction.
- BWP's share of the ***Intermountain Power Project*** (IPP) coal-fired generating plant in Utah will be retired in 2025.
- In accordance with SB100, procurement of additional ***renewable energy*** resources to increase BWP's current 32% of retail sales in 2017 to 60% by 2030 and increasing thereafter. By the end of the planning period in 2038, BWP would have renewables equivalent to a 67% RPS – approximately double the current level.
- Additional quantities of fast-ramping ***energy storage*** and other resources would be needed to address the intermittency of renewable resources.
- BWP's greenhouse gas emissions (***GHG***) should be dramatically reduced by about 87% over the planning period, consistent with California Air Resources Board (CARB) targets.
- While IRP results depend on the future outcomes of many currently-uncertain assumptions, BWP should maintain ***future electric rate increases*** at or below the long-run rate of inflation.

2.2 Starting with Customers

2.2.1 Public Input

BWP solicited public input in August 2018. Notices were posted on the BWP website, on social media, and by direct e-mail. More than 1,200 responses were received, an all-time record for BWP IRPs. (By way of contrast, BWP's survey for its 2015 IRP garnered only about 100 responses.)

The process is described in more detail in Chapter 5 of this Report. In summary of the findings:

- **Renewable Energy.** BWP should exceed state mandates for renewable energy while working to maintain annual electric rate increases at or below the long-run rate of inflation.
- **Greenhouse Gas Emissions.** BWP should adopt state greenhouse gas emission reduction targets while working to maintain annual electric rate increases at or below the long-run rate of inflation.
- **Use of Natural Gas for Electricity Generation.** Along with the preference for more renewable energy and lower greenhouse gas emissions, Burbank customers recognize the potential need to the limited amounts of new natural gas-fired generation capacity to the extent it is needed to integrate renewable energy and help ensure Burbank's electric service reliability.

- **Beneficial Electrification.** BWP should encourage cost-effective increases in electricity consumption where doing so would lead to reduced greenhouse gas emissions.
- **Utility-Customer Partnership Programs.** BWP should offer customers Utility-Customer Partnership programs to help customers control how they use their electric end uses during relatively costly peak periods. In developing customer programs, BWP should account for customer concerns about third party control (or even BWP control) over their load management devices.
- **Disadvantaged Communities.** BWP should consider the public input to the IRP in the future when designing programs for its Disadvantaged Communities.

Customers also suggested BWP consider the differences between the motivations of renters and landlords when designing customer programs. They also expressed an interest in BWP emphasizing on energy storage in its planning.

The IRP is designed to be responsive to this public input.

2.2.2 Demand and Energy Forecast

The Plan also includes a peak demand and energy forecast of Burbank customer's electricity needs (Table 2.1). "Peak demand" refers to the times when demand on the system is greatest, such as on a very hot day when air-conditioning is used extensively. This BWP "net energy for load" (i.e., generation requirements including customer load plus transmission and distribution losses) forecast over the long term lies between the CEC Low-Range and Mid-Range forecasts for Burbank.

Like the CEC Low-Range and Mid-Range forecasts that bracket it, this forecast for Burbank includes impacts of customer-owned generation such as rooftop solar. The forecast was then adjusted for the impacts of incremental BWP actions for customer-side energy resources as described in the next Section. It is important to note that, for the purposes of this IRP, the forecast reflects some (but not all) development under consideration in Burbank.

	2019	2020	2021	2022	2023	2024	2025	2030	2035	2038
Energy (GWh)	1,131	1,131	1,131	1,131	1,136	1,138	1,140	1,153	1,180	1,211
Peak (MW)	308	306	306	308	310	311	310	310	309	307

Table 2.1: Forecasted BWP Energy and Peak Demand Needs 2019 to 2038.

2.3 Customer-Side Resources

In accordance with the loading order, BWP first meets load growth with cost-effective energy efficiency, then renewable energy. Energy resources located on the customers' side of their electric meter are the first to be implemented. These include EE programs, DR programs, and programs to encourage and support transportation electrification.

2.3.1 Energy Efficiency

For this IRP, BWP staff contracted with Cadmus Inc., a recognized expert, to review Burbank's existing EE programs, their cost effectiveness, and potential areas for further improvement. Working with BWP staff, Cadmus confirmed that BWP's current programs are cost-effective. They also suggested improvements to existing BWP programs and potential new programs to both fulfill SB350 targets for Burbank and drive cost reductions, including peak demand reductions. The resulting total "enhanced" program impacts are summarized on Table 2.2 below.

Portfolio Metric	2019	2020	2021	2022	2023	2028	2033	2040
Cumulative Energy Savings (MWh)	12,834	25,636	38,514	51,288	64,240	134,766	177,444	208,842

Table 2.2: Summary of Cumulative Enhanced EE Program Impacts

Comparing Table 2.2 to Table 2.1, these EE program impacts on Table 2.2 represent an annual savings of about 1% of total BWP energy sales in 2019, and they accumulate over the planning period. They conform with SB350's call for a "doubling" of customer energy efficiency. The incremental impacts of the enhanced programs (that is, the increases in the enhanced programs compared to existing programs that were assumed to already be included in the BWP forecast) were applied as adjustments to the load forecast.

However, it is important to note that this enhanced portfolio scenario is simply a forecasted estimate and not necessarily a feasible cost-effective proposal to implement. BWP will further investigate the enhanced portfolio scenario to implement cost-effective programs and components that achieve operational and regulatory goals while maintaining electric rate increases at or below the long-run rate of inflation.

	2019	2020	2021	2022	2023	2024	2025	2030	2035	2038
EE Savings Baseline (GWh)	13	25	33	40	48	55	62	88	95	96
EE Enhanced (GWh)	13	26	39	51	64	77	91	154	188	202
Decrement from Load Forecast (GWh)	0	0	5	11	17	23	29	65	93	106
Forecast after Decrement (GWh)	1,131	1,131	1,126	1,120	1,119	1,114	1,110	1,088	1,187	1,105

Table 2.3: Incremental Enhanced EE Program Adjustments to the Load Forecast.

Table 2.3 summarizes the incremental impacts of the enhanced EE programs that are not included in the load forecast. Therefore, they were subtracted from the forecast for purposes of the IRP.

2.3.2 Demand Response

BWP also tasked Cadmus to develop illustrative, conceptual alternatives for demand response (DR) programs to best serve Burbank's needs. DR programs are utility-customer partnership programs that encourage customers to modify the use of their electric devices (such as air conditioners) to reduce their electric consumption during periods of high electric system demands. Such peak periods are a significant driver for electric system capacity investments and thus costs.

BWP has not offered DR programs in the past. However, the increasing effects of the Duck Curve make consideration of peak demand management even more important than in the past. In addition, Burbank has a primarily commercial and residential customer base with little heavy industrial customer load that operates "24 x 7". This results in a relatively low annual system load factor (i.e., average load compared to annual peak load) of only about 40%. That means the BWP system has relatively sharp peak demands. Peak demand management has potential.

Portfolio Metric	2019	2020	2021	2022	2023	2028	2033	2040
Cumulative Energy Savings (MWh)	5.4	20.7	135.2	244.3	333.9	492.0	535.5	578.9
Demand Reductions (MW)	0.02	0.6	1.8	4.2	7.4	17.0	20.7	25.4
Cumulative Program Delivery Costs ($000)	$442	$647	$1,308	$2,024	$2,756	$6,210	$9,667	$15,024
Total Resource Cost (TRC) Ratio	2.31							

Table 2.4: Summary of Cumulative DR Program Impacts

However, as with the EE findings, it is important to note that this enhanced portfolio scenario is simply a forecasted estimate, and not necessarily a cost-effective proposal to implement. BWP will further investigate the enhanced portfolio scenario to implement programs and components that achieve operational and regulatory goals, while also maintaining electric rate increases at or below the long-run rate of inflation.

Table 2.4 summarizes the DR program potential identified by Cadmus. For planning purposes, BWP staff has adopted these potentials as goals and they were applied to the load forecast.

The DR impacts shown on Table 2.4 represent nearly 0.8% of BWP's forecasted peak demand in 2019, growing to about 1.3% of peak demand in 2040. Figure 2.1 provides an illustration of DR impacts superimposed on a daily dispatch schedule.

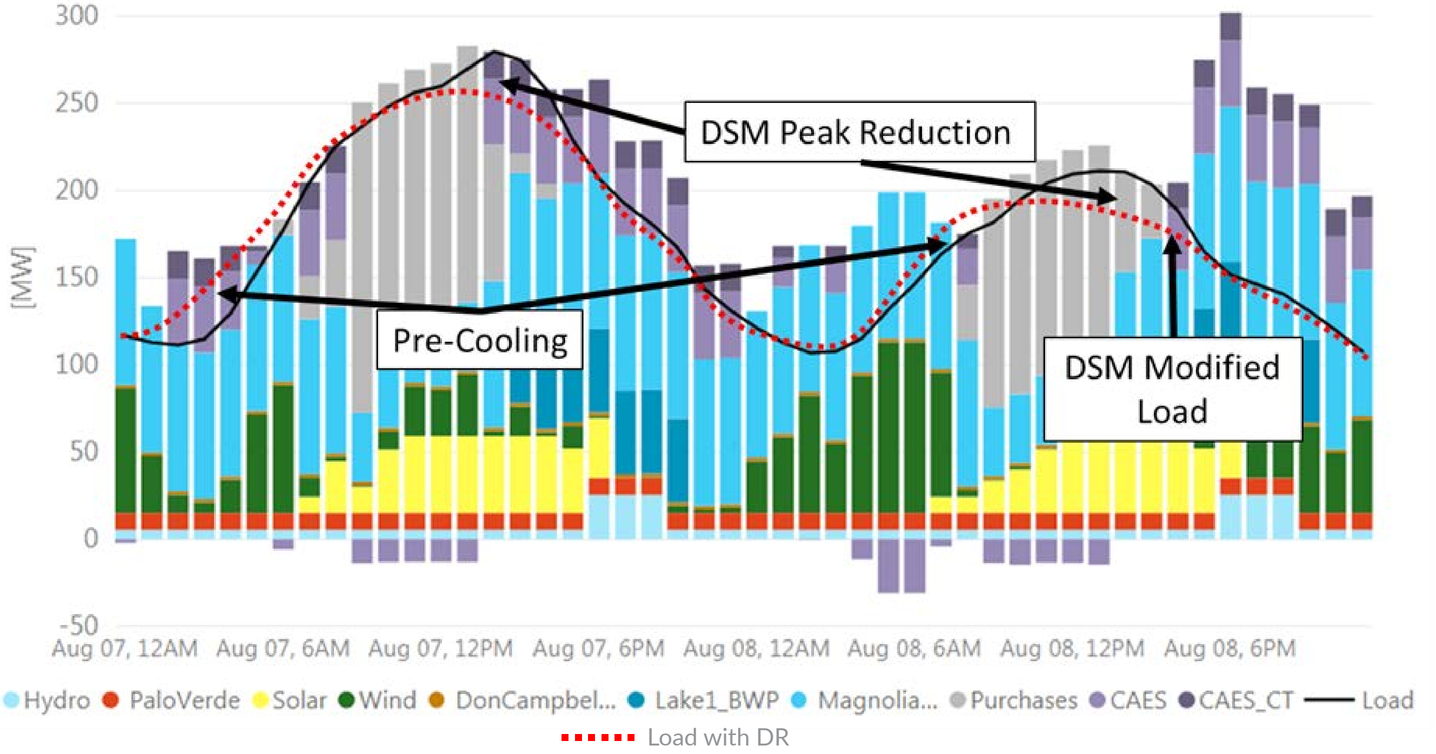

Figure 2.1: Illustration of DR Impacts on a Daily Load and Supply Dispatch.

2.3.3 Electric Vehicles

Electric vehicles (EV) are becoming increasingly popular and cost-effective. An electric vehicle powered by renewable energy results in far less annual GHG emissions than its gasoline or diesel-fueled counterparts. As a result, SB350 encourages deployment of EVs as a part of statewide GHG remissions reduction efforts.

Electric vehicle load for the Burbank service territory was calculated using the CEC's EV Forecast Tool. Table 2.5 summarizes the EV growth that was added to the load forecast. BWP can assist such developments by encouraging installation of EV charging stations and other related efforts.

	2018	2019	2020	2021	2022	2023	2024	2025	2030	2035	2038
Additional EV Load (GWh)	8	10	11	12	13	13	14	14	14	15	15

Table 2.5: Summary of Assumed Transportation Electrification Impacts

This load increase from electric vehicles amounts to about 1.5% of total BWP electric sales by 2038. This amount of energy is equivalent to about 5,000 EVs in Burbank, including about 3,250 EVs registered in Burbank and about 1,750 EVs from outside of Burbank that are charged in the City.

2.3.4 Customer-Owned Generation

As described in Chapter 3, BWP customers in general enjoy very high electric service reliability. Nevertheless, some customers, such as hospitals, have their own backup internal combustion engine-powered generator sets for their unique reliability needs.

In modern applications, customer-owned generation typically involves rooftop solar installations. Burbank has seen rooftop solar installations and these installations are expected to become more prevalent in the future. The impacts of such developments were assumed to be already captured in the CEC peak demand and energy forecast for Burbank used in the IRP. Larger customer solar developments such as proposed at the Burbank airport are included in quantities of "generic" solar resources developed in the supply-side plans described below.

2.3.5 Results of Customer-Side Impacts

The net result of ongoing customer activities and programs culminates in relatively little electric load growth for Burbank, as illustrated in Figure 2.2.

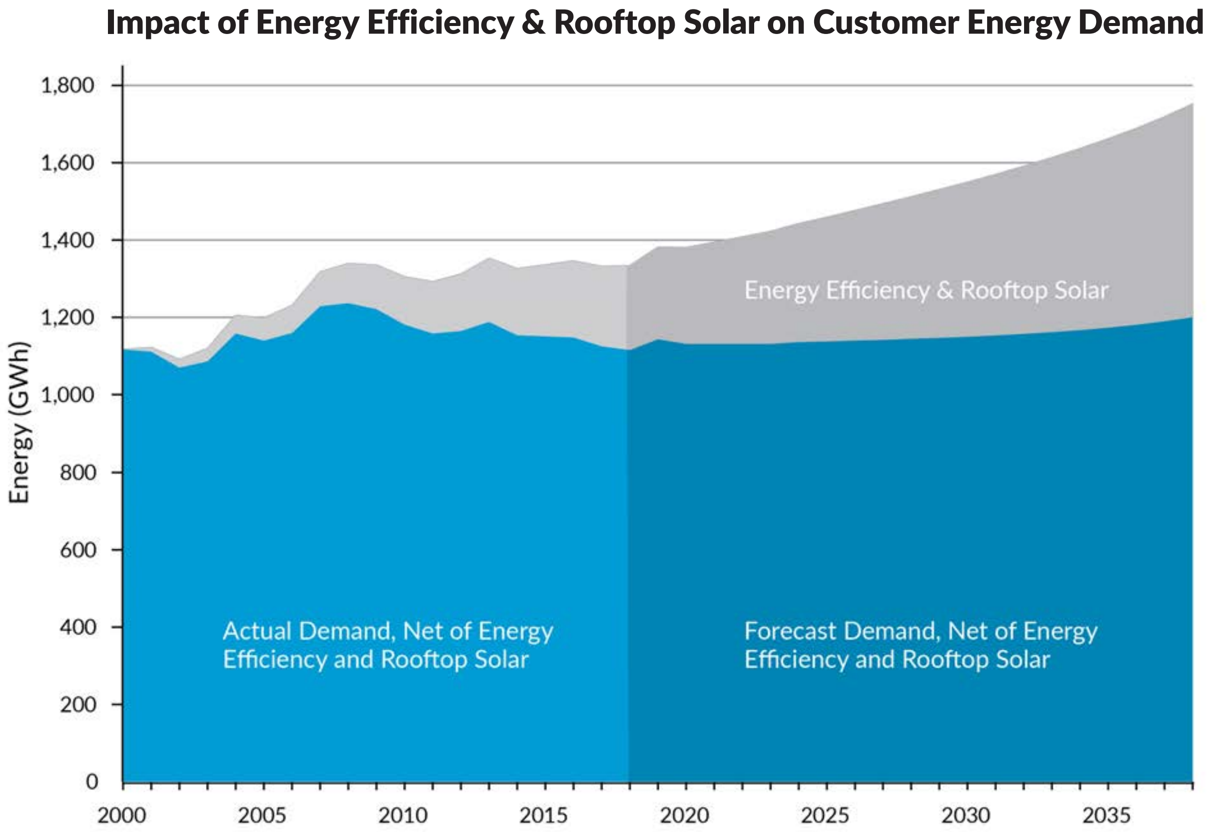

Figure 2.2: Conceptual Illustration of the Impact of EE and Rooftop Solar

Source: BWP

2.4 Supply-Side Resources: The SB350 Future

During most of the IRP development process, one of the primary drivers of the planning was to fulfill the provisions of SB350. In addition to requiring POUs like Burbank to file IRPs with the CEC for the first time, SB350 included multiple requirements for IRPs including a 50% Renewable Portfolio Standard (RPS) by 2030. It also resulted in detailed CEC Guidelines for what needs to be included in IRPs. In addition to being primarily a key BWP planning document, the IRP was developed in part to fulfill these Guidelines.

Although the provisions of SB350 were superseded by SB100 late in the planning process, much of the planning applicable to SB100 occurred in the context of SB350 per the CEC. Incremental changes to the SB350 results to reflect an SB100 future are addressed in the next Section of this Report.

BWP retained Ascend Analytics LLC (Ascend), an expert in power system modeling and analysis, to help develop and analyze the various resource options. Ascend performed cost and reliability analyses and comparisons of various planning “portfolios”. A portfolio is a grouping of resource options that for planning purposes together form a potential approach for the future. Ascend and BWP staff analyzed nearly 30 such portfolios in total. See Chapter 6 for a detailed discussion of the analysis that is summarized below.

2.4.1 Retirement of IPP coal in 2025

A key feature of this IRP is the planned retirement of the 1,800 MW IPP coal plant in 2025. Located in Delta, Utah, IPP is a primary baseload energy source for Burbank and other Southern California municipal utilities including LADWP and others. Burbank has a 4.2% participation share (74 MW) in the coal plant. In 2017, provided about 30% of BWP customers' annual energy needs.

Replacing this major energy source and maintaining Burbank's share in the existing 2,400 MW Southern Transmission System (STS) high-voltage direct current (HVDC) transmission line from IPP to Southern California are critical topics for BWP, as discussed in Chapter 6.

2.4.2 IPP Coal Replacement Options

The planning process developed multiple diverse portfolios of alternative resources to replace BWP's share of the IPP coal plant. These included a 35 MW share (4.2%) of the proposed 840 MW natural gas-fired combined-cycle plant which was used as a base case for comparison with other portfolios; large quantities of renewable energy including wind power from Wyoming and solar power located in Utah at or near IPP; energy storage at IPP including compressed air energy storage (CAES) and/or 4-hour batteries; internal combustion engines (ICEs) which are modern, natural gas-fired and efficient versions of traditional reciprocating engine diesel generation units; and various combinations of all of these resources.

Table 2.6 provides a listing of the various IPP coal replacement portfolios that were examined.

Portfolio #	CC	WY Wind	Utah Solar	CAES	Batteries (MW of 4 hr)	ICEs	Wind/Solar Addition	Ancillary Batteries (MW of 1 hr)	Transmission on STS
1	35	0	0	0	113	0	221	74	126
2	35	102	0	0	113	0	69	81	126
3	35	188	0	80	0	0	44	120	126
4		102	0	0	50	54	69	74	54
5		46	44	54	0	0	113	73	54
6		46	44	0	113	0	113	73	54
7		46	44	0	50	54	113	73	54
8	35	0	0	100	0	0	221	74	126
9		102	0	0	113	0	69	74	54
10		102	0	54	0	0	69	74	54
11	35	46	44	54	113	0	113	73	126
12	35	46	44	0	0	0	113	73	126

Table 2.6: IPP Coal Replacement Portfolios Evaluated Under SB350 (Megawatts)

An important consideration in BWP's IPP replacement is BWP's share of the STS transmission line capacity. BWP currently has rights to 108 MW on the STS. Based on current agreements with LADWP effective subsequent to retirement of the IPP coal plant, the analysis assumed BWP's share would be 126 MW if BWP participates in the proposed combined-cycle project at IPP. It would be reduced to 54 MW if BWP does not participate in the project.

In addition to resources at or near IPP, "generic" renewables resources were added to the analysis as necessary to fulfill any resulting shortfalls in fulfilling the RPS requirements throughout the planning period. These included wind from unspecified locations in New Mexico, Nevada or Arizona, and additional solar at unspecified locations within or adjacent to the LADWP balancing authority area (the LADWP balancing authority area is discussed in Section 4.3.3).

The costs of each portfolio included costs of BWP energy efficiency and demand response programs described above; investment-related costs in new plant capital, fuel and operations and maintenance costs for BWP resources (both existing and new), power purchase agreement costs for renewable energy to fulfill RPS requirements, transmission costs for existing and new resources, GHG emissions costs, and costs of necessary energy purchases from others. The analysis also included calculation of long-term risk factors for each portfolio to facilitate comparisons between portfolios as well as opportunistic, non-speculative market sales to other systems.

Ascend also assessed the reliability of each portfolio using Loss of Load Hours (LOLH) criteria. LOLH is the long-recognized industry standard for evaluating the reliability of a utility's energy supply resources (excluding transmission and distribution reliability). It is a measure of how much installed supply capacity the utility needs to meet its annual peak demand. The supply system's reliability underlies the 99.998% reliability of service (including transmission and distribution reliability too) that BWP customers currently enjoy.

The historical industry criterion is to assure an LOLH of less than 24 hours of supply system outage in a ten-year period. Based on the calculated LOLH of each portfolio, Ascend added additional batteries and associated costs to the portfolio as necessary to equalize the reliability of the portfolios for comparability.

2.4.3 Results: Replacing IPP Coal

The results of the economic analysis are summarized on Figure 2.3 below. It ranks the total forecasted costs over the planning period of the twelve lowest-cost planning portfolios from highest cost to lowest cost.

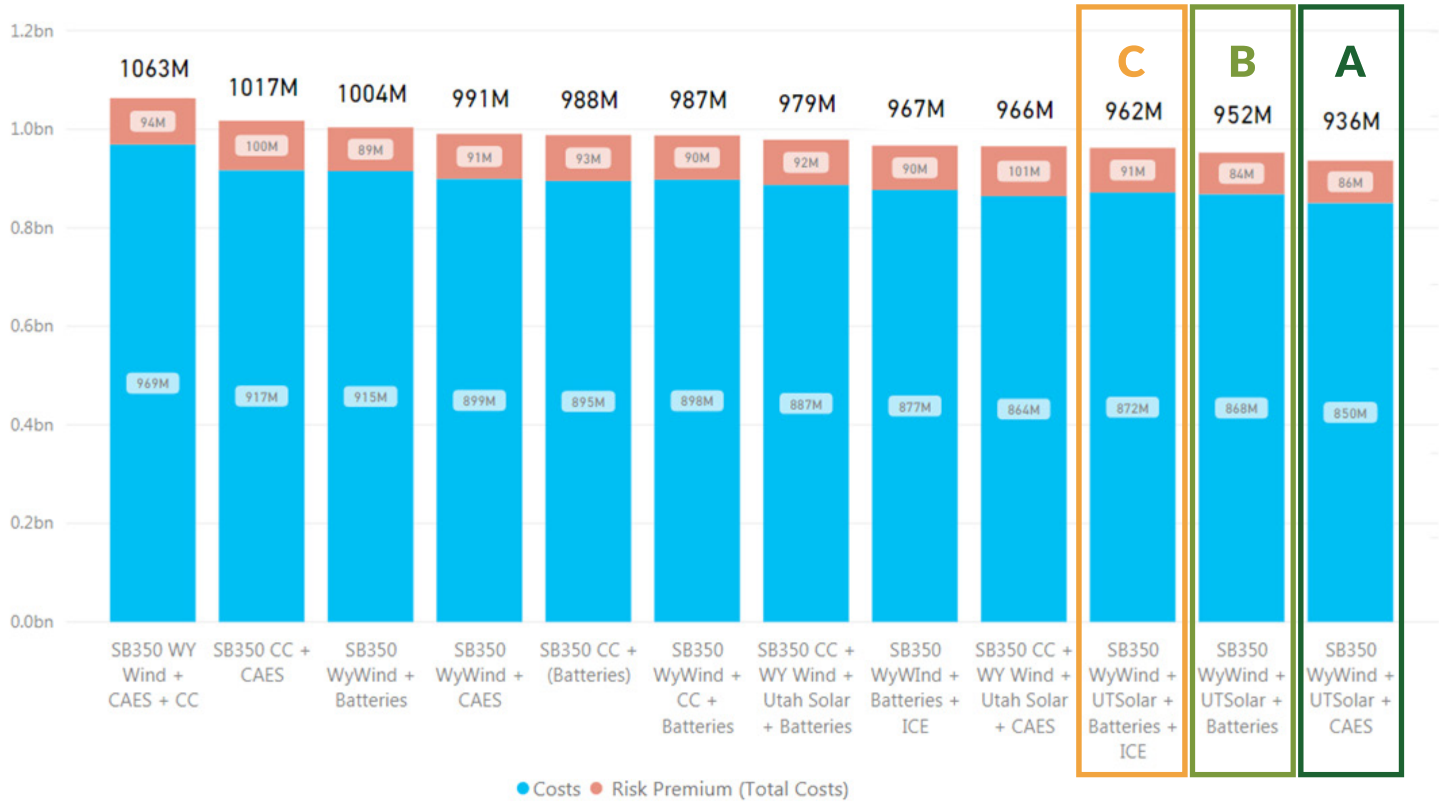

Figure 2.3: Total Cost Ranking of the Lowest-Cost Portfolios for SB350. (Present Value 2019$)

The three lowest-cost portfolios (Portfolios 5, 6 and 7 from Table 2.6) all entail the same renewable energy content including Wyoming wind and Utah solar, plus energy storage (either CAES or 4-hour batteries). One of them also includes ICE generation units.[2] The Preferred Portfolios include:

- Preferred Portfolio A is Wyoming wind, Utah solar, balanced by CAES.
- Preferred Portfolio B is Wyoming wind, Utah solar, balanced by batteries.
- Preferred Portfolio C is Wyoming wind, Utah solar, balanced by batteries and ICEs.

The total costs of these three portfolios over the planning period are very similar. These three portfolio options, combined with BWP's share of the existing Milford 1 wind project near IPP, load BWP's share of the STS line to high levels, thereby effectively utilizing BWP's investment in it. The fact that these diverse portfolio options are similar in cost is an advantage for BWP, because Burbank seeks economies of scale in pursuing them. Projects like these involve large investments and are typically shared by multiple utilities, like the Hoover Dam is shared. Implementation of them will involve cooperation and negotiations with LADWP and others. These other utilities will have their own IRP goals to pursue which may not align exactly with BWP's IRP goals.

The analysis also identified needs for flexible capacity resources to help integrate intermittent renewables, including the Duck Curve. These would be provided by additional, short-duration (1/2-hour and 1-hour) batteries.

The Combined-Cycle Option

The results also show that the proposed natural gas-fired combined-cycle gas turbine ("CC") option at IPP is not a good choice for BWP, despite the fact that not participating in the CC project would result in less STS capacity being available to BWP. With increasing renewable energy contributions during the period, the analysis shows the annual operation and usefulness of BWP's share of the CC starts reasonably high and then drops very low after only about ten years. (By way of reference, the nominal operating life of such a plant should be at least 30 years).

Thus, from a planning perspective the CC option does not appear to be beneficial for BWP when compared to other options. Its GHG emissions would not meet State greenhouse gas emissions targets in 2030 in combination with GHG emissions from Magnolia and Lake One, BWP's local generating facilities. And the total costs of resource portfolios including this option are higher than the preferred options. Meanwhile, BWP is also mindful of the declining costs of renewable energy and energy storage as well as the 2045 100% clean energy target of SB100.

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[2] Not to be confused with "IceBear" building air conditioners, of which there are several in Burbank.

2.5 Supply-Side Resources: The SB100 Future

During the planning process, in addition to the SB350 base case, the potential impacts of the then-proposed SB100 were also considered as a "sensitivity case." With enactment of SB100 late in the planning process (in September 2018), it became the new base case. Chapter 6 also provides details of the analysis for an SB100 future, as summarized below.

2.5.1 Retirement of IPP Coal in 2025

Like the SB350 future, the SB100 analysis assumed retirement of the IPP coal plant in 2025. It assumed the same Burbank STS capacity share assumptions as for SB350 described above.

2.5.2 Same IPP Coal Replacement Options as in SB350

The analysis of the SB100 future involved the same replacement portfolio options for IPP coal used in the SB350 analysis. The primary difference between the two futures involved the increased RPS requirements of SB100: 60% RPS by 2030 and increasing further thereafter. The portfolios were designed to fulfill these RPS requirements. Figure 2.4 provides an illustration of the renewable energy resources used to fulfill SB100 in all three Preferred Portfolios during the planning period.

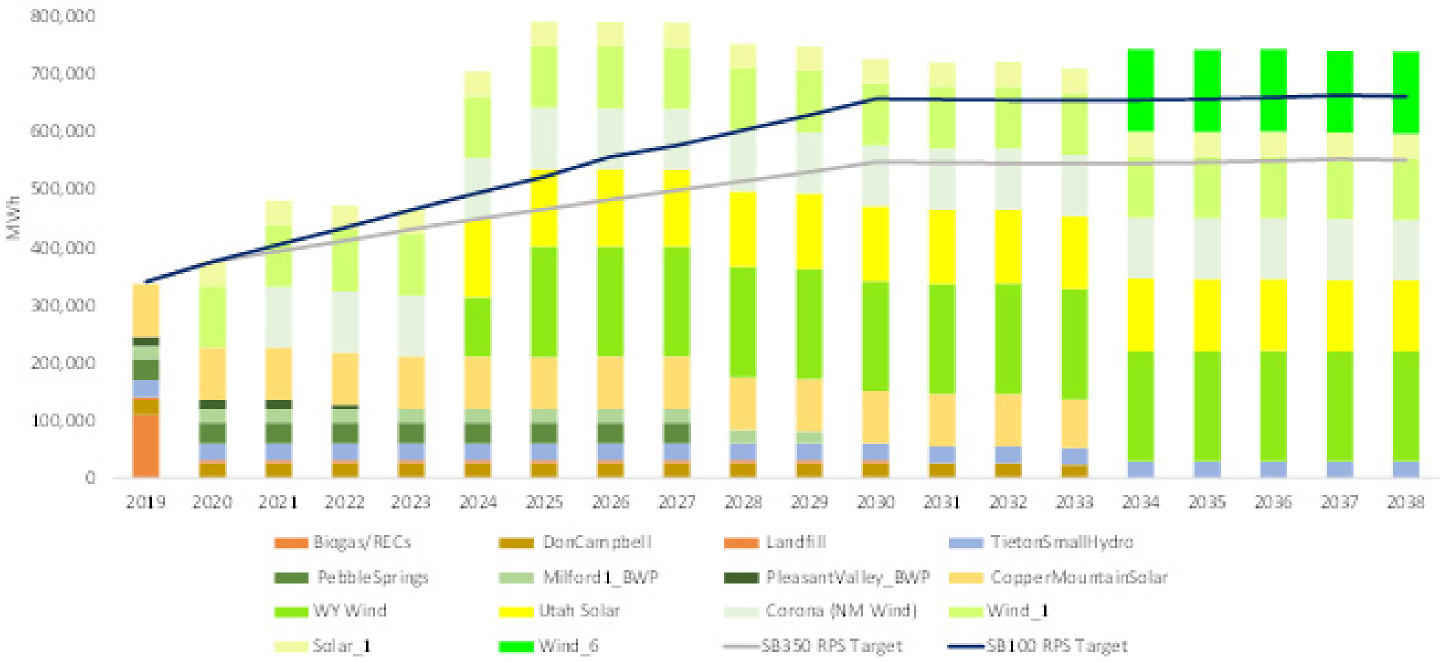

Figure 2.4: Example: Renewable Capacity to Meet 60% RPS by 2030, All Preferred Portfolios.

Portfolio #	CC	WY Wind	Utah Solar	CAES	Batteries (MW of 4 hr)	ICEs	Wind/Solar Addition	Ancillary Batteries (MW of 1 hr)	Transmission on STS
1	0	102	0	0	113	0	160	79	54
2	0	102	0	54	0	0	160	79	54
3	0	46	44	0	50	54	204	97	54
4	0	102	0	54	0	0	160	79	126*
5	0	46	44	54	0	0	204	97	54
6	0	46	44	0	113	0	204	97	54

Table 2.7: Resource Portfolios Evaluated for an SB100 future.

* In portfolio 4, to examine the value of STS capacity in SB100, 126 MW of STS transmission line was used even though BWP would not be a participant in the CC project.

SB100 established a target of 100% clean energy by the year 2045, which is outside the planning period of this IRP. However, consistent with SB100, the trajectory of renewables additions was assumed to continue beyond 2030 on a trend line to achieve 100% clean energy in 2045. Renewables levels equivalent to a 67% RPS are achieved by the end of the planning period—approximately twice the current BWP renewables level.

Table 2.7 summarizes the portfolios evaluated for the SB100 future.

2.5.3 Results: Replacing IPP Coal

The economic findings for SB100 were similar to those described earlier for SB350. The same three portfolios (Preferred Portfolios A, B and C) from the SB350 analysis were again least-cost. Cost advantages of using CAES at IPP (Preferred Portfolio A) became stronger due to its longer storage duration (i.e., 48 hours) compared to shorter-duration batteries. Long-duration storage like CAES offers appears to become more valuable as renewable energy levels increase.

The results of the economic analysis are summarized on Figure 2.5 below. It depicts the total costs over the planning period of the six lowest-cost portfolios in rank order from highest to lowest.

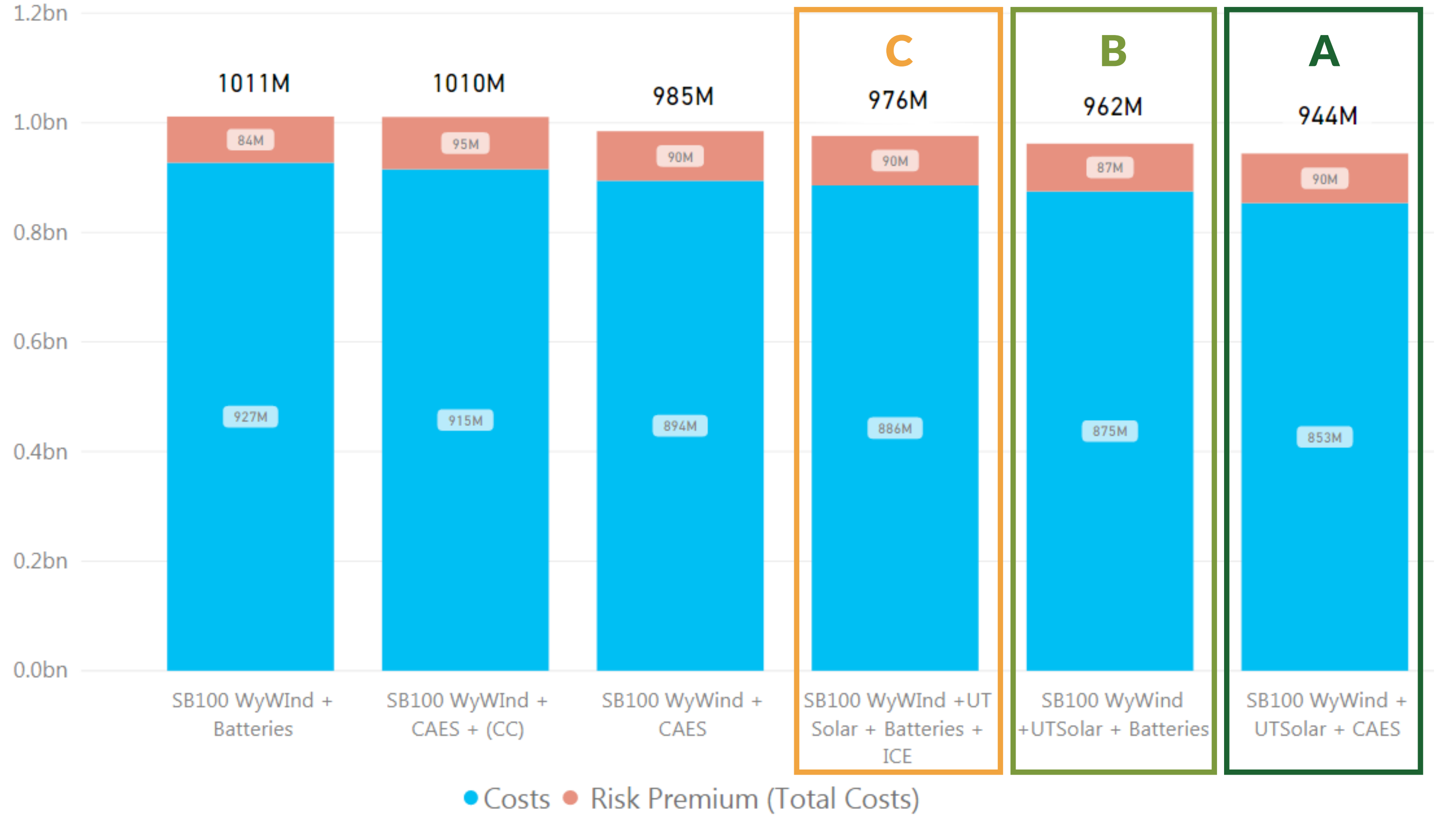

Figure 2.5: Total Cost Ranking of the Lowest-Cost Portfolios for SB100. (Present Value 2019$)

Figure 2.5 shows that, like in SB350, the same portfolios (Preferred Portfolios A, B and C) are lowest cost, and similar in total cost. These are Portfolios 2, 1, and 3, respectively, from SB100 Table 2.7. While their storage capabilities are the same as in SB350, these preferred portfolios have more renewable energy for SB100.

Table 2.8 provides a summary of the resource components of the three Preferred Portfolios.

	Preffered A: Wind, Solar, and CAES	Preffered B: Wind, Solar, and Batteries	Preffered C: Wind, Solar, ICEs, and Batteries
Wyoming Wind	46 MW	46 MW	46 MW
Utah Solar	44 MW	44 MW	44 MW
CAES (48 Hour Duration)	54 MW		
ICEs			54 MW
Batteries (4 Hour Duration)		113 MW	50 MW

Table 2.8: Resources in SB100 Preferred Portfolios A, B and C.

2.6 Over-Generation at High RPS Levels

The RPS is defined based on average energy use over the year. To fulfill the RPS requirements, an RPS of greater than 50% requires BWP to have installed renewable capacity exceeding its annual peak demand. This means it will have more renewable energy than it needs on many days of the year when peak demands are commonly lower than the annual peak demand.

Figure 2.6 illustrates this effect. The graph at the top of the Figure depicts the energy dispatch on a summer (high demand) week in July 2030. The graphs at the bottom of the Figure depicts the energy dispatch on an April spring week with lower customer loads.

On summer days, the match between renewable supply and customer loads is manageable. However, on Spring days the non-dispatchable renewable output can exceed customer load. Considering that these modeling results for BWP are probably typical of that observed by other California utilities, the question is who would buy the over-generation when it occurs? The answer to this question is beyond the scope of individual utilities' IRPs. Addressing it is one of the Action Items described in Chapter 7.

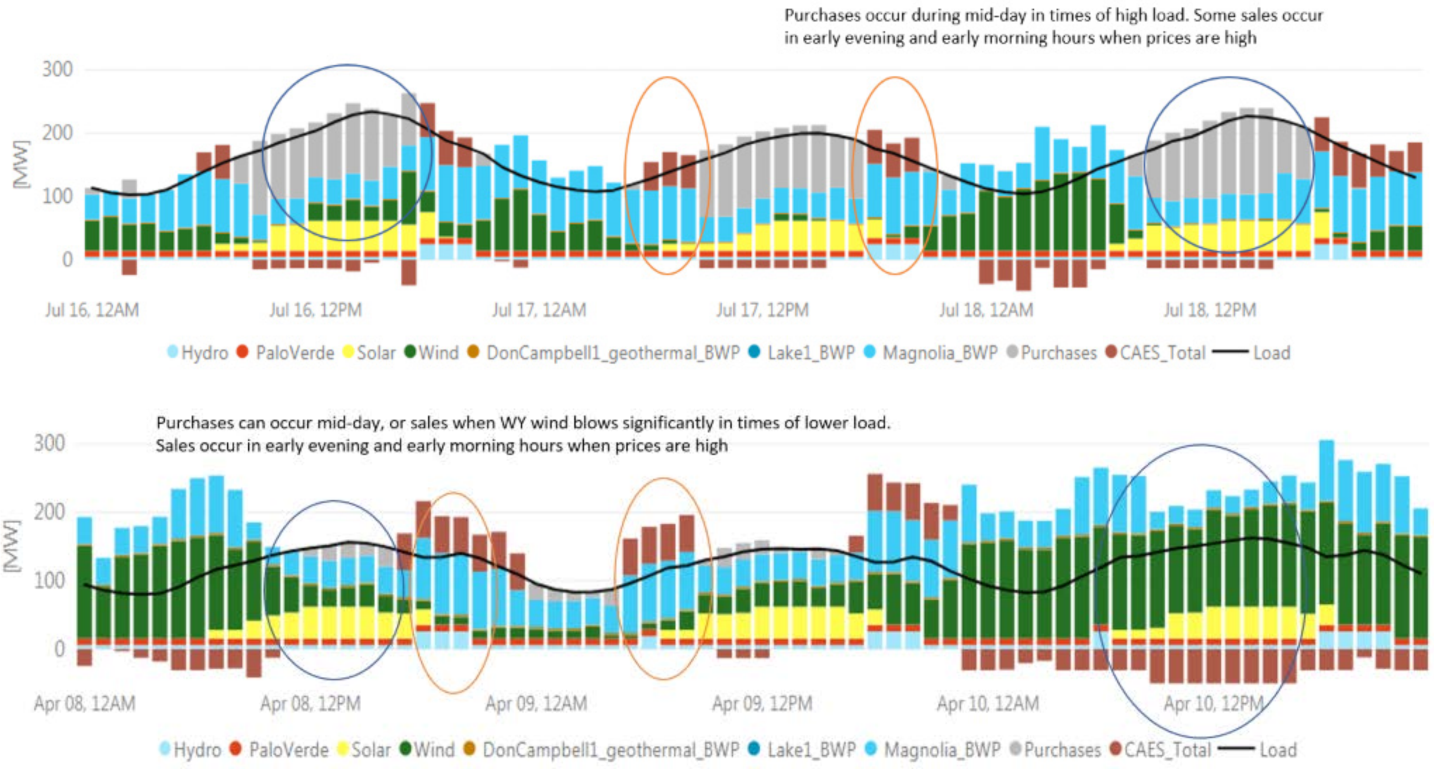

Figure 2.6: SB350 Portfolio 10 Hourly Dispatch Sample in the Summer and Spring of 2030 (WY Wind + CAES)

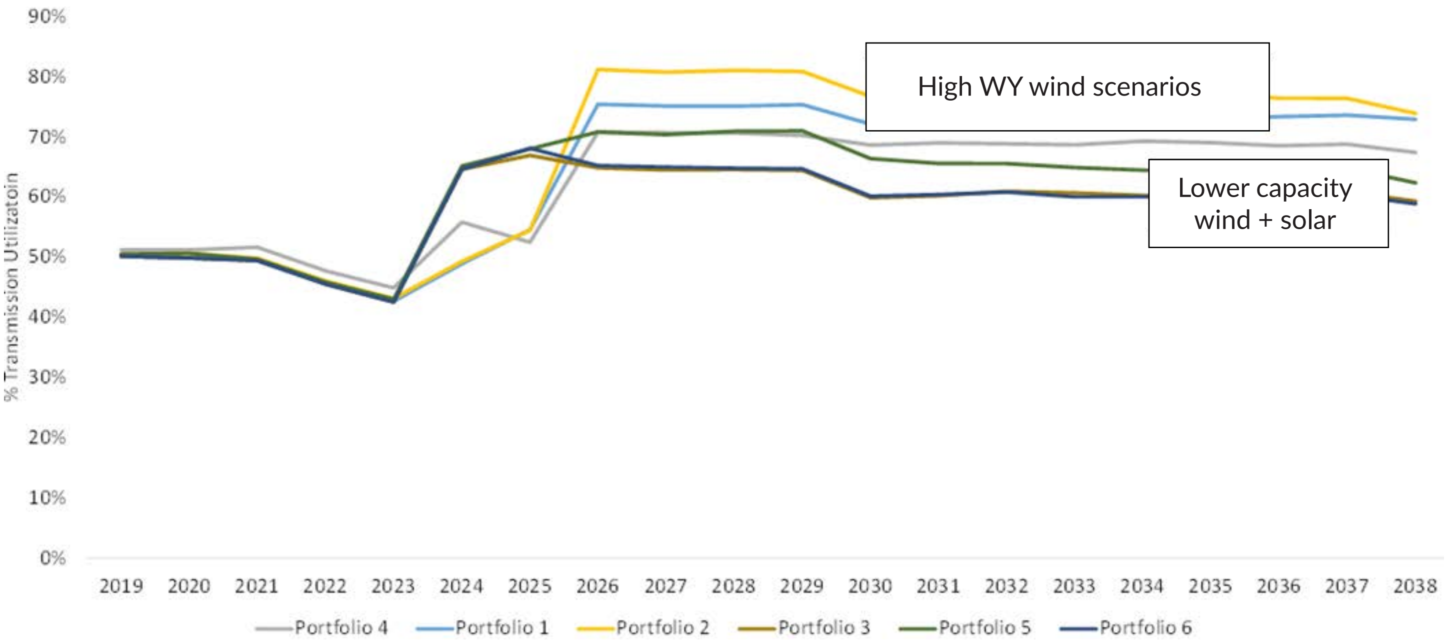

Figure 2.7: Loading of BWP Allocation of STS Transmission Capacity for each SB100 Portfolio Evaluated. (Annual load factor in %)

2.7 STS Transmission Utilization

As noted earlier, the STS transmission line is an asset for BWP. Figure 2.7 provides an illustration of the loading of BWP's allocation of STS transmission capacity achieved by the SB100 portfolios.

Figure 2.7 shows that the portfolios with storage at IPP (Portfolio "2" which is Preferred Portfolio A; and Portfolio 1 which is Preferred Portfolio B) achieve the highest STS utilization. Using 102 MW of Wyoming wind renewable energy, their load factors exceed the forecasted STS load factor prior to IPP coal retirement in 2025. For example, in Preferred Portfolio A the 54 MW of CAES acts as a transmission asset, protecting the STS line from overload when renewable output is high. Then, it releases the surplus renewable energy when STS is not constrained, thereby "packing" the STS with renewable energy.

2.8 Greenhouse Gas Emissions

The least-cost, Preferred Portfolios A, B and C for both the SB350 and SB100 futures all entail dramatic reductions in GHG gases compared to current levels: an estimated 87% reduction by the end of the planning period for the SB100 future.

The analysis forecasts that the least-cost portfolios can achieve the California Air Resources Board (CARB) targets for Burbank GHG emissions in 2030 with only modest reductions in the operation of MPP, which by then will be the primary source of GHG emissions in the BWP fleet. Figure 2.8 illustrates how Burbank's GHG emissions (in millions of metric tons per year) will drop with increasing renewable energy levels in the SB100 future over the period for the CC replacement project at IPP and the three Preferred Portfolios.

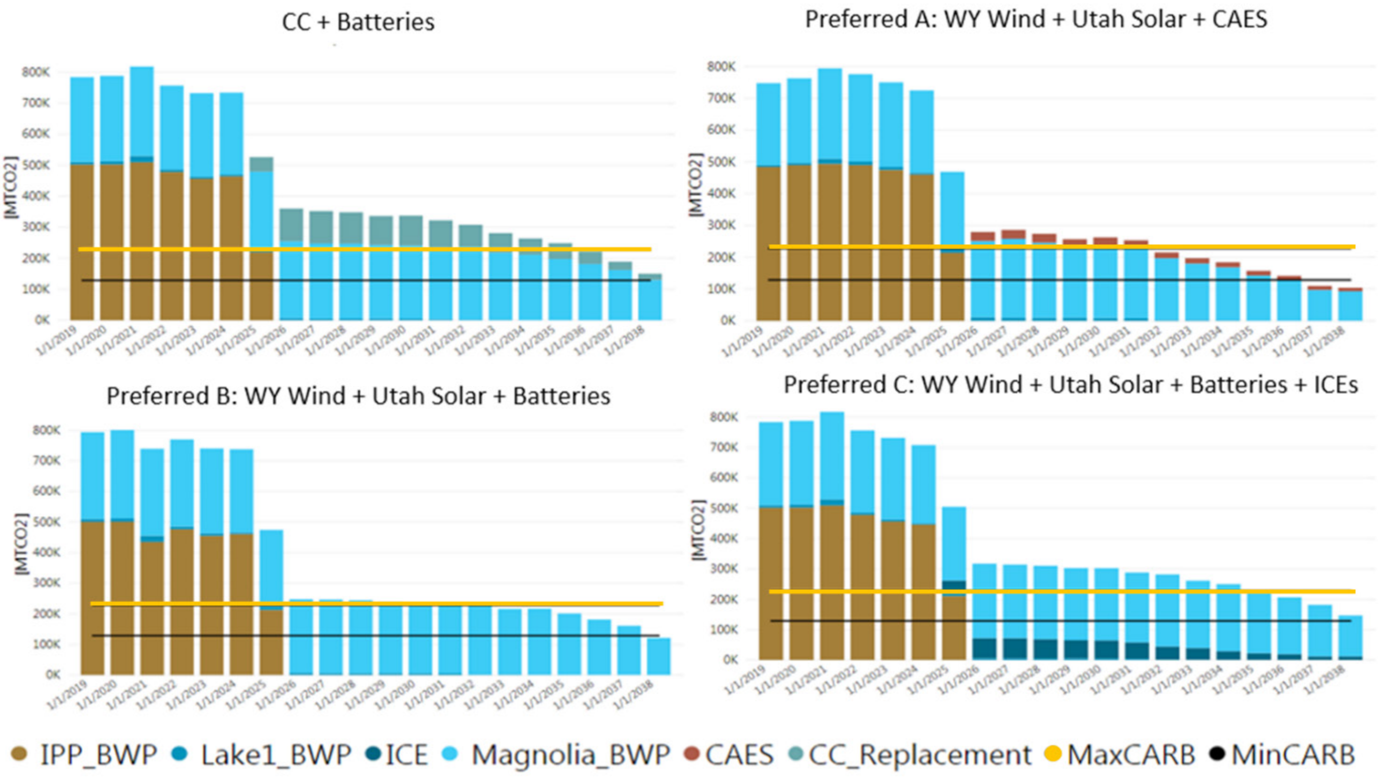

Figure 2.8: BWP GHG Emissions Reductions with Increasing Renewables in SB100 for CC Renewal project at IPP and the 3 IRP Preferred Portfolios.

2.9 Transmission

BWP is a member of the LADWP Balancing Area (BA). As such, LADWP is responsible for bulk transmission (that is, above 69 kilovolts (kV)). Accordingly, bulk transmission system reliability is not a BWP responsibility outside of operating its electric system and resources in accordance with the conventions established by the Western Electricity Coordinating Council (WECC) and commonly-accepted utility practice.

However, future transmission availability and cost are key factors affecting the IRP. The issues include:

- STS capacity available to BWP as a result of the IPP coal replacement project.
- Transmission to deliver generic renewables to Burbank ("generic" referring to renewables with locations to be determined later).
- Transmission to deliver Wyoming wind to IPP site for subsequent delivery to Burbank vis the STS.

These issues are addressed in the proposed Action Items for this IRP outlined later in this Chapter.

2.10 Distribution

BWP continues its historical levels of excellent distribution reliability. Although distribution historically not been addressed in IRPs, BWP recognizes that local resources like customer-owned distributed energy resources like rooftop solar will likely affect the distribution system in the future.

With its current high reliability, automated meter infrastructure (known as AMI) and minimal customer load growth, BWP's distribution system is well-positioned to transition to such a future. In this connection, unused BWP distribution substation sites should be reserved for potential future use as locations for batteries.

2.11 Customer Rate Impacts

Estimated annual resource costs of the IRP for both the SB350 and SB100 futures are similar. This happens because the future cost of additional renewables and energy storage are increasingly cost-effective, while GHG costs make fossil fuels like natural gas increasingly expensive.

Although planning for the future by its nature is inherently uncertain, BWP's goal is to contain future electric rate increases at or below the long-run rate of inflation. See Chapter 6 for details.

2.12 EIM Participation

The Energy Imbalance Market (EIM) is an initiative by the California Independent System Operator (CAISO) to create a larger daily wholesale electricity marketplace with more participants to enable additional sharing of diverse resources. Participation is voluntary, although BWP could not participate unless its Balancing Authority, LADWP, would join.

The Ascend analysis indicates there are potential cost savings and operational advantages if BWP would participate in the EIM. And potential disadvantages for not participating. This topic deserves further consideration and is included in the proposed Action Items listed below.

2.13 Proposed Policy Guidelines

Through the IRP process BWP has found that, while the business of providing Burbank with reliable, affordable, and sustainable electric service is changing rapidly, the policy guidelines for its business remain largely the same as approved in the 2015 IRP.

- BWP should continue to meet electricity demand growth from energy efficiency and conservation, then renewables. BWP does not plan any new fossil-fueled power generation, except as needed to cost-effectively integrate renewable energy and maintain reliability.
- BWP should optimize cost-effective energy efficiency and conservation programs.
- BWP should add renewable energy to the extent needed.
- BWP should plan to achieve greenhouse gas emissions reductions consistent with state goals.
- BWP should maintain low cost of service, including striving to maintain rate increases at or below the long-run rate of inflation.

2.14 Action Items

As described in Chapter 7, various actions by BWP are indicated on both the customer-side and the supply-side of the meter to achieve these outcomes, subject to Council direction and approval:

1. **Rate Design.** Design time-varying rates that encourage customers to shift their consumption away from higher cost periods to lower cost periods.
2. **Demand Response (DR).** Consider cost-effective BWP customer DR programs.
3. **Beneficial Electrification.** Enhance and extend BWP efforts to encourage growth in beneficial electrification that reduces GHG emissions, including electric vehicles.
4. **Disadvantaged Communities.** Develop and implement a program to target disadvantaged communities with selected BWP energy efficiency, demand response, and beneficial electrification programs.
5. **IPP Coal Replacement.** Work with LADWP and other IPP participants to determine resources that will replace IPP coal plant when it is retired in 2025. Particular focus should be given to BWP's share in the STS transmission line from the IPP site in Utah to Southern California.
6. **Transmission Delivery for Renewables.** Identify options and costs for transmission delivery of large quantities of renewable energy resulting from SB100
7. **Solar Over-Generation.** Work to mitigate the impact of solar generation (including morning and afternoon ramping, overgeneration, and instantaneous intermittency) such that reliability and affordability are maintained.
8. **EIM Participation.** Evaluate possible participation in the Energy Imbalance Market if and when BWP's Balancing Authority, LADWP, joins the EIM.
9. **Resource Positioning.** Position BWP's resources to work with the Duck Curve to the greatest extent possible to minimize costs and maximize reliability for Burbank. In this connection, evaluate futher improvement in the operational flexiblity of the Magnolia Power Project (MPP).

Additional details on these Actions are provided in Chapter 7.

2.12 Conclusion

The IRP positions BWP to provide reliable, affordable, and sustainable electric service to Burbank for decades to come.

Chapter 3

BWP in 2019

3.1 About BWP

Burbank Water and Power

Burbank Water and Power is a vertically-integrated, publicly-owned municipal utility. Being vertically integrated means that BWP generates, transmits, and distributes power to Burbank customers. BWP is owned and operated by the City of Burbank and is governed by its Board and the Burbank City Council. BWP is not-for-profit, delivering service at cost.

BWP is committed to providing reliable, affordable and sustainable electricity service to Burbank. BWP's reliability is superb, maintaining electricity service to BWP's customers 99.998% of the time in 2017. In terms of affordability, BWP's rates are near the lowest in the region, with annual rate increases at or below the long-run rate of inflation for the last decade. And BWP's commitment to sustainability is strong: In 2007, BWP was the first utility to commit to 33% renewables by 2020 and BWP reached 33.3% renewables in fiscal year 2016-17. [3]

BWP maintains its commitment to reliability, affordability and sustainability as BWP plans for the future. This will not be easy. BWP faces significant opportunities and challenges, as policies and regulations, market conditions, electricity demand, market access and other aspects of the utility business evolve. Therefore, BWP must stay ahead of the pack by constantly looking ahead, planning ahead and acting ahead so that BWP remains a leader in reliable, affordable and sustainable electric service for years to come.

Please see Exhibit D for a timeline of BWP's history, focused on both customer-side and power supply-side resources.

City of Burbank

Burbank is known as the ***Media Capital of the World*** and is home to two of the world's largest studios, Warner Bros. Entertainment and The Walt Disney Company. The city is also home to thousands of smaller businesses, many of whom moved to Burbank in the early 1990s after the aerospace industry contracted and real estate became more available. These businesses have come to expect cost-effective and reliable electric service, as well as additional services such as fiber optic networking.

Burbank also has a vibrant residential community, with a housing mix of about 18,750 single family homes that range from post-World War II bungalows to two story view homes. There are also about 28,850 multifamily homes. In total, BWP serves 44,633 residential, 5,255 small commercial, 1,295 medium commercial, 163 large commercial, and 81 extra-large customer accounts (Figure 3.1).

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[3] BWP reached 31.9% in 2017-18. The slight reduction from the prior fiscal year was the result of an underperforming biomethane supply contract.

BWP's Electric Load

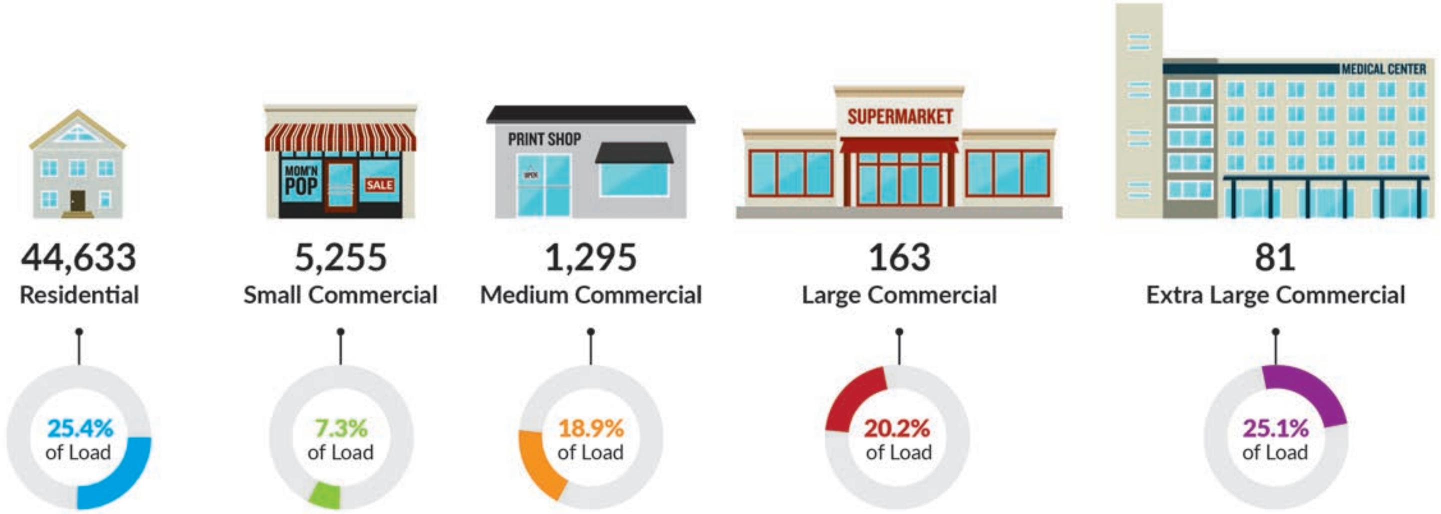


Figure 3.1: BWP's Electric Load

Source: BWP

3.2 Load

BWP serves the electricity needs of Burbank. In utility terms, these needs are called "load." Managing and forecasting Burbank's load is necessary to ensure affordability and reliability. As BWP moves forward, there will be significant challenges to forecasting BWP's load due to changing customer use patterns brought on by energy efficiency, increasing rooftop solar, and legislative mandates to reduce GHG emissions which contribute to climate change. Therefore, it is essential to understand load, load patterns, annual energy requirements, and the specific load change challenges BWP is preparing to meet.

Load is measured in watts and, for convenience, in multiples of watts, including kilowatts (kW or 1,000 watts) and megawatts (MW or 1,000,000 watts). A customer creates load when he or she turns on a light or an air conditioner or starts a factory. That load then has duration – the amount of time the light is on or the factory is running – so a time element is added: 1 kW for 1 hour is 1 kilowatt hour (kWh), 1 kW for 2 hours is 2 kWh, and so on.

BWP serves this load by delivering electricity through the electrical system: the network of wires, transformers, switches, and other equipment that make up the electricity grid. BWP generates some of this electricity itself, buys some of it from power plants that it has rights to, and buys some from the electricity markets.

Electricity itself is a challenging thing, as it travels at the speed of light and must be consumed the instant that it is produced: the electric grid has limited ways to store it cost effectively in large quantities. So, electricity generation in the system must always match closely to load to maintain safe operation and customers' lights (and other loads) on.

To maintain this crucial balance, BWP must accurately forecast its loads, both for the short-term and the long-term. Historically, Burbank's load grew year-to-year, but since 2009 load has remained flat or even decreased. In fact, Burbank's load today is about 10% lower than it was ten years ago. The reductions have been the result of economic recession, combined with a lack of economic development in Burbank, energy efficiency and conservation efforts by BWP and its customers, and solar generation installed in the city (Figure 3.2).

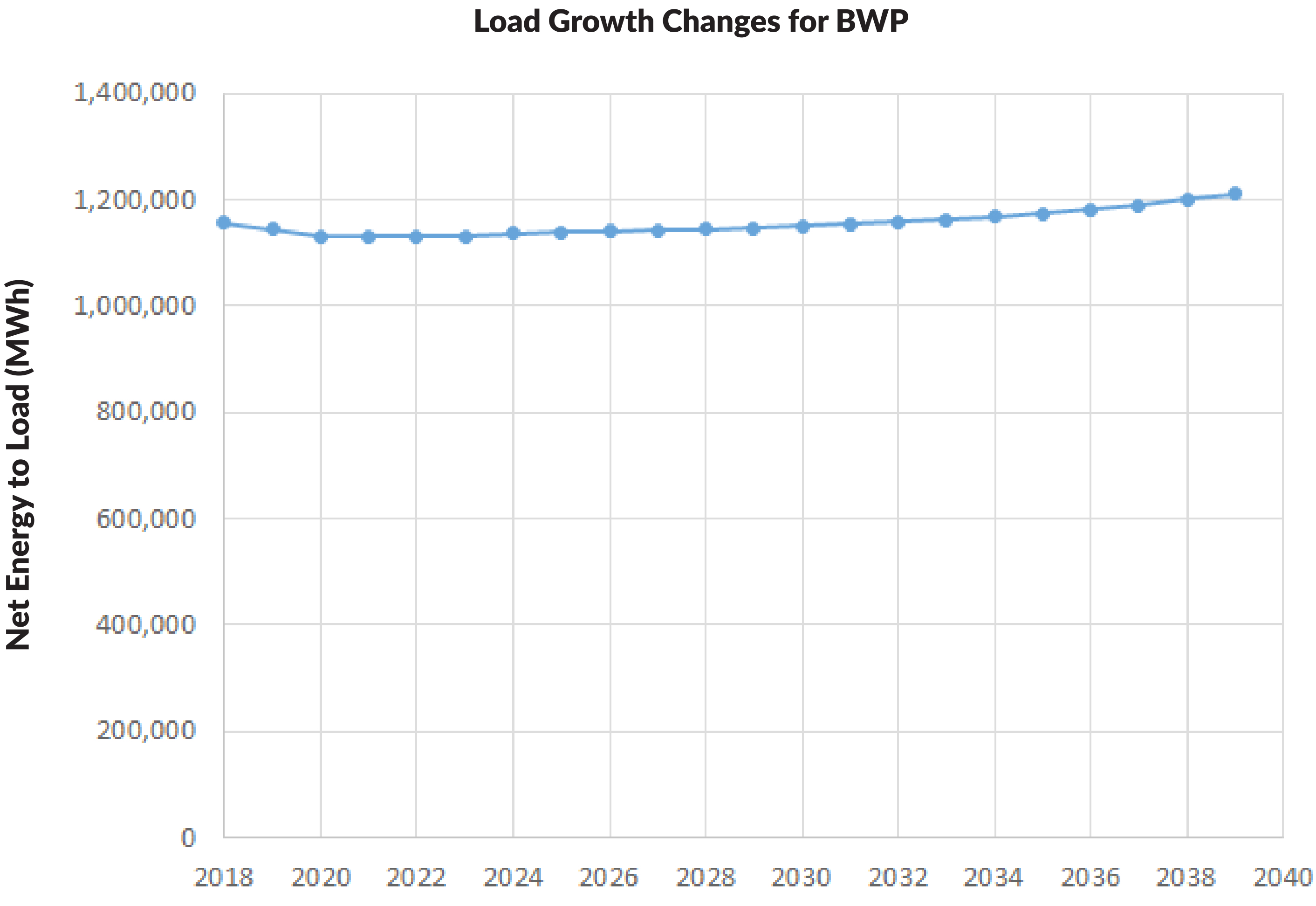


Figure 3.2: Load Growth Changes for BWP

Source: BWP

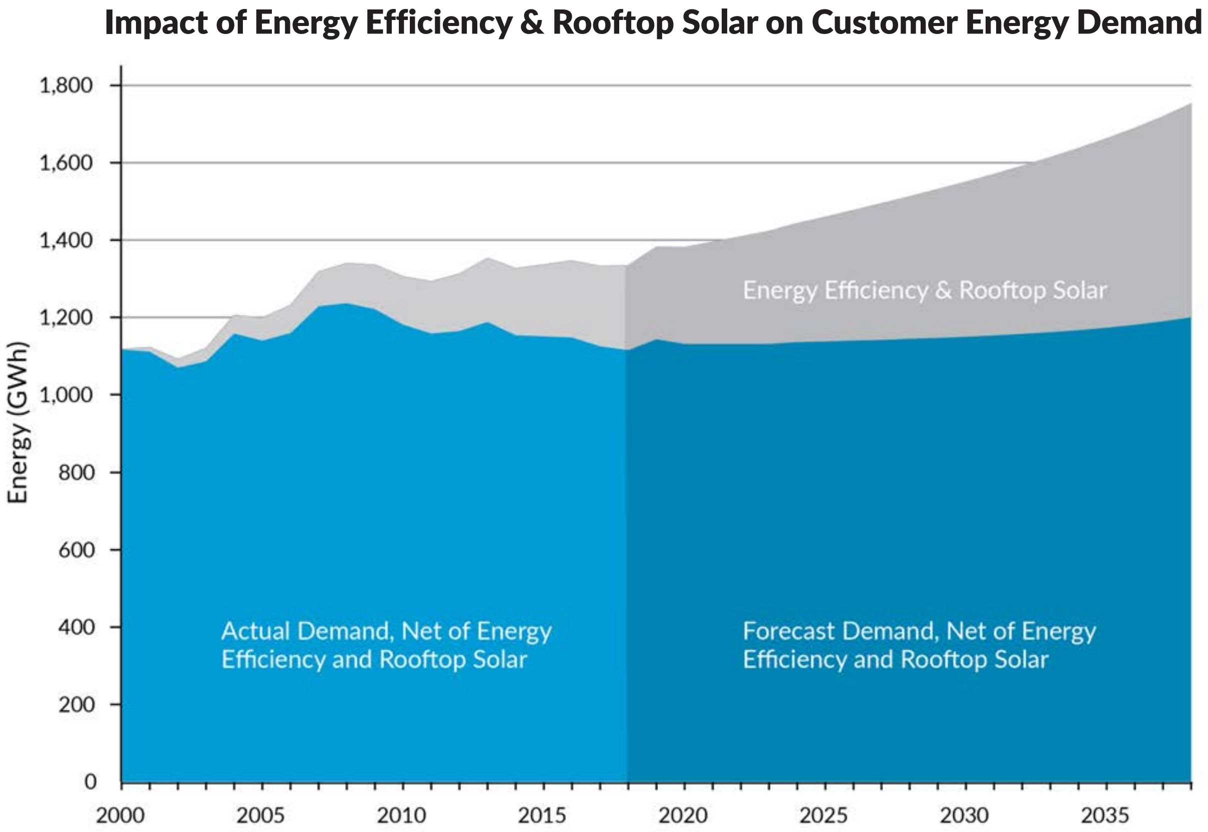


Figure 3.3: Conceptual Illustration of the Impact of EE and Rooftop Solar
Source: BWP

BWP forecasts flat loads – no load growth – in the short and medium-term, with significant uncertainty over the long term. This long-term uncertainty, discussed in more detail elsewhere in this IRP, is due to uncertainties in economic growth and electrification (which would cause load to grow), additional installations of rooftop solar (causing loads to shrink), and other factors (See Figure 3.3 for a conceptual illustration of these effects).

For BWP, aggregate peak demand is a single half-hour or hourly period which represents the highest point of customer consumption of electricity. BWP's all-time peak demand was 322 MW in 2017. BWP's peak demand is forecast to remain flat at about 314 to 322 MW for the next several years.

3.2.1 BWP is a Fully-Resourced Utility

Burbank is currently adequately resourced to meet load, and any growth or new requirements over the next several years are expected to be met through energy efficiency and conservation, rate design, demand-side management, and renewable energy. This approach, known as the "Loading Order," is consistent with both state and local policy direction and was reflected in BWP's 2015 IRP. The Loading Order is a progression of preferred generation options and reflects contemporary social and environmental policy.

However, BWP will lose a current primary energy resource, the Intermountain Power Project (IPP) in Utah, when it is retired in 2025. Much of the effort in this IRP is focused on appropriate and cost-effective replacements for this capacity and energy as BWP's renewable energy requirements continue to grow over the planning period.

3.2.2 Load Patterns

Loads are different – often very different – depending on the time of day, the day of the week, the season, and the prevailing weather.

For example, we tend to use less power at 4:00 a.m. than we do at 4:00 p.m. Even in our 24/7 world, most of us wake up in the morning and turn on an appliance such as a TV or coffee maker. We also crank up the air conditioning in mid-afternoon if we're hot and turn on electric lights in the evening for a few hours before turning them off again when going to sleep. At night, loads are lower, but power is still needed for refrigerators and cable TV boxes, streetlights and traffic lights, hospitals, police and fire stations and businesses with graveyard shifts, and charging our phones, laptops, and, increasingly, electric vehicles.

Because of air conditioning, loads tend to be much higher in the warmer months than in the cooler months. Since most businesses operate during the normal "9 to 5" work day from Monday to Friday, loads are higher during work days than on the weekends.

The electricity that is being used right now was actually planned for years ago. But it is generated at the instant that it is consumed. As part of BWP's obligation to serve its customers, BWP must be ready to meet customer load demand at any time of the day or night.

3.2.3 Annual Energy Requirements

If one were to graph all the hourly energy requirements required to meet load over the course of a year and arrange them from the highest to lowest requirement, the result would be what utilities call a "load duration curve". The load duration curve shows the percentage of time that BWP's load is at or above a certain level. BWP's load duration curve for 2017 is shown in Figure 3.4.

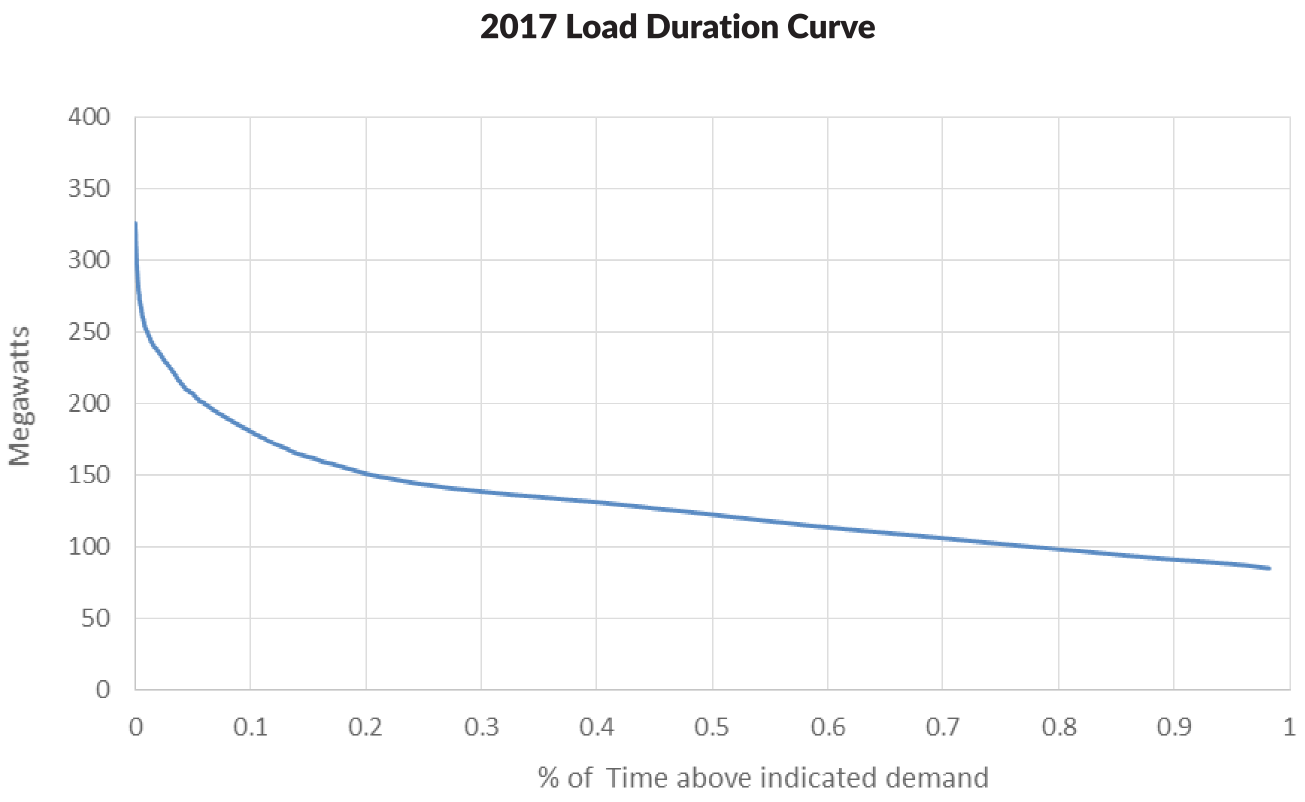


Figure 3.4: BWP 2017 Load Duration Curve
Source: BWP

The load duration curve shows how much generation capacity is needed to supply Burbank's load and how many hours of the year that capacity is utilized. The load duration curve above shows that Burbank's minimum load was 80 MW, meaning there was no time during the year in which BWP supplied less than 80 MW. The curve also shows how much capacity is needed to meet Burbank's maximum (or "peak") demand, which is a period representing the highest point of customer consumption of electricity.

The load duration curve reveals that BWP supplied more than 251 MW only 1% of the time. In other words, there were 88 hours in the year when the total electric load on Burbank's system was greater than 251 MW. With a peak load of 322 MW, that means that 71 MW (322 minus 251) must be available to serve its peak needs for less than 88 hours every year.

These peak loads tend to occur during hot weather and so BWP's peak load of 322 MW only needs to be planned for during those anticipated periods.

Load Factor

"Load factor," in turn, is a measurement of a utility's system utilization relative to its peak, calculated as average load divided by peak load. On an annual basis, BWP's load factor is about 40.5%. This is not uncommon for a city like Burbank, with strong peaks during hot weather and during the work week but much lower loads at night and over the weekend. By way of contrast, a city like Vernon, California, which is almost entirely industrial, has a much higher annual load factor, reflecting the fact that its factories operate almost around-the-clock. Because air conditioning is a small component of a manufacturer's electricity use, Vernon's load is less sensitive to hot weather.

Load factor is important, as it describes how efficiently a utility can use its infrastructure. From a rate perspective, a higher load factor – more electricity flowing over the system – means that the fixed costs of that system can be recovered over a larger amount of electricity sales, which tends to lower the cost of each kilowatt sold. As described elsewhere in this IRP, BWP is developing a number of strategies to raise its load factor.

The Need for Flexibility

Finally, in addition to ensuring sufficient capacity for peak load periods, BWP's increasing renewable energy resources and their natural intermittency (that is, the wind does not always blow, and the sun shines only during the day. Plus, clouds may periodically block the sun during the day) means BWP must provide flexible, fast-ramping resources to counter this intermittency.

Further, when the sun comes up in the morning and when it sets in the evening creates the "Duck Curve" effect described in the next Section. This means the rest of the BWP supply system must adjust downward quickly in the morning, then quickly upward again in the evening. This drives requirements for not just adequate amounts of total supply capacity, but also a portion of that capacity must be flexible enough to ramp quickly.

3.2.4 The Duck Curve

The California Independent System Operator (CAISO) is the entity that operates most of California's electric grid. BWP is not part of the CAISO, but its challenges are similar. The CAISO published a graph of what its net load looks like today, and what it could look like in the future as California adds more and more intermittent renewable generation (primarily solar) to the grid. See Figure 3.5. This chart is called the "Duck Curve" because it resembles a duck floating in the water.

In Figure 3.5 below, the blue lines at the top are what the net load (that is, the load seen by CAISO's non-renewable resources) looked like in 2012 and 2013, based on real data from the grid. The brown lines are future projections of what the net load might look like, culminating with 2020. In the recent past, the speed of growth of the actual Duck Curve impact has repeatedly exceeded forecasts.

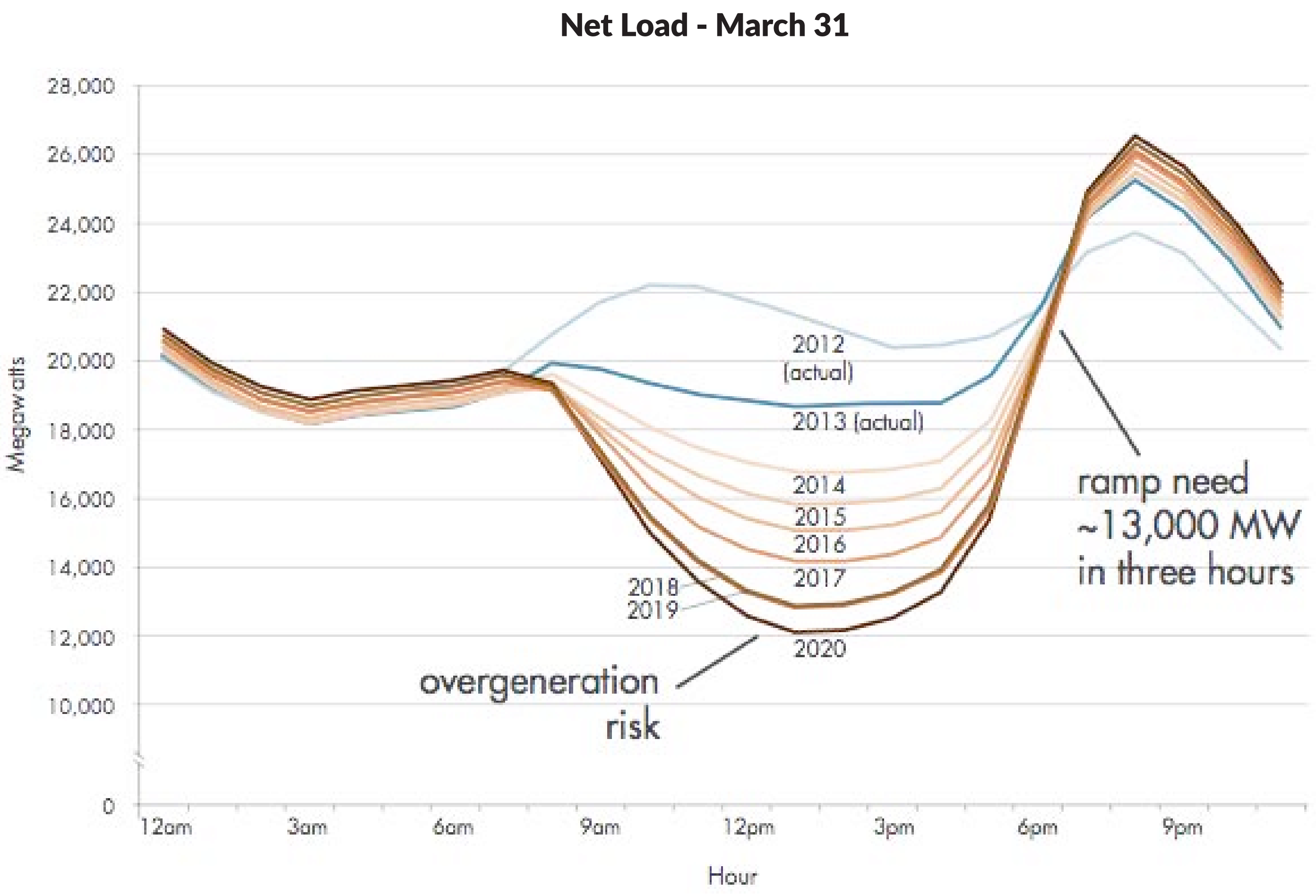


Figure 3.5: CAISO's "Duck Curve"
Source: CAISO

There is a slight pick-up in the morning (before much sunlight) as people wake up and start to use electricity. This is the duck's tail. Later, as the sun comes up, load increases from those TVs and coffee makers, but solar power generation picks up even faster, dropping into the belly of the duck. As a result, what used to be the system peak (the middle of the day) increasingly looks like a trough. In fact, as solar output increase in the morning power plants (both conventional and renewable) produce more energy than we can consume. In the evening, when everyone goes home from work and turns on air conditioners and televisions, the sun goes down, solar power stops generating, and the curve begins to ramp into the duck's head. Suddenly, generation needs to increase by a large amount – and very quickly.

And there is more than just one single duck. There are actually hundreds of ducks: a different duck for every day of the year. And the duck changes over time – it gets fatter, so to speak – as more solar power is added to the mix.

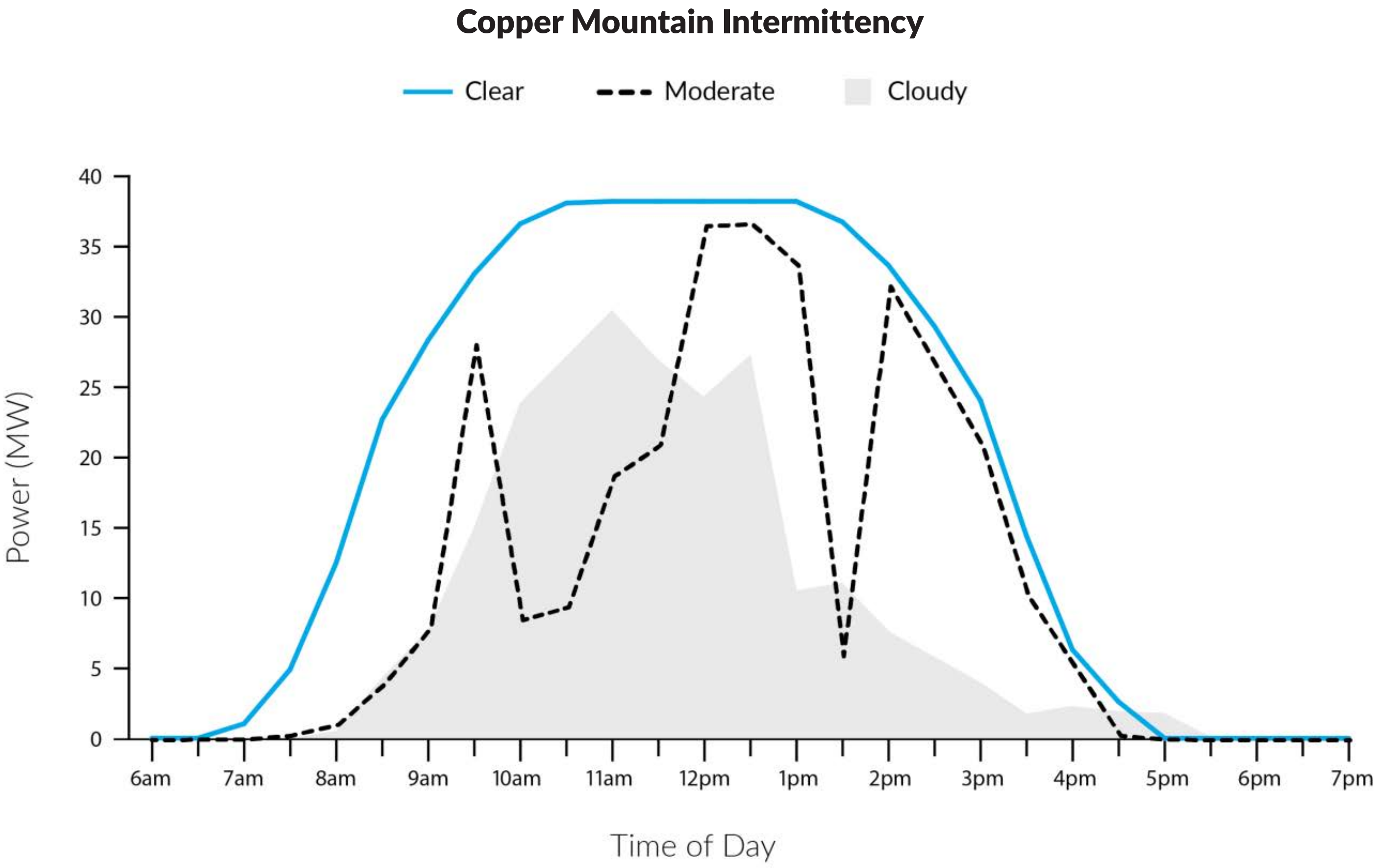


Figure 3.6: Copper Mountain Solar 3 Intermittency

Source: BWP

The Duck creates two major challenges to California utilities. The first is the rapid ramp down of net load at the beginning of the day, and then the ramp up that occurs towards the end of the day, when the sunlight diminishes. The conventional base-load power sources are limited in their ability to ramp down as the sun comes up, and to ramp back up to meet the sudden demand of customers as they come home from work and start using electricity.

The second challenge is that variable power sources like solar cannot produce power all the time: solar is dependent on daylight. Along with the rising and setting sun, passing clouds and shade from trees cause solar generation to stop and start (and stop and start again) during the day. For example, Figure 3.6 shows these effects at BWP's primary solar energy source, the Copper Mountain Solar 3 project (Copper Mountain) in Boulder City, Nevada

BWP is challenged to manage the variation in output from intermittent renewable resources.

As described in Chapter 6 of this IRP, the Duck Curve and intermittency of renewables represent challenges for system reliability and resource adequacy. That is, continuing to maintain sufficient total installed supply capacity to serve peak customer loads as affected by increasing solar and wind impacts; and to maintain sufficient flexible capacity to deal with ramping and intra-hour renewables intermittency. This IRP analyzes both challenges.

These challenges affect utilities and system planners all over California. They will become increasingly difficult to manage as more renewable generation (primarily solar) is added to the grid.

These two challenges have imperfect solutions. The first can be met by minimizing over-generation midday by shutting either renewables or other plants down or by increasing midday loads, both by shifting loads to mid-day and with energy storage. The afternoon ramp issue requires the dispatchable power plants and energy storage on the system to ramp up production at a rapid rate to maintain load-generation balance. This can be mitigated by increasing mid-day loads (thus decreasing the size of the afternoon ramp), by adding storage that can supplement power supplies at that time, by adding non-solar, dispatchable, fast-ramping generating resources, and by decreasing loads in the late afternoon and evening.

Figure 3.7 below is a complete CAISO snapshot of these challenges over the longer term.

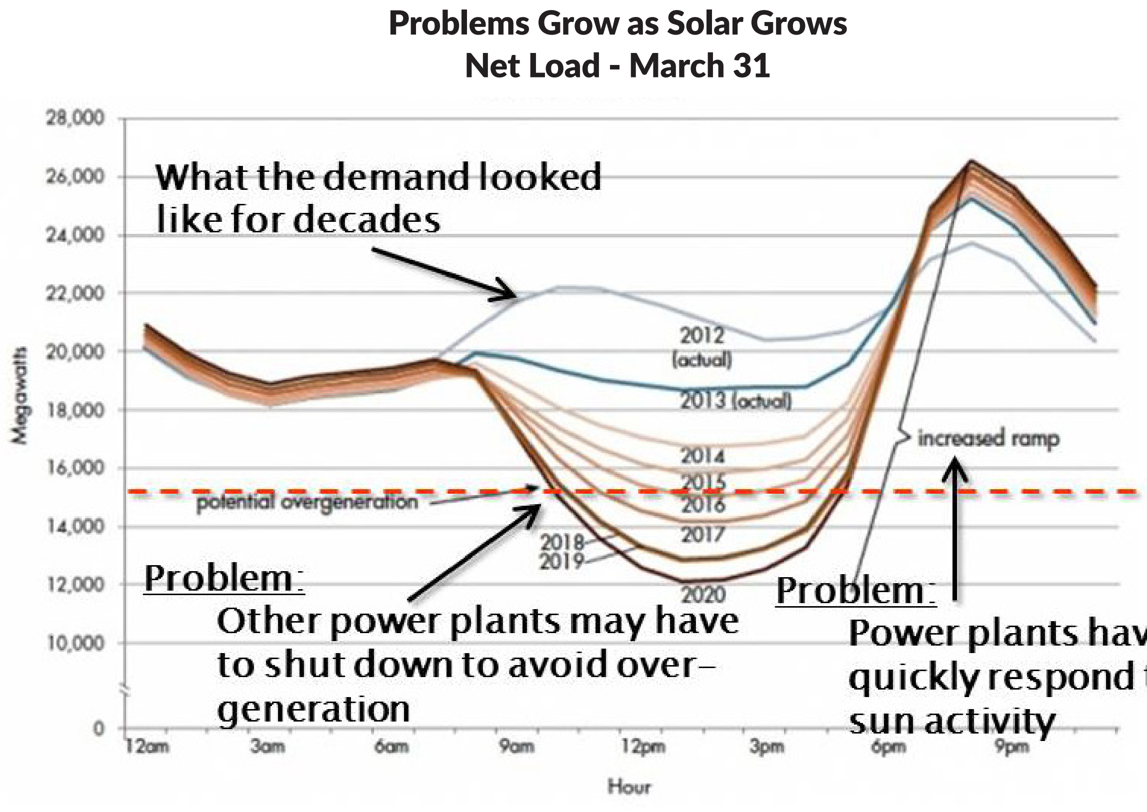
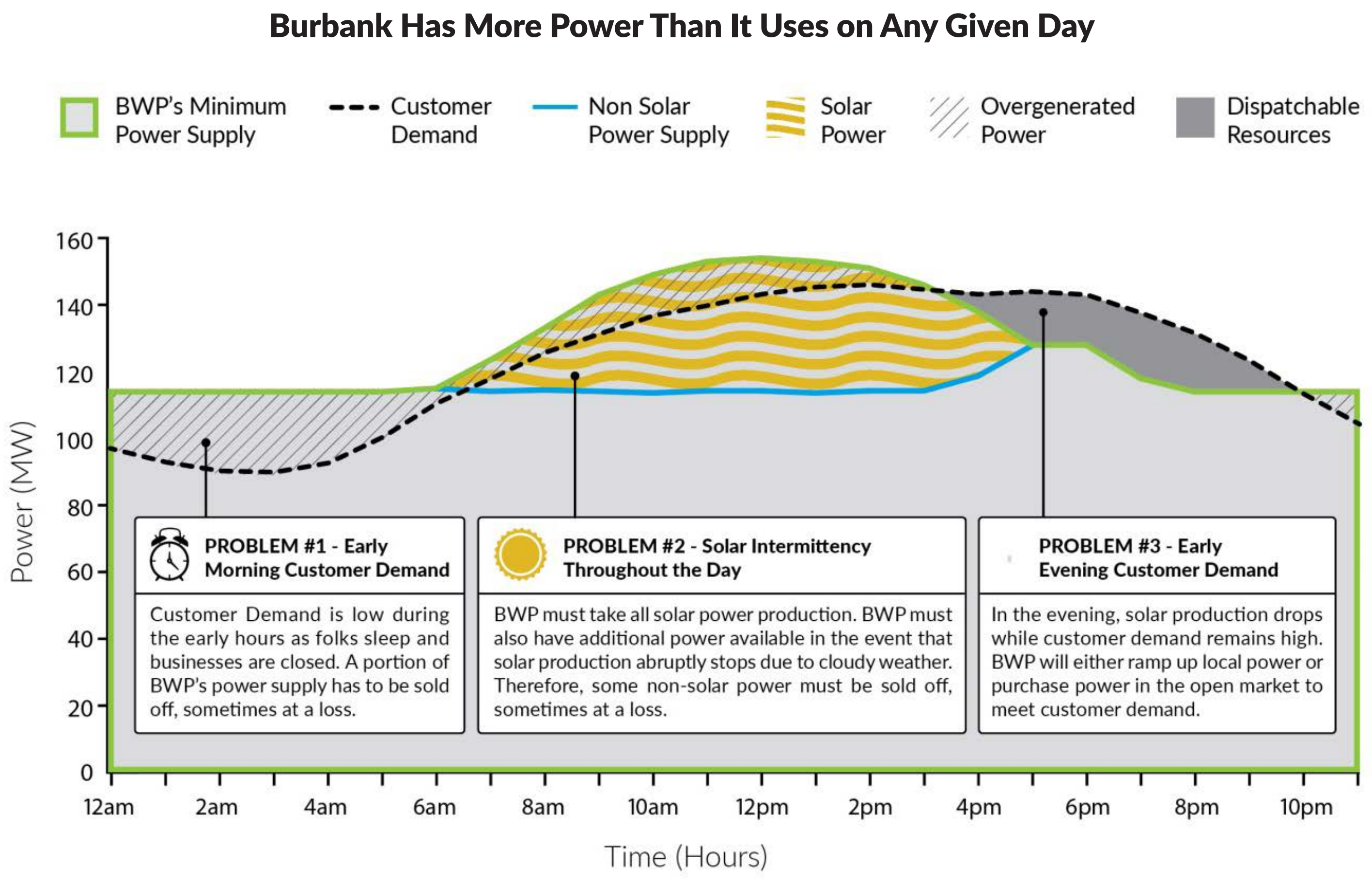


Figure 3.7: Problems Grow as Solar Grows

Source: CAISO



Burbank Has More Power Than It Uses on Any Given Day

PROBLEM #1 - Early Morning Customer Demand

Customer Demand is low during the early hours as folks sleep and businesses are closed. A portion of BWP's power supply has to be sold off, sometimes at a loss.

PROBLEM #2 - Solar Intermittency Throughout the Day

BWP must take all solar power production. BWP must also have additional power available in the event that solar production abruptly stops due to cloudy weather. Therefore, some non-solar power must be sold off, sometimes at a loss.

PROBLEM #3 - Early Evening Customer Demand

In the evening, solar production drops while customer demand remains high. BWP will either ramp up local power or purchase power in the open market to meet customer demand.

Figure 3.8: Burbank has More Power than it Uses on Any Given Day

Source: BWP

3.2.5 Over-Generation

Figure 3.8 represents a typical day in Burbank during Spring 2015 and is illustrative of the current situation.

"BWP's Power Supply" in lime green is the minimum amount of power supply BWP has available through power supply contracts with other sources or from local generation at BWP facilities to make sure that BWP's customers have the power they need throughout the day. These sources can be ramped up or power can be purchased in the market if load increases. "Customer Demand" is the black line representing the actual amount of energy BWP customers used on that day to meet all their energy needs, which was between 90 MW to 140 MW. The "Non-Solar Power Supply" is the blue line representing the amount of non-solar power supply resources used to meet the needs of BWP customers, which is typically between 85 and 140 MW per day.

Due to the uncertainty of solar production, BWP must always have reserves that can be ramped up if clouds or trees cast shadows over BWP's solar generation. The uncertainty of solar creates pressure on BWP costs and eventually customer rates, especially with more rooftop solar. The impacts of increased rooftop solar are discussed later in this IRP.

The wavy lime green with gray slanted area represents BWP's share of Copper Mountain. Its output can go away at any time, depending on cloud coverage. During the middle of the day, Copper Mountain produces up to 40 MW for BWP. If its production suddenly drops, BWP needs to ramp up power supply at another facility or purchase power on the open market to make up for the 40 MW to avoid financial penalties and/or even suffer a power outage.

"Over-generated power" is the grey slanted lines between the "BWP's Power Supply" and the "Customer Demand," representing the amount of power over generation that must be sold in the market. In this example, it accounts for as much as 30 MW. This type of over-generation is has recently become normal in the utility business. In the near-term, over-generation is a result of being fully resourced before BWP began adding renewable energy to its portfolio. In the long-term (i.e., after the IP coal plant is retired in 2025), over-generation will result from high RPS levels based on average annual energy consumption. During times of low loads, the non-controllable renewables will exceed customer needs during certain hours of the day.

At a statewide level CAISO notes that potential actions to address such over-generation challenges (that will be faced by all California utilities during the planning period) would also include: 1) extending the control area beyond California to other states so that low-cost surpluses can serve customers over a larger geographic area, and 2) increasing participation in the western Energy Imbalance Market (EIM) in which real-time energy is made available in western states, subject to market and system conditions.

3.3 Generation

How is Power Produced?

A reliable power system does not depend on a single power generation resource or a single method of producing power. Rather, a reliable power system uses diversity of resources, technologies, customer activities, fuels, and power plant operating characteristics to maintain reliable electric service at all times.

Conventional methods of power generation use coal, natural gas, nuclear, or water (i.e., hydroelectric power plants) to produce electricity. Power can also be produced from renewable sources, including wind, solar, geothermal energy, and landfill gas.

Both groups are important, and BWP does not rely on just one group, or even one source within a group. Instead, BWP relies upon a mix of both conventional and renewable generation. Each type has its own role in BWP's supply portfolio.

For example, take solar generation. Once a solar plant is built, the energy produced has no fuel costs and no emissions. But if there's cloud cover or at nighttime, no solar power is generating. No sun means no solar power generation. That's why conventional, dispatchable sources are still important, as they can generate power anytime.

3.3.1 Baseload, Load-Following, Peaking and Intermittent Power Resources

Some plants, like coal-fired, nuclear, and geothermal, run continuously day and night. Such 24 hours per day, 365 days per year power is called ***baseload*** power. Others, usually fueled with natural gas, can adjust their output as loads change throughout the day. These are called load-following. Magnolia provides both baseload and load-following power.

Peaking plants also primarily use natural gas but can include energy storage as well. They are quick-starting, quick-ramping power plants or energy storage resources that supply power when loads exceed the output of the baseload and load-following plants, or when net load is changing quickly. Peaking plants are also called upon to help integrate intermittent renewable energy (discussed below).

Baseload Resources

Baseload resources help serve the steady load that BWP must serve at all times. As such, a baseload resource runs for months on end without interruption. When operated this way, baseload resources produce reliable, cost-effective power. Baseload resources can be fueled by natural gas, coal, nuclear, hydroelectric, landfill gas or geothermal energy. An example is BWP's share of the Intermountain Power Project (IPP) coal-fired plant, scheduled to be retired in 2025.

Baseload resources are slower to "ramp" – accelerate or decelerate, increasing or decreasing power output, respectively – and often can't ramp very fast. In this way, baseload resources are the freight locomotives of power generation: the best option for long, steady hauls.

More recent developments in energy supply are resulting in a decreasing emphasis on traditional baseload resources. Instead, the advent of large quantities of intermittent renewables are providing large portions of energy previously provided by baseload plants. As described in Chapter 6, this development has also accentuated the need for fast-reacting, flexible resources to integrate the renewable energy in a reliable manner.

Load-Following Resources

While baseload resources are predictable, load often is not. As people and businesses go about their days, load increases and decreases minute-by-minute, hour-by-hour. Load-following resources increase and decrease their output with it. Load-following resources are usually fueled with natural gas – like many baseload resources – but are designed to ramp faster, usually at some cost to efficiency. As such, load-following resources can be thought of as the 18-wheelers of the power supply: not as efficient as base-load resources, but able to drive in the heavy traffic (so to speak) of changing loads.

Hydroelectric resources can also play a load-following role in the power system, as they can start, stop, and ramp relatively quickly. As described in Chapter 6, increasingly “flexible” resources such as energy storage are taking on the traditional “load-following” role.

Peaking Resources

Peaking resources are the sprinters of the group: a power plant that can be switched on and ramped up when power is needed, usually within minutes.

Peaking power plants have traditionally been fueled by natural gas. Peaking plants, usually based on jet aircraft engines, are designed for maximum flexibility at the cost of efficiency. (In contrast, baseload plants are designed for efficiency at the cost of flexibility.)

Hydroelectric resources can also play a peaking role in the power system, as they can start, stop, and ramp relatively quickly.

Energy storage resources such as batteries or compressed air energy storage (CAES) can also operate as peaking resources with high levels of operational flexibility. Their primary applications include integrating renewable resources.

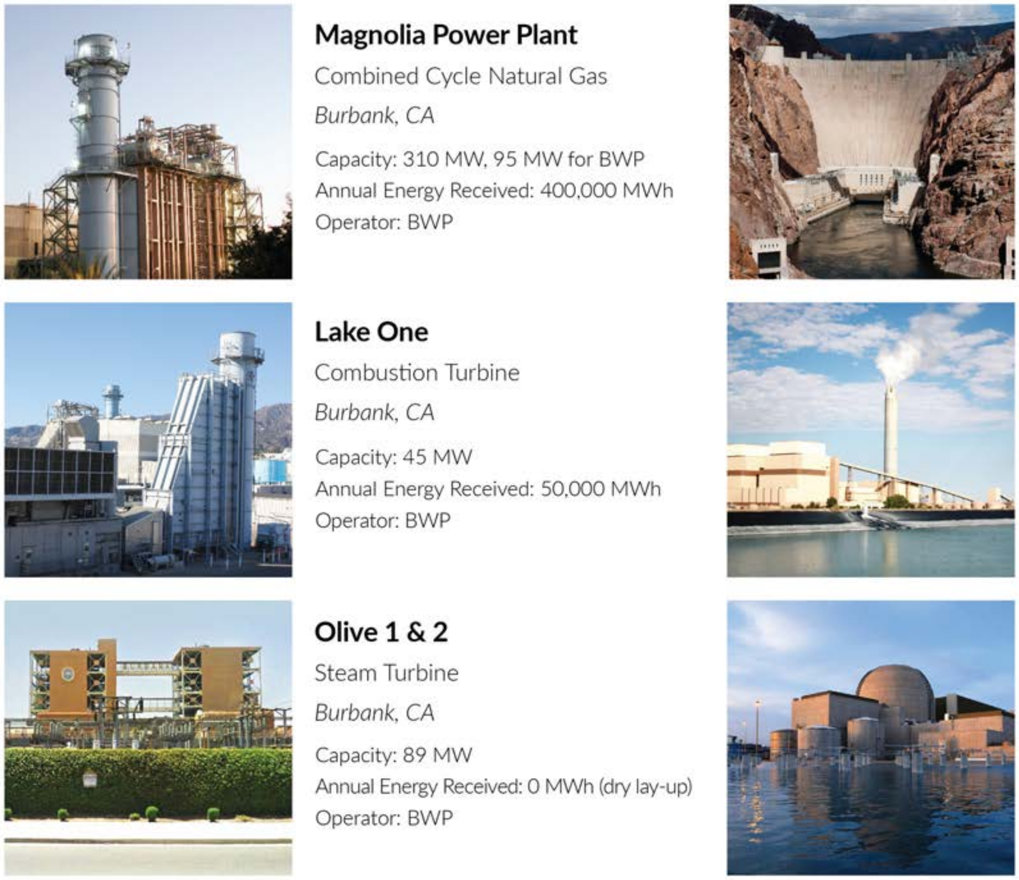
Intermittent Resources

Conventional baseload, load-following and peaking resources, despite their differences, are all dispatchable to one degree or another. Operators can change their output by controlling the supply of fuel into the power plant itself. Intermittent resources, on the other side, have no such control.

For example, solar power plants, by virtue of using the sun as fuel, only produce power when the sun is shining, but not when clouds pass over or at nighttime. In the same way, wind power plants only produce power when the wind is strong enough to move the wind turbine blades. Wind and sun can only be predicted within a short time frame. Therefore, intermittent resources challenge efforts to balance generation and load in real-time.

The challenges associated with intermittent resources are discussed in more detail elsewhere in this IRP. Figure 3.9 is an illustration of BWPs’ existing conventional power sources.

Burbank's Conventional Power Sources



Local Generating Units

Magnolia Power Plant
Combined Cycle Natural Gas
Burbank, CA
Capacity: 310 MW, 95 MW for BWP
Annual Energy Received: 400,000 MWh
Operator: BWP

Lake One
Combustion Turbine
Burbank, CA
Capacity: 45 MW
Annual Energy Received: 50,000 MWh
Operator: BWP

Olive 1 & 2
Steam Turbine
Burbank, CA
Capacity: 89 MW
Annual Energy Received: 0 MWh (dry lay-up)
Operator: BWP

Contractual Resources

Hoover Dam
Dam located on the Colorado River
Along the NV-AZ Border
Capacity: 1951 MW, 20.125 MW for BWP
Annual Energy Received: 26,000 MWh
Operator: Federal Government

Intermountain Power Project
Two Unit Coal-Fired Thermal Plant
Near Delta, UT
Capacity: 1900 MW, 74 MW for BWP
Annual Energy Received: 576,000 MWh
Operator: LADWP / IPSC

Palo Verde
Nuclear Generating Station
Near Wintersburg, AZ
Capacity: 4,010 MW, 9.5 MW for BWP
Annual Energy Received: 70,000 MWh
Operator: Arizona Public Service Co.

Figure 3.9: BWP's Conventional Power Sources
Source: BWP

In this connection, it is important to note that, decade after decade, BWP has continued to modernize its local conventional power plants since the first power plant was installed at the BWP campus in 1941. That power plant, a 10 MW oil-powered unit called "Magnolia 1", would be the first of ten different power plants on the campus, now represented by MPP, Lake One, and the Olive 1 and 2 units. Unlike many prior BWP plants, these units operate on natural gas and not oil. Further, as detailed in this IRP, MPP and Lake One were "best-in-class" technology when they were commissioned in 2005 and 2002, respectively, representing steady progress in BWP's local conventional power generation towards cleaner fuels, higher efficiency, and stronger environmental performance.

3.3.2 Renewable Resources

In 2007, Burbank became the first city to commit to a 33% renewable power supply portfolio standard. Since then, BWP has undertaken several initiatives to bring renewable resources into its power supply portfolio. By 2015, 34% of Burbank's power supply came from renewable resources, five years ahead of schedule. Today, renewable resources represent about 32% of total supplies.

Like conventional generation resources, different types of renewable resources have different characteristics. Solar and wind are intermittent, only generating when the sun shines or the wind blows, respectively. Geothermal and small hydroelectric are base-load and can operate around-the-clock. Table 3.1 is a listing of BWP's current renewable power sources.

Subsequent to Burbank making its commitment to renewable energy in 2007, the "33% by 2020" mandate was codified in California law and regulation as the Renewable Portfolio Standard (RPS). In particular, the CEC adopted detailed rules for RPS compliance to which BWP (and all California utilities) must comply. Under the RPS program, renewable energy is measured in Renewable Energy Credits (RECs). One REC represents one MWh of renewable energy.

Burbank's Renewable Power Sources

Project	Location	Technology	Annual Energy
Burbank Solar Demonstration	Burbank, CA	Fixed Tilt - Solar PV	9 MWh
Copper Mountain Solar 3	Boulder City, NV	Fixed Tilt - Solar PV	91,000 MWh
Pebble Springs Wind Project	Gilliam County, OR	Wind	29,000 MWh
Milford Wind Project	Beaver & Millard Counties, UT	Wind	26,500 MWh
Pleasant Valley	Unita County, WY	Wind	14,500 MWh
Burbank Micro-Hydro	Burbank, CA	Conduit Hydro	700 MWh
Cuiquita Canyon Landfill	Valencia, CA	Landfill Gas	10,500 MWh
Don A. Campbell	Mineral County, NV	Geothermal	19,000 MWh
Desert Harvest	Riverside County, CA	Single Axis - Solar PV	43,000 MWh
Renewable Exchange	Various	Various	56,000 MWh

Table 3.1: BWP's Renewable Power Sources

Source: BWP

In 2015, California Law SB350 established an increased RPS requirement of 50% by 2030. More recently, SB100 that was enacted in September 2018 further increases the RPS to 60% by 2030, with a target of 100% clean energy by 2045. This IRP initially examined the potential outcomes of both SB350 as a base case, and SB100 as a sensitivity case. With enactment of SB100 late in the planning process, it became the new base case.

The RPS rules divide renewable resources into three Portfolio Content Categories (colloquially known as "buckets"), each with its own requirements:

- **Portfolio Content Category 1 (PCC1)** – A renewable energy generator directly connected to or delivering to a California Balancing Authority, such as the LADWP Balancing Authority, without substituting electricity from another source.

  For example, BWP's share in Copper Mountain is PCC1 because it is delivered to the LADWP Balancing Authority at the Marketplace Substation.

- **Portfolio Content Category 2 (PCC2)** – Allows energy and RECs not delivered to a California Balancing Authority. This includes energy received as a swap for previously generated energy into a California Balancing Authority within the same calendar year as the RPS-eligible generator.

  For example, the Morgan Stanley Exchange is PCC2 as BWP delivers energy to Morgan Stanley year-round, while Morgan Stanley delivers RPS-eligible energy to BWP from March to October.

- **Portfolio Content Category 3 (PCC3)** – RECs only, without energy.

In addition, pursuant to its mandate, BWP procured renewable energy supplies before the Portfolio Content Category system was enacted. This energy is referred to as "grandfathered" or "PCC0" renewable energy.

The RPS program requires a certain amount of compliance in a given year and also sets limits on how much of each Portfolio Content Category may be counted against a utility's RPS requirements in a given year.

3.3.3 Generation Diversity and Beneficial Impact on Rates

Integration of different fuels and technologies produces the least-cost, highest reliability power production mix. Power production costs change because the input fuel costs – including natural gas, coal, and nuclear – change over time. The uncertainty of the future cost of these fuels translates into uncertainty for the production cost of electricity. This is known as production cost risk.

Like a balanced financial investment portfolio of stocks and bonds, a diversified energy supply portfolio is the most cost-effective tool available to manage production cost risk—particularly during periods of technology and cost uncertainty. In addition, a diverse power generation technology mix is essential to cost-effectively integrate renewable energy.

3.4 Transmission Resources

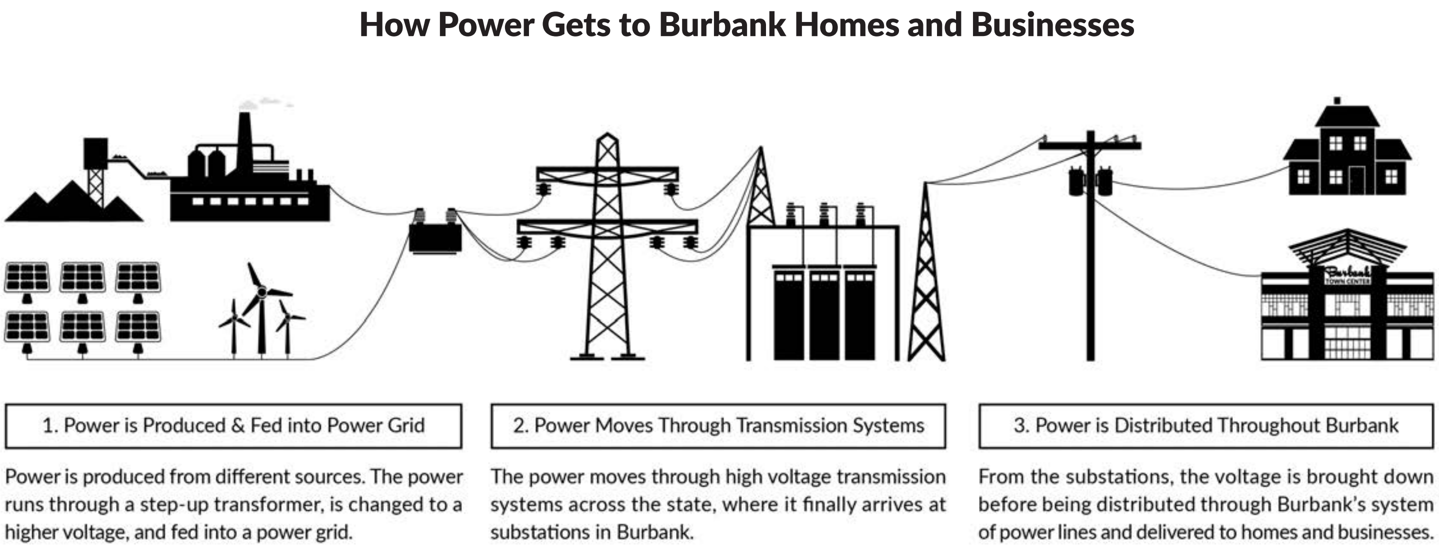
Power transmission is the delivery of energy from its place of generation, purchase, or sale to the distribution system that takes it to load. See Figure 3.10. Burbank has ownership in or contractual entitlements to numerous regional transmission facilities. Transmission lines bring electric energy to load and BWP uses its contractual and ownership rights to deliver electricity generated, and purchased, to Burbank.

History of BWP's Transmission Rights

The utility business has changed tremendously over the years. Historically, BWP has worked with Southern California Public Power Authority (SCPPA) and other entities to participate in major new transmission projects so that BWP can move power from power generation sources or other entities throughout the Western United States.

Over time, BWP has focused on engaging in new transmission contracts and on finding advantageous power resources or supplies that help keep electric rates low. SCPPA was formed in 1980 to help finance these projects for municipal utilities with economies of scale to keep costs low. BWP worked with other participants through SCPPA to jointly build major transmission lines, such as Mead-Phoenix and Mead-Adelanto, which are described in Appendix 2. BWP helped build these projects and has rights to schedule and move power over these transmission lines.

Figure 3.11 provides an illustration of BWP's current transmission rights.


How Power Gets to Burbank Homes and Businesses

1. Power is Produced & Fed into Power Grid

Power is produced from different sources. The power runs through a step-up transformer, is changed to a higher voltage, and fed into a power grid.

2. Power Moves Through Transmission Systems

The power moves through high voltage transmission systems across the state, where it finally arrives at substations in Burbank.

3. Power is Distributed Throughout Burbank

From the substations, the voltage is brought down before being distributed through Burbank's system of power lines and delivered to homes and businesses.

Figure 3.10: How Power Gets to Burbank Homes and Businesses

Source: BWP

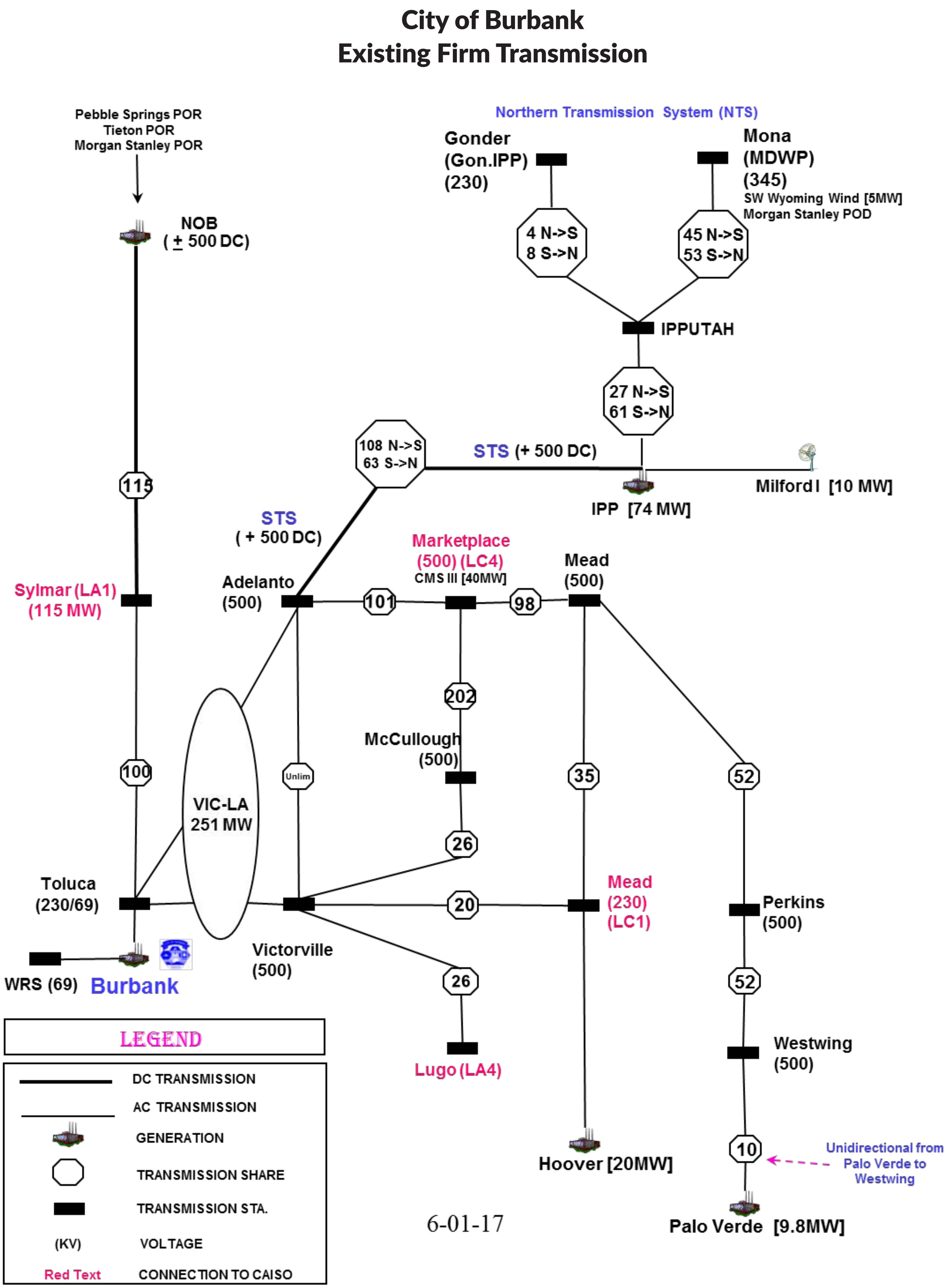


Figure 3.11: BWP's Transmission Rights

Source: BWP

Details of BWP's transmission rights are provided in Appendix 2.

These transmission rights (illustrated above and described in Appendix 2) are adequate to service BWP's current needs. They also enable BWP to participate in the wholesale power market. However, as more renewable energy is added and/or replaced, it may be necessary to acquire additional transmission service or participate in the development of new transmission facilities.

BWP can also enter into swap and other agreements to use a third party's transmission assets. In this case, BWP might purchase renewable energy from a distant power plant and swap it to a third party, which would then deliver substitute energy to BWP closer to Burbank. In this sort of arrangement, a third party also absorbs the intermittency of that renewable energy source (if any). Arrangements like these are just another method of acquiring resources in the most cost-effective manner.

3.4.1 Bulk Transmission Reliability Issues

BWP is a member of the LADWP Balancing Area (BA). As such, bulk transmission (i.e., above 69 kV) is the responsibility of LADWP, not BWP. However, BWP's plans in this IRP include large amounts of additional renewable energy resources. Depending on their size and location, these resources may need transmission developments to enable them, as described in the next Section.

3.4.2 Transmission Planned Upgrades and Additions

This IRP highlights potential needs for additional transmission capacity to enable new renewable energy resources:

Southern Transmission System

The Southern Transmission System (STS) currently consists of a high voltage direct current (HVDC) line from the IPP site near Delta, Utah to Adelanto. This line currently carries the baseload output of the IPP coal plant. As discussed elsewhere in this IRP, the IPP coal plant is scheduled for retirement in 2025.

Several of the leading resource options for replacement of the IPP coal plant entail new facilities at the IPP site, combined with renewable energy developments in Utah or Wyoming. Depending upon the resources chosen, BWP will need to work with LADWP and others to ensure continued access to STS capacity to get the outputs of these resources to Burbank. These discussions are related to the eventual choice of the resource(s) to replace the IPP coal plant.

Transmission for Generic Renewable Resources

This IRP also includes plans for additional “generic” renewable resources to fulfill the requirements of SB100. These resources could conceptually be located in New Mexico, Nevada, Arizona, California, or in combinations of them. The transmission necessary to support such developments remains to be developed and is an Action Item for this IRP as described in Chapter 7. BWP developed preliminary estimates of the cost of such transmission for purposes of the IRP analysis. This need to be further developed in more detail.

BWP will need to study the options for and costs of such developments. The impact of such imports of additional renewable energy via transmission on the LADWP Balancing Authority also needs to be evaluated and priced. Accordingly, these activities are included in the IRP Action Items list in Chapter 7.

3.5 Distribution

BWP provides Burbank with electrical service through a distribution network which includes electric stations, sub-transmission lines, distribution lines, and transformers. An electric power distribution system is the final stage in the delivery of electric power that carries electricity to individual consumers.

A large portion of Burbank’s electric infrastructure was constructed from the 1940s through the 1960s to serve the typical loads of that era, with 4 kV service. The infrastructure has since been expanded and updated over the years. Commercial developers supported and assisted in funding the expansion of the BWP system, beginning the transition from a 4 kV system to the more reliable 12 kV service and from large air-insulated electric substations to smaller, more modern, gas-insulated substations. Updating the distribution lines from 4 kV to 12 kV allowed BWP to deliver three times as much electricity, reducing power losses in the system and improving reliability.

With the investment in more reliable 12 kV substation capacity, including the San Jose, Golden State, Keystone, Hollywood Way, Burbank, and Ontario Substations, BWP has been steadily transferring customers from the 4 kV service to the more reliable and efficient 12 kV service.

The 12 kV substations are primarily served from the 34.5 kV systems. Future substations will be served from the 69 kV system where possible, allowing BWP to realize additional efficiency and reliability. While BWP has made significant progress in the last 20 years, several 4 kV substations and associated distribution systems remain.

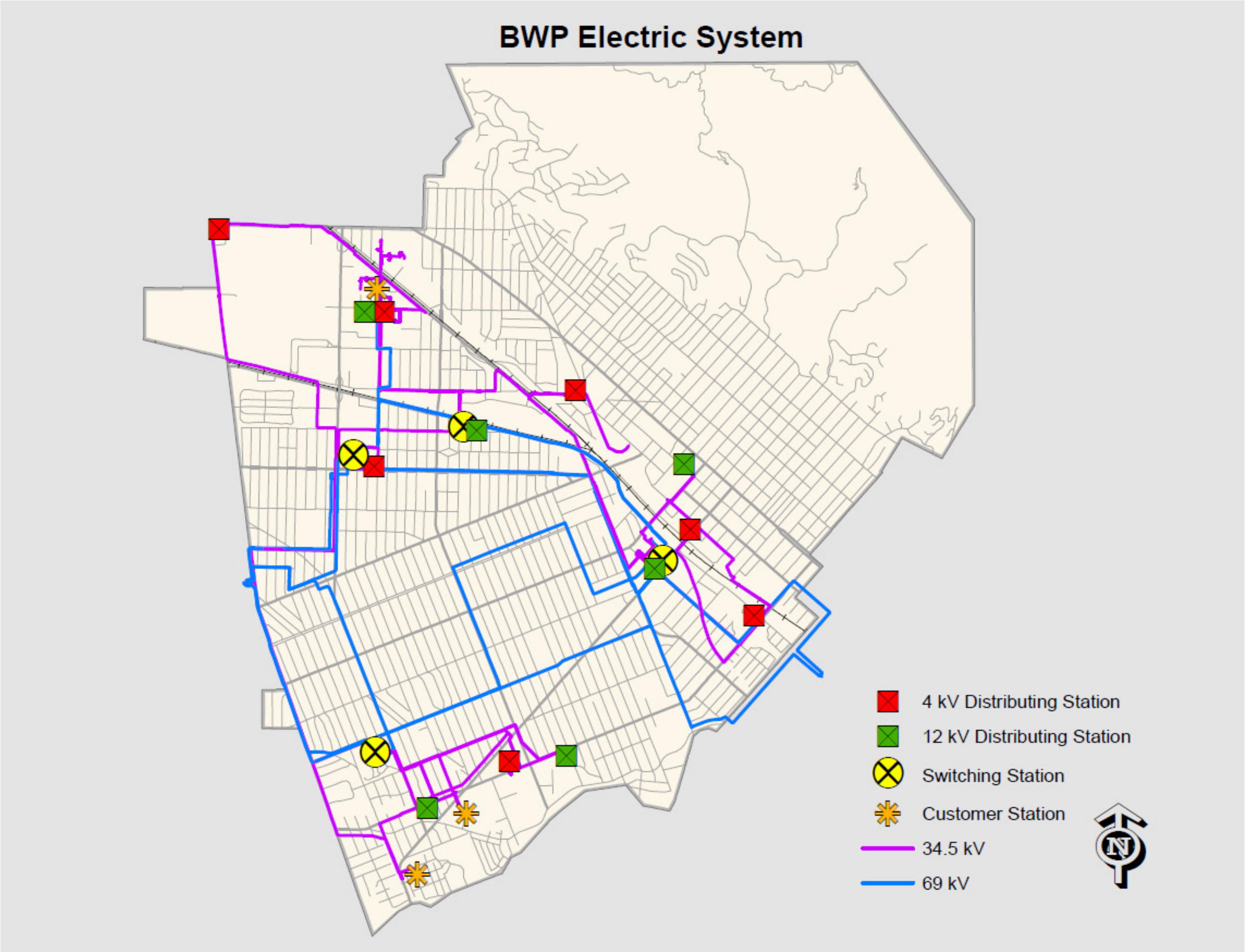


Figure 3.12: BWP's Electric Distribution System

Source: BWP

BWP's distribution system consists of the following:

- Service area of approximately 17 square miles
- Approximately 34 miles of 69 kV sub-transmission
- Approximately 45 miles of 34.5 kV sub-transmission
- Thirteen distribution substations, two customer substations, and four switching stations
- Approximately 203 miles of 4 kV distribution
- Approximately 130 miles of 12 kV distribution
- Approximately 10,600 poles
- Approximately 5,800 distribution transformers
- Approximately 52,500 customer electric meters
-

Figure 3.12 provides an illustration of the BWP distribution system.

Over the decades, the residential and small commercial load has grown, primarily driven by increasing population, increasing air conditioning installations, larger homes, electronic devices and appliances that provide our modern conveniences and creature comforts. As discussed in this IRP, Burbank's loads may not grow significantly in the future, as the impacts of development are mitigated by continued energy efficiency efforts.

Reducing losses on the distribution system has beneficial impacts on rates and the environment by reducing fuel consumption, stretching the lifespans of transmission and generating facilities, and reducing air pollution and GHG emissions. These efforts are consistent with BWP's goals of reliability, affordability, and sustainability. In this connection, BWP has taken significant steps to reduce losses among all its major distribution system elements. In fact, BWP has met approximately 22% of its customer peak demand increase since 1980 simply by improving its distribution system. Overall, BWP has reduced distribution system losses by approximately 37% since 1999.

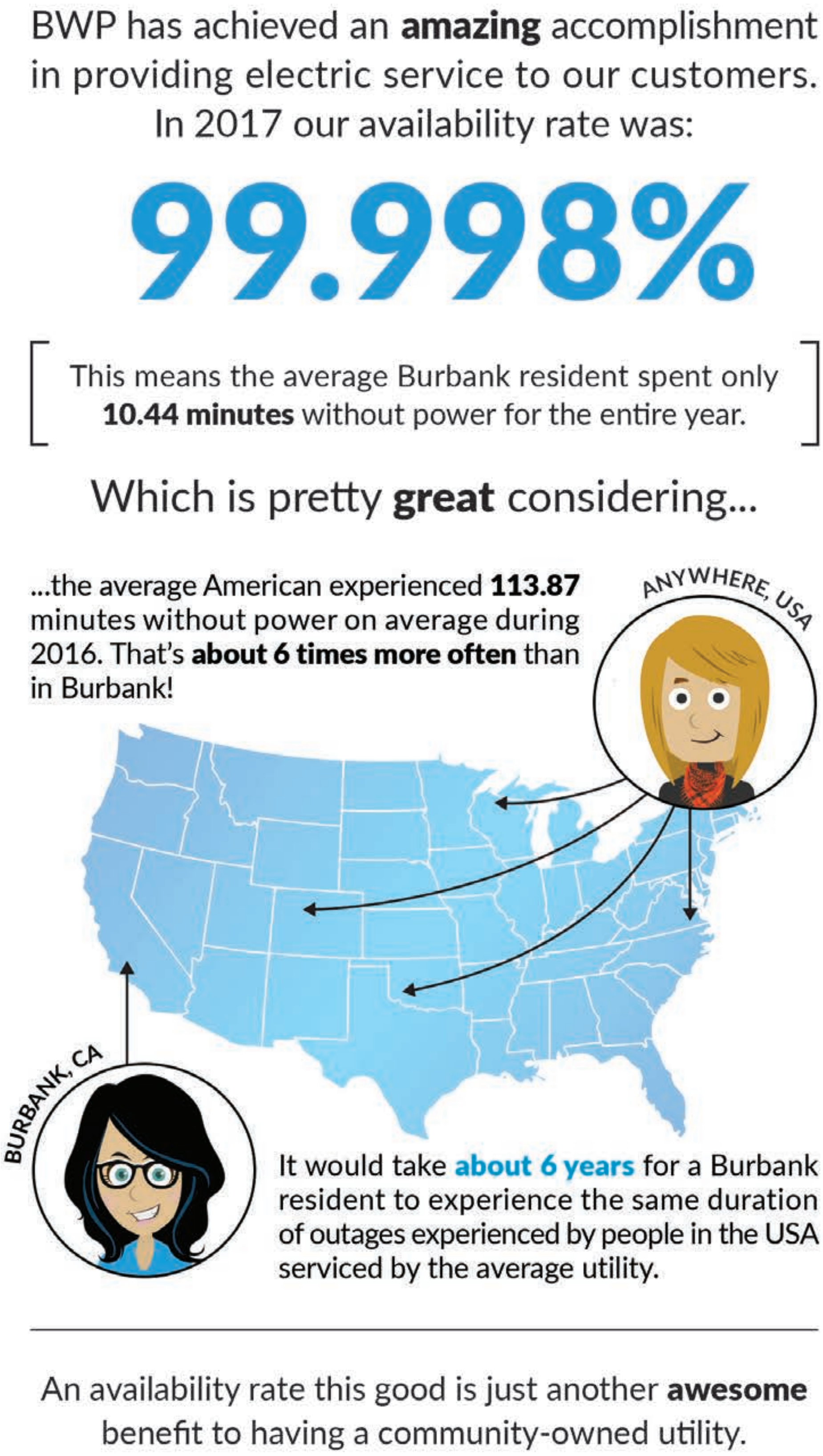
3.5.1 Distribution Reliability

BWP monitors Burbank's electric system performance in order to measure and maintain electric reliability. BWP had a service availability of 99.996% in 2016 and 99.998% in 2017. This means that the average Burbank resident spent only 18.5 minutes in 2016 and 10.4 minutes in 2017 without power for the entire year. For comparison, the average American experienced 113.8 minutes without power on average during 2016, about 6 times more often than in Burbank in 2016. In other words, it would take about 6 years for a Burbank resident to experience the same duration of outages experienced by people in the U.S. served by the average utility. Note that only 2016 comparisons were used here, because 2017 outage numbers for the U.S. were not available at the time this IRP was drafted.

BWP is one of the most reliable electric utilities in the nation and again was recently recognized as a national leader in electric reliability by the American Public Power Association (APPA) earning the Reliable Public Power Provider Diamond level designation. This is the highest designation possible, with BWP scoring 100 out of a possible 100 points.

In 2015, BWP completed its Electric Distribution Master Plan to provide a long-term economic strategy for maintaining and improving the safety, reliability, and operational efficiency of the electric distribution system.

By having a long-term vision and approach, BWP is strategically addressing these issues, as well as planning methodically to age BWP's assets gracefully while continuing to maintain reliability. Distribution projects associated with the Distribution Master Plan are discussed in Section 3.5.3.



BWP has achieved an **amazing** accomplishment in providing electric service to our customers. In 2017 our availability rate was:

99.998%

This means the average Burbank resident spent only **10.44 minutes** without power for the entire year.

Which is pretty **great** considering...

...the average American experienced **113.87** minutes without power on average during 2016. That's **about 6 times more often** than in Burbank!

It would take **about 6 years** for a Burbank resident to experience the same duration of outages experienced by people in the USA serviced by the average utility.

An availability rate this good is just another **awesome** benefit to having a community-owned utility.

Figure 3.13: BWP's Reliability Comparison

Source: BWP

3.5.2 Anticipating Customer DER Developments

BWP recognizes that larger quantities of customer-owned Distributed Energy Resources (DER), such as rooftop solar and battery storage, can impact the reliability of the distribution system. These impacts to reliability could include, but are not limited to, circuit loading, system protection, voltage excursions, power quality, substation equipment limits, and operational flexibility. While BWP does not currently have large penetrations of DER that yield these types of reliability issues, BWP will continue to monitor its DER applications and perform capacity studies, as necessary, to ensure reliability of the electric system. In addition, because of its grid modernization efforts described in Section 3.6, BWP monitors distribution system voltages and circuit loading using data analytics through its Advanced Metering Infrastructure.

Furthermore, BWP is also mindful of the lower levels of fault current produced by non-rotating sources and anticipate that further studies and additional protective relaying technology may be required to account for these lower levels of fault current. Lastly, recognizing the potential, future need of battery storage within Burbank, BWP is considering the use of land at decommissioned substations for the installation of energy storage as strategic, cost-effective locations for connecting energy storage to BWP’s sub-transmission and distribution systems.

3.5.3 Distribution Planned Upgrades and Additions

As part of the Distribution Master Plan, a strategic 20-year Capital Improvement Program (CIP) was established and, whenever possible, these CIP projects were leveraged to resolve multiple challenges with each investment.

BWP recently constructed a new 67 MVA, 12kV electrical substation, the Ontario Substation, to provide additional 12 kV capacity for converting and retire two of its oldest 4 kV electrical substations, the Victory and Winona Substations. With the additional 12 kV capacity from Ontario Substation, BWP will be able to retire these two electrical substations in the future and potentially utilize this land for energy storage applications.

The new Ontario Substation is also currently served by two 69 kV sub-transmission lines, moving away from serving distributing substations with its older 34.5 kV system. BWP standardized on utilizing its 69kV sub-transmission system, which is more robust than its older 34.5kV system and generates lower system losses. This also creates an opportunity for BWP to eliminate one of its four 69/34.5kV substations, yielding a strategically good location for the future installation of energy storage if desired, due to its proximity to an existing 69 kV switchyard.

BWP has installed microprocessor relaying on all of its distribution feeders along with a robust WiFi mesh network throughout its electrical distribution system. This has created an opportunity to utilize this infrastructure to solve more challenging protective relaying issues presented by larger penetrations of DER in the future.

As part of BWP's effort to achieve a 60% RPS by 2030, BWP is planning a 1 to 2 MWDC rooftop solar facility at the Hollywood-Burbank Airport Regional Intermodal Transportation Center. BWP will also use this opportunity to observe the various effects of distributed generation on BWP's 12kV distribution network and provide an opportunity for the utility to engage BWP customers like the airport.

BWP has taken other steps in supporting a larger penetration of sustainable, customer-owned distributed energy resources. In 2016, BWP updated its distributed generation interconnection agreement for distributed generation above 1 MW to reflect the City's policy of meeting additional energy demands from renewable energy sources, not from fossil-fueled generation. Later in 2018, BWP updated its solar interconnection agreement to address requirements for battery storage systems and compliance with applicable electrical standards. Currently, as part of the APPA Demonstration of Energy & Efficiency Developments (DEED) program, BWP is also sponsoring and conducting activities related to energy innovation through student research for the development of EV load prediction and charging scheduling for grid services and cost reduction.

3.6 Grid Modernization

BWP's grid modernization has enhanced Burbank's distribution system with advanced technology including digital meters, storage, renewable energy sources and other technologies. The new meters and devices allow for sending and receiving meter data or device status to the utility without any manual intervention such as meter reading, having customers calling in meter reads or physically inspecting electrical equipment. BWP uses this enhanced data to provide numerous benefits to customers, and for operations and energy efficiency.

- Grid modernization has improved service to BWP's customers and promoted efficiency. The primary technical components of this grid modernization include: A fiber optic Ethernet switched services network and a citywide secure WiFi mesh network serve as the primary networks that allow for two-way data flow between BWP and digital meters.
- Advanced Metering Infrastructure (AMI). BWP implemented three essential systems to transmit and maintain meter read data:
    - Digital water and electric meters.
    - Water and electric wireless meter reading systems with two-way secure mesh radio communication, and
    - Meter Data Management System to store and manage meter data.

These systems work together to gather and store meter data which is used for data analytics and billing.

BWP has utilized data from these systems to improve safety, reliability, and/or operational efficiency of the distribution system.

BWP has performed an assessment of the existing software applications for system operators in its Energy Control Center including include Supervisory Control and Data Acquisition, Automatic Generation Control, load forecasting, and an Outage Management System. To meet its current needs and adapt to future requirements, BWP is considering upgrading its systems to an Advanced Distribution Management System (ADMS).

3.6.1 Grid Modernization Benefits

This data, in turn, has been used to make targeted improvements in BWP's distribution system to the benefit of BWP's customers. By applying state-of-the-art analytic tools, BWP can analyze and better understand load growth, circuit loading, and power quality. BWP can analyze the incoming meter data and develop strategies to improve system performance and operational characteristics. After upgrading its software tools in the future with an ADMS, BWP will be able to use this data to manage system demand and optimize system performance. This data has also helped with right-sizing of transformers and with making system improvements to improve reliability during high load periods.

At the same time, the data allows BWP's customers to become more informed about their energy consumption and empowers them to adjust their consumption. BWP has been delivering a periodic, personalized report to its customers on their energy consumption compared to their neighbors.

Grid modernization also aids in providing interval meter data, so customers can take advantage of Time-of-Use (TOU) rates. TOU rates can offer cost savings by encouraging customers to shift energy usage from high to low demand times, optimizing system offerings, and reducing operating costs. In a similar vein AMI also lends itself to demand-side programs, allowing customers to see and control their discrete energy use and BWP to develop and implement programs to incentivize energy use reductions during discrete critical periods. Ultimately, these strategies will reduce peak loading on distribution facilities, prolong distribution asset life, and defer capital investment.

3.6.2 Grid Modernization Helps Promote Transportation Electrification

Electric vehicles (EV) are an essential piece of BWP's transportation electrification (TE) strategy to reduce GHG emissions and further accommodate integration of renewable energy. TE aims to use clean electric energy to fuel transportation, reducing the use of petroleum-based fuels such as gasoline, diesel, and natural gas. Grid modernization allows BWP to offer TOU rates, which incentivizes EV drivers through charging during lower-cost hours at work or at home.

BWP is pursuing the installation of BWP-owned EV chargers at high-density residential areas and commercial parking lots as well as looking into installing and managing private workplace charging for interested businesses.

BWP is promoting and using TE as a load resource to help achieve new environmental goals, integrate renewable energy, and maintain grid reliability. BWP benefits from TE through better grid utilization by incentivizing EV charging to lower cost hours when energy usage is typically low, mitigating the effects of rooftop solar generation by managing EV load during the day, and potential load growth opportunities.

For its part, BWP is at the forefront of EV adoption for BWP's own operations, from automobiles to utility "bucket" trucks to forklifts. Starting in 2005, BWP has purchased over 25 hybrids and EVs as a fundamental component of BWP's ongoing commitment to sustainability:

Year	Make/Model	Section
2005	Hybrid Honda Civic	Engineering
2004	Hybrid Honda Civic	Fleet Pool
2007	Hybrid Toyota Prius	Ot Department
2009	Hybrid Honda Civic	Fleet Pool
2008	Hybrid Toyota Camry	Agm/Cfo
2008	Hybrid Toyota Camry	Agm/Water
2009	Hybrid Toyota Camry	Agm/Power Plant
2012	Hybrid Bucket Truck	Distribution
2012	Hybrid Bucket Truck	Distribution
2011	Hybrid Ford Escape	Water Engineering
2011	Hybrid Ford Escape	Electric Shop
2012	Hybrid Toyota Camry	Agm/Ot
2013	All Electric Ford Focus	Fleet Pool
2013	All Electric Ford Focus	Comm Shop
2013	All Electric Ford Focus	Water Department
2013	All Electric Toyota Rav	Customer Service
2013	All Electric Toyota Rav	Electric Shop
2013	Plug-In Bucket Truck	Distribution
2013	Plug-In Bucket Truck	Electric Shop
2013	Plug-In Ford C-Max	Customer Service
2013	Plug-In Ford C-Max	Safety

3.6.3 Grid Modernization Reduces Power Outages, Improves Power Quality

Grid modernization also improves the reliability of BWP's distribution system. For example, by reducing the duration and frequency of outages caused by mylar balloons, palm fronds, birds and rodents with digital relays and automatic reclosing on feeder circuit breakers, BWP was able to reduce customer outage minutes by an annual average of over 1 million minutes between 2014 and 2017.

Prior to AMI deployment, BWP could respond only when a customer called to complain about their electric service. Now, with a fully-deployed AMI network, staff is able to see voltage conditions throughout the system. Such proactive monitoring of service levels further reduces system losses and provides a better-quality power service to the customers.

In summary, BWP is reducing costs through predictive analytics and anticipating transformer failures before they occur. Ultimately, BWP is responding to customer needs more quickly through the use of its data.

3.7 Energy Efficiency

BWP's long-standing commitment to energy efficiency is an extension of its commitment to reliable, affordable, and sustainable electric service to Burbank. In 1998, California Assembly Bill 1890 (Brulte, 1996) created massive electrical restructuring in the state. One of the provisions of AB 1890 was to create a Public Benefits Charge, now equal to 2.85% of electric rate revenues. These funds were mandated to be collected and spent on four electric categories:

1. Cost-effective energy efficiency and conservation activities;
2. Research, development, and demonstration programs to advance science or technology that are not adequately provided by competitive and regulated markets;
3. In-state operation and development of existing, new, and emerging renewable resource technologies; and.
4. Programs for low-income electricity customers.

BWP has provided the citizens and businesses of Burbank with award-winning Public Benefits programs and initiatives, including:

- **Renewable Energy Programs:** Through FY 16-17, BWP's Solar Support Rebate program continued to offer both residential and commercial customers with rebates for installing solar panels. In FY 2016-17, the rebate for residential customers was $0.32 per watt installed, and $0.24 per watt installed for commercial customers. In FY 16-17, 28 rebates were provided for solar PV systems that are westerly-facing, to minimize the effects of the Duck Curve, a requirement that has been in place for three years. The program was discontinued after FY 16-17 after the legislatively-mandated 10-year program term ended, mainly due to falling solar panel prices and the fact that more than two-thirds of new residential solar photovoltaic (PV) systems were being installed without a rebate.
- **Low-Income Programs:** BWP offers a Lifeline rate to about 2,000 income-qualified customers, which is a discount to the standard residential rate and among the most generous in the state. BWP also developed the Refrigerator Exchange program for Lifeline customers to replace customers' existing primary, and often less energy-efficient, refrigerators with an ENERGY STAR model at no cost to them. Lifeline customers in single-family homes are required to participate in BWP's free Home Improvement program to further reduce their electric, water, and natural gas bills.
- **Research, Development and Demonstration:** BWP operates a demonstration program of 34 Ice Bear units installed at City-owned buildings and large businesses. The Ice Bear is a peak-shifting thermal energy storage unit that works with air conditioners, essentially just a tank containing water that is frozen during off-peak hours. The ice is then used to provide cooling instead of the air conditioner's compressor during peak hours. In FY 2016-17, the units provided about 250 kW of peak demand reduction.

California Senate Bill 1037 (Kehoe, 2005) established several important policies regarding energy efficiency, including a statewide commitment to cost-effective, reliable, and feasible energy efficiency, with the expectation that all utilities should consider energy efficiency before investing in other resources to meet growing demand. Assembly Bill 2021 (Levine, 2006) added to these policies by requiring the establishment of 10-year energy savings targets on a triennial basis. Assembly Bill 2227 (Bradford, 2012) amended the requirement to a quadrennial basis. BWP supports these policies and aggressively pursues all cost-effective energy efficiency opportunities.

These legislative changes led to the development of energy efficiency programs, which provide savings to customers and helped reduce GHG emissions by reducing energy consumption. With new energy efficiency measures, BWP strategically utilizes Public Benefit funds to expand energy efficiency program offerings and to meet legislative targets. For example, when a customer replaces a single pane window with an energy-efficient one, the new window helps keep heat from escaping in the winter, the customer uses less energy to heat the home while still staying comfortable. In the summer, efficient windows help keep the heat out and the air conditioner does not need to run as often, saving electricity.

When a customer replaces an appliance, such as a refrigerator or washing machine, or office equipment, such as a computer or printer, with a more energy-efficient model, the new equipment provides the same service but uses less energy. This saves the customer money on their energy bill and reduces the amount of greenhouse gases going into the atmosphere.

BWP has collaboratively worked with the California Municipal Utilities Association (CMUA), Northern California Power Agency (NCPA), and SCPPA since 2005 to measure the effectiveness of energy efficiency programs and to report savings in a consistent and comprehensive manner. In December 2006, the first joint report on energy efficiency was submitted to the CEC. Since then, BWP has participated in this reporting effort annually.

3.7.1 Energy Efficiency Portfolio Results

The following, reported to the CEC in March 2018, provides a snapshot of the efficacy of BWP's efficiency programs. These numbers reflect FY 2016-17 program activity:

- **Significant Investment:** BWP spent $3.1 million on energy efficiency programs and overhead.
- **Peak Demand Reduction:** BWP programs reduced peak demand by 4.6 MW.
- **Energy Savings:** Gross annual savings totaled 14.1 million kWh.
- **Lifecycle Savings:** Gross lifecycle savings accruing from BWP's efficiency portfolio reached nearly 119 million kWh.
- **Retail Sales:** Burbank has 44,633 residential and 6,794 commercial service connections, serving a total population of 105,000 residents and more than 3,300 businesses. During FY 2016-17, a total of 1,080 million kWh were sold, 25% to residents and 75% to Burbank's commercial customers.
- **Cost-Effectiveness:** Applying the Total Resource Cost (TRC) test, the principal measure used in the industry to determine program cost-effectiveness, BWP's Portfolio TRC was 1.13.

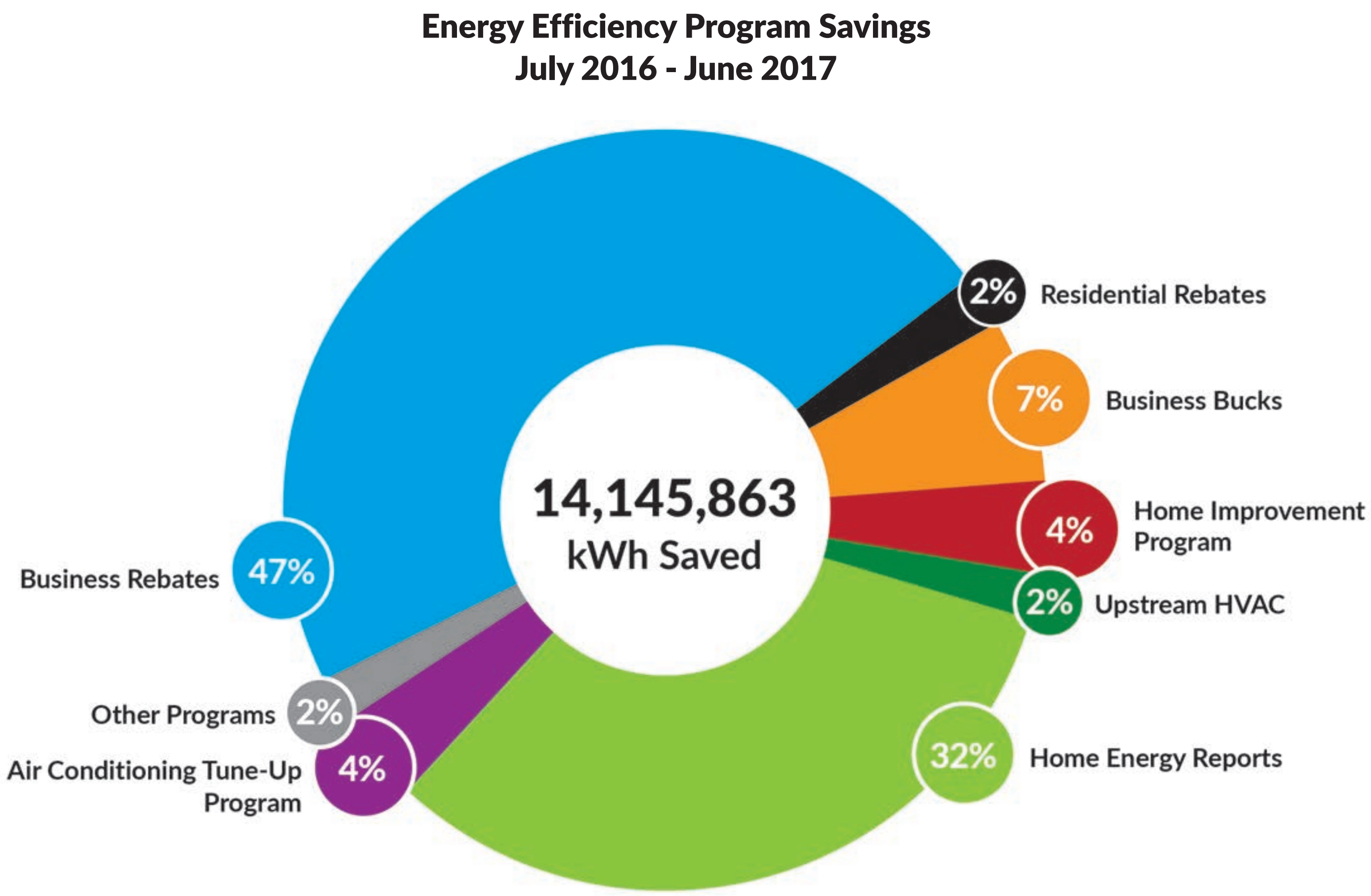


Figure 3.149: BWP's Energy Efficiency Program Savings

Source: BWP

3.7.2 Current Energy Efficiency Portfolio Strategy

As a result of nearly 20 years of energy efficiency efforts, increasingly stringent building codes, and a community ethos of sustainability, the average Burbank household uses less than 500 kWh per month. This admirable efficiency baseline makes it a challenge to design more programs that can squeeze more energy efficiency "juice" out of a smaller and smaller "lemon."

BWP's energy efficiency portfolio has been designed to reflect BWP's commitment to provide reliable, affordable, and sustainable electric service to Burbank.

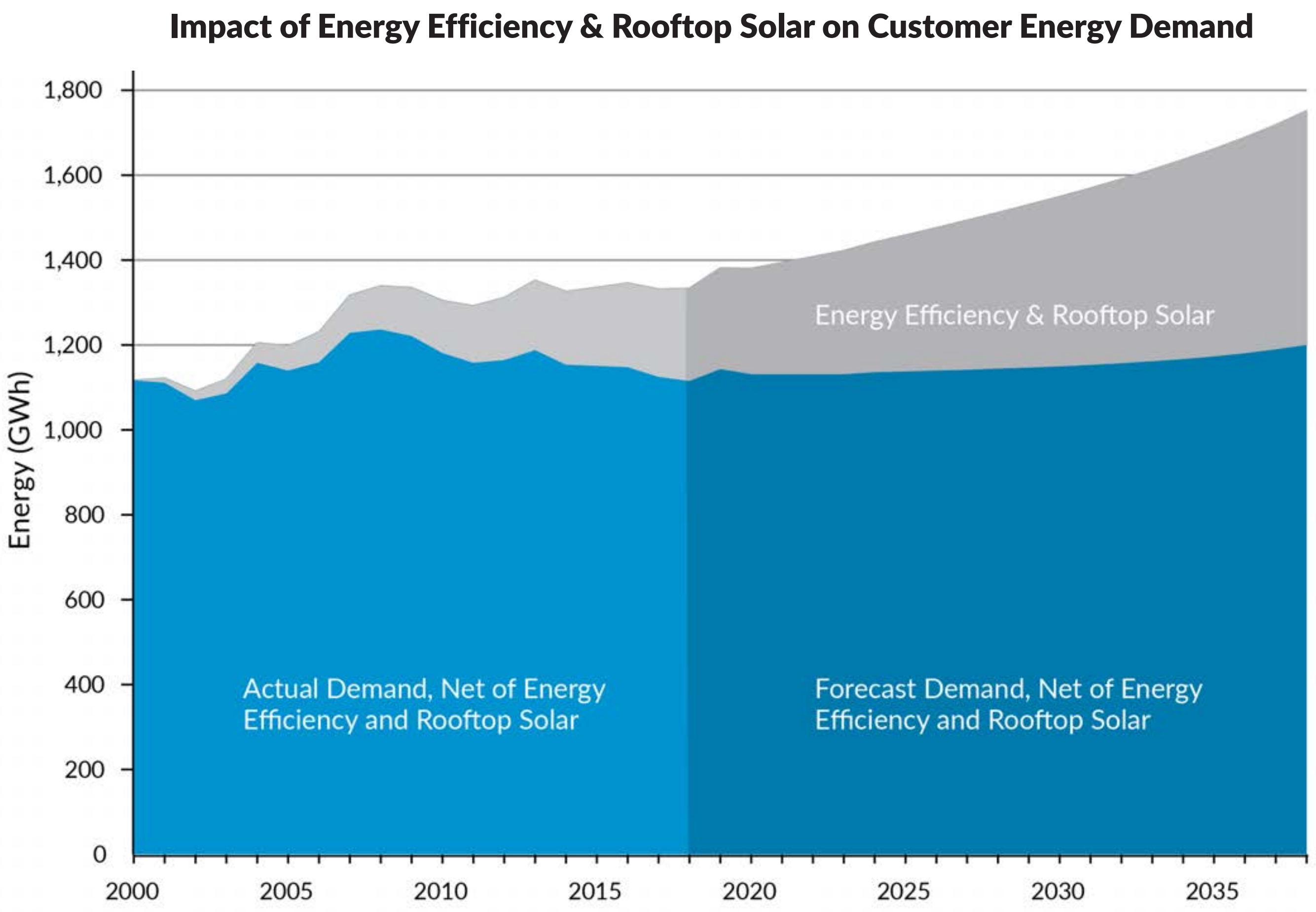


Figure 3.15: Impact of Energy Efficiency and Rooftop Solar

Source: BWP

3.7.3 Long-Term Impact of Efficiency Efforts

Early and ongoing active management efforts in efficiency and conservation pay big dividends. BWP has a growing efficiency portfolio, where each initiative gains more and more traction with customers over time and reaps significant rewards. As a result, while Burbank is growing, Burbank's net load growth has abated over time and is estimated to level out even further to a possible negative load growth scenario. BWP's long-standing goal, established with the 1998 Public Benefits requirement, has been to offset energy use by 1% annually. What appears to be a modest goal is, in fact, both challenging and impactful. The graph that follows is a conceptual illustration of the dramatic impact of the successful efficiency and conservation efforts.

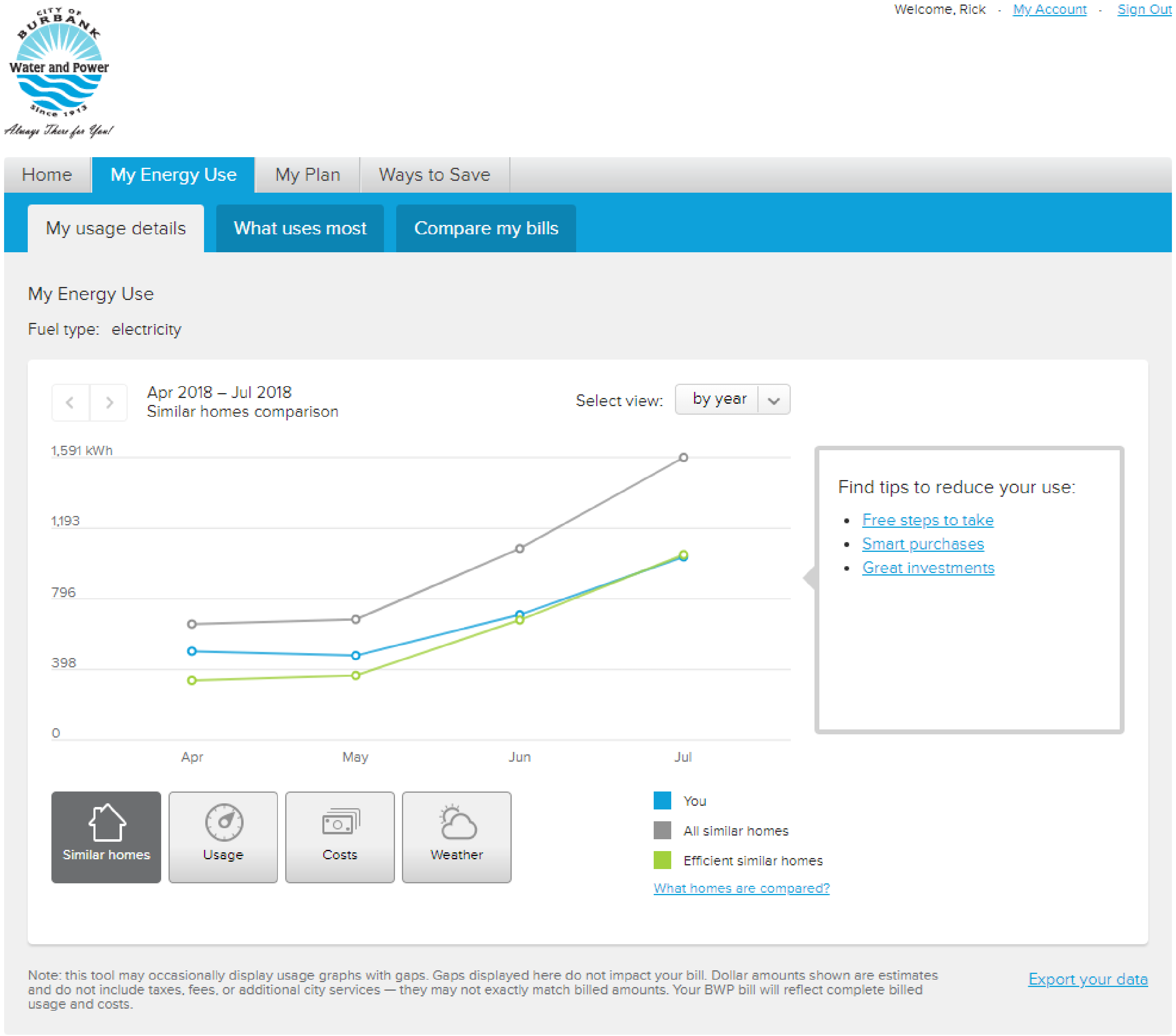
3.7.4 Ongoing Responsiveness to the Community

BWP regularly evaluates each program and reviews market conditions in order to improve services to residents and businesses. Research has shown that energy efficiency program success is a three-legged stool, with the three legs represented by:

- financial attractiveness
- installation availability
- awareness

As a result, most programs are free for customers to participate in and have a direct installation component. Awareness is addressed through print and digital communications to customers emphasizing BWP's role as a community utility. BWP plans to move beyond traditional bill inserts and mass marketing and toward the use of the website as a long format storytelling tool and central location for BWP information, transitioning the quarterly Currents newsletter from print to digital, using video content to communicate important BWP topics, and expanding the use of social media to reach new and targeted audiences.

Innovative communication methods can be incorporated into traditional energy efficiency programs to increase energy savings and customer engagement. For example, in FY 2016-17, BWP completed its sixth year of providing Home Energy Reports to residents that spur behavioral change and energy savings. The program saved nearly 4.6 million kWh and is BWP's largest and most cost-effective residential energy efficiency program. Households can also view their reports online via a customer web portal to view daily and hourly energy use. These reports also contain a library of efficiency tips. Figure 3.16 provides an example of a report.



My Energy Use

Fuel type: electricity

Apr 2018 – Jul 2018
Similar homes comparison

Select view: by year

Find tips to reduce your use:

- Free steps to take
- Smart purchases
- Great investments

Note: this tool may occasionally display usage graphs with gaps. Gaps displayed here do not impact your bill. Dollar amounts shown are estimates and do not include taxes, fees, or additional city services — they may not exactly match billed amounts. Your BWP bill will reflect complete billed usage and costs.

Figure 3.16: Sample of BWP's Web Page on Customer Energy Use

Source: BWP

Some of the ongoing programs include:

- **Energy Solutions** – Currently open to any business customer, this program provides rebates for any type of energy efficiency project. In FY 2016-17, BWP encourages LED lighting projects with a rebate of $0.10 per kWh of annual energy saved, and $0.05 per kWh for all other projects.

BWP also sends a customized digital newsletter, known as The Wire, to program participants and other large business customers that provides technical and operations assistance to save energy and water. The newsletter allows BWP to promote its rebates and other programs and gives customers the ability to interact with their key account managers and other experts. BWP also plans to make a similar customized digital newsletter available to small- and medium-sized businesses.

- **Home Improvement Program** – For residents, BWP's flagship program is the Home Improvement Program, which is available at no charge. The program was designed to reduce electric use. BWP introduced the program in November 2009 as a whole house, direct install program and has been expanding it ever since. BWP has also partnered with the Southern California Gas Company and the Metropolitan Water District of Southern California to leverage additional funding and reduce natural gas and water use as well.

The program has several components, including:

- in-home audit with energy and water education; and
- free installation of CFL and LED bulbs and water saving devices.

In addition, BWP assesses single family homes for additional services. The assessment is like an audit where BWP physically inspects the home to see if it is eligible for upgrades. If it qualifies, the measures are then installed. The assessments include:

- installation of attic insulation;
- duct testing and sealing;
- central air conditioning tune-ups and air sealing; and
- outdoor water conservation measures.

In FY 2016-17, BWP upgraded more than 650 homes as part of the program, with an average annual savings of more than 900 kWh per household, or about 10% of the average single-family home's annual consumption. As of September 2018, the program has served nearly 7,800 households, more than 15% of Burbank households, after less than ten years of operation.

With current changes to the program, many of the participating residents are now qualified to receive incentives through the state's Advanced Energy Upgrade California Program. In addition, the program continues to receive awards from the CMUA and the American Council for an Energy-Efficient Economy (ACEEE).

3.7.5 Other Energy Efficiency Program Descriptions

BWP has grouped energy efficiency programs by associated sector and category classifications used in the reporting tool summary table provided to the State.

- **Residential and Non-Residential Cooling:** BWP provides services that address all aspects of space cooling for residential homes and commercial buildings, including rebates for the purchase of high-efficiency air conditioners and heat pumps, and free HVAC tune-ups. For FY 2016-17, these programs resulted in more than 1.4 MW of peak demand reductions.
- **Residential Refrigeration:** BWP provides rebates for the purchase of ENERGY STAR refrigerators, including 189 in FY 2016-17. BWP also provides new ENERGY STAR refrigerators at no cost to income-qualified customers. In addition, BWP also removes and recycles residents' second refrigerators at no cost in order to reduce their bills and reduce these older appliances' impact on the grid. Through these three programs, 420 inefficient refrigerators were removed or replaced with more efficient models in FY16-17, resulting in more than 105,000 kWh in annual electricity savings.
- **Non-Residential Lighting:** BWP provides free direct installation services, including for high efficiency lighting, to all qualified small businesses in Burbank. BWP also provides rebates per annual electricity saved for customized lighting projects, including $0.10 per kWh saved for LED lighting. Through these efforts, BWP achieved 1.8 MW in peak demand savings and 5.9 million kWh in annual electricity savings for our commercial customers.

3.7.6 BWP's Energy Efficiency Programs

A description of each energy efficiency program ranked by FY16-17 annual savings is shown below in Tables 3.2 and 3.3.

All of these programs have led to significant energy savings in Burbank (Figure 3.19).

2016-17 SAVINGS		PROGRAM DETAILS	LIFETIME SAVINGS
47%	**6,700,486** kWh	Business Rebates Rebate program open to all Burbank Businesses who make energy-efficiency retrofits at their facilities.	**76,884,259** kWh
32%	**4,555,823** kWh	Home Energy Reports Report mailed quarterly to residents showing energy use compared to 100 similar Burbank homes.	**9,111,646** kWh
7%	**925,435** kWh	Business Bucks Direct install program for small to mid-sized businesses. Provides up to $5,000 in energy-saving installations.	**9,997,532** kWh
4%	**615,167** kWh	Home Improvement Program Free program for Burbank residents that provides home upgrades and energy and water saving devices.	**6,469,721** kWh
4%	**505,028** kWh	Air Conditioning Tune-Ups Program ensures that Burbank businesses and residents get the highest AC performance possible from tune-ups.	**5,050,276** kWh
2%	**308,525** kWh	Upstream HVAC Program Rebates provided to distributors of high efficiency HVAC equipment.	**4,627,875** kWh
2%	**224,076** kWh	Residential Rebates Cash rewards for residents who purchase and install high-efficiency appliances and products in their home.	**2,964,863** kWh

Figure 3.2: BWP's Energy Efficiency Programs

Source: BWP

2016-17 SAVINGS	PROGRAM DETAILS	LIFETIME SAVINGS
2% **311,323 kWh**	**Other Programs**	**3,540,773 kWh**
119,789 kWh	**LivingWise School Kits** Kits with energy and water saving devices provided to all 6th grade BUSD students.	**1,078,101 kWh**
48,313 kWh	**Water Transportation Savings** Energy saved from transporting less water due to Burbank's reduced water consumption.	**193,253 kWh**
48,100 kWh	**Refrigerator Round Up** BWP environmentally recycles second household refrigerators and provides the homeowner with $50.	**240,500 kWh**
42,420 kWh	**Made in the Shade** Residential and business shade tree program designed to reduce air conditioning use and costs.	**1,272,600 kWh**
34,196 kWh	**Refrigerator Exchange** Low-income residents may replace their old refrigerator with a free Energy Star™ unit.	**478,744 kWh**
14,200 kWh	**Ice Bear Energy Shift** Ice-making units that attach to commerical air conditioners to save energy in peak hours.	**213,000 kWh**
4,305 kWh	**Efficient Lightbulb Distribution** At events, BWP provides CFL and LED light bulbs for Burbank Residents.	**64,575 kWh**

Figure 3.3: BWP's Energy Efficiency Programs

Source: BWP

Energy Savings

YEAR	NET PEAK SAVINGS kW	GROSS ANNUAL SAVINGS kWH	GROSS LIFECYCLE SAVINGS kWH	TOTAL RESOURCE COST (TRC)
2010-11	4,262	13,824,872	160,474,123	1.26
2011-12	4,386	12,356,629	124,768,204	1.76
2012-13	3,249	11,292,372	103,374,349	2.08
2013-14	3,097	11,730,959	97,005,344	2.14
2014-15	3,044	14,000,539	129,783,711	2.64
2015-16	3,156	12,725,118	98,125,833	1.87
2016-17	4,551	14,145,863	118,646,946	1.13

Table 3.4: Burbank's Energy Savings
Source: BWP

3.7.7 Programs for Disadvantaged Communities

BWP assists Disadvantaged Communities in two areas: reduction in local pollution sources and customer programs targeted at such communities. A map of designated Disadvantaged Communities in Burbank and surrounding areas is provided in Chapter 5.

Reduction in Local Air Pollution

Many Disadvantaged Communities identified by the State of California in the Burbank area are located along the route of Interstate Highway 5. Interstate 5 and Highway 134 are sources of significant air emissions from gasoline and diesel-fueled vehicles. As transportation transitions to EVs as described elsewhere in this IRP, the Disadvantaged Communities adjacent to the Interstate will benefit from reduced air pollution. See Section 6.1.3 for a discussion of BWP efforts supporting EVs.

Potential sources of air emissions in or near the Disadvantaged Communities and within the purview of BWP are the Magnolia, Lake One, and Olive 1 and 2 natural gas-fired generating plants on the BWP campus next to the Interstate highway which, in the early 2000s, replaced older, less environmentally friendly, and less efficient units that caused significantly more pollution than Magnolia and Lake.

As a result, emissions from power generating units at the BWP Campus have decreased significantly since that time.

Customer Programs

As described elsewhere in this IRP, BWP has a long tradition of offering customer programs for low-income and other similarly-challenged groups of Burbank customers. BWP also offers programs to residents and businesses that are identified as Disadvantaged Communities. Most recently, this includes the installation of 16 electric vehicle chargers at the Burbank Town Center, an area identified as a Disadvantaged Community, partly due to its proximity to Interstate 5. This project will help incentivize the purchase of electric vehicles for nearby residents, as well as improve their air quality from the hundreds of visitors driving through and using the chargers. This project is further discussed in Section 6.1.3.

BWP also attempts to target energy efficiency programs to customers in Disadvantaged Communities areas. During FY 2016-2017, BWP offered the Home Improvement Program also exclusively to customers served by the McCambridge feeder, which includes thousands of homes in a Disadvantaged Communities area. Through this targeting, BWP saw a reduction in peak demand of between one and two percent. More importantly, Burbank residents in this area have been able to realize increased comfort in their homes and significant bill savings.

As discussed in Chapter 5, public input for this IRP was supportive of BWP efforts to address Disadvantaged Communities with various customer programs. In response to SB350 provisions regarding Disadvantaged Communities, BWP plans to develop and implement a program to target Disadvantaged Communities with selected BWP energy efficiency, demand response, and beneficial electrification programs.

3.8 Customer Distributed Generation

Distributed generation refers to small-scale power generation occurring at or near where it will be used. Often, renewable energy technologies are employed as these generation sources on the customer’s side of the meter. In contrast, BWP’s power generation portfolio is primarily comprised of large-scale generation located either outside Burbank or within BWP’s distribution system, but not within the customers’ premises. Two examples of such local generation resources are Magnolia Power Plant and Lake One. Customer-owned distributed generation in Burbank is primarily comprised of solar PV systems, commonly known as rooftop solar.

3.8.1 Rooftop Solar

Customer-owned rooftop solar has both benefits and drawbacks. It is environmentally friendly and does not require transmission to reach customers. On the other hand, it is an intermittent resource – it only generates electricity when the sun is shining but virtually no generation occurs at night or in substantial cloud cover. This swing in generation not only presents a challenge to electric grid reliability (such as the Duck Curve) but also influences rate design as discussed elsewhere in this IRP.

In the early days of solar PV technology and when the cost of installation was high, BWP offered rebates through the Solar Support Rebate program. In FY16-17, as solar PV prices have declined and customer decisions to install rooftop solar became independent of rebates, BWP discontinued its rebate program. Burbank continues to see a steady progress in rooftop solar installations.

Falling prices, tax incentives, and no-money-down leasing arrangements have created a new solar reality for many Californians. In an August 2016 survey, nearly 15 percent of Burbank homeowners said they plan to install solar panels at their home in the next two years. This is nearly four times the number of homeowners that have already installed solar panels.

To date, there are more than 700 customer-owned rooftop solar PV systems in Burbank totaling more than 7.2 MW of capacity.

BWP expects that by 2020, there will be between 8 and 10 MW of cumulative capacity installed in Burbank with approximately 811,000 MWh of solar annual generation from customers annually. Table 3.5 provides a year-by-year history of distributed generation additions in Burbank.

Solar generation will increasingly affect BWP's resource planning. BWP must be prepared to deal with the impacts of solar makes on BWP's system in the middle of the day, when solar power is being generated. Properly balancing the increase of this intermittent power source to BWP's system is paramount to ensuring low electric rates and high reliability.

3.8.2 Fuel Cells

Distributed generation technologies include solar systems, reciprocating engines (similar to vehicle engines) and fuel cells. While reciprocating engines are typically used as emergency standby systems due to air emission restrictions, natural gas-powered fuel cells offer a cleaner, but still fossil-fueled, approach that can operate as baseload generation 24 hours a day.

In recent years, fuel cells have gained attention as another option for customer-owned distributed generation. Fuel cell technologies provide efficiency benefits similar to that of large-scale utility-owned generating facilities

Distributed Generation Growth in Burbank

YEAR	MWh	MW	NUMBER OF SYSTEMS INSTALLED	TOTAL SYSTEMS IN BURBANK
2009 - 10	344.0	1.51	71	71
2010 - 11	1,576.1	0.95	42	113
2011 - 12	401.7	0.26	11	124
2012 - 13	279.2	0.18	34	158
2013 - 14	412.5	0.26	51	209
2014 - 15	711.4	0.46	89	298
2015 - 16	1,534.6	1.01	173	471
2016 - 17	2,849.3	1.83	133	604
2017 - 18	1,285.1	0.84	99	703
TOTAL:	**9,393.9**	**7.30**	**703**	**703**

	RESIDENTIAL	COMMERCIAL
Systems	649	54
Avg. System Size (kW)	4.8	74.5

Table 3.5: Incremental Annual Distributed Generation Additions in Burbank

Source: BWP

but are smaller and can be located at the customer's site and can produce electricity continuously. For larger customers, fuel cells may have economic appeal.

The State of California as a matter of policy supports customer-owned generation to reduce electric load, reduce greenhouse gases, and improve the electric delivery system. However, and specifically regarding fuel cells, the issues for Burbank are:

- Conformance of natural gas-powered fuel cells with Burbank's energy policy encouraging renewable energy, and
- Impact to Burbank rate payers.

First, as a community-owned utility, BWP's mission is to provide reliable, sustainable, and affordable energy services to every resident and business in Burbank. To meet energy demands, BWP follows both State and local policy direction regarding the type of energy resource used, generated, or purchased. This is called the "loading order" and was described earlier in this IRP. In line with the State's loading order, the Burbank City Council, nearly a decade ago, formally committed to meet all electric load growth in the City with energy efficiency or renewable energy. These policy decisions were confirmed in BWP's 2015 IRP.

Current fuel cell technology uses natural gas to power the cell. Natural gas is a fossil fuel and hence a non-renewable resource. While fuel cells are a valuable generation alternative in certain circumstances, their reliance on fossil fuel makes their presence in Burbank inconsistent with the loading order. Further, public input for this IRP indicates a willingness for new fossil-fueled generation only to integrate renewables and provide reliability for Burbank; fuel cells do not provide these benefits.

While state policy encourages the expansion of Distributed Energy Resources (DER) to reduce peak energy demand, reduce distribution line losses, defer distribution system upgrades, and increase service reliability, very few of these benefits have been adequately quantified. In Burbank, customer generation offers little practical assistance for the electrical system. Burbank has maintained its infrastructure and has invested in its internal transmission and distribution system on an ongoing basis. BWP's electrical line losses are low and system reliability is astonishingly high, with 99.998% availability in 2017.

BWP's high reliability and system performance magnifies the fact that the Burbank transmission and distribution system is in a much better position than other utilities and would not benefit from customer distributed generation to the same degree.

Burbank is also currently fully-resourced until the retirement of the IPP coal plant in 2025. In fact, Burbank is over-resourced due to BWP's commitment to conservation and the addition of utility and customer-owned renewable energy. Adding resources when none are needed has consequences to the other customers that must be considered.

Second, traditional electric rates are designed to recover costs on units of energy sold, including both fixed and variable costs. If consumption drops, fixed costs currently included in the unit cost of energy will not be recovered. Under the current rate structure, customers who self-generate and reduce their purchase of energy from the utility will not be contributing to the recovery of certain fixed costs, such as distribution wires and power poles. Unless there is growth in the City to contribute to fixed cost recovery, these fixed costs must be shifted to other customers.

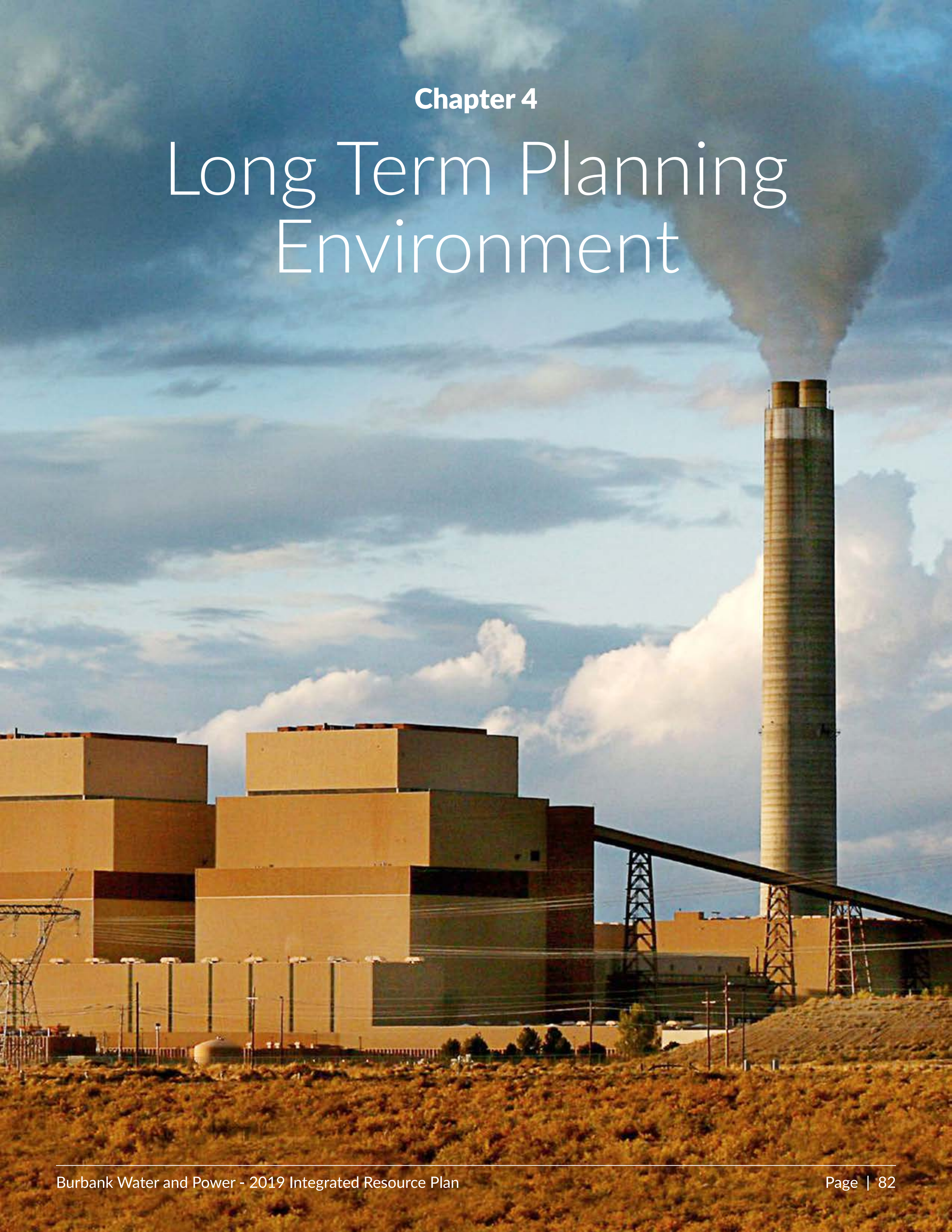
Consistent with City Council direction on April 28, 2015, BWP has deferred consideration of allowing fuel cells, fueled by fossil fuels, until such time as there is sufficient growth to mitigate the rate impacts to the non-participating electric customers. Along the same directive, BWP will consider fuel cells, if the fuel cells are fueled with CEC-qualified renewable fuel.

3.8.3 Customer Energy Storage

Customers can also implement energy storage on their sites. See Chapter 6 for a discussion of these opportunities.

Chapter 4

Long Term Planning Environment



4.1 Legislative and Regulatory Factors

The electric power industry including the generation, transmission, distribution and sale of reliable electric power to our customers is changing dramatically. The increased pressure to change the business and mechanics of operations is due to a variety of factors that focus on altering the power and commodity market developments, politics, new technologies, the economy and customer preference for conservation and renewable energy.

The electric utility industry and specifically, locally publicly owned utilities are heavily regulated at the national, state, and local levels. As a result, legislative mandates and an increase in regulatory requirements significantly influence long-term resource planning for BWP and pose many new challenges to maintain safe and reliable operation of the electric system. This Chapter describes the various legislative and regulatory factors that affect BWP's resource planning decisions.

4.1.1 Greenhouse Gas Emissions

Over the past decade there has been a focus and increase of utility-related regulation and legislation to reduce greenhouse gas (GHG) emissions while promoting energy independence and economic development. Achieving GHG reductions in BWP's power supply while maintaining reliable and affordable service is the primary challenge with respect to transforming BWP's power supply to include increasing amounts of sustainable sources.

In the past century, human activities have released large amounts of carbon dioxide (CO2) and other greenhouse gases into the atmosphere. The majority of greenhouse gas emissions have come from burning fossil fuels although deforestation, industrial processes, and some agricultural practices can also emit gases into the atmosphere or greatly slow down the natural rate of GHG absorption from the atmosphere. In California, the sector that produces the greatest amount of GHG is transportation.

The City of Burbank adopted a Greenhouse Gas Reduction Plan (GGRP) in 2013. The Plan states:

> ***"Climate change is a reality, and human activity is its primary cause."***

4.1.2 Federal Legislation

President Trump's administration has changed the political dynamics between the State of California and the federal government, and they remain at odds. The political shift in opinions for the preservation of coal and nuclear power plants throughout the U.S. has resulted in uncertainty in the electric industry, including uncertainty about future availability of financing options, including grants, tax incentives and municipal bond exemptions.

4.1.3 Tax-Exempt Financing

Tax-exempt financing is the primary method of securing the capital needed for governments (like the City of Burbank) and municipally-owned utilities (like BWP) to finance large-scale infrastructure construction. This infrastructure includes the power system: from power plants to transmission and distribution facilities, and other utility assets. Tax-exempt financing allows municipal entities to issue bonds that are not subject to federal income tax for the bondholders, therefore lowering borrowing costs and the cost of infrastructure projects. Access to this type of financing tool facilitates local government borrowers to make infrastructure improvements at ultimately lower costs to the public than what could be done through privately-owned development.

Tax-exempt financing remains available but is periodically subject to legislative challenge. BWP, together with SCPPA and other regional and national bodies, continues to monitor legislation surrounding its favorable tax treatment.

4.1.4 California Legislation

For more than a decade, California has been on the leading edge of state policies affecting energy efficiency, the environment and resource planning. The American Council for an Energy Efficient Economy (ACEEE) currently scores California as #2 in the United States pursuant to its annual ACEEE Energy Efficient Scorecard, which ranks the effectiveness of state energy efficiency policies and program efforts.

The following legislation has shaped California's current energy policy since 1996.

4.1.4a Energy Efficiency Legislation

California legislation affecting customer energy efficiency efforts includes the following:

- Assembly Bill (AB) 1890 – Public Benefits Surcharge (1996)

AB 1890 specifies that all electric distributing agencies must set aside 2.85% of annual electric retail revenues for public benefit programs. Eligible programs for this spending requirement must fall into at least one of the following four categories related to the public benefits of electricity:

✓ Energy efficiency;
✓ Low-income electric rate assistance;
✓ Renewable energy; and,
✓ Research, demonstration and development.

- Senate Bill (SB) 1037 – Achieving Energy Efficiency (2005)

SB 1037 established several energy efficiency policies including a statewide commitment to energy efficiency with a goal that all utilities consider energy efficiency before investing in any other resources to meet growing demand.

- Assembly Bill 2021 – Verifying Energy Efficiency Programs (2006)

AB 2021, together with companion legislation SB 1037, requires independent evaluation to measure and verify the energy and demand savings produced by a utility's energy efficiency programs.

AB 2021 also requires that publicly owned utilities go through a third-party to identify all potentially achievable cost-effective energy efficiency savings, and update the ten-year targets every three years.

4.1.4b State Greenhouse Gas Reduction Legislation and Executive Orders

The California legislature has recognized that electricity generation represents a significant part (about 19%) of total carbon emissions in and for the State (Figure 4.1).

2016 Total CA Emissions: 429.4 MMTCO2e

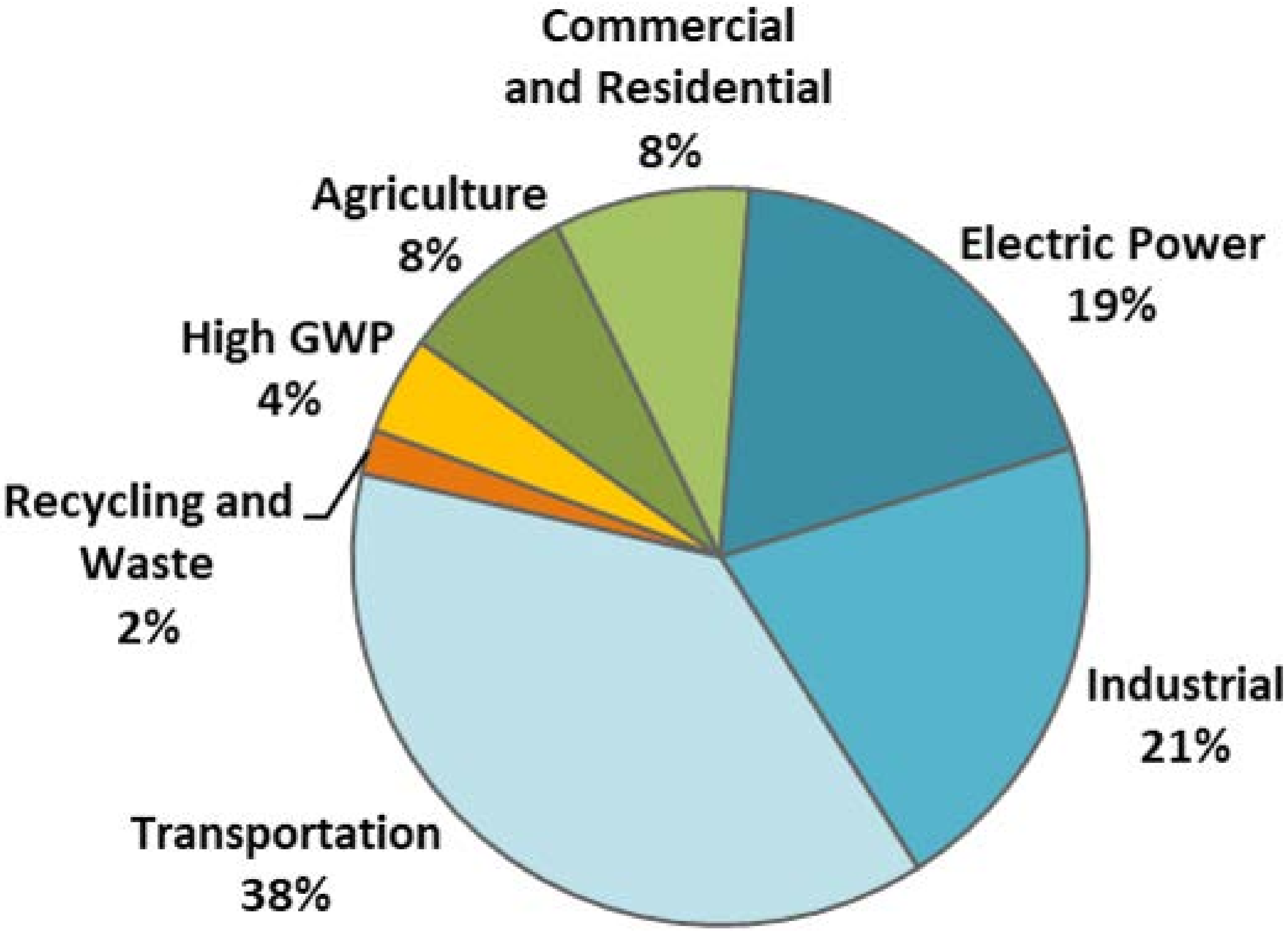


Figure 4.1: California Carbon Emissions by Source in 2016
Source: CARB Greenhouse Gas Inventory, June 2018

In addition to the energy efficiency legislation listed above, California legislative, executive, and regulatory actions in recent years have combined to reduce GHG emissions in the state. Such actions have included:

- ***Senate Bill 2:*** Mandatory State Renewable Portfolio Standards (2002)

Established in 2002, under Senate Bill 1078, accelerated in 2006 by Senate Bill 107 and expanded in 2011 under Senate Bill 2, California's Renewables Portfolio Standard (RPS) is one of the most ambitious renewable energy standards in the country.

The RPS program requires all utilities, to increase renewable energy resources to 33% of total energy by 2020. This legislation set the stage for California Governor Edmund G. Brown Jr. to increase to 50%, renewable sources by 2030, in Assembly Bill 350.

- ***Senate Bill 1*** – Subsidies for Customer Solar (2005)

In 2005, SB 1 was enacted with the intention of expanding rooftop solar PV systems as a means to reduce energy use and therefore GHG. It had two mandates:

1. Required utilities provide subsidies to customers for the installation of PV solar systems on their premises.
2. Established resource adequacy requirements for all load-serving entities in the State.

This means that municipal utilities must maintain and have physical generating capacity that is adequate to meet its peak demand requirements.

- ***Executive Order S-03-05*** (2005)

In this Order, Governor Schwarzenegger established a target for statewide GHG emission reductions to 80% below 1990 levels by 2050.

- ***Senate Bill 1368*** – Fossil Fuel Emissions Limits (2006)

SB 1368 set emission limits on resources that California electric utilities can import from outside California. Pursuant to SB 1368, California electric utilities will not be able to enter into energy contracts for terms longer than five years from high-GHG power resources, such as the IPP coal plant. In particular, SB 1368 specifies that for resources expected to run at greater than a 60% capacity factor, the average CO2 output needs to be less than 1,100 lbs./MWh. IPP coal's average CO2 output exceeds this threshold.

The most significant impact of SB 1368 is that it severely limits BWP's ability to renew its contracts with IPP coal after the current contracts expire in 2027.

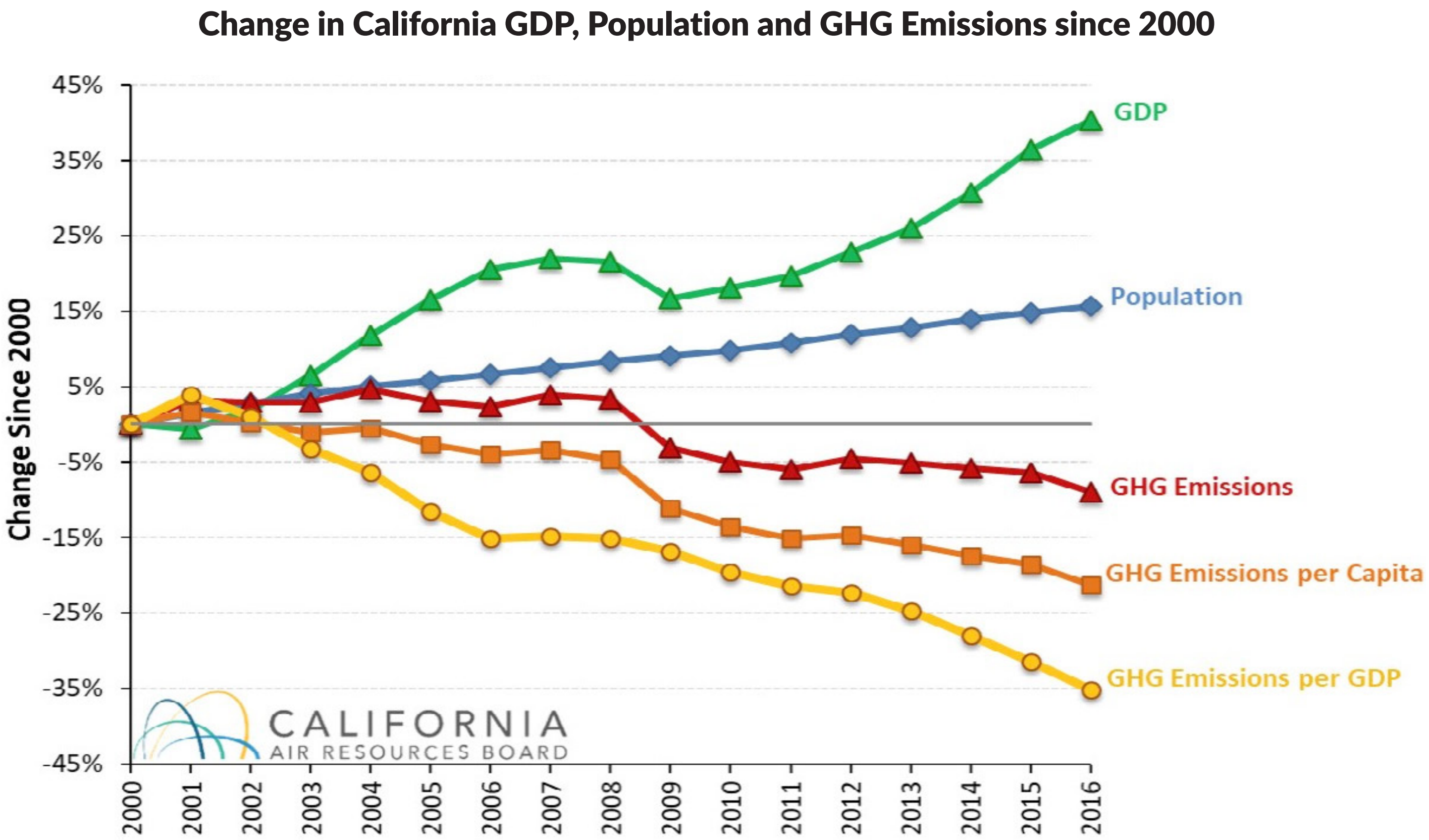
- ***Assembly Bill 32*** – Greenhouse Gas Limits (2006)

AB 32 was far-reaching, first-of-its-kind legislation to reduce GHG.

The goal of AB 32 is to reduce GHGs to 1990 levels by 2020. Today, California's goal is a reduction of 80% below 1990 levels by 2050. However, until recently, there was not a State plan or mid-term target between 2020 and 2050.

Under AB 32, the California Air Resources Board (CARB), a state regulatory agency, is responsible for monitoring and reducing GHG emissions. This responsibility included developing a scoping plan for regulating statewide GHG emission caps, mandatory GHG reporting, and evaluating the impact of AB 32 on the economy, environment, and power system reliability.

Figure 4.2 below illustrates the historical downward trend in total statewide GHG emissions over the period 2000 to 2016.



Metric	Associated 2016 Value
GDP	2.3 trillion (2009 $)
Population	39.3 million
GHG Emissions	429.35 $MMTCO_2e$
GHG Emissions per Capita	10.8 metric tons CO_2e per person
GHG Emissions per GDP	187 metric tons CO_2e per million dollars

Figure 4.2: Historical California Total GHG Emissions (2000 - 2016)

Source: California Air Resources Board, GHG Inventory 2000-2016, 2018 Edition

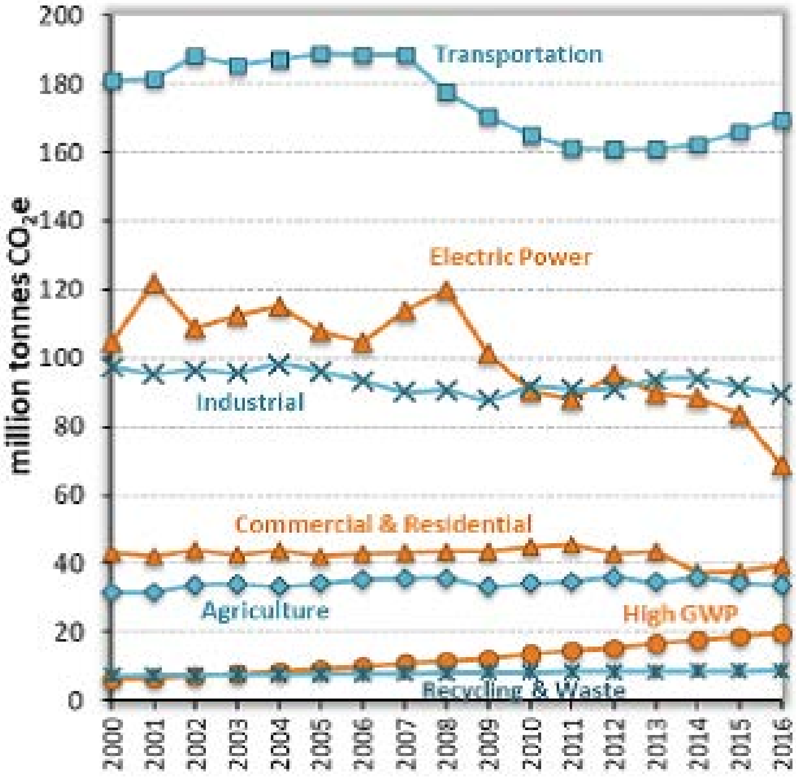


Figure 4.3: California Sectoral GHG Emissions (2000-2016)

Source: California Air Resources Board, GHG Inventory 2000 – 2016, 2018 Edition

Figure 4.3 above illustrates the corresponding historical trend in California statewide GHG emissions by sector from 2000 through 2016. This Figure shows the potential for further reductions in the transportation sector, most likely by switching from gasoline and diesel fuels to renewable energy-based electricity and hydrogen.

In 2012, CARB developed California's landmark GHG Cap-and-Trade Program, under which companies must hold enough GHG emission allowances to cover GHG emissions created by their activities. The availability of GHG allowances is designed to decrease over time, such that affected companies and utilities are compelled to either reduce GHG emissions or buy allowances to cover GHG emissions that have not yet been reduced.

Because of early action in the form of setting renewable energy targets and acquiring renewable resources, prior to passage of AB32, the electric utility industry was allocated allowances throughout the term of the program (through 2020) to help reduce the costs of the program. Burbank expects to receive its annual allotment. Figure 4.4 below shows the annual allowances that have been and will be allocated to Burbank.

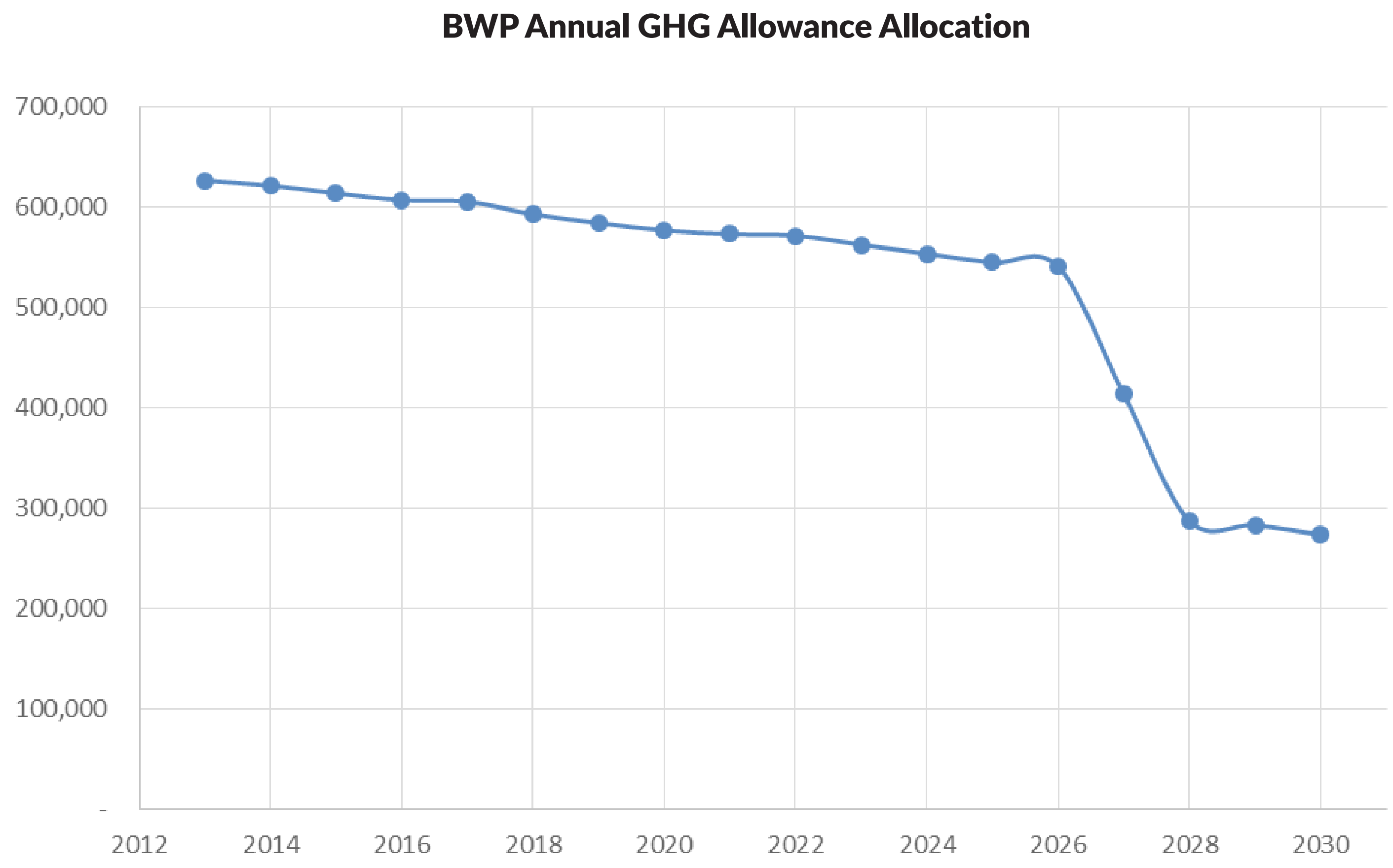


Figure 4.4 – Cap and Trade Compliant Instrument Allocation
Source: California Air Resources Board

AB 32 has the potential to reduce California's GHG emissions substantially, as shown in Figure 4.5 below. GHG emission reductions are measured in millions of metric tons of carbon dioxide emissions (MMT CO2).

Pre-2020 and Post-2020 Emissions Trajectories

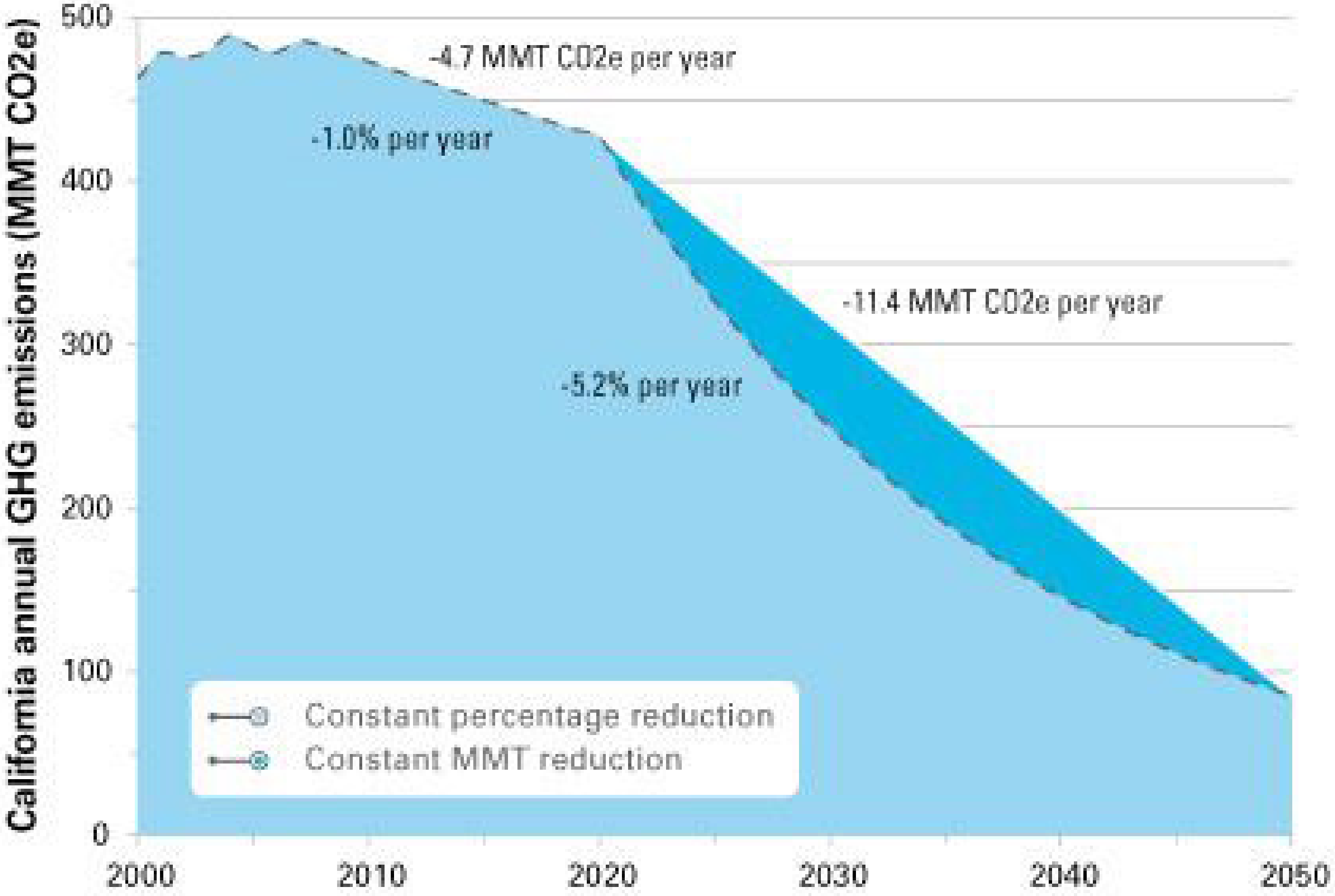


Figure 4.5 – Pre- and Post-2020 Emissions Trajectories

Source: California Air Resources Board

AB32 has also impacted the transportation fuel industry, specifically via the Low Carbon Fuel Standard (LCFS). The LCFS calls for a reduction of at least 10% in the carbon intensity of California's transportation fuels by 2020. These reductions include not only tailpipe emissions but also all other associated emissions from production, distribution and use of transport fuels within the state.

The standard is also aimed to reduce the state's dependence on petroleum, create a market for clean transportation technology, and stimulate the production and use of alternative, low-carbon fuels in California. Low-carbon fuels cause much less CO2 emissions than conventional fuels when combusted. Low-carbon fuels include compressed natural gas, liquefied petroleum gas (natural gas or propane), and alternative fuels such as biodiesel, bio-alcohol, propane, biomass, and chemically-stored electricity such as fuel cells or batteries.

Additional executive and legislative action followed:

- ***Executive Order B-30-15*** (2015)

  In April 2015, Governor Brown issued Executive Order B-30-15, which established a new interim statewide GHG emission reduction target to reduce GHG emissions to 40% below 1990 levels by 2030, in order to ensure California meets its target of reducing GHG emissions to 80% below 1990 levels by 2050 as set in AB 32.

- ***Governor's 50-50 Plan – Senate Bill 350*** (2015)

  In Governor Brown's January 2015 inaugural address, he called for 50% of California's electricity to come from renewable sources by 2030, up from a 33% goal by 2020. Governor Brown also called for doubling the energy efficiency of existing buildings and reducing automobile dependency on oil and gas by 50%.

  In October 2015, Governor Brown signed SB 350 into law which moved much of the Governor's plan into effect, less the plan on reduction of automobile dependency on oil and gas by 50%.

  SB 350 aims to do the following:

  - Increase the RPS to 50% by 2030;
  - Direct the CEC to set annual statewide targets to double energy savings through energy efficiency by 2030;
  - Initiate the process to create a multi-state regional governance structure for the CAISO;
  - Create new integrated resource planning requirements for investor-owned utilities, many of the publicly owned electric utilities (including BWP), electric service providers, and community choice aggregators; and
  - Direct the CARB to adopt regulations to remove disincentives for utility investment in transportation electrification

- ***Senate Bill 100*** – California Renewables Portfolio Standard Program; emissions of greenhouse gasses, 100% Clean Energy (2018)

  This Bill (SB 100) was originally introduced in 2017 and was enacted in the 2018 legislative session on September 10, 2018.

  Among other things, the Bill includes the following elements that influence BWP's IRP going forward:

  - Further increase the RPS from 50% to 60% by December 31, 2030 and also speeds up interim requirements.

  - Establishes a statewide target of 100% of total retail electricity sales to come from zero carbon resources by December 31, 2045.
  - Encourages conversion of energy end-uses now fueled by fossil fuels to electricity where such a change would reduce GHG emissions.

  SB 100 will take effect on January 1, 2019. Although it was not yet passed during most of the preparation of this IRP, its RPS and clean energy target elements were used as sensitivity cases to anticipate its potential impacts on Burbank.

- ***Executive Order B-55-18*** (2018)

  On September 10, 2018, Governor Brown issued Executive Order B-55-18, directing state agencies to develop a framework to achieve carbon neutrality no later than 2045 and to maintain negative emissions thereafter. The new goal is in addition to the existing statutory requirement to reduce emissions to at least 40% below 1990 levels by 2030 and the goal of achieving an 80% reduction by 2050 under an Executive Order issued in 2015. The Governor noted the Executive Order is intended to combat climate change more broadly.

- ***Revised CEC Guidelines: CARB Targets for POUs***

  On September 19, 2018 the CEC revised its IRP Guidelines for publicly-owned utilities including BWP. Among other things, the revised Guidelines established GHG emissions targets for publicly-owned utilities. These targets, which represent pro-rata shares of the overall California emissions reduction goals in the CARB Scoping Plan, have been observed in the development of this IRP.

4.1.5 IRP Requirements Summaries and Checklist

The various legislative, executive and regulatory actions listed above contain requirements to be addressed in utility IRPs. The California Energy Commission (CEC) subsequently issued Guidelines for the content of IRP Reports of Publicly-Owned Utilities (POU) like BWP.

Chapter 9, Appendix 4 provides a summary checklist table of these actions, mapped to the Chapters and pages of this IRP that fulfill them. The checklist is provided for the reviewer's convenience in reviewing this 2019 IRP and its compliance with the various requirements.

4.1.6 Beyond 2020

With SB 32, SB 350 and SB 100, California is moving to reduce GHG emissions to minimize the impacts of climate change. BWP has the same goal: to reduce GHG emissions, in large part through achieving a 60% RPS by 2030 while maintaining affordable and reliable electric service for Burbank customers.

4.2 Rate Design

As a not-for-profit locally-owned public utility, BWP's electric rates are designed to recover only the cost of providing highly reliable electric service to its customers while maintaining sound financial standing. The costs to serve BWP's ratepayers include the cost of owning, operating and maintaining its power plants, power purchases including renewable energy, transmission and distribution infrastructure, metering and billing systems, customer service and energy efficiency programs, communications equipment, buildings, and transportation fleet.

4.2.1 The Ratemaking Process

The ratemaking process is generally composed of three steps: 1) determining the revenue requirement, 2) completing a cost of service analysis, and 3) rate design.

Revenue Requirements

BWP's electric utility revenue requirement is the total amount of revenue it must recover in order to pay for its operations and maintenance expense, pay-as-you-go (PAYGO) capital, debt service coverage, and reserve requirements. This approach to determining the revenue requirement is sometimes referred to as the "cash-needs" approach, which differs from a rate of return or "utility basis" approach common among investor-owned utilities. BWP's annual revenue requirements are calculated prospectively for five years as part of BWP's annual financial planning and budget process; however, the revenue requirement is only approved one year at a time by the Burbank City Council.

Cost of Service

The purpose of a cost of service study is to ensure that each customer class is paying its fair share of total system costs by determining what it costs to serve each class. In doing so it greatly informs the rate design process because rates are often designed to recover specific system costs.

A cost of service analysis is used to determine each customer class's fair share of the annual revenue requirement and to inform rate design. Each customer class' share of the revenue requirement as determined by the cost of service analysis can be referred to as the "class cost of service." BWP generally completes an electric cost of service analysis every five years at which time each class cost of service may be updated. The most-recent cost-of-service analysis for the electric utility was completed in 2013. BWP has most frequently chosen to use an average or "embedded" cost approach to completing its cost of service analyses. An embedded cost of service analysis typically involves three steps: 1) functionalization, 2) classification, and 3) allocation. The basis for the analysis is typically a recent year of actual operating results, which is called the "test year."

Functionalization is the process of categorizing the utility's operations and maintenance expense and net assets (original cost less depreciation or "book value") into system functions such as generation, transmission, distribution, and customer service.

Classification is the process of classifying costs by function according to how those costs vary. For example, bulk power supply costs tend to vary based on energy throughput, while distribution capacity costs tend to vary based on peak demand. In these cases, bulk power supply costs are classified by the energy classification type while distribution capacity costs are classified by the peak demand classification type. Each classification type describes units of service for all customer classes. Common classification types include energy, demand, customers, and meters.

Allocation is the process of allocating the classified costs to customer classes in proportion to each class's share of the total units of service for each classification type. For example, all costs that are classified by the energy classification type are allocated among the different customer classes based on each class' share of the total energy units of service measured in kilowatt-hours. The class cost of service is the total costs allocated to each class for each classification type. BWP's currently has five major customer classes: residential, small commercial (Schedule C), medium commercial (Schedule D), large commercial (Schedule L) and extra-large commercial (Schedule XL).

Rate Design

Once the class cost of service is determined for each customer class, rates can be designed to recover that amount. Rate design may vary between and within the major customer classes depending on, for example, the type of residential customer (standard, lifeline, or electric vehicle owner), or the service voltage (primary or secondary). Rate design may also vary due to differing objectives for certain classes or subclasses and/or due to billing system constraints. A detailed discussion of BWP's current rates is presented in the Current Electric Rates section below.

4.2.2 Appropriate Price Signals

Beyond ensuring that each customer class pay its fair share of operating and maintaining the electric utility, BWP believes its rates should send appropriate price signals to customers to help them understand—and respond to—how the utility's costs vary overall. Naturally, the more energy customers use, the more costs are incurred. However, when and how customers use more energy greatly impacts which costs are incurred for BWP and how much. BWP believes electric rates should be designed to reflect the when and how costs are incurred. This belief is reflected in the rates for BWP's largest commercial customers. Commercial customers are subject to time-varying energy charges called Time-of-Use (TOU) rates, which reflect the cost of time-varying bulk power supply, and demand charges that reflect the cost of maintaining both distribution system capacity and peak power supply capacity.

TOU rates were introduced for BWP’s extra-large customers in 2007, for large customers in 2008, followed by medium commercial customers in 2015 and small commercial customers in 2017. BWP plans to roll out TOU rates to residential customers in 2020. TOU rates are further discussed in the next section.

4.2.3 Current Electric Rates

BWP’s currently has five major customer classes: residential, small commercial (Schedule C), medium commercial (Schedule D), large commercial (Schedule L) and extra-large commercial (Schedule XL). Residential service includes service for lifeline customers and electric vehicle owners. Lifeline customers are senior and/or disabled customers that are eligible for discounted electric rates. Electric vehicle owners may elect to receive service under BWP’s optional electric vehicle owner rate schedule, which offers lower energy rates during off-peak periods. This rate schedule is discussed in further detail below.

BWP’s commercial customers are assigned one of the four commercial classes based on their monthly demand—the maximum instantaneous 5- or 15-minute interval reading per billing period. Commercial customers are assigned to classes as summarized on Figure 4.6 below:

Commercial Customer Classes for Rates	
Commercial Class	**Monthly Demand**
Commercial Class	Monthly Demand
Small (Schedule C)	Less than 20 kVA
Medium (Schedule D)	Between 20 kVA and 250kVA
Large (Schedule L)	Between 250 kVA and 1,000 kVA
Extra Large (Schedule XL)	Over 1,000 kVA

Figure 4.6 – Commercial Customer Classes for Rates

	(1) Energy Charges		(2) Fixed Monthly Charges		(3) Demand Charges		
Customer Class	2-Tier Inclining Block Energy Charges*	Time of Use Energy Charges*	Customer Service Charge	Service Size Charge	Demand Charge	Distribution Demand Charge	Reliability Services Demand Charge
Residential	✓		✓	✓			
Small Commercial		✓	✓				
Medium Commercial		✓	✓		✓		
Large Commercial		✓	✓			✓	✓
Extra Large Commercial		✓	✓			✓	✓
*includes Energy Cost Adjustment Charge (ECAC)							

Figure 4.7 – Types of Charges Applicable to the Major Customer Classes

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Each customer class is subject to either a "2-part tariff" or "3-part tariff." Residential customers and small customers are subject to a 2-part tariff in which they pay a monthly fixed service charge and per-kWh energy charges. Medium, large, and extra-large commercial customers are also subject to monthly service charges and energy charges; however, they are also subject to per-Kilovolt-Ampere (kVA) demand charges. Each rate, or "part", is generally designed to recover specific costs, which are revealed by the cost of service analysis. Figure 4.7 above summarizes the types of charges that each major customer class is subject to.

Energy Charges

All of BWP's metered customers are subject to per-kilowatt-hour energy charges, which are inclusive of the energy cost adjustment charge (ECAC) The ECAC is an energy charge that specifically recovers the cost of variable power supply costs including, but not limited to, fuel and purchased power expenses.

BWP currently employs two types of energy charges: 2-tier inclining-block and time of use.

2-Tier Inclining-Block Energy Charges

Residential service customers, except for those customers that elect the optional electric vehicle rate, are subject to 2-tier inclining-block energy charges. 2-tier inclining-block energy charges offer energy at two inclining or increasing rates. The first, cheaper rate, applies to consumption up to the upper bound of the first “block” or tier. The second, more-expensive rate, applies to incremental consumption above the first block or tier. For standard residential service customers, the upper bound of the first block is 300 kWh. For residential lifeline customers, the upper bound of the first block is 400 kWh. The purpose of inclining-block energy charges is to encourage conservation, as higher consumption is subject to a higher rate.

Time of Use Energy Charges

Time of use (TOU) energy charges are energy charges that may vary based on the time of day, day of week, month of year, and observance of holidays. Currently, all commercial customers are subject to time of use energy charges. BWP plans to roll out a similar TOU rate structure as the default rate option to all residential customers in 2020. This rate schedule will be designed to shift energy use from high-cost periods, such as in the evening between 4pm and 7pm, to low-cost periods. Currently, residential customers that own electric vehicles may elect to enroll in BWP’s optional residential electric vehicle rate schedule, which utilizes time of use energy charges.

Currently, there are three time of use periods, which have corresponding energy charges. These are, in order of increasing price: off peak, mid peak, and on peak. Figure 4.8 below summarizes the time of use periods for all commercial customers.

	Summer		**Non-Summer**	
Time	**Weekday**	**Weekends & Holidays**	**Weekday**	**Weekends & Holidays**
Midnight to 8am	Off	Off	Off	Off
8am to 4pm	Mid	Off	Mid	Off
4pm to 7pm	On	Off	Mid	Off
7pm to 11pm	Mid	Off	Mid	Off
11pm to Midnight	Off	Off	Off	Off

Figure 4.8: Time Periods for Time of Use (TOU) Rates.

Time	Summer	Non-Summer
Midnight to 8am	Off	Off
8am to 4pm	Mid	Mid
4pm to 7pm	On	Mid
7pm to 11pm	Mid	Mid
11pm to Midnight	Off	Off

Figure 4.9: Time Periods for Time of Use (TOU) Rates for Residential Electric Vehicle Owners.

Figure 4.9 above summarizes the time of use periods for residential electric vehicle owners.

The summer season is from June 1 through October 31, while the non-summer season is from January 1 through May 31, and November 1 through December 31. Observed holidays are New Year's Day (January 1), Presidents' Day (third Monday in February), Memorial Day (last Monday in May), Independence Day (July 4), Labor Day (first Monday in September), Veterans Day (November 11), Thanksgiving Day (fourth Thursday in November), and Christmas (December 25).

BWP believes that time of use rates are a useful demand side management tool for reducing overall system costs. Time of uses rates can encourage customers to change their consumption patterns such that they reduce the utility's need to procure energy and capacity during the most expensive periods of the year. Time of use rates can also encourage customers to shift their consumption to periods of the year when energy (often renewable) and capacity is in excess. These changes in consumption patterns can be beneficial to both the customer and BWP in terms of cost savings.

TOU rates will become an increasingly important tool for BWP as it continues to integrate more intermittent renewable resources. The specific challenges that arise from integrating more renewable energy is discussed in detail in Chapter 6. BWP is currently in the process of developing a residential TOU rates proposal to replace the existing 2-tier inclining-block energy charges. BWP believes in the potential for residential customers to respond to TOU rates, lowering their bills and decreasing the utility's cost to serve customers on a long-term basis.

Fixed Monthly Charges

Fixed monthly charges are generally designed to recover the cost of customer service and billing. For residential customers, they may also take the form of a service size charge, is designed to recover secondary distribution system costs.

Customer Service Charge

All customers are subject a fixed monthly customer service charge with the exception of residential lifeline customers. This charge ranges from $8.61 (FY 2018-19) for residential customers to $117.51 (FY 2018-19) for extra-large commercial customers. Note that for commercial customers, the monthly customer service charge may vary depending on whether the customer is unmetered, has single phase service, or three-phase service.

Service Size Charge

The service size charge recovers customer-specific system costs, including the cost of wires and transformers and is determined by the customer's electrical panel size and the number of homes or buildings sharing a single transformer.

Customers are categorized as follows for the service size charge:

- Small: Service location with two or more meters per service drop and does not meet definition of large; typically multifamily residential.
- Medium: Service location with one meter per service drop and does not meet definition of Large; typically single family residential.
- Large: Service with panel size greater than 200A.

Demand Charges

Demand charges are typically designed to recover capacity costs associated with transmission, distribution, and/or generation. The simple demand charge, which is designed to recover all of these costs only applies to medium commercial customers on a per-kVA basis. Two separate demand charges apply to large and extra-large customers, as discussed below.

Demand Charge – Medium Commercial

Medium commercial customers are subject to a simple demand charge, which is designed to recover the cost of distribution, transmission, and generation capacity. This charge is measured on a per-kVA basis.

Distribution Demand Charge

The distribution demand charge is a per-kVA demand charge that applies to both large and extra- large commercial customers. It is designed to recover distribution capacity costs. It is measured on an all-hour or "non-coincident peak" (NCP) basis, meaning that the demand reflects the maximum interval read of all reads during a given billing period. This is in contrast to a "coincident peak" (CP) basis for demand measurement, which only measures demand during a subset of monthly hours when the entire system is believed to peak.

Reliability Services Demand Charge

The reliability services demand charge is also a per-kVA demand charge that applies to both large and extra-large commercial customers. It is designed to recover generation capacity or "peaking costs". It is also measured on an NCP basis.

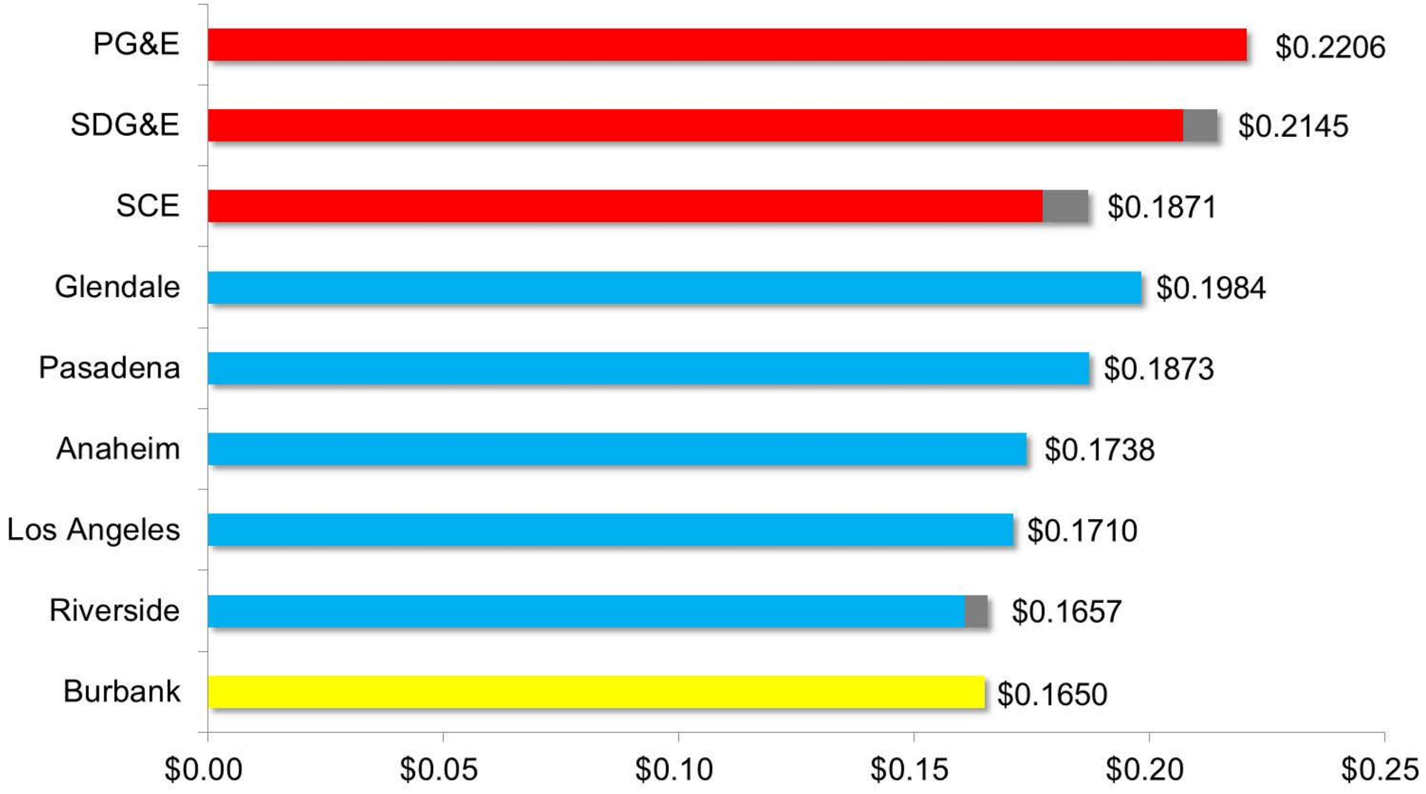

Figure 4.10: 2018 Residential Electric Revenue per kWh Comparison[4]

Source: BWP

4.2.4 Electric Rate Comparison

BWP's residential electric rates remain among the lowest in the region including other municipal utilities, as well as investor-owned utilities. BWP's electric rates have increased at less than the long-run rate of inflation for more than a decade.

Figure 4.10 above presents a comparison of the average residential revenue per kWh for utilities comparable to BWP. This rate is useful for comparison as it eliminates differences in rate design, which may favor certain designs over others at different consumption levels. The red bars represent this rate for investor-owned utilities, while the blue bars represent this rate for locally-owned public utilities apart from BWP. BWP's rate is represented by the yellow bar. The gray bars represent pending increases that are likely to occur during BWP's fiscal year 2018-19.

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[4] For comparison purposes, BWP's rate includes its in-lieu transfer to the City of Burbank.

Unlike most electric utilities, BWP does not utilize "cost trackers." Cost trackers are fees or charges in addition to its rates that automatically track and adjust to unanticipated changes in costs such as natural gas or wholesale power costs, the costs of meeting state-mandated renewable energy requirements, or a change in sales. All fees and charges are brought before the City Council for approval on an annual basis. Note that while the BWP General Manager has the authority to adjust the Energy Cost Adjustment Charge (ECAC) on a monthly basis, adjustments have not been made for over 10 years.

BWP has also developed short-term as well as long-term energy procurement strategies to reduce price risks and volatility. These strategies are monitored by BWP management utilizing the Energy Risk Management Policy, originally adopted in 2003 and amended in April 2009 and December 2017. Under the Energy Risk Management Policy, the Risk Oversight Committee was formed and meets regularly to discuss the power supply risks, market condition, and transactions needed to maintain reliable and affordable rates to Burbank.

4.3 Balancing Authority Services

At any given moment, Californians are consuming enormous amounts of electricity. This electricity is supplied by an interconnected grid of conventional and renewable generation plants, transmission lines, substations, distribution lines, transmission towers, and power poles. The standards for the operation of the interconnected grid in the western region of the United States and Canada are developed by the Western Electricity Coordinating Council, or "WECC."

For operational purposes, WECC resides over smaller areas called "balancing authorities" (or "BA"). Each BA is responsible for safe, reliable electricity supply within its area and between its areas to other Bas. Within each BA, individual utilities – like BWP – have a subset of the same operational responsibilities.

To keep electricity flowing reliably and safely, operations at each level – the WECC level, the BA level, and the utility level – must play their part in continuously balancing the supply and demand of electricity. This ensures that enough power is available to meet electricity needs without placing undue stresses on the interconnected power system.

4.3.1 Western Electricity Coordinating Council

For the western U.S., the Western Electricity Coordinating Council (WECC) is the organization that sets technical and operating standards for the interconnected electrical grid. Figure 4.11 below is a map of the continental U.S and the area that WECC oversees.

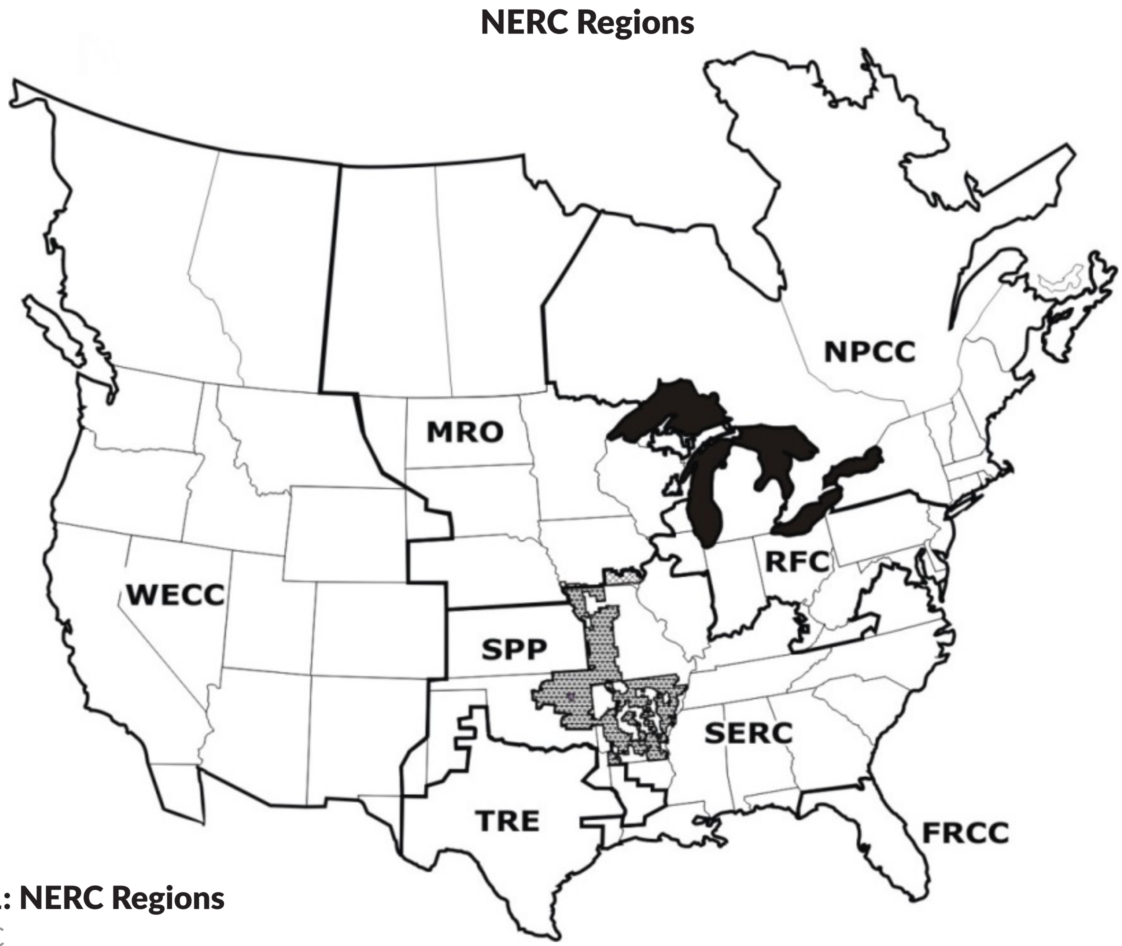

Figure 4.11: NERC Regions

Source: NERC

Among these criteria is WECC's reserve criteria that mandates readiness for unforeseen events, such as equipment failures and natural disasters, which are the most important for reliable power supply. WECC's reserve criteria requires Bas to provide the following reserves to ensure region reliability:

1. Regulating Reserve – This is spinning reserve capacity that must be immediately available and responsive to the needs of the electric grid. This is the generating cushion required to maintain interconnection reliability by balancing real power demand and supply in real-time.

2. Contingency Reserve – Power plants must have an amount of spinning and/or supplemental reserve power which can be made available within 10 minutes of an outage to replace a resource.

- Spinning reserve is any online back-up energy production capacity which can be made available to a transmission system within 10 minutes.
- Supplemental reserve is off-line generating capacity which is capable of being brought online within 10 minutes.

4.3.2 Balancing Authorities

There are currently 38 BA's in the Western Interconnection, which serves most of the Western U.S., Western Canada and some of Mexico. (Figure 4.12)

When the electrical infrastructure was first being built 130 years ago, individual power companies developed their own local electricity systems which, over time, became interconnected with one another. Connections between the neighboring electricity systems improved reliability and efficiency of the whole system, while still allowing the individual power companies to remain in control to serve their own customers' needs. The

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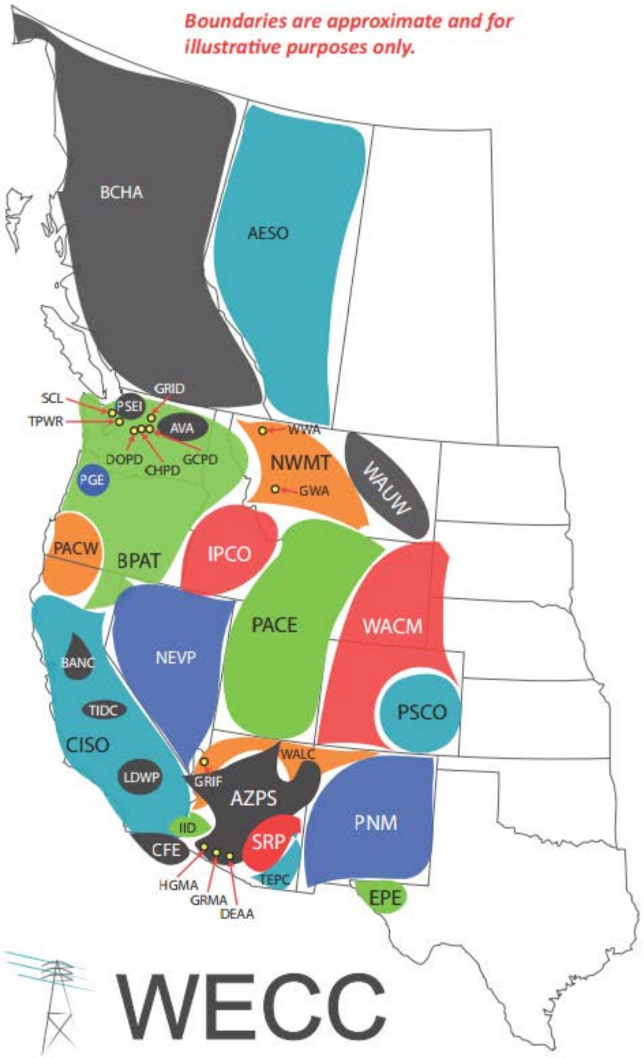


Western Interconnection Balancing Authorities (38)

AESO - Alberta Electric System Operator
AVA - Avista Corporation
AZPS - Arizona Public Service Company
BANC - Balancing Authority of Northern California
BCHA - British Columbia Hydro Authority
BPAT - Bonneville Power Administration - Transmission
CFE - Comision Federal de Electricidad
CHPD - PUD No. 1 of Chelan County
CISO - California Independent System Operator
DEAA - Arlington Valley, LLC
DOPD - PUD No. 1 of Douglas County
EPE - El Paso Electric Company
GCPD - PUD No. 2 of Grant County
GRID - Gridforce
GRIF - Griffith Energy, LLC
GRMA - Sun Devil Power Holdings, LLC
GWA - NaturEner Power Watch, LLC
HGMA - New Harquahala Generating Company, LLC
IID - Imperial Irrigation District
IPCO - Idaho Power Company
LDWP - Los Angeles Department of Water and Power
NEVP - Nevada Power Company
NWMT - NorthWestern Energy
PACE - PacifiCorp East
PACW - PacifiCorp West
PGE - Portland General Electric Company
PNM - Public Service Company of New Mexico
PSCO - Public Service Company of Colorado
PSEI - Puget Sound Energy
SCL - Seattle City Light
SRP - Salt River Project
TEPC - Tucson Electric Power Company
TIDC - Turlock Irrigation District
TPWR - City of Tacoma, Department of Public Utilities
WACM - Western Area Power Administration, Colorado-Missouri Region
WALC - Western Area Power Administration, Lower Colorado Region
WAUW - Western Area Power Administration, Upper Great Plains West
WWA - NaturEner Wind Watch, LLC

Figure 4.12: WECC Balancing Authorities
Source: WECC

development of Balancing Authorities (BA)helps to maintain the stability and safety of the entire grid. Problems, such as outages caused by fires or earthquakes, can be isolated and controlled without causing a risk to other parts of the electric grid.

In California, there are eight BAs (See Figure 4.13):

1. Balancing Authority of Northern California (BANC)
2. California Independent System Operator (CAISO)
3. Imperial Irrigation District (IID)
4. Los Angeles Department of Water and Power (LADWP)
5. PacifiCorp-West
6. Sierra Pacific Power (SPP)
7. Turlock Irrigation District (TID)
8. Western Area Lower Colorado (WALC)

The CAISO is the largest of the BAs in California, covering 132,000 square miles in 58 California counties and a small portion of Nevada (Figure 4.13).

LADWP, Burbank and Glendale are in Los Angeles Department of Water and Power's (LADWP) BA. BWP has been a member of the LADWP BA area (previously called a "control area") since 1937.

A BA has several ways to maintain the balance of supply and demand, from turning generators up and down and on and off, to importing or exporting electricity to or from their neighbors.

Balancing Authority Areas

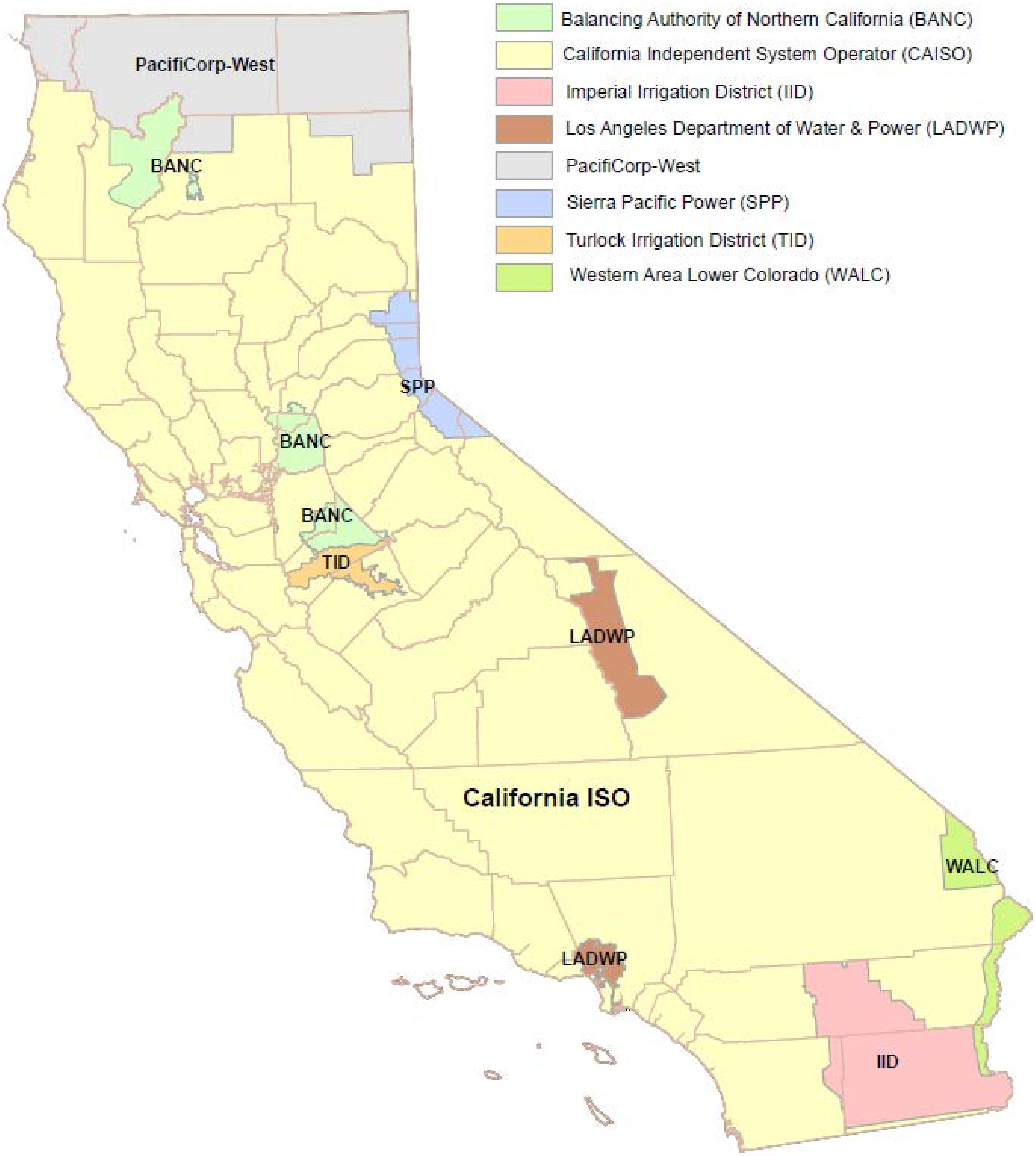


Figure 4.13: Balancing Authority Areas in California

Source: CEC

4.3.3 BWP Within LADWP's Balancing Authority

Even though BWP is a member of LADWP's BA, it still needs to provide for its own reserve requirements to cover possible unforeseen events involving its own operations, including its share of generating facilities and transmission lines. Historically, BWP has met this reserve requirement using its local generating facilities. This arrangement was governed by the Southern California Utility Power Pool (SCUPP) agreement, which governed the participation of LADWP, BWP, and Glendale Water and Power (GWP) in LADWP's BA.

In 2011, LADWP cancelled the SCUPP. The SCUPP did not reflect modern industry practice, costs, or cost-allocation. While operations were not affected by this termination, operating within a BA without a formal agreement is a poor practice. For many years after the SCUPP was canceled, LADWP, BWP, and GWP worked to develop a new BA agreement.

4.3.4 Balancing Authority Solution

In 2015, following complex negotiations involving intertwined technical, operational, commercial, legal and regulatory issues, LADWP, BWP and GWP were successful in negotiating a Balancing Authority Area Services Agreement (BAASA) that is cost-based and founded on modern industry policy and practice. It is comprehensive, flexible, and fair. It should provide a durable basis for BWP's operations and planning.

As part of the BAASA, BWP also negotiated the opportunity to purchase all of its reserve obligations from LADWP, instead of using BWP's own assets and limited market access to provide for the reserves. BWP reserve obligations were determined during and through negotiation of the BAASA as 40 MW of spinning capacity and 40 MW of supplemental capacity for a total of 80 MW of reserve capacity. In this connection, it is important to note that LADWP does not guarantee that the full 80 MW of these reserves will be available for purchase every year, subject to LADWP's load growth and resource planning. BWP staff works closely with LADWP staff to manage this risk.

4.4 Southern California Public Power Authority (SCPPA)

SCPPA, a joint powers authority, was created for the purpose of planning, financing, developing, acquiring, constructing, operating and maintaining projects for the generation or transmission of electric energy. SCPPA is governed by its Board of Directors, which consists of a representative from each of its Member Agencies. BWP's General Manager is its representative on the SCPPA Board.

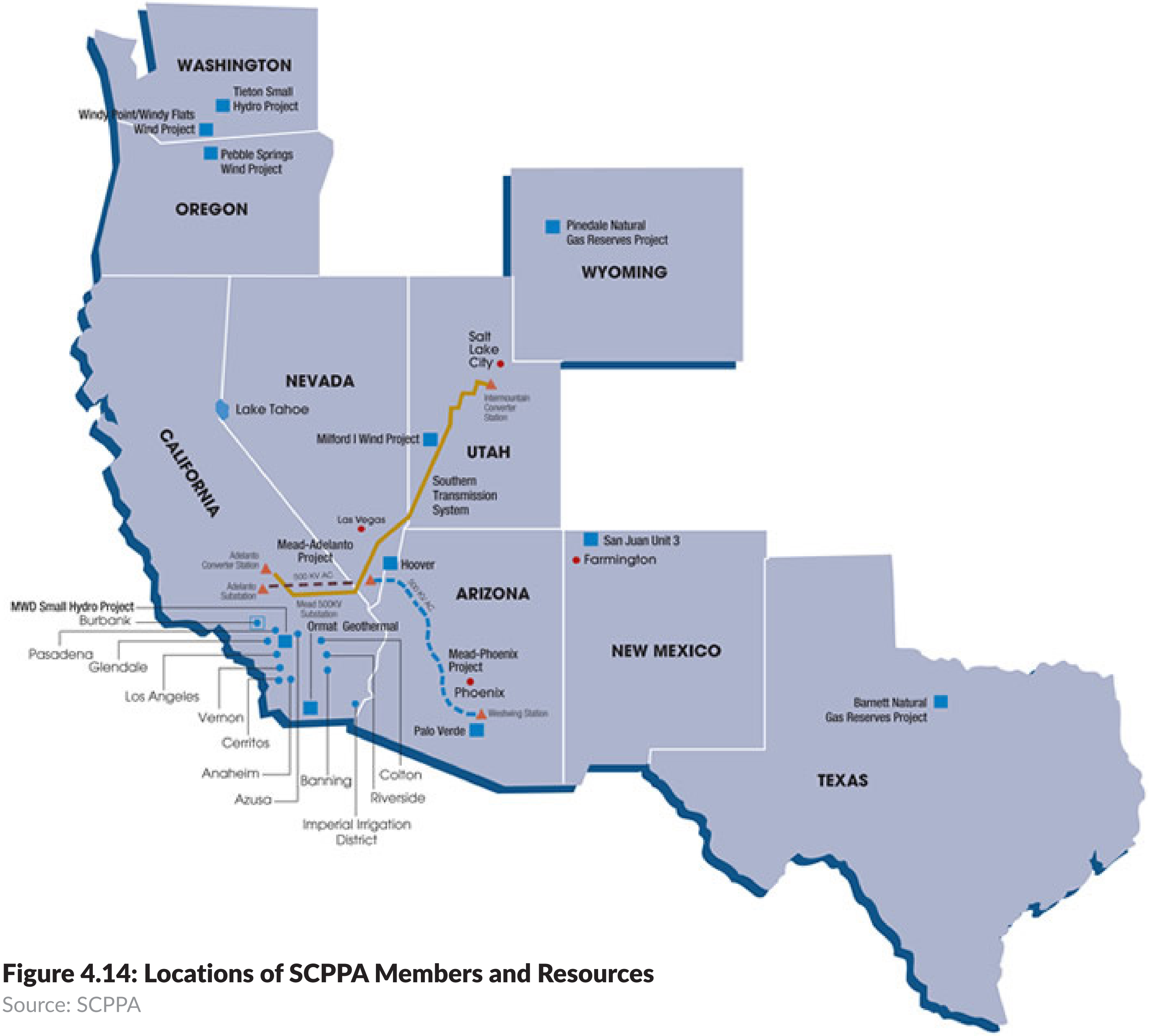


Figure 4.14: Locations of SCPPA Members and Resources

Source: SCPPA

BWP works within the SCPPA framework on a variety of generation, transmission and renewable energy projects that use economies of scale to help keep BWP costs down and electric rates low. In addition, SCPPA issues Requests for Proposals for new initiatives, including procurement of renewable energy resources.

In other words, membership in SCPPA lets BWP (and SCPPA's other members) band together in order to "punch above their weight" in seeking the best outcomes for their respective ratepayers and cities.

Member Agencies consist of eleven cities (and one irrigation district) which supply electric energy within Southern California, including the municipal utilities of the cities of Anaheim, Azusa, Banning, Burbank, Cerritos, Colton, Glendale, Los Angeles, Pasadena, Riverside, and Vernon, and the Imperial Irrigation District. (Figure 4.14)

4.5 Compressed Air Energy Storage (CAES)

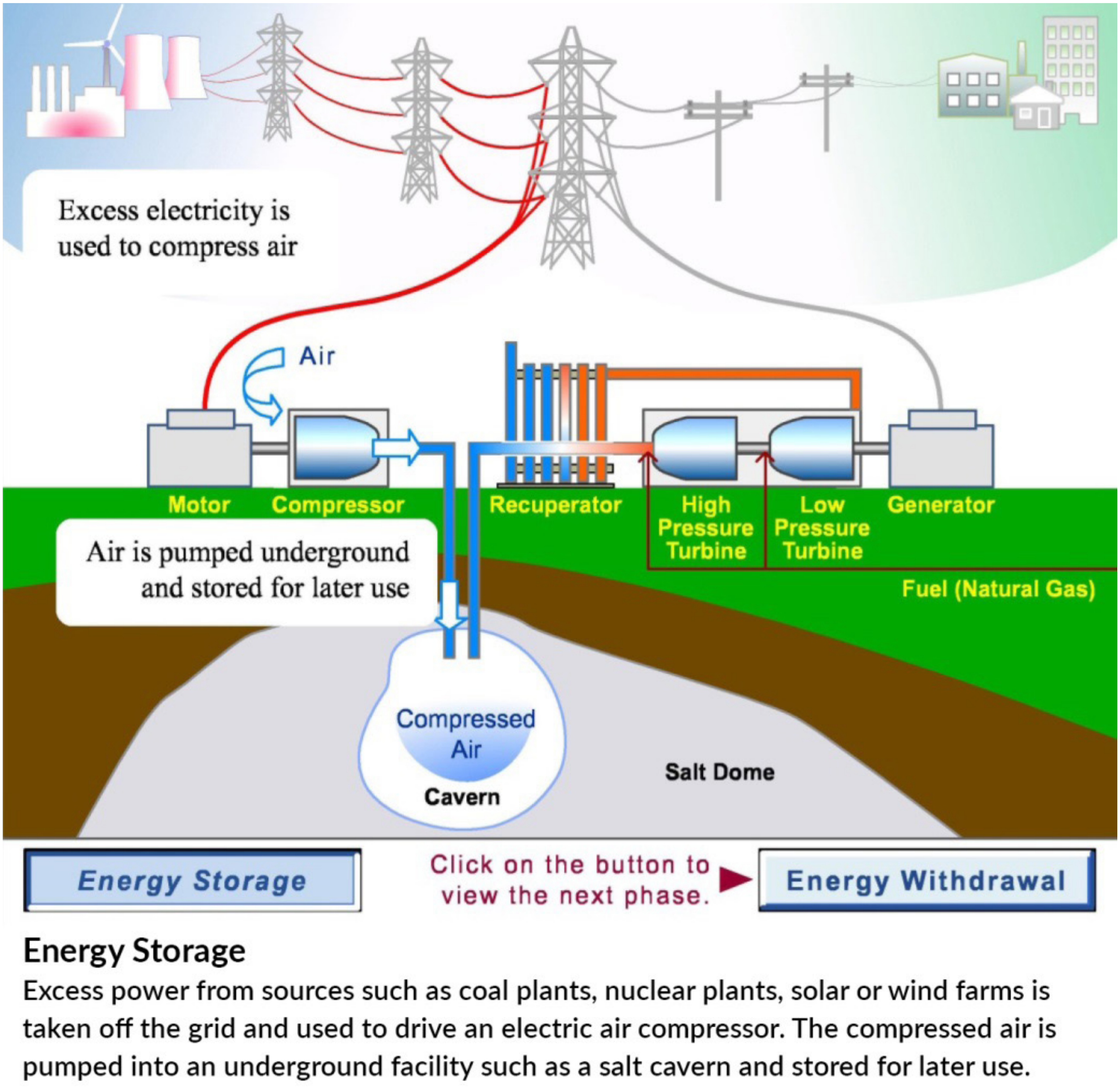
BWP must constantly look ahead, plan ahead, and then act decisively. In this connection, in addition to battery storage BWP is carefully evaluating compressed air energy storage (CAES) as a potential component of its future power supply portfolio.

CAES is essentially a large mechanical battery that takes an intermittent resource and turns it into a controllable one. When electricity is generated and not needed, the electricity is used to pump air into an underground cavern at very high pressure where the air can be stored.

In cooperation with LADWP and SCPPA who are leading the analysis, BWP is investigating the use of energy storage to assist in operating its system reliably and cost-effectively in an increasingly renewable power system, including BWP's own procurement of renewable energy in response to the RPS mandate. Specifically, BWP seeks to avoid over-generation in the middle of the day, reduce power generation ramping in the late afternoon, and manage instantaneous intermittency from renewable resources like solar energy.

When electricity is needed, in a CAES unit the air is supplemented by a small amount of natural gas. A small amount of natural gas is burned in the air stream to re-heat the air. Instead of a compressor, you have, in effect, a balloon of compressed air underground. The air loses heat underground, so in order to make electricity, natural gas gets burned in the air stream reheating the air which then runs through a turbine and turns a generator.

When CAES is used to enable large quantities of renewable energy, a relatively small amount of the total energy of the storage and renewables combination is provided by natural gas. For example, SB100 Preferred Portfolio A features a combination of Wyoming Wind, Utah Solar and CAES at IPP. Appendix 3B shows that, assuming 30% of the total energy output of a CAES unit is provided by natural gas, by the end of the planning period only about 1% of the total energy of this combination at IPP is provided by natural gas. In the future, advanced turbine technology now in development may enable replacement of the natural gas with clean-burning hydrogen—further reducing the GHG signature of this resource.



Excess electricity is used to compress air

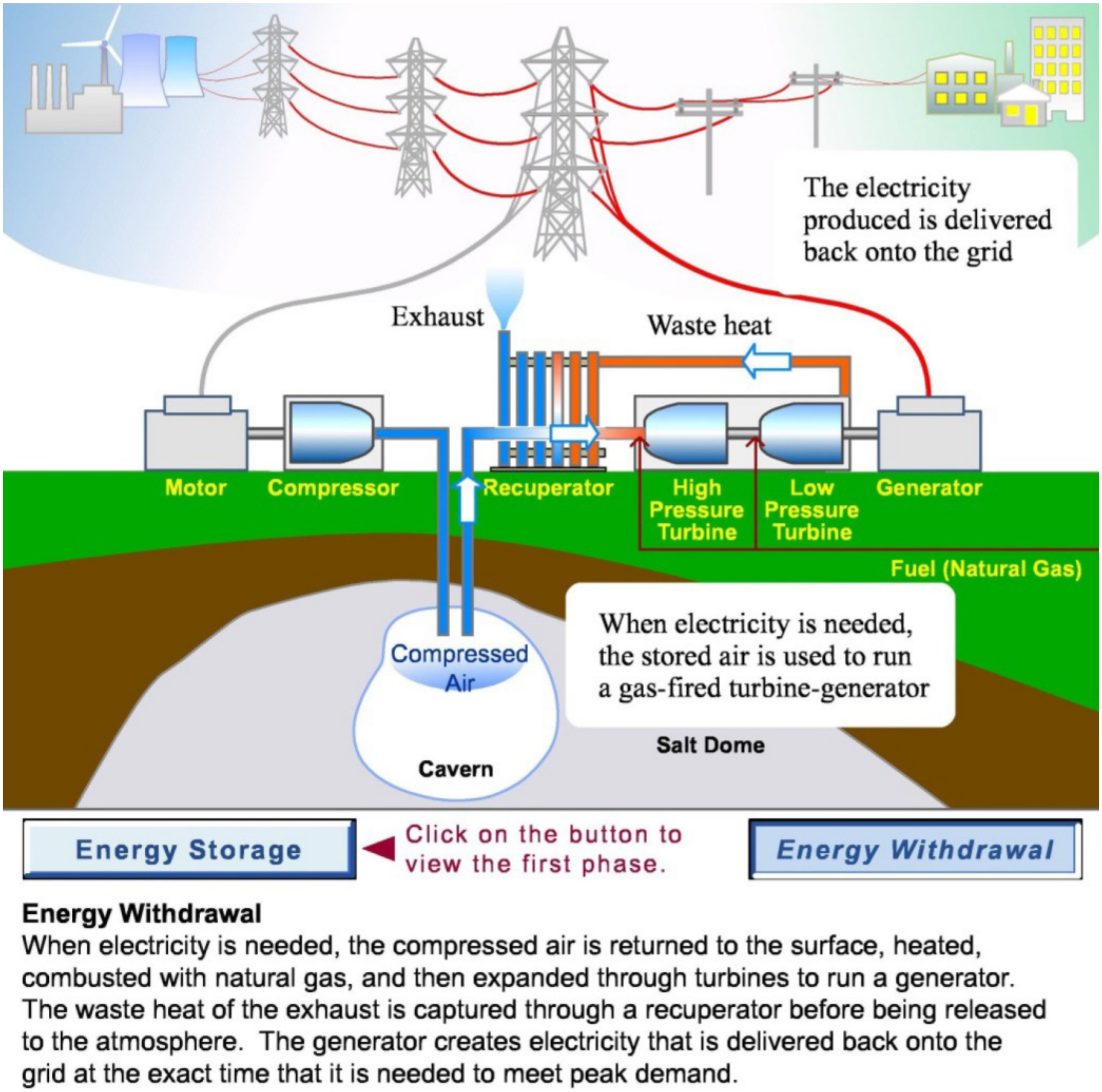
Air is pumped underground and stored for later use

Click on the button to view the next phase.

Energy Storage

Excess power from sources such as coal plants, nuclear plants, solar or wind farms is taken off the grid and used to drive an electric air compressor. The compressed air is pumped into an underground facility such as a salt cavern and stored for later use.

Figure 4.15: CAES Energy Storage Cycle Overview



Energy Withdrawal

When electricity is needed, the compressed air is returned to the surface, heated, combusted with natural gas, and then expanded through turbines to run a generator. The waste heat of the exhaust is captured through a recuperator before being released to the atmosphere. The generator creates electricity that is delivered back onto the grid at the exact time that it is needed to meet peak demand.

Figure 4.16: CAES Generation Cycle Overview

An ideal site for a CAES project may be Delta, Utah where Intermountain is located. Large salt deposits exist thousands of feet beneath the Intermountain site which can be used for the underground air storage. Delta is also very well-positioned at the top of the STS transmission system. The salt deposits are plentiful and proven. The site has hosted Intermountain for decades and has ample water, railroad access, and a proven workforce.

CAES is one of only two types of technology that can store energy for hours or days instead of minutes. The other technology also capable of this is pumped hydroelectric. However, CAES is more cost-effective on a capital costs basis than pumped hydro, at about half the cost of pumped hydro. Both CAES and pumped hydro depend on specific geology for success. Thus, the salt deposits at the Intermountain site, ideal for CAES, are particularly advantageous.

CAES technology is proven at two active CAES projects: one in Alabama and one in Germany.

Technology	Hours of Discharge Potential	Total Capital Cost ($/kW)	Total Capital Cost per kWh Stored ($/kWh)
Compressed Air - Large Salt (150 MW to 900 MW)	48	$1,660 - $1,900	$35 - $40
Pumped Hydro - Conventional (1000 MW)	10	$2,500 - $4,000	$250 - $400
Batteries (Lithium Ion)			
- 4 hours	4	$580	$145
- 1 hour	1	$381	$381
- ½ hour	½	$231	$426

Figure 4.17 - Energy Storage Cost Comparison

Sources: Ascend Analytics (batteries), EPRI (pumped hydro) and Schulte Associates LLC (CAES)

	Combined Cycle (CC)	CAES	CAES is
Technology Status	Mature	Mature	**Similar**
Capital Cost ($/kW for 2025 COD, Delta site)	$1,330	$1,660	**Higher**
Fixed O&M Cost (2010$)	$19.80/kW-yr	$16.60/kW-yr	**Similar**
Roundtrip efficiency (%)	~50%	~50%	**Similar**
Ramp Rate (%/minute)	5%	20%	**Better**
Minimum load (% of maximum)	55%	10%	**Better**
O&M increases with cycling?	Yes	No	**Better**
Operational start-up cost ($)	$Large	$Small	**Better**
Ability to integrate renewables	1MW:1MW	2MW:1MW	**Better**
Ability to store?	No	Yes	**Better**
CO2 emissions (Ton/MWh generated)	0.5	0.3*	**Better**
*When storing renewable energy			

Figure 4.18: CAES and Combined Cycle Gas Turbine (CC) Comparison, 800 to 900 MW-scale facilities.
Sources: Schulte Associates LLC

4.5.1 SCPPA Request for Proposals (RFP) for CAES Options

As an initial exploration into available CAES offerings and costs, SCPPA issued a competitive Request for Proposals (RFP) in November 2017. The RFP requested vendor information regarding their CAES offerings including technology, operation and proposed costs. It also sought information on potential renewable developments that could be combined with the CAES offerings to enable the storage to qualify for federal investment tax credits (ITC).

Several vendor proposals were received in response to the RFP. SCPPA is currently evaluating the proposals with input from LADWP, BWP, and other SCPPA members.

4.5.2 Wyoming Wind

If a storage project moves forward at the IPP site (either batteries or CAES), there is potential that it could use and enable low-cost wind energy in southeast Wyoming. Southeast Wyoming is an excellent location for wind, with strong, consistent winds rivaling those found out in the ocean. Such strong, consistent winds allow a wind project to produce energy at a greater percentage of the time, driving down the cost of each MWh produced and making integration easier.

The wind energy could conceptually be moved from Wyoming to Delta, Utah over proposed new high-voltage, direct current (HVDC) transmission. There are several large wind projects being planned in Wyoming, with proposed HVDC developments associated with them. With CAES or batteries at Delta, this wind energy could be controlled and sent to BWP over the existing Southern Transmission System (STS). In coordination with SCPPA and LADWP, BWP is considering this as a potential way to economically achieve very high levels of renewable energy for Burbank customers.

Chapter 5

BWP Customer Perspectives

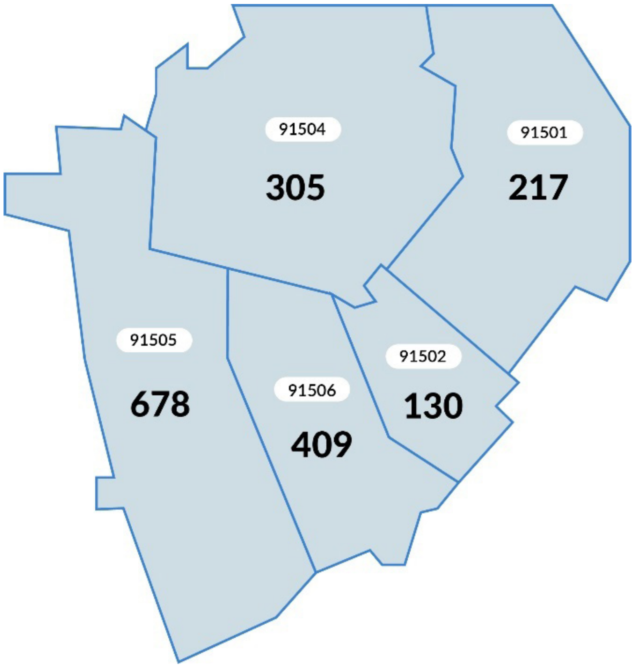
5.1 Public Education and Outreach

Public input is a fundamental part of the integrated resource planning process: a utility's IRP should reflect the needs and desires of the community it services. In this context, BWP set out to interact with Burbank residents and businesses to determine their perspectives on Burbank's energy future, both in person and via the internet. BWP developed an engaging set of videos to establish a baseline of familiarity with topics that drew customer feedback to express their opinions.

During the month of August 2018 BWP conducted two town hall meetings and publicized the availability of an on-line survey using various digital media channels including social media, email, and advertisements on the City of Burbank and BWP websites. The Burbank community responded at an unprecedented level and completed 1,222 surveys from residents and businesses across the City. The number of responses received by outreach method and by zip code are shown below.

Number of Responses by Outreach Methods	
Town Hall Meetings	45
City and BWP Websites	46
Social Media	397
Email	734

Number of Responses by Zip Code



5.2 Major Issues Discussed

BWP set out to gain customer perspectives on major issues impacting BWP's provision of reliable, affordable, and sustainable electric service to Burbank:

- Renewable Energy – How much and at what impact to electric prices?
- Greenhouse Gas Reductions – What efforts to make and at what impact to electric prices?
- Use of New Natural Gas to Ensure Reliability and Integrate Renewable Energy – Is it appropriate?
- Beneficial Uses of Electricity – Is the community in favor?
- Utility – Customer Partnership Programs – How should the relationship be defined?
- Support for Environmentally Disadvantaged Communities – Is the community in favor?

5.3 What BWP Heard from Customers

5.3.1 The Primary Issues

Issue 1: Renewable Energy

California government regulations had set a target of 50% of electric generation to come from renewable energy by the year 2030. Subsequent to the public input process, Senate Bill 100 (SB 100) further increased this regulation to 60% on September 10, 2018.

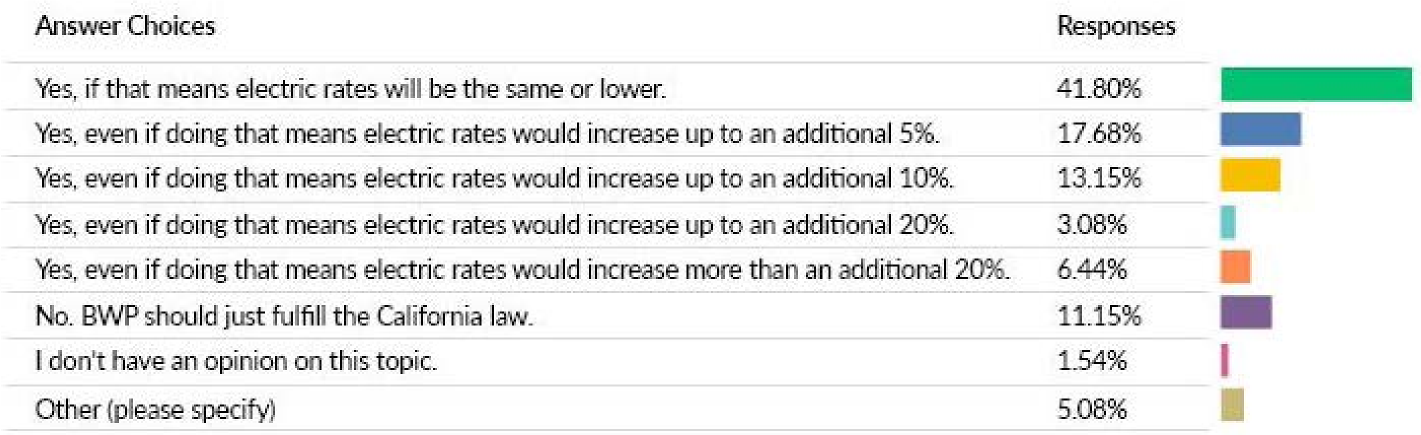
BWP currently produces 32% of electricity delivered to customer from renewable sources. The use of renewable energy adds challenges of matching when electricity is produced and when energy is used. The issue is complicated because electricity must be consumed when it is produced and the technology to cost-effectively store large amounts of electricity is still developing.

Subsequent to the public input process, on September 10, 2018, Senate Bill 100 was signed into law in California increasing the 2030 Renewable Portfolio Standard goal from 50% to 60%, with and aspiration for 100% clean energy by 2045.

The public was asked:

Should BWP work to exceed the (then) current California law requiring 50% renewable energy by 2030?

Results:

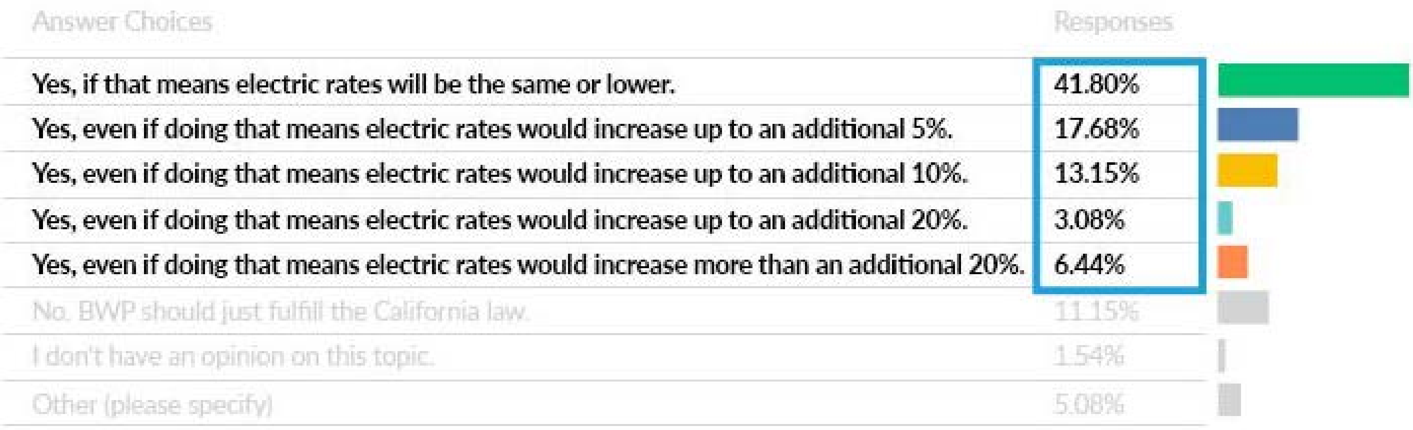


Answer Choices	Responses
Yes, if that means electric rates will be the same or lower.	41.80%
Yes, even if doing that means electric rates would increase up to an additional 5%.	17.68%
Yes, even if doing that means electric rates would increase up to an additional 10%.	13.15%
Yes, even if doing that means electric rates would increase up to an additional 20%.	3.08%
Yes, even if doing that means electric rates would increase more than an additional 20%.	6.44%
No. BWP should just fulfill the California law.	11.15%
I don't have an opinion on this topic.	1.54%
Other (please specify)	5.08%

Highlights:

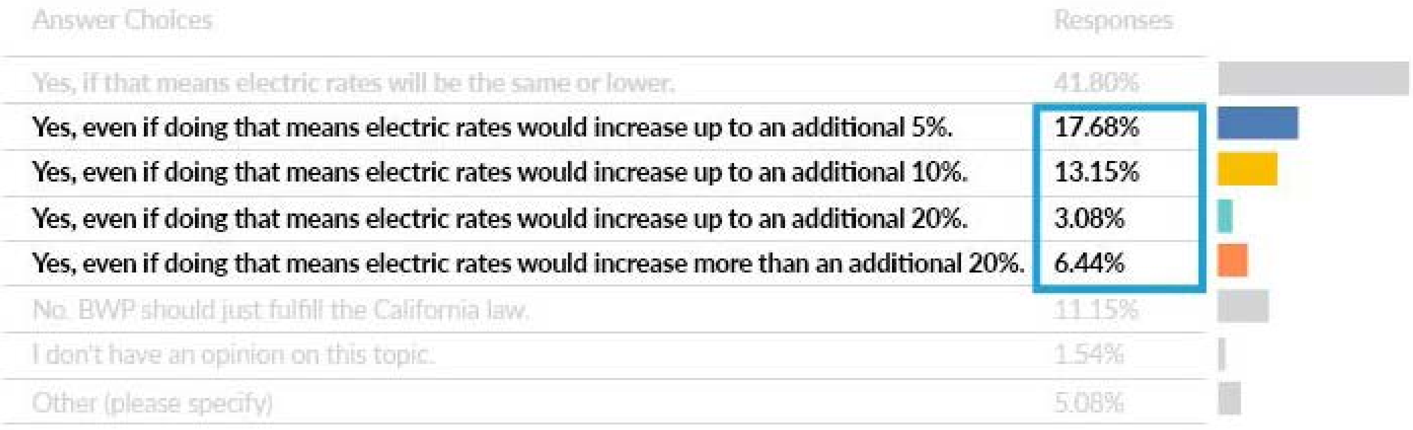
Respondents show a preference for BWP to exceed regulated goals for renewable energy, but that preference diminishes as the price goes up.

- 82% or 906 respondents believe that, depending on price, BWP should work to exceed the current law compared to 11% that believe BWP should just fulfill the (then) current law.



Answer Choices	Responses
Yes, if that means electric rates will be the same or lower.	41.80%
Yes, even if doing that means electric rates would increase up to an additional 5%.	17.68%
Yes, even if doing that means electric rates would increase up to an additional 10%.	13.15%
Yes, even if doing that means electric rates would increase up to an additional 20%.	3.08%
Yes, even if doing that means electric rates would increase more than an additional 20%.	6.44%
No. BWP should just fulfill the California law.	11.15%
I don't have an opinion on this topic.	1.54%
Other (please specify)	5.08%

- 40% or 445 respondents believe Burbank should work to exceed the (then) current law even if that means prices would increase up to an additional 5%.



Answer Choices	Responses
Yes, if that means electric rates will be the same or lower.	41.80%
Yes, even if doing that means electric rates would increase up to an additional 5%.	17.68%
Yes, even if doing that means electric rates would increase up to an additional 10%.	13.15%
Yes, even if doing that means electric rates would increase up to an additional 20%.	3.08%
Yes, even if doing that means electric rates would increase more than an additional 20%.	6.44%
No. BWP should just fulfill the California law.	11.15%
I don't have an opinion on this topic.	1.54%
Other (please specify)	5.08%

- 5% or 56 respondents selected “Other” and specified the following top opinions:
  - » BWP should surpass regulated goals and rates should be lower: 21 responses.
  - » BWP should surpass regulated goals, with the belief that rates may rise only temporarily: 9 responses.

Finding: BWP should exceed state mandates for renewable energy while working to maintain annual electric rate increases at or below the long-run rate of inflation.

Issue 2: Greenhouse Gas Reductions

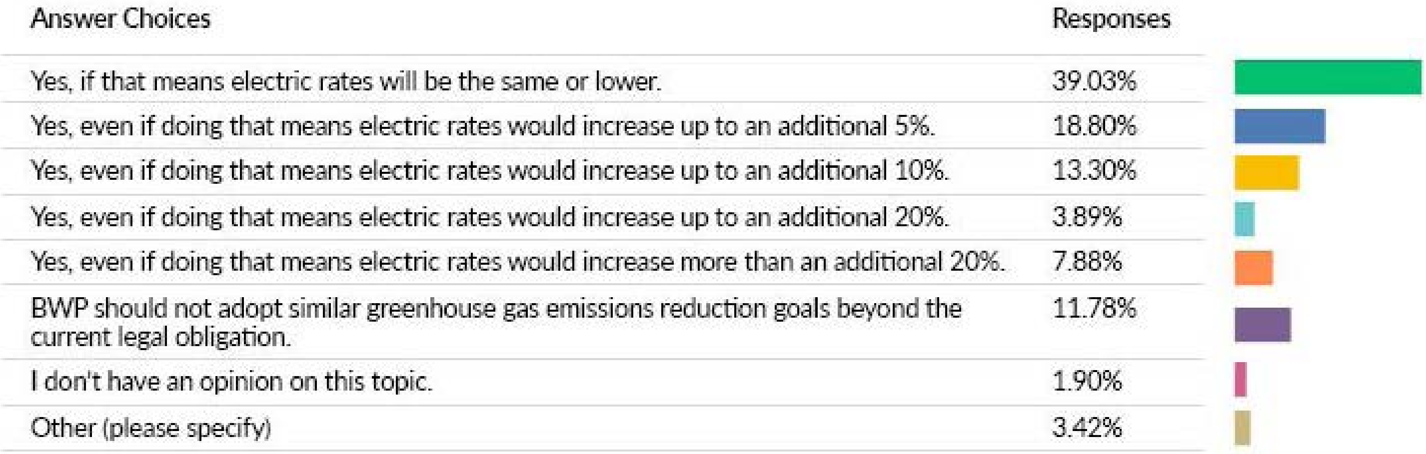
Regulators have set targets for private utilities to reduce the production of greenhouse gasses. This is in addition to targets set for renewable energy. At the time of the public input process, these targets did not apply to public utilities like Burbank, but they are indicative of state policy goals.

Meeting these possible greenhouse gas reduction regulations would be achieved by customer's making their homes and businesses more energy efficient, increases in renewable energy, and switching out older and higher greenhouse gas emitting electric generators with newer and cleaner generators.

The public was asked:

Should BWP adopt greenhouse gas emissions reduction goals, even though the (then) current targets do not apply to public power providers like Burbank?

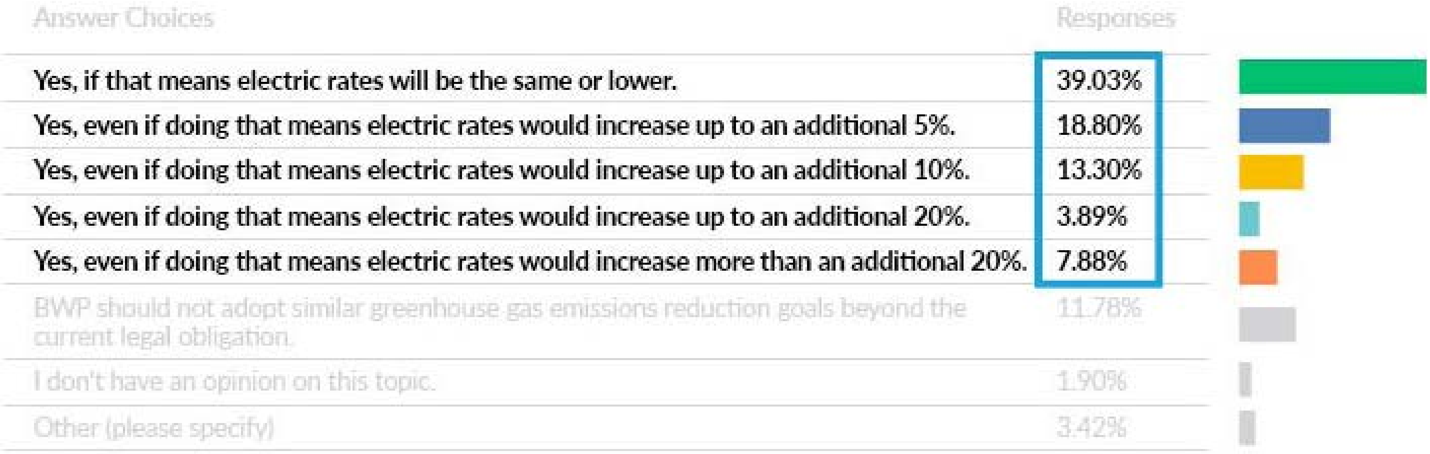
Results:



Answer Choices	Responses
Yes, if that means electric rates will be the same or lower.	39.03%
Yes, even if doing that means electric rates would increase up to an additional 5%.	18.80%
Yes, even if doing that means electric rates would increase up to an additional 10%.	13.30%
Yes, even if doing that means electric rates would increase up to an additional 20%.	3.89%
Yes, even if doing that means electric rates would increase more than an additional 20%.	7.88%
BWP should not adopt similar greenhouse gas emissions reduction goals beyond the current legal obligation.	11.78%
I don't have an opinion on this topic.	1.90%
Other (please specify)	3.42%

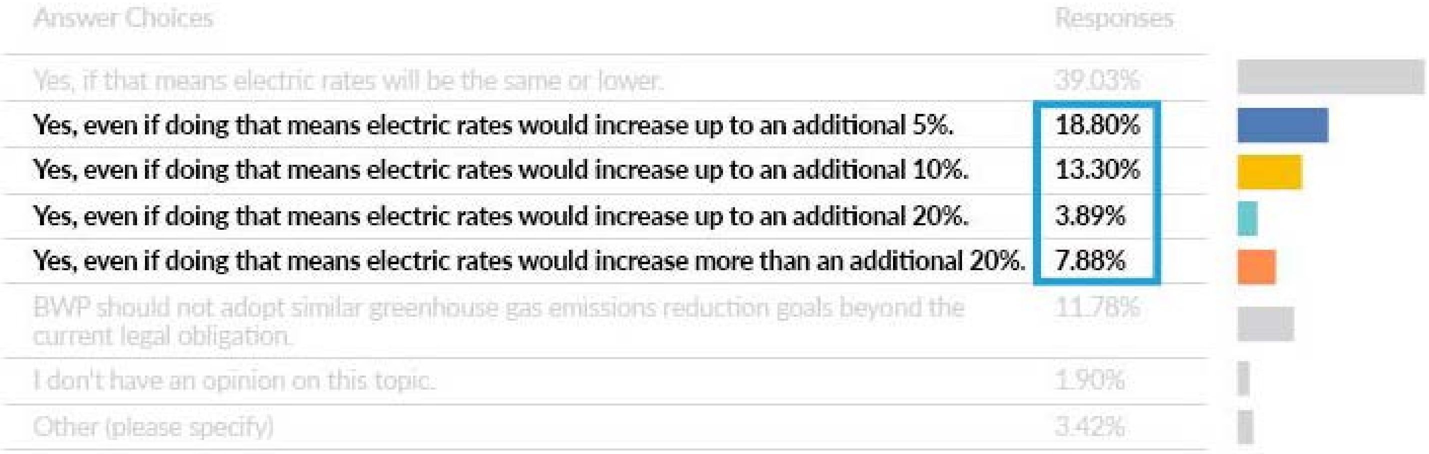
Highlights:

- Respondents show a preference for BWP to adopt state emissions targets for greenhouse gas emissions, but that preference diminishes as the price goes up.
- 82% or 873 respondents believe that, depending on price, BWP should adopt greenhouse gas reduction goals compared to 11% or 124 respondents who believe BWP should not adopt reductions goals beyond any legal requirements.



Answer Choices	Responses
Yes, if that means electric rates will be the same or lower.	39.03%
Yes, even if doing that means electric rates would increase up to an additional 5%.	18.80%
Yes, even if doing that means electric rates would increase up to an additional 10%.	13.30%
Yes, even if doing that means electric rates would increase up to an additional 20%.	3.89%
Yes, even if doing that means electric rates would increase more than an additional 20%.	7.88%
BWP should not adopt similar greenhouse gas emissions reduction goals beyond the current legal obligation.	11.78%
I don't have an opinion on this topic.	1.90%
Other (please specify)	3.42%

- 43% or 462 respondents believe Burbank should adopt greenhouse gas reduction goals even if that means prices would increase up to an additional 5%.



Answer Choices	Responses
Yes, if that means electric rates will be the same or lower.	39.03%
Yes, even if doing that means electric rates would increase up to an additional 5%.	18.80%
Yes, even if doing that means electric rates would increase up to an additional 10%.	13.30%
Yes, even if doing that means electric rates would increase up to an additional 20%.	3.89%
Yes, even if doing that means electric rates would increase more than an additional 20%.	7.88%
BWP should not adopt similar greenhouse gas emissions reduction goals beyond the current legal obligation.	11.78%
I don't have an opinion on this topic.	1.90%
Other (please specify)	3.42%

- 3% or 36 respondents selected “Other” and specified the following top opinions:
  - » BWP should surpass regulated greenhouse gas targets and rates rates should be lower. 8 responses
  - » BWP should surpass regulated greenhouse gas targets at any cost. 8 responses

These results indicate Burbank customers in general are interested in BWP meeting state GHG reduction goals, even though at the time of the public input BWP as a public utility was not subject to such state regulations. However, like their responses on renewable energy goals, most customers are cautious about such goals potential impact on future electric prices.

Finding: BWP should adopt state greenhouse gas emission reduction targets while working to maintain annual electric rate increases at or below the long-run rate of inflation.

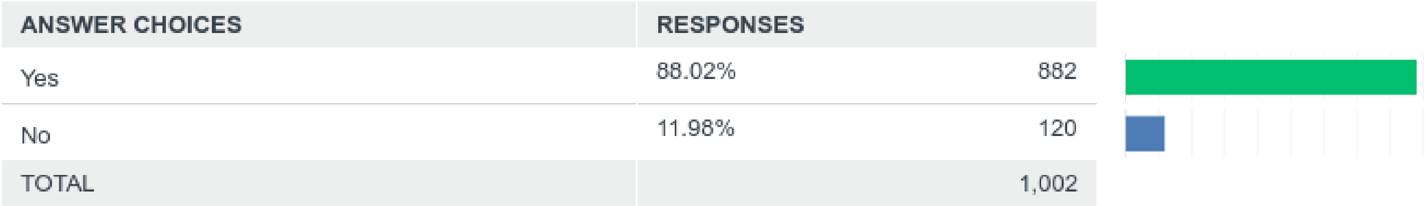
Subsequent to the public input process, on September 7, 2018 the California Energy Commission (CEC) assigned GHG reduction targets to public utilities including BWP, corresponding to those previously assigned to private utilities.

Issue 3: Use of New Natural Gas to Ensure Reliability and Integrate Renewable Energy

The public was asked:

Do you believe it is appropriate for Burbank to use limited amounts of new natural gas-fired generation capacity as may be necessary and cost-effective to ensure service reliability while helping to integrate renewable energy?

Results:



ANSWER CHOICES	RESPONSES	
Yes	88.02%	882
No	11.98%	120
TOTAL		1,002

Highlights:

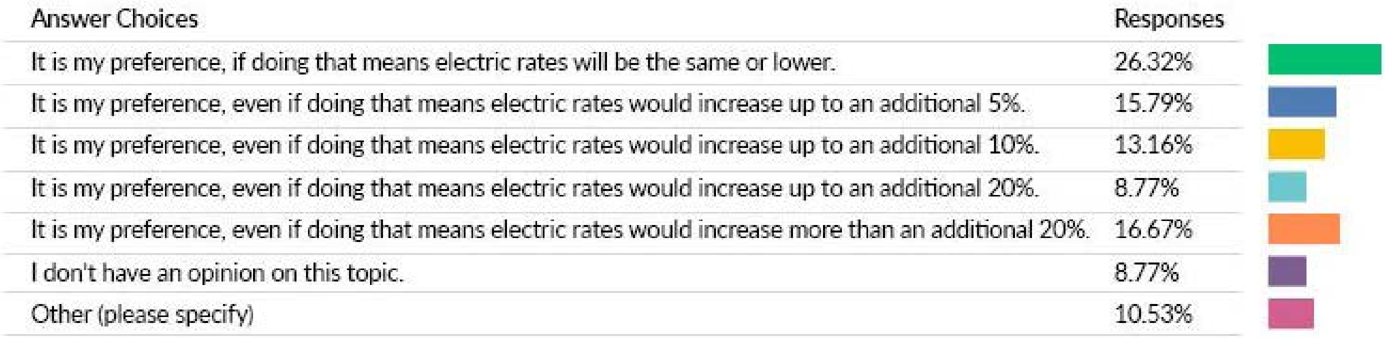
Along with support for renewable energy and reduction of greenhouse gas emissions, 88% of respondents recognize the need to use fossil fuel to ensure reliability and integrate renewable energy.

- 88% or 882 respondents believe Burbank should use limited amounts of new natural gas-fired generation as necessary to integrate renewables energy and ensure reliability.
- 11% or 120 respondents marked “No”.

  For the 11% or 120 respondents that marked “No” to using limited new natural gas, they were then asked to specify any preference regarding what technologies other than new natural gas Burbank should use to ensure Burbank’s electric reliability while supporting and integrating its renewable energy developments. The top responses are:

»	Solar Power	34 responses
»	Renewable Energy	26 responses
»	No preference but the issues is important	10 responses

From the 11% or 120 respondents that marked “No” to using limited new natural gas, they were also asked about electric rate increases related to their preference on technologies to ensure reliability. These results show respondents are price sensitive to their suggested alternative.



Answer Choices	Responses
It is my preference, if doing that means electric rates will be the same or lower.	26.32%
It is my preference, even if doing that means electric rates would increase up to an additional 5%.	15.79%
It is my preference, even if doing that means electric rates would increase up to an additional 10%.	13.16%
It is my preference, even if doing that means electric rates would increase up to an additional 20%.	8.77%
It is my preference, even if doing that means electric rates would increase more than an additional 20%.	16.67%
I don't have an opinion on this topic.	8.77%
Other (please specify)	10.53%

Finding: Along with the preference for more renewable energy and lower greenhouse gas emissions, Burbank customers recognize the potential need to use limited amounts of new natural gas-fired generation capacity to the extent it is needed to integrate renewable energy and help ensure Burbank’s electric service reliability.

Issue 4: Beneficial Uses of Electricity

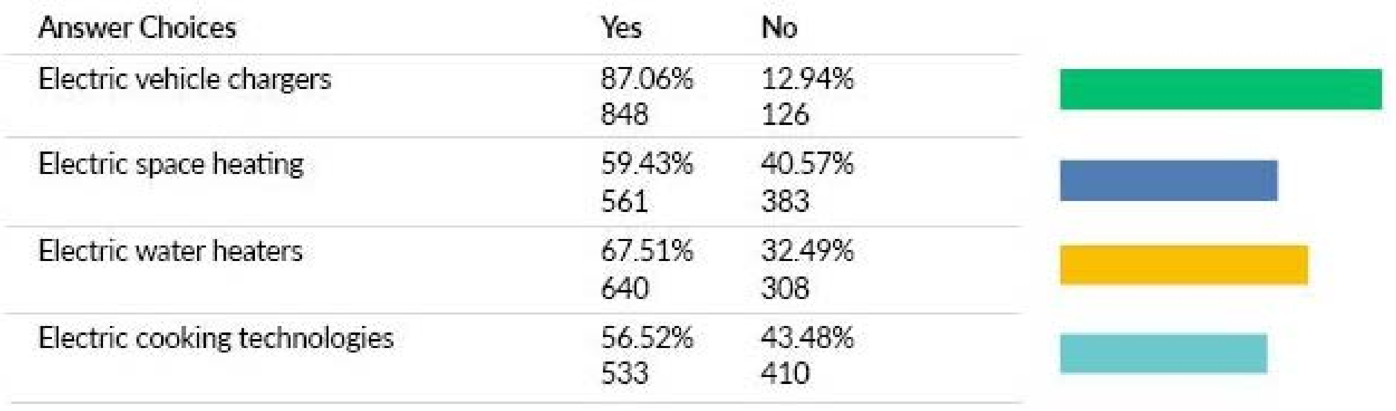
The electric utility industry has spent the last few decades under a view that electricity consumption should be reduced wherever economically sound to do so. However, there is currently a growing understanding that some increases in electric use can be beneficial to the extent it would result in reduced greenhouse gas emissions.

The growing adoption of electric vehicles is one example. Other examples include the electrification of major appliances such as water heating, space heating, and other business equipment and appliances. The electrification of transportation and other uses can lead to lower greenhouse gasses as more electricity is generated from generating sources such as renewables that produce less (or no) greenhouse gasses.

The public was asked:

For the following list of devices, indicate whether you believe Burbank should encourage their installation and use, if it results in reductions in greenhouse gas emissions?

Results:



Answer Choices	Yes	No
Electric vehicle chargers	87.06% 848	12.94% 126
Electric space heating	59.43% 561	40.57% 383
Electric water heaters	67.51% 640	32.49% 308
Electric cooking technologies	56.52% 533	43.48% 410

Highlights:

- The belief that Burbank should encourage electric vehicle use by the installation of electrical vehicle chargers stands out at 87%.

These results indicate Burbank customers are receptive to beneficial increases in electric consumption, where it results in reduced greenhouse gas emissions.

Finding: BWP should encourage cost-effective increases in electricity consumption where doing so would lead to reduced greenhouse gas emissions.

Issue 5: Utility – Customer Partnership Programs

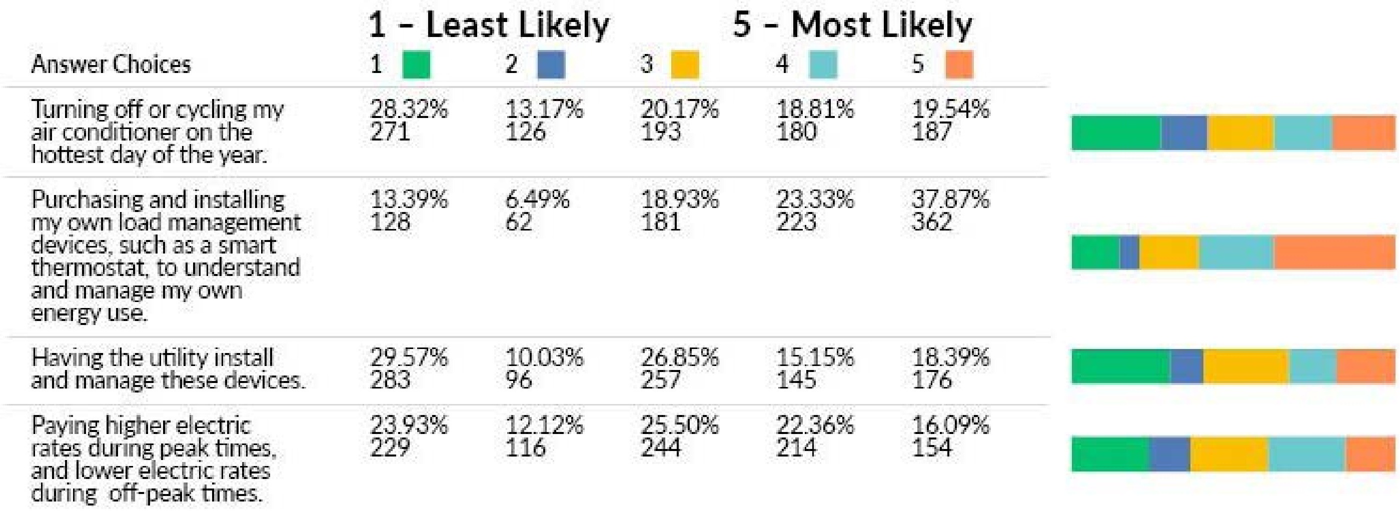
Residential customers may be able to play a bigger role in lowering their own electric bills by partnering with BWP to make smart choices about using their appliances. For example, BWP could provide a message about higher electric prices and customers could adjust the temperature setting on the home thermostat. Adjusting the thermostat during a hot summer day when most households are running their air conditioners helps lower the cost and helps the utility meet the high demand for electricity.

BWP could offer Utility-Customer Partnership programs designed to make smart decisions about how and when customers use electricity. However, Burbank customers must first be willing to participate in these programs.

The public was asked:

On a scale of 1 to 5, how likely are you to participate in each of the following hypothetical BWP Utility – Customer partnership Initiatives:

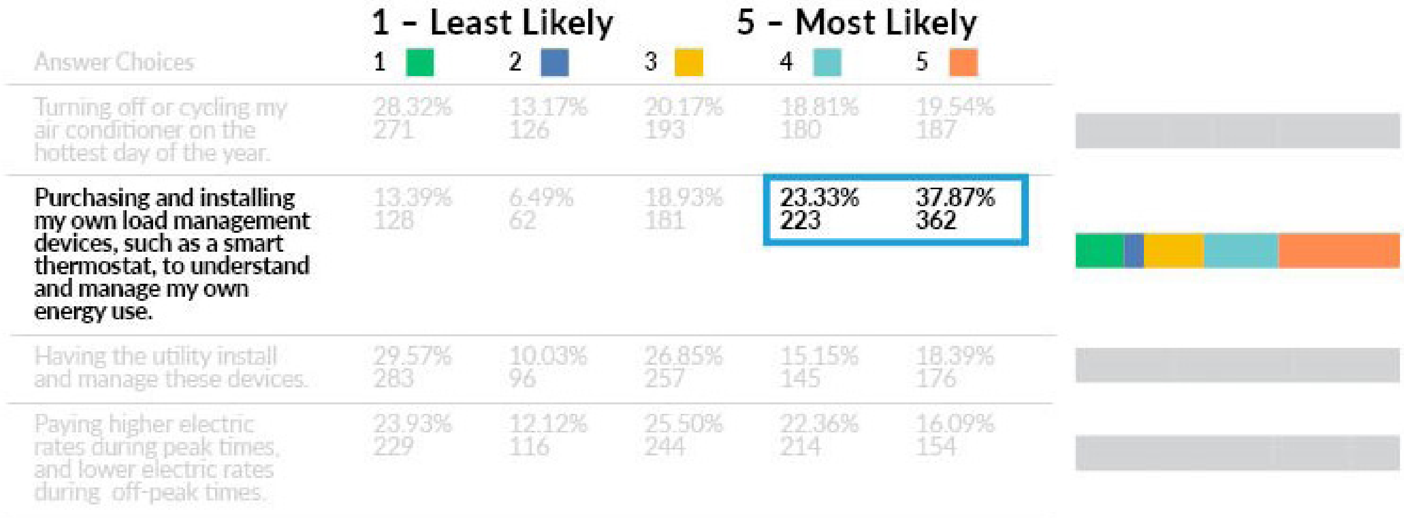
Results:



	1 – Least Likely			5 – Most Likely	
Answer Choices	1 🟩	2 🟦	3 🟨	4 🟦	5 🟧
Turning off or cycling my air conditioner on the hottest day of the year.	28.32% 271	13.17% 126	20.17% 193	18.81% 180	19.54% 187
Purchasing and installing my own load management devices, such as a smart thermostat, to understand and manage my own energy use.	13.39% 128	6.49% 62	18.93% 181	23.33% 223	37.87% 362
Having the utility install and manage these devices.	29.57% 283	10.03% 96	26.85% 257	15.15% 145	18.39% 176
Paying higher electric rates during peak times, and lower electric rates during off-peak times.	23.93% 229	12.12% 116	25.50% 244	22.36% 214	16.09% 154

Highlights:

Respondents indicated a higher preference, 60%, to own and manage their own load management devices, such as a smart thermostat, to manage their electric usage. Correspondingly, respondents prefer to control their load management devices to manage their own use of energy, not a third-party or even BWP. These results and the discussion at the town hall meeting indicate that some, not all, customers would be interested in considering such programs.



	1 - Least Likely			5 - Most Likely	
Answer Choices	1 🟩	2 🟦	3 🟨	4 🟦	5 🟧
Turning off or cycling my air conditioner on the hottest day of the year.	28.32% 271	13.17% 126	20.17% 193	18.81% 180	19.54% 187
Purchasing and installing my own load management devices, such as a smart thermostat, to understand and manage my own energy use.	13.39% 128	6.49% 62	18.93% 181	**23.33% 223**	**37.87% 362**
Having the utility install and manage these devices.	29.57% 283	10.03% 96	26.85% 257	15.15% 145	18.39% 176
Paying higher electric rates during peak times, and lower electric rates during off-peak times.	23.93% 229	12.12% 116	25.50% 244	22.36% 214	16.09% 154

Finding: BWP should offer customers Utility-Customer Partnership programs[6] to help customers control how they use their electric end uses during relatively costly peak periods. In developing customer programs, BWP should account for customer concerns about third party control (or even BWP control) over their load management devices.

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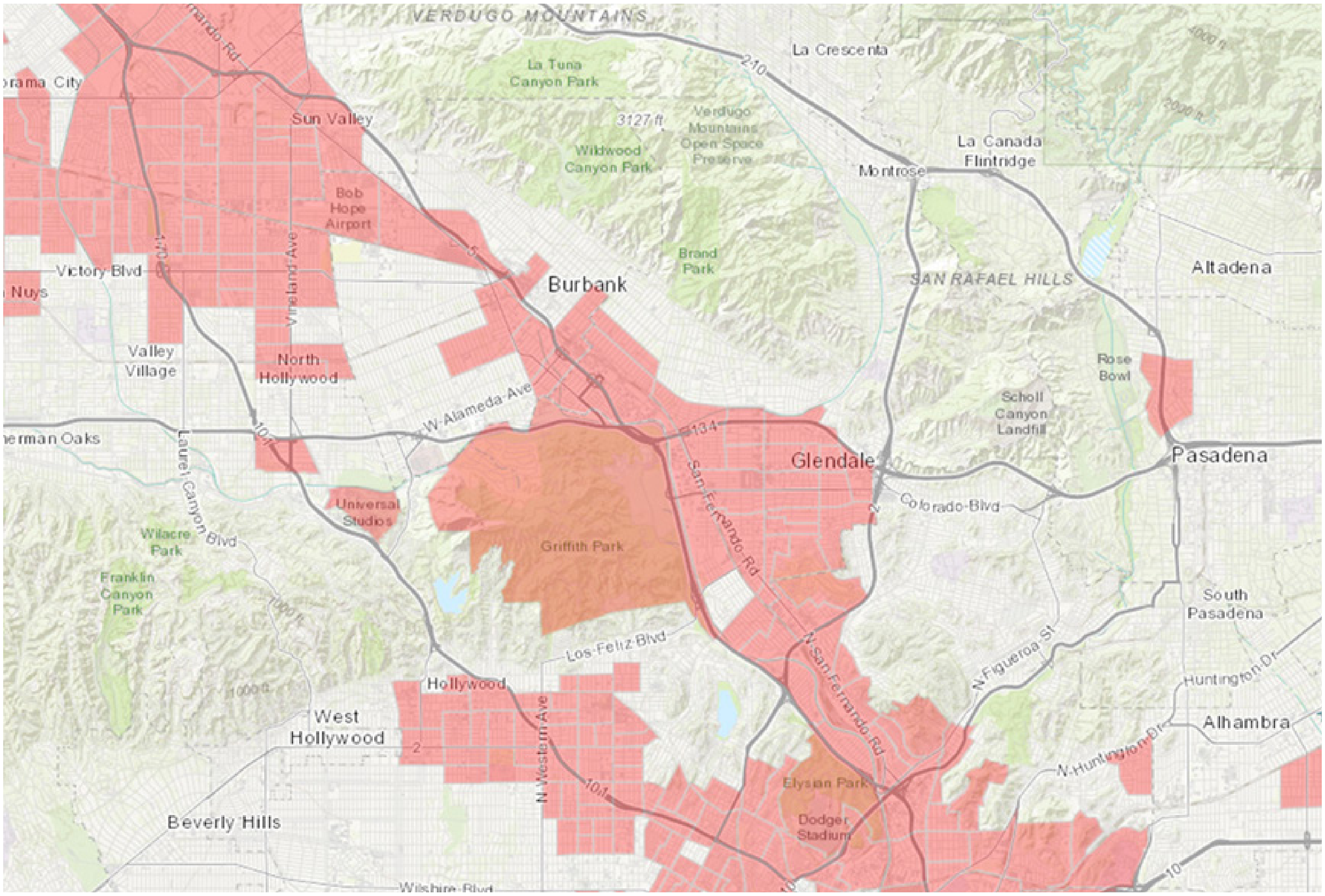
[6] In traditional utility parlance, such programs are typically called Demand Response (DR) programs.

Issue 6: Disadvantaged Communities

Historically, communities were defined as “disadvantaged” using socio-economic factors such as income, education, and occupation. The State of California has added to the definition “Disadvantaged Communities” to also include a formula to locate areas most burdened by pollution from multiple sources. In other words, California has expanded the definition to include exposure to environmental pollutants.

The following map provides an illustration of the location of Disadvantaged Communities in Burbank and surrounding areas, as identified by the State of California. As shown on the map, most of the communities are located along the Interstate 5 highway corridor.

Designated Disadvantaged Communities in Burbank and Adjacent Areas[7]



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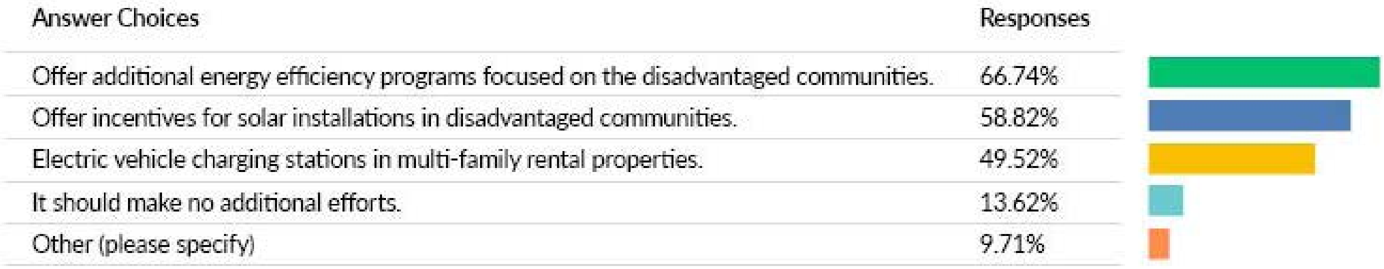
[7] Source: State of California CalEnviroScreen 3.0 Tool.

BWP has traditionally offered programs for customers who meet income qualifications such a discounted electric rate, assistance to make a onetime payment, and energy efficiency programs such as offering an energy efficient refrigerator. California law encourages utilities to include programs for “Disadvantaged Communities” in their plans.

The public was asked:

What should Burbank do to promote clean energy efforts in its Disadvantaged Communities? Select any/all that apply:

Results:



Answer Choices	Responses
Offer additional energy efficiency programs focused on the disadvantaged communities.	66.74%
Offer incentives for solar installations in disadvantaged communities.	58.82%
Electric vehicle charging stations in multi-family rental properties.	49.52%
It should make no additional efforts.	13.62%
Other (please specify)	9.71%

Highlights:

- 66% of respondents selected the choice to offer additional efficiency programs.
- 58% of respondents selected the choice to offer solar installation incentives.

Finding: BWP should consider this public input in the future when designing programs for its Disadvantaged Communities.

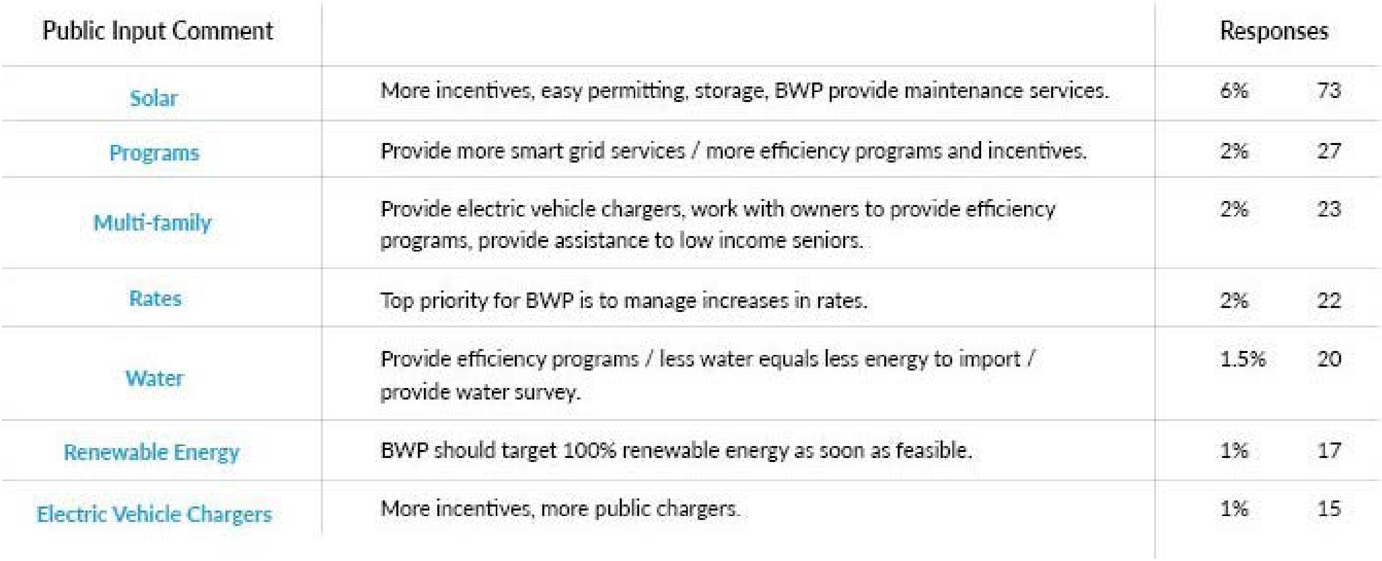
5.3.2 Open Question

The last question of the survey provided an opportunity for the public to share any topic or issue not asked in the survey. Just over 300 responses or 25% were received as summarized below:

The public was asked:

Is there a topic or issue you are especially concerned about that we didn't ask you about?

Top Responses:



Public Input Comment		Responses	
Solar	More incentives, easy permitting, storage, BWP provide maintenance services.	6%	73
Programs	Provide more smart grid services / more efficiency programs and incentives.	2%	27
Multi-family	Provide electric vehicle chargers, work with owners to provide efficiency programs, provide assistance to low income seniors.	2%	23
Rates	Top priority for BWP is to manage increases in rates.	2%	22
Water	Provide efficiency programs / less water equals less energy to import / provide water survey.	1.5%	20
Renewable Energy	BWP should target 100% renewable energy as soon as feasible.	1%	17
Electric Vehicle Chargers	More incentives, more public chargers.	1%	15

Finding: BWP should observe and recognize these public preferences as it enacts its energy plans for the future.

5.3.3 Other Topics

Among other things, the town hall meetings identified two topics of significant interest among the participating Burbank residents:

- **Renter vs. Owner Issues in Energy Efficiency Programs.**

  Participants in the town hall meetings pointed out that there are significantly different motivations for energy efficiency efforts between building owners and renters. If a building owner is paying for the energy consumption, they have incentive to invest in energy efficiency measures. Conversely, if the renter is paying the energy bill, the building owner may not have such motivations.

  Finding: BWP should recognize the differences in energy efficiency investment motivations between owners and renters when designing customer energy efficiency and demand response programs.

- **Energy Storage**

  Another topic of interest among public participants at the town hall meetings was energy storage. Whether advanced batteries, compressed air energy storage (CAES) or other energy storage technologies, participants recognized that energy storage can and should play a key role in the process of integrating renewable energy and thereby reducing greenhouse gas emissions.

  It was clear that the meeting participants expect to see a strong energy storage element in BWP's resource plan, assuming it would be cost-effective to do so.

  Finding: BWP should consider cost-effective energy storage in its IRP.

Chapter 6

BWP: The Next 20 Years

BWP's approach to resource planning involves looking ahead, planning ahead and acting ahead with the goal of continuing to lead the Southern California region in reliability while offering low rates and meeting all renewable requirements. The next 20 years will be no different.

6.1 Customer Energy Use

BWP assumptions for this IRP forecast project that customers' energy usage will remain relatively flat over the next 20 years. As actual loads in the future deviate from the forecast, BWP can either slow down or speed up procurement of renewable energy and energy storage resources accordingly. Chapter 2 provides an overview of the load forecast.

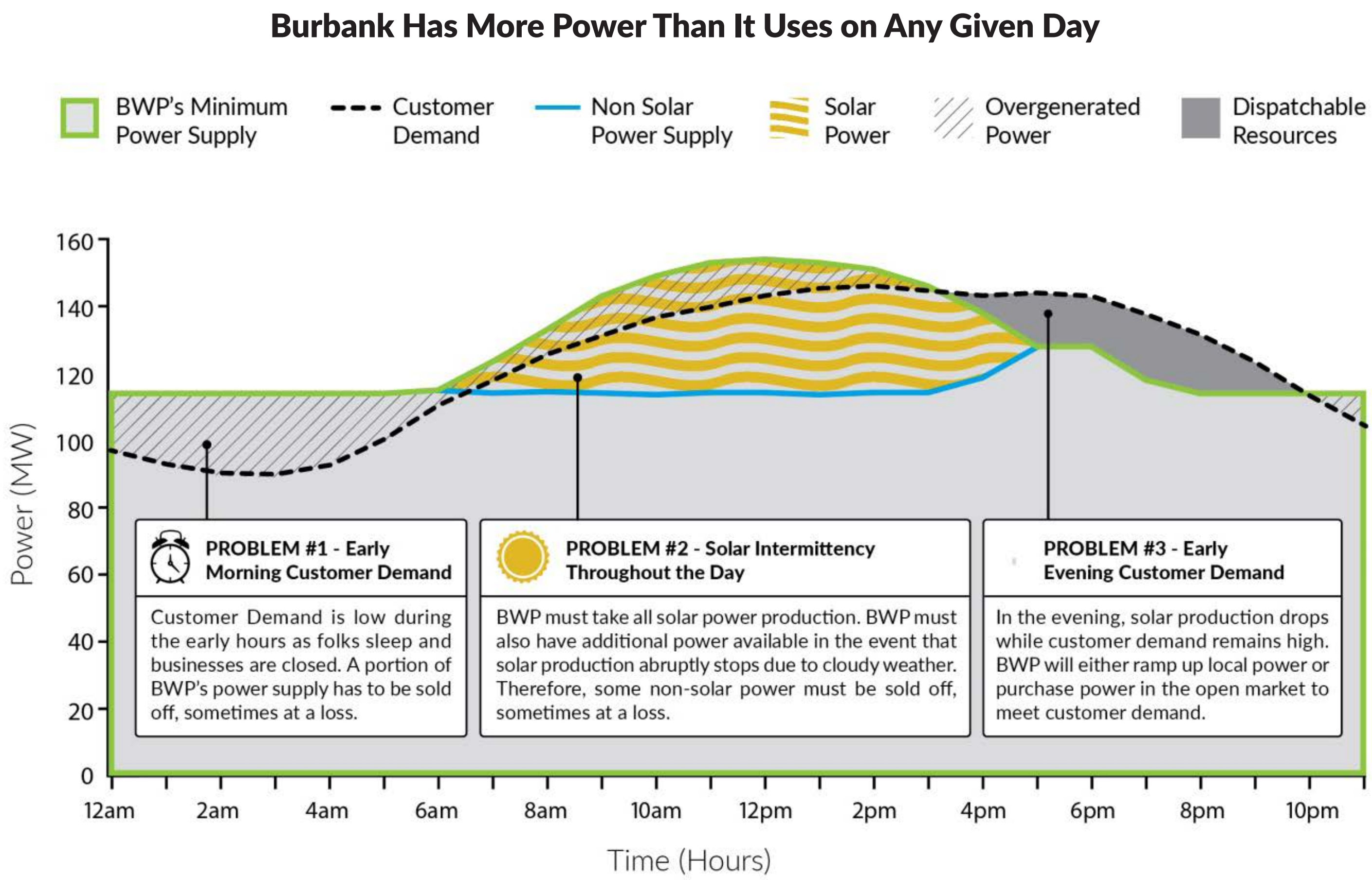
Three factors primarily drive this forecast. First, Burbank is a fully built-out city and, for the purposes of this IRP, expectations for further development are modest. Second, California Senate Bill 350, enacted in October 2015, doubles statewide energy efficiency mandates through 2030. Third, more customers will elect to install solar as installation costs continue to decline. These last two factors – energy efficiency and distributed generation – are expected to mitigate load growth. Growth in sales resulting from electric vehicles is also expected to be modest, albeit increasing.

That said, load growth can be highly uncertain, especially over the longer term. Weather, local development and population growth, economic trends, and energy consumption behaviors are among the key variables that impact BWP's view of future resource needs. Accurately forecasting any one of these variables over a 20-year period is a considerable challenge. If load growth occurs, it will be met by equivalent increases in conservation, energy efficiency, and renewable energy (including rooftop solar), pursuant to California's loading order.

6.1.1 Over-Generation

At the same time, the amount of intermittent energy on the grid is expected to increase, perhaps substantially. As physics dictates that electricity must be consumed the moment it is generated, this will likely intensify an already growing over-generation problem in California. At the current time, on an energy basis Burbank is over-supplied until the IPP coal plant is retired in 2025 (Figure 6.1). Then, new resources will be needed to replace IPP.

As discussed in Chapter 3, the Duck Curve is a challenge for all California utilities, including BWP. Rapid growth in solar PV energy generation capacity creates a glut of energy in the middle of the day – too much, in fact, to be used by customers on all but the hottest days. This is true of all solar PV: from the smallest rooftop system to large utility-scale projects like Copper Mountain. Something has to give, and it is usually non-solar generators forced to reduce production to less efficient levels or turn off altogether.



PROBLEM #1 - Early Morning Customer Demand

Customer Demand is low during the early hours as folks sleep and businesses are closed. A portion of BWP's power supply has to be sold off, sometimes at a loss.

PROBLEM #2 - Solar Intermittency Throughout the Day

BWP must take all solar power production. BWP must also have additional power available in the event that solar production abruptly stops due to cloudy weather. Therefore, some non-solar power must be sold off, sometimes at a loss.

PROBLEM #3 - Early Evening Customer Demand

In the evening, solar production drops while customer demand remains high. BWP will either ramp up local power or purchase power in the open market to meet customer demand.

Figure 6.1: Burbank has More Power Than It Uses on Any Given Day

Source: BWP

At the end of a hot day when sunlight diminishes and solar switches off, load continues to increase rapidly. This requires non-solar generation to “ramp up” dramatically – to increase production from minimum to maximum – very rapidly. Most legacy non-solar generators are not designed for this kind of ramping and are quite costly to operate this way, if they can even operate this way at all.

Unfortunately, the Duck Curve is only forecast to get “fatter” as time goes on, increasing both mid-day over-generation and afternoon ramping needs, as more solar is added to the electricity system.

6.1.2 Strategies to Mitigate the Duck Curve

In order to facilitate integration of more renewable energy, BWP hopes to influence customers to use power when it is more plentiful and less expensive. BWP can do this by implementing different strategies, starting with a move from tiered rates to Time-of-Use (TOU) rates. TOU rates, by adjusting electricity rates during the day based on BWP's cost to provide it, would provide a financial incentive to consume energy in lower-cost periods. For example, solar production during daytime hours will drive prices down and encourage consumption while the sun is shining. Conversely, prices would be higher when the sun sets, discouraging consumption. Thus, the impact of over-generation and the severity of the late afternoon ramp would be decreased.

Another strategy is to develop new business opportunities to increase or shift load via increased electrification (especially transportation electrification), demand response (DR), and to help manage the "Duck Curve."

Like most utilities, BWP designs its electric rates to recover the cost of serving its customers and to fairly recover these costs among its different customer classes. Beyond these minimum goals, BWP designs its electric rates to send appropriate price signals and align with long-term power supply planning goals.

In designing its electric rates, BWP specifically looks at ways to encourage conservation, higher load factors and more manageable daily load shapes. BWP also takes into consideration its potential daily load shapes as a result of future energy efficiency, conservation, distributed generation, and electrification.

BWP can encourage higher load factors and more manageable daily load shapes through time varying, or TOU rates. TOU rates vary based on the time of day, day of week, and season to reflect the varying costs of serving our customers throughout the year. Approximately 85% of BWP's current commercial energy usage is charged based on TOU rates. Starting in 2016, all of BWP's commercial customers have been charged TOU rates and BWP will propose to charge all of its remaining customers based on TOU rates in 2020.

BWP's current TOU rates and rate design are designed to mitigate the effects of a "Duck Curve" in Burbank. BWP's TOU rates are designed to reduce daily peak energy and demand during the weekday hours of 4:00 PM to 7:00 PM, when utility and customer solar begins to decline and BWP must quickly ramp up its flexible resources to meet demand. By reducing energy usage during these hours, BWP can more easily and economically meet its customer demand throughout the afternoon, maintain reliability, and continue to integrate renewables.

6.1.3 Transportation Electrification

In order to meet the goals of GHG emissions reductions related to Assembly Bill (AB) 32, Governor Brown's Zero Emission Vehicle Action Plan calls for a goal of 1.5 million electric vehicles (EV) on the road by 2025. This goal has since increased to 5 million EVs on the road by 2030.

To achieve these sales and emissions goals and facilitate the integration of renewable energy, BWP proposes a multi-faceted EV Charging Program, with progressively increasing annual goals and with components tailored to each customer segment's characteristics and needs.

Specifically, BWP seeks to integrate renewable resources to fill the daytime gap between supply and demand through electric vehicle charging and the overall electrification of transportation. This consistent source of load will also make it easier for BWP to manage the grid's steep ramp up in the evening.

In addition, EV charging is a complement to existing energy efficiency and customer service programs. BWP's approach includes charger rebates, as well as non-monetary incentives, such as TOU rate discounts and EV Ride & Drive events. The sum of this increased engagement with customers has been shown to lead to increased customer satisfaction, with both residential and commercial customers.

Workplace Charging

BWP's belief in the efficacy of workplace charging is demonstrated through ongoing experience with its employees.

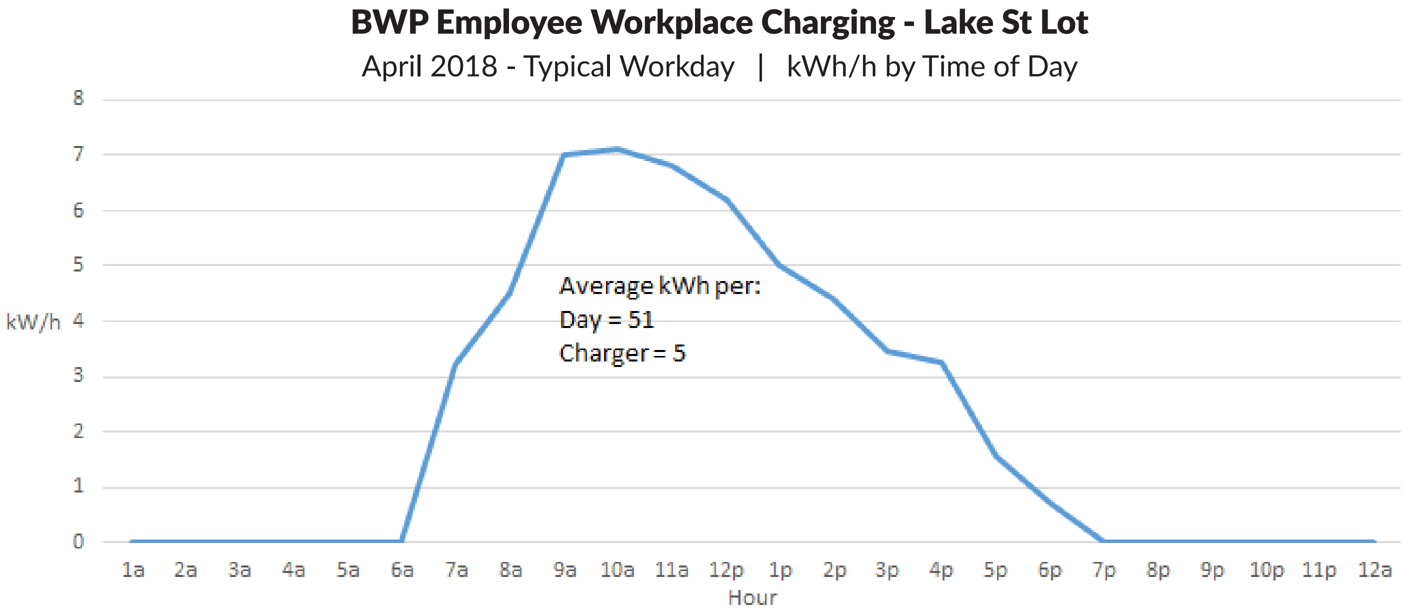


Figure 6.3: BWP Employee Workplace Charging

Source: BWP

BWP benefits through the provision of workplace charging, as the daily usage profile for workplace charging meets BWP's requirement for sustained and consistent electric load. In addition, the period of use between 8am and 4pm matches up with the availability of renewable energy, mainly from solar resources. Figure 6.3 shows average daily charging load from the BWP employee chargers.

BWP will continue to work with employers to assess the need for managed charging, rebates, and/or the direct installation of charging infrastructure. With the target market for the overall Workplace Charging program being defined as all Burbank employers, BWP will conduct periodic workplace charging surveys of City departments and business customers to see what type of infrastructure makes the most sense for BWP and the employer.

Various approaches can then be evaluated for renewable energy integration, load impact, operational and cost effectiveness, and customer satisfaction.

Public Charging

BWP's Public Charging Program began in 2011. With the assistance of multiple federal grants, BWP installed 11 Level 2 chargers in six parking lots, five of them located downtown. Following this success, in 2015, BWP applied for and received a $165,000 grant from the CEC for the installation of 16 curbside Level 2 chargers on the sidewalks of major streets. In 2016, through the use of another CEC grant, BWP installed Burbank's first DC Fast Charger. Until recently, these three projects encompassed the entirety of BWP's Public Charging network that owns, operates, and maintains these charging connectors.

BWP recently worked with the Burbank Town Center (BTC) to install 16 new Level 2 chargers, divided equally between the BTC's two parking garages. BWP benefits from the ownership of public chargers and can control pricing and usage and receive environmental credits.

As of September 2018, the chargers are online. BWP's next planned public charger installation is to own and operate (per an existing agreement) a DC Fast Charger at the Hollywood Burbank Airport by November 2018. With these new chargers, Burbank is estimated to have one public charger for about every 2,500 residents. This compares to a state metric of one public charger for about every 8,000 residents.

The Burbank Town Center chargers are also located in areas identified as Disadvantaged Communities (discussed in Sections 3.7.7 and 5.3).

Rates

BWP's current TOU rates for public charging include a higher per kWh rate (incorporating peak electric rates and a peak demand charge) during the summertime peak hours. As each public charger includes third-party software control capability, BWP can apply unique TOU rates that vary by charger, as well as type of charger (Level 2 or DC Fast Charger) and location.

Burbank Charging Station Costs

Charging station costs at Burbank stations varies by the time of day.
There is no minimum or maximum charge to charge your vehicle.

Off-Peak Hours

Charging costs are $0.1736 per kWh for Level 1 & 2, and $0.2817 per kWh for the DC Fast Charger.

Summer Peak Hours (4p-7p)

Charging costs are $0.3039 per kWh for Level 1 & 2, and $0.4931 per kWh for the DC Fast Charger.

Figure 6.4 – BWP Public EV Charging Rates
Source: BWP

BWP's Public Charging Rates are shown on Figure 6.4 above.

New Construction Developments

BWP's goal is to facilitate the installation of additional EV charging infrastructure throughout the City. The most cost-effective method to achieve this goal is to require EV charging infrastructure for new or retrofitted developments. In these cases, the cost and effort to install charging infrastructure is much lower or negligible compared to adding it to an existing building.

The term "EV-ready" is generally defined as:

- Pre-installation of the panel, conduit, wire, and other equipment necessary to run electricity to potential EV chargers
- Sufficient electric capacity for the proposed charging infrastructure

BWP will work to promote EV readiness and charging infrastructure in new developments. BWP will also assist developers who seek to go beyond compliance and want to install chargers, similar to the Burbank Town Center project, which was constructed by a third-party to be EV-ready.

Residential Charging

According to the Center for Sustainable Energy, which manages the state's Clean Vehicle Incentive Program, there are nearly 1,000 EVs registered with a Burbank address. This total number of EVs may not be accurate, as it does not account for:

- EVs that were originally registered in Burbank, but are now located outside of Burbank, such as those that were returned to a dealer at the end of a lease.
- EVs that did not receive a rebate due to the consumer having an annual income above the qualification cap.
- EV consumers who did not apply for the rebate despite being eligible.

While the number may not be accurate, it is a good proxy for the current size of the Burbank EV market and can be used as a benchmark with other neighboring cities. The size of the overall EV market can be defined as roughly two cars per household, or about 86,000 cars.

Given this, BWP can focus efforts towards the residential market on the following activities:

- Rebates for Level 2 charger purchases
- Ride and Drive events
- Marketing and Education

Electric Vehicle Forecast

The California Energy Commission has a goal of facilitating 1.5 million EVs on the roads by 2025 and the installation of about 250,000 public chargers to charge these EVs. Based on Burbank's 0.25 percent share of California's population, this converts to about 3,250 EVs and about 600 public chargers, or one public charger for every five EVs.

Given BWP's workplace and public charging programs, trying to match a state goal based on the number of EVs may not be appropriate. Instead, BWP plans to propose a policy that ensures that charger installation is tied to EV growth and ensures that charger installation and operation are cost-effective. BWP can also evaluate other metrics related to the ratio between public and residential charging and environmental credit accumulation.

Transportation Electrification Findings

Based on continued consumer adoption of EVs, as well as BWP's promotion and facilitation of workplace and public charging, electric vehicle load for Burbank service territory was calculated using the California Energy Commission's EV Forecast Tool. The cumulative annual load increase was added to the load forecast and is summarized on Table 6.1 below:

	2018	2019	2020	2021	2022	2023	2024	2025	2030	2035	2038
Additional EV Load (GWh)	8	10	11	12	13	13	14	14	14	15	15

Table 6.1 – BWP Forecast of Cumulative Electric Vehicle Load (2019 to 2038)
Source: Cadmus

The cumulative added electric load in 2038 represents about 1.5% of total BWP annual energy sales. It is equivalent to about 5,000 electric vehicles in Burbank, including about 3,250 EVs registered in Burbank and the balance EVs from outside Burbank that are charged in Burbank.

6.1.4 Load-Shifting Opportunities

With current California law requirement of 60% renewable energy by 2030 and the Duck Curve, BWP will require new innovations to meet these challenges head-on. BWP is investigating the use of energy storage to absorb over-generation in the middle of the day and reduce power generation ramping in the late afternoon when customers come home from work as well as other challenges of integrating renewable energy.

See Section 6.3 for a discussion of customer-side and supply-side storage options.

6.1.5 Load Management

BWP's load management efforts encompass programs that impact customers' use of energy, including energy efficiency and demand response programs. BWP's portfolio has been designed to reflect Burbank's goals as well as meet legislative mandates. At the same time, BWP is adjusting to changes in the utility industry, including slowing load growth and the Duck Curve.

As a result, BWP's load management efforts seek to pursue all cost-effective and operationally sound programs that can also meet the above challenges. These may include programs based on net load and demand savings, including demand response programs, which BWP has never operated before.

BWP's promotion of transportation electrification offers an opportunity to help address both the Duck Curve and negative load growth as more California consumers purchase electric vehicles (EVs). In FY 17-18, BWP initiated a managed charging pilot program for large commercial customers. The program includes enhanced EV charger incentives as an inducement to operate them during daylight hours – between 8am and 4pm – in order to better integrate with renewable resources. Through a software dashboard, BWP has the ability to reduce the charging level of the charger during outages or a limited number of peak demand or other load management events, with total peak demand reduction potential of about 300 kW.

For residents, the primary way to reduce peak demand is through air conditioning equipment and maintenance. BWP's AC Tune-up program provided nearly 1,000 air conditioning unit tune-ups in FY 16-17, resulting in peak demand savings of nearly 500 kilowatts, and making it our largest residential peak demand savings program. BWP plans to expand this program in FY 18-19, potentially to include the early replacement of inefficient AC units. The replacement of these units can both reduce BWP's grid demands and help reduce customers' electric bills.

BWP proposes to continue offering its current suite of programs, in order to maintain customer access and availability, and market consistency. In addition, BWP plans to emphasize measures that result in demand reductions, similar to the aforementioned controls for EV charging and maintenance air conditioners. The impacts of BWP's enhanced portfolio scenario, where demand reduction measures are incorporated into existing programs, are discussed below.

Energy Efficiency Findings

For this IRP, BWP staff contracted with Cadmus Inc., a recognized expert, to review Burbank's existing energy efficiency (EE) programs, their cost effectiveness, and potential areas for further development. Working with BWP staff, Cadmus confirmed that BWP's current programs are cost-effective. They also suggested improvements to existing BWP programs and potential new programs to both fulfill SB350 targets for Burbank and drive cost reductions for Burbank, including peak demand reductions. The resulting "enhanced" program impacts are summarized on Table 6.2 below. The incremental impacts of the enhanced program were applied as adjustments to the IRP's load forecast. The impacts of existing programs were assumed to be included in the load forecast.

Under an enhanced portfolio scenario, BWP's potential is 12,834 MWh of energy savings in 2019 and 2.6 MW of demand reductions. By 2040, BWP's potential of cumulative persisting savings by 2040 in the enhanced portfolio is 208,842 MWh of energy savings and 4.2 MW of demand reductions. The total cost to deliver the portfolio over the forecast period (2019 to 2040) including incentives and administrative costs is $136.3 million. The levelized cost of energy (LCOE) and levelized cost of demand (LCOD) of the portfolio over the forecast period is estimated at $0.094/kWh and $406/kW respectively, with a portfolio Total Resource Cost (TRC) as defined by the State of California is estimated at 1.24 (see Table 6.2).

However, it is important to note that this enhanced portfolio scenario is simply a forecasted estimate and not necessarily a cost-effective proposal to implement. The portfolio is meant to outline energy savings potential without budgetary constraints. In reality, BWP's current Public Benefits program budget also provides for Low Income, Renewable, and Research and Development programs, in addition to Energy Efficiency programs. In addition, this scenario includes several programs that were not cost-effective according to the TRC test. BWP will further investigate the enhanced portfolio scenario to implement programs and components that achieve operational and regulatory goals, while also maintaining reliable and affordable electric service to Burbank.

Portfolio Metric	2019	2020	2021	2022	2023	2028	2033	2040
Cumulative Energy Savings (MWh)	12,834	25,636	38,514	51,288	64,240	134,766	177,444	208,842
Cumulative Demand Reductions (MW)	2.6	2.6	2.6	2.7	2.8	3.5	4.0	4.2
Cumulative Program Delivery Costs ($000)	$5,472	$10,948	$16,473	$22,069	$27,773	$58,914	$94,368	$147,235
Levelized Cost of Energy ($/lifetime kWh)	$0.094							
Levelized Cost of Demand ($/kW)	$405.8							
Total Resource Cost (TRC) Ratio	1.24							

Table 6.2 – BWP Enhanced Energy Efficiency Portfolio Performance Metrics (2019 to 2040)

With enhancements to BWP's energy efficiency portfolio it is possible to increase demand reductions during a typical peak demand period by 41% while still meeting its SB 350 energy savings targets. The extent of additional demand reductions under the enhanced scenario can be seen with Figure 6.5 below, which shows the difference in demand reductions of all energy efficiency programs under the business-as-usual (i.e. base case) scenario and the enhanced scenario during a typical peak demand period (August 6th).

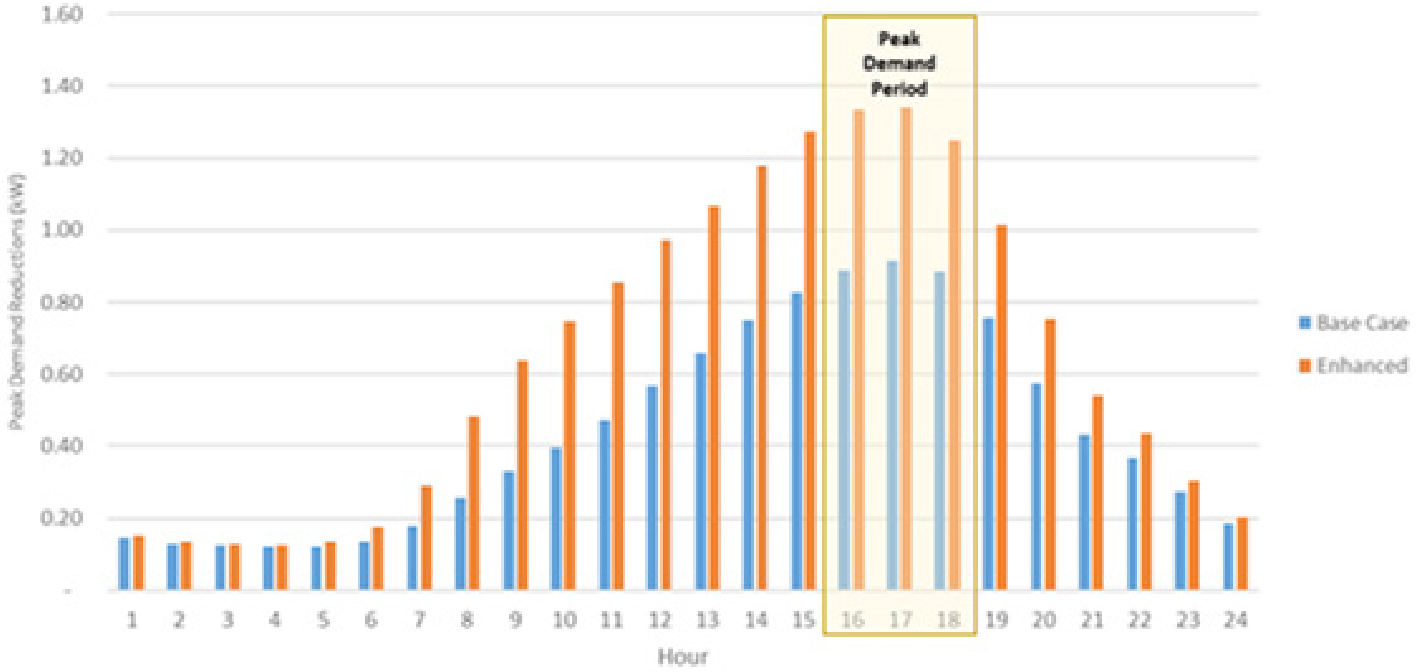


Figure 6.5 – Energy Efficiency Portfolio Peak Demand Reductions by Hour by Scenario–August 6th

Source: BWP

Demand Response Findings

BWP is also considering the implementation over the long-term of demand response programs. Examples of such programs include TOU pricing rates, Critical Peak Pricing (CPP) rates (which include a super-peak period rate), and behavioral demand response, where notifications are provided to customers to persuade them to use less energy during peak periods.

BWP's first implementation of a demand response-type program is the managed charging pilot, which not only also incentivizes the use of the chargers during off-peak periods but disincentivizes the use of the EV chargers during peak periods. BWP's potential implementation of any future demand response programs will likely require more customer education and information than for our current energy efficiency programs.

Under the enhanced portfolio scenario with full implementation of all demand response products, Cadmus calculated BWP's potential is 0.2 MW of demand reductions in 2019. By 2040 the enhanced portfolio's potential is 19.3 MW of demand reductions. Cadmus also calculated the program costs associated with fully implementing the enhanced portfolio scenario. The total cost to deliver the portfolio over the forecast period (2019 to 2040) including incentives and administrative costs is $15M with a portfolio TRC estimated at 2.31 (see Table 6.3).

However, as with the energy efficiency findings, it is important to note that this enhanced portfolio scenario is simply a forecasted estimate and not necessarily a cost-effective proposal to implement. The portfolio is meant to outline peak demand savings potential without budgetary constraints. In reality, BWP's current Public Benefits program budget also provides for Energy Efficiency, Low Income, Renewable, and Research and Development programs, in addition to Demand Response programs. BWP will further investigate the enhanced portfolio scenario to implement programs and components that achieve operational and regulatory goals, while also maintaining reliable and affordable electric service to Burbank.

Portfolio Metric	2019	2020	2021	2022	2023	2028	2033	2040
Cumulative Energy Savings (MWh)	5.4	20.7	135.2	244.3	333.9	492.0	535.5	578.9
Demand Reductions (MW)	0.02	0.6	1.8	4.2	7.4	17.0	20.7	25.4
Cumulative Program Delivery Costs ($000)	$442	$647	$1,308	$2,024	$2,756	$6,210	$9,667	$15,024
Total Resource Cost (TRC) Ratio	2.31							

Table 6.3 – BWP Enhanced Demand Response Portfolio Performance Metrics (2019 to 2040)

Source: BWP

6.2 Energy Storage

6.2.1 What is Energy Storage?

The basic function of an energy storage system is to absorb energy when it is not needed, store it for a period of time with minimal loss, and then release it when needed. When deployed in the electric system, energy storage can serve a number of important roles in balancing generation and load, especially as increasing amounts of intermittent renewable energy resources are brought onto the system.

These applications can occur on a large, regional scale (e.g., within the bulk electric system) and at a more local scale (e.g., on the local distribution system or "behind the meter" on a customer's site),and can comprise a wide variety of technologies in various stages of development, including battery technologies, flywheels, and compressed air energy storage.

Energy storage is a potential enabling tool to continue to achieve BWP's commitment to reliable, affordable, and sustainable electric service to Burbank. For example, energy storage has the potential to effectively integrate intermittent renewable energy resources (such as solar and wind energy) by better matching the output of those resources to Burbank's needs.

6.2.2 Storage Options for BWP

Energy storage options include both customer-side and supply-side alternatives.

6.2.2.1 Customer-Side Storage

BWP is evaluating the costs and benefits of customer-owned energy storage systems. As TOU rates are implemented for BWP's residential customers, the benefits of customer-side energy storage will become more apparent to customers. Whether BWP provides a financial incentive for customer-owned energy storage in exchange for utility control or simply provide price points to which the customer can adjust their energy storage dispatch, both options could lead to better load management, distribution system support, and energy price savings for the customer and/or BWP.

BWP seeks to explore opportunities for storage in a variety of forms. BWP is interested in the development of customer-side programs that yield the equivalent benefits of real equipment installations however, without installing any actual equipment. One concept being discussed is a form of thermal storage: pre-cooling a home. This involves running an air-conditioning system continuously in the middle of the day, when demand on the electric system is lower and while supplies are plentiful. The goal would be to cool a home enough to require little or no cooling during Burbank's late afternoon and early evening system peak, when electric system equipment is being stressed and the costs to serve load are the highest.

6.2.2.2 Supply-Side Storage

Batteries

As described in more detail later in this Chapter 6, BWP's plans for large-scale utility application of battery storage include both "long term" (4 hours) batteries for dependable capacity and "short-term" (1/2 to 1 hour) batteries for system regulation.

Compressed Air Energy Storage (CAES)

At the utility scale, BWP is carefully evaluating compressed air energy storage (CAES) as a large-scale, long-duration energy storage option. CAES is essentially a large mechanical battery that takes an intermittent resource and turns it into a dispatchable source. When electricity is generated and not needed, the electricity runs a compressor that pumps air under pressure into an underground cavern, where it is stored. When the electricity is needed, the air is released and, with a small amount of natural gas, it is run through a generator to produce electricity.

As described in Chapter 4, BWP is investigating possible use of CAES as part of replacement alternative for the IPP coal project at Delta, Utah. For example, BWP has been an important catalyst for the investigation of compressed air energy storage (CAES) at the IPP site. The geology of this site, featuring a major underground salt deposit capped by solid rock, is particularly well-suited to CAES. A CAES project at this site has the potential to access low-cost, high-quality wind resources in Wyoming, store that energy and make it dispatchable through CAES, and transmit it down the existing STS direct current transmission line that currently brings IPP's output to Southern California. In the alternative, long-term batteries may be a workable solution at IPP as well. Such projects also have the potential to relieve solar-driven over-generation issues in California, by absorbing that over-generation and then retransmitting it back to California when needed.

More generally, BWP is preparing its system for distribution-level storage in a number of ways. BWP is working closely with SCPPA and its fellow SCPPA member utilities in investigating potential energy storage technologies and projects, through leadership in an Energy Storage Working Group, as well as participation in a Renewable Energy and Energy Storage Request for Proposals. BWP is also looking into the installation of battery technology at locations of decommissioned substations where physical space is available, and infrastructure is already in place to tie into existing distribution.

6.3 Generation Portfolio

6.3.1 Supply-Side Resources: The SB350 Future

During most of the IRP development process, one of the primary drivers of the planning was to fulfill the provisions of SB350. In addition to requiring POUs like Burbank to file IRPs with the CEC for the first time, SB350 includes multiple requirements for IRPs including a 50% RPS by 2030. It also resulted in detailed CEC Guidelines for what needs to be included in IRPs. In addition to being a key BWP planning document, the IRP was developed in part to fulfill these Guidelines.

Although the RPS provisions of SB350 were superseded by SB100 late in the planning process, much of the planning applicable to SB100 occurred in the context of SB350 per the CEC Guidelines for IRPs. Incremental changes to the SB350 results to reflect an SB100 future are addressed in the next Section of this IRP.

BWP retained Ascend Analytics LLC to help develop and analyze the various resource options. Ascend performed cost and reliability analyses and comparisons of various planning "portfolios". A portfolio is a grouping of resource options that together form an alternative approach for the future. Ascend and BWP analyzed nearly 30 such portfolios in total.

Table 6.4 provides a listing of installed costs for the various resource options used in the portfolios.

Resource	$/kW-installed (2025)	$/kWh stored (2025)
CC	$1,317	NA
CT	$1,000	NA
CAES	$1,660	$35
Battery (4 hour)	$580	$145
Battery (1 hour)	$281	$281
Battery (1/2 hour)	$231	$462
ICE	$1,100	NA
WY Wind	$22/MWh	NA
Utah Solar	$27/MWh	NA
Generic Wind	$27-31/MWh	NA
Generic Solar	$29-31/MWh	NA

Table 6.4 – Technology Costs of Various Resource Options.

6.3.1.1 Retirement of IPP coal in 2025

A key feature of this IRP is the planned retirement of the 1,800 MW IPP coal plant in 2025. Located in Delta, Utah, IPP is a primary baseload energy source for Burbank and other Southern California municipal utilities including LADWP and others. Burbank has a 4.2% participation share (74 MW) in the coal plant. In 2017, provided about 30% of BWP customers' annual energy needs.

Replacing this major energy source and maintaining Burbank's share in the existing 2,400 MW Southern Transmission System (STS) high-voltage direct current transmission line from IPP to Southern California are critical topics for BWP.

6.3.1.2 IPP Coal Replacement Options

The IRP planning process initially defined for consideration 12 diverse portfolios of alternative resources to replace BWP's share of the IPP coal plant. These included a 35 MW share (4.2%) of the proposed 840 MW natural gas-fired combined-cycle plant which was used as a Base Case for comparison with other portfolios; large quantities of renewable energy including Wyoming wind and solar located in Utah at or near IPP ("Utah solar"); energy storage at IPP including compressed air energy storage (CAES) or and 4-hour batteries; internal combustion engines (ICEs) which are modern, natural gas-fired and efficient versions of traditional reciprocating engine diesel generation units; and various combinations of all of these resources.

An important consideration is BWP's share of the STS transmission line capacity. BWP currently has rights to 108 MW on the STS. Based on current agreements with LADWP effective subsequent to retirement of the IPP coal plant, the analysis assumed BWP's share would be 126 MW if BWP participates in the proposed combined-cycle project at IPP. It would be reduced to 54 MW if BWP does not participate in the project.

In addition to resources at or near IPP, "generic" renewables resources were added to the plan as necessary to fulfill any resulting shortfalls in fulfilling the RPS requirements throughout the planning period. These included wind from unspecified locations in New Mexico, Nevada or Arizona, and additional solar at unspecified locations on or near the LADWP BA. Table 6.5 provides a summary of the various portfolios examined for SB350.

Portfolio #	CC	WY Wind	Utah Solar	CAES	Batteries (MW of 4 hr)	ICEs	Wind/Solar Addition	Ancillary Batteries (MW of 1 hr)	Transmission on STS
1	35	0	0	0	113	0	221	74	126
2	35	102	0	0	113	0	69	81	126
3	35	188	0	80	0	0	44	120	126
4		102	0	0	50	54	69	74	54
5		46	44	54	0	0	113	73	54
6		46	44	0	113	0	113	73	54
7		46	44	0	50	54	113	73	54
8	35	0	0	100	0	0	221	74	126
9		102	0	0	113	0	69	74	54
10		102	0	54	0	0	69	74	54
11	35	46	44	54	113	0	113	73	126
12	35	46	44	0	0	0	113	73	126

Table 6.5: Resource Portfolios Evaluated under SB350 (Megawatts)

The costs of each portfolio included costs of BWP energy efficiency and demand response programs described above; investment-related costs in new plant capital, fuel and operations & maintenance costs for BWP supply resources (both existing and new), power purchase agreement costs for renewable energy to fulfill RPS requirements, transmission costs for existing and new resources, GHG emissions costs, and costs of necessary energy purchases from others. The analysis included calculation of a long-term risk premium for each portfolio. This captured the potential long-time upside cost risk of variations in weather, and its effects on market prices.

The analysis also estimated potential revenues of opportunistic, non-speculative market sales to other systems. These revenues were netted against total costs to yield total costs of each portfolio in net present value over the planning period.

Ascend also assessed the reliability of each portfolio using Loss of Load Hours (LOLH) criteria. LOLH is the long-recognized national industry standard for evaluating the reliability of a utility's energy supply resources (excluding transmission and distribution reliability). It is a measure of how much installed supply capacity the utility needs to meet its annual peak demand. The supply system's reliability underlies the 99.998% reliability of service (including transmission and distribution reliability too) that BWP customers currently enjoy.

The historical industry criteria is to assure an LOLH of less than 24 hours of supply system outage in a ten-year period. Based on the calculated LOLH of each portfolio, additional batteries and associated costs were added by Ascend to the portfolio as necessary to equalize the reliability of the portfolios for comparability.

6.3.1.3 Results: Replacing IPP Coal with Renewables and Storage

The results of the economic analysis for SB350 are summarized on Figure 6.6 below. It depicts the total costs over the planning period of the twelve lowest-cost planning portfolios in rank order from highest to lowest.

The three lowest-cost portfolios all entail renewable energy including Wyoming wind and Utah solar, plus energy storage (either CAES or 4-hour batteries). One of them also includes ICE generation units.[8] The total costs of these three portfolios over the planning period are very similar. We call them, in order of increasing total costs, Preferred Portfolios A, B and C. These three portfolio options for replacement of the IPP coal plant, combined with BWP's share of the existing Milford 1 wind project near IPP, load BWP's share of the STS line to high levels, thereby effectively utilizing BWP's investment in it. They include:

- Preferred Portfolio A is Wyoming wind, Utah solar, balanced by CAES.
- Preferred Portfolio B is Wyoming wind, Utah solar, balanced by batteries.
- Preferred Portfolio C is Wyoming wind, Utah solar, balanced by batteries and ICEs.

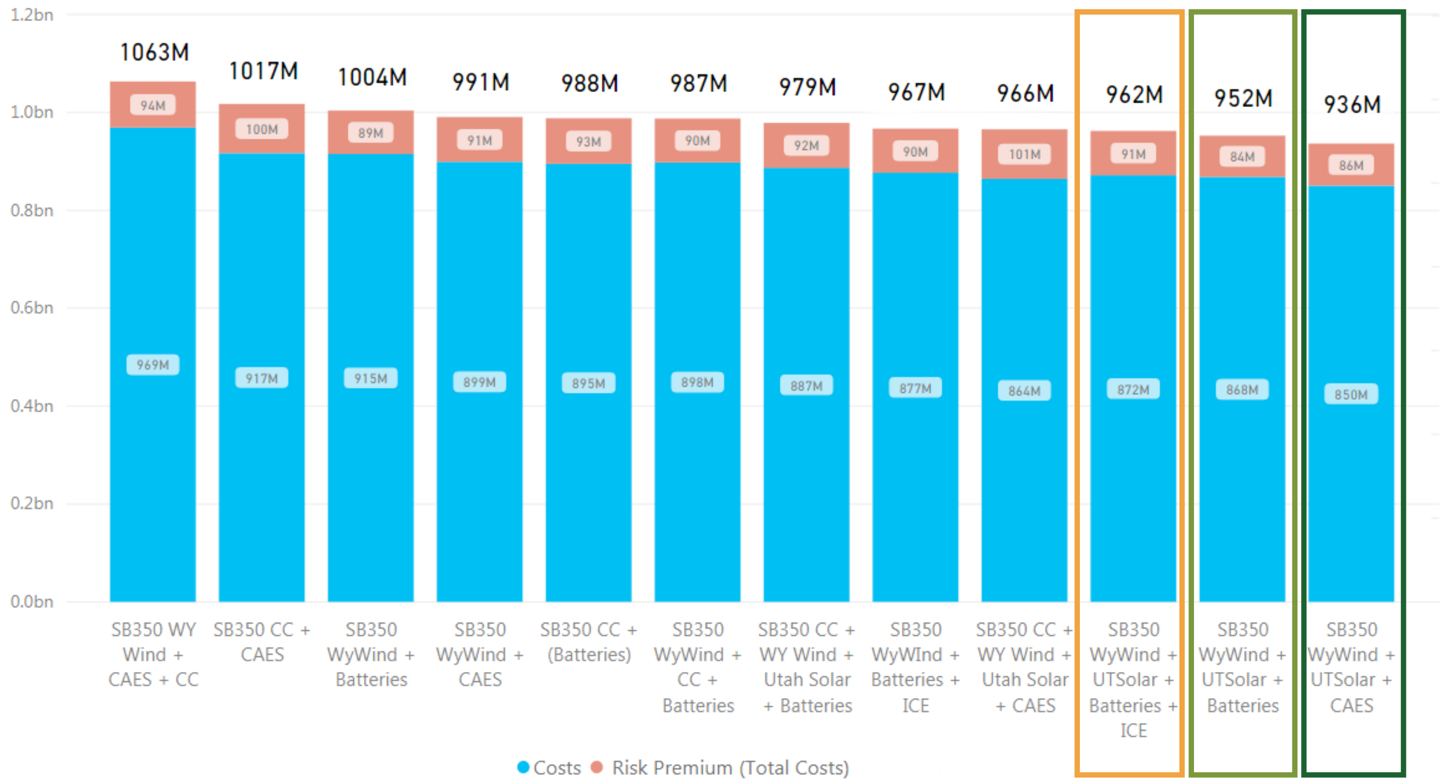


Figure 6.6: Total Cost Ranking of the Lowest-Cost Portfolios for SB350. (Present Value 2019$)

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[8] Not to be confused with "IceBear" building air conditioners, of which there are several in Burbank.

	Preffered A: Wind, Solar, and CAES	Preffered B: Wind, Solar, and Batteries	Preffered C: Wind, Solar, ICEs, and Batteries
Wyoming Wind	46 MW	46 MW	46 MW
Utah Solar	44 MW	44 MW	44 MW
CAES (48 Hour Duration)	54 MW		
ICEs			54 MW
Batteries (4 Hour Duration)		113 MW	50 MW

Table 6.6: Preferred Portfolios for IPP Coal Replacement

The total costs shown in Figure 6.7 include potential market sale revenues netted against costs. Additional analysis confirmed that ignoring such revenues (which can be speculative) in SB350 does not change the total cost ranking of the Preferred Portfolios.

Table 6.6 provides a summary of the three Preferred Portfolios for replacement of IPP coal.

The fact these diverse options are similar in cost is an advantage for BWP, because Burbank seeks economies of scale in pursuing them. Projects like these involve large investments and are typically shared by multiple utilities, like the Hoover Dam is shared. Implementation of them will involve cooperation and negotiations with LADWP and others. They will have their own IRP goals to pursue. BWP has some cost flexibility in these discussions because multiple possible portfolio combinations offer similarly low costs for BWP.

The analysis also identified needs for flexible capacity resources to help integrate intermittent renewables and enable BWP to handle the operational ramping requirements of the Duck Curve. These would be provided by additional, short-duration (1/2-hour and 1-hour) batteries.

The Combined-Cycle Option

The results also show that the proposed natural gas-fired combined-cycle ("CC") option at IPP is not a good one for BWP. With increasing renewable energy contributions during the period, the analysis shows the annual operation and usefulness of BWP's share of the CC starts reasonably high and then drops very low after only about ten years. (By way of reference, the nominal operating life of such a plant should be at least 30 years.)

Figure 6.7 provides the SB350 total costs of all portfolios that included the CC option.

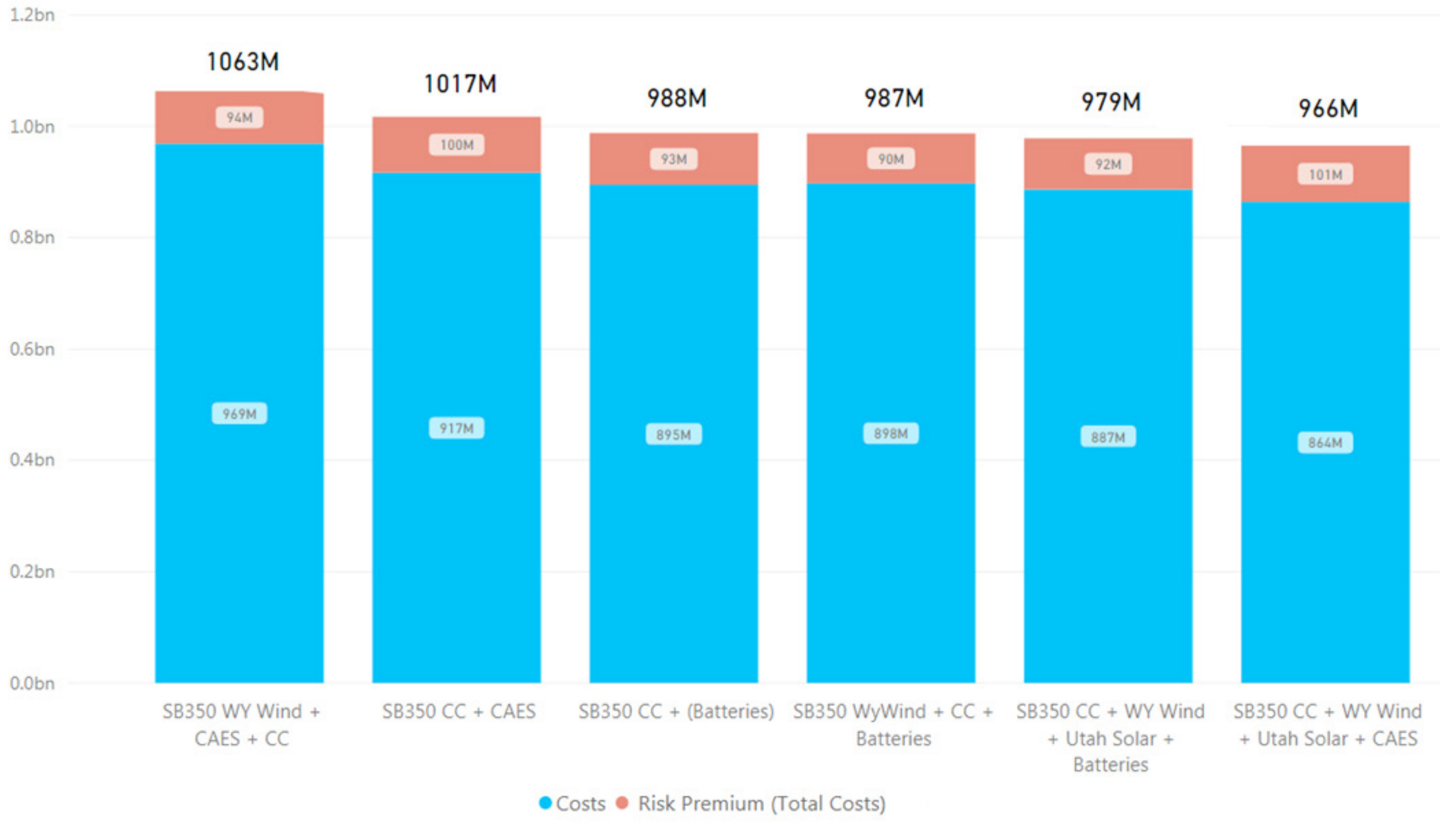


Figure 6.7: Total Cost of Portfolios Containing the CC Option for SB350 Future.

All three of the Preferred Portfolios in SB350 had lower total costs than those including the CC option. Further analysis (Table 6.7) highlights the dynamics potentially affecting BWP's share of the CC option over the planning period – particularly as its annual capacity factor falls due to increasing renewable energy.

	2026	2030	2035	2038
Combined-Cycle* Capacity Factor	92%	86%	44%	18%
Carbon Price ($/MTon)	$45	$67	$86	$97
Average On-Peak Power Price ($/MWh)	$28.58	$28.34	$29.68	$31.17
Average Off-Peak Power Price ($/MWh)	$23.73	$23.17	$23.92	$25.06
* CC Replacement comes online July 2025				

Table 6.7 – The Combined Cycle Option at IPP Faces Increasingly Challenging Economics Over the Planning Period. (Present Value 2019$)

Thus, from a planning perspective the CC option appears to be less beneficial for BWP compared to other options. Its carbon emissions would not meet State greenhouse gas emissions targets. And the total costs of resource portfolios including this option are higher than the preferred options. Meanwhile, BWP is also mindful of the declining costs of renewable energy and energy storage as well as the 2045 100% clean energy target of SB100.

Market Sales Opportunities

The analysis of an SB350 future also indicates that while the Duck Curve entails operating challenges for utilities like BWP, it may also offer opportunities. The opportunities arise from potential market sales revenues for utilities the position their portfolios and operations to take advantage of sales opportunities in the peak time periods of the Duck Curve (i.e., evening hours as the sun sets). Utilities that best position themselves to work with the Duck Curve (rather than against it) may be able to store cheap solar over-generation during the day (produced by others), and release and sell any surpluses to others in the evenings when market prices are favorable and using the proceeds to reduce costs for BWP customers.

6.3.2 Supply-Side Resources: The SB100 Future

During the planning process, in addition to the SB350 “base case”, the potential impacts of the then-proposed SB100 were also considered as a “sensitivity case.” With enactment of SB100 late in the planning process (in September 2018), it became the new base case.

6.3.2.1 Retirement of IPP Coal in 2025

Like the SB350 analysis, the SB100 analysis assumed retirement of the IPP coal plant in 2025. It assumed the same Burbank STS capacity share assumptions as for SB350 described above.

6.3.2.2 Same IPP Coal Replacement Options as in SB350.

The analysis of the SB100 future involved the same replacement portfolio options for IPP coal used in the SB350 analysis. The primary difference between the two futures involved the increased RPS requirements of SB100: 60% RPS by 2030 and increasing further thereafter. The overall resource portfolios were designed to fulfill these RPS requirements. Figure 6.9 provides an illustration of the renewable energy resources used to fulfill SB100 during the planning period. The same RPS resources were used in all three Preferred Portfolios for SB100.

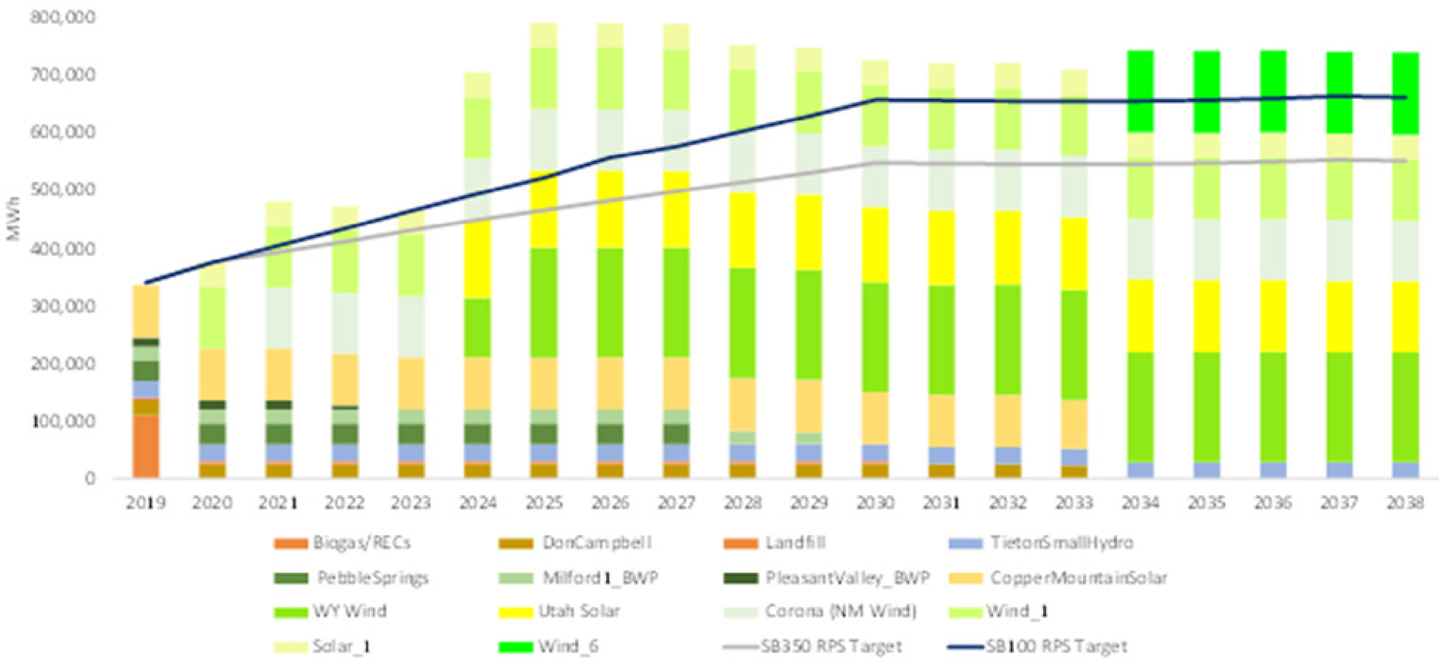


Figure 6.8: Renewable Capacity Added to Meet 60% RPS by 2030, All Preferred Portfolios.

The Preferred Portfolios were designed to fulfill the 60% RPS in 2030. The provisions of SB100 established a target of 100% clean energy by the year 2045. This end date is outside the planning period of this IRP. However, consistent with SB100's aspirational goals, the trajectory of renewables additions was assumed to continue beyond 2030 on a trend line to achieve 100% clean energy in 2045. This resulted in the equivalent of a 67% RPS by the end of the planning period in 2038, or nearly twice the RPS currently delivered by BWP.

(GWh)	2020	2021	2022	2023	2024	2025	2030	2035	2038
Retail Sales	1,131	1,125	1,120	1,119	1,115	1,110	1,088	1,087	1,105
Existing RPS	204	204	198	192	192	192	149	25	25
Wyoming Wind					103	192	192	192	192
Utah Solar					136	135	130	126	123
New Mexico Wind		106	106	106	106	106	106	106	106
New Mexico Wind (Generic)	107	107	107	107	107	107	107	250	250
Arizona/California Solar (Generic)	43	43	43	43	43	43	43	43	43
Total RPS Energy (SB350)	377	482	474	467	706	793	728	744	742
RPS %	33%	43%	42%	41%	62%	70%	67%	68%	67%

Table 6.8 – RPS Energy Procurement Plan for Meeting SB100 Target by 2030.

Portfolio #	CC	WY Wind	Utah Solar	CAES	Batteries (MW of 4 hr)	ICEs	Wind/Solar Addition	Ancillary Batteries (MW of 1 hr)	Transmission on STS
1	0	102	0	0	113	0	160	79	54
2	0	102	0	54	0	0	160	79	54
3	0	46	44	0	50	54	204	97	54
4	0	102	0	54	0	0	160	79	126*
5	0	46	44	54	0	0	204	97	54
6	0	46	44	0	113	0	204	97	54
* In portfolio 4, to examine the value of STS capacity in SB100, 126 MW of STS transmission line was used even though BWP would not be a participant in the CC project									

Table 6.9: Resource Portfolios Evaluated for SB100 (Megawatts).

Table 6.9 provides a summary of the resource portfolios evaluated for SB100.

6.3.2.3 Results: Replacing IPP Coal with Renewables and Storage

The economic findings for SB100 were similar to those described earlier for SB350. The same three portfolios (Preferred Portfolios A, B and C) from SB350 were again least-cost. Cost advantages of using CAES at IPP (Preferred Portfolio A) became stronger due to its longer storage duration (48 hours) compared to shorter-duration batteries. This characteristic of CAES appears to become more valuable as renewable energy levels increase.

The results of the economic analysis are summarized on Figure 6.9 below. It depicts the total costs over the planning period of the six lowest-cost portfolios in rank order from highest to lowest.

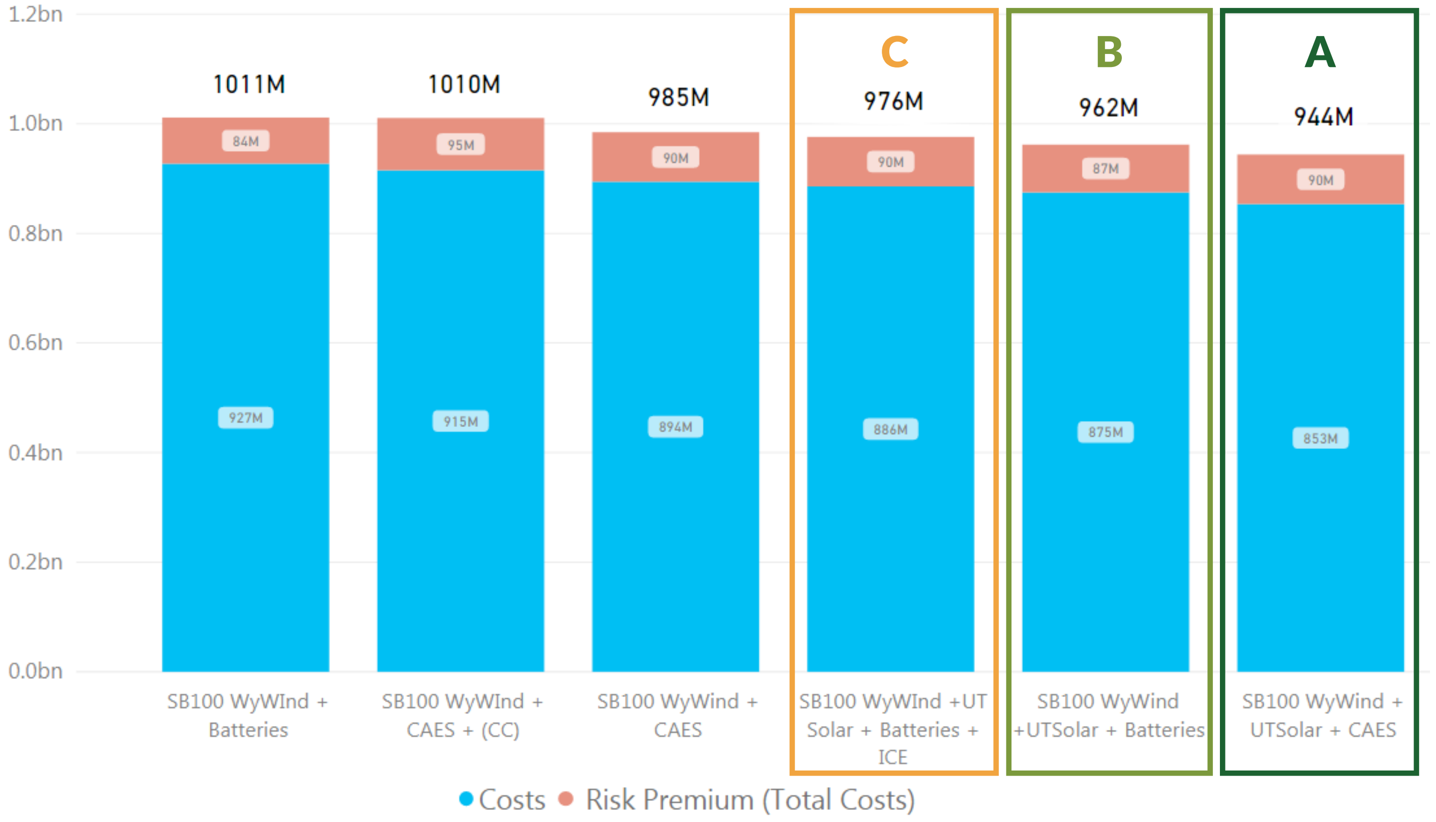


Figure 6.9: Total Cost Ranking of the Lowest-Cost Portfolios for SB100. (Present Value 2019$)

Figure 6.9 shows that, like in SB350, the same portfolios (Preferred Portfolios A, B and C) are lowest cost, and similar in total cost. While their storage capabilities are the same as in SB350, these Preferred Portfolios have more renewable energy for SB100.

The total costs shown in Figure 6.9 include potential market sale revenues netted against costs. Additional analysis confirmed that ignoring such revenues (which can be speculative) in SB100 causes the Preferred Portfolio C to drop one place in the ranking, replaced by SB100 Wyoming Wind + CAES.

Similar to the SB350 analysis, the results show potential opportunities for market sales revenues for utilities that position themselves to take advantage of opportunities provided by the Duck Curve.

6.3.2.4 Preferred Portfolio A

Figure 6.10 provides an illustration of the capacity expansion plan for Preferred Portfolio A. Capacity contributions of renewable resources are expressed in terms of their Effective Load Carrying Capability (ELCC), which is the average output that can be expected from them at peak load times, rather than their total installed capacity.

Figure 6.11 provides an illustration of the energy dispatch for Preferred Portfolio A.

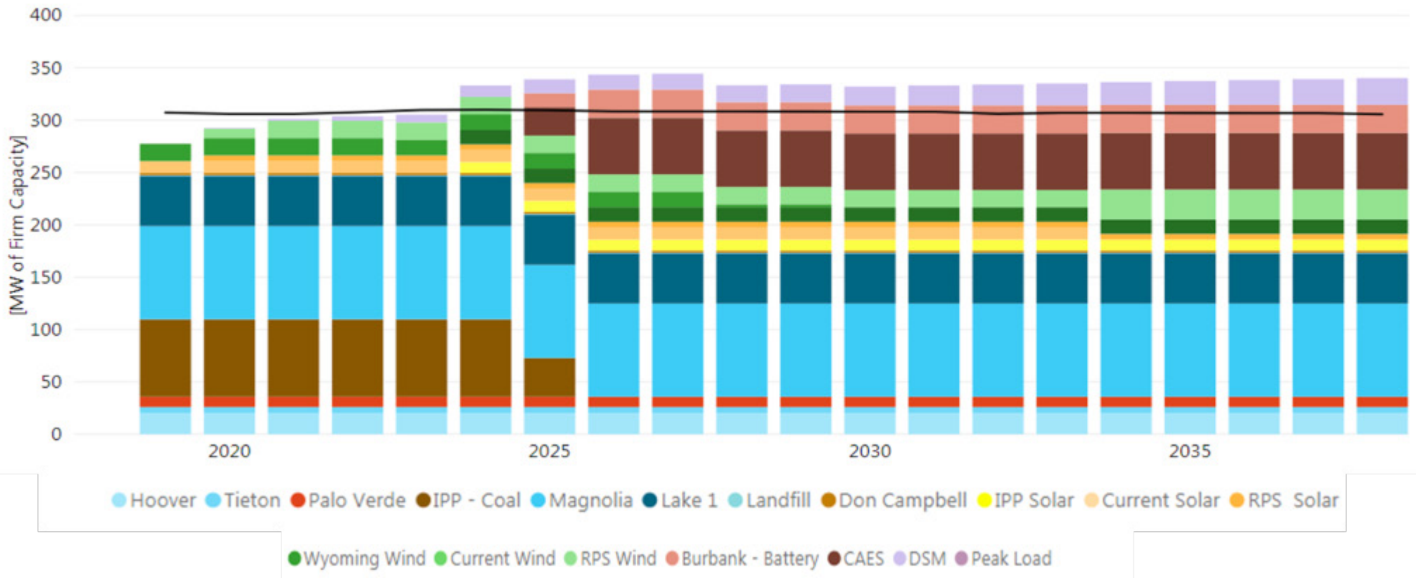


Figure 6.10: Capacity Expansion Plan for SB100 Preferred Portfolio A.

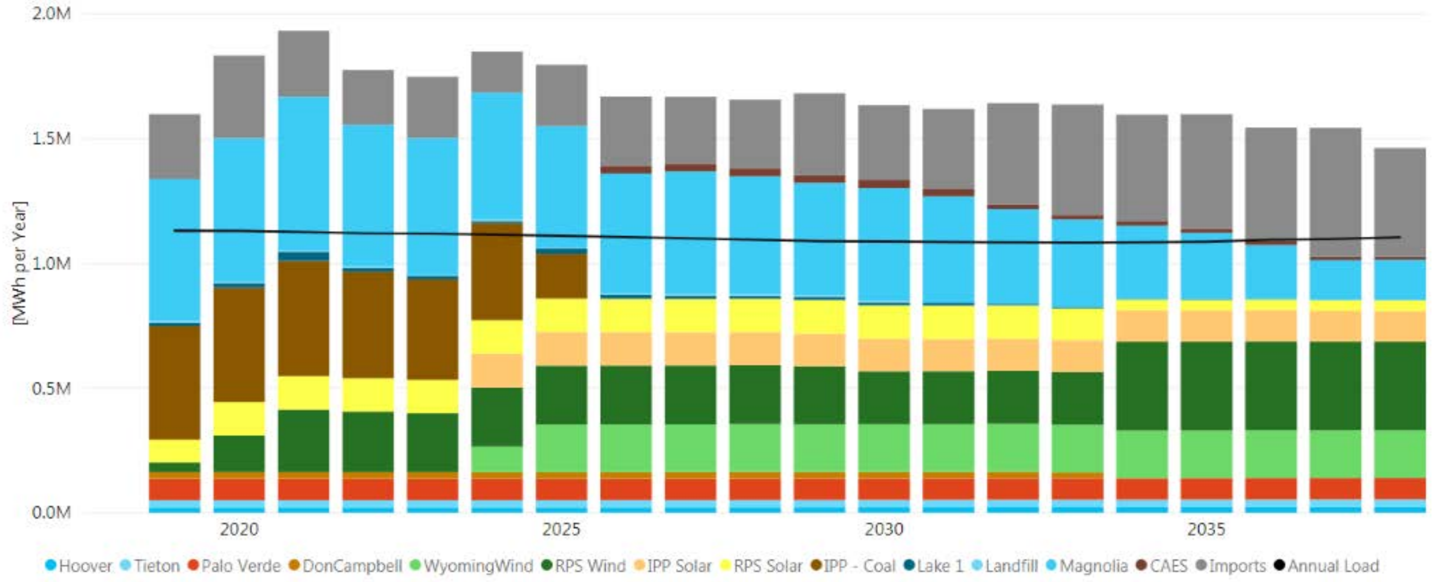


Figure 6.11: Energy Expansion Plan for SB100 Preferred Portfolio A.

6.3.2.5 Preferred Portfolio B

Figure 6.12 provides an illustration of the capacity expansion plan for Preferred Portfolio B. As in Preferred Portfolio A, above, renewable capacities are expressed in terms of their ELLCs.

Figure 6.13 provides an illustration of the energy dispatch for Preferred Portfolio B.

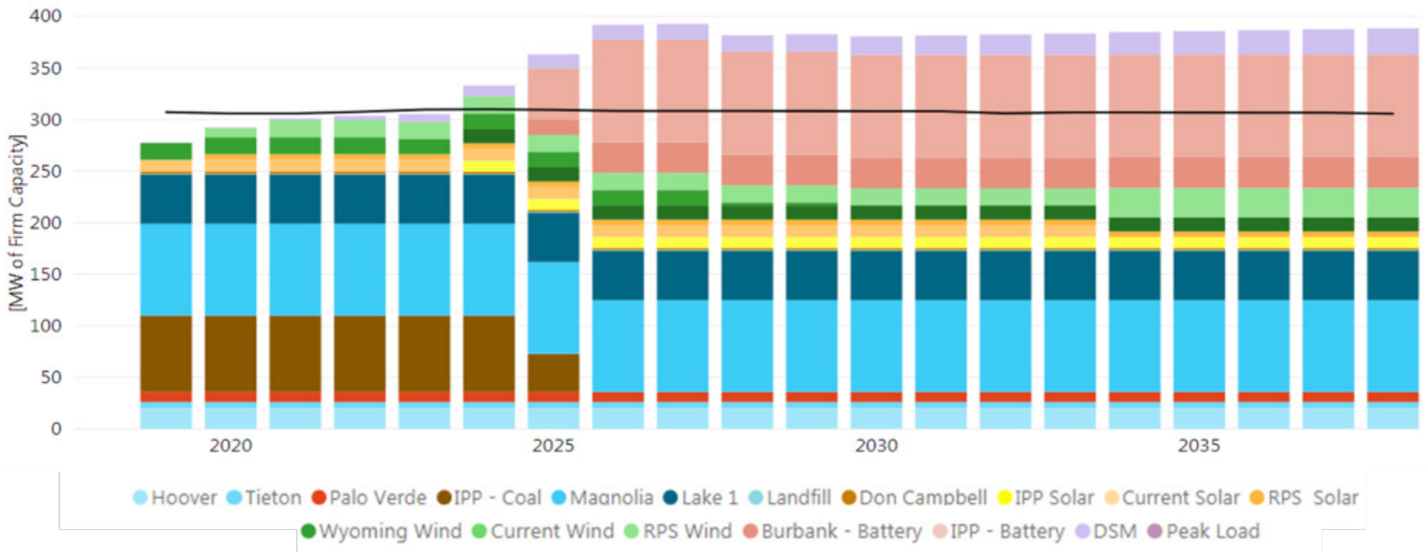


Figure 6.12 – Capacity Expansion Plan for SB100 Preferred Portfolio B.

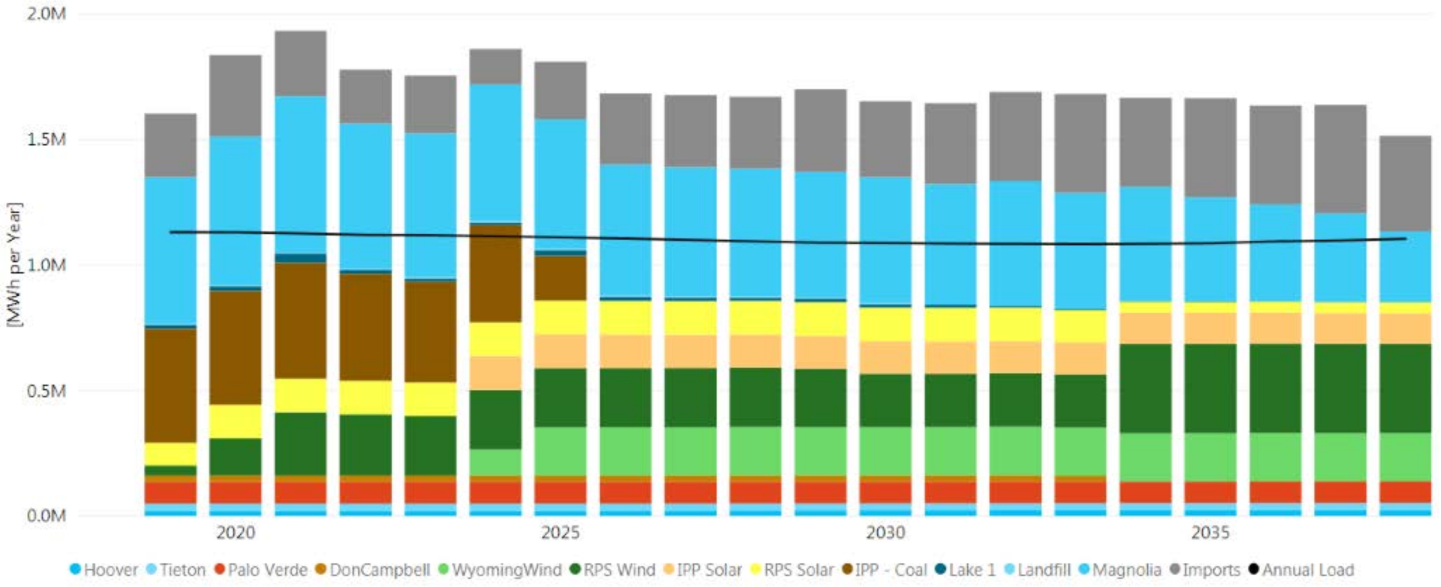


Figure 6.13: Energy Expansion Plan for SB100 Preferred Portfolio B.

6.3.2.6 Preferred Portfolio C

Figure 6.14 provides an illustration of the capacity expansion plan for Preferred Portfolio C. As in Preferred Portfolio A, above, renewable capacities are expressed in terms of their ELLCs.

Figure 6.15 provides an illustration of the energy dispatch for Preferred Portfolio C.

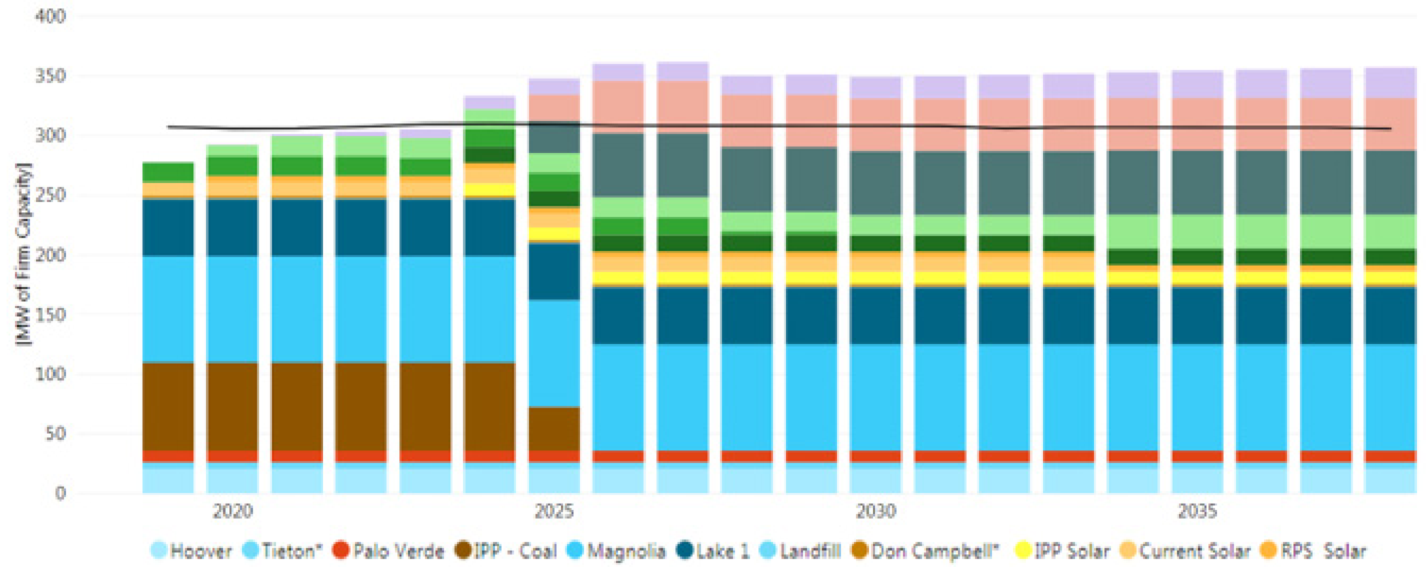


Figure 6.14: Capacity Expansion Plan for SB100 Preferred Portfolio C.

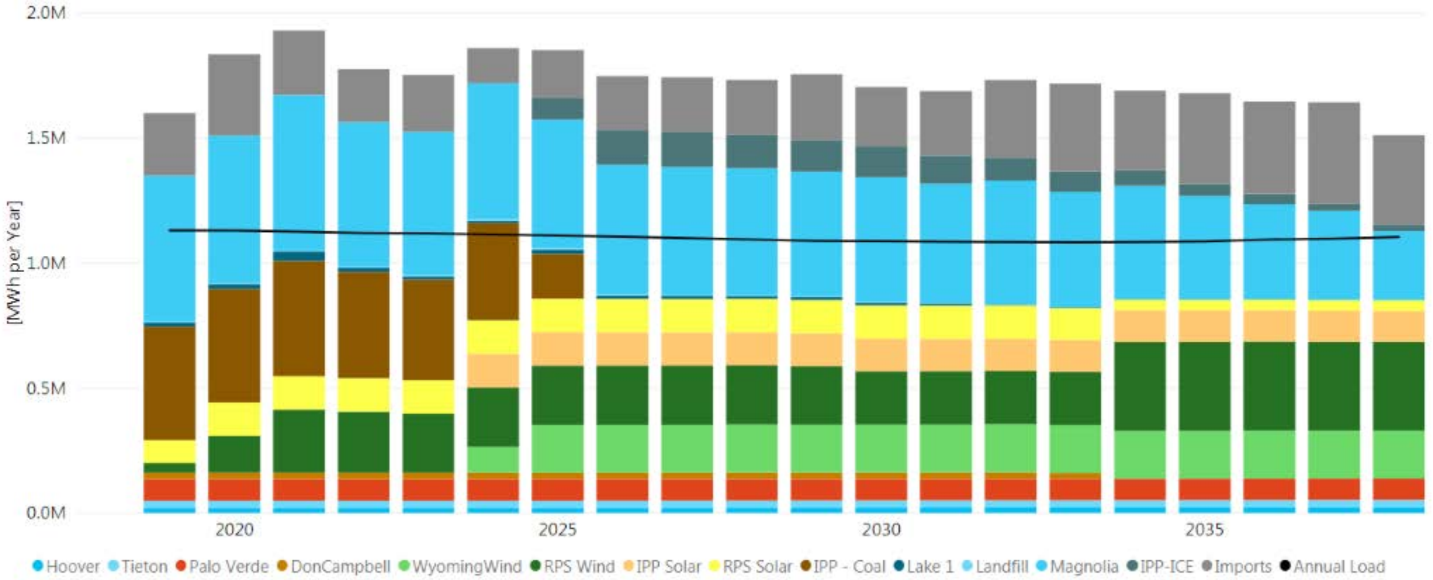


Figure 6.15: Energy Expansion Plan for SB100 Preferred Portfolio C.

6.4 Resource Adequacy

The term Resource Adequacy (RA) refers to ensuring the supply system has sufficient quantity and flexibility to support reliability. It has two forms: total installed capacity, and flexible operating capacity.

6.4.1 Installed Capacity

The installed capacity consideration of RA involves having enough total installed capacity to meet system peak demands. Because the various generation resources themselves have differing reliabilities, a system with relatively reliable resources can operate with a lower level of total installed capacity than a system with less reliable resources. Traditionally, RA has been expressed in terms of installed capacity reserve or reserve margin. This is the generation reserve above the annual peak demand, expressed as a percentage.

The various portfolios of resources were equalized in their system reliability using Loss of Load Hours (LOLH) calculations. Additional batteries were added to each portfolio as necessary to make their LOLH acceptable.

Appendix 3A, Capacity Resource Accounting Table, compares the reserve margins of the three Preferred Portfolios for SB100. Preferred Portfolio A features a reserve margin of about 8% to 11% over the planning period, compared to 22% to 27% for Preferred Portfolio B, and 12% to 16% for Preferred Portfolio C. This happens because, while the CAES technology in Preferred Portfolio A is reliable like the battery technologies of Preferred Portfolios B and C, the 48-hour storage capacity of the CAES is more reliable than the 4-hour storage capacity of the batteries. Similarly, ICE units in Preferred Portfolio C are more reliable than 4-hour batteries alone in Preferred Portfolio B.

6.4.2 Flexible Capacity

Flexible capacity refers to those supply resources that can operationally start up fast and ramp their output up or down quickly. This flexibility is increasingly important to integrate intermittent renewable energy resources.

Various supply resources have varying levels of flexibility. Baseload resources are designed to run constantly at high efficiencies. They are not very flexible in an operating sense. In contrast, at the other end of the flexibility spectrum batteries and particularly short-term (1/2-hour and 1-hour) batteries are very flexible.

The analysis determined the quantity of flexible capacity that was needed in each portfolio to reliably operate the system. Short-term ("ancillary services") batteries and associated costs were added to each portfolio as necessary to provide sufficient operational flexibility.

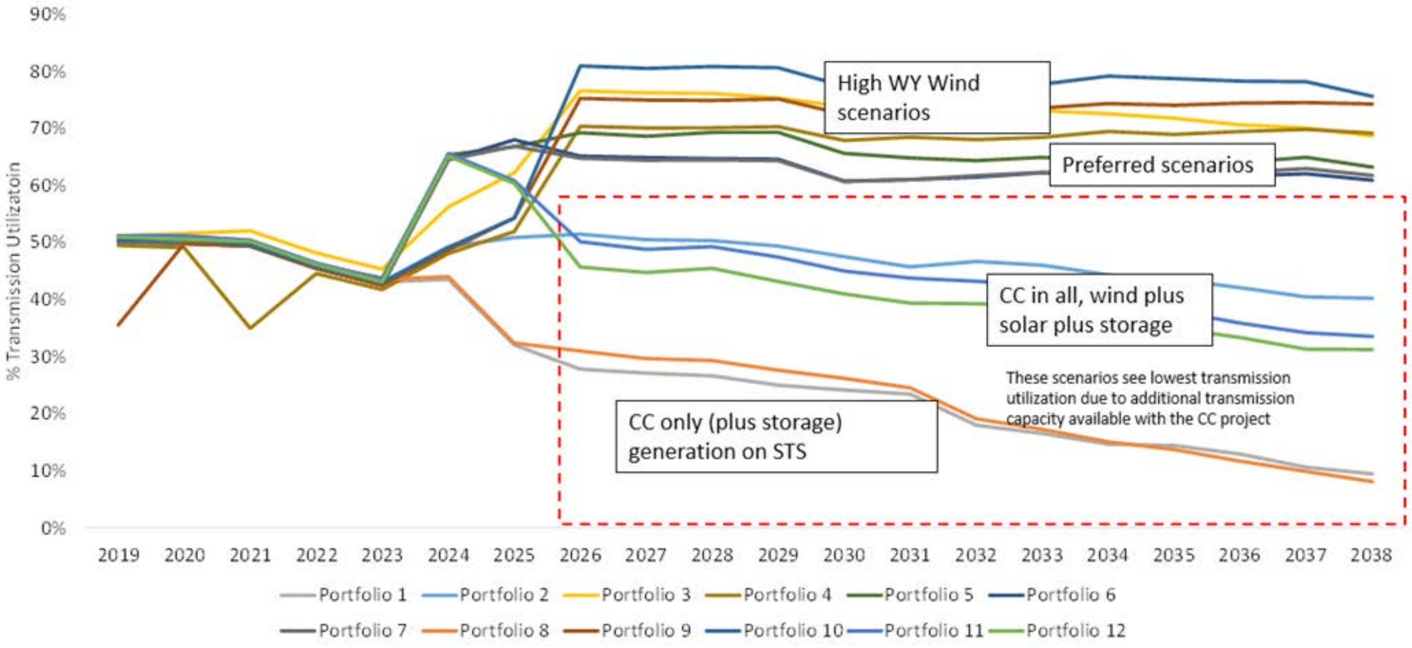


Figure 6.16: Annual Loading of BWP Allocation of STS Transmission Capacity for each SB350 Portfolio Evaluated. (Annual load factor in %)

6.5 STS Transmission Utilization

As noted earlier, the STS transmission line is an asset for BWP. Figure 6.16 provides an illustration of the various STS loading of BWP's allocation of STS achieved by the SB350 portfolios.

Figure 6.16 shows the portfolios with high levels of Wyoming wind had the best utilization of BWP's share of STS. Portfolios including the CC option and 126 MW allocation of STS for BWP had lower utilization.

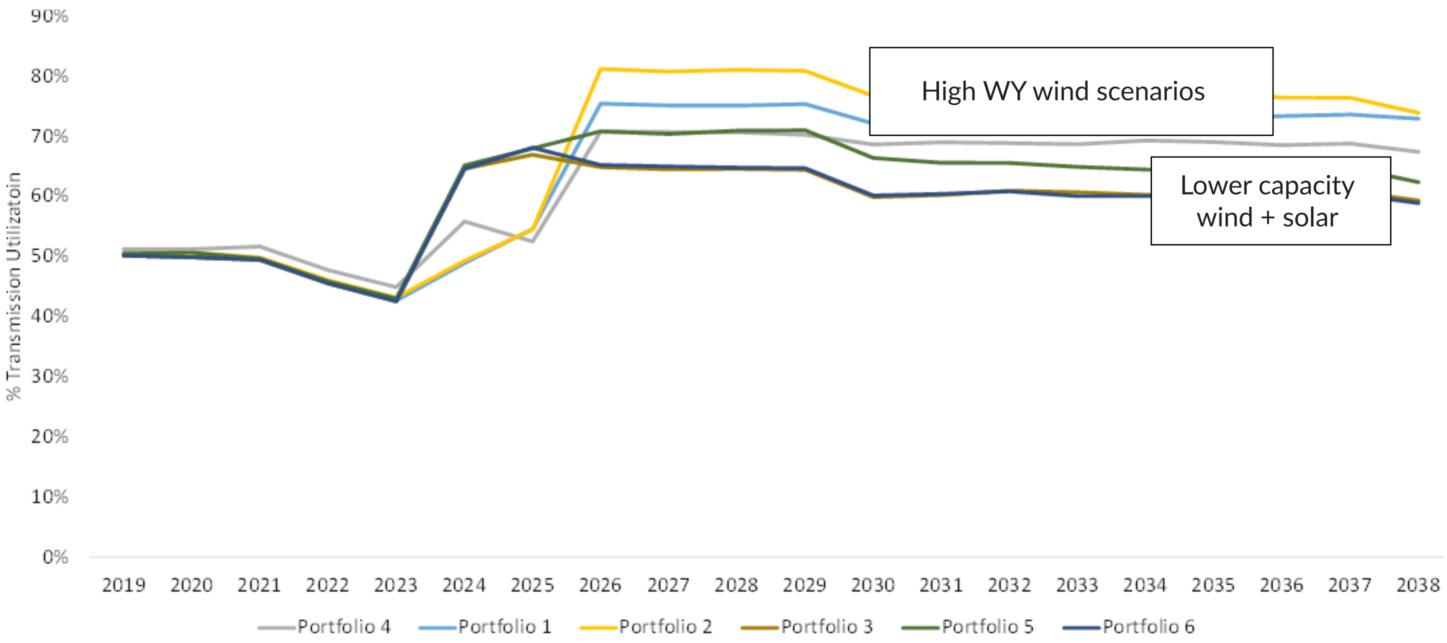


Figure 6.17: Loading of BWP Allocation of STS Transmission Capacity for each SB100 Portfolio Evaluated. (Annual load factor in %)

Figure 6.17 provides an illustration of the STS loading of BWP's allocation of STS achieved by the SB100 portfolios.

Figure 6.17 shows that the portfolios with storage at IPP (Portfolio "2", which is Preferred Portfolio A; and Portfolio 1, which is Preferred Portfolio B) achieve the highest utilization of BWP's allocation of STS capacity. Using renewable energy as fuel, their load factors exceed the forecasted STS load factor prior to IPP coal retirement in 2025.

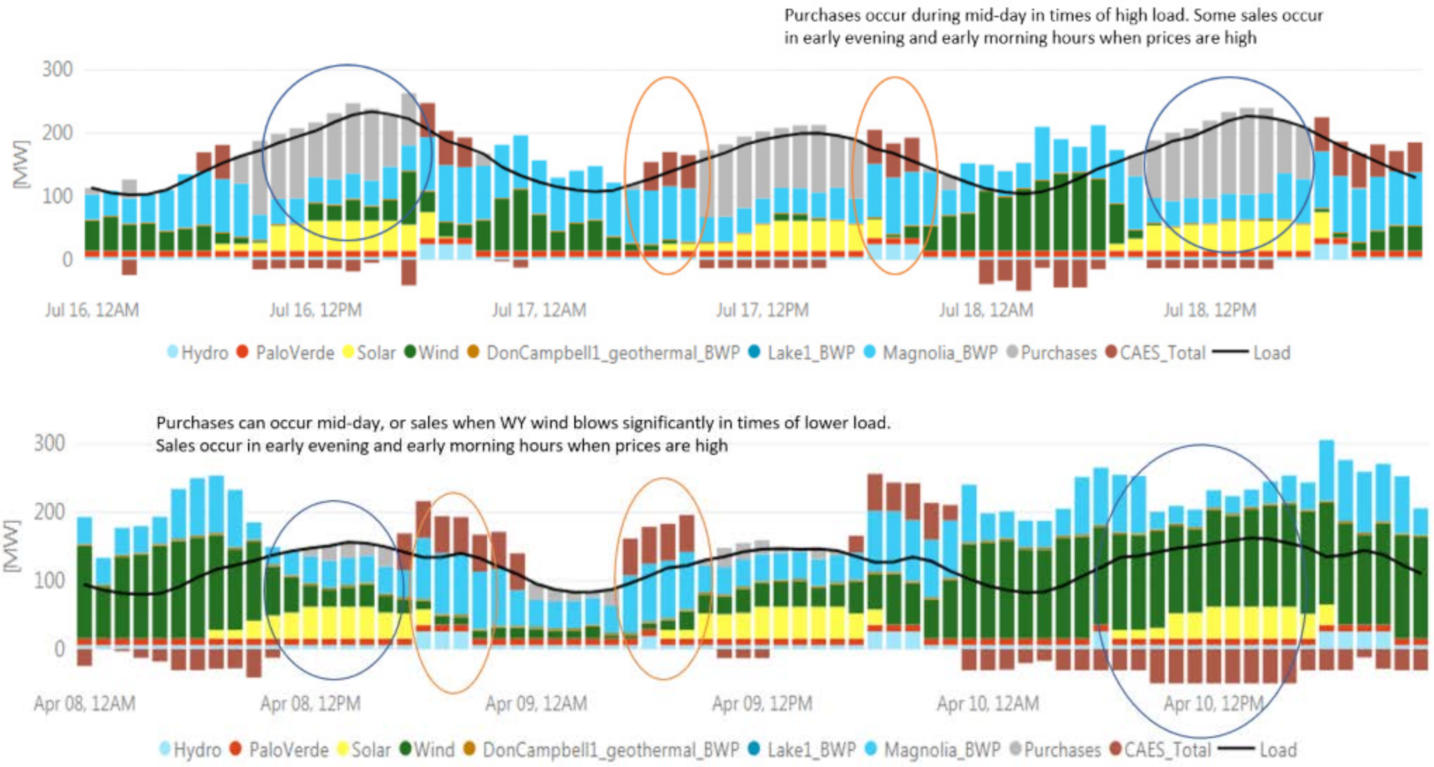
6.6 Over-Generation at High RPS Levels

The RPS is defined based on average energy use over the year. To fulfill the RPS requirements, an RPS of greater than 50% requires BWP to have installed renewable capacity exceeding its annual peak demand. This means it will have more renewable energy than it needs on many days of the year when peak demands are commonly lower than the annual peak demand.

Figure 6.18 illustrates this effect. The graph at the top of the Figure depicts the energy dispatch on a summer (high demand) week in July 2030. The graph at the bottom of the Figure depicts the energy dispatch on an April spring week with lower customer demands.

On summer days, the match between renewable supply and customer loads is manageable. However, on Spring days the non-dispatchable renewable output can exceed customer load. Considering that these modeling results for BWP are probably typical of that observed by other California utilities, the question is who would buy the over-generation when it occurs? The answer to this question is beyond the scope of individual utilities' IRPs.

Addressing it is one of the Action Items described in Chapter 7.



Purchases occur during mid-day in times of high load. Some sales occur in early evening and early morning hours when prices are high

Purchases can occur mid-day, or sales when WY wind blows significantly in times of lower load. Sales occur in early evening and early morning hours when prices are high

Figure 6.18 - SB350 Portfolio 10 Hourly Dispatch Sample in the Summer and Spring of 2030 (WY Wind + CAES)

6.7 Greenhouse Gas Emissions

The least-cost, Preferred Portfolios A, B and C for both the SB350 and SB100 futures all entail dramatic reductions in GHG gases compared to current levels: an estimated 87% reduction by the end of the planning period for the SB100 future.

The IRP analysis forecasts that the least-cost portfolios can achieve the CARB targets for Burbank GHG emissions in 2030 with only modest reductions in the operation of the Magnolia plant, which by then will be the primary source of GHG emissions in the BWP fleet. Figure 6.19 illustrates how Burbank's GHG emissions (in millions of metric tons per year) will drop with increasing renewable energy levels in the SB100 future over the period for the CC replacement project at IPP and the three Preferred Portfolios.

As shown on Figure 6.19, all the portfolios shown have GHG emission trends that fall below the CARB maximum limits in the mid-2030s; although not by the CARB target date of 2030. The primary driver of this trend following the retirement of IPP coal is increasing levels of renewables over time displacing the output of more and more fossil energy—either from the CC replacement plant if implemented, or BWP's share of the existing Magnolia plant.

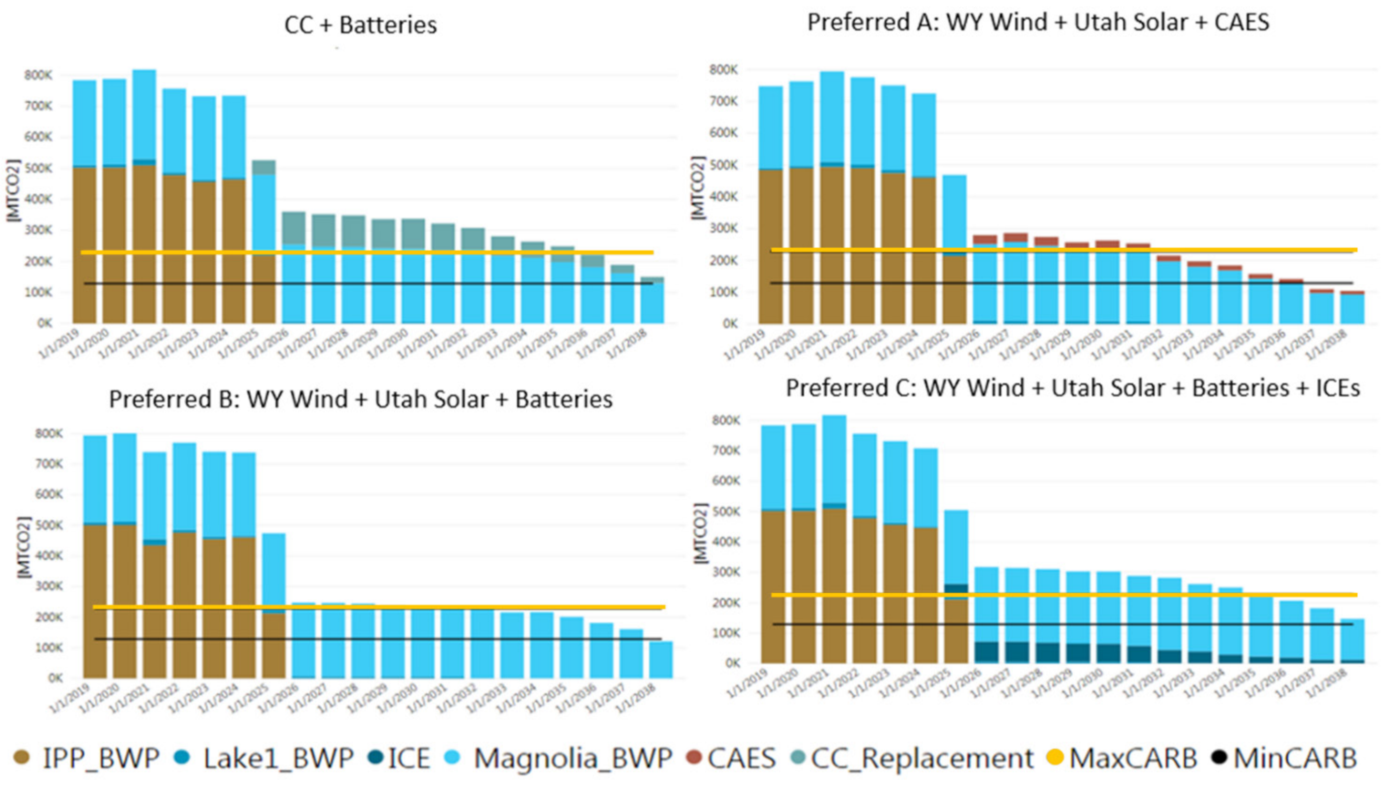


Figure 6.19: BWP GHG Emissions Reductions with Increasing Renewables in SB100 for CC Renewal project at IPP and the 3 IRP Preferred Portfolios.

6.8 Comparison of the IPP Replacement Options

Selection of the best IPP replacement option for BWP involves many factors to consider. Table 6.10 summarizes the various planning considerations in comparing the three Preferred Portfolios, and portfolios that include the CC option.

	Preferred A: Wind, Solar, CAES	**Preferred B: Wind, Solar, Batteries**	**Preferred C: Wind, Solar, ICEs, and Batteries**	**Combined Cycle at IPP**
Strengths	• Accommodates a large amount of renewables with long-duration storage • Large capacity Value	• Highly flexible resource • Big EIM market upside potential • Dramatically reducing cost curve • Low carbon	• Highly flexible resource • Big EIM market upside potential • Dispatchable resource available when needed	• Aligns with LADWP • Keeps BWP's transmission rights • Large capacity resource at IPP
Weaknesses	• Not as flexible as batteries or ICEs • CT emites GHGs	• Dependent on renewable output • Shorter duration than CAES	• Higher cost portfolio	• High cost • Do not need the energy
Risks	• Not many CAES units built before. Capital cost could be higher than we assumed here. • Does it fit in with 100% GHG free?	• Cost curves do not decline as fast as expected • Degradation of batteries is worse than expected	• Still thermal, so some risk of GHG regulation, but not much is needed	• Stranded asset risk

Table 6.10 – Summarizing the IPP Replacement Options.

6.9 Impact on BWP Customers' Rates

As a key aspect of this IRP, BWP examined the potential impact of these directional planning outcomes on Burbank customers' electric rates.

The IRP results depend on the future outcomes of many currently uncertain assumptions. These include, but are not limited to, the future availability and cost of renewables and transmission to get them to Burbank, the ability of BWP to share in large multi-participant projects to achieve economies of scale, and establishment of a regional or statewide ability to manage renewable integration cost-effectively. Assuming successful outcomes of these and other assumptions, it is BWP's goal to contain future electric rate increases at or below the long-run rate of inflation.

Chapter 7

Proposed Policy Guidelines and Action Items

BWP is committed to providing reliable, affordable, and sustainable electric service to Burbank. BWP does so in the context of state and federal regulatory mandates, local mandates, and under the direction of its Board and the Burbank City Council.

7.1 Policy Guidelines

Through the IRP process BWP has found that, while the business of providing Burbank with reliable, affordable, and sustainable electric service is changing rapidly, the policy guidelines for its business remain largely the same as approved in the 2015 IRP.

- BWP should continue to meet electricity demand growth from energy efficiency and conservation, then renewables. BWP does not plan any new fossil-fueled power generation, except as needed to cost-effectively integrate renewable energy and maintain reliability.
- BWP should optimize cost-effective energy efficiency and conservation programs.
- BWP should add renewable energy to the extent needed.
- BWP should plan to achieve greenhouse gas emissions reductions consistent with state goals.
- BWP should maintain low cost of service, including striving to maintain rate increases at or below the long-run rate of inflation.

7.2 Action Items

Consistent with these guidelines, the IRP includes the following action items:

a. **Rate Design.** Design time-varying rates that encourage customers to shift their consumption away from higher cost periods to lower cost periods.

b. **Demand Response (DR).** Consider cost-effective BWP customer DR programs.

c. **Beneficial Electrification.** Enhance and extend BWP efforts to encourage growth in beneficial electrification that reduces GHG emissions, including electric vehicles.

d. **Disadvantaged Communities.** Develop and implement a program to target disadvantaged communities with selected BWP energy efficiency, demand response, and beneficial electrification programs.

e. **IPP Coal Replacement.** Work with LADWP and other IPP participants to determine resources that will replace IPP coal plant when it is retired in 2025. Particular focus should be given to BWP's share in the STS transmission line from the IPP site in Utah to Southern California.

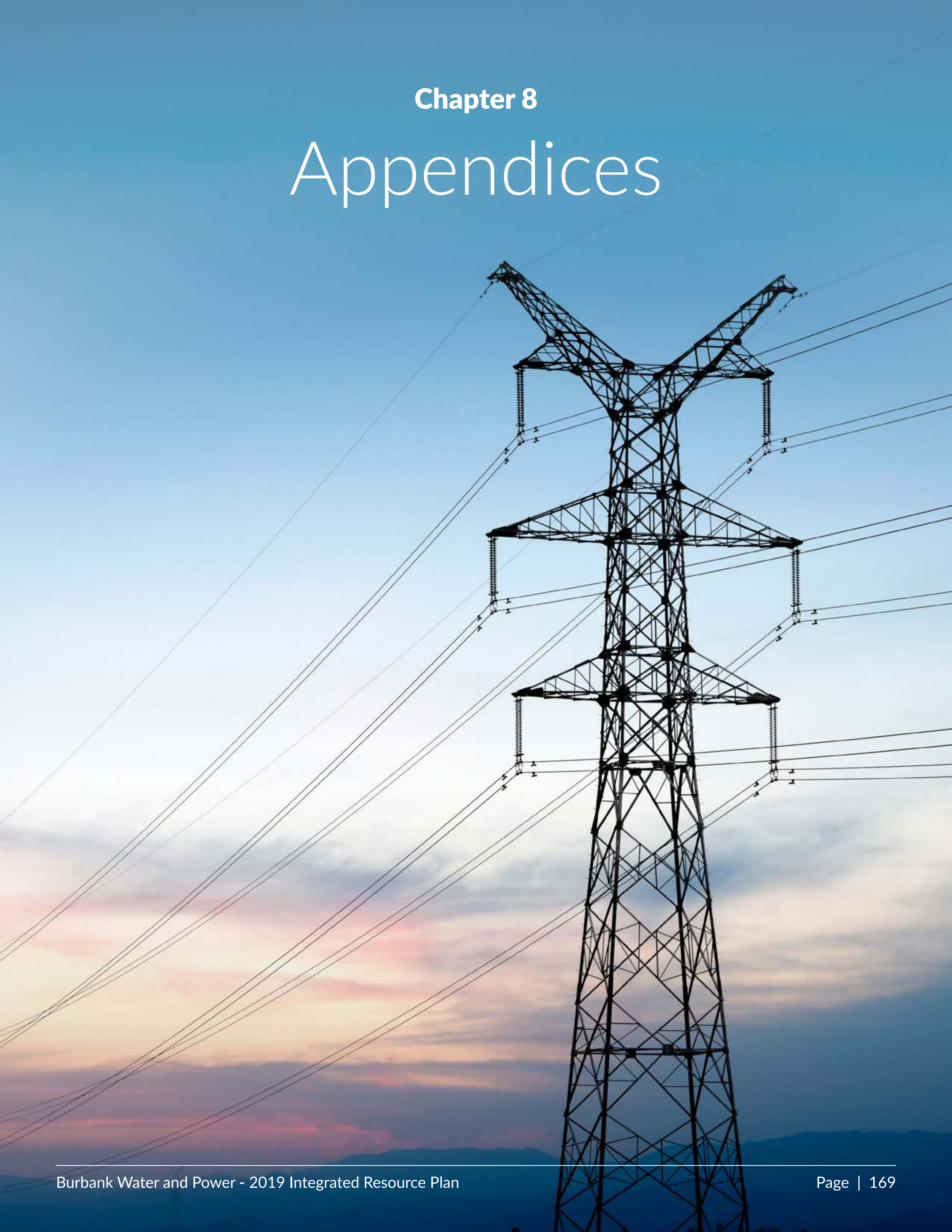
f. **Transmission Delivery for Renewables.** Identify options and costs for transmission delivery of large quantities of renewable energy resulting from SB100.

g. **Solar Over-Generation.** Work to mitigate the impact of solar generation (including morning and afternoon ramping, overgeneration, and instantaneous intermittency) such that reliability and affordability are maintained.

h. **EIM Participation.** Evaluate possible participation in the California Independent System Operator's (CAISO) Energy Imbalance Market (EIM) if and when BWP's Balancing Authority, LADWP, joins the EIM.

i. **Resource Positioning.** Position BWP's resources to work with the Duck Curve to the greatest extent possible to minimize costs and maximize reliability for Burbank. In this connection, evaluate further improvement in the operational flexibility of the Magnolia Power Project (MPP).

This IRP positions BWP to provide ***reliable, affordable, and sustainable*** electric service to Burbank for decades to come.



Chapter 8

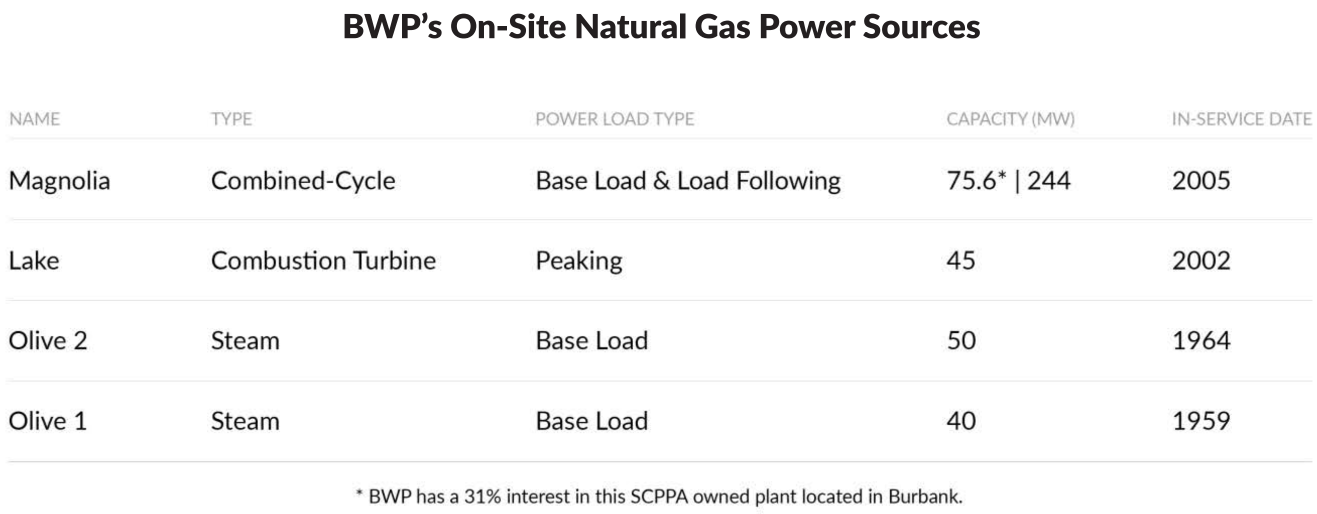
Appendices

Appendix 1. Generation

Power Generated in Burbank

Natural Gas-Fired Generation

Burbank has had local generation facilities for more than 80 years. BWP's current local generation resources are natural gas-fired units that went into service between 1959 and 2005.



BWP's On-Site Natural Gas Power Sources

NAME	TYPE	POWER LOAD TYPE	CAPACITY (MW)	IN-SERVICE DATE
Magnolia	Combined-Cycle	Base Load & Load Following	75.6* | 244	2005
Lake	Combustion Turbine	Peaking	45	2002
Olive 2	Steam	Base Load	50	1964
Olive 1	Steam	Base Load	40	1959

* BWP has a 31% interest in this SCPPA owned plant located in Burbank.

Table 8.1 – BWP's On-Site Natural Gas Power Sources
Source: BWP

Lake One (Peaking)

The Lake One unit, a 47 MW General Electric LM-6000 simple-cycle combustion turbine, went into service in 2002. At the time, the unit represented "best of class" combustion turbine technology.

Lake One is a peaking power plant. It often generates during hot summer days when loads are high and it serves as a reserve when it sits idle. The expected annual output of this unit for retail load is approximately 25,000 MWh per year, or about 2.1% of BWP's net energy load.

Magnolia Power Plant (Baseload/Load-Following)

In 2002, BWP participated in a Southern California Public Power Authority (SCPPA) combined-cycle generating plant that was built in and operated by Burbank known as the Magnolia Power Plant (Magnolia). In September 2005, this unit went into service using "best in class" natural gas combined-cycle technology. This unit can be used for either base-load or load-following power.

Magnolia is based on a General Electric 7FA combustion turbine. The term combined-cycle refers to how the plant recycles the waste heat from the combustion turbine, by turning it into steam and using it to power a steam turbine. The nominal output of the plant is 242 MW, but for limited periods it can be augmented with supplemental firing (similar to afterburners on military aircraft) and steam injection to produce up to 310 MW.

Burbank hosts and operates the plant and has an entitlement to 31% of the plant's output, approximately 75 MW (or up to 95 MW with afterburners). The efficiency of the facility is very high. Magnolia's average availability for Years 2013 – 2017 was 96%. The availability factor of a power plant is the percentage of the time the unit is actually able to operate. Magnolia generally always runs when available, while other plants may not. When compared to other utilities, Magnolia's 96% availability factor is excellent.

Olive 1 and 2 (Reserves)

The Olive 1 and 2 steam generating units are BWP's oldest existing units, and went into service in 1959 and 1964, respectively. Since 2012, Olive 1 and 2 have been placed in "dry-layup" for long term preservation of the boiler, condenser, turbine and related piping. The consequence is that these units would require at least 45 days of repair and refurbishment prior to starting again.

BWP is investigating options to replace Olive 1 and 2. The options and scenarios described in Chapter 6 of this IRP Report would accomplish this. BWP has studied replacing the units with combustion turbines similar to Lake One, internal combustion engines, renewables, storage (such as batteries), or a mix of technologies that could yield the flexibility required to operate in the future.

Power Generated Outside of Burbank

Nearly all of the power imported into Burbank is generated outside of California. BWP enters into long-term contracts for this power or jointly owns them with other municipal partners. This enables economies of scale needed to procure power at favorable prices, fund large projects, and obtain the most favorable financing rates.

BWP often participates with other municipally-owned electric utilities in Southern California through a Joint Powers Authority called the Southern California Public Power Authority (SCPPA) to develop and participate in new generation and transmission projects. SCPPA has been used by BWP to finance participation in the Southern Transmission System (STS), Palo Verde, Magnolia and Hoover. A similar agency based in Utah called the Intermountain Power Agency (IPA) was used to develop the Intermountain Power Project ("Intermountain") with the State of Utah.

Many of the power resources located outside of Burbank are provided via power supply agreements whose terms expire within the 20-year planning term of this IRP, as noted below. The analysis described in Chapter 6 includes these contract terminations and provides for their replacements over time.

Hoover Dam (Load-Following/Peaking/Reserves)	
Location	On the Colorado River along the Nevada-Arizona border.
Capacity	20 MW (of Hoover's 2,080 MW aggregate capacity).
Energy	26,600 MWh per year, plus the potential for a portion of any additional excess energy that might be available from high stream flows. In 1983, the Hoover uprating project allowed Burbank to add about 5 MW of capacity to Burbank's existing 15, for a total of 20.
Owner	U.S. Government, through the U.S. Bureau of Reclamation.
Operator	Western Area Power Administration. The energy is received via a contract with SCPPA
Term	This contract remains in effect until September 30, 2017. The parties taking power from this facility are currently negotiating the terms and conditions of receiving power from this facility after 2017.

Palo Verde Nuclear Generating Station (Baseload)	
Location	South of Phoenix, near Wintersburg, Arizona.
Capacity	9.5 MW, which is 4.4% of SCPPA's 216.5 MW interest (of Palo Verde's 4,010 MW aggregate capacity).
Energy	Approximately 70,000 MWh per year.
Operator	Arizona Public Service Company.
Term	This contract remains in effect until 2047.

Intermountain Power Project (Baseload and Transmission)	
Location	Delta, Utah.
Capacity	Approximately 74 MW (about 4% of the plant's 1,800 MW aggregate capacity).
Energy	576,000 MWh per year.
Owner	Intermountain Power Agency, an instrumentality of the State of Utah.
Operator	Intermountain is operated by the Los Angeles Department of Water and Power (LADWP) through an independent corporation called the Intermountain Service Corporation.
Term	The original term runs through July 15, 2027.

Intermountain is comprised of three assets:

1. 1,800 MW coal-fired, two-unit power plant located in Delta, Utah;
2. 490-mile 500 kilovolt (kV) direct current transmission line which transmits the electricity generated by the power plant in Delta to Southern California, known as the STS; and,
3. Two alternating current transmission lines which transmit the electricity from the power plant in Delta to delivery locations elsewhere in Utah (and a portion of Nevada), known as the NTS.

Intermountain has operated since the mid-1980s and serves 36 different municipal utilities in Utah and California, including Anaheim, Burbank, Glendale, Los Angeles, Pasadena, and Riverside (the purchasers). Los Angeles Department of Water and Power (LADWP), as the operating agent, operates and maintains Intermountain, the STS, and the NTS. LADWP purchases the majority of Intermountain's output. BWP's share of Intermountain is approximately 74 MW of electricity generation, 108 MW (north to south) of STS capacity, and 27 MW (north to south) of NTS capacity. BWP's share of the Intermountain is about 4%. The coal plant will be retired in 2025; repowering is discussed elsewhere in this IRP.

Valley Pumping Plant (Baseload)

In 2002, BWP installed a small micro-hydro system to take advantage of a required pressure reduction where the City's water facilities interface with the Metropolitan Water District of Southern California (MWD) at the Valley Pumping Plant. Peak output of the facility is approximately 550 kW. The micro-hydro system is used when BWP purchases water from MWD.

Ameresco Landfill Gas to Energy (Baseload)

In 2010, BWP began to receive 1.7 MW from the Ameresco Landfill Gas to Energy project pursuant to a long-term contract. This project produces energy by using landfill gas (methane) from the Chiquita Canyon Landfill, which is located approximately five miles west of the City of Santa Clarita along State Highway 126.

The facility consists of two small combustion turbines and produces approximately 10,500 MWh per year, which corresponds to nearly 1% of Burbank's annual requirements.

BWP's contract with Ameresco expires in November 2026, within the planning period of this IRP.

Pleasant Valley Wind (Intermittent)

In 2006, BWP signed a 16-year power purchase contract with PPM Energy, Inc. to purchase 5 MW of wind power from Pleasant Valley Wind Project, located in Southwest Wyoming. The project is owned by Florida Power & Light and marketed to BWP by PacifiCorp. The energy from this project amounts to 14,500 MWh annually, or approximately 1.2% of BWP's energy requirements.

The power sales agreement will expire in June 2022, within the planning period of this IRP.

Milford Wind I (Intermittent)

In 2009, BWP began receiving 10 MW of wind power from the Milford I Wind Project, located near Intermountain, under a long-term-contract. The 10 MW under this contract will supply 26,500 MWh annually, which is approximately 2.2% of BWP's energy requirements.

BWP has the option to purchase the Milford Wind I Project on the 10th or 20th year anniversary date after commercial operation began, i.e. 2019 and 2029.

The power sales agreement will expire in November 2029, within the planning period of this IRP.

Pebble Springs Wind (Intermittent)

In 2009, BWP began receiving 10 MW of wind power from the Pebble Springs Wind Project, located in northern Oregon, under a long-term-contract. Pebble Springs provides approximately 2.4% of BWP's energy requirements, or 29,000 MWh annually.

BWP has the option to purchase the Pebble Springs Wind Project on the 10th anniversary of the start of commercial operation, or 2019.

The power sales agreement will expire in November 2027, within the planning period of this IRP.

Tieton Hydro (Base-load)

In 2009, BWP began receiving 50% of the output of the Tieton Hydropower Facility, located in south-central Washington State. Then, later in 2009 the Cities of Burbank and Glendale purchased the facility via SCPPA. Burbank's 50% share in the facility provides approximately 24,000 MWh annually to Burbank, which is about 2% of BWP requirements.

Don A. Campbell I Geothermal (Baseload)

In 2013, BWP entered into a 20-year contract for geothermal power from a new development called Wild Rose Geothermal Project. Wild Rose has since been renamed Don A. Campbell. The project was built by global geothermal project developer, owner and operator Ormat Technologies, Inc. in Mineral County, Nevada. The facility went into commercial operation in 2013. Burbank has rights to 15.4% of the output, about 2.49 MW nominally and receives approximately 19,000 MWh annually.

The power sales agreement will expire in November 2033, within the planning period of this IRP.

Copper Mountain Solar 3 (Intermittent)

In late 2012, BWP entered into a 20-year contract for solar PV power from Copper Mountain. The project was built by Sempra U.S. Gas and Power near Boulder City, Nevada. The facility went into commercial operation in November 2013. Burbank has rights to 16% of the output, about 40 MW nominally, and receives approximately 86,000 MWh annually.

The power sales agreement will expire in 2033 and BWP has the option to purchase the facility at the 10th, 15th or 20th year anniversary date after commercial operation began.

Biomethane (Baseload/Load-Following)

In 2011, Burbank signed four separate contracts for a supply of pipeline quality biogas, referred to as biomethane, in support of BWP's RPS obligations.

Biomethane is a renewable form of natural gas, produced from landfills and sewage treatment plants. BWP burns this "green natural gas" in Magnolia in place of conventional natural gas. As such, biomethane is an important component of BWP's RPS compliance strategy, using the very efficient Magnolia right here in Burbank, without the need to utilize BWP's finite transmission resources to bring power from distant resources.

Each of these biomethane supply agreements runs for 10-years at a fixed cost. Under the contracts, BWP receives up to 3,000 Dth/day, generating approximately 150,000 MWh of renewable energy in a year or about 13% of Burbank's power supply.

Appendix 2. BWP's Transmission Rights

Pacific Northwest DC Intertie ("DC Intertie")	
Desorption	Double pole +/- 500 kV DC transmission system and extends a total of 850 miles. It has a maximum rating of 3,100 MW.
Location	From Celilo in northern Oregon to Sylmar, California.
BWP Share	115 MW of transmission capacity on a 580 mile segment of the line from the Nevada/Oregon Border (NOB) to Sylmar, California.
Use	The DC Intertie is primarily used to bring energy from Burbank's renewable resources in the Pacific Northwest region to Burbank, as well as make purchases or sales of energy to or from the region as available.

Southern Transmission System ("STS")	
Description	488-mile-long, double pole +/- 500 kV DC transmission system.
Location	From Intermountain in Central Utah to the Adelanto Switching Station near Victorville in Southern California.
BWP Share	108 MW (4.5%) of capacity on the STS based upon a line rating of 2,400 MW. STS is part of Intermountain described previously.
Use	The line is primarily used to bring Burbank's power entitlements from Intermountain as well as power from Milford Wind to the Los Angeles Basin. The line has secondary uses of bringing economy energy from Utah and Nevada to the L.A. basin.

Northern Transmission System (“NTS”)	
Description	Two, 50-mile long, 345 kV AC lines.
Location	From Intermountain to Mona Substation in Utah and to the Gonder Substation in Nevada.
BWP Share	Up to 38 MW of firm capacity and energy on the NTS. NTS is also part of Intermountain described previously.
Use	The line was built to move Intermountain power to Utah entities. However, when those entities signed the Excess Power Sales Agreement they had no use for a portion of the line, so the California entities involved in the project were able to acquire the rights. These lines are primarily used for wholesale trading and buying short-term power from the market when it is attractively priced.

McCullough –Victorville Line 2	
Description	180-mile 500 kV AC transmission line.
Location	From the McCullough transmission hub near Las Vegas to Victorville, California.
BWP Share	In 1980, Burbank acquired a 2.5% entitlement, which corresponds to 25 MW of capacity based on the line’s current rating and continues until May 31, 2030.
Use	Burbank uses this line to make power transactions with entities in Nevada, New Mexico, and Arizona.

Hoover Transmission Service Agreement with LADWP	
Description	An agreement with LADWP to bring Hoover power from the plant to Burbank.
Location	LADWP's transmission system between Southern Nevada to the Los Angeles basin.
BWP Share	January 1992, BWP entered into a firm transmission service contract with LADWP for the delivery of BWP's total Hoover entitlement of 20 MW of firm capacity to Receiving Station E ("RS-E").
Use	BWP brings Hoover power into the LADWP System through this service agreement for delivery to Burbank. The contract expires on September 30, 2017, coincident with the expiration of Burbank's Hoover entitlement agreements. Negotiations are underway to renew this contract.

Intermountain Transmission Service Agreement with LADWP	
Description	This is a contract with LADWP to provide 84 MW of firm transmission service.
Location	Power is received at the 500 kV bus of Adelanto Switching Station and delivered to RS-E.
BWP Share	This contract expires on June 15, 2027, coincident with Burbank's Intermountain entitlement contract expiration.
Use	This contract allows a path for BWP's Intermountain entitlement, as well as some extra firm transmission capacity for transactions with other utilities in Utah and Nevada.

Victorville-Receiving Station E ("RS-E") Transmission Service Agreement with LADWP	
Description	This contract with LADWP provides 25 MW of firm transmission service.
Location	Power is received at the 500 kV bus of the Adelanto Switching Station or the 500 kV bus of the Victorville Switching Station and delivered to RS-E.
BWP Share	This contract will expire on May 31, 2030, coincident with the expiration of Burbank's rights and entitlement in the McCullough-Victorville line 2.
Use	BWP uses this arrangement to match BWP's rights and entitlement in the McCullough-Victorville line 2.

Marketplace-Adelanto Transmission Service	
Description	A 500 kV transmission line.
Location	The Marketplace-Adelanto 500 kV transmission line runs from the new Marketplace Substation, approximately 17 miles southwest of Boulder City, Nevada, to the vicinity of Adelanto, California.
BWP Share	The line is rated at 1,200 MW and BWP has an entitlement to 11.5% of the 67.9% interest held in the project by SCPPA, which results in approximately 94 MW of capacity for BWP.
Use	In addition to this entitlement, the transmission arrangement also provides Burbank access to the McCullough Substation, which is connected by a short tie-line to the Marketplace Substation. It provides for greater flexibility by allowing BWP to conduct transactions from both locations.

Adelanto-Receiving Station E ("RS-E") Transmission Service Agreement with LADWP for Mead-Adelanto Project	
Description	This Agreement provides up to 94 MW of transmission service over the LADWP Transmission System.
Location	The RS-E Agreement provides an arrangement between Adelanto and Burbank for power transmitted over the Marketplace-Adelanto project.
BWP Share	Under the Agreement, Burbank can adjust the amount of transmission capacity it receives up to a total of 94 MW.
Use	This contract is open-ended and can continue at Burbank's discretion as long as the Marketplace-Adelanto transmission line remains in-service.

Marketplace-Mead 500/230 kV-Westwing Transmission Service	
Description	This agreement provides for transmission service between the Westwing Substation in Arizona near Phoenix, to the Mead Substation in Nevada near Las Vegas, to the Marketplace Substation which is also located in near Las Vegas.
Location	This transmission service is comprised of three different legs incorporating the Marketplace Substation, the Mead and McCullough Substations, and the Westwing and Perkins Substations northwest of Phoenix, Arizona.
BWP Share	In the Marketplace to Mead 500 kV leg, Burbank has rights to 70 MW of firm capacity, which corresponds to 16.9% of SCPPA's 22.4% interest in this section. In the Mead Substation portion, Burbank has rights to 35 MW corresponding to 15.9% of SCPPA's 17.8% interest. In the Mead to Westwing section, which goes through the Perkins Substation, Burbank has the majority interest with 35 MW derived from a 14.7059% interest in SCPPA's 18.3077% ownership in this section.
Use	The line is used to bring BWP's Palo Verde entitlements home and also for acquiring short-term power purchases from the region whenever it is economic do so.

Sylmar-Receiving Station E Transmission Service Agreement with LADWP for the Pacific Northwest DC Intertie	
Description	This agreement provides for transmission service on the LADWP Beltline transmission system between Sylmar and Burbank.
Use	Burbank uses it to bring up to 100 MW of transmission service associated with the DC Intertie from the Sylmar DC facilities to RS-E substation. Burbank has negotiated an agreement with LADWP to restore Burbank's access rights to CAISO's market through this Sylmar substation. That agreement became effective in January 2016.

Appendix 3. Standardized Tables

3A: Capacity Resource Accounting Table (CRAT): Preferred Portfolio A

(Megawatts)

Capacity Expansion: Preferred A																					
Asset	ELCC	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Magnolia	100%	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
IPP - Coal	100%	74	74	74	74	74	74	37													
CAES	100%							27	54	54	54	54	54	54	54	54	54	54	54	54	54
IPP - ICE	100%																				
IPP - Battery	88%																				
Burbank - Battery	88%							14	27	27	27	27	27	27	27	27	27	27	27	27	27
Wyoming Wind	30%						14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
RPS Wind	30%		9	17	17	17	17	17	17	17	17	17	17	17	17	17	29	29	29	29	29
Current Wind	30%	17	17	17	17	15	15	15	15	15	3	3	0	0	0	0	0	0	0	0	0
IPP Solar	30%	0	0	0	0	0	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
RPS Solar	30%	0	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Current Solar	30%	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	0	0	0	0	0
Hoover	100%	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Tieton*	100%	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Palo Verde	100%	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Don Campbell*	100%	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Landfill	100%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lake 1	100%	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Demand Response	100%	0	1	2	4	7	11	13	14	15	16	17	18	19	20	21	22	23	24	24	25
Peak Demand with EE		307	306	306	307	310	310	309	308	308	308	308	308	308	306	307	307	307	307	307	306
Peak Demand without EE		308	306	306	308	310	311	310	309	309	309	310	310	310	308	309	309	309	309	309	307
Total Supply Capacity		277	292	301	304	305	333	339	343	344	333	334	332	333	334	335	336	337	338	339	340
Reserve Margin with EE		-10%	-4%	-2%	-1%	-1%	7%	10%	11%	12%	8%	8%	8%	8%	9%	9%	10%	10%	10%	11%	11%
Reserve Margin without EE		-10%	-4%	-2%	-1%	-2%	7%	9%	11%	11%	8%	8%	7%	8%	9%	9%	9%	9%	10%	10%	11%
LOLH/Year																					
* Summer Capacity																					

3A: Capacity Resource Accounting Table (CRAT): Preferred Portfolio B

(Megawatts)

Capacity Expansion: Preferred B																					
Asset	ELCC	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Magnolia	100%	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
IPP - Coal	100%	74	74	74	74	74	74	37													
CAES	100%																				
IPP - ICE	100%																				
IPP - Battery	88%							50	99	99	99	99	99	99	99	99	99	99	99	99	99
Burbank - Battery	88%							15	30	30	30	30	30	30	30	30	30	30	30	30	30
Wyoming Wind	30%						14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
RPS Wind	30%		9	17	17	17	17	17	17	17	17	17	17	17	17	17	29	29	29	29	29
Current Wind	30%	17	17	17	17	15	15	15	15	15	3	3	0	0	0	0	0	0	0	0	0
IPP Solar	30%						11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
RPS Solar	30%		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Current Solar	30%	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	0	0	0	0	0
Hoover	100%	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Tieton*	100%	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Palo Verde	100%	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Don Campbell*	100%	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Landfill	100%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lake 1	100%	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Demand Response	100%	0	1	2	4	7	11	13	14	15	16	17	18	19	20	21	22	23	24	24	25
Peak Demand with EE		307	306	306	307	310	310	309	308	308	308	308	308	308	306	307	307	307	307	307	306
Peak Demand without EE		308	306	306	308	310	311	310	309	309	309	310	310	310	308	309	309	309	309	309	307
Total Supply Capacity		277	292	301	304	305	333	363	392	393	382	383	381	382	382	383	385	386	387	388	389
Reserve Margin with EE		-10%	-4%	-2%	-1%	-1%	7%	17%	27%	27%	24%	24%	24%	24%	25%	25%	25%	26%	26%	26%	27%
Reserve Margin without EE		-10%	-4%	-2%	-1%	-2%	7%	17%	27%	27%	23%	24%	23%	23%	24%	24%	25%	25%	25%	26%	26%
LOLH/Year																					

* Summer Capacity

3A: Capacity Resource Accounting Table (CRAT): Preferred Portfolio C

(Megawatts)

		Capacity Expansion: Preferred C																			
Asset	ELCC	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Magnolia	100%	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
IPP - Coal	100%	74	74	74	74	74	74	37													
CAES	100%																				
IPP - ICE	100%							27	54	54	54	54	54	54	54	54	54	54	54	54	54
IPP - Battery	88%							22	44	44	44	44	44	44	44	44	44	44	44	44	44
Burbank - Battery	88%						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wyoming Wind	30%						14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
RPS Wind	30%		9	17	17	17	17	17	17	17	17	17	17	17	17	17	29	29	29	29	29
Current Wind	30%	17	17	17	17	15	15	15	15	15	3	3	0	0	0	0	0	0	0	0	0
IPP Solar	30%						11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
RPS Solar	30%		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Current Solar	30%	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	0	0	0	0	0
Hoover	100%	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Tieton*	100%	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Palo Verde	100%	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Don Campbell*	100%	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Landfill	100%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lake 1	100%	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Demand Response	100%	0	1	2	4	7	11	13	14	15	16	17	18	19	20	21	22	23	24	24	25
Peak Demand with EE		307	306	306	307	310	310	309	308	308	308	308	308	308	306	307	307	307	307	307	306
Peak Demand without EE		308	306	306	308	310	311	310	309	309	309	310	310	310	308	309	309	309	309	309	307
Total Supply Capacity		277	292	301	304	305	333	347	360	361	350	351	349	350	351	352	353	354	355	356	357
Reserve Margin with EE		-10%	-4%	-2%	-1%	-1%	7%	12%	17%	17%	14%	14%	13%	14%	15%	15%	15%	15%	16%	16%	17%
Reserve Margin without EE		-10%	-4%	-2%	-1%	-2%	7%	12%	17%	17%	13%	13%	13%	13%	14%	14%	15%	15%	15%	15%	16%
LOLH/Year																					

* Summer Capacity

3B: Energy Balance Accounting Table (EBAT): Preferred Portfolio A

(Megawatt-Hours)

Energy Expansion: Preferred A																				
Asset	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Magnolia	570,875	576,557	617,406	569,786	548,315	509,907	485,046	482,066	492,927	474,152	451,565	453,815	426,691	381,387	352,192	294,662	267,682	217,121	159,925	162,372
IPP - Coal	455,493	459,064	461,933	427,421	403,966	389,772	180,137	0	0	0	0	0	0	0	0	0	0	0	0	0
CAES	0	0	0	0	0	0	0	30,796	30,801	30,454	29,410	31,514	30,256	20,038	18,427	16,997	16,264	15,239	13,474	12,104
IPP - ICE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IPP - Battery	0	0	0	0	0	0	0	(13,560)	(13,461)	(13,241)	(12,916)	(13,942)	(13,267)	(8,422)	(8,029)	(7,410)	(6,956)	(6,241)	(5,604)	(5,083)
Wyoming Wind	0	0	0	0	0	102,967	191,487	191,487	191,487	192,063	191,487	191,487	191,487	192,063	191,487	191,487	191,487	192,063	191,487	191,487
RPS Wind	75,865	183,574	288,772	280,397	273,126	273,635	273,129	273,125	273,127	236,917	233,730	212,923	212,923	213,221	212,922	355,856	355,854	356,552	355,857	355,854
IPP Solar	0	0	0	0	0	135,794	134,843	133,899	132,962	132,031	131,107	130,189	129,278	128,373	127,475	126,582	125,696	124,816	123,943	123,075
RPS Solar	91,137	133,744	133,632	133,632	133,632	133,744	133,632	133,632	133,632	133,744	133,632	133,632	133,632	133,737	127,165	42,495	42,495	42,594	42,495	42,495
Hoover	20,934	20,941	20,938	20,942	20,940	20,941	20,928	21,153	21,364	21,578	21,794	22,011	22,232	22,454	22,678	22,905	23,135	23,364	23,599	23,826
Tieton	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845
Palo Verde	85,848	86,083	85,848	85,848	85,848	86,083	85,848	85,848	85,848	86,083	85,848	85,848	85,848	86,083	85,848	85,848	85,848	86,083	85,848	85,848
Don Campbell	26,230	26,352	26,254	26,255	26,256	26,352	26,255	26,256	26,255	26,352	26,256	26,256	26,256	26,352	23,352	0	0	0	0	0
Landfill	4,818	4,831	4,813	4,818	4,816	4,830	4,666	4,788	4,782	4,792	4,781	4,756	0	0	0	0	0	0	0	0
Lake 1	15,135	18,659	37,005	14,988	13,460	9,335	22,218	16,209	14,244	12,570	13,986	12,633	10,965	5,255	4,040	2,773	1,868	1,430	878	660
Net Energy for Load	1,131,017	1,130,895	1,125,830	1,120,272	1,119,348	1,114,973	1,110,388	1,105,523	1,100,398	1,094,837	1,089,478	1,087,672	1,085,843	1,084,303	1,083,035	1,084,297	1,086,976	1,094,485	1,098,195	1,104,836
Total Supply	1,375,181	1,538,648	1,705,448	1,592,932	1,539,204	1,722,204	1,587,035	1,414,545	1,422,813	1,366,341	1,339,525	1,319,970	1,285,147	1,229,385	1,186,403	1,161,040	1,132,219	1,081,867	1,020,747	1,021,483
Net Position	244,164	407,753	579,618	472,660	419,856	607,231	476,647	309,022	322,415	271,504	250,047	232,298	199,304	145,082	103,368	76,743	45,243	(12,618)	(77,448)	(83,353)

3B: Energy Balance Accounting Table (EBAT): Preferred Portfolio B

(Megawatt-Hours)

Energy Expansion: Preferred B																				
Asset	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Magnolia	583,259	590,455	621,599	578,557	572,443	545,120	515,226	520,952	513,782	509,756	499,128	500,753	481,228	497,497	463,106	453,918	415,003	385,246	353,029	281,315
IPP - Coal	454,581	454,650	461,871	426,850	402,091	388,695	178,994	0	0	0	0	0	0	0	0	0	0	0	0	0
CAES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IPP - ICE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IPP - Battery	0	0	0	0	0	0	0	(14,807)	(14,988)	(14,902)	(14,568)	(15,662)	(15,656)	(12,773)	(12,597)	(12,506)	(12,212)	(12,610)	(12,405)	(12,658)
Wyoming Wind	0	0	0	0	0	102,967	191,487	191,487	191,487	192,063	191,487	191,487	191,487	192,063	191,487	191,487	191,487	192,063	191,487	191,487
RPS Wind	75,865	183,574	288,772	280,397	273,126	273,635	273,129	273,125	273,127	236,917	233,730	212,923	212,923	213,221	212,922	355,856	355,854	356,552	355,857	355,854
IPP Solar	0	0	0	0	0	135,794	134,843	133,899	132,962	132,031	131,107	130,189	129,278	128,373	127,475	126,582	125,696	124,816	123,943	123,075
RPS Solar	91,137	133,744	133,632	133,632	133,632	133,744	133,632	133,632	133,632	133,744	133,632	133,632	133,632	133,737	127,165	42,495	42,495	42,594	42,495	42,495
Hoover	20,934	20,941	20,939	20,941	20,940	20,942	20,941	21,153	21,363	21,578	21,794	22,011	22,231	22,454	22,679	22,906	23,135	23,366	23,596	23,834
Tieton	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845
Palo Verde	85,848	86,083	85,848	85,848	85,848	86,083	85,848	85,848	85,848	86,083	85,848	85,848	85,848	86,083	85,848	85,848	85,848	86,083	85,848	85,848
DonCampbell	26,228	26,352	26,255	26,255	26,255	26,351	26,254	26,256	26,256	26,352	26,256	26,256	26,256	26,352	23,352	0	0	0	0	0
Landfill	4,818	4,831	4,813	4,818	4,814	4,830	4,653	4,792	4,792	4,804	4,790	4,764	0	0	0	0	0	0	0	0
Lake 1	14,972	18,798	37,058	15,052	13,381	9,417	22,609	16,329	14,403	12,660	14,223	12,701	10,968	5,584	3,998	2,704	1,870	1,413	841	619
Net Energy for Load	1,131,017	1,130,895	1,125,830	1,120,272	1,119,348	1,114,973	1,110,388	1,105,523	1,100,398	1,094,837	1,089,478	1,087,672	1,085,843	1,084,303	1,083,035	1,084,297	1,086,976	1,094,485	1,098,195	1,104,836
Total Supply	1,386,488	1,548,272	1,709,632	1,601,194	1,561,376	1,756,423	1,616,462	1,421,512	1,411,512	1,369,931	1,356,272	1,333,749	1,307,040	1,321,436	1,274,279	1,298,135	1,258,022	1,228,368	1,193,536	1,120,714
Net Position	255,471	417,377	583,802	480,922	442,028	641,450	506,074	315,989	311,114	275,094	266,794	246,077	221,197	237,133	191,244	213,838	171,046	133,883	95,341	15,878

3B: Energy Balance Accounting Table (EBAT): Preferred Portfolio C

(Megawatt-Hours)

	Energy Expansion: Preferred C																			
Asset	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Magnolia	583,432	589,931	621,299	578,320	572,767	545,056	514,964	518,465	512,060	507,745	497,456	497,942	478,782	495,629	462,102	453,534	414,648	380,694	357,098	275,911
IPP - Coal	454,619	454,283	462,072	426,852	402,350	388,893	179,301	0	0	0	0	0	0	0	0	0	0	0	0	0
CAES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IPP - ICE	0	0	0	0	0	0	88,686	140,559	140,718	133,549	125,351	124,026	112,865	92,532	82,872	61,880	49,260	41,800	26,484	26,371
IPP - Battery	0	0	0	0	0	0	0	(10,449)	(10,610)	(10,554)	(10,356)	(10,872)	(10,985)	(9,361)	(9,297)	(9,376)	(9,209)	(9,456)	(9,436)	(9,557)
Wyoming Wind	0	0	0	0	0	102,967	191,487	191,487	191,487	192,063	191,487	191,487	191,487	192,063	191,487	191,487	191,487	192,063	191,487	191,487
RPS Wind	75,865	183,574	288,772	280,397	273,126	273,635	273,129	273,125	273,127	236,917	233,730	212,923	212,923	213,221	212,922	355,856	355,854	356,552	355,857	355,854
IPP Solar	0	0	0	0	0	135,794	134,843	133,899	132,962	132,031	131,107	130,189	129,278	128,373	127,475	126,582	125,696	124,816	123,943	123,075
Solar	91,137	133,744	133,632	133,632	133,632	133,744	133,632	133,632	133,632	133,744	133,632	133,632	133,632	133,737	127,165	42,495	42,495	42,594	42,495	42,495
Hoover	20,932	20,941	20,938	20,941	20,939	20,941	20,939	21,153	21,361	21,577	21,792	22,011	22,232	22,452	22,677	22,905	23,135	23,365	23,598	23,832
Tieton	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845
Palo Verde	85,848	86,083	85,848	85,848	85,848	86,083	85,848	85,848	85,848	86,083	85,848	85,848	85,848	86,083	85,848	85,848	85,848	86,083	85,848	85,848
Don Campbell	26,231	26,352	26,255	26,256	26,256	26,352	26,255	26,256	26,256	26,352	26,256	26,256	26,256	26,352	23,352	0	0	0	0	0
Landfill	4,818	4,831	4,813	4,818	4,814	4,830	4,656	4,754	4,752	4,762	4,744	4,691	0	0	0	0	0	0	0	0
Lake 1	14,952	18,876	37,077	15,099	13,506	9,402	17,544	12,649	11,289	10,190	11,248	10,037	8,842	3,065	2,586	1,565	774	735	564	307
Net Energy for Load	1,131,017	1,130,895	1,125,830	1,120,272	1,119,348	1,114,973	1,110,388	1,105,523	1,100,398	1,094,837	1,089,478	1,087,672	1,085,843	1,084,303	1,083,035	1,084,297	1,086,976	1,094,485	1,098,195	1,104,836
Total Supply	1,386,680	1,547,459	1,709,553	1,601,008	1,562,085	1,756,541	1,700,131	1,560,225	1,551,727	1,503,305	1,481,141	1,457,016	1,420,006	1,412,991	1,358,035	1,361,621	1,308,833	1,268,091	1,226,782	1,144,468
Net Position	255,663	416,564	583,723	480,736	442,737	641,568	589,743	454,702	451,329	408,468	391,663	369,344	334,163	328,688	275,000	277,324	221,857	173,606	128,587	39,632

3C: Greenhouse Gas Emissions Accounting Table (GEAT): Preferred Portfolio A

(Metric Tons CO2 Equivalent)

	Emissions: Preferred A																			
Asset	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Magnolia	270,808	272,530	289,403	270,020	260,793	244,821	233,248	232,765	238,413	229,680	219,521	220,965	209,112	186,703	173,301	147,920	136,088	113,687	88,006	88,506
IPP - Coal	507,778	511,163	513,274	483,513	463,329	451,490	212,361													
CAES								26,745	26,739	26,440	25,540	27,267	26,187	17,345	15,952	14,716	14,076	13,168	11,648	10,446
IPP - ICE																				
Lake 1	9,166	11,387	22,923	9,166	8,254	5,668	13,716	9,803	8,628	7,487	8,354	7,619	6,580	3,190	2,425	1,647	1,110	857	524	396
(Units in MTCO2e)																				
Total GHG Emissions	748,250	763,448	794,749	776,343	750,722	725,266	469,219	279,808	286,470	274,148	257,265	263,036	253,914	215,693	197,433	184,658	157,687	141,980	109,917	104,415
Distance From Target	520,250	535,448	566,749	548,343	522,722	497,266	241,219	51,808	58,470	46,148	29,265	35,036	25,914	(12,307)	(30,567)	(43,342)	(70,313)	(86,020)	(118,083)	(123,585)
Upper 2030 CARB Target	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000
Lower 2030 CARB Target	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000

3C: Greenhouse Gas Emissions Accounting Table (GEAT): Preferred Portfolio B

(Metric Tons CO2 Equivalent)

	Emissions: Preferred B																			
Asset	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Magnolia	276,083	278,636	290,888	273,548	272,057	261,246	246,906	250,655	247,757	246,235	242,102	243,295	235,051	242,304	226,323	224,118	205,895	192,565	178,649	141,606
IPP - Coal	506,992	507,338	513,213	483,016	461,689	450,554	211,367													
CAES																				
IPP - ICE																				
Lake 1	9,069	11,464	22,946	9,206	8,206	5,729	13,918	9,884	8,728	7,556	8,510	7,669	6,593	3,411	2,399	1,613	1,110	847	500	371
(Units in MTCO2e)																				
Total GHG Emissions	784,069	788,296	818,056	756,683	732,286	708,721	466,709	255,365	251,592	249,915	246,363	246,628	237,701	241,416	224,537	221,995	202,495	188,060	171,789	135,467
Distance From Target	556,069	560,296	590,056	528,683	504,286	480,721	238,709	27,365	23,592	21,915	18,363	18,628	9,701	13,416	(3,463)	(6,005)	(25,505)	(39,940)	(56,211)	(92,533)
Upper 2030 CARB Target	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000
Lower 2030 CARB Target	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000

3C: Greenhouse Gas Emissions Accounting Table (GEAT): Preferred Portfolio C

(Metric Tons CO2 Equivalent)

	Emissions: Preferred C																			
Asset	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Magnolia	276,149	278,425	290,762	273,450	272,177	261,198	246,832	249,155	246,546	244,966	240,961	241,514	233,407	241,541	225,956	223,952	205,670	190,119	180,655	138,734
IPP - Coal	507,030	507,021	513,378	483,019	461,906	450,726	211,629													
CAES																				
IPP - ICE	0	0	0	0	0	0	43,532	68,993	69,064	65,557	61,528	60,872	55,399	45,420	40,681	30,379	24,184	20,522	13,007	12,960
Lake 1	9,048	11,504	22,966	9,234	8,280	5,719	10,717	7,618	6,778	6,060	6,704	6,028	5,280	1,848	1,567	928	459	436	334	182
(Units in MTCO2e)																				
Total GHG Emissions	784,067	788,295	818,054	756,679	732,285	708,641	506,324	317,853	314,765	310,958	303,412	303,151	294,189	282,336	261,627	249,986	224,284	206,773	182,182	149,961
Distance From Target	556,067	560,295	590,054	528,679	504,285	480,641	278,324	89,853	86,765	82,958	75,412	75,151	66,189	54,336	33,627	21,986	(3,716)	(21,227)	(45,818)	(78,039)
Upper 2030 CARB Target	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000	228,000
Lower 2030 CARB Target	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000	129,000

3D: Renewable Portfolio Standard (RPS) Procurement Table (RPT): Preferred Portfolio A

(Megawatt-Hours)

	RPS Compliance: Preferred A																			
Asset	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Biogas/RECs	107,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wyoming Wind	0	0	0	0	0	102,967	191,487	191,487	191,487	192,063	191,487	191,487	191,487	192,063	191,487	191,487	191,487	192,063	191,487	191,487
RPS Wind	75,865	183,574	288,772	280,397	273,126	273,635	273,129	273,125	273,127	236,917	233,730	212,923	212,923	213,221	212,922	355,856	355,854	356,552	355,857	355,854
IPP Solar	0	0	0	0	0	135,794	134,843	133,899	132,962	132,031	131,107	130,189	129,278	128,373	127,475	126,582	125,696	124,816	123,943	123,075
RPS Solar	91,137	133,744	133,632	133,632	133,632	133,744	133,632	133,632	133,632	133,744	133,632	133,632	133,632	133,737	127,165	42,495	42,495	42,594	42,495	42,495
Tieton	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845
Don Campbell	26,230	26,352	26,254	26,255	26,256	26,352	26,255	26,256	26,255	26,352	26,256	26,256	26,256	26,352	23,352	0	0	0	0	0
Landfill	4,818	4,831	4,813	4,818	4,816	4,830	4,666	4,788	4,782	4,792	4,781	4,756	0	0	0	0	0	0	0	0
Retail Sales [MWh]	1,131,017	1,130,895	1,125,830	1,120,272	1,119,348	1,114,973	1,110,388	1,105,523	1,100,398	1,094,837	1,089,478	1,087,672	1,085,843	1,084,303	1,083,035	1,084,297	1,086,976	1,094,485	1,098,195	1,104,836
RPS Need (SB350) [%]	30%	33%	35%	37%	38%	40%	42%	43%	45%	47%	48%	50%	53%	55%	55%	55%	55%	55%	55%	55%
RPS Need (SB100) [%]	30%	33%	36%	36%	41%	44%	47%	50%	52%	55%	57%	60%	61%	63%	64%	65%	67%	68%	69%	71%
RPS Need (SB350) [MWh]	339,305	373,195	394,041	414,501	425,352	445,989	466,363	475,375	495,179	514,573	522,949	543,836	575,497	596,367	595,669	596,363	597,837	601,967	604,007	607,660
RPS Need (SB100) [MWh]	339,305	373,195	405,299	403,298	458,933	490,588	521,882	552,762	572,207	602,160	621,002	652,603	662,364	683,111	693,142	704,793	728,274	744,250	757,755	784,434
Actual RPS Generation [MWh]	333,895	377,345	482,318	473,948	466,676	706,167	792,859	792,033	791,091	754,745	749,839	728,090	722,422	722,591	711,247	745,265	744,378	744,871	742,627	741,756
Net RPS Position [MWh]	(5,410)	4,150	88,277	59,447	41,324	260,178	326,496	316,658	295,912	240,171	226,889	184,254	146,925	126,225	115,577	148,902	146,541	142,904	138,620	134,096
RPS Position [%]	30%	33%	43%	42%	42%	63%	71%	72%	72%	69%	69%	67%	67%	67%	66%	69%	68%	68%	68%	67%

3D: Renewable Portfolio Standard (RPS) Procurement Table (RPT): Preferred Portfolio B

(Megawatt-Hours)

	RPS Compliance: Preferred B																			
Asset	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Biogas/RECs	107,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wyoming Wind	0	0	0	0	0	102,967	191,487	191,487	191,487	192,063	191,487	191,487	191,487	192,063	191,487	191,487	191,487	192,063	191,487	191,487
RPS Wind	75,865	183,574	288,772	280,397	273,126	273,635	273,129	273,125	273,127	236,917	233,730	212,923	212,923	213,221	212,922	355,856	355,854	356,552	355,857	355,854
IPP Solar	0	0	0	0	0	135,794	134,843	133,899	132,962	132,031	131,107	130,189	129,278	128,373	127,475	126,582	125,696	124,816	123,943	123,075
RPS Solar	91,137	133,744	133,632	133,632	133,632	133,744	133,632	133,632	133,632	133,744	133,632	133,632	133,632	133,737	127,165	42,495	42,495	42,594	42,495	42,495
Tieton	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845
DonCampbell	26,228	26,352	26,255	26,255	26,255	26,351	26,254	26,256	26,256	26,352	26,256	26,256	26,256	26,352	23,352	0	0	0	0	0
Landfill	4,818	4,831	4,813	4,818	4,814	4,830	4,653	4,792	4,792	4,804	4,790	4,764	0	0	0	0	0	0	0	0
Retail Sales [MWh]	1,131,017	1,130,895	1,125,830	1,120,272	1,119,348	1,114,973	1,110,388	1,105,523	1,100,398	1,094,837	1,089,478	1,087,672	1,085,843	1,084,303	1,083,035	1,084,297	1,086,976	1,094,485	1,098,195	1,104,836
RPS Need (SB350) [%]	30%	33%	35%	37%	38%	40%	42%	43%	45%	47%	48%	50%	53%	55%	55%	55%	55%	55%	55%	55%
RPS Need (SB100) [%]	30%	33%	36%	36%	41%	44%	47%	50%	52%	55%	57%	60%	61%	63%	64%	65%	67%	68%	69%	71%
RPS Need (SB350) [MWh]	339,305	373,195	394,041	414,501	425,352	445,989	466,363	475,375	495,179	514,573	522,949	543,836	575,497	596,367	595,669	596,363	597,837	601,967	604,007	607,660
RPS Need (SB100) [MWh]	339,305	373,195	405,299	403,298	458,933	490,588	521,882	552,762	572,207	602,160	621,002	652,603	662,364	683,111	693,142	704,793	728,274	744,250	757,755	784,434
Actual RPS Generation [MWh]	333,894	377,345	482,318	473,947	466,674	706,166	792,844	792,037	791,103	754,756	749,848	728,098	722,422	722,591	711,247	745,265	744,378	744,871	742,627	741,756
Net RPS Position [MWh]	(5,411)	4,150	88,278	59,446	41,321	260,177	326,481	316,662	295,924	240,183	226,898	184,262	146,925	126,225	115,577	148,902	146,541	142,904	138,620	134,096
RPS Position [%]	30%	33%	43%	42%	42%	63%	71%	72%	72%	69%	69%	67%	67%	67%	66%	69%	68%	68%	68%	67%

3D: Renewable Portfolio Standard (RPS) Procurement Table (RPT): Preferred Portfolio C

(Megawatt-Hours)

RPS Compliance: Preferred C																				
Asset	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Biogas/RECs	107,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wyoming Wind	0	0	0	0	0	102,967	191,487	191,487	191,487	192,063	191,487	191,487	191,487	192,063	191,487	191,487	191,487	192,063	191,487	191,487
RPS Wind	75,865	183,574	288,772	280,397	273,126	273,635	273,129	273,125	273,127	236,917	233,730	212,923	212,923	213,221	212,922	355,856	355,854	356,552	355,857	355,854
IPP Solar	0	0	0	0	0	135,794	134,843	133,899	132,962	132,031	131,107	130,189	129,278	128,373	127,475	126,582	125,696	124,816	123,943	123,075
Solar	91,137	133,744	133,632	133,632	133,632	133,744	133,632	133,632	133,632	133,744	133,632	133,632	133,632	133,737	127,165	42,495	42,495	42,594	42,495	42,495
Tieton	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845	28,845
Don Campbell	26,231	26,352	26,255	26,256	26,256	26,352	26,255	26,256	26,256	26,352	26,256	26,256	26,256	26,352	23,352	0	0	0	0	0
Landfill	4,818	4,831	4,813	4,818	4,814	4,830	4,656	4,754	4,752	4,762	4,744	4,691	0	0	0	0	0	0	0	0
Retail Sales [MWh]	1,131,017	1,130,895	1,125,830	1,120,272	1,119,348	1,114,973	1,110,388	1,105,523	1,100,398	1,094,837	1,089,478	1,087,672	1,085,843	1,084,303	1,083,035	1,084,297	1,086,976	1,094,485	1,098,195	1,104,836
RPS Need (SB350) [%]	30%	33%	35%	37%	38%	40%	42%	43%	45%	47%	48%	50%	53%	55%	55%	55%	55%	55%	55%	55%
RPS Need (SB100) [%]	30%	33%	36%	36%	41%	44%	47%	50%	52%	55%	57%	60%	61%	63%	64%	65%	67%	68%	69%	71%
RPS Need (SB350) [MWh]	339,305	373,195	394,041	414,501	425,352	445,989	466,363	475,375	495,179	514,573	522,949	543,836	575,497	596,367	595,669	596,363	597,837	601,967	604,007	607,660
RPS Need (SB100) [MWh]	339,305	373,195	405,299	403,298	458,933	490,588	521,882	552,762	572,207	602,160	621,002	652,603	662,364	683,111	693,142	704,793	728,274	744,250	757,755	784,434
Actual RPS Generation [MWh]	333,897	377,345	482,319	473,948	466,674	706,167	792,848	791,999	791,062	754,714	749,802	728,025	722,422	722,591	711,247	745,265	744,378	744,871	742,627	741,756
Net RPS Position [MWh]	(5,408)	4,150	88,278	59,448	41,322	260,178	326,485	316,625	295,883	240,141	226,853	184,189	146,925	126,225	115,577	148,902	146,541	142,904	138,620	134,096
RPS Position [%]	30%	33%	43%	42%	42%	63%	71%	72%	72%	69%	69%	67%	67%	67%	66%	69%	68%	68%	68%	67%

Appendix 4. Checklist: Requirements for Publicly-Owned Utility IRP Reports

This Appendix 4 provides a listing of requirements for IRP filings by Publicly-Owned Utilities (POU) like Burbank, mapped to the sections of this report where each requirement is fulfilled. This Appendix can be used by reviewers as a checklist for compliance.

4A: Requirements by California Legislative Bill

Statute	Subd.	Requirement	IRP Reference
AB 32 (Nunez, Chapter 488, Statutes of 2006)	Section 1 (Health & Safety Code Division 25.5, §38550)	Established greenhouse gas emissions reduction target of 1990 levels by 2020.	Chapter 4, pages 87-91
SB 32 (Pavley, Chapter 249, Statues of 2006)	Section 2 (HSC Code Division 25.5, §38566)	Codified GHG emission reduction target in Executive Order B-30-15 of 40% below 1990 levels by December 31, 2030.	Chapter 4, page 92
SB 350 (de León, Chapter 547, Statutes of 2015)	Section 6 (PRC §25310)	Established targets for statewide energy efficiency and demand reductions to achieve a cumulative doubling of customer energy efficiency by January 1, 2030.	Chapter 4, page 92
	Sections 35 & 36 (PUC §9621 and §9622)	Requirement for the 16 largest publicly-owned utilities (POU) file Integrated Resource Plans with the California Energy Commission (CEC)	To be fulfilled by filing of this IRP with the CEC on or before April 30, 2019.
	Section 24 (PUC §399.30)	Increased California Renewable Portfolio Standard (RPS) for electric load-serving entities to not less than 50% renewables by December 31, 2030.	Chapter 4, page 92
SB 100 (de León, Enacted in September, 2018)	Section 4	Further increased California RPS to 50% by 2026 and 60% by 2030.	Examined as a possible future scenario, Chapter 4, pages 92-93

4B: Requirements by California Executive Order

Order	Requirement	IRP Reference
California Governor’s Executive Order S-3-05 (Schwarzenegger, June 1, 2005)	Established target for statewide GHG emission reductions to 80% below 1990 levels by 2050.	Chapter 4, page 87
California Governor’s Executive Order B-30-15 (Brown, April 29, 2015)	Established target for statewide GHG emission reductions to 40% below 1990 levels by 2030 (a mid-point toward previously-established target for 2050 in Order S-B-05).	Chapter 4, page 92

4C: Requirements by California Code

Code	Part	Requirement	IRP Reference
H&SC Division 25.5	§38550	Established greenhouse gas emissions reduction target of 1990 levels by 2020.	Chapter 4, page 87
PRC §25310	(c)	Established targets for statewide energy efficiency and demand reductions to achieve a cumulative doubling of customer energy efficiency by January 1, 2030.	Chapter 2, page 17
PUC §399.30	(a), (b)	Increased California Renewable Portfolio Standard (RPS) for electric load-serving entities to not less than 50% renewables by December 31, 2030.	Chapter 4, page 92
PUC § 9621	(a)	IRP filing requirement for POUs with annual electricity sales exceeding 700 GWh.	BWP annual sales are about 1,100 GWh.
	(b)	Governing Board of POU to adopt IRP and a process for updating the plan every five years on or before January 1, 2019.	Burbank City Council adopted IRP and process on [12/11/18]
	(b)(1)	IRP to meet greenhouse gas emissions reduction targets reflecting POU's contribution to statewide reduction of 40 percent from 1990 levels by 2030.	Chapter 4, page 92
	(b)(2)	IRP to ensure procurement of at least 50% renewable energy resources by 2030.	Appendix 3D, RPT
	(b)(3)	Meet goals of Sections (D) to (H) inclusive of paragraph (1) of subdivision (a) of Section 454.52: • Minimize impacts on ratepayers' bills. • Ensure system and local reliability. • Strengthen diversity, sustainability and resilience of bulk transmission and distribution systems and local communities. • Enhance distribution systems and demand-side energy management. • Minimize localized air pollutants and other greenhouse gas emissions, with early priority on disadvantaged communities. Meet the goal of fulfilling its obligation to serve its customers at just and reasonable rates.	Chapter 6, page 165, Chapter 3, pages 56, 59 and Chap 6, p. 159 Chapter 3, page 54-56 Chapter 3, p. 61 Chapter 3, page 57-63 Chapter 3, page 76-77 Chapter 6, page 165

Code	Part	Requirement	IRP Reference
	(c)(1)	IRP to address procurement of the following: • Energy efficiency and demand response. • Energy storage. • Transportation electrification. • Diversified procurement portfolio of both short-term and long-term products. • Resource adequacy requirements pursuant § 9620.	Chapter 6, p. 140-143 Chapter 6, p. 144-145 Chapter 6, p. 136-140 Appendix 3A, CRAT Chapter 6, p. 159
	(c)(2)(A)	The POU governing board may authorize all source procurement to ensure an optimum resource mix.	Option of City Council
	(c)(2)(B)	The POU governing board may authorize procurement of resource types to meet GHG reductions and other goals but may not compete favorably in price against other resources.	Option of City Council
	(d)	The POU shall satisfy the notice and public disclosure requirements with respect to the IRP and any updates.	Cover Letter
PUC § 9622	(a)	POU IRPs to be submitted to the CEC.	Cover letter
	(b)	The CEC shall review the IRPs and plan updates. If Commission determines an IRP is consistent with §9621, and shall provide recommendations to correct deficiencies.	
	(c)	The CEC may adopt guidelines to govern submissions of IRPs.	See Requirements from CEC Guidelines.

4D: Requirements by CEC Guidelines for POU IRP Reports

Topic	Page	Requirement	IRP Reference
Demand Forecast	4	Propose demand and energy forecast w/o AAEE.	Chapter 2, page 16
	4	Use of CEC forecast recommended.	Chapter 2, page 16
	5	System modeling must use demand forecasts for outside regions.	Modeling used declining implied system heat rates
	5	Use of alternative forecasts (high, low) recommended.	Modeling used multiple weather forecasts
Resource Procurement Plan	5	Diversified Procurement Portfolio • Data sufficient to demonstrate a diversified portfolio.	Appendix 3A, CRAT
	5	RPS Planning Requirements • Forecasted RPS Procurement targets.	Appendix 3D, RPT
	6	• Renewables Procurement forecast.	Appendix 3D, RPT
	6	• RPS Procurement Plan.	Appendix 3D, RPT
	6	• Supplemental Information regarding RPS compliance.	Appendix 3D, RPT
Energy Efficiency and DR Resources	7	Data sufficient to demonstrate plans to double customer efficiency by 2030.	Chapter 2, page 17
	7	Estimates of peak capacity demand impacts of planned DR programs.	Chapter 6, p. 140-143
	7	Discussions of DR impacts including TOU rates.	Chapter 4, p. 95-101, Chapter 6, p. 135-137
Energy Storage	8	Narrative assessment of storage to address solar over-generation and ramping.	Chapter 6, p. 133-134 and 144-145

Topic	Page	Requirement	IRP Reference
Energy Storage	8	- Amount of multi-hour storage needed to mitigate solar over-generation/ramping.	Chapter 6, Tables 6.5 and 6.9
	8	- Any quantitative analysis undertaken by POU regarding cost-effectiveness of multi-hour storage.	Chapter 6, p. 144-159
Transportation Electrification	8-9	Background data on transportation electrification, "...to the extent possible".	Chapter 6, p. 136-140
		Electric load and GHG impacts of transportation electrification included in the IRP.	Chapter 6, Table 6.1
System and Local Reliability	10	Reliability criteria for peak demand, including installed reserve capacity.	Chapter 6, p. 159
	10-11	Local reliability, including discussion of any areas that are transmission-constrained.	Chapter 3, page 56
	10	Flexible Capacity - Information sufficient to demonstrate the Plan has sufficient flexible capacity.	Chapter 6, page 159
	10	- Estimates of solar over-generation and ramping requirements.	Chapter 6, p. 162
Greenhouse Gas Emissions	11	Information sufficient to demonstrate compliance with GHG reductions goals.	Chapter 6, p. 163 Appendix 3C, GEAT
	11	Narrative to support assumptions/planned programs to achieve planned GHG goals.	Chapter 6, p. 163
Retail Sales	11	A report or study on impact of preferred IRP plan on customer rates.	Chapter 6, page 165
	11	Identification of IRP elements or scenarios that would result in large rate impacts.	Chapter 6, page 165

Topic	Page	Requirement	IRP Reference
Transmission and Distribution Systems	11	Bulk Transmission System • A narrative on any bulk transmission reliability concerns and plans to resolve them.	Chapter 3, page 56
	11	Distribution System • A discussion of any distribution system reliability concerns.	Chapter 3, pages 59-60
	12	• Planned upgrades or enhancements to the distribution system.	Chapter 3, p. 61-62
Localized Air Pollutants and Disadvantaged Communities	12	Information sufficient to demonstrate goals of minimizing local pollutants.	Chapter 3, p. 76-77
	12	Discussion of current programs to minimize local air pollution in disadvantaged areas.	Chapter 3, p. 76-77
	13	CEC suggestions for potential POU efforts for disadvantaged communities (Examples): • Maximizing energy efficiency savings. • Community solar. • Workforce training. • Financing for clean energy improvements.	Chapter 3, p. 77
Standard Data Tables	3-4	Capacity Resource Accounting Table (CRAT)	Appendix 3A
	3-4	Energy Balance Accounting Table (EBAT)	Appendix 3B
	3-4	GHG Emissions Account Table (GEAT)	Appendix 3C
	3-4	RPS Procurement Table (RPT)	Appendix 3D

Chapter 9

Exhibits

Exhibit A

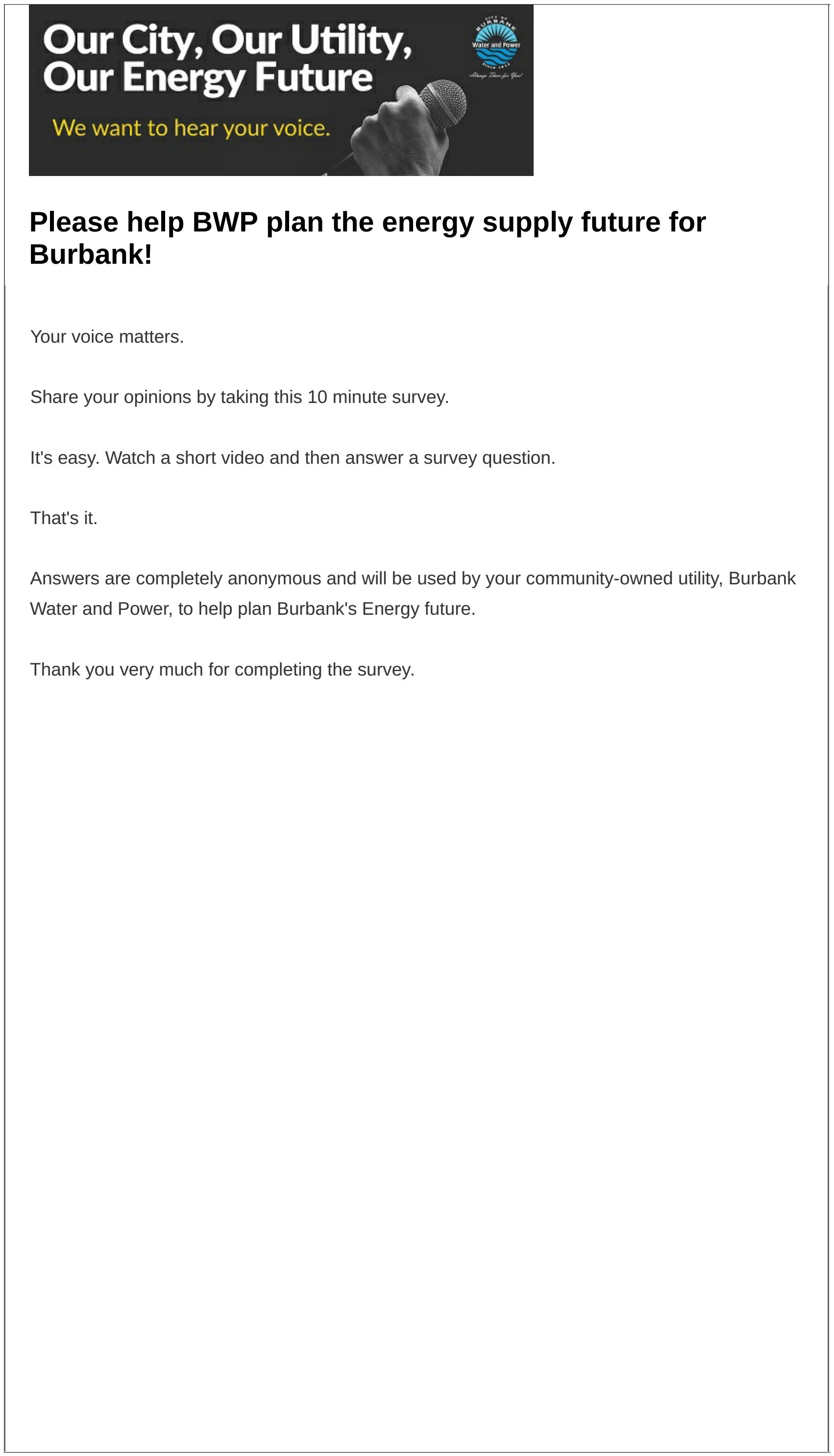
BWP’s Fiscal Year 2016-17 Energy Efficiency Programs

BWP'S ENERGY EFFICIENCY PROGRAMS
Ranked by FY 16-17 Peak Demand Savings

Program Name	FY 16-17 Peak Demand Savings (kW)	FY 16-17 Energy Savings (kWh)	FY 17-18 Approved Budget	FY 18-19 Proposed Budget
Business Rebates	1,646	6,700,486	$450,000	$450,000
Home Energy Reports	880	4,555,823	$285,000	$0
AC Tune-Ups	667	505,028	$250,000	$200,000
Home Improvement	496	615,167	$1,400,000	$1,421,500
Business Bucks	316	925,435	$100,000	$50,000
Ice Bear Peak Shifters	250	14,200	$0	$0
Upstream HVAC	194	308,525	$250,000	$250,000
Residential Rebates	82	224,076	$150,000	$130,000
Refrigerator Roundup	10	48,100	$20,000	$0
Made in the Shade	10	42,420	$50,000	$60,000
LivingWise	0	119,789	$61,000	$55,000
Water Programs	0	48,313	$0	$0
Refrigerator Exchange	0	34,196	$85,000	$80,000
Efficient Lighting	0	4,305	$0	$0
Peak Demand Initiatives	0	0	$0	$250,000
TOTAL	**4,551**	**14,145,863**	**$3,101,000**	**$2,946,500**
1% GOAL	**3,200**	**11,000,000**		
GOAL ATTAINMENT	**142%**	**129%**		

Exhibit B

IRP Online and Town Hall Meetings Survey



Please help BWP plan the energy supply future for Burbank!

Your voice matters.

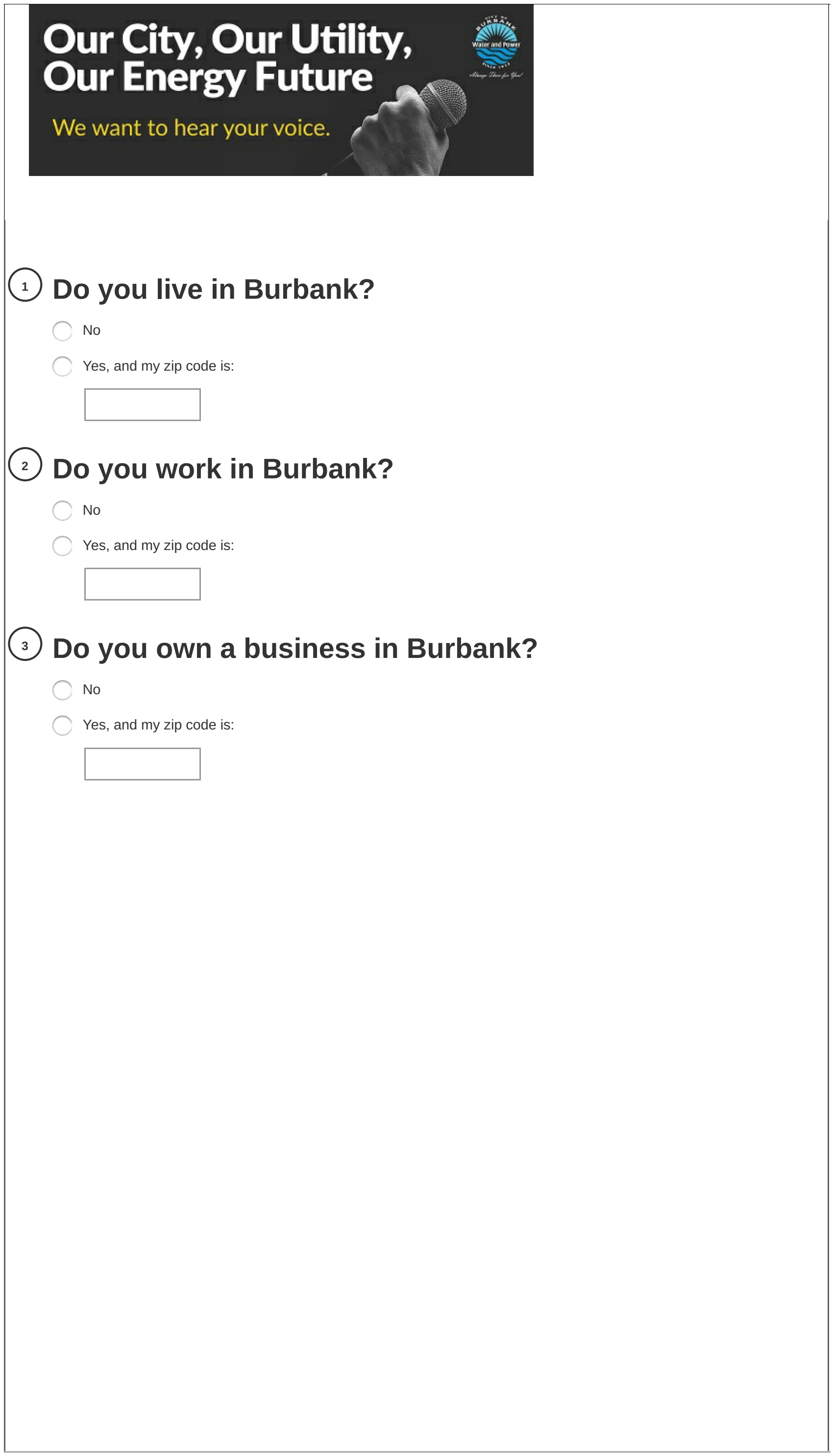
Share your opinions by taking this 10 minute survey.

It's easy. Watch a short video and then answer a survey question.

That's it.

Answers are completely anonymous and will be used by your community-owned utility, Burbank Water and Power, to help plan Burbank's Energy future.

Thank you very much for completing the survey.



Our City, Our Utility, Our Energy Future

We want to hear your voice.

① Do you live in Burbank?

○ No

○ Yes, and my zip code is:

② Do you work in Burbank?

○ No

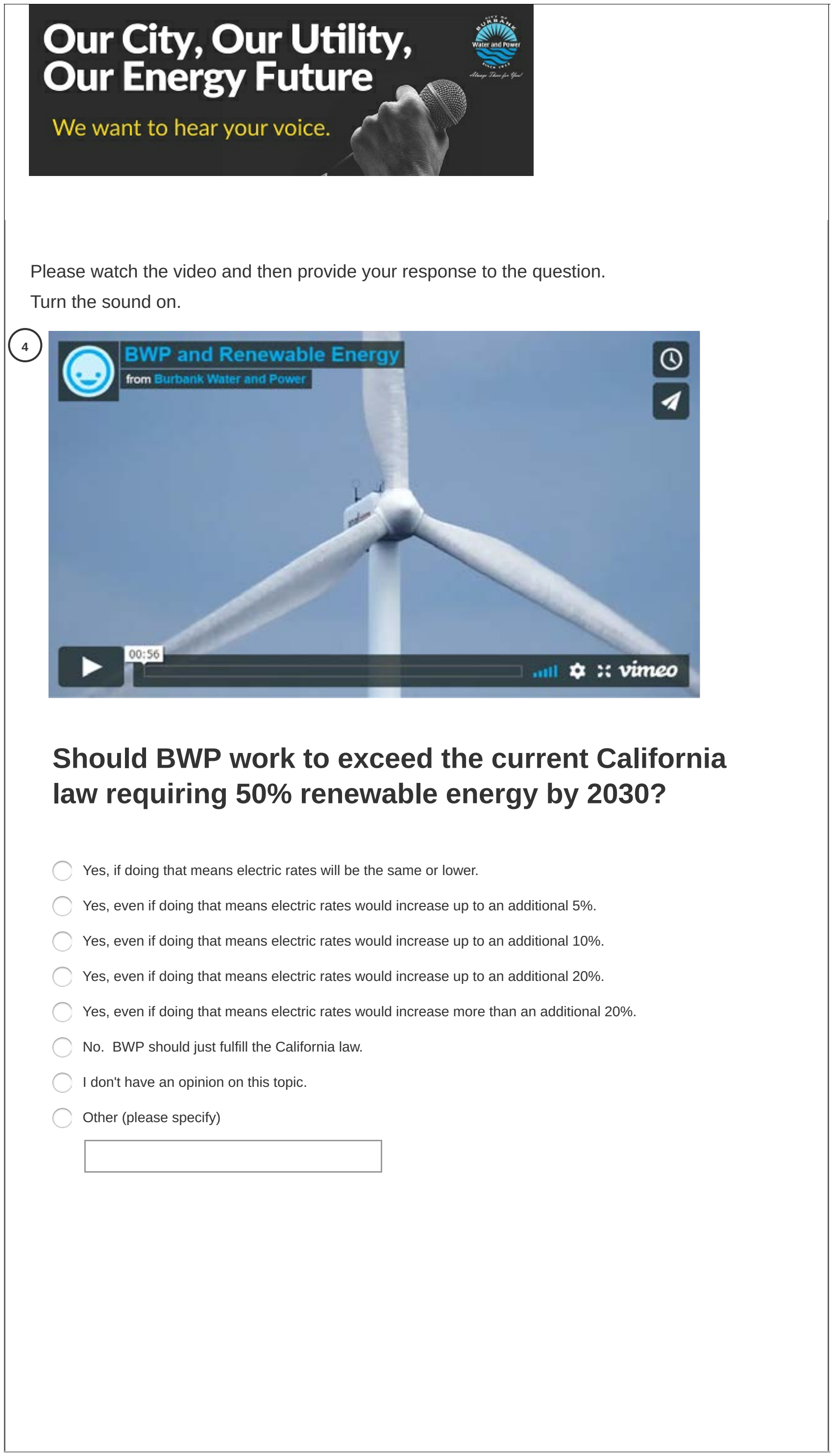
○ Yes, and my zip code is:

③ Do you own a business in Burbank?

○ No

○ Yes, and my zip code is:

2

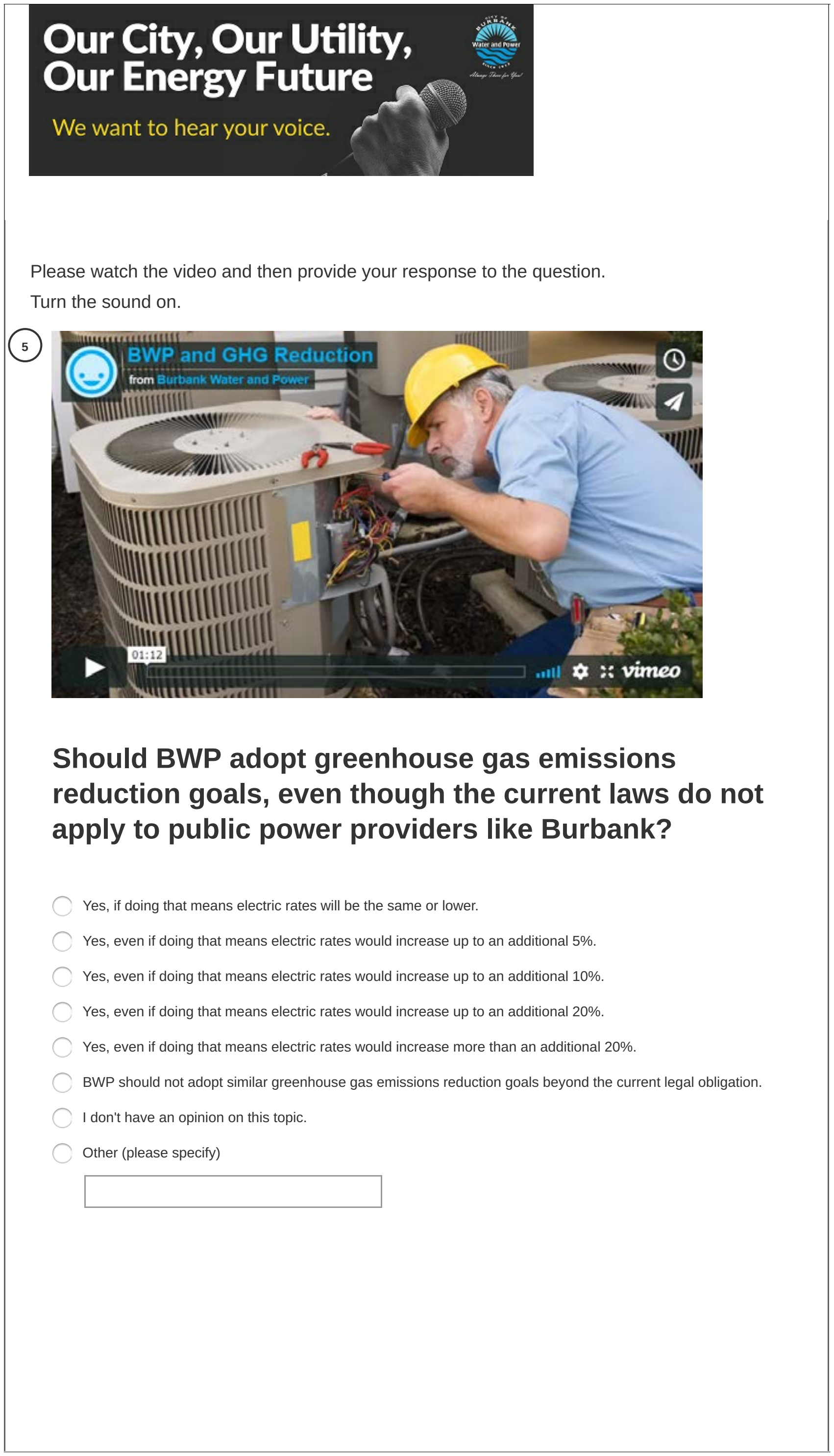


Please watch the video and then provide your response to the question.
Turn the sound on.

④

Should BWP work to exceed the current California law requiring 50% renewable energy by 2030?

○ Yes, if doing that means electric rates will be the same or lower.
○ Yes, even if doing that means electric rates would increase up to an additional 5%.
○ Yes, even if doing that means electric rates would increase up to an additional 10%.
○ Yes, even if doing that means electric rates would increase up to an additional 20%.
○ Yes, even if doing that means electric rates would increase more than an additional 20%.
○ No. BWP should just fulfill the California law.
○ I don't have an opinion on this topic.
○ Other (please specify)



Please watch the video and then provide your response to the question.
Turn the sound on.

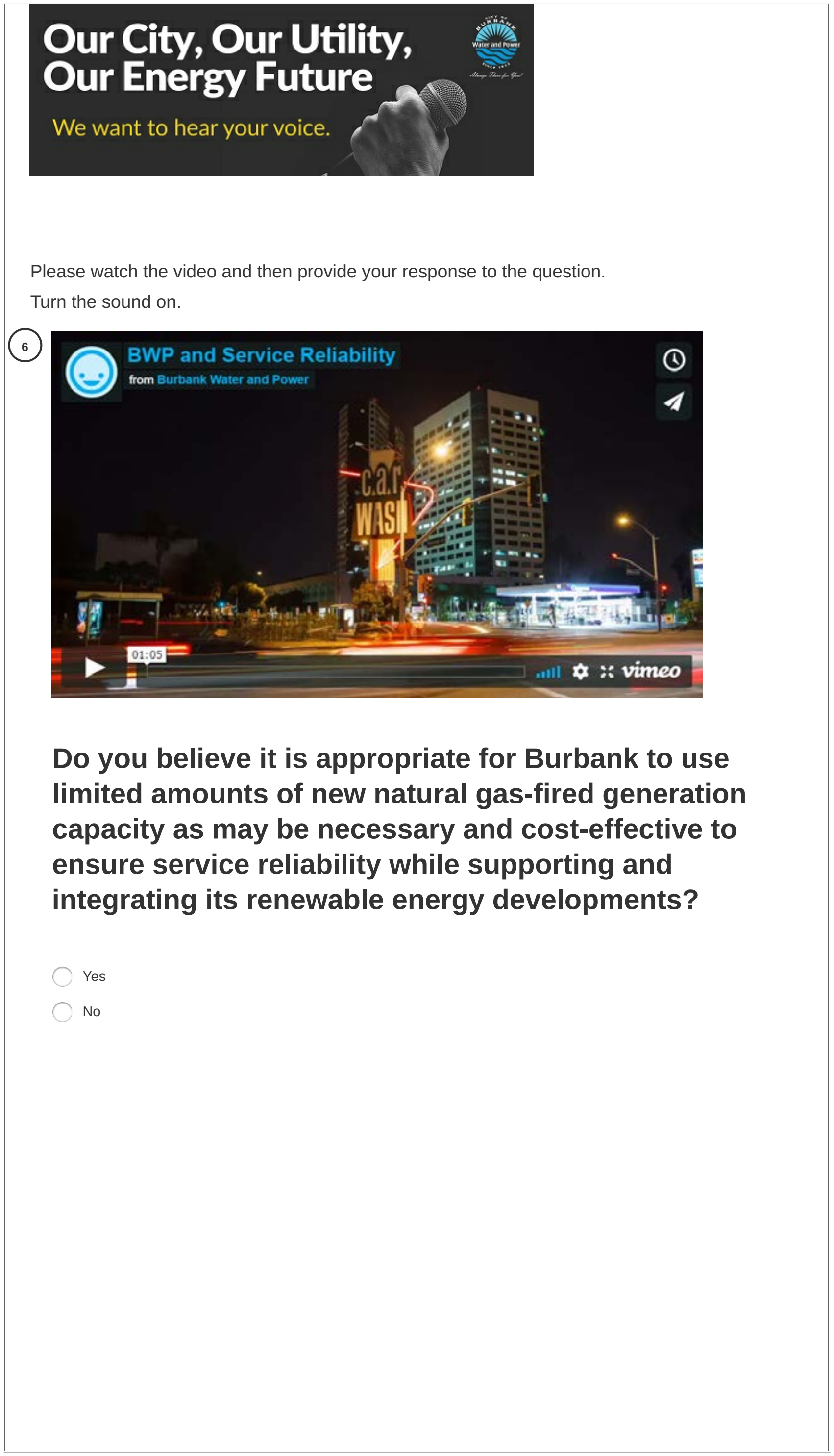
⑤

Should BWP adopt greenhouse gas emissions reduction goals, even though the current laws do not apply to public power providers like Burbank?

- ○ Yes, if doing that means electric rates will be the same or lower.
- ○ Yes, even if doing that means electric rates would increase up to an additional 5%.
- ○ Yes, even if doing that means electric rates would increase up to an additional 10%.
- ○ Yes, even if doing that means electric rates would increase up to an additional 20%.
- ○ Yes, even if doing that means electric rates would increase more than an additional 20%.
- ○ BWP should not adopt similar greenhouse gas emissions reduction goals beyond the current legal obligation.
- ○ I don't have an opinion on this topic.
- ○ Other (please specify)

☐

4



Please watch the video and then provide your response to the question.
Turn the sound on.

6

Do you believe it is appropriate for Burbank to use limited amounts of new natural gas-fired generation capacity as may be necessary and cost-effective to ensure service reliability while supporting and integrating its renewable energy developments?

○ Yes

○ No

⑦

Since you answered No to Q6, please specify your preference regarding what technology(ies) other than natural gas Burbank should use to ensure service reliability while supporting and integrating its renewable energy developments:

☐

⑧

With regard to your preference above regarding what technology(ies) other than natural gas Burbank should use to ensure service reliability:

○ It is my preference, if doing that means electric rates will be the same or lower.
○ It is my preference, even if doing that means electric rates would increase up an additional 5%.
○ It is my preference, even if doing that means electric rates would increase up to an additional 10%.
○ It is my preference, even if doing that means electric rates would increase up to an additional 20%.
○ It is my preference, even if doing that means electric rates would increase more than an additional 20%.
○ I don't have an opinion on this topic.
○ Other (please specify)

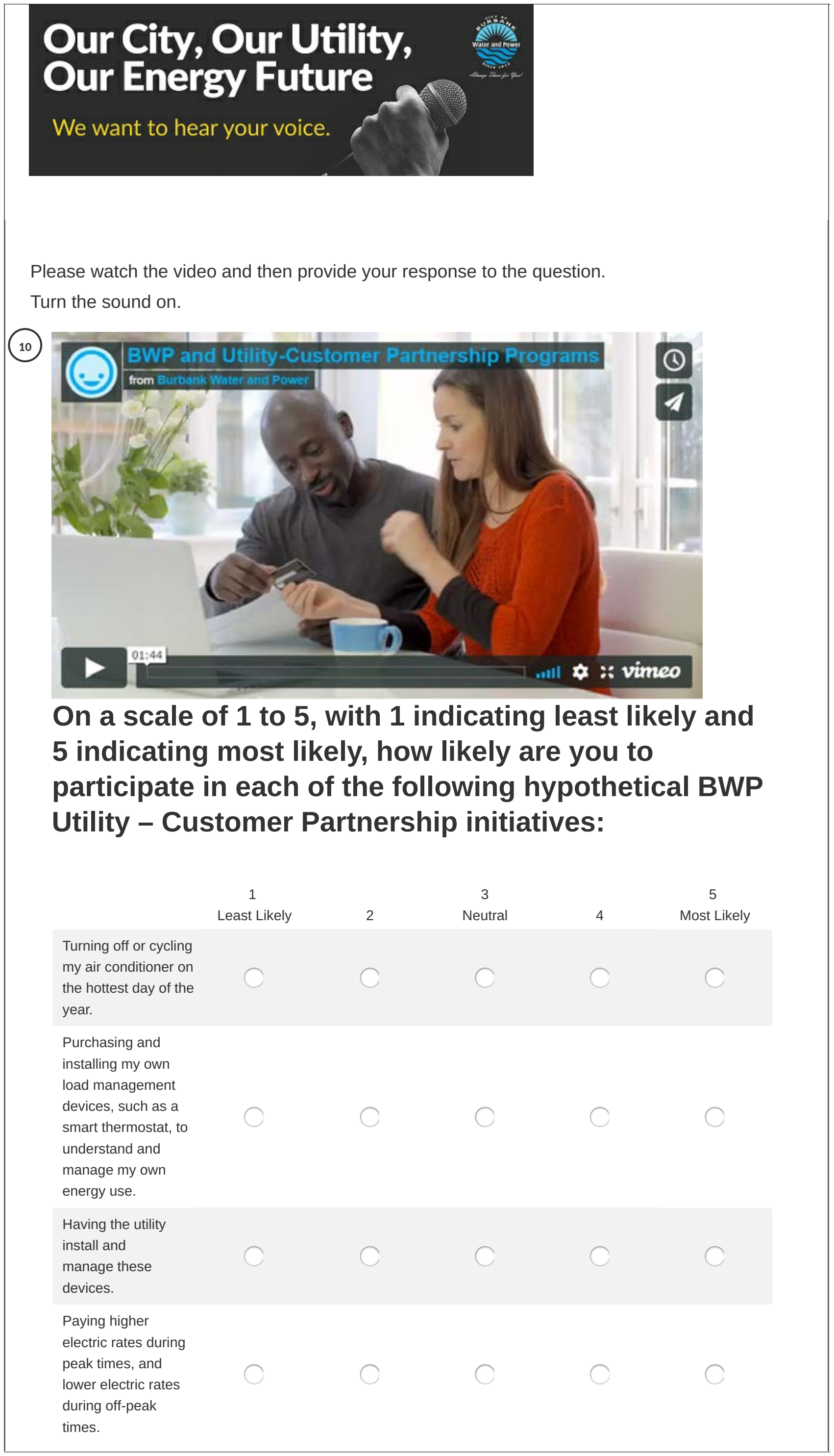
☐

Please watch the video and then provide your response to the question.
Turn the sound on.

⑨

For each of the following devices below, please indicate whether you believe Burbank should encourage their installation and use, if it results in reductions in greenhouse gas emissions?

	Yes	No
Electric vehicle chargers	○	○
Electric space heating	○	○
Electric water heaters	○	○
Electric cooking technologies	○	○



Please watch the video and then provide your response to the question.

Turn the sound on.

⑩

On a scale of 1 to 5, with 1 indicating least likely and 5 indicating most likely, how likely are you to participate in each of the following hypothetical BWP Utility – Customer Partnership initiatives:

	1 Least Likely	2	3 Neutral	4	5 Most Likely
Turning off or cycling my air conditioner on the hottest day of the year.	○	○	○	○	○
Purchasing and installing my own load management devices, such as a smart thermostat, to understand and manage my own energy use.	○	○	○	○	○
Having the utility install and manage these devices.	○	○	○	○	○
Paying higher electric rates during peak times, and lower electric rates during off-peak times.	○	○	○	○	○

8

Please watch the video and then provide your response to the question.
Turn the sound on.

⑪

What should Burbank do to promote clean energy efforts in its disadvantaged communities? Select any/all that apply:

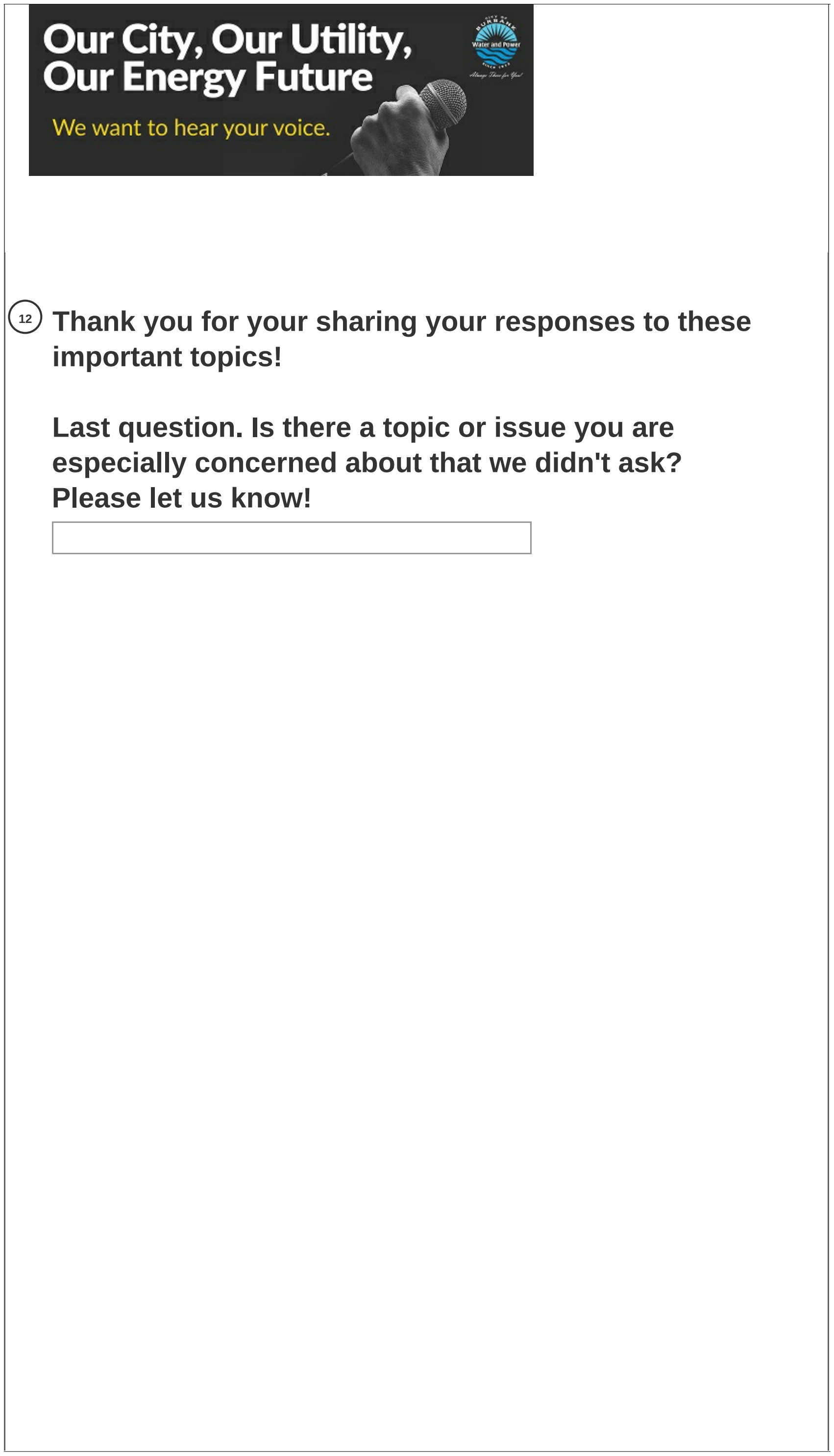
☐ Offer additional energy efficiency programs focused on the disadvantaged communities.

☐ Offer incentives for solar installations in disadvantaged communities.

☐ Electric vehicle charging stations in multi-family rental properties.

☐ It should make no additional efforts.

☐ Other (please specify)



⑫ **Thank you for your sharing your responses to these important topics!**

Last question. Is there a topic or issue you are especially concerned about that we didn't ask? Please let us know!

10

Exhibit C

BWP Glossary of Terms

Advanced Metering Infrastructure (AMI) – An integrated system of smart meters, communications networks, and data management systems that enable two-way communication between utilities and customer.

Alternating Current (AC) - An electric current that reverses its direction 60 times a second at regular intervals, this is the standard used in power grids across the nation.

Alternative Energy - Energy as solar, wind, hydro, nuclear or other, that can replace or supplement traditional fossil-fuel based sources of energy such as coal, oil, and natural gas.

Ancillary Services - The electric services in addition to the bulk supply that are required to control and regulate the delivery of electricity to end-users and to maintain system reliability. These include automatic generation control, reserves, voltage support and black start.

Annual Usage - The total amount of electricity consumed in a year by a given end-user.

Balancing Authority – The responsible entity that integrates resource plans ahead of time, and balances energy load, transfers, and generation within a Balancing Authority Area in real time.

Baseload - Electricity usage that is constant through a specified time period. Also used to refer to the generating units that run all 24 hours of the day to serve a system’s base-load demand.

Battery - A container consisting of one or more cells, in which chemical energy is converted into electricity and used as a source of power

Biodiesel - A biofuel intended as a substitute for diesel.

Capacity - The maximum electric power output of a generating unit or the maximum amount of power that lines or equipment can safely carry.

Carbon Footprint - The amount of CO2 and other carbon compounds emitted due to the consumption of fossil fuels by a particular person, group, etc.

Climate Change - A change in global or regional weather patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric CO2 produced by the use of fossil fuels.

Cogeneration - The use of fuel to produce electricity as well as another product such as steam or hot water.

Commercial Customer - An end-user that uses power to create a service. Sometimes also used by utilities to refer to manufacturing customers smaller than 500 kW.

Commodity - A raw material or product that can be bought and sold. Electricity is a commodity.

Compressed Air Energy Storage ¬- CAES is essentially a large mechanical battery that takes an intermittent resource and turns it into a controllable resource. When electricity is generated and not needed, that electricity is used to pump air into an underground cavern at very high pressure where the air can be stored. When electricity is needed, the air is fueled by a small amount of natural gas to re-heat the air. The re-heated air then runs through a turbine and turns a generator, thereby producing electricity.

Congestion Charge - A charge by an ISO to market participants who utilize a congested path.

Congestion Management - The process of allocating transmission capacity when congestion occurs.

Congestion - A condition that occurs when the amount of requested transactions across a transmission path exceeds the physical capacity of the path.

Contingency Reserve Requirement - Reserve power which can be made available within 10 minutes of an outage to replace the lost resource.

Cost of Service - The total amount of money, including return on invested capital, operation and maintenance costs, administrative costs, taxes, and depreciation expense required to provide a utility service.

Current – With respect to electricity, is the flow of electrons particles through a conducting medium, such as a wire.

Curtailment - The act of reducing or restricting the output of renewable generators under conditions of transmission congestion or unfavorable economics.

Customer Choice - The ability of an end-use customer to choose their electricity supplier.

Dekatherm (Dth) - A standard unit of measure of natural gas, equal to ten therms, which is approximately the energy equivalent of burning 1,000 cubic feet of natural gas.

Demand Charge - The portion of a rate that is based on the maximum demand recorded over a specified period of time.

Demand Response - Economic programs that offer end-use customers the opportunity to modify their electric usage in response to wholesale market price signals. Demand Side Management (DSM) - The act of reducing energy consumption or moving energy use from peak to off-peak periods in order to reduce overall energy costs.

Demand - The total amount of electricity used at any given moment in time usually measured in kW or MW.

Direct Current - An electric current flowing in one direction only.

Distributed Generation - Generation located at an end-use customer's facility.

Distribution - One of the three parts that makes up the electric grid. The delivery of electricity over low to medium voltage lines to end-use consumers. Distribution is owned and represented by the consumer's local distribution company (LDC), and is state regulated.

Duck Curve – A name for a system condition caused by solar PV generation that creates over generation during the afternoon and is followed by the need to steeply increase the output of controllable generation as the sun sets late in the afternoon and into the evening..

Electricity - A form of energy that can be transmitted across conductors.

End-user - The ultimate consumer of electricity.

Energy Efficiency - The act of using less electricity to perform the same amount of work or to get the same end value.

Energy Services Company (ESCO) - A company that provides services to end-users relating to their energy usage. Common services include energy efficiency and demand side management.

Federal Energy Regulatory Commission (FERC) - The United States federal agency that regulates the transmission and wholesale sale of electricity and natural gas in interstate commerce and regulates the transportation of oil by pipeline in interstate commerce. Flywheel - A mechanical device that stores energy in the form of kinetic energy by rotating a mass at very high speeds. The kinetic energy stored in a flywheel can easily be converted to electricity and vice versa.

Forward Market - A market where delivery of the item purchased will occur at some future point in time.

Fossil Fuel - A natural fuel such as coal or gas, formed through geological processes over very long periods of time, from the remains of living organisms.

Fuel Cell - A cell producing an electric current directly from a chemical reaction.

Futures Contract - A supply contract between a buyer and seller where the buyer is obligated to take delivery and the seller is obligated to provide delivery of a fixed amount of commodity at a predetermined price and location at a specific period in time. Futures are bought and sold through an exchange such as NYMEX.

Generation - One of the three parts that make up the electric grid, a term that refers to power plants, large and small.

Generator – Is used synonymously with the term power plant. (Although technically, the generator is the part of the power plant that converts the mechanical power of a spinning shaft to electricity).

Geothermal - Energy obtained by tapping underground reservoirs of heat, usually near volcanoes or other hot spots on the surface of the Earth.

Geothermal Power - Energy derived from heat within the Earth's interior.

Global Warming - The warming of the earth's atmosphere due to increasing concentrations of greenhouse gases.

Green Power – A term used to describe electricity generated from renewable resources.

Greenhouse Effect - The trapping of the sun's energy in a planet's lower atmosphere due to the greater transparency of the atmosphere to visible radiation from the sun than to infrared radiation emitted from the planet's surface.

Greenhouse Gas - A gas that contributes to the greenhouse effect by absorbing infrared radiation, e.g., CO2, natural gas, and chlorofluorocarbons

Grid - The name used for the bulk interconnected transmission system.

Hedge - The initiation of a transaction in a physical or financial market to reduce risk.

Hydro Power - Power that is derived from the weight and motion of water, used as a force to drive a turbine or other machinery.

Imbalance - The discrepancy between the amount of electricity an entity delivers into the grid and the actual amount the entity consumed.

Independent Power Producer (IPP) - A generation company that is not part of a regulated, vertically-integrated utility company that sells output under a long-term contract.

Independent System Operator (ISO) - Synonymous with RTO - An independent entity that provides system operation functions including managing system reliability and transmission access.

Industrial Customers - An end-user that uses power for the manufacturing or production of a product.

Intermittency – Naturally varying energy output over time compared to the controllable output over time.
For example, intermittency is a characteristic of solar and wind energy, since these sources are inconsistent in generating power compared to a fossil fired power plant that can be controlled to produce a constant or desired amount of power over time.

Internal Combustion Engine (ICE) - An electrical generation technology that uses as its prime mover an engine that produces motive power by the burning of natural gas, gasoline, oil or other fuel with air inside the engine, the hot gases produced being used to drive a piston as they expand.

Investor-Owned Utility - A regulated monopoly utility that is owned by shareholders and run as a for-profit entity.

Kilowatt (kW) - A unit of energy equal to 1,000 watts: equivalent to approximately 1.34 horsepower.

Kilowatt-hour (kWh) - A unit of energy equal to 1,000 watts consumed or delivered over the course of 1 hour. The kWh is most commonly known as a billing unit for energy delivered to consumers by electric utilities.

Lighting Retrofit - The practice of replacing lighting components in a facility with counterparts that make it use energy more efficiently.

Lithium-Ion (Li-Ion) - A type of rechargeable battery in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging.

Load Factor - An indicator of how steady an end-user electrical load is. It is measured by dividing the average amount of power required to serve a load by the peak amount of powerused to serve the same load, over time.

Load Power Supplied - The electricity that an electric utility instantaneously delivers to a customer when devices using electricity are switched on.

Load Profile – The variation of electrical load over a period of time.

Load Serving Entity (LSE) - An entity that sells electric supply to an end-user.

Load - An amount of end-use demand.

Local Distribution Company (LDC) - A regulated utility that provides distribution services to end-users.

Losses - Energy lost during the transmission of energy from the generator to the end-user, caused by imperfections in conductors.

Megawatt - A unit of power equal to one million watts.

Megawatt (MW) - A unit of energy equivalent to 1,000 kW or 1,000,000 watts.

Megawatt-hour (MWh) - A unit of energy equivalent to 1,000 kilowatt-hours or 1,000,000 watt-hours.

Meter - A device used to measure the amount of electricity flowing through a point on the system.

Monopoly - A marketplace characterized by only one seller.

Municipal Utility - Also known as “muni.” A utility-owned and operated by a municipality.

Native Load - The end-use customer load of a specific utility.

Natural Gas - Flammable gas, consisting largely of methane and other hydrocarbons, occurring naturally underground (often in association with petroleum) and used as fuel.

Nuclear Energy - The energy released during nuclear fission used to generate electricity.

Off-peak - The hours during the day when demand is at its lowest.

Option - A contract that gives the holder the right, but not the obligation, to purchase or sell a commodity at a specific price within a specified time period in return for a premium payment.

Over Generation – An excess of power produced exceeding load demand.

Peak Demand - The maximum demand for electricity in a given period of time.

Peak - The hours during the day when demand is at its highest.

Peaking Units - Generating units run only during times of peak demand on a system.

Photovoltaic (PV) - The process of converting radiation from sunlight directly into electricity using specially designed silicon cells.

Plug-in Electric Vehicle (PEV) – An electric vehicle that utilizes rechargeable batteries, or another storage device, that can be restored to full charge by connecting the vehicle to an external electric power source.

Power Purchase Agreement (PPA) - A contract for the sale or purchase of electricity.

Power Quality - A measure of the level of voltage and/or frequency disturbances.

Power - A synonym for electricity or energy.

Public Utility Commission (PUC) - The state agency that regulates the activities of investor-owned utilities (and also municipal utilities in some states).

Public Utility - A regulated entity that supplies the general public with an essential service such as electricity, natural gas, water or telephone.

Rate Base - The net investment in facilities, equipment and other property a utility has constructed or purchased to provide utility services to its customers.

Rate Case - The regulatory proceeding in which a utility's rates are determined.

Rate Design - The development and structure of rates for regulated electric services.

Rate - The price for electricity charged by a utility.

Regulation - The rules established by state or federal agencies that effectuate governing laws. The term is also used in system operations to describe ramping a generating unit up or down to match supply to demand in real time.

Regulator - The governmental entity that defines the rules that that make up regulation.

Reliability - A measure of how often electrical service is interrupted.

Renewable Energy Credit (REC) - Tradable non-tangible energy commodities in the United States that represent the environmental attributes of electricity generated from an eligible renewable energy resource.

Renewable Fuel - A fuel that is naturally replenished such as wind or solar.

Reserves - Generation capacity that is available to the system operator if needed, but that is not currently generating electricity.

Residential Customer - An end-user that uses power in a home.

Resource Adequacy - A utility resource planning measure that seeks to ensure sufficient supplies for the safe and reliable operation of the grid in real time, and to provide appropriate incentives for the siting and construction of new resources needed for reliability in the future.

Retail Access - The opportunity for an end-user to buy electric supply from someone other than his regulated utility distribution company.

Retail Competition - The opportunity for multiple electric suppliers to compete to sell electric supply service to end-use customers.

Scheduling - The process of determining which generating units will be generating or on reserve status for a specific hour. Also the process of determining which requested transactions across a transmission line will be allowed to occur.

Service Territory - The geographical area served by a utility.

Smart Grid - Hardware, software and other upgrades added to the power system to enhance responsiveness to events that impact the electrical power grid and optimize day-to-day operational efficiency.

Smart Meter - An advanced electric meter that records consumption in intervals of an hour or less and communicates that information back to the utility for monitoring and billing purposes.

Solar Panel - A collection of solar cells shaped into a panel that is designed to convert the sun's light energy into electric energy.

Solar Power - The generation of electricity from sunlight. This can be done directly as with PV, PVI or indirectly asking concentrated solar power (CSP).

Spot Market - The short-term market for electricity - usually refers to day-ahead, hour ahead and real-time markets.

Stranded Costs - Utility costs that result from assets with outstanding debt obligations acquired under prior regulatory rules that can no longer be operated due to new regulatory rules.

Substation - A facility containing switches, transformers and other equipment used to adjust voltages and monitor circuits.

Sunlight - Light from the sun.

Supply - Electricity available to the grid.

Sustainable - Able to be maintained at a certain rate or level.

System Peak - The recorded point in time at which the maximum load on an electrical system is reached.

Time-of-Use (TOU) – Energy rates that are volumetric ($/kWh) which vary based on the time of day, season, and observation of holidays.

Transmission - The transport of electricity over high-voltage power lines from generations to the interconnection with the distribution system. Transmission is under the jurisdiction of the Regional Transmission Organization (RTO) and is regulated by FERC.

Transportation Electrification (TE) – A utility strategy to use clean electric energy to fuel people's transportation needs, resulting in a reduction in the use of petroleum-based fuels such as gasoline, diesel, and natural gas.

Utility - An entity that generates transmits and/or distributes electricity from facilities that it owns and operates.

Volt - The difference of potential that would drive one ampere of current against one ohm of resistance.

Wind Power - Power obtained by harnessing the energy of the wind.

Exhibit D

BWP's Historical Timeline 1 of 3

BWP History 1886 – 1987

1886 - The Providencia Land, Water and Development Company is formed to serve the area that later becomes Burbank in 1911.

1911 - The City of Burbank is incorporated.

1927 - The City of Burbank charter was enacted and rules and regulations were developed to guide the PSD. PSD now works under direction of the City Manager and Burbank City Council.

1941 - Magnolia 1 steam unit (10 MW), comes into service.

1942 - Magnolia 2 steam unit (10 MW) starts service.

1968 - Pacific Northwest Power Agreement with Bonneville Power Admin. is executed and necessary for DC Intertie transmission use.

1969 - Magnolia 5 gas turbine (17 MW) enters service.

1982 - Magnolia 1 and 2 units are retired.

1985 - The first 12 kV Distribution station named San Jose begins operation, sparking efforts to convert Burbank's distribution system from 4kV to 12 kV.

1900 1910 1920 1930 1940 1950 1960 1970 1980

1913 - Burbank sells $20,000 in bonds to purchase existing electric facilities. The Public Service Department (PSD) begins operations. The first power is distributed within the City of Burbank, supplied by the Southern California Edison Company.

1916 - Additional bonds are approved for building more electric distribution facilities. Power is purchased from the Southern California Edison company via McNeil Distributing Station on Chandler Blvd.

1931 - Burbank enters a 50 year contract for energy from Hoover Dam to the extent of 5.109 MW of demand and 25,000 MW-hours per year. At the time, experts thought this was a foolish plan.

1937 - The first power from Hoover Dam is distributed to Burbank through Burbank's own power lines.

1942 - Citizens approve a transfer of funds to Burbank's General Government of 2% of electrical sales for street lighting in lieu of taxes.

1948 - Magnolia 3 steam unit (20 MW) starts service.

1953 - Magnolia 4 steam unit (30 MW) starts service.

1959 - Olive 1 (42 MW) is placed into service.

1970 - Pacific Northwest/ Southwest DC Intertie placed in operation. (Burbank's share is 56 MW.)

1972 - Olive 3 gas turbine (22 MW) enters service.

1975 - Olive 4 gas turbine (31 MW) enters service.

1977 - The PSD Advisory Board is established to assist the City Council in decisions relating to the PSD dept.

1987 - Renewal agreement with Western Area Power Administration for 5.125 MW Hoover Dam power is signed.

1987 - The Intermountain Power Project is completed. Burbank's 67 MW share of this 16,000 MW coal plant will supply up to 50% of the City's energy.

Exhibit D

BWP's Historical Timeline 2 of 3

BWP History 1988 – 2005

1988 - Burbank executes a 20-year, 40 MW power agreement with Bonneville Power Administration for continued DC Inertie use.

1988 - A 25 year Power Sales agreement is signed with Portland General Electric for 10 MW of capacity and exchange energy.

1989 - DC Intertie expanded to 3,100 MW. Burbank's line capacity is now 105 MW.

1996 - The initial Citywide Fiber Optic System is placed into operation.

1997 - The first dual purpose electric station is completed, serving both Walt Disney and surrounding neighborhoods. It is the 12,470-volt, 60 MVA Keystone Distributing Station.

2001 - BWP unveils the first commercial landfill power plant using Capstone microturbine technology that runs on landfill gas, producing 300 KW of renewable energy.

2002 - BWP installs 2 hydro generators at the Valley Pumping Plant. High pressure water is used to run two turbine generators, producing enough renewable electricity to run up to 200 households.

1988 1990 1992 1994 1996 1998 2000 2002 2004

1991 - Natural gas pipeline capacity is acquired on the PGT/PG&E Pipeline Expansion Project.

1992 - The new "Supervisory Control and Data Acquisition" (SCADA) system is completed. PSD completes a revenue bond sale of $17 million for the expansion of electric capital facilities and $10 million for the expansion of domestic and reclaimed water systems.

1993 - Natural gas pipeline capacity is acquired on the El Paso Pipeline System.

1996 - The Mead/Phoenix and Mead/Adelanto Transmission Projects placed in operation. Burbank's share is 35 MW & 94MW, respectively.

1996 - AB 1890 deregulating California's electric industry is approved.

1997 - Fiber Optic System interconnected with Los Angeles Department of Water and Power.

1998 - Magnolia 3 is retired from service.

2000 - The Magnolia Power Project is created. A major construction project of the Southern California Public Power Authority, this 310 MW combined cycle generating unit will serve the cities of Burbank, Anaheim, Glendale, Pasadena, Cerritos and Colton.

2001 - The Public Service Department (PSD) changes it's name to Burbank Water and Power.

2002 - BWP begins an industry first treatment of reclaimed water by installing an innovative Reclaimed Water Treatment System for our on-site power plants. This system produces ultra pure water, displacing all need for potable (drinking) water in BWP power plants.

2002 - Lake One, a 47 MW peaking unit, is placed in operation. The import capacity of Victorville Receiving Station is more than doubled.

2005 - An upgrade and expansion of landfill power plants takes place, resulting in total production of 550 KW of energy produced from a renewable resource.

Exhibit D

BWP's Historical Timeline 3 of 3

BWP History 2005 – 2018

- **2005** - Magnolia Power Plant (MPP) entered into service.
- **2006** - Contract for Pleasant Valley Wind in Wyoming executed.

- **2007** - Contract with Powerex for on-peak and off-peak exchange executed.
- **2008** - TOU rates extended to all customers over 1,000 kVA demand.
- **2008** - Installed customer solar exceeds 1 MW capacity.
- **2009** - $20 million Smart Grid infrastructure Department of Energy grant received.
- **2009** - Pebble Springs Wind Project (Oregon) enters service.

- **2010** - TOU rates extended to all customers over 250 kVA demand.
- **2010** - Installed customer solar exceeds 2 MW capacity.
- **2010** - Ameresco landfill generation project enters into service.

- **2011** - Electric vehicle charging stations installed.
- **2011** - Customer Solar installations exceed 1% of system peak demand.
- **2012** - 40 MW of Copper Mountain Solar is added to Burbank's energy portfolio.

- **2014** - BWP wins the Customer Service Week 2014 Expanding Excellence Award for "Best Smart Infrastructure Project".
- **2015** - BWP wins the Customer Service Week 2015 Expanding Excellence Award for "Best CIS Implementation Project".

2006 2008 2010 2012 2014 2016 2018

- **2007** - Burbank is the first in the nation to Commit to using 33% Renewable energy by the year 2020.
- **2007** - WiFi network citywide expansion to support Smart Grid initiated.

- **2007** - Contract for Milford Wind 1 Project in Utah is executed.

- **2009** - Green Home House Call program (now called Home Improvement Program) is initiated.

- **2009** - Ice Bear energy storage program launched.
- **2009** - Tieton Hydropower facility began power deliveries to Burbank.

- **2010** - BWP ranked #4 nationally in installed solar per customer.
- **2010** - BWP receives two Smart Grid grants totaling $1.5 million.
- **2011** - BWP Administration building remodel completed.

- **2012** - Smart Grid is implemented.
- **2013** - Burbank adds 2.5 MW of geothermal power from Don A. Campbell.

- **2013** - BWPs EcoCampus earns two LEED Platinum certifications and a Sustainable Sites Initiative certification —the only industrial site certified in the world.

- **2015** - Burbank reaches the 2007 goal of providing 33% renewable energy to the community, five years ahead of schedule!
- **2016** - Burbank signs new Electric service contract with Hoover Dam.

- **2018** - Burbank executes contract to receive 22 MW of Desert Harvest Solar PV.